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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
Ministry of Home Affairs, Provincial Councils and Local Government
Democratic Socialist Republic of Sri Lanka

THE STUDY ON IMPROVEMENT OF SOLID WASTE MANAGEMENT IN SECONDARY CITIES IN SRI LANKA

ACTION PLAN FOR BADULLA

FINAL REPORT

Volume V-1A

MAIN REPORT

DECEMBER 2003

KOKUSAI KOGYO CO., LTD.

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List of Volumes

Volume	Name of Reports
I	Summary
II	Main Report
III	Supporting Report
IV	SWM Guideline for Local Governments
V-1A	Action Plan for Badulla, Main Report
V-1B	Action Plan for Badulla, Supporting Report
V-2A	Action Plan for Chilaw, Main Report
V-2B	Action Plan for Chilaw, Supporting Report
V-3A	Action Plan for Gampaha, Main Report
V-3B	Action Plan for Gampaha, Supporting Report
V-4A	Action Plan for Kandy, Main Report
V-4B	Action Plan for Kandy, Supporting Report
V-5A	Action Plan for Matale, Main Report
V-5B	Action Plan for Matale, Supporting Report
V-6A	Action Plan for Negombo, Main Report
V-6B	Action Plan for Negombo, Supporting Report
V-7A	Action Plan for Nuwara Eliya, Main Report
V-7B	Action Plan for Nuwara Eliya, Supporting Report

This is Action Plan for Badulla, Main Report.

In this report, the project cost is estimated using the September 2003 prices and at an exchange rate of 1 US$ = 117.02 Japanese Yen = 95.28 Rupees

Contents

List of Tables

List of Figures

List of Abbreviations

BMA	Badulla Municipal Area
CDA	Community Development Assistant
CDO	Community Development Officer
CEA	Central Environmental Authority
DEA	Divisional Environmental Officer
DF/R	Draft Final Report
EIA	Environmental Impact Assessment
F/S	Feasibility Study
GDP	Gross Domestic Product
IC/R	Inception Report
IDP	Infectious Disease Prevention
IEE	Initial Environmental Examination
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
MCB	Municipal Council Badulla
MOH	Medical Officer of Health
MGTP	Management Plan
M/M	Minutes of Meeting
MOHALG	Ministry of Home Affairs, Provincial Councils and Local Government
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGO	Non-Governmental Organisation
O&M	Operation and Maintenance
PDM	Project Design Matrix
PHI	Public Health Inspector
POS	Public Opinion Survey
P/R	Progress Report
SLILG	Sri Lankan Institute of Local Governance
S/W	Scope of Work
SWM	Solid Waste Management
WTP	Willingness to Pay

Chapter 1 Background Conditions

1.1 Introduction

This plan was prepared by Badulla Municipal Council (BMC) by itself with JICA's technical assistance. Any decisions in the Study were made by BMC.

1.2 Basic Fact Sheet

1.0	**General Data**	
1.1	Province	Uva
1.2	District	Badulla
1.3	Local Authority Status	Municipal Council
1.4	Location	Eastern part of Central highlands, 230km north-east of Colombo.
1.5	Topography	Basin type generally flat landscape in central city area surrounded by high hills on all sides. Altitude varies from 700-920m.
1.6	Matale Municipal Area (BMA)	1036 ha
1.7	No. of Council Members	15
2.0	**Socio-economic Data**	
2.1	Total Population (2001)	40,920 (2002 estimate = 41,358)
2.2	Daily Floating Population	10,000
2.3	Average Population Density	39.5 (2001)
2.4	Population Growth Rate	1.07% (1981-2001 average annual compound growth rate)
2.5	Approximate No of Households	7,869 (calculated from approximate family size)
2.6	Approximate Family Size	5.2 (UDA estimate)
3.0	**Overall MMC Data**	
3.1	Total Cadre (2002)	249
3.4	Total Budget Expenditure (2002)	57,861,000 Rs
4.0	**Solid Waste Management (SWM)**	
4.1	Collection Amount (2002)	19.7T/d (7,191 Tonnes/year)
4.2	Budget Expenditure for SWM works	7,717,000 Rs
4.3	Cadre for SWM works	84
4.4	Ratio of SWM workers to all employees	25.2%
4.5	Ratio of SWM to total expenditure	13.3%
4.6	SWM expenditure per capita	187 Rs/person
4.7	SWM expenditure per tonne waste	1,073 Rs/tonne

Data Sources: Section 1 and 2 – mainly Development Plan for Badulla MC, BMC with technical assistance from UDA, 1994; Section 3 and 4 – BMC 2002 budget and this study.

1.3 Natural and Social Conditions

Badulla is both main town and provincial capital of the Badulla district and Uva province. It houses the provincial government ministries and departments, most of the district offices of the central government, the provincial hospital (Badulla General hospital) and major provincial educational facilities.

It functions as a distribution centre of food, fertiliser and fuel in addition to private sector wholesale establishments and is the major financial centre in Uva province. It is accessible by both road and rail from Colombo.

Its annual rainfall varies from 995-1,885mm, while mean monthly temperature is 20°C. Vegetation mainly comprises wetzone crops and trees, while the Rambukpota and Kuda Oyas (rivers) make confluence with the Badulu Oya at Hanwella within Badulla city. Land use is tabulated below.

Category	1994	
	Area (ha)	%
Residential	424.40	41.00
Commercial	14.20	1.40
Industrial	4.70	0.50
Public use	43.39	4.30
Religious	9.60	0.90
Parks and playgrounds	13.10	1.20
Roads and transport	93.10	9.00
Cemeteries	6.40	0.60
Agriculture	170.80	16.40
Vacant land	161.40	15.70
Forest land	30.00	2.90
Waterbodies	64.20	6.20
Total	1036.4	100.00

Source: Development Plan for Badulla MC Area, BMC with technical assistance from UDA, 1994

1.4 Main Implications for SWM

The main implications of this background information on Matale for SWM are:

- SWM services should be of a high quality, due to Badulla being a busy district and provincial capital.
- Commercial and institutional waste generation may be high.
- Garden waste generation may also be high due to Badulla's climate and the abundant vegetation, plants and trees throughout the city.
- It can be difficult to obtain the cooperation of the significant floating population in SWM.
- The surrounding steep topography and plentiful rainfall can generate a large amount of soil sediment that enters the city's drains requiring regular removal to avoid blockages.
- It may be very difficult to acquire new land for a landfill within the city limits due to its urbanized condition, three rivers running through the city and hilly surrounding topography.

Chapter 2 Current SWM Condition

2.1 Current Waste Stream

The "waste stream" refers to the "flow" of waste from generation to final disposal. It describes and quantifies the waste generated by different sources within the scope of this Study and quantifies the amounts of waste collected, recycled and disposed of by different means. Determination of the waste stream is one of the most important tasks to be completed in the formulation of a SWM Plan. Waste stream results (Sept 2002) are summarised in this section, with additional details being given in the supporting report.

2.1.1 Waste Stream Terminology

The terms used in the waste stream model adopted for BMA are defined below.

