

3 Municipal Solid Waste Mater Plan

3.1 Pre-conditions for a Master Plan

3.1.1 Siting Future Disposal Sites

In order to formulate an SWM M/P it is indispensable to establish the location of disposal site(s) for the target year. Upon consideration of the characteristics of DSM, such as administration, vast area, large population, etc., the basic concept of the M/P concerning future disposal site allocation for DSM city is that each district, i.e. Kinondoni (north), Temeke (south) and Ilala (west), should have a disposal site for managing all waste generated within the district. Based on this concept, DCC presented the Study Team with 7 candidate sites. These seven candidate sites were investigated and evaluated for their possibilities and applicability for future disposal sites for DSM. The results of the evaluation are described below.

- In the Kinondoni district, it was found that all three sites are more or less suitable for new disposal sites because they satisfied the critical requirements. However, as a result of the overall evaluation, Kunduchi New MECCO quarry site, is concluded to be the most appropriate site for a new disposal site in terms of social, environmental, technical and financial aspects. Kunduchi New MECCO quarry site is, therefore recommended for the new disposal site for the Kinondoni district (north).
- As for the Temeke district, none of the three candidate sites were found to be suitable for future disposal sites because they did not meet the required capacity. In addition, all of them are not suitable from social and environmental aspects. It is, therefore, recommended that DCC makes a renewed effort to locate appropriate sites for the Temeke district (south) in Charambe, Toangoma, and Kipawa wards instead of Mbagala ward.
- Although only one candidate site was presented by DCC for the Ilala district, the site was rejected due to its small capacity, it was realised during the field reconnaissance that Pugu ward has a high potentiality for future disposal sites. It is recommended that DCC should continue to find suitable disposal sites in Pugu ward for the Ilala district (west).
- In conclusion, only Kunduchi New MECCO quarry site is recommended as the new disposal site, which was examined in the feasibility study conducted in the third phase in this study. However, the recommendation that each district should have a disposal site shall be respected for the SWM Master Plan because the concept is quite reasonable and appropriate.

3.1.2 Forecast of Future Population and Waste Amount

a. Population Forecast

Since there is no existing authorised population projections for DSM, the future population of the study area is forecast, as shown in Table 3-1, based on the 1988 census and relevant studies.

Table 3-1: Population Forecast

Unit: Person

Area	Area (km ²)	1996	1999	2002	2005
UA	5.9	56,880	57,463	58,113	58,831
SUPA	92.3	776,356	969,557	1,274,494	1,779,702
SUUA	94.7	963,016	1,148,544	1,398,422	1,726,505
RA	247.0	233,978	279,535	334,699	401,422
Total	439.9	2,030,231	2,455,099	3,065,729	3,966,466

b. Forecast of Future Waste Amount

Due to the following reasons the study team assumes that the household waste generation rate until 2005 shall remain at 698 g/cap/d.

- The waste generation rate of 698 g/cap/d based on the survey results of DSM is higher than that of other African and developing countries.
- The measured waste generation rates have uncertainties because the survey was conducted only once.
- The generation rate of the garden waste and house cleaning waste, i.e. grass cuttings and wood and others which amounts to 44.7 % of the household waste, will decrease due to urbanisation and changes in housing style.

Since various measures to reduce the number of petty traders and the informal sectors' activities are being implemented in DSM, the generation rate of waste from the informal sector is forecast to gradually decrease by 10 % per annum. On the contrary, the decrease will directly contribute to the increase in commercial and market waste generation.

Based on the above-mentioned assumption and the population forecast, the future waste amount was forecast as shown in Table 3-2.

Table 3-2: Forecast of Future Waste Amount

Unit: ton/day

Year	1996	1999	2002	2005
Population	2,030,000	2,455,000	3,066,000	3,967,000
Household	1,417	1,713	2,140	2,768
Commercial	27	51	82	128
Institutional	11	12	17	21
Market	33	59	93	140
Street Sweeping	1	2	5	6
Informal Sector	282	308	345	403
Total	1,771	2,145	2,682	3,466

c. Waste Composition Forecast

The analysis focuses on the comparison of the data provided by the WACS and other countries, assuming that changes in waste composition would generally result in the waste characteristics of a developed economy shown below.

- Less kitchen waste and more paper and plastic.
- Less grass and wood and more metal and glass.

- Reduced apparent specific gravity.

The frame of the waste composition in 2002 and 2005 is set as shown in Table 3-3.

Table 3-3: Waste Composition Forecast

Physical Composition	1996	2002	2005
Kitchen	45.03 %	42 %	42 %
Paper	4.07 %	7 %	8 %
Textile	1.10 %	1 %	1 %
Plastic	2.01 %	4 %	5 %
Grass/Wood	25.11 %	23 %	22 %
Leather/Rubber	0.71 %	1 %	1 %
Metal	1.65 %	2 %	2 %
Glass	2.90 %	3 %	3 %
Ceramic/Stone	0.33 %	1 %	1 %
Other	17.09 %	16 %	15 %
Total	100.00 %	100 %	100 %

d. Future Waste Stream

The waste stream in 2005 was forecast as follows.

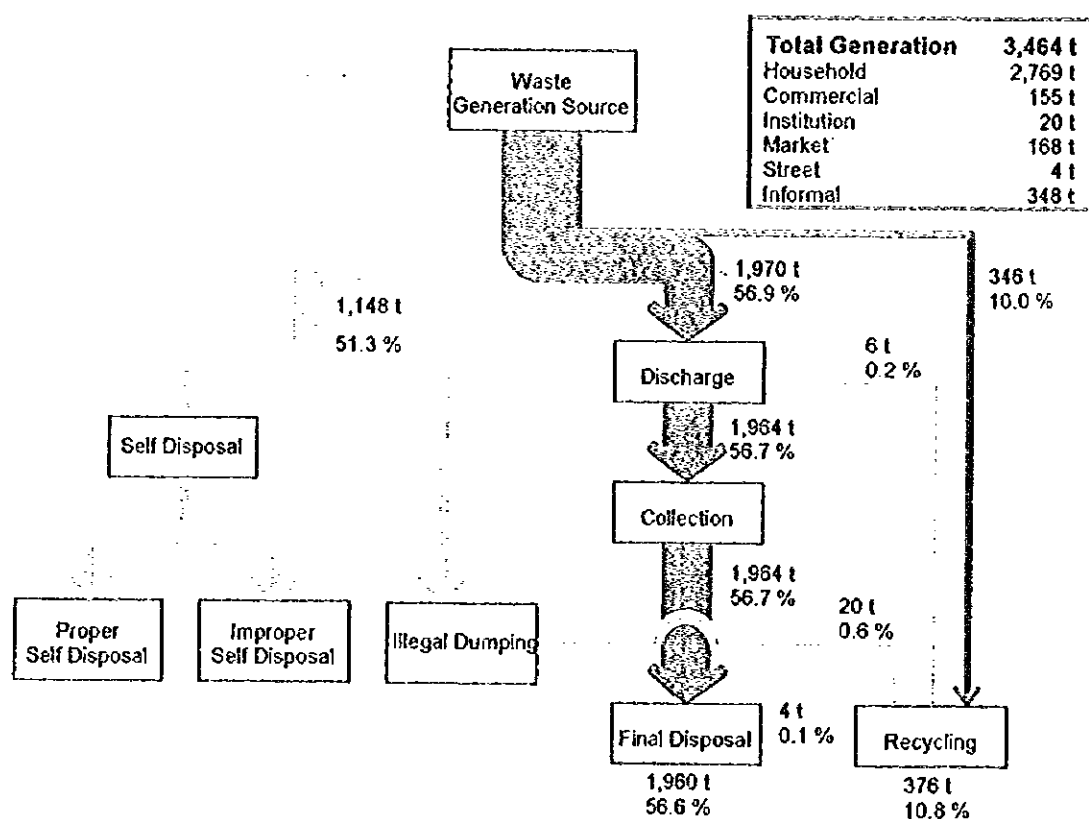


Figure 3-1: Waste Stream in 2005

3.1.3 Other Pre-conditions

a. Financial Conditions

a.1 Prices

The cost estimate in this Master Plan is based on the price level as of the end of February 1997. Furthermore, the annual inflation rate (approximately 15% in 1996) is not taken into account in this Master Plan as prices are converted into the present value in the financial evaluation.

a.2 Opportunity Cost of Capital

The present real interest rate of the Bank of Tanzania, 11.6 %, is adopted to calculate the opportunity cost of capital (cut-off rate), which is a judgement criteria of FIRR.

a.3 Foreign Exchange Rate

The foreign exchange rate of Tsh. against USD and YEN is employed to convert the foreign portion of the project cost. The inter-bank mean rate as of the end of February 1997 was adopted, which was Tsh. 597.8 to USD 1 and YEN 120.85, respectively.

b. Economic Conditions

b.1 Taxes and subsidies

Taxes and subsidies are deducted from the economic cost, since these taxes represent a transfer of income to the national economy.

b. Conversion rate to economic prices

The standard conversion factor (SCF) of 0.9347 is adopted, which is the conversion rate of locally-traded goods and services into internationally-competitive real economic prices, based on the trade statistics of the last five years. Moreover, in the same manner as SCF, the consumption conversion factor (CCF) of 0.9201 is used, which mainly converts wages for skilled labour force into economic prices. Shadow wage rate of 0.611, a conversion factor used to modify the cost of unskilled labour force, is also adopted here.

3.2 Examination of An Optimum System

3.2.1 Institutional Requirements

The evaluation of the present SWM in this study concludes that the current institutional problems are more serious for DSM than the technical problems. In particular, the existing technical problems are rooted in the existing institutional problems. Hence, any proposal for a technical system will not last without provision of a proper institutional system. Therefore, when a future SWM system for DSM is discussed, priority should be given to the formulation of the future institutional system and the future technical system should then be formulated in line with the institutional system proposal.

a. Administration and Organisation

As for the first priority for the administrative and organisational improvement, an independent body with full responsibilities for SWM (i.e. the Waste Management Authority) shall be established within the DCC in order to integrate functions dispersed to the three departments (i.e. health, works and planning) and to provide administrative, operational and financial autonomy. A proposal for the new waste management authority is illustrated in Figure 3-2.

Secondly, a Supervision and Monitoring Committee which shall be directly under the DCC shall be established in order to monitor and control the operation, finance and administration regarding SWM in DSM.

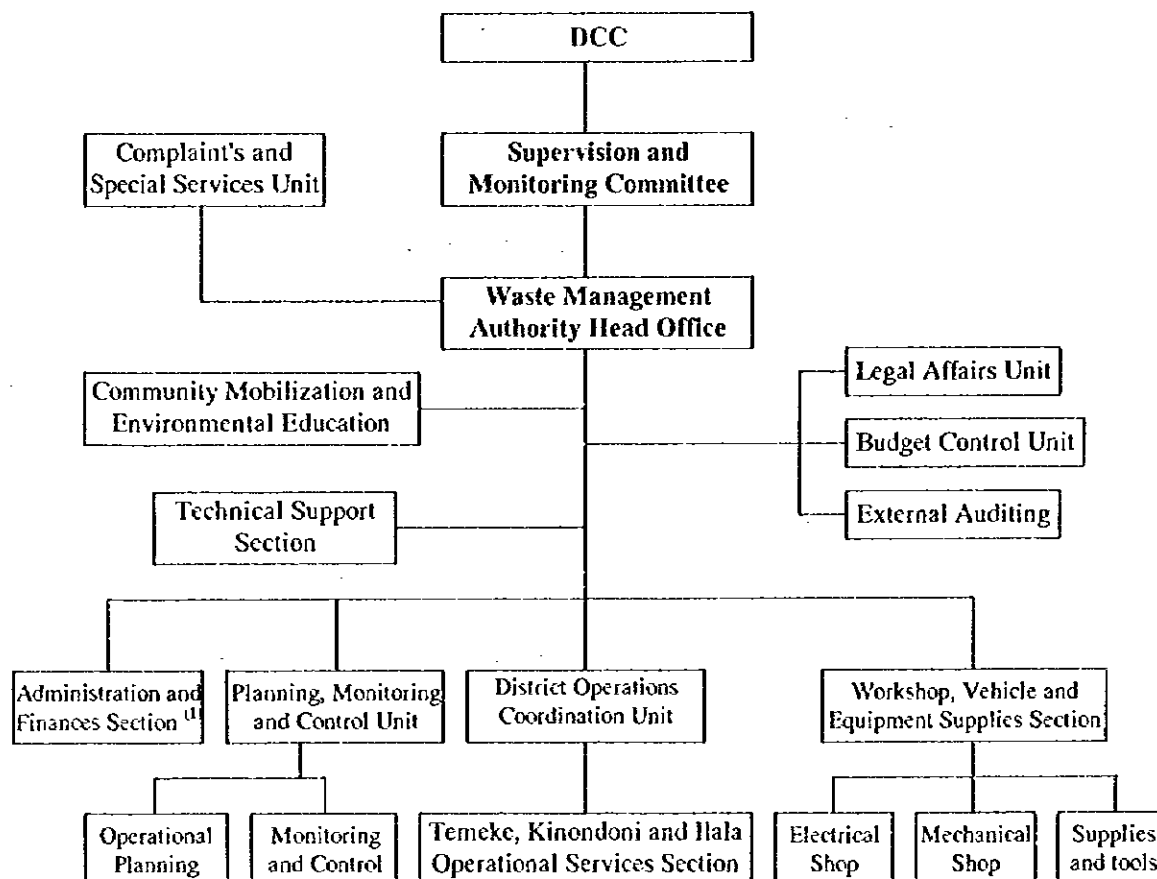


Figure 3-2: Proposed Organisational Structure of Waste Management Authority

b. Legislation

The present scattered legislation regarding SWM shall be consolidated into one sanitation code and, at the same time, update it to take into account present habits and customs (such as garbage storage in plastic bags in lieu of trash cans). Further, there is a need to review its provisions and demands in order to make it more simple and compatible with local standards and the level of services usually provided.

Clear policies and guidelines for the provision of private refuse collection services in the form of contracting out services shall be established.

c. Financial Sources and Refuse Collection Charges

The majority of the citizens are not willing or can not afford to pay for the refuse collection services and the collection cost of the RCC (Refuse Collection Charge) should not exceed the value collected per client. Taking these into consideration the allocation of a special fund for cleansing services (SWM) from DCC's tax revenues shall be done through the enhancement of the city tax collection capability.

Although the fund shall be a main financial source for cleansing services, the RCC system shall be maintained in order to establish a "Beneficiary-Pay-Principle" in the future. At first the Team recommends a joint billing system for RCC with water/sewerage fees of the newly established DAWASA (Dar es Salaam Water and Sewerage Authority). If the joint billing is not feasible due to certain impediments, DCC shall collect RCC for commercial waste collection when business licenses are applied for and for special services such as door to door collection services to the high income households.

d. Operation Models and Privatisation

In order to examine the extent of the privatisation the following operational models were examined:

- Direct Municipal Operation
- Independent City Authority Operation
- Municipal - Private Contractor Operation
- Private Concessionaire Operation
- Community Organisation (CBO or NGO) Operation
- Private, Formal and Informal Providers Operation (free market)

As a result of the examination, the "Municipal-Private Contractor Operation" model seems to be most appropriate based on the current situation and history of DSM.

In this model the study area is divided into the DCC's operation area and the private contractors' operation area. The contracting system with private operators shall be changed from concession to contracting out of services. A scheme of privatisation, from a concession system to the contracting out system, is presented in the table below.

Phase Area	Present (Feb. 1997)	F/S Phase (2000 - 2002)	M/P Phase (2003 - 2005)
UA	Concessionaire	Contractors	Contractors
SUPA	Concessionaire and DCC	DCC and Contractors	Contractors
SUUA	Concessionaire and DCC	DCC	DCC and Contractors
RA	No services	No services	DCC

Contractors of DCC shall be selected through open and competitive bidding, the same selection procedure as those for civil works. The important issues for the selection of a contractor are:

- to maintain an open competition.
- to have diversity of bidders.
- to prepare a contract form which enables control and monitoring of the contractor.
- to have a pre-qualification system before the tender.

- to maintain transparency in the tender evaluation.

e. Monitoring and Information Management System

It is very important to establish an information management system for monitoring and control to achieve an improved SWM as proposed in the SWM Master Plan. The proposed monitoring system will feed the monitoring and control commission, which will continuously check the quality and costs of the service provided by the DCC and the private concessionaires.

A human resources development programme shall be developed in order to train professionals involved with solid waste management. The program shall cover a broad spectrum of professionals and employees, from management to operational levels, including those responsible for supporting activities.

f. Public Education and Co-operation

Improved public co-operation is fundamental to improved solid waste management in DSM. Three essential issues need to be addressed in a public co-operation programme:

- demonstrating tangible improvements in refuse collection and disposal services to the public.
- public education on solid waste management.
- informing the public and gaining their acceptance for the proposed institutional, administrative and legislative changes.

Although the implementation of the above program requires initial investment, the actual cost required is relatively small while potential benefits are high. The programme must be carefully planned and should be conducted together with a publicity/information campaign using the mass media (radio, newspapers, TV) which will inform the public of relevant issues, particularly achievements of the programme, thus helping further to convince the public of the DCC's new found competence in solid waste management.

3.2.2 Selection of An Optimum Technical System

Taking the current situation and background of SWM in DSM considerably into account, the policies for the selection of a technical system are as follows.

- 1) Systems and technologies to be adopted should be as simple as possible so that operation and maintenance would be easy and inexpensive.
- 2) The foreign currency requirements for the purchase, operation and maintenance of systems should be minimised. The use of locally available materials and services should be maximised.
- 3) The use of labour intensive rather than capital intensive techniques should be used where technically feasible and economically viable.
- 4) Technical system proposals have to be consistent with the institutional system proposals to ensure their efficiency.

The screened potential subsystems for DSM based on the current situation, background and above policies are listed in Table 3-4.

Table 3-4: Potential Subsystems for SWM in DSM

Technical Systems	Technical Sub-systems	Sub-system Components
Discharge and Storage	<ul style="list-style-type: none"> • Source Separation • Type of Storage Equipment 	<ul style="list-style-type: none"> • Mixed discharge • Separate discharge • Paper or plastic sacks • Dustbins • On-site storage • Containers (1 to 2 m³) • Skips
Primary Collection	<ul style="list-style-type: none"> • Type of Collection System 	<ul style="list-style-type: none"> • Handcart • Animal cart • Human pedal cart • Cart attached to motorbike • Three-wheel autorikshaw
Secondary Collection and Transportation	<ul style="list-style-type: none"> • Collection Frequency • Collection Method • Type of Collection Service • Collection Schedule • Type of Collection Vehicle • Transportation System • Transfer Station 	<ul style="list-style-type: none"> • Mixed collection • Separate collection • Curb collection • Door-to-door collection • Bell collection • Point collection • Public container collection • Day collection • Night collection • Compactor truck • Tractor and trailer • Tipper truck • Skip truck • Handcart • Motor vehicle • Railway • Water Haulage
Street Sweeping	<ul style="list-style-type: none"> • Cleaning Method 	<ul style="list-style-type: none"> • Manual street sweeping • Mechanical cleaning • Vacuum cleaning • Flushing
Intermediate treatment	<ul style="list-style-type: none"> • Incineration • Refuse Drive Fuel (RDF) • Biogas Production • Pyrolysis • Composting • Size Reduction • Mechanical and Scavenging Sorting 	<ul style="list-style-type: none"> • Centralised composting plant • On-site/community based composting
Recycling	<ul style="list-style-type: none"> • Government Related • Private Sector Centred 	
Final Disposal	<ul style="list-style-type: none"> • Method of Sanitary Landfill 	
Maintenance of Vehicles and Equipment	<ul style="list-style-type: none"> • Preventive Service Workshop • Full Service Workshop 	

Upon consideration of the proposed institutional system, the optimum MSWM technical system selected was examined and the results of the examination are summarised in Table 3-5.

Table 3-5: An Optimum MSW Technical System Municipal SWM Mater Plan

System	Proposal
Discharge and Storage	<ul style="list-style-type: none"> • Source separation: Separate recyclable and non recyclable wastes • Type of storage: Plastic sack Public skip container • Collection frequency: More than twice a week • Collection method: Mixed collection for non-recyclable wastes • Type of collection: <ul style="list-style-type: none"> UA: Curb side collection SUPA: Curb side collection and Point collection SUUA: Curb side collection and Point collection RA: Point collection • Collection time: Day collection for most areas, and night and early morning collection for the city centre • Type of collection vehicle: <ul style="list-style-type: none"> UA: 4 ton compactor truck (6 ton tipper truck by 2002) SUPA: 6 ton tipper truck and 8 ton skip truck SUUA: 6 ton tipper truck and 8 ton skip truck RA: 8 ton skip truck • Transportation system: Direct transport by motor vehicle
Primary Collection	<ul style="list-style-type: none"> • Handcart collection is generally appropriate for most areas in DSM which require primary collection.
Secondary Collection and Transportation System	<ul style="list-style-type: none"> • UA: 4 ton compactor truck (6 ton tipper truck by 2002) • SUPA: 6 ton tipper truck and 8 ton skip trucks • SUUA: 6 ton tipper truck and 8 ton skip trucks • RA: 8 ton skip truck
Street Sweeping	<ul style="list-style-type: none"> • Manual sweeping method
Intermediate Treatment	<ul style="list-style-type: none"> • Only on-site composting is encouraged.
Recycling	<ul style="list-style-type: none"> • Recycling activities are encouraged through institutional and educational programmes as long as collection does not involve any cost.
Final Disposal	<ul style="list-style-type: none"> • Each district with a sanitary landfill for the disposal of its own waste. • Sanitary landfill (either Level 2 or 3) is adopted.

3.3 Municipal SWM Master Plan

3.3.1 Planning Frameworks

a. Goals

The principal goal of the SWM Master Plan is **to establish a proper management system for SW by the target year 2005 in Dar es Salaam City**, this being the centre of the country's economic and industrial activities and where approximately 8% of the national population lives.

Through the establishment of a proper SWM system, **the Plan aims at:**

- **preservation of the environment and public health, and sustainable development of the city; and**
- **promotion and growth of the Tanzanian economy through gaining foreign investment.**

b. Targets

In order to achieve the principle goal of the master plan, the targets for major technical system components for each phase are set up and tabulated in Table 3-6.

Table 3-6: Targets for Establishment of Major Technical System Components

Components	Phase	Present (1996)	Phase I (1997 - 1999)	Phase II (2000 - 2002)	Phase III (2003 - 2005)
1. Refuse Collection Rate					
UA		90 %	100%	100%	100%
SUPA		17 %	30%	50%	70%
SUUA		0 %	4%	30%	50%
RA		0 %	0%	0%	10%
2. Length Covered by Street Sweeping Service		34 km	50 km	100 km	100 km
3. Intermediate Treatment and Recycling		No treatment facilities other than pilot on-site compost and an incinerator for medical waste	Promotion of organised recycling	Promotion of organised recycling	Promotion of segregation at generation for recycling
Rate of Recycling From Generation Source		6.5 %	6.5 %	8.0 %	10.0 %
Total Recycling		7.3 %	7.3 %	8.8 %	10.8 %
4. Final Disposal Landfill Sites		Vingunguti	Vingunguti	Kunduchi	Kunduchi: Level 2 Ilala, Temeke
Sanitary Landfill Level		Open Dumping	Level 1 ¹	Level 2 ²	Level 3 ³

c. Strategy

The strategies to be adopted in the three planning stages are summarised below.

Phase 1 (1997 - 1999): Preparation for Implementing F/S Projects

Technical Aspects

- Upon consideration of the very limited refuse collection fleet of DCC at present, for the time being DCC shall provide and expand refuse collection services involving the private sector as much as possible. Refuse collection areas shall be divided into **Area for Private Operation: urban area (UA)**, **Area for Either Private or DCC Operation : semi-urban planned developed area (SUPA)** and **Area for DCC Operation: semi-urban unplanned developed area (SUUA)** and rural area (RA). Area (A) shall be serviced by the private contractors and Area (B) by DCC. The priority of the service expansion is the order of UA, SUPA, SUUA and RA in accordance with the degree of urbanisation.

¹ Level 1 means controlled tipping method.

² Level 2 means sanitary landfill without liner for leachate

³ Level 3 means sanitary landfill with liner for the prevention of leachate percolation into the underground

- A reliable collection service with fixed collection frequencies and schedule shall be established.
- In order to implement the first priority projects (F/S projects), the required funds shall be secured and a detailed design of the projects shall be conducted. Then, facilities shall be constructed and vehicles and equipment procured.
- Site selection work shall be conducted to identify appropriate disposal sites for the Temeke (south) and Ilala (west) Districts.

Institutional Aspects

- Development of clear policies and guidelines for the provision of private refuse collection by contracting out services.
- Establishment of a more autonomous and independent solid waste management organisation (i.e., the Waste Management Authority) which will integrate functions dispersed in the three departments (Health, Works and Planning) and be fully responsible for the provision of solid waste services (including cesspit emptying services) for the city in order to enable independent competency on administration, operation and accounting.
- Allocation of a revolving fund to the Waste Management Authority, under the authority of the head of the organisation, to be used for procurement of fuel, spare parts, and all other supplies and parts which require prompt payment.
- Enhancement of the city's tax collection capability and allocation of a special fund for cleansing services (SWM) from DCC's tax revenues.
- Although the fund shall be a main financial source for cleansing services, a joint billing system for RCC with water/sewerage charges of the newly established DAWASA (Dar es Salaam Water and Sewerage Authority) shall be examined in order to establish a "Beneficiary-Pay-Principle" in the future. If the joint billing is not feasible due to certain impediments, DCC shall collect RCC (Refuse Collection Charge) for commercial waste collection when business licenses are applied for and for special services such as door to door collection services to the high income households.
- Improvement of legislation dealing with solid waste management: formulation of a Sanitary Code.
- Organisation of a human resources development project in order to train the professionals involved with solid waste management
- Establishment of an independent body (the Supervision and Monitoring Committee) to monitor and control the cleansing services of DCC and the private contractors.

Phase 2 (2000 - 2002): Implementation of F/S Projects

Technical Aspects

- Operation of facilities constructed and vehicles and equipment procured in Phase 1.

- Using the newly procured skip trucks and containers, DCC shall expand its refuse collection service up to 30 % to the SUUA where the collection services coverage target is only 4 % in Phase 1.
- Conduct a feasibility study for the projects (such as construction of disposal sites for Temeke and Ilala Districts) proposed in the M/P, other than the first priority projects, and to secure funds for implementation. When the funds are secured, the detailed designs of the projects are to be carried out.

Institutional Aspects

- Further enhancement of the city's tax collection capability for a financially self-sustainable SWM as well as review of RCC and tipping fee of the disposal site according to the cost incurred to establish a "Beneficiary-Pay-Principle".
- Strengthening of the Supervision and Monitoring Committee for the cleansing services, with emphasis on participation of the private sector.
- Strengthening the management and administration system conceived and implemented in phase 1.

Phase 3 (2003 - 2005): Implementation of M/P Projects

Technical Aspects

- The refuse collection services shall be expanded to 70 % for SUPAs and 50 % for SUUAs respectively.
- The M/P projects, such as construction of disposal sites for Temeke and Ilala Districts, shall be implemented.
- In order to pursue efficiency, the option of whether the operation of the northern Kinondoni District disposal site will be entrusted to the private sector shall be examined.

Institutional Aspects

- Further enhancement of the city's tax collection capability and review of RCC and tipping fees of the disposal site according to the cost incurred. With these improvements a sustainable SWM in DSM city will be established. In concrete terms, DCC will be able to construct facilities and procure equipment required for a sound SWM.
- Development of a nation-wide plan for waste minimisation and recycling.

3.3.2 The Municipal SWM Master Plan

a. Outline of the Master Plan

The SWM master plan for DSM city is presented in Table 3-7. The outline of the master plan in the table is described below.

Technical System

- The proposed refuse collection system is categorised into i. Curb side collection by tipper trucks without primary collection and ii. Point collection by skip trucks without primary collection depending on accessibility of the refuse collection vehicles.
- DCC will promote recycling activities (which will not be financially supported by DCC) such as on-site composting at generation but shall not construct/operate any collective intermediate and/or recycling facilities. The construction/operation of those facilities shall be born by the private sector if there are any interests.
- Manual street sweeping shall be applied as much as possible.
- Wastes collected from the 3 districts shall be disposed of at their own disposal site by a sanitary landfill operation.

Institutional System

- A Waste Management Authority (WMA) shall be newly established under DCC and be responsible for the SWM in DSM city including cesspit emptying services.
- Refuse collection shall be provided either the contractors selected through contracting out of services or by the WMA of DCC directly.
- A Supervision and Monitoring Committee shall be established in order to monitor and control the cleansing services of DCC and the private contractors.
- The main financial source for the cleansing services shall be from a special fund allocated from the city taxes and the RCC (refuse collection charge). As for the RCC, a joint billing system with water/sewerage fees of the newly established DAWASA (Dar es Salaam Water and Sewerage Authority) or RCC (Refuse Collection Charge) for commercial waste collection when business licenses are applied for and for special services such as door to door collection services to the high income households shall be applied.

b. The SWM Master Plan

Based on the examination of the optimum institutional and technical system, the SWM Master Plan (M/P) for DSM city is formulated as shown in Table 3-7. In order to understand the table the main indices of the M/P and location map of the main facilities are presented in Figure 3-3 and Figure 3-4.