Table 2-1 : Waste Stream Terminology

Term	Definition/Explanation
Generation	Production of all waste at source.
On-site disposal	Waste is disposed of by the generator within their property, usually by burial in a pit and/or burning of the waste or sometimes incineration (e.g. hospitals).
On-site composting	Organic waste is composted within the property of the generator itself in order to produce a useful product - compost.
Discharge	Part or all of the waste generated is put out f or collection either within the property of the source itself (e.g. local hotels, some institutions), outside the property (e.g. in bins or in small piles at the roadside) or at an approved collection point (e.g. concrete bins located around the town).
Collection	Waste discharged by a source is collected by Badulla Municipal Council (BMC) for transportation to the final disposal site.
Disposal	Waste collected by BMC is discharged at the final disposal site.
Recycling	Part or all of the waste generated is sold or given to an external person/shop/company, etc. for reuse or recycling. In this context, recycling generally refers to the recovery of inorganic and non-compostable waste materials, particularly plastics/polythene, paper[1], glass, metals and some textile scraps. Recycling may take place at source, following discharge and collection, and from the final disposal site and illegal dumps.
Composting	Readily biodegradable waste (e.g. food/kitchen, garden, paper wastes) is collected and then decomposed aerobically in a controlled manner at a commercial compost facility run by BMC, an NGO or the private sector. Composting may be carried out in order to reduce the weight, volume, and polluting strength of waste to be subsequently placed in the landfill and/or to produce a marketable product for sale.
Illegal dumping	Part or all of the generated waste is dumped outside the generator's property in an area where such behaviour is prohibited (e.g. open spaces, drains, canals, etc.).

2.1.2 Waste Sources

The main sources of municipal solid waste (MSW) considered in this Study are households, commercial enterprises, markets, institutions, industries and "other" (green spaces, road/drain cleaning) wastes. Each of these sources is briefly described below.

[1] Many types of paper may readily be composted, while other types are only slowly biodegradable or not suitable for composting (e.g., glossy magazines).

Table 2-2 : Main Waste Generation Sources

Source	Description
Household	Waste generated from domestic activities, including food preparation, cleaning, fuel burning, yard sweeping, gardening and other miscellaneous household wastes (e.g. old clothing, appliances, etc.).
Commercial	Wastes generated by trade, service and some manufacturing enterprises, excluding markets and industries (covered separately).
Markets and Slaughterhouse	Waste from markets selling a high proportion of vegetables, fruit, meat and/or fish (i.e. Central and Welekade markets, Pola) and the BMC slaughterhouse.
Institutions	Wastes from schools, other educational institutes, hospitals, government offices (including BMC, police and prison) and religious places. Hospital waste includes some hazardous items as discussed further below and in Section 1.3.
Industries	Wastes from sawmills (1), timber depots (6), mills (16), lathe workshops (2), garment factory (1), distillery and Colombo Commercial Engineering Co.
Other	• Waste from green spaces - parks, playgrounds, racecourse, cemetery, etc. • Road/drain cleaning waste, collected by BMC labourers.
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc. These wastes are not usually handled by BMC but are dealt with by the contractors involved. Typically, they are used as clean fill on other sites or in low-lying areas. Hence, they are not considered further in this Study.
Hazardous (Special)	Hazardous wastes originating from various sources, including household items (e.g. batteries, spray cans, etc.). These are described separately for each category, as appropriate. The management of sharps, clinical, body parts and highly infectious wastes from hospitals is a major concern in Badulla.

2.1.3 Waste Generation

2.1.3.1 Waste Generation Rates

Waste generation rates were measured or estimated from a combination of quantitative data and interview surveys. Key points are summarised here.

- An average household waste generation rate of 0.477kg/cap.d was adopted based on measured data from Matale, which is similar in size and characteristics to Badulla, with the Matale data being increased slightly to account for the higher proportion of food/kitchen waste present in Badulla waste compared with that of Matale.
- Commercial waste generation is 7.2T/d (17.5% of MSW), equivalent to 5.84kg/enterprise.d. These quantities were determined from survey data for a mixture of large and small commercial waste generators, together with BMC trade licence and garbage collection data. They are considered realistic, being supported by observations of business activities within BMA, Badulla being both the district and Uva province capitals, and the moderate floating population (estimated at 10,000) entering the city each day.
- Market/slaughterhouse waste generation (4.0T/d, 9.8% of MSW, 13.7kg/stall.d) is based on data for the Central and Welekade markets, Polas and slaughterhouse within BMA. This is considered reasonable, the waste generation rate being relatively high, due to the large amount of waste generated at the Sunday Pola and traders from nearby areas thought to be discharging their waste at the Central market collection points.

- Hazardous waste generation is relatively small, comprising typical everyday items (e.g. spraycans, batteries, fluorescent tubelights, etc. which are disposed with normal garbage. The Muthiyangana Raja Maha Viharaya and Unicorn garment factory produce the most hazardous waste of the places surveyed.
- Significant quantities of healthcare hazardous wastes are produced by the Badulla General Hospital, with the other two hospitals within Badulla producing small amounts of such wastes. Total healthcare hazardous waste generation is estimated to be approximately 0.67T/mth of clinical wastes, 0.92T/mth of body parts and placentas, 0.06T/mth of sharps and a small quantity of highly infectious wastes.
- Total MSW generation is 41.2T/d, equivalent to 1.00kg/cap.d. Waste generation by source is shown in the following figure.

Table 2-3: Estimated Waste Generation Quantities (2002)

Source	Waste Generation Data			Waste Generation		
	WGR	WGR Unit	No of Units	Amount (T/d)		%
Residential	0.477	Kg/person.d	41,358	19.73	19.73	47.9
Commercial	5.84	Kg/enterprise.d	1,235	7.22	7.22	17.5
Markets/Slaughterhouse	13.7	Kg/stall.d	295	4.04	4.04	9.8
Institutions:						
• Schools	0.013	Kg/(students+staff).d	16,123	0.20		
• Other education	0.065	Kg/(students+staff).d	6,919	0.45		
• Hospitals	0.363	Kg/(patients+staff).d	4,054	1.47		
• Govt offices	0.236	Kg/worker.d	2,717	0.64		
• Religious	3.23	Kg/clergy.d	90	0.29	3.06	7.4
Industries:						
• Sawmill/Timber Depots	357	Kg/industry.d	7	2.50		
• Rice/grinding Mills	221	kg/mill.d	16	3.53		
• Other	0.92	Kg/worker.d	263	0.24	6.27	15.2
Other:						
• Green spaces (parks, etc.)	0.59	T/d	0.59			
• Road/drain cleaning	0.27	T/d	0.27	0.86	0.86	2.1
Total	1.00	Kg/person.d	41,358	41.17	41.17	100.0
Farms	6.45	Kg/worker.d	391	2.52	2.52	8.8
Other:						
• Parks/Racecourse	2.71	Kg/worker.d	139	0.38		
• Road/drain cleaning	0.41	T/d		0.41	0.79	2.7
Total	1.02	Kg/person.d	28,201	28.79	28.79	100.0