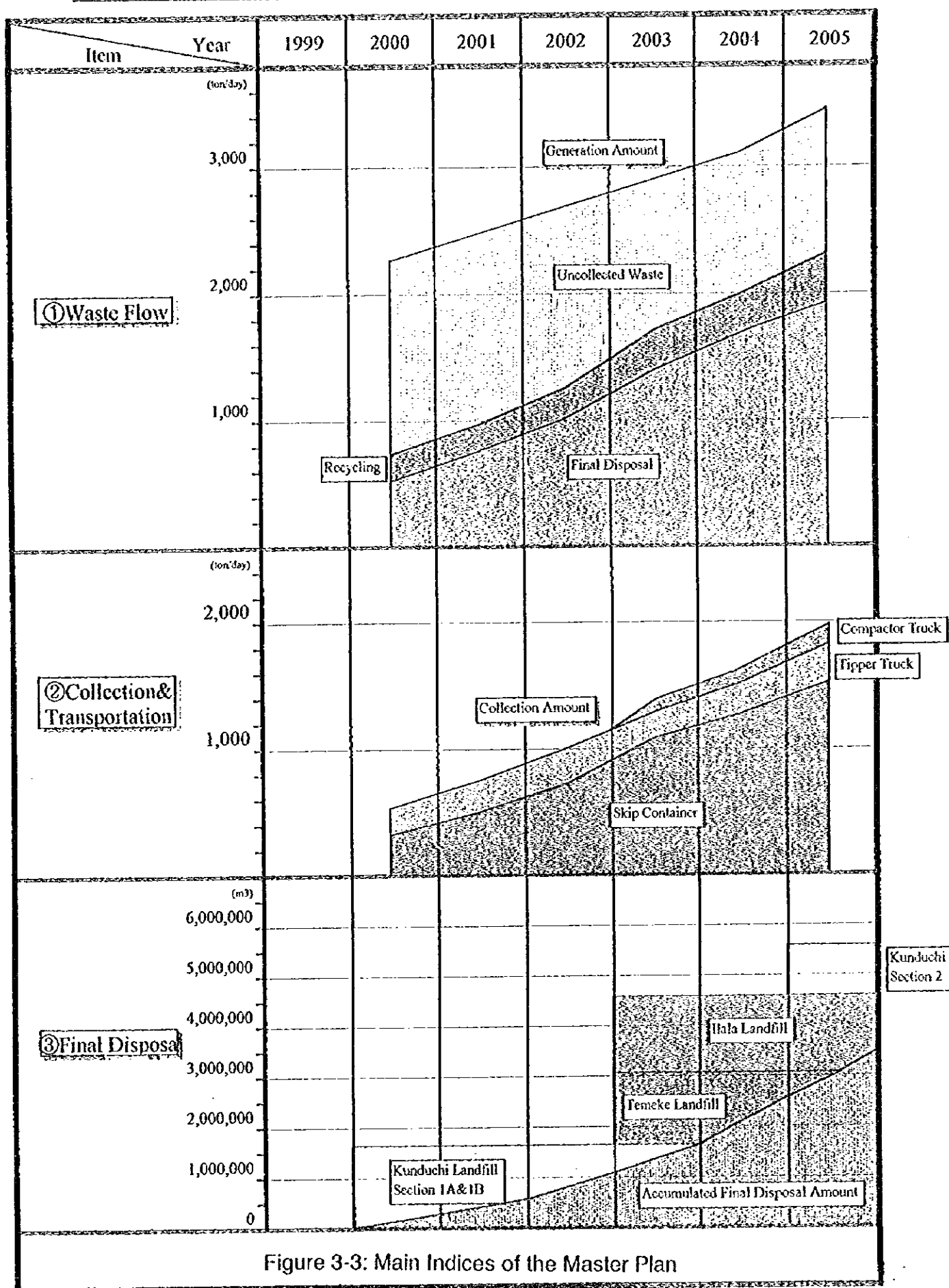


Figure 3-3: Main Indices of the Master Plan

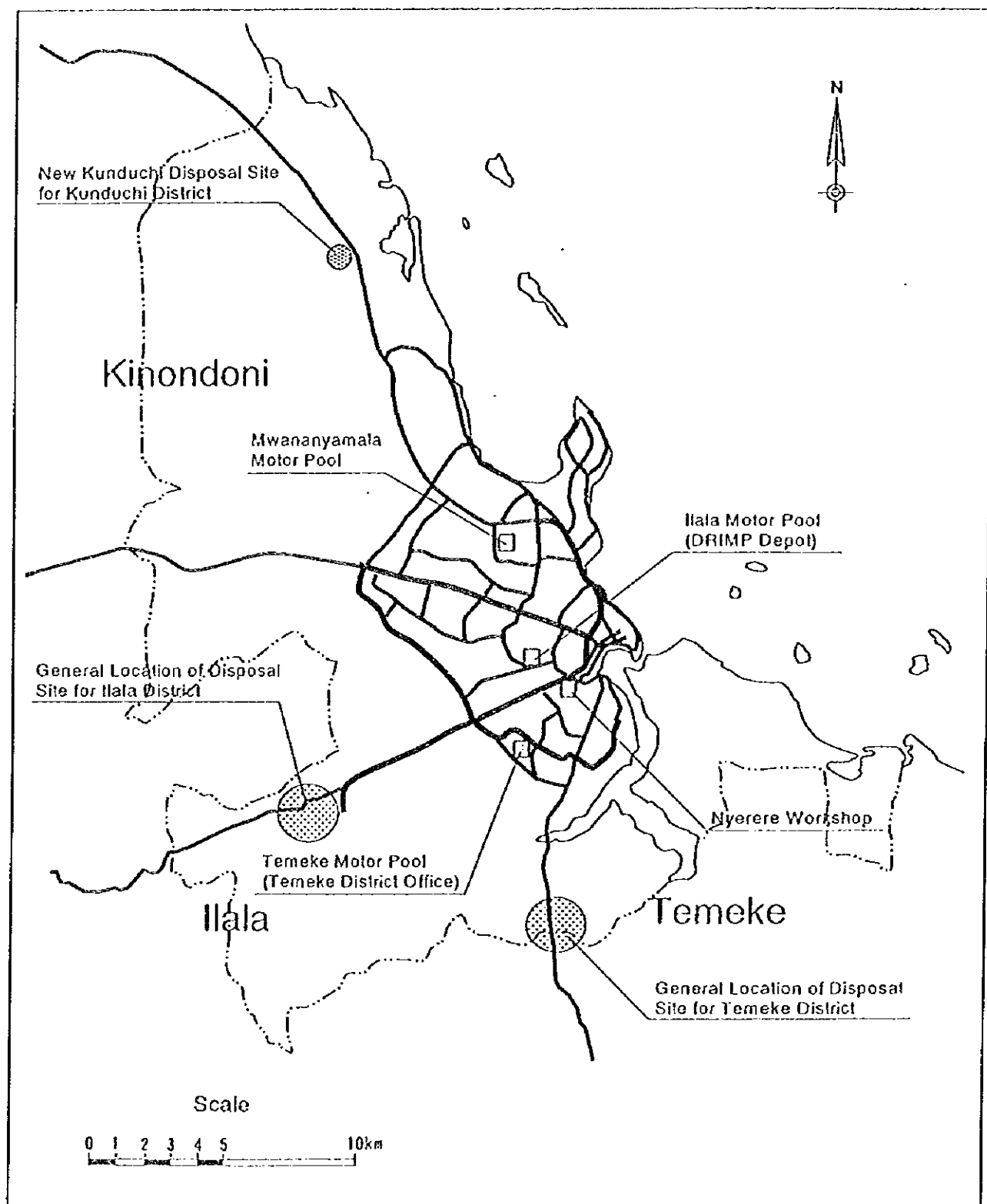


Figure 3-4: Location Map of Main Facilities

Table 3-7: Outline of the SWM M/P

Components	Phase Present (1996)	Phase I (1997 - 1999)	Phase II (2000 - 2002)	Phase III (2003 - 2005)
1. Refuse Collection & Transportation				
Population in DSM	2,261,000	2,859,000	3,736,000	5,066,000
Population in the study area	2,030,000	2,455,000	3,066,000	3,966,000
Waste generation amount (t/d)	1,772	2,144	2,678	3,464
Collection rate of all waste	8 %	17 %	37 %	57 %
Collection rate of household waste	5 %	15 %	33 %	52 %
Waste collection amount (t/d)	143	362	1,001	1,960
Nos. of households served	23,604	85,640	235,298	479,609
Served population	101,500	368,250	1,011,780	2,062,320
Non served population	1,928,500	2,086,750	2,054,220	1,903,680
Collection system	Point & curb side collection	Point & curb side collection	UA: Curb side collection SUPA: Curb side collection and Point collection SUUA: Curb side collection and Point collection	UA: Curb side collection SUPA: Curb side collection and Point collection SUUA: Curb side collection and Point collection RA: Point collection
Major type of vehicles	Tipper Skip truck Tractor trailer	Tipper Skip truck Tractor trailer	UA: 6 ton tipper truck SUPA: 6 ton tipper truck and 8 ton skip trucks SUUA: 6 tons tipper truck and 8 tons skip trucks	UA: 4 ton compactor truck SUPA: 6 ton tipper truck and 8 ton skip trucks SUUA: 6 ton tipper truck and 8 ton skip trucks RA: 8 ton skip trucks
Transportation system	Direct haulage	Direct haulage	Direct haulage	Direct haulage
Executing organisations	DCC	Cleansing unit, Health dept 5 concessionaires	WMA NA	WMA NA
Private contractors				
Required main equipment				
6 ton tipper trucks	14	NA	50	66
8 ton skip trucks	1	NA	67	95
4 ton compactor truck	0	NA	0	10
8 m ³ skip with lids	0	NA	134	190
8 m ³ open skip	8	NA	536	760
No. of workers				
DCC	40 (Aug.1996)	NA	152	132
Contractors	127 (Aug.1996)	NA	165	323
Unit cost				
DCC (USD/ton)	24.85 (1994)	NA	21.44 (excluding tipping fee)	17.33 (excluding tipping fee)
Private contractors (USD/ton)	13.14 (1994) (including dumping fee)	NA		
2. Street Sweeping				
Method of sweeping	Manual	Manual	Manual	Manual
Length of sealed regional road in DSM (km)	60.7	60.7	100	100
Length of served road (km)	32.8	50	100	100
Operator	Contractors	Contractors	Contractors	Contractors
Nos. of workers				
Private contractor	72	110	220	220
DCC	3	5	5	5
Contractors	69	105	215	215
Unit cost				
DCC (USD/ton)	Not available		This cost is included in the collection cost.	This cost is included in the collection cost.
Contractor (USD/ton)	Not available			
Main equipment	Manual	Manual	Manual work with litter boxes	Manual work with litter boxes
3. Intermediate treatment	•Community based pilot composting facilities •Simple incinerator for infectious waste	• No requirement other than on-site & community based ones	• On-site composting	• On-site composting
4. Recycling				
Recycling rate from generation	6.5 %	6.5 %	8.0 %	10.0 %

Components	Phase	Present (1996)	Phase I (1997 - 1999)	Phase II (2000 - 2002)	Phase III (2003 - 2005)
Overall recycling rate Recycling system		7.3 % • No organised recycling	7.3 % • DCC needs to organised present recycling system	8.8 % • Private sector centred system • DCC encourage to organise recycling activities	10.8 % • Private sector centred system • DCC promotes the separate discharge of wastes for recycling
5. Final Disposal Method of operation Final disposal site		Open dumping Vingunguti	Level 1 Vingunguti	Level 2 Kunduchi	Level 2 or 3 Level 2 for Kunduchi Level 3 for Ifala & Temeke
Transportation distance (km)		8.7	8.7	18	13 (average)
Operation by		DCC	DCC	WMA	WMA
Nos. of workers		11	11	34	85
Tipping fee (Tsh/ton)		800	800	3,600	6,100
Unit cost (USD/ton)		N.A	N.A	5.37	9.22
Main equipment		Bulldozer 1	Bulldozer 1	Bulldozer: 3 Excavator: 1 Tipper truck: 3 Pickup: 1	Bulldozer: 6 Excavator: 3 Tipper truck: 6 Pickup: 3
6. Maintenance & Repair Preventive Maintenance		Mwananyamala depot	Mwananyamala depot	Nyerere workshop	Nyerere workshop
Major repair		Mwananyamala depot	Mwananyamala depot	Private workshop	Private workshop
Operation by		E & M sec, Works Dept., DCC	E & M sec, Works Dept., DCC	WMA	WMA
Nos. of workers		17	17	65	98
7. Public Organisations Responsible on SWM Competent authorities		Health Dept., DCC Cleansing Sec.	Health Dept., DCC Cleansing Sec.	WMA WMA	WMA WMA
Operation by					
Nos. of staff		1	10	30	50
8. Financial Matters Unit SWM Cost (Tsh/ton)					
Revenue Source		• Tax • RCC collected by concessionaires	• Tax • RCC collected by concessionaires	• Tax • RCC collected by joint billing with water or • Special RCC collected by DCC	• Tax • RCC collected by joint billing with water or • Special RCC collected by DCC
Breakdown of Revenue					
Tax (M. Tsh)		296	548	1,165	1,868
RCC (M. Tsh)		not available	-	1,426	2,684
Total Revenue (M. Tsh)		not available	-	2,591	4,552
Total revenue per capita (Tsh)		not available	223	845	1,148
Total revenue per beneficiary (Tsh)		not available	1,488	2,561	2,207
SWM budget per capita (Tsh)		160	223	360	471
DCC Budget (M. Tsh.)		5,910	10,963	23,291	37,368
Tax Revenue (M. Tsh)		2,540	7,062	18,775	32,140
Subsidy (M. Tsh)		3,370	3,901	4,516	5,228
Tax Forecast Scenario		not available	Moderate	Moderate	Moderate
Share of SWM budget		5 %	5 %	5 %	5 %
Collection Rate of RCC		15 %	15 %	20 %	20 %
Tariff Level for RCC (Tsh/month/household)		150 or 900	150 or 900	1,250	1,250
9. Role of Private Org. SWM services privatised		• Parts of refuse collection • Street sweeping Concession contract	• Parts of refuse collection • Street sweeping Concession contract	• Parts of refuse collection • Street sweeping Lump sum contract	• Parts of refuse collection • Street sweeping Lump sum contract
Type of contract					
10. Legislation		There are basic legislation but lack of enforcement	Consolidation of scattered legislation on SWM into a Sanitary Code	Enforcement of the Sanitary Code	Establishment of a law for waste minimisation and recycling
11. Public Cooperation		There are very little public education programmes and co-operation	Informing of proposed institutional, administrative and legislative changes on SWM	Conduct of active public education and cooperation campaigns	Promotion of waste minimisation and recycling campaigns
12. Medical SWM		• No clear classification of medical solid waste, • No discharger's responsibility,	• Establishment of clear classification for medical SW and code of practice, • Infectious wastes shall be properly	• Enforcement of strict segregation, separate collection, transportation and disposal system for infectious waste,	• Establishment of thermal treatment of infectious waste with hazardous waste

Components	Phase	Present (1996)	Phase I (1997 - 1999)	Phase II (2000 - 2002)	Phase III (2003 - 2005)
		Lack of laws, codes & enforcement	treated at generation	• Examination of thermal treatment of infectious waste with hazardous industrial SW	
13. Industrial SWM		• No clear classification of industrial solid waste • No discharger's responsibility, Lack of laws, codes & enforcement	• Establishment of clear classification of industrial SW • Examination of HISW generation amount and its disposal methods	• Enforcement of proper disposal of hazardous industrial SW • Examination of thermal treatment of infectious waste with hazardous industrial SW	• Establishment of thermal treatment of infectious waste with hazardous waste

3.3.3 Project Costs

Table 3-8 summarises the total project costs, including the operation and maintenance costs from 1999 to 2005, to implement all the master plan projects.

Table 3-8: Cost Schedule of the Master Plan Projects

			unit: Mill.Tsh							
Category	Category	Description	1999	2000	2001	2002	2003	2004	2005	
Direct Cost	Collection & Transport	Invest. for equipment	3,644	1,384	1,691	298	1,284	1,496	478	
		O&M for labor	0	147	174	204	219	246	296	
		O&M for material & fuel	0	235	320	424	444	524	619	
		Spare parts & repair	0	337	454	595	629	740	874	
		sub-total	3,644	2,103	2,639	1,521	2,577	3,005	2,267	
	Final Disposal	Kunduchi	Invest. for facilities	831	0	0	430	0	580	0
			Invest. for equipment	600	0	150	0	0	0	0
			O&M for labor	0	20	20	21	19	19	19
			O&M for material & fuel	0	64	70	92	62	64	67
			Spare parts & repair	0	60	60	75	54	54	54
		Ifala	Invest. for facilities	0	0	0	1,755	0	0	0
			Invest. for equipment	0	0	0	196	150	0	0
			O&M for labor	0	0	0	0	16	17	17
			O&M for material & fuel	0	0	0	0	44	61	65
			Spare parts & repair	0	0	0	0	40	54	54
		Temeke	Invest. for facilities	0	0	0	1,755	0	0	0
			Invest. for equipment	0	0	0	398	0	150	0
			O&M for labor	0	0	0	0	16	16	17
			O&M for material & fuel	0	0	0	0	42	45	61
			Spare parts & repair	0	0	0	0	40	40	54
		sub-total	1,431	144	300	4,722	484	1,102	411	
	Street Sweeping	Invest. for facilities	0	0	0	0	0	0	0	
		Invest. for equipment	23	23	23	0	0	0	0	
		O&M for labor	0	73	91	110	110	110	110	
		O&M for material & fuel	0	25	31	38	38	38	38	
		Spare parts & repair	0	9	12	14	14	14	14	
		sub-total	23	132	158	162	162	162	162	
	Total			5,098	2,378	3,097	6,405	3,223	4,269	2,840
Indirect Cost	Maintenance Workshop	Invest. for facilities	42	0	0	0	0	0	0	
		Invest. for equipment	297	0	0	0	0	0	0	
		O&M for labor	4	28	33	40	46	52	60	
		O&M for material & fuel	0	11	14	17	19	22	25	
		Spare parts & repair	0	15	18	22	26	29	34	
		sub-total	342	54	64	80	91	104	119	
	Motor pool	O&M for labor	0	3	3	3	3	3	3	
		O & M for others	0	4	4	4	4	4	4	
		sub-total	0	7	7	7	7	7	7	
	Administration	Invest. for facilities	29	0	0	0	0	0	0	
		Invest. for equipment	123	21	21	31	21	21	21	
		O&M for labor	38	48	58	67	77	86	96	
		O&M for material & fuel	0	8	10	11	13	15	16	
		Spare parts & repair	4	4	5	6	7	8	9	
		sub-total	194	81	93	115	117	130	142	
	Total			536	142	165	202	215	241	268
Grand Total			5,634	2,520	3,262	6,607	3,438	4,510	3,108	

3.3.4 Financial Analysis

The objective of financial analysis is to financially evaluate the SWM Master Plan for DSM city and to select a financially sustainable plan.

a. Pre-conditions of the Analysis

Pre-conditions for the financial analysis are set up in the table below.

Project Life	6 years from 2000 to 2005
Executing Bodies	DCC and part of the refuse collection services will be contracted out to the private sector.
Investment Plan	The M/P proposes the disposal of all waste in the New Kunduchi Disposal Site (2000-2002), which will be in the northern part of DCC, after the closure of the Vingunguti disposal site in 2000. The financial analysis was therefore carried out assuming that in 1999 both DCC and the contractors will purchase all vehicles and equipment required past the year 2000.
Scrap Value	The vehicles procured after 1999 will have some residual value when the project completes in the year 2005. The scrap value of these vehicles will be accordingly included as revenue for 2006.
Cut-off Rate	A cut-off rate, also known as an opportunity cost of capital, is fixed at 11.6 % per annum, which is equivalent to the real interest rate in the capital market of Tanzania. However, the cost to be covered by a grant was excluded from the project cost in the financial analysis.

b. Case Studies

For the financial analysis several cases are set up regarding the following 3 aspects:

- Financial sources: Financial sources for the investment of the project cost
- Revenue source 1: RCC system
- Revenue source 2: Special Fund to be allocated from revenue from the city's tax revenue

b.1 Financial Sources for the investment of the project cost

The following 3 cases were presented as financial sources.

Case	Description
A	All of the project costs are covered by a loan.
B	The investment in 1999 for the construction of the final disposal site and landfill equipment is granted by foreign aid.
C	All investment in 1999 for the construction of the final disposal site, landfill equipment, refuse collection vehicles, machinery for the maintenance workshop, etc. are granted by foreign aid.

b.2 Refuse Collection Charge System

Following two cases were assumed for the refuse collection charge system.

Case 1	Joint billing with water supply and sewerage fee by DAWASA
Case 2	Special RCC collected by DCC

b.3 Special Fund to be allocated from the city's tax revenues

Following three cases were assumed for the total amount of special fund allocated from the city's tax revenues.

Case a	Most optimistic scenario of increase in city tax revenue and allocation ratio for solid waste management
Case b	Most likely scenario of increase in city tax revenue and allocation ratio for solid waste management
Case c	Most pessimistic scenario of increase in city tax revenue and allocation ratio for solid waste management

c. Refuse Collection Charge (RCC)

Various conditions regarding the RCC system are set up as below.

c.1 Joint billing with water supply charge by DAWASA

c.1.1 Household waste

Target people	All households that receive refuse collection services
Amount of RCC	Tsh. 1,250 per household per month (according to the interview on willingness to pay)
Billing rate	30 %: (present provision rate of water supply (40%) x present billing rate of water supply charge (80%))
Collection cost rate of RCC	30%: 30% of RCC is paid to DAWASA for the collection cost

c.1.2 Wastes other than household waste

Target people	All dischargers of official, commercial and market waste that receive the service
Amount of RCC	Tsh. 20,000 per ton (approximately 1.33 times of Willingness to Pay of household waste)
Billing rate	70%: present provision rate of water supply of 80% x present billing rate of water supply charge of 90%
Collection cost rate of RCC	30%: 30% of RCC is paid to DAWASA for the collection cost.

c.2 Special RCC collected by DCC

c.2.1 Business Waste (Commercial, Market and Institutional Wastes)

Target people	All dischargers of official, commercial and market waste that receive the service
Amount collected	Tsh. 20,000 per one ton (approximately 1.33 times of Willingness to Pay of household waste)
Billing rate	80%

c.2.2 Household Waste

Concerning household waste, the special RCC is to be set up for the special refuse collection services, such as door to door collection, bulky waste collection, garden waste collection, etc., where collections costs are generally more expensive than for normal household waste.

d. Forecast for increase in city tax revenue and allocation rate for solid waste management projects

The forecast for the total amount of special fund allocated from the city's taxes to solid waste management in the financial evaluation, which is a major source of income, is based on the forecast of increase in city tax revenue and allocation rate of this income to the solid waste management project.

d.1 Forecast of City Tax Revenue

d.1.1 Type of City Tax Revenue

The city tax revenue of Dar es Salaam City comprises of seven major taxes: the development levy, property tax, petrol levy, service levy, hotel levy, business license, market dues and other taxes.

d.1.2 Forecast Method of Increase in Tax Revenue Ratio

Future increase in tax revenue is determined by the three factors below by forecasting potential tax revenue (total revenue when 100 % of tax payers pay tax) of various taxes and comparing these factors against potential.

- Growth rate of the potential tax revenue
- Maximum collection rate of the actual revenue to the potential revenue
- Growth rate of the actual revenues

d.1.3 Growth Rate of Potential Tax Revenue

Basically, potential tax revenue of each city tax increases in proportion to the economic growth rate of Dar es Salaam City, as long as the tax rate remains unchanged. Therefore, the increase rate of the potential tax revenue is fixed at 5.0% per annum, which is the target real growth rate of Tanzania's GDP.

d.1.4 Maximum Collection Rate of the Actual Revenue to the Potential Revenue

Maximum collection rates of the actual revenue to the potential revenue are classified into two groups, namely, the economically determined group and politically predetermined group and target rates were set per group.

Group	Tax Group	Maximum Collection Rate of the Actual Revenue to the Potential Revenue
Maximum collection rate decided economically	Development Levy, Property Tax, Service Levy, Hotel Levy, Business Licenses, market Dues, Other taxes	80%
Maximum collection rate decided politically	Petrol Levy	100%

d.1.5 Increase Rate in Tax Revenue

Bearing in mind the above potentials, forecast of increase in tax revenue was employed and classified into four groups; extremely high potential of tax revenue increase, relatively high group, low group and group whose tax revenue increase is politically predetermined. Furthermore, the maximum collection rate of the actual to potential revenue compared to the previous year was applied, and a forecast was employed

according to the three scenarios, namely, optimistic, moderate, and pessimistic scenarios.

Group	Type of tax	Increase rate of tax revenue (%)			Maximum collection rate of actual revenue to the potential revenue (%)
		Optimistic	Moderate	Pessimistic	
Extremely high potential	Service Levy	170.0%	150.0%	130.0%	80.0%
relatively high potential	Development Levy, Property Tax, Hotel Levy	160.0%	140.0%	120.0%	80.0%
Low potential	Market Dues, Business Licenses, others	130.0%	120.0%	110.0%	81.0%
Group whose increase in tax revenue is politically determined	Petrol Levy	170.0%	150.0%	130.0%	100.0%

d.2 Allocation of the City's Tax Revenue to the Solid Waste Management Budget (Special Fund)

Allocation of tax revenues to the budget of solid waste management projects for the last five years changed at a rate of around 5 % as follows.

Year	1991	1992	1993	1994	1995
Allocation rate for the budget of SWM project	5.5%	5.1%	5.2%	5.0%	4.8%

Considering these conditions, the forecast of change in allocation ratio of city tax revenue to solid waste management projects was employed classified into three cases as follows.

Optimistic scenario	Allocation rate shall be increased by 0.2% annually from the present 5.0%. Assume that budget allocation rate in 2005 to be 6.8%.
Moderate scenario	Maintain the present allocation rate of 5.0%. Assume that budget allocation rate in 2005 to be 5.0%.
Pessimistic scenario	Allocation rate shall be decreased by 0.2% annually from the present 5.0%. Assume that budget allocation rate in 2005 to be 3.2%.

d.3 Scenario of increase of city tax revenue and allocation rate to Solid Waste Management project

With the combinations (three scenarios of increase rate of city tax revenue and three scenarios of tax allocation rate) of the increase in city's tax revenue and tax allocation rate to the solid waste management projects, the following nine cases were set up regarding the total amount of special fund allocated from the city's tax revenue to the solid waste management project, by having a most optimistic case (case a), moderate case (case b) and most pessimistic case (case c).

Case	Increase rate of tax revenue	Allocation rate of city taxes
Most optimistic case, case a	Optimistic scenario	Optimistic scenario
	Optimistic scenario	Moderate scenario
	Optimistic scenario	Pessimistic scenario
Moderate case, case b	Moderate scenario	Optimistic scenario
	Moderate scenario	Moderate scenario
	Moderate scenario	Pessimistic scenario
	Pessimistic scenario	Optimistic scenario
	Pessimistic scenario	Moderate scenario
Most pessimistic case, case c	Pessimistic scenario	Pessimistic scenario

e. Financial Internal Rate of Return (FIRR)

FIRR was calculated regarding the following the combined eighteen cases (3x2x3) of the three cases of project cost (A: all loan, B: grant provided only for disposal site, C: grant provided for disposal site, collection vehicles, workshops), two cases of billing (RCC) system (1: joint billing, 2. RCC only for special collection service), and the three scenarios of forecast regarding the special fund allocated from the city's tax revenue. The result is as follows.

Table 3-9: FIRRs of Each Financial Case Study

Financial Plan for Investment	Financial Source	Revenue Forecast	Case	FIRRs (%)
All loan	Tax and RCC collected by joint billing with water supply charge	Optimistic	A-1-a	1.52%
		Most Probable	A-1-b	-5.38%
		Pessimistic	A-1-c	-13.90%
	Tax and Special RCC collected by DCC	Optimistic	A-2-a	-2.83%
		Most Probable	A-2-b	-8.91%
		Pessimistic	A-2-c	-17.79%
Grant provided only for the investment in 1999 for construction of the disposal site and landfill equipment	Tax and RCC collected in joint billing with water supply charge	Optimistic	B-1-a	4.88%
		Most Probable	B-1-b	-3.14%
		Pessimistic	B-1-c	-12.56%
	Tax and Special RCC collected by DCC	Optimistic	B-2-a	-0.10%
		Most Probable	B-2-b	-7.66%
		Pessimistic	B-2-c	-16.74%
Grant provided for all investment in 1999	Tax and RCC collected in joint billing with water supply charge	Optimistic	C-1-a	31.92%
		Most Probable	C-1-b	8.34%
		Pessimistic	C-1-c	-7.05%
	Tax and Special RCC collected by DCC	Optimistic	C-2-a	17.01%
		Most Probable	C-2-b	0.57%
		Pessimistic	C-2-c	-12.76%

Following conclusion was drawn from the above FIRRs.

- In the case where there is a total loan scheme, FIRRs of all the financial cases was much lower than the opportunity cost of capital (cut-off rate) of Tanzania. Therefore, it is not financially feasible. It implies that supply of higher external financial sources such as foreign grant assistance for investment is essential.
- In the case where grant assistance covers investment cost for 1999 to construct the final disposal site and acquire landfill equipment, it is judged that all financial

cases will be financially unrealistic because the FIRR in all cases are under the cut-off rate. It implies that more financial resources, not only for the final disposal site but also for other investment costs, with a higher foreign grant equivalent is indispensable.

- In the case where all required investment for 1999 is granted, RCC is collected by DAWASA with water charge and tax forecast is most probable, the FIRR is 8.34 %. Although this value is slightly lower than the cut off rate of 11.6 %, the project implementation can be made financially feasible by DCC making additional efforts such as collect more taxes, increase RCC collection rate, etc.
- In the case where all required investment for 1999 is granted, special RCC is collected by DCC and tax forecast is most probable, the FIRR is 0.57 %. Although this value is lower than the cut off rate of 11.6 %, the required operation and maintenance cost can be at least covered by the revenue. In addition, further investment can be made by making additional efforts such as collect more taxes, increase RCC collection rate, etc.

3.4 Examination on the Master Plan by Pilot Projects

a. Pilot Projects

As can be clearly seen from the current refuse collection coverage rate of 8.1 %, DSM has a poor SWM system. Although various agencies have conducted many SWM studies in DSM, no improvements have been observed yet. Judging from previous experiences, numerous problems are bound to surface with the implementation of the projects proposed in the M/P. Pilot projects were carried out in the study to identify these problems and ways to be overcome these difficulties. The objectives of the pilot projects are summarised below.

- Examination of the applicability of technologies proposed in the master plan.
- Acquisition of basic data for the preliminary design of the feasibility study.
- Enhancement of public awareness and increase public participation in SWM.
- Demonstration of some improvement measures to authorities concerned and the public.

b. Implementation of Pilot Projects

The following four pilot projects were implemented.

Code:

- A. Enhancing of Public Awareness on SWM.
- B. Environmental Improvement of the Vingunguti Disposal Site.
- C. Improvement of the Refuse Collection System in Kariakoo.
- D. Improvement of the Refuse Collection System in Buguruni.

Pilot projects were planned in order to examine the applicability of the technologies and plans proposed in the Master Plan as countermeasures to problems identified in the first phase of the study.

Table 3-10: Contents of Pilot Projects

Current Problems	Proposals in the M/P	Contents of Pilot Projects	Code No.
Inappropriate technical system and lack of resources	Improvement of refuse collection system	<ul style="list-style-type: none"> To examine the expedience of skip collection system in Kariakoo and Buguruni. 	C, D
	Sanitary Landfill	<ul style="list-style-type: none"> Improvement of the environmental sanitary condition of the landfill site and its environs. Demonstration of environmental protection technologies such as gas removal, soil cover, etc. Demonstration and technical transfer of waste amount control system by using the computerised weighbridge system installed by JICA. 	B
	Improvement of street cleaning system	<ul style="list-style-type: none"> Installation of 100 litter bins in Kariakoo ward and garbage collection from them. 	C
Lack of knowledge of dangers by refuse	Education on refuse	<ul style="list-style-type: none"> Production of 20,000 refuse education textbooks. Trial lessons on refuse to primary school pupils. Seminar on refuse education to primary school teachers. Poster competition by primary school pupils. Educational cultural show on refuse. Educational film show on refuse. 	A
Lack of moral concern about refuse	To raise public awareness of refuse problems and to promote public cooperation	<ul style="list-style-type: none"> "Beautify Your City" campaign was conducted. In order to improve public spirit in DSM and make people feel responsible for maintaining the city clean, the catch phrase "Beautify Your City" for public the campaign was adopted. Most activities in the pilot projects were concentrated in February with February named as "Beautify Dar es Salaam Month". The contents of the pilot projects were publicised timely. Banners, posters, stickers, TV, newspaper, T shirts, etc. were used in order to advertise "Beautify Your City" and promote public cooperation. An open 10 km Taka Race from the City Hall to the National Stadium took place on 2nd March as the closing event of "Beautify Dar es Salaam Month" in order to raise public awareness on refuse. Every participant ran with stickers showing "Beautify Your City" on the front of his/her shirt. 	A

c. Findings from Pilot Projects

Through the implementation of the pilot projects the Team found out the following important issues for the modification of the M/P and the execution of the F/S for the first priority projects.

- i. It is difficult to gain public co-operation for the prevention of littering if a sufficient refuse collection service is not provided. For example, the litter bins installed in Kariakoo ward were used not only for litter but also for the discharge of residential and commercial wastes. Most of them became refuse collection points as a result. This shows that litter bins (which requires public co-operation for the prevention of littering) can not function according to their purpose without the provision of a sufficient refuse collection system. This also indicates that the skip collection system can work in Kariakoo ward, i.e. in the SUPA.

- ii. Public co-operation for primary refuse collection to a skip can be obtained if refuse collection services are sufficiently provided. For example in Buguruni ward, although skip containers were placed just beside the Uhuru road which is some distance from residential areas, it was observed that considerable amounts of household wastes were discharged into them. This proved that a considerable number of people would bring and discharge their wastes into skips to be installed along a trunk road even without primary collection services in the SUUA.
- iii. A major problem with any future campaign is the perception many residents have of the DCC. In the words of one participant: "DCC says a lot but does little". This is the main reason why many residents thought it was unfair to ask citizens to change their attitudes without a corresponding improvement in DCC's SWM performance. It is vital that the general public's perception of DCC is improved and this will primarily be achieved through improved SWM performance, not by education and awareness raising campaigns.
- iv. Programmes for public education require sufficient "attraction power" for the public so that the majority of public are willing to participate in them by their own will. Educational cinema shows and culture shows conducted as pilot projects gathered large audiences every time and it was shown that the cinema show in particular is a very cost effective measure for public education.

3.5 Project Evaluation

The projects proposed in the Master Plan were evaluated in terms of their technical, social, environmental, financial and economic impacts.

The technical evaluation concluded that the simplicity of the proposed technical system is very appropriate for the present level in DSM. Although problems in vehicle and equipment maintenance are foreseen, they can be overcome by improvements in the proposed maintenance workshop.

The social evaluation concluded that the implementation of the proposed projects would generate various positive significantly intangible impacts such as improvements in public health and sanitary conditions, prevention of floods, promotion of foreign investment and tourism, increase in land value, etc.

The environmental evaluation concluded that the positive effects from the projects shall outnumber the negative impacts.

In the financial evaluation, FIRR (financial internal rate of return) for the 18 cases were calculated. As a result, if:

- All investment cost for 1999 is granted.
 - The most probable scenario of increase of tax revenue is taken.
 - RCC is collected by either DAWASA included in the water charges or the DCC directly.
- 1) In the case where RCC is collected by DAWASA with water charges, FIRR is 8.34 %. Although this value is slightly lower than the cut off rate of 11.6 %, the

project implementation can be made financially feasible by DCC making additional efforts such as collect more taxes, increase RCC collection rate, etc.

- 2) In the case where special RCC is collected by DCC, FIRR is 0.57 %. Although this value is lower than the cut off rate of 11.6 %, the required operation and maintenance cost can be at least covered by the revenue. In addition, further investment can be made by making additional efforts such as collect more taxes, increase RCC collection rate, etc.

As a result the EIRR is calculated at 9.25 % which is almost equal to the cut off rate, i.e. 11.6 %. Therefore the implementation of the master plan will contribute to the national economy.

The overall evaluation concluded that the execution of the Master Plan would be essential to maintain the basic level of urban environment sanitation and public health and to enable sustainable urban development for DSM, at the same time it would be feasible technically, socially, environmentally, financially and economically.

3.6 Initial Environmental Examination (IEE)

JICA's Environmental Guidelines⁴ have been followed for the IEE. The JICA Guidelines list 23 environmental items for evaluation under the headings: 'social environment', 'natural environment' and 'pollution'. For this study, a 24th item ('litter') was added under the 'pollution' heading. The IEE covered the proposed disposal site and the main access road (Bagamoyo Road) from the disposal site to the intersection with Sam Nujoma Road at Mwenge. Only this section of road was included as it will experience the most significant increase in traffic volume due to the passage of refuse collection vehicles.