Notes: WGR = waste generation rate

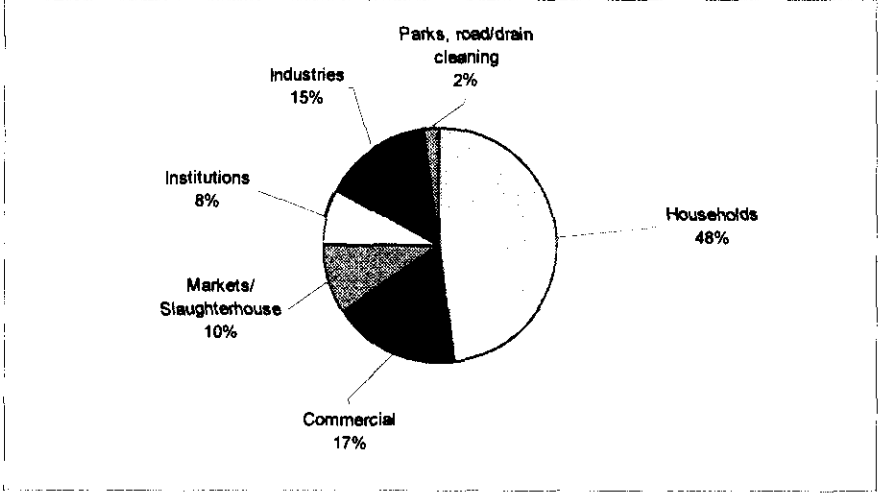


Figure 2-1: BMA Waste Generation by Source (2002)

2.1.3.2 Factors Affecting Waste Generation

The main factors affecting waste generation in Badulla are summarised below:

- Waste generation from commercial enterprises, markets, institutions and some industries increases approximately 2-3 times during festivals (e.g. Sinhala/Tamil New Year) and other special occasions (weddings and school holidays for hotels).
- Seasonal variations, with waste generation increasing during the "leaf falling" season (Apr-June), mainly due to increased garden waste.

2.1.4 Waste Stream Breakdown

2.1.4.1 Field Investigation Results

Field investigation results on the proportions of waste being disposed of on-site, discharged for collection, directly hauled to landfill, composted on-site, recycled at source or illegally dumped are tabulated below.

Table 2-4: Waste Stream Field Investigation Results (2002)

Source	Recovery/Disposal Method (%)	Waste Generation Rates/Quantities Calculations
Households	Discharge = 43.4% OSD = 33.1% ID = 14.3% Compost = 7.0% Recycling = 2.3%	Household survey results, modified to account for an estimated 80% garbage collection service coverage in BMA.
Commercial (survey of 15 small and 18 large waste generators)	Discharge = 78.9%	31 places discharge some (14) or all (17) of their garbage for BMC collection.
	OSD = 10.2%	Seven places burn all (Badulla Tourist Inn) or most (New Rajan Printers) or some (5) of their garbage on-site.
	Recycling = 5.8%	16 enterprises recycle some waste, comprising monthly totals of 148kg paper, 30kg cardboard, 615 bottles, 105-110 polysacks, 150 plastic containers, 450kg metals, 50kg food/kitchen waste for animal feed, dust from a jewellery shop, and 150 tyres from CTB[2].
	Direct haul = 5.1%	CTB directly hauls most of its garbage to the BMC disposal site.
Markets and slaughter-house	Discharge = 94.7% Recycling = 3.5% ID = 1.5% Compost = 0.2%	All market and Pola waste is collected by BMC, except for recycling of about 40kg/mth paper/cardboard. The slaughterhouse uses some animal dung as garden manure while animal skins, bones, hooves and fat are sold to Colombo, garden waste is burnt and 60kg/d of animal dung is disposed directly to the Badulla Oya.
Schools	Discharge = 78.5% OSD = 21.5%	All five schools surveyed (64% of BMA school population) discharge most (3) to all (2) of their garbage for BMC collection, while another three burn/bury some of their garbage on-site.
Other educational institutes	Discharge = 49.4%	Four institutes (Nurses Training School, Technical College, Sri Siddartha and Vidyothansa tuition centres) surveyed. Only one discharges most of their garbage for BMC collection.
	OSD = 47.5%	Four of these burn/bury all (2) or some (2) of their garbage on-site.
	ID = 3.1%	Sri Siddaratha dumps some waste on the banks of a stream/river.
	Recycling = 0.1%	Nurses Training School recycles about 3kg/mth of paper.
Hospitals	Discharge = 95.5%	All three hospitals in Badulla (General, Central and Lanka Nursing Home) have their non-risk healthcare waste (HCW) collected by BMC, except for small quantities of cardboard, plastic/glass bottles/containers and coconuts recycled by the General and Central hospitals. Central hospital discharges very small quantities of clinical wastes for BMC collection.

[2] Omitted from waste stream calculations as this is considered a special case, which would distort the waste stream percentages if included.

Source	Recovery/Disposal Method (%)	Waste Generation Rates/Quantities Calculations
	DH = 2.0%	General hospital takes body parts and placentas directly to the cemetery every 10 days.
	OSD = 1.7%	General Hospital disposes its clinical waste on-site, while sharps and highly infectious wastes are burnt on-site in its own incinerator. Central hospital and Lanka Nursing Home burn/bury small quantities of body parts, placentas and sharps waste on-site.
Government offices (6 out of 43 offices surveyed)	Discharge = 73.7%	Three offices discharge most (2) to all (1) of their garbage for BMC collection. All police and some prison waste also collected by BMC.
	OSD = 20.1%	Four, including the prison, burn some (2) to all (1) of their waste.
	Recycling = 6.2%	Prison recycles about 1,200kg/mth of waste coconuts.
Religious Places (1 out of 27 surveyed)	Discharge = 42.7% OSD = 39.8% Compost = 17.2% Recycling = 0.3%	Muthiyangana Raja Maha Viharaya (most significant religious place in BMA) produces around 220kg/d of garbage, discharging most of it for BMC collection, while burning some waste on-site, recycling some paper and composting 1,500kg/mth of flowers (temple offerings). Waste stream data was estimated for other religious places using Kandy/Matale data.
Timber Depots (3 out of 6) and Sawmills (1)	Recycling = 79% ID = 21%	All sawdust and woodchips are recycled, either being given away for free (sawdust) or sold (woodchips), except for 8.3T/mth of sawdust and woodchips which are open dumped along the banks of a stream/river by Central Timber Stores.
Rice and grinding mills (2 out of 16 surveyed)	Recycling = 72.9% DH = 27.1%	One mill recycles all of its waste, while the other recycles about 20%, directly hauling the rest of its waste to the BMC disposal site. Other mills are thought to follow similar practices, as BMC stated that at least three mills directly haul their waste to the disposal site.
Other industries (5 surveyed)	OSD = 66.4%	One lathe workshop, the garment factory and engineering company burn some-most of their waste on-site
	Recycling = 18.2%	Two lathe workshops largely recycle their waste (80kg/mth of metals). Other significant recycling includes the distillery (667 bottles/mth), garment factory (350kg/mth of textiles) and engineering company (200kg/mth of metals).
	Discharge = 15.5%	Distillery discharges most of its waste for BMC collection.
Green spaces (parks, etc.)	Compost = 78.5%	Waste from the Botanical Gardens, Dewala Park is composted on-site. Waste from Vincent Dias playground, 80% of racecourse waste, and 50% of waste from other parks and green spaces is assumed to be composted.
	Discharge = 21.5%	Garbage from the Children's Park is collected by BMC. About 20% of racecourse waste and 50% of waste from other parks and green spaces is assumed to be collected by BMC.
Road/drain cleaning	OSD = 50% Discharge = 50%	Assumed 50% of road/drain cleanings are simply deposited at the side of the road/drains, while the other 50% is collected by BMC.

Notes: OSD = on-site disposal, DH = direct haul, ID = illegal dumping.

2.1.4.2 Recycling and Composting at Other Points of the Waste Stream

In addition to recycling at source, recycling may occur at other points of the waste stream. The quantities of recyclable materials collected at these places were estimated as follows:

- **Following discharge**, individuals (scavengers) may sift through discharged waste prior to collection, recovering items of value to them for reuse/recycling. The amount of recyclables recovered in this manner is assumed to be negligible due to the large number of individuals collecting recyclables directly from households (46% of surveyed households) and other places (i.e. at source), rather than following discharge; the widespread practice of households taking recyclable materials to shops (28% of surveyed households); and very few people observed doing this.
- **During collection**, an estimated 30% of BMC workers salvage bottles, cardboard and metals from the collected waste for sale. About 39kg/d of materials are believed to be recovered in this manner, based on interviews with BMC collection workers.

- **At the final disposal site**, only one BMC labourer is stationed at the final disposal site and he does not collect recyclable materials. However, there are some scavengers who do collect an estimated 81kg/d of recyclables at this location.
- **Recycling at other illegal dumping sites** was estimated to be 18kg/d on a pro rata basis from the final disposal site recycling amount.

This gives a total quantity of materials recycled at places other than at source of 138kg/d, equivalent to 0.3% of total waste generation.

Some materials are taken directly to middlemen for recycling by individual collectors and BMC labourers. Based on interviews with eight middlemen in the city, the total amount of materials recovered in this manner from within BMA is estimated to be 1.02T/d, which is approximately consistent with total at source recycling (0.96T/d, excluding slaughterhouse, sawmill/timber depot and rice/grinding mills waste recycling of 4.7T/d).

The materials recovered from different points of the waste stream are summarised below.

Table 2-5: Summary of Recycling Data

Material	No of Households (120 surveyed)		Recycling Quantities (kg/d)	
	Giving items to *individual* collectors	Taking items to *shops*	During collection	Collected by *middlemen* (within BMA)
Paper/cardboard	18	2	10.0	209
Plastic	1	0	0.0	117
Glass	48	31	13.9	260
Metal	6	0	15.4	369
Textiles	10	0	0.0	0
Tyres	1	0	0.0	0
Battery cases	0	0	0.0	67
Total	55	33	39.3	1,022

Notes:
1. Although 101 households are visited by individual collectors, only 55 actually give recyclable materials to these collectors.
2. Iron is by far the most common type of metal collected followed by aluminium. Some copper and brass are also collected.

2.1.4.3 Collection and Disposal Quantities

Current disposal quantities were determined from a JICA load count survey at the final disposal site over the seven day period: 24-30 September 2002. The JICA survey data was converted to tonnes, as shown below, using measured vehicle capacities (m^3) for the two wheel tractor, four wheel tractor trailers and the compactor, filling factors based on JICA survey data and typical waste density data.

Table 2-6: BMC SWM Vehicle Volume and Tonnage Data

Vehicle	Registration	Volume (m^3)	Density (kg/m^3)	Fill factor (%)	Tonnage (T)
2WT	74-1732	2.94	390	0.73	0.84
4WT Trailer	37-6053	8.80	390	1.02	3.50
	49-0682	4.55	390	1.09	1.94
Compactor	68-7907	3.70	608	0.92	2.06

Note: Actual vehicle dimensions are given in the supporting report. Density data: 390kg/m^3 for BMC tractors/trailers and 608kg/m^3 for the compactor, based on WACS survey data for BMC collection vehicles[3] (310kg/m^3), an in-situ waste density of 390kg/m^3 for a large four wheel tractor trailer (6.3m^3) and 608kg/m^3 for a small 4m^3 compactor, measured by weighbridge in Colombo in Jul-Aug 2002 and comparative data from Kandy and Matale.

The current BMC disposal quantity of 19.6T/d is approximately the same as the collection quantity, due to the small quantity (39kg/d) of recyclable materials collected by BMC workers between discharge and disposal. The difference between the amount of waste discharged for collection (20.8T/d) and the amount actually collected is 1.1T/d. This amount is assumed to represent waste that is illegally dumped (in addition to that already counted), waste that is discharged for collection but never collected, or waste that is collected and then disposed of at places other than the BMC disposal site. It has been added to the illegal dumping amount.

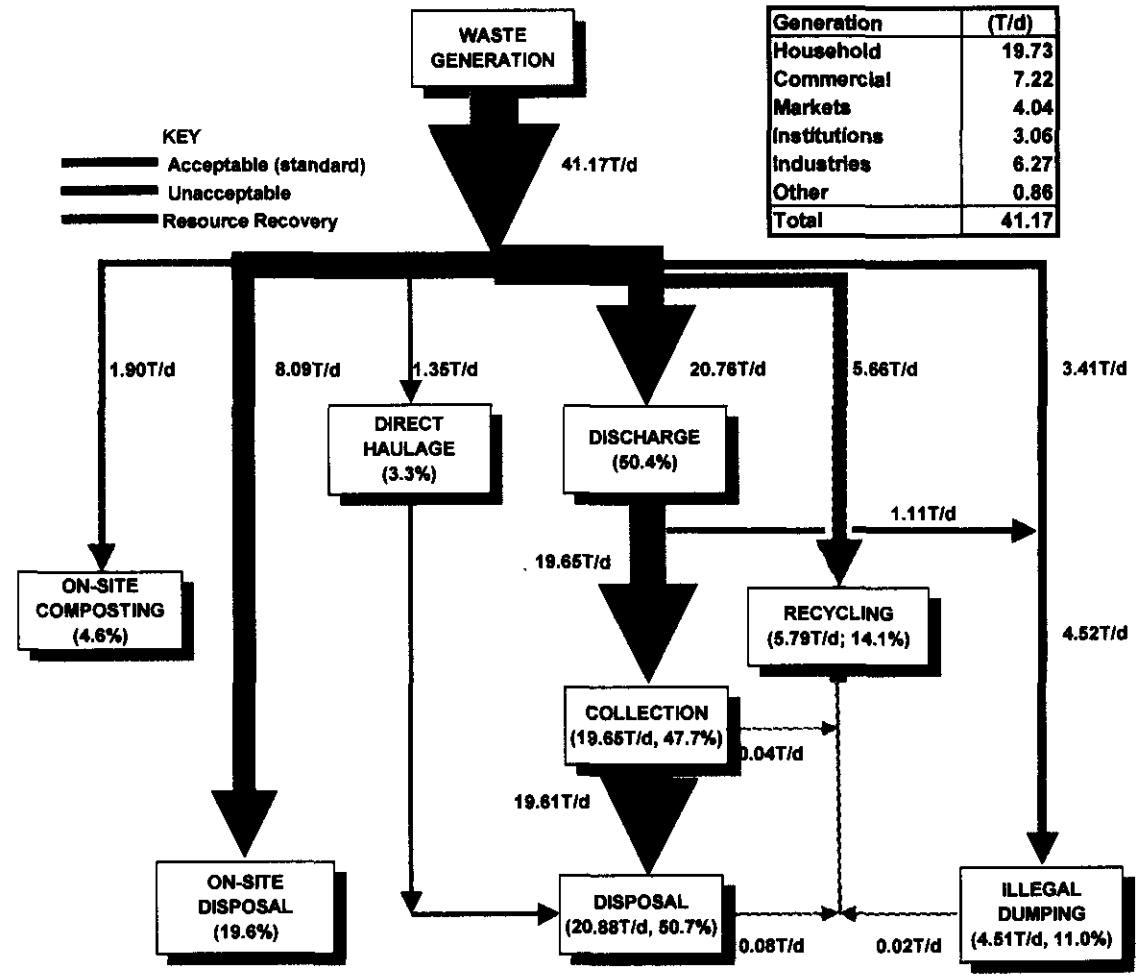
2.1.5 Waste Stream

Waste stream data for Badulla is tabulated below.

Table 2-7: Waste Stream Breakdown

Source	On-site Disp.	On-site compost	Dis-charge	Recy-cling	Illegal Dumping	Direct Haulage	Gener-ation
Household	6.53	1.38	8.56	0.45	2.82	0.00	19.73
Commercial	0.73	0.00	5.70	0.42	0.00	0.37	7.22
Markets/ Slaughterhouse	0.00	0.01	3.82	0.14	0.06	0.00	4.04
Institutions:							
• Schools	0.04	0.00	0.16	0.00	0.00	0.00	0.20
• Other Educ.	0.21	0.00	0.22	0.00	0.01	0.00	0.45
• Hospitals	0.03	0.00	1.41	0.01	0.00	0.03	1.47
• Govt offices	0.13	0.00	0.47	0.04	0.00	0.00	0.64
• Religious	0.12	0.00	0.12	0.00	0.00	0.00	0.29
Industries:							
• Timber	0.00	0.00	0.00	1.98	0.53	0.00	2.50
• Mills	0.00	0.00	0.00	2.57	0.00	0.95	3.53
• Other	0.16	0.00	0.04	0.04	0.00	0.00	0.24
Other:							
• Green spaces	0.00	0.47	0.13	0.00	0.00	0.00	0.59
• Roads/drains	0.14	0.00	0.14	0.00	0.00	0.00	0.27
Sub-total	8.09	1.90	20.76	5.66	3.41	1.35	41.17
Collection and Disposal							
Recycling at coll'n			-0.04	0.04			
Adjustment			-1.11		1.11		
Landfill disposal			19.61				
Recycling at disposal			-0.08	0.08			
Recycling at illegal dump sites				0.02	-0.02		
Total	8.09	1.90	19.53	5.79	4.51	1.35	41.17
%	19.6	4.6	47.4	14.1	11.0	3.3	100.0

[3] The JICA survey result represents the average density of composite samples of garbage extracted from different collection vehicles over a four day period (four samples).



Generation	(T/d)
Household	19.73
Commercial	7.22
Markets	4.04
Institutions	3.06
Industries	6.27
Other	0.86
Total	41.17

Figure 2-2: BMC – Current Waste Stream (2002)

The waste stream shows:

- Most waste (20.8T/d, 50%) is discharged for BMC collection and disposal, with 20.9T/d being disposed of to landfill (including direct haulage).
- On-site disposal is the second most common disposal method (8.1T/d, 20%). This is appropriate in some parts of Badulla (e.g. houses with large properties, institutions).
- Illegal dumping is also very common (4.5T/d, 11.0%). This should be eliminated in the future.
- Resource recovery, via on-site composting (1.9T/d, 4.6%) and recycling (5.8T/d, 14.1%) are both significant. They should be promoted further in the future.

2.1.6 Breakdown of Waste Discharge Amount

The amounts of different wastes being disposed of to landfill are tabulated below. This shows:

- The amount of compostable organic materials is about 16T/d (78%), excluding paper.
- Higher value recyclables (glass, hard plastic and metal) amount to only 2.9% (0.4, 0.1 and 0.2T/d respectively), indicating most of these items are already being recycled.

- Lower value recyclables (paper, textile, soft plastic) are present in larger quantities (15.2%: 2.3T/d, 0.3T/d and 0.6T/d respectively), indicating less of these items are being recycled. Of these materials, paper has the most (but still limited) potential for increased recycling, particularly if it can be sorted at source and collected separately. Otherwise, once mixed with other garbage, it becomes contaminated and is much more difficult and expensive to recycle.

Table 2-8: Amounts of Waste to Disposal (2002)

Survey Items	Categories	Percentage	Disposal amount (T/d)
Physical composition (wet base)	Kitchen waste	64.3%	13.4
	Grass & wood	14.1%	2.9
	Paper	10.8%	2.3
	Textile	1.3%	0.3
	Soft plastic	3.1%	0.6
	Hard plastic	0.3%	0.1
	Leather & rubber	0.4%	0.1
	Metal	0.8%	0.2
	Glass	1.8%	0.4
	Ceramic & stone	2.8%	0.6
	Others	0.2%	0.0
	Total	100.0%	20.9
Bulk density		0.31kg/l	

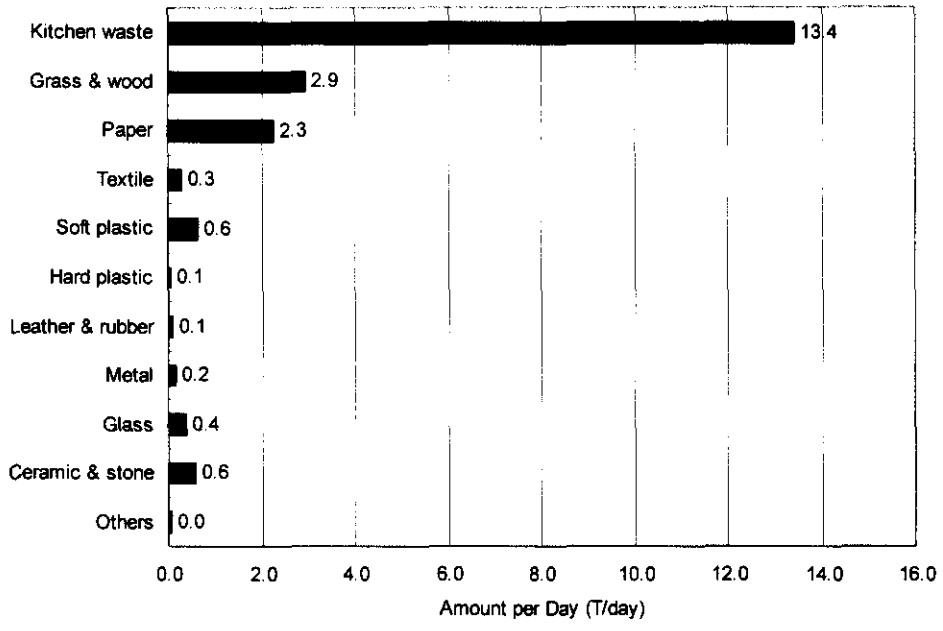


Figure 2-3: Daily Amount to Disposal (2002)