The IEE concluded that the following items would be included in the Environmental Impact Assessment (EIA).

1. Economic activities
2. Traffic and public facilities
3. Public health
4. Waste
5. Hazards/Risks
6. Topography and geology
7. Groundwater
8. Hydrological situation
9. Flora and fauna
10. Landscape/Aesthetics
11. Air pollution
12. Water pollution
13. Soil contamination
14. Noise and vibration
15. Offensive odour
16. Litter

⁴ Environmental Guidelines for Infrastructure Projects No. VI Solid Waste Management, JICA, Sept 1992

3.7 General Recommendation on Industrial and Medical Solid Waste Management

3.7.1 Industrial Solid Waste Management (ISWM)

a. Necessity of Further Survey

The survey on ISW conducted in this study was not substantial due to the absence of an inventory of industries and lack of resources available for the study. A more detailed survey on ISWM, therefore, should be conducted after an inventory of existing factories has been compiled.

b. Laws and Regulations

A classification system for industrial solid wastes which will distinguish hazardous wastes from non-hazardous wastes should be formulated.

The national government and the DCC should co-ordinate in formulating laws, regulations and guidelines regarding ISW, bearing in mind the hierarchy of the laws, ordinances and guidelines, to avoid conflicts in environmental legislation.

A control and enforcement system to eliminate illegal dumping of ISW must be established urgently in co-operation with the various agencies concerned.

Legislation which ensures economic incentives to dischargers in return for improved practice should be introduced. This is in order to assist them in taking measures to minimise the discharge of ISW and to use pollution control technologies.

c. Administration and Organisation

An administrative structure which ensures proper ISWM should be established by clearly defining the roles of each organisation concerned.

The different levels of government and the governmental agencies should co-ordinate in law enforcement activities related to ISWM.

The DCC should co-operate with the national government authorities on matters related to nuisances and hazards to people caused by mismanagement of industrial wastes.

d. Plans and Technologies

Guidelines and plans should be made with regard to ISWM to serve as a standard which enterprises have to comply with.

The number of staff responsible for ISWM should be increased and given the necessary training.

Furthermore, the administrative officers should have technical knowledge (in discharge, treatment, recycling, and disposal methods, etc.), correct information and work towards the development of appropriate technologies.

The administration should transfer technical information to dischargers and provide them with technical aid through various schemes.

e. Reduction of Generation of ISW at Generation Sources

Dischargers should take action to minimise the amount of ISW through controlling the generation, discharge and recycling amount, although the present generation amount of ISW is not large.

Dischargers should introduce processes which will enable the treatment of ISW at the generation source. Dischargers should examine production methods and take proper countermeasures to mitigate environmental pollution caused by their wastes.

In addition, all enterprises should endeavour to increase the recycling rate through utilisation plans for recyclable materials.

f. Inventory System of Dischargers

Each discharger should submit to the DCC information on the characteristics, amount, treatment and discharge methods of industrial waste they generate. The inventory system is effective for supervising ISWM as long as precise registration and continuous updating of inventories are implemented.

g. Manifest System of ISW

As the first step for a manifest system which should be implemented in future, the administrative agencies should issue permits to transportation companies which allow them to transport industrial wastes from premises. The permits which include necessary information such as characteristics of waste, type of equipment to be used, person responsible, emergency manual, etc., should be submitted in advance of seeking approval.

h. Segregation of Hazardous Wastes

Dischargers should segregate hazardous and non-hazardous wastes at source in order to control the amounts of ISW to be treated and to be disposed of and so that the reuse and recycling of wastes are encouraged.

i. Treatment and Disposal

The first priority for ISWM should be to establish proper measures for treatment and final disposal of hazardous wastes.

Basic treatment and final disposal methods needed for ISW are chemical treatment such as neutralisation, oxidation and reduction, thermal treatment such as incineration, and sanitary landfill. There are various characteristics of ISW so it is necessary to find the best treatment and final disposal options from a technical and economic point of view.

In many cases the most convenient treatment and final disposal method is secured landfill, as it has the lowest cost. The central government should encourage the private sector to construct such facilities for the sake of environmental protection.

Until the commissioning of such landfills for ISW, hazardous wastes should be stored within generators' premises.

j. Supervision and Advice

Appropriate supervision and sound advice from the central government are most important for the steady introduction of ISWM. Accordingly, the administrative capacity should be improved and consolidated so that inspections can be conducted and advice given to dischargers on storage, transportation and final disposal of ISW.

3.7.2 Medical Solid Waste Management

a. Guidelines

In order to enable the government to implement a medical SWM plan, the guideline on medical SWM which are in line with the Sanitary Code containing a section on medical SWM should be put into effect as soon as possible.

b. Education on Source Segregation of Infectious and Non-infectious Wastes

When the medical SW guidelines are enforced, education of staff in medical institutions should be conducted in order to promote source segregation and storage of the infectious and non-infectious wastes.

c. Hierarchy of Legislation

There should be co-ordination between the national government and the DCC, when producing laws, regulations and guidelines on medical SW, bearing in mind the hierarchy of the laws, ordinances and guidelines, so as to avoid legislative inconsistency.

d. Coordination

The different levels of government should co-ordinate in law enforcement activities related to medical SWM.

e. Role of the DCC

The role of the DCC should be to co-operate with the national government authorities mainly on matters related to nuisances and hazards to people, in general, produced by the mismanagement of medical SW.

f. Enforcement

Medical institutions which violate source segregation regulations for infectious wastes should be strictly punished.

g. Relevant Studies and Projects

The Dar es Salaam Urban Health Project is currently conducting a comprehensive study, "Health Care Waste Management in District Health Facilities" on medical SWM for DSM with the assistance of the Swiss Centre for Development Cooperation in Technology and Management (SKAT). The Tanzanian authorities are requested to respect the findings and recommendations of this study concerning medical SW.

4 Feasibility Study for the First Priority Project

4.1 Outline of the First Priority Projects

a. Targets of the First Priority Projects

The first priority projects aim to improve the solid waste collection, transportation and disposal systems and the night soil collection and transport systems in order to attain the targets between 2000 and 2002 shown in Table 4-1.

Table 4-1: Targets of the First Priority Projects

Item	1996	2000	2001	2002
Improvement of Waste Collection, Transport and Disposal System				
Population in Dar es Salaam (persons)	2,261,000	3,114,050	3,404,211	3,736,041
Population within the Study area (persons)	2,030,000	2,633,000	2,835,000	3,066,000
Waste generation amount (ton/day)	1,772	2,300	2,476	2,678
Waste collection amount (ton/day)	143	545	757	1,001
Waste collection rate (%)	8.1	23.7	30.6	37.4
Population receiving waste collection services (persons)	101,500	624,021	867,510	1,011,780
Road length swept (km)	32.8	67	83	100
Final disposal				
Disposal amount (m ³ /year)	57,183	221,028	307,006	405,989
Name of the disposal site	-	Kunduchi New Disposal Site		
Level of disposal method	Level 1	Level 2		
Improvement of Night Soil Collection and Transport System				
Total night soil collection amount (m ³ /day)	277	1,422	1,531	1,655
Night soil amount to be collected by DCC (m ³ /day)	155	392	423	457

b. Implementation of Pilot Projects

The outline of the first priority projects which was proposed to materialise the targets in Table 4-1 are shown in Table 4-2.

Table 4-2: Contents of the First Priority Projects

Name of Project	Contents																				
Improvement of Waste Collection, Transport and Disposal System																					
Improvement of Waste Collection and Transport	<ul style="list-style-type: none">Procurement of main equipment:<table><tr><th></th><th>1999</th><th>2000</th><th>2001</th></tr><tr><td>6 ton tipper truck</td><td>units 40</td><td>5</td><td>5</td></tr><tr><td>8 ton skip truck</td><td>units 31</td><td>16</td><td>20</td></tr><tr><td>8 m³ skip container with lid</td><td>nos. 62</td><td>32</td><td>40</td></tr><tr><td>8 m³ skip container without lid</td><td>nos. 248</td><td>128</td><td>160</td></tr></table>		1999	2000	2001	6 ton tipper truck	units 40	5	5	8 ton skip truck	units 31	16	20	8 m ³ skip container with lid	nos. 62	32	40	8 m ³ skip container without lid	nos. 248	128	160
	1999	2000	2001																		
6 ton tipper truck	units 40	5	5																		
8 ton skip truck	units 31	16	20																		
8 m ³ skip container with lid	nos. 62	32	40																		
8 m ³ skip container without lid	nos. 248	128	160																		
Development of the New Kunduchi Dispsal Site	<ul style="list-style-type: none">To construct 2 landfill section of 4 sections in 1999.To start the landfill operation in 2000.Landfill sanitary level: Level 2 (Sanitary landfill without a liner for the prevention of leachate percolation)Total landfill capacity is 3.5 million m³. The capacity of the 2 landfill sections to be developed in 1999 is 1.6 million m³.Main facilities: access road, office, landfill sections, drainage work, etc.Landfill equipment: 2 bulldozers, 1 backhoe, 3 tipper truck, 1 pickup																				
Improvement of Street Sweeping	<ul style="list-style-type: none">Procurement of main equipment: 4 ton tipper truck, 3 units in 1999, 1 units in 2000 and 2001																				
Improvement of the Nyerere Workshop	<ul style="list-style-type: none">To furnish the office in 1999 and to start its operation in 2000.Facility improvement: drainage system, water tank, electricityProcurement of machinery for maintenance, mobile workshop, etc.																				
Improvement of Administrative System	<ul style="list-style-type: none">Improvement of the office for WMA and procurement of office equipmentInstitutional building																				
Improvement of Night Soil Collection and Transport System	<ul style="list-style-type: none">Procurement of main equipment: 6 m3 cesspit empty trucks, 8 units in 1999, 4 units in 2000 and 2001.																				

4.2 Improvement of Waste Collection, Transport and Disposal System

4.2.1 Improvement of Waste Collection and Transport Project

The targets of refuse collection amounts and rates in the first priority project are summarised in the table below.

Table 4-3: Targets of the Collection and Transportation Plan

Items	Unit	2000	2001	2002
Total Waste Generation Amount	tons/day	2,300	2,476	2,678
Waste Collection Amount				
Whole DSM	tons/day	545	757	1,001
UA	tons/day	73	74	78
SUPA	tons/day	338	438	557
SUUA	tons/day	135	243	366
RA	tons/day	0	0	0
Waste Collection Rate				
Whole DSM	%	23.7	30.6	37.4
UA	%	100.0	100.0	100.0
SUPA	%	36.7	43.3	50.0
SUUA	%	12.7	21.3	30.0
RA	%	0.0	0.0	0.0

a. Refuse Collection Frequency

The frequency of refuse collection shall be at least twice a week.

b. Refuse Collection Vehicles Plan

The planned type of refuse collection vehicles, refuse collection areas and collection amounts are as shown in the table below.

Table 4-4: Plan of Refuse Collection Vehicles

Area	Type of Vehicles	Waste Collection Amounts		
		2000 tons/day	2001 tons/day	2002 tons/day
UA	6 ton tipper trucks	86	88	90
SUPA	6 ton tipper trucks	138	153	163
	8 ton skip trucks	256	357	487
SUUA	6 ton tipper trucks	16	28	43
	8 ton skip trucks	142	256	384
Total		638	882	1,167

c. Refuse Collection Equipment Plan

The required number of equipment are based on the refuse collection vehicle plan as shown in the table below.

Table 4-5: Refuse Collection Equipment Plan

Area	Type of Vehicles	Average number of trip per vehicle times/day	Refuse collection & transportation capacity per vehicle ton/day	Planned Number of Equipment		
				2000	2001	2002
UA	6 ton tipper trucks	1.93	6.02	14	15	15
SUPA	6 ton tipper trucks	1.93	6.02	23	25	28
	8 ton skip trucks	5.25	13.1	20	27	38
	8m ³ skip container with a lid			62	94	134
	8m ³ skip container without a lid			138	176	246
SUUA	6 ton tipper trucks	1.93	6.02	3	5	7
	8 ton skip trucks	5.25	13.1	11	20	29
	8m ³ skip container without a lid			110	200	290
Total	6 ton tipper trucks	1.93	6.02	40	45	50
	8 ton skip trucks	5.25	13.1	31	47	67
	8m ³ skip container with a lid			62	94	134
	8m ³ skip container without a lid			248	376	536

d. Operation Plan

Each district is to have its own motor pool in order to shorten the travelling distances of refuse collection vehicles and to enable supervisors to practically control refuse collection works. Preventive checks on refuse collection vehicles will be carried out at each motor pool. The proposed locations of motor pools are as follows.

- Kinondoni District: Mwananyamala depot.
- Ilala District: DRIMP depot.
- Temeke District: Temeke District Office

There will be no need for land acquisition because all of the proposed sites are owned by DCC.

4.2.2 Development of the New Kunduchi Disposal Site Project

a. Planned Improvement Level of the New Kunduchi Disposal Site

The underground water survey of the New Kunduchi Disposal Site revealed the following findings.

- The proposed landfill site is located near (2.5km) the Indian Ocean and the groundwater flow is towards the Ocean. Therefore, the leachate that would be generated in the landfill will have minimum impact on potential groundwater sources.
- The groundwater in the area of the proposed landfill site is saline⁵. Therefore, all inhabitants in the area are already connected to water pipes.

Based on the above-mentioned findings the Study Team examined which of the following types of sanitary landfill is appropriate for the proposed landfill:

- Level 2: Landfill without a bottom liner and with percolation of leachate to the groundwater/Indian Ocean.

⁵ "Coast/Dar es Salaam Regions Water Master Plan" prepared by the Canadian company CBA Engineering Ltd. 1979.

Level 3: Landfill with a bottom liner and facilities for collection and evaporation of leachate.

The examination shows that Level 3 requires a considerable financial burden in comparison to Level 2 as shown in the table below.

Table 4-6: Preliminary Cost Comparison of Level 2 and Level 3 of Sanitary Landfill

Cost Items	Construction (Million Tsh.)	O&M (Million Tsh.)	Total (Million Tsh.)	Unit Cost (Tsh./ton)
A. Level 2	3,121	1,589	4,710	1,682
B. Level 3	7,210	1,650	8,860	3,164
B/A	2.31	1.04	1.88	1.88

Note: The Kunduchi New MECCO landfill is assumed to operate from year 2000 to 2008. The total disposal amount for this period is estimated to be 2.4 million tonnes, i.e. 2.64 million m³.

Based on the findings of the underground water survey and cost comparison of the two levels the Team proposes Level 2 (without a bottom liner) as the recommended concept for the proposed landfill. The reasons are:

- With the user-pays-principle, the tipping fee of the proposed landfill shall be more than four times greater than the present fee of 800 Tsh./ ton. This may lead to an increase in illegal dumping operations.
- Although the final decision on the level shall depend on the EIA, the Team considers the impact of the leachate (without a liner) on the groundwater and the people in the vicinity will be minimal.

b. General Description of the Plan

The descriptions of the proposed New Kunduchi Disposal Site are described below and the general layout is shown in Figure 4-2.

Name of Facility:	New Kunduchi Disposal Site
Location:	The Kunduchi New MECCO quarry, Kunduchi, Kinondoni, Dar es Salaam
Area of the site:	26 hectares
Present condition:	Exhausted coralline limestone quarry site. The depth of the cavities are about 10 to 15 m.
Status of land	The proposed site is state owned and its ownership consists of surface and mining rights. Mining rights are under the control of the Ministry of Energy and Mineral (MEM) and that of the proposed site have been granted to four private and governmental organisations. The surface right of the proposed site is owned by the DCC. The mining right expires after the mineral is exhausted with confirmation by MEM. Approximately 90 % of mineral in the proposed site has there are no minerals within the present site which is to be developed during the first phase.

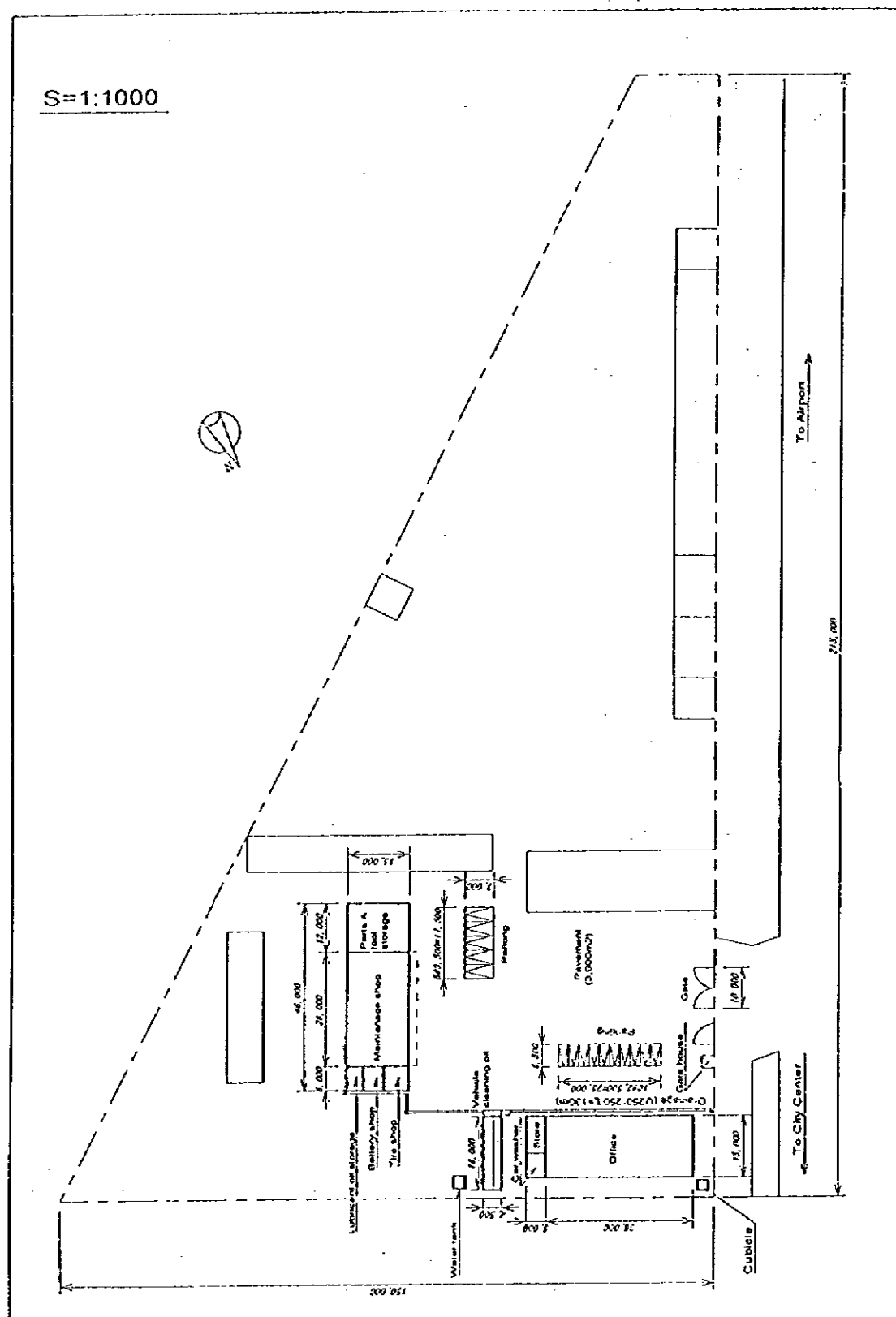


Figure 4-1: General Improvement Plan of the Nyerere Workshop

Waste to be received : Household, commercial, institutional, market, street sweeping, bulky, garden, non-hazardous industrial, non-hazardous medical and construction wastes.

Life years: 11 years from 2000 to 2010

Capacity of the landfill section:

Landfill Section	Area (ha)	Landfill Capacity (m ³)	Construction Period	Operational Period	Operational Years
1A	6	900,000	1999 (1st phase)	2.5	2000-2002
1B	5	700,000	1999 (1st phase)	2.0	2003-2004
2	8	1,000,000	2004 (2nd phase)	3.5	2005-2007
3	7	900,000	2007 (2nd phase)	3.0	2008-2010
Total	26	3,500,000		11.0	2000-2010

Structure of disposal site: Sanitary landfill without a bottom liner

Final elevation of landfill: 72 m

Final height of landfill: 12 m above the New Bagamoyo Road

Depth of landfill: 10 m to 27 m

Scavenging: Scavenging is prohibited.

Operation hour: from 7:30 am till 6:00 pm

Main facilities: Site office, approach road, weighbridge, shelter for heavy equipment maintenance, car wash, access road, fence, gate, divider, drainage, water supply, water tank, buffer zone, plantation, primary leachate collection and leachate reserve pond

Landfill equipment:

Description	Capacity	Use	2000	2001	2002	2003	2004	2005
Bulldozer	210PH	Spreading and compaction of waste	2	2	3	3	3	3
Backhoe	0.7m ³	Excavation of coverage soil and site maintenance	1	1	1	1	1	1
Tipping truck	10 tons	Transporting coverage soil	3	3	3	3	3	3
Pickup	2 tons	Transporting materials	1	1	1	1	1	1

4.2.3 Improvement of Street Sweeping Project

The contents of the street sweeping project shown below is to be contracted out.

Item	unit	2000	2001	2002	2003	2004	2005
Planned length of road to be swept	m	67	83	100	100	100	100
4 ton tipper truck	units	3	4	5	6	6	6
Driver	person	3	4	5	6	6	6
Sweeping worker	person	110	147	183	220	220	220

4.2.4 Improvement of the Nyerere Workshop

The Nyerere workshop, which is currently not in use, will be improved as a central workshop for refuse equipment as shown in Figure 4-1. The workshop is supposed to provide only preventive maintenance services. Major repair services are to be conducted in private garages. There will be no need for land acquisition because the proposed site is owned by DCC.



4.2.5 Conclusion of the EIA on the New Kunduchi Disposal Site

Based on the result of Initial Environmental Examination (IEE), surveys were conducted regarding the effect of the following environmental items for evaluation. This was done in order to assess the environmental effect posed by the establishment of the new Kunduchi disposal site.

- 1) Economic activities, 2) Traffic and public facilities, 3) Public health, 4) Waste, 5) Hazards/Risks, 6) Topography and geology, 7) Groundwater, 8) Hydrological situation, 9) Flora and fauna, 10) Landscape/aesthetics, 11) Air pollution, 12) Water pollution, 13) Soil contamination, 14) Noise and vibration, 15) Offensive odour 16) Litter

As a result, the Environmental Impact Assessment Matrix shows that the project will have various positive and negative impacts. However, all negative impacts will be minor except those regarding traffic (heavy traffic, increase in frequency of traffic accidents and exhaust gas) and can be minimised through appropriate mitigation measures such as implementation of traffic lane expansion in the congested areas, strengthening traffic regulation, and improvement of collection vehicles. Therefore, the result of EIA showed that all negative impact can be within the tolerance level by taking appropriate measures.

The major benefit of the project will be the provision of a sanitary landfill which will be used as the final disposal site for DSM city from 2000 - 2002 and then for Kinondoni district⁶, from 2003 - 2010. There is an urgent need for a new landfill as the remaining capacity of the Vingunguti landfill is 1-2 years, moreover, waste is being disposed of by open dumping at Vingunguti, thus currently creating many environmental problems in the immediate and surrounding areas.

The conceptual design for the landfill is considered to be appropriate. Furthermore, the operational policies and procedures proposed in the conceptual design will minimise the negative environmental impacts associated with the project. The absence of an impermeable bottom liner and consequent direct infiltration of leachate into the primary groundwater between the site and Indian Ocean is considered to be acceptable as it has been assessed that the leachate will have a minimum impact on potential groundwater resources in the area due to the site's proximity to the ocean. The groundwater is saline, already badly polluted and is not being used for human consumption.

During operation, some temporary negative environmental impacts on the topography and landscape/aesthetics due to landfilling, especially while operating in sections 1A and 1B, will be experienced. However, longer term permanent improvements in the topography, landscape/aesthetics, and flora and fauna will provide far greater positive impacts on the site. Similarly, the provision of land for agricultural or recreational activities is another major positive impact and will benefit the residents in surrounding areas.

⁶ The percentage of the DSM population living in Kinondoni district is projected to be 41 % in 2003 and to decrease by around 1 % per year (Source: The Study on Solid Waste Management in DSM; JICA, 1996).

Negative economic impacts at the site will be minimised by allowing mining companies and small scale miners to continue mining sections 2 and 3 until 2004 and 2007, by which stage the coralline limestone should be exhausted, while sections 1A and 1B are being constructed and operated. Furthermore, economic activity in the area around the site will be increased during construction and operation, especially the business of food vending.

The policy of prohibiting scavenging at the new disposal site will result in a loss of income and livelihood for scavengers and middlemen currently operating at the Vingunguti disposal site, a decrease in the amount of waste materials recycled, and a major upset to the recycling system in the city. However, the negative impacts will be minor because the number of scavengers affected will be less than 100. Furthermore, the SWM Master Plan proposes to promote recycling by segregation at the source in order to mitigate these negative impacts and also to improve the recycling rate.

The transit of refuse collection vehicles will have a low negative impact on traffic volumes and the incidence of accidents along New Bagamoyo Road between Sam Nujoma Road and the disposal site. This negative impact will be mitigated by expanding traffic lanes in the congested areas and strengthening traffic regulation. Increase of pollution load of SO₂ and NO_x can be expected. It is recommended that refuse collection vehicles should be fitted with appropriate devices for reducing vehicle emissions. Furthermore, monitoring of exhaust gas concentrations should be conducted.

It is recommended that this project should be approved and implemented according to the proposed timetable because the considerable positive impacts far outweigh the negative ones.

4.2.6 Project Evaluation

The improvement of refuse collection and transportation system and the development of the New Kunduchi Disposal Site are closely linked and therefore their financial feasibility are analysed together as the improvement of refuse collection, transportation and disposal system.

a. Project Cost Summary

The estimated project costs are summarised in the table below.

Table 4-7: Cost Schedule of the First Priority Projects

unit: million Tsh

Category	Category	Description	1999	2000	2001	2002	2003	2004	2005
Direct Cost	Collection and Transportation	Invest. for equipment	3,644	1,384	1,691	0	0	0	0
		O&M for labour	0	147	174	204	204	204	204
		O&M for material & fuel	0	235	320	424	424	424	424
		Spare parts & repair	0	337	454	595	595	595	595
		sub-total	3,644	2,103	2,639	1,224	1,224	1,224	1,224
	Final Disposal Kunduchi Site	Invest. for facilities	831	0	0	430	580	0	0
		Invest. for equipment	600	0	150	0	0	0	0
		O&M for labour	0	20	20	21	21	21	21
		O&M for material & fuel	0	64	70	92	92	92	92
		Spare parts & repair	0	60	60	75	75	75	75
	sub-total	1,431	144	300	617	767	187	187	
	Street Sweeping	Invest. for equipment	23	23	23	0	0	0	0
		O&M for labour	0	73	91	110	110	110	110
		O&M for material & fuel	0	25	31	38	38	38	38
		Spare parts & repair	0	9	12	14	14	14	14
		sub-total	23	132	158	162	162	162	162
	Total Direct Cost		5,098	2,378	3,097	2,023	2,153	1,573	1,573
Indirect Cost	Maintenance Workshop	Invest. for facilities	42	0	0	0	0	0	0
		Invest. for equipment	297	0	0	0	0	0	0
		O&M for labour	4	28	33	40	40	40	40
		O&M for material & fuel	0	11	14	17	17	17	17
		Spare parts & repair	0	15	18	22	22	22	22
		sub-total	342	54	64	80	80	80	80
	Motor Pool	O&M for labour	0	3	3	3	3	3	3
		O&M for material & fuel	0	4	4	4	4	4	4
		sub-total	0	7	7	7	7	7	7
	Administration	Invest. for facilities	29	0	0	0	0	0	0
		Invest. for equipment	123	21	21	0	0	0	21
		O&M for labour	38	48	58	67	67	67	67
		O&M for material & fuel	0	8	10	11	11	11	11
		Spare parts & repair	4	4	5	6	6	6	6
		sub-total	194	81	93	85	85	85	106
	Total Indirect Cost		536	142	165	171	171	171	192
Grand Total		5,634	2,521	3,261	2,174	2,324	1,744	1,765	

b. Financial Analysis

As a "take-off project" of the Master Plan, the proposed improvement of urban solid waste collection transport system and the new Kunduchi disposal site establishment plan was evaluated from a financial perspective among priority projects supposed to be implemented between 2000 and 2002. Eighteen cases were studied as were done in Master Plan as a combination of preconditions and cases in the evaluation of the priority project. Results of the FIRR from this study are as follows.

Financial Plan for Investment	Financial Source	Revenue Forecast	Case	FIRRs (%)
All loan	Tax and RCC collected by joint billing with water supply charge	Optimistic	A-1-a	2.42%
		Most Probable	A-1-b	-8.15%
		Pessimistic	A-1-c	-19.20%
	Tax and Special RCC collected by DCC	Optimistic	A-2-a	-1.83%
		Most Probable	A-2-b	-12.34%
		Pessimistic	A-2-c	-23.35%
Grant provided in 1999 for the investment in construction of the disposal site and landfill equipment	Tax and RCC collected by joint billing with water supply charge	Optimistic	B-1-a	8.13%
		Most Probable	B-1-b	-4.62%
		Pessimistic	B-1-c	-17.20%
	Tax and Special RCC collected by DCC	Optimistic	B-2-a	3.05%
		Most Probable	B-2-b	-9.42%
		Pessimistic	B-2-c	-21.81%
Grant provided for all investment in 1999	Tax and RCC collected in joint billing with water supply charge	Optimistic	C-1-a	62.99%
		Most Probable	C-1-b	24.70%
		Pessimistic	C-1-c	-6.94%
	Tax and Special RCC collected by DCC	Optimistic	C-2-a	40.92%
		Most Probable	C-2-b	10.24%
		Pessimistic	C-2-c	-14.80%

Following conclusion was drawn from the above FIRR calculation.

- In the case where the loan covers the whole scheme, FIRRs of all financial cases remain much lower than the opportunity cost of capital (cut-off Rate) of Tanzania. Therefore, it is not financially feasible. It suggests that a higher external financial source such as foreign grant assistance is essential.
- In the case where grant assistance covers investment cost in 1999 for the construction of the final disposal site and landfill equipment, it is judged that all financial cases will be financially infeasible because the FIRRs are below the cut-off rate. It implies that more financial supply, not only for the final disposal site but also for other investment costs with a higher foreign grant equivalent is indispensable.
- When all required investment for 1999 is granted, the RCC is collected by DAWASA with water charge and most probable tax forecast is used (Case C-1-b) the FIRR is 24.70 %. It concluded that the implementation of projects would be financially feasible because it exceeds the cut off rate of 11.6 %. Refer to Figure 4-3.
- When all required investment for 1999 is granted, special RCC is collected by DCC and the tax forecast taken is most probable (C-2-b), FIRR is 10.24 %. Although this value is slightly lower than the cut off rate of 11.6 %, the project implementation can be made financially feasible by DCC making additional efforts such as collecting more taxes, increase collection rate of special RCC , etc.