2.2 BMC Waste Management Institutional Setting

The BMC Health Department is responsible for waste management within BMA. Specific responsibilities include:

- Collection of MSW within BMA, including the planning of collection routes and daily scheduling of garbage collection vehicles.
- Transportation of the collected MSW to the final disposal site.
- Cleaning and garbage removal from public markets.

- Septic tank and toilet emptying services.
- Street/drain cleaning.
- Collection of any SWM fees levied for the services provided.
- Enforcement of local ordinances and national laws related to SWM.
- Implementation of policies relating to waste minimization, recycling, public education/awareness, etc.

The Health and Works department are both responsible for the cleaning of public spaces (e.g. parks, playgrounds, etc.).

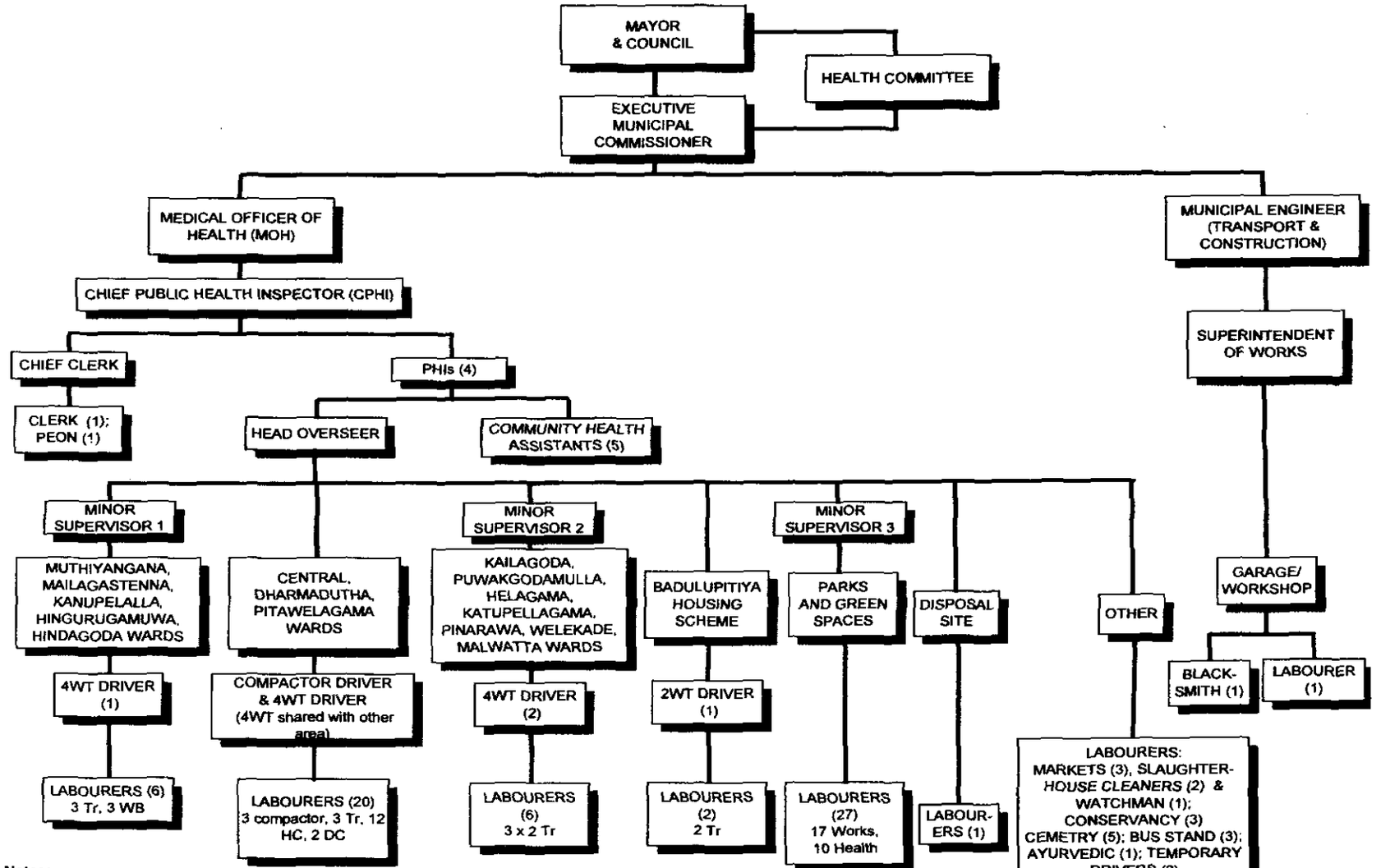
2.2.1 Organisational Structure

The current waste management organizational structure is illustrated below.

The Chief Public Health Inspector (CPHI) has overall responsibility for all of BMC's waste management activities, including SWM, whilst four other PHIs assist him in these duties. At the next organizational level, there are four Supervisors (Head Overseer and three Minor Supervisors) each responsible for different waste management areas of the city, as set out in the following table and figure. Beneath them, there are four drivers and 77 labourers (all permanent, with two acting as temporary drivers; 45 sinhala, 28 tamil and 4 muslim; 59 male, 18 female). These labourers are assigned to different areas, based on an actual SWM labour strength of 70, as the number of actual labourers present on any one day never exceeds 70 and is typically less than this due to absenteeism. There are also five Community Health Assistants, who have some involvement in SWM, and three administrative staff (chief clerk, clerk and peon).

BMC's allocated cadre for labourers is 84.

The Health Committee serves as an advisory committee to the Council, dealing with all health issues, including SWM. BMC staff on this committee comprise the MC Accountant, Secretary, Engineer, Superintendent of Works, CPHI, Municipal Commissioner, Revenue Inspector and Chief CDO. Elected members comprise the Mayor, Deputy Mayor and 13 Councillors. Meetings are normally held monthly and the committee is relatively active.