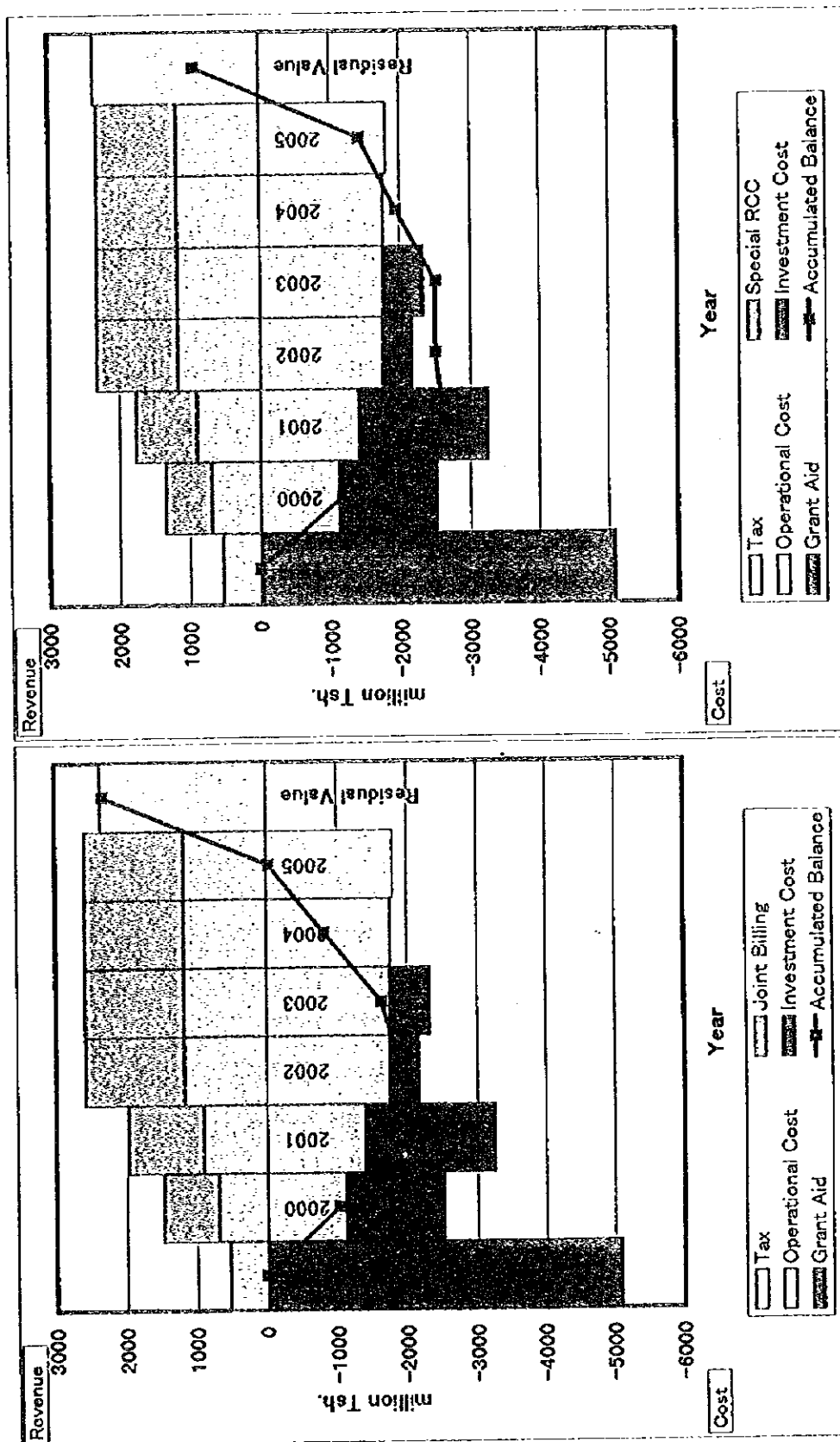


Figure 4-3: Financial Implementation Plan for Case C-1-b Figure 4-4: Financial Implementation Plan for Case C-2-b

Note: The revenue after the year 2001 was set up to be constant because the waste collection amount will be constant. The investments in 2002 and 2003 are required for expansion of the Kunduchi disposal site. Although these works are not included in the first priority projects, they are required to be included in the financial analysis until 2005 because these works will be actually needed to continue the first priority projects.

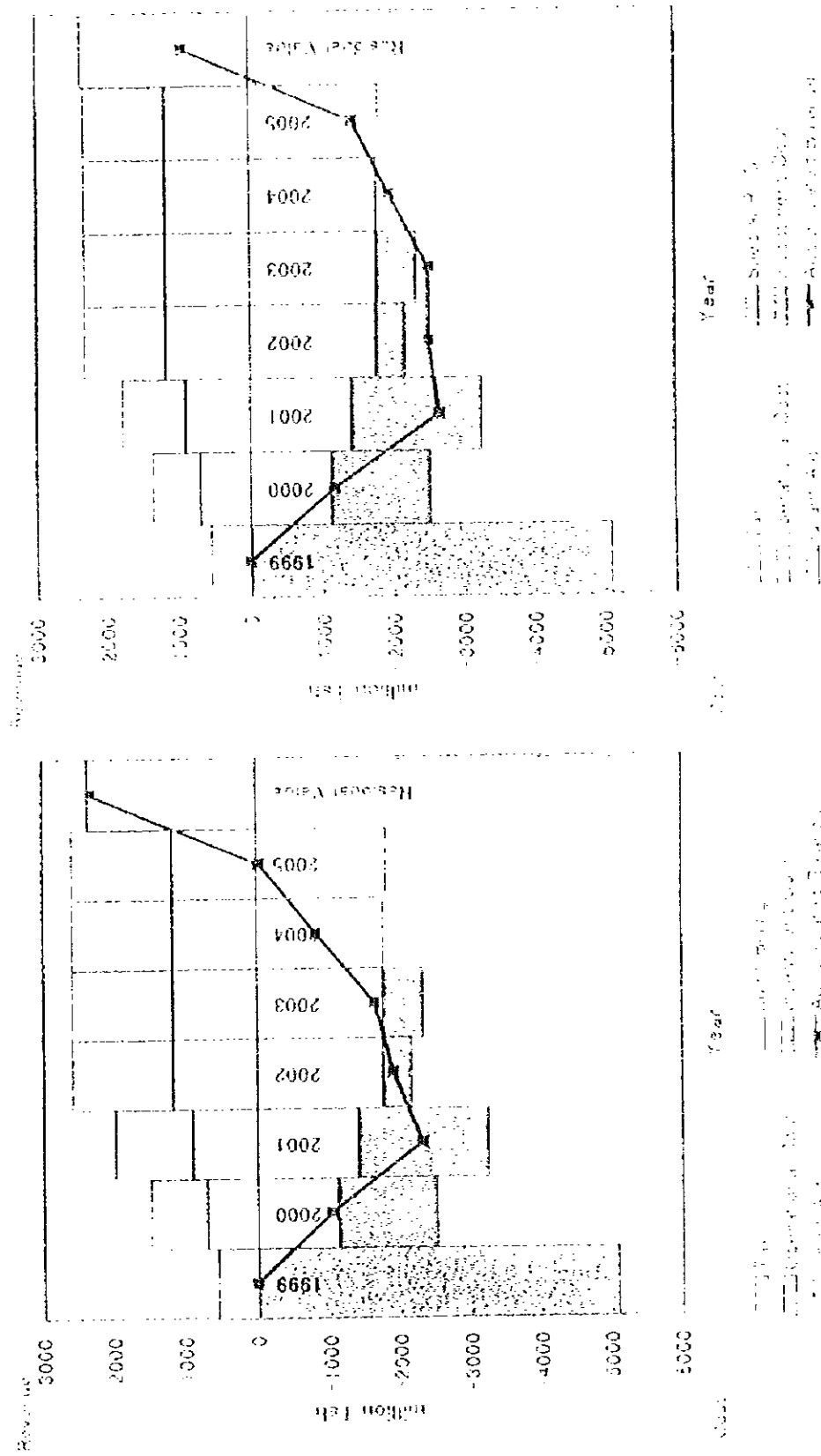


Figure 10: Revenue and Residual Value (Case 0-10)

The revenue and residual value of the project are shown in Figure 10. The revenue is calculated based on the sales volume and the price of the product. The residual value is calculated based on the cost of the product and the depreciation rate.

c. Project Evaluation

The first priority projects, that is the refuse collection and transportation system improvement project and the development project of the New Kunduchi disposal site, were evaluated in terms of their technical, social, environmental, financial and economic impacts.

c.1 Technical Evaluation

The proposed technical system in the first priority projects is basically the same as the present system consisting of waste collection, transport and disposal. Therefore the issues to be considered only concern ways to ensure appropriate operation, maintenance and management.

As for the waste collection and transport system, the intended number of refuse collection vehicles is 71 in 2000 and 117 in 2002. Because it is considered to be difficult for DCC to operate all vehicles directly, the total number of vehicles to be under the responsibility of DCC is to be maintained at less than 50 by contracting out 100% of refuse collection works for the urban area and 30% of the planned developed area to private refuse collection companies. It is judged to be feasible for DCC to operate about 50 vehicles because they used to operate 53 vehicles in 1987.

Concerning maintenance of equipment, DCC's maintenance capability has achieved a sufficient level with the help of JICA's expert technical assistance since 1993.

As for the final disposal system, the plan proposes to introduce the sanitary landfill method abandoning the present open dumping. The technical reasons as to why the sanitary landfill method is currently not employed are unavailability of coverage soil near Vingunguti and lack of loading and transport equipment. In the proposed project, enough borrow pit for daily coverage can be secured within the New Kunduchi Disposal Site. In addition, the project includes procurement of loading and transport equipment, and therefore there will be no problems to conduct sanitary landfill operations.

Since the existing maintenance workshop and repair machinery are in a poor condition and the distance to the site where heavy landfill equipment are operating will increase, problems related to maintenance of refuse collection vehicles and landfill equipment are predicted to occur. These problems are proposed to be solved by improvement of the Nyerere workshop and procurement of a mobile workshop in the project.

The overall technical evaluation concluded that the simplicity of the proposed technical system is very appropriate for the technical level in DSM.

c.2. Social Evaluation

The implementation of the project will bring various benefits. The number of people who will benefit from refuse collection services by the implementation of the project is approximately 640,000. As a knock-on effect, it will contribute less drain blockages due caused by refuse as well as flooding, which in turn will increase road life and reduce water pollution of surface and ground water sources. The improved sanitary condition and landscape will generate various significantly positive impacts such as encouraging foreign investment, promoting tourist industry and increasing land prices.

c.3 Environmental Evaluation

The EIA concluded that the predicted positive impacts would outnumber the predicted negative impacts; all predicted negative impacts could be mitigated within the permissible limits.

The predicted positive impacts to the environment are that the present topography will be improved by backfilling existing large cavities by refuse, in other words recovery of natural environment, and that the present landscape will be improved by covering it with soil and recovery of flora, etc.

The closure of the existing Vingunguti disposal site, which is causing an impact, will improve the surrounding environment.

c.4 Financial Evaluation

- In the case where a loan covers the whole scheme, the project will be infeasible in all financial cases because the FIRR is significantly lower than the opportunity cost of capital of Tanzania.
- In the case where grant assistance covers investment cost in 1999 for the construction of the final disposal site and landfill equipment, it is judged that all financial cases will be financially infeasible because the FIRR in all cases are under the cut-off rate.
- In the case where all required investment for 1999 is granted, RCC is collected by DAWASA with water charge and tax forecast is most probable, (Case C-1-b) the FIRR is 24.70 %. It concluded that the implementation of projects would be financially feasible because it exceeds the cut off rate of 11.6 %. Refer to Figure 4-3.
- In the case where all required investment for 1999 is granted, special RCC is collected by DCC and tax forecast is most probable, (C-2-b) FIRR is 10.24 %. Although this value is slightly lower than the cut off rate of 11.6 %, the project implementation can be made financially feasible by DCC making additional efforts such as collecting more taxes, increase collection rate of special RCC, etc.

c.5. Economic Evaluation

As a result the EIRR is calculated at 9.88 % which is close to the cut off rate of 11.6 %. Therefore, the implementation of the master plan will contribute to the national economy.

c.6 Overall Evaluation

As an overall conclusion, the execution of the refuse collection and transportation system improvement project and the development project of the New Kunduchi disposal site is essential to enable a sustainable technical, social, environmental, financial and economic development.

4.3 Improvement Project of the Night Soil Collection and Transportation System

Night soil collection and management was not included in the original scope of work. This task was added in response to the request by Tanzanian side during the study. Therefore, only determination of the required number of cesspit empty trucks for DCC to collect night soil and determination of the required charge was covered.

4.3.1 Precondition for the Improvement of the Night Soil Collection System

The improvement of the night soil collection system was planned based on the following assumptions according to the data obtained through the field surveys.

- 1) The population using the toilets which need to be emptied periodically was assumed to be 27 % of the total population.
- 2) The discharge amount of excreta was assumed to be 2 litres per person/d.
- 3) The four sectors dealing with cesspit emptying services in DSM in 1997 will retain their shares as follows in future.

• DAWASA:	20.7 %
• DCC:	27.6 %
• Private cesspit empty service enterprises:	10.3 %
• Other ordinary private institutions:	41.4 %
- 4) DCC will collect all night soil from its served population.
- 5) Four out of eight cesspit emptying trucks will stop their operation in 1999 as they are decrepit.
- 6) The remaining four cesspit emptying trucks will work until 2003.
- 7) The capacity of the tank will be 6 m³.
- 8) The average number of trips per day will be 5 times.
- 9) The average amount of night soil collected will be 21 m³ per truck.
- 10) The night soil collected will be discharged into oxidation ponds or dumping points which are under DAWASA's control.
- 11) DCC will pay a dumping charge of 3,000 Tsh, per truck of night soil, to DAWASA.
- 12) The present capacity of oxidation ponds was assumed to be sufficient for receiving all night soil to be collected by the plan, because the study on the night soil reception capacity was out of the scope of the study.

4.3.2 Night Soil Collection Plan

The night soil collection plan prepared based on the above assumptions are shown in the table below

Table 4-8: Night Soil Collection Plan

Description	2000	2001	2002	2003	2004	2005
Population	2,632,965	2,835,037	3,065,729	3,327,394	3,624,014	3,966,460
Population needing cesspit empty services	710,901	765,460	827,747	898,396	978,484	1,070,944
Required amount collected m ³ /d	1,422	1,531	1,655	1,797	1,957	2,142
Required Number of Collection Trucks	68	73	79	79	79	79
Planned Number of DCC's Trucks	19	21	22	22	22	22

4.3.3 Project Evaluation

a. Financial Parameters

The basic parameters for financial evaluation are similar to those used in the solid waste management as shown below.

Financial Parameters	Conditions
Price Level	Same as the price level as of the end of February 1997
Cut-off Rate	Same as the real interest rate of the Bank of Tanzania (11.6% per annum)
Foreign Exchange Rate	Same as the mean inter-bank rate among commercial banks as of the end of February 1997
Residual Value	Included into the revenue in 2006 at market price

b. Project Cost

Considering the absolute shortage of night soil collection vehicles in DSM, 18 new vehicles shall be procured within a 3 year period between 1999-2001, in addition to the currently operating 8 collection vehicles. The project cost includes the procurement cost of vehicles which amounts to 786 million Tsh., the operation and maintenance cost of relevant vehicles, and the night soil disposal fee, as shown below.

Table 4-8 Night Soil Collection and Haulage Overall Project Cost

Cost Item	Unit: million Tsh						
	1999	2000	2001	2002	2003	2004	2005
No. of cesspit emptying trucks to be procured	8	4	4	0	0	0	0
Procurement of Vehicles	655	87	44	0	0	0	0
Operation & Maintenance	0	152	168	176	176	176	176
Night Soil Disposal	0	89	99	103	103	103	103
Total Project Cost	655	241	311	279	279	279	279

c. Project Revenues

Based on the assumption that the present collection and haulage fee of 5,000 Tsh/trip will not be able to cover the operation and maintenance cost of vehicles, a plan to increase the collection and haulage fee was made based on the case scenarios shown below. The revenues from the night soil collection services entirely depend on the number of collection and haulage trips made. Hence, in consideration of the number of currently operating vehicles, the collection and haulage trips were estimated as follows:

Year	2000	2001	2002 - 2005
No. of Trips Per Annum	20,805 trips	22,995 trips	24,090 trips

d. Case Evaluation

The following 6 cases were comparatively evaluated in terms of collection fees and financial source.

Collection Fee \ Project Cost	Project Cost Covered by Loan	Vehicle Procurement Cost Subsidised by Grant in 1999
5,000 Tsh/trip	Case A-1	Case B-1
9,000 Tsh/trip	Case A-2	Case B-2
13,000 Tsh/trip	Case A-3	Case B-3

e. Evaluation Results

The results of the calculation produced the following FIRR rates:

Collection Fee \ Project Cost	Project Cost Covered By Loan	Vehicle Procurement Cost Subsidised by Grant in 1999
5,000 Tsh/trip	-54.18%	-53.66%
9,000 Tsh/trip	-36.61%	-31.27%
13,000 Tsh/trip	-15.46%	38.41%

The results indicate that the project would be infeasible if the overall cost is subsidised by a loan, as it would incur a negative FIRR rate. However, the project would be financially feasible if the 1999 vehicle procurement cost is subsidised by a grant and if a collection fee of 11,000 Tsh/trip is imposed.

If the vehicles to be procured in the first year are covered by a grant, and if a collection fee of 10,500 Tsh/trip is imposed, the FIRR rate shall be equivalent to the cut-off rate of 11.6%. Accordingly, the DSM municipality would be able to shoulder the operation and maintenance costs and the purchase of 3 additional vehicles either for 2000 or 2001, if the grant is used to purchase 15 vehicles in 1999, the collection fee is raised to 10,500 Tsh/trip, and if the present share of the beneficiaries of the collection and haulage services expenses is doubled.

4.3.4 Issues to be Reminded

This Improvement Project of the Night Soil Collection and Transport System was prepared in a very short time under limited conditions, and therefore the following issues should be reminded for implementation.

- The examination on the disposal capacity of night soil because it has not been investigated in this Study.
- Whether the proposed night soil collection charge is accepted has to be examined because it has not been done in this Study. However, it is expected that the magnitude of willingness to pay for night soil collection charge is larger than that for RCC because night soil is too difficult to be collected and dumped by themselves and the negative impacts created when it is not collected is much larger than refuse.