Notes:

1. 2WT = two wheel tractor, 4WT = four wheel tractor, DC = drain cleaner, HC = handcart, GS = gully sucker, WB = wheelbarrow
2. Conservancy = septic tanks, toilets, Infectious disease prevention

Figure 2-4: BMC Waste Management Organisational Chart

Table 2-9: BMC – Breakdown of Waste Management Staff and Equipment

Area	Ward (No)	CPHI	PHIs	Supervisors	Labourers		Collection Points		Handcarts	Vehicles	Public Toilets
					Tasks	No	Perm	Temp			
PHI-I	Kailagoda (1) Puwakgodamulla (2) Pitawelagama (3) Central (10)		I	MS-2 MS-2 HO HO	Garbage collection Sweeping	18 18	11 5 2 10	4 4 1 9	4	3 x 4WT 1 x 2WT 1 x Cr	4
PHI-II	Helagama (4) Katupellagama (5) Pinarawa (6) Muthiyangana (11)	CPHI	II	MS-2 None MS-2 MS-1	Drain cleaning	8	6 N/a 4 4	2 N/a 2 7			0
PHI-III	Welekade (7) Malwatta (8) Dharmadutha (9)		III	MS-2 MS-2 HO			8 6 6	7 3 7			2
PHI-IV	Mailagastenna (12) Kanupelalla (13) Hingurugamuwa (14) Hindagoda (15)		IV	MS-1 MS-1 MS-1 MS-1			6 4 5 3	5 5 6 4			1
Markets				0		3					
Slaughterhouse				0		2					
Septic tanks/ Toilets/IDP				0		3				GS	7
Disposal sites				0		1					
Other				MS-3 (Public spaces)		17			1		
BMC Total		1	4	4		70	80	66	5	3 x 4WT, 1 x 2WT, 1 x Cr, 1 x GS	
Allocated cadre						84					

Notes:

1. DC = drain cleaner, (C)PHI = (Chief) Public Health Inspector, HO = Head Overseer, MS = minor supervisor, SW = sweeper, GS = gully sucker, Tr= tractor, 2WT = two wheel tractor, 4WT = four wheel tractor.
2. Street sweeping = 15 labourers; drain cleaners = 4; garbage collection labourers = 5, tractor labourers = 19, final disposal site = 1
3. Other = Cemetery (5), Botanical Garden (3), Children's park (2), Bus stand (3), Slaughterhouse Watchman (1), Ayurvedic hospital/medical centre (1), temporary drivers (2).

2.2.2 Waste Management Equipment (as of September 2002)

Current waste management vehicle fleet details are summarized below, together with estimated vehicle lifetimes, based on practical experience of BMC staff.

Table 2-10: Waste Management Vehicle Fleet and Supporting Equipment

Vehicles/ equipment	No	Use (Capacity)	Approx. life (yrs)
Handcarts	5	SWM collection, road and drain cleaning	2-4
Two wheel tractor (2WT)	1	Badulupitiya Housing scheme SWM collection	15-20
Four wheel tractor (4WT)	3	SWM collection	15-20
Four wheel tractor trailers	3	SWM collection	8-10
Compactor	1	SWM collection	8-10
Gully sucker	1	Septic tank/toilets emptying	10-20

Garbage collection vehicle labourer, sweeper, drain cleaner and special zone equipment details are summarised below.

Table 2-11 : Vehicle Labourer and Equipment Details

Vehicle/Task	Labourers	Equipment
Handcart	3	1 basket, 2-3 ekel brooms, rake
2WT	2	Fork, ekel broom, basket
4WT	3	Fork, ekel broom, 2 baskets
Compactor	3	Fork, ekel broom, 2 baskets

Notes:
1. Handcarts generally have three labourers – a pusher and two sweepers.
2. Labourers said that BMC does not provide gloves. Hence, they must buy gloves themselves if they want them at 50Rs ea. However, BMC said if they issue boots, gloves and/or raincoats, labourers tend to sell these items.

2.2.3 BMC Waste Management Services Labour Force and Equipment

2.2.3.1 SWM (Garbage) Collection, Street and Drain Cleaning

BMC's garbage collection, street sweeping and drain cleaning labour force and equipment comprises:

- Four handcarts, one 2WT (two wheel tractor), three 4WTs (four wheel tractors) and one compactor. One of the four wheel tractors has been out of service for some time.
- Four PHIs, one Senior Overseer, two minor supervisors, five drivers (including two labourers acting as temporary drivers) and 45 permanent labourers (including one at the final disposal site). Another minor supervisor is responsible for the cleaning of public spaces (e.g. parks, playgrounds).

2.2.3.2 Markets and Slaughterhouse

Badulla's Central and Welekade markets and Wednesday/Sunday Pola are cleaned by BMC labourers. Three labourers are normally assigned for the cleaning of the Central and Welekade markets, while the Pola are cleaned on Monday and Thursday by 2-5 MC labourers. The slaughterhouse and surrounds are cleaned by two MC labourers.

2.2.3.3 Septic Tank, Toilet Emptying and IDP Services

These services include:

- The management and maintenance of public toilets.
- The provision of gully sucker services within Badulla and to some areas outside BMA on request.
- Mosquito control (spraying).

The septic tank/toilet emptying/IDP services equipment and labour force comprises:

- Seven public toilets. BMC currently cleans the public toilets at the Sunday Pola, Botanical Garden, Hanwella, and Children's Park. The Central Bus Stand toilet is cleaned by the private sector.
- One gully sucker.
- Three conservancy labourers.

2.2.4 SWM Costs

BMC's 2002 budget costs, tabulated below, show that 13.3% of BMC's budgeted expenditure was allocated to SWM. This is mainly due to the high number of BMC employees engaged in SWM works (25% of total). These results are on the low side compared with other study towns, with SWM expenditure accounting for an average of 22.0% (range = 13-35%) of LA budgeted expenditure and SWM workers an average of 29% (range = 22-37%) of all LA workers, by cadre.

Table 2-12: BMC Budget SWM Costs and Employees (2002)

Item	SWM	BMC Total	SWM as % of Total
Budget Expenditure (million Rs)	7.72	57.9	13.3
BMC Employees (by cadre)	84	249	25.2

2.2.5 Waste Collection/Disposal Fees

No places currently pay any garbage collection or disposal fees, nor does BMC have a separate fee charging system for garden waste collection and removal.

During May 2001-April 2002, gully sucker income averaged around 20,000Rs/mth, ranging from 2,812 to 44,169Rs/mth.

However, informal payments to garbage collection workers are relatively common and include:

- 3% of 120 households surveyed pay an average of 37Rs/yr "reward".
- 12 (20%) of commercial/industrial and institutional places surveyed pay an average of 1,454Rs/yr (range = 50 to 6,000Rs/yr).

2.2.6 SWM Bylaws

Standard Sri Lankan SWM by-laws are in place, most of which are very old and out-of-date. By-law enforcement is poor with many people following illegal practices. Action may be taken under the Penal Code Ordinance to file cases against SWM lawbreakers.

2.2.7 BMC Workshop

Workshop staff comprise one blacksmith and one labourer. Workshop facilities are very basic, comprising welding plant, hand drill, air pump, ramp and a water pump. There are no hoist, lathe, or grinding facilities. Consequently, only minor vehicle repair works are undertaken at the BMC

workshop such as tyre patching, washing small welding jobs (e.g. trailer patching), eliminating diesel blocks, etc. BMC staff indicated they have the capability to repair trailer sides and bottoms. All other maintenance tasks are given to the private sector.

A stock of basic spare parts (e.g. oil/diesel filters, tyres, tubes, iron, nails, welding rods, handcart wheels, etc.) are kept in the BMC Stores. Procurement of these spare parts can be approved by the Superintendent of Works. Any other repair/maintenance works must be authorised by the Municipal Commissioner. An Assessor will put a value on the required works, following which quotations will be called for, a contract will be awarded and the repair works undertaken. This whole process may take 2-3 months, depending on the type and value of the required works.

BMC estimate that about 75% of total vehicle maintenance/repair expenditure is spent on the maintenance of SWM vehicles.

2.3 SWM System Components

2.3.1 Discharge, Collection and Transportation

2.3.1.1 SWM Collection Zones

Badulla is divided into three areas for SWM, sweeping and drain cleaning purposes. In addition, the cleaning of parks and green spaces is treated separately. Field investigations found that the BMC garbage collection service covers ~75-85% of Badulla (population basis). An average service coverage of 80% has been adopted for this study.

2.3.1.2 BMC SWM Discharge System

Most waste generators discharge their mixed garbage by one of the following methods:

- At the roadside for primary collection by handcart followed by transfer to one of around 80 permanent rectangular concrete bins located around the town.
- Directly to these concrete bins/collection points.
- At the roadside. About 66 temporary collection points have been identified where there is no bin, but which are used by residents and other waste generators for garbage discharge.

Some residents do use plastic bags or dustbins, a few residents and commercial/industrial enterprises give their garbage directly to the collection vehicle, and some commercial/industrial enterprises may have it collected directly from their premises. More details are given in the supporting report.

These practices result in lots of scattered garbage and mini-dumps, creating poor sanitary conditions, due to animals - goats, cows, cats and dogs - looking amongst the garbage for food.

Moderate-high amounts of garden waste are produced in the city, particularly during April-June. These are typically discharged illegally at community collection points or at the roadside for subsequent

collection by BMC. Often, garden waste is burnt at such places, while building waste is also commonly present.

These observations show that there is an urgent need to improve the current discharge system.

2.3.1.3 BMC SWM Collection System

a. Collection System

Garbage is collected from these informal and formal collection points and directly from the discharger (see supporting report for details). The collection frequency ranges from daily (e.g. Central, Dharmadutha wards) to 1-2 times/week (e.g. Kanupelalla, Hingurugamuwa) to on request (e.g. Katupellagama).

Garbage collection by vehicle is difficult in most of the steeply sloping areas outside the city centre, which typically have poor, narrow road access as well.

Time and motion studies undertaken by the Study team for a four wheel tractor and the lorry on 19 September 2002 found that the tractor using the large trailer (8.8m^3 capacity) took 2h39min to complete one round, with loading making up 78% of the total working time. In contrast, the compactor was able to complete three trips within 4h 9min, even with loading making up 76% of the total round time. Two rounds only took 70min. Travel time to and from the landfill is very short being 2-3min for the compactor and 6min for the tractor.

b. BMC Collection Vehicle Unit Costs

BMC collection vehicle unit costs were calculated for handcarts, tractors and the lorry using actual trips (Sep 24-30, 2002) and cost data supplied by BMC, supplemented by data from other sources where necessary. These costs are illustrated below (refer additional report for details). This data shows:

- Handcart operation with three labourers is expensive, ranging from 1,865Rs/T for three trips/d to 1,119Rs/T for five trips/d.
- Two wheel tractor costs are high (822Rs/T), primarily due to only 1.4 trips being completed each day and also to high annual maintenance costs.
- Four wheel tractor costs are good (268-254Rs/T) , this primarily being due to the high daily tonnage collected by both tractors. However, these costs should be viewed with caution, as they were estimated from JICA survey data taken during a 7day period when both tractors were operating a two shift system for at least 50% of the week.
- Compactor unit costs are moderate. However, these should also be viewed with caution as the compactor was out of service for 3.5 days during the JICA survey, meaning the average daily number of trips had to be estimated from limited data.

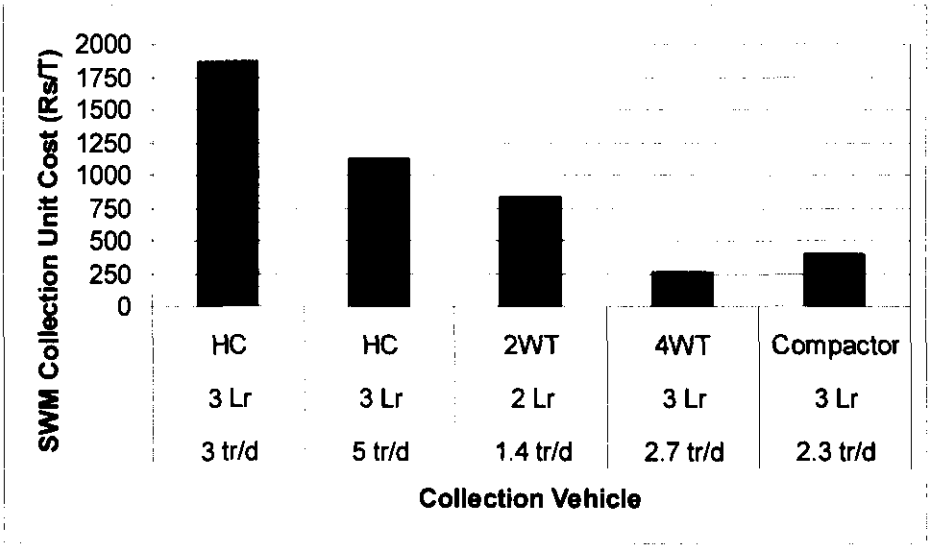


Figure 2-5: BMC Garbage Collection Vehicles – Unit Costs (2002)

c. Assessment

Investigation of the present garbage collection system shows that it involves some wasted effort. For example, handcarts working in the central city area undertake primary collection and then discharge their loads to bins or temporary collection points (i.e. on to the ground), from where they must be loaded again into a collection vehicle.

Another major problem is that many of the SWM collection vehicles are relatively old (average age: two wheel tractor: 10yrs, four wheel tractor: 12yrs, reconditioned compactor: 4yrs in Sri Lanka) and require frequent maintenance. Vehicle repairs/maintenance often takes a long time, especially for compactors due to delays in obtaining spare parts.

These high costs indicate there is considerable potential for reducing handcart, tractor and compactor unit costs by decreasing the number of labourers, increasing the number of daily trips, and improving the collection efficiency, while handcart use should be restricted to essential places only.

JICA studies indicate that BMC tractor/trailers (4.6 and 8.8m^3) carry a similar (1.9T/load) and greater (3.5T/load) amount