5 Conclusions and Recommendations

5.1 Conclusion

a. Amount of municipal solid waste generated and the waste stream

As of 1996, the amount of municipal solid waste generated is estimated to be 1,772 tons/day. According to the data collected by utilising the weighbridge installed at the Vingunguti disposal site for this Study (the only disposal site in Dar es Salaam city) only 143 tons, i.e. 8.1%, of the daily waste generated is collected and disposed of. The rest of the waste is either illegally dumped (47.8 %, 847 tons/day), self disposed (36.9%, 654 tons/day), or recycled (7.3%, 130 tons/day).

The present waste generation amount is estimated to increase twofold to 3,464 tons/day in correlation to the forecast population increase of 3.97 million in 2005 from 2.03 million in 1996. These waste problems are predicted to worsen by 2005 if no countermeasures are taken. Therefore, an appropriate municipal solid waste management system has to be established urgently.

b. The importance of SWM in urban environment sanitation

Financial and human resources in Dar es Salaam City is extremely limited. Considering the need to provide maximum administrative services with such limited resources, apportioning more resources solely for the improvement of the solid waste management services is not justifiable from the administrative and citizens' viewpoint. Therefore, the current urban environment sanitation was examined in this study in order to assess the significance of solid waste management services in the urban environment sanitation sector. The results indicate that water supply improvement should take precedence over SWM. The improvement of SWM is strongly demanded by the public according to the POS results in which SWM is ranked second in order of priority for improvement. However, considering that only 22% of households have taps in their houses and only 5% are connected to the sewerage system, it is necessary to make plans which will bring about maximum improvement but is cost effective, as the fund allocated for the improvement of solid waste management project will be limited.

c. Technical System

The present technical system of the solid waste management in Dar es Salaam city is very weak in every aspect. As a result, most of the waste generated (more than 85%) is not properly treated. In addition, the city also lacks the financial support indispensable for the establishment of a technical system. The following are the main conclusions formed through this survey regarding the technical system.

- Judging from the conditions of urban infrastructure (especially roads) in Dar es Salaam city, except for the UA, it would be difficult to provide refuse collection services to all districts using the curb side collection system which requires access roads for the collection vehicles.
- Therefore, the point collection system, which obliges beneficiaries to bring their waste to points accessible to collection vehicles, should be adopted for some of SUPA, and the majority of SUUA and RA.

- The pilot project confirmed the residents' willingness to cooperate in primary collection (i.e. taking their wastes to the collection sites) as long as waste collection service is sufficiently provided.
- Judging from the results of compost market survey, it is not feasible to establish compost facilities (off-site) utilising waste as raw materials. On the premise that cost for facility construction and product transport does not have to be shouldered, the production and utilisation of composts (on-site) at the waste generation sources should be promoted.
- The present rate of waste recycled to the total waste generated 7.3%, is a highly creditable attempt, considering only 12% of the total waste generated is recyclable.
- The establishment of a new disposal site is an urgent issue as the Vingunguti disposal site, the only waste disposal site in the city, is creating adverse impacts to the surrounding environment and its remaining economic life is a few more years.
- With regard to the improvement of the technical system, first priority should be given to the establishment of basic refuse collection and final disposal systems. Therefore, volume reduction and resource recovery (i.e., recycling, recyclable waste collection), which requires cost sharing by public institutions, should be promoted after a fundamental technical system is established.

d. Institutional System

The solid waste management institutional system is also very weak and encompasses various problems. The important conclusions formed through this study regarding the institutional system are as follows.

- At present, the Cleansing Unit of the Health Department, which is mainly in charge of solid waste management is weak in all aspects and lacks the ability to assume its responsibilities. Moreover, one of the main reasons for the organisational system's weakness is attributed to the fact that jurisdiction over solid waste management services is shared by three Departments.
- Opportunity to receive training in order to do the job well is not provided to the people engaged in solid waste management (from administrators to labourers). It is, therefore, of vital importance to conduct human development programmes to develop human resources that would ensure a sustainable solid waste management system.
- Dar es Salaam City is constantly lacking in funds and its total budget in 1995 was only Tsh.5.91 billion (US\$9.89 million), which is Tsh.2,610 (US\$4.37) per year per person. Furthermore, the budget for cleansing services in the same year was Tsh.362 million (US\$605 thousand), only Tsh.160 (US\$0.27) per year per person, which is extremely low compared with other developing countries. Therefore, unless this chronic defect is solved by countermeasures such as increasing revenue from city taxes, a proper solid waste management system cannot be established.
- The expansion of refuse collection services by a concession system, due to DCC's financial weakness, is unrealistic. Therefore, to establish the solid waste

management system of Dar es Salaam City, DCC's ability to conduct the services should be reinforced first. Accordingly, the enhancement of the agency's operational (acquisition of equipment and necessary personnel) and financial capabilities should be given top priority (increase city taxes revenues and RCC collection amount).

- Since the private sector cannot directly collect RCC which it needs to provide the service, a system in which an incentive should be established to effectively collect RCC.
- Laws relevant to solid waste management which are contained in various legislation, should be rearranged and unified.
- The establishment of a function for the supervision and control of the cleansing services offered by DCC and private contractors is necessary.

e. Priority project

As a result of the discussion with DCC based on the basic plan formulated, the following projects were selected as priority projects to be completed by 2002 and their feasibility study (F/S) was carried out.

Table 5-1: Priority Projects and Project Cost (Investment)

unit: million Tsh

Category	Contents of Projects	Type	1999-2003	
			Required Investment	Required Grant of Total Investment
Improvement of Waste Collection, Transport and Disposal System	Improvement of Waste Collection and Transport <i>Procurement of refuse collection vehicles and skips, etc.</i>	Equip.	6,719	3,644
	Development of the New Kunduchi Disposal Site <i>Construction of a disposal site, procurement of sanitary landfill equipment</i>	Facil. Equip.	1,841 750	831 600
	Improvement of Street Sweeping <i>Procurement of equipment to collect street sweeping waste, etc.</i>	Equip.	69	23
	Improvement of the Nyerere Workshop <i>Procurement of machinery for repair of refuse collection vehicles and sanitary landfill equipment</i>	Facil. Equip.	42 297	42 297
	Improvement of Administrative System <i>Renovation of office facilities, procurement of educational equipment, etc.</i>	Facil. Equip.	29 165	29 123
	Improvement of Night Soil Collection and Transport <i>Procurement of cesspit empty trucks, etc.</i>	Equip.	786	655
Detailed Design and Supervision			1,070	624
Total			11,768	6,868

Note:

* The amount of required grant covers the investment required in 1999 which will play a role in a take-off project.

f. Evaluation of First Priority Projects

The first priority projects were divided into the following two components and evaluated.

- Improvement project of refuse collection, transport and disposal system.
- Improvement project of night soil collection and transport system.

f.1 Improvement project of refuse collection, transport and disposal system

Project evaluation for the improvement project of refuse collection, transport and disposal system was conducted in terms of technical, social, environmental, financial, and economic perspectives.

The financial evaluation, FIRR (financial internal rate of return) for the 18 cases were calculated. As a result if:

- all investment cost for 1999 is granted.
 - the most probable scenario of increase of tax revenue is taken.
 - RCC is collected by either DAWASA included in the water charges or the DCC directly.
- 1) In the case where RCC is collected by DAWASA with water charges, the project would be financially feasible because the FIRR is 24.70 %, exceeding the cut off rate of 11.6 %.
 - 2) In the case where special RCC is collected by DCC, the FIRR is 10.24 %. Although this value is slightly lower than the cut off rate of 11.6 %, it can be made financially feasible by DCC making additional efforts such as collecting more taxes, increase collection rate of special RCC, etc.

As a result the EIRR is calculated at 19.56 % which is close to the cut off rate of 11.6 %. Therefore the implementation of the master plan will contribute to the national economy.

As an overall conclusion, the execution of the refuse collection and transportation system improvement project and the development project of the New Kunduchi disposal site is essential to enable a sustainable technical, social, environmental, financial and economic development.

f.2 Improvement project of night soil collection and transport system

The results indicate that the project would be unrealisable if the overall cost is subsidised by a loan, as it would incur a negative FIRR rate. However, the project would be financially feasible if the 1999 vehicle procurement cost is subsidised by a grant and if a collection fee of 10,500 Tsh/trip is imposed.

However, this was prepared in a very short period under limited conditions, and therefore the following issues should be reminded for implementation.

- The examination on the disposal capacity of night soil because it has not been investigated in this Study.
- Whether the proposed night soil collection charge is accepted has to be examined because it has not been done in this Study. However, it is expected that the magnitude of willingness to pay for night soil collection charge is larger than that for RCC because night soil is too difficult to be collected and dumped by themselves and the negative impacts created when it is not collected is much larger than refuse.

g. Conclusion of the EIA

Based on the results of the IEE, surveys were conducted regarding the following environmental items in order to do the EIA for the Kunduchi new disposal site construction project.

- | | |
|----------------------------------|--------------------------|
| 1) Economic activities | 9) Flora and fauna |
| 2) Traffic and public facilities | 10) Landscape/aesthetics |
| 3) Public health | 11) Air pollution |
| 4) Waste | 12) Water pollution |
| 5) Hazards/Risks | 13) Soil contamination |
| 6) Topography and geology | 14) Noise and vibration |
| 7) Groundwater | 15) Offensive odour |
| 8) Hydrological situation | 16) Litter |

The Environmental Impact Assessment matrix shows that the project will have various positive and negative impacts, although the latter will only be minor, except those regarding traffic (traffic jams, increase in traffic accidents and exhaust gas emissions). These negative impacts can be minimised through appropriate mitigation measures such as expanding the traffic lane in congested areas, strengthening traffic regulations, and improving collection vehicles. The result of the EIA showed that all adverse impacts can be kept within the permissible level by adopting mitigation measures.

5.2 Recommendation

a. Implementation of the Master Plan

The basic goal of this master plan is "to establish a proper solid waste management system in Dar es Salaam City by 2005". The establishment of this management system shall attract foreign investment and consequently promote national economic development as well as preserve the urban environment and public health, and a sustainable development of the city.

The master plan is evaluated as feasible from a technical, social, environmental, financial, and economic viewpoints. Therefore, DCC should to implement this master plan based on the strategies proposed in this study with the cooperation of the central government

b. Improvement of Technical System

In order to realise the master plan, the technical system needs to be improved as follows.

- The most suitable collection system shall be adopted according to the characteristics of the areas. The collection system shall be either of the following depending on the accessibility to the collection points: (1) without primary collection: curb side collection by tipper trucks. (2) with primary collection: point collection by skip trucks.
- DCC needs to conduct the refuse collection services with as much cooperation from the private sector as possible, as its collection vehicles are very limited in

number. Collection services should be extended to the following areas in their order of urbanisation starting from UA, SUPA, SUUA, and finally RA.

- Regarding maintenance of vehicles and any kind of heavy equipment necessary for solid waste management, Nyerere Workshop needs to be remodelled and at least the tools necessary to do preventive maintenance needs to be secured.
- To conduct recycling activities with construction and operation of associated facilities by public institutions, generally require additional funding. Therefore, although composting at waste generation sources shall be recommended, collective processing and recycling facilities shall neither be built nor operated. Construction and operation of these facilities shall be entrusted to the private sector. Reduction and resource recovery by 2005 shall be achieved by administratively (in a way which lessens financial burden) promoting recycling activities by dischargers and private companies including the informal sector.
- Taking into account the high unemployment rate and poor road surface conditions, street sweeping services should be done manually.
- The new Kunduchi disposal site should be developed and sanitary landfill operations should start by 2000 when Vingunguti disposal site becomes obsolete. Furthermore, disposal sites in both Ilala and Temeke districts shall be prepared and waste collected in these districts shall be disposed of at their respective disposal sites by sanitary landfilling.
- For the disposal site selection in both Ilala and Temeke districts, it is necessary to select disposal sites where construction and operation costs can be minimised as much as possible, adopting a method used by the study team to select the new Kunduchi disposal site.
- This study provided data regarding the quantity and composition of waste and the waste stream, which are the bases for proper solid waste management and waste stream. For the future re-examination of this plan, waste composition and quantity shall be surveyed regularly to accumulate basic data such as daily and seasonal fluctuation.
- By using the weighbridge installed at the Vingunguti disposal site, data on waste collection and disposal can be collected and analysed for the development of a more effective and sound collection and disposal system. This experience should be disseminated to the municipalities throughout Tanzania.

c. Improvement of Institutional System

The establishment of a strong and sound institutional system is most important to realise the master plan, making its technical system sustainable. Therefore, DCC needs to improve the institutional system by conducting the following to implement the priority projects (take-off projects) of the master plan.

- Integrate functions dispersed through the three departments (Health, Works and Planning) and establish an independent Waste Management Authority within DCC to assume all solid waste management responsibilities, including night soil collection. The Waste Management Authority shall be given the authority to

independently conduct the administrative, operative and financial aspects of the services.

- Establish a Supervision and Monitoring Committee, an independent organisation to supervise and control the cleansing services provided by DCC and private contractors.
- Improve the city's tax collection capability and use city taxes as the main financial source for cleansing services by allocating a special fund for solid waste management.
- In order to establish the "beneficiary-pay-principle" in the future, the RCC system needs to be continued. However, the expenses of this system should not exceed the amount collected. Therefore, the joint billing of RCC with the water charge by DAWASA shall be considered. In case the adoption of this system is not possible due to some hindrance, DCC shall directly collect special RCCs.
- The type of contract shall be shifted from a concession contract system where collection services and RCC collection are consigned to private collectors, to the contracting out system in which DCC pays the contractor a service fee. To make the most of the private company's capabilities, clear policies and guidelines for the consignment of private companies for waste collection by the contracting out system should be formulated.
- Improve legislation relevant to solid waste management and incorporate them into the Sanitary Code.
- In view of the poor financial capabilities of DCC (service provider of cleansing) and the residents (beneficiaries), resident participation is very important for an efficient solid waste management system. DCC should, therefore, actively conduct promotional campaigns and educational programmes in order to gain their cooperation. Books and educational videos produced and used in the pilot project of this Study should be utilised effectively.
- Provide training for the people engaged in solid waste management and formulate a human resource development plan to improve their basic skills.

d. Financial Source

The funding for solid waste management shall mainly come from the special fund allocated from the city's taxes and the RCC. However, the financial analysis of the overall solid waste management project clearly states that even in the case of an optimistic revenue in which the income of the city and RCC are at its maximum (A-1-a), the project would still be infeasible, as the FIRR reaches only 2.32% when investment fund is all on loan.

According to the results of the financial analysis, the funding for implementing the priority projects, the take-off projects of the master plan, scheduled for 1999 should be subsidised either by the central government or by bilateral or multilateral grant aid. Other than these priority projects, projects (i.e. vehicles and equipment replacement and facility expansion) necessary to realise the Master Plan shall be subsidised by the internal reserves from the special fund mentioned previously, RCC, tipping fees, etc.

The establishment of a sound financial system would firstly rely on accurate cost calculation for efficiently conducting operation, and secondly, restricting the use of collected RCC for reinvestments into solid waste management and its operation cost.

Table 5-2 shows the financial requirements to make the implementation of M/P and F/S projects feasible.

Table 5-2: Financial Requirements for Master Plan

Category 1	Category 2	Requirements
City taxes	Revenue	<ul style="list-style-type: none"> • Service levy, petrol levy: to retain at least 50 % of annual growth rate based on performance in 1996. • Development levy, property tax, hotel levy: to retain at least 40 % of annual growth rate based on performance in 1996. • Business license, market levy, others: to retain at least 20 % of annual growth rate based on performance in 1996.
	Budget allocation to SWM works	<ul style="list-style-type: none"> • To retain the SWM budget allocation rate at 5.0 % until 2005.
RCC	Joint billing	<ul style="list-style-type: none"> • Household waste: the collection rate shall exceed 30 %. • Waste other than household waste: the collection rate shall exceed 70 %. • The actual revenue from RCC excluding cost and commission shall be less than 30 % of RCC.
	Special RCC	<ul style="list-style-type: none"> • Charge all wastes other than household and informal wastes
	Amount of RCC	<ul style="list-style-type: none"> • Household: 1,250 Tsh/household/month • Other than household waste: 20,000 Tsh/ton
Institution		<ul style="list-style-type: none"> • Establishment of the Waste Management Authority. • Establishment of the Supervision and Monitoring Committee. • To allocate a budget for the special fund for solid waste management. • To introduce RCC by joint billing with water charges by DAWASA or special RCC collected directly by DCC. • To change the contract method from a concession to contracting out. • Improve legislation relevant to solid waste management and incorporate them into the Sanitary Code. • To conduct promotional campaigns and educational programmes. • Provide training for the people engaged in solid waste management and formulate a human resource development plan.





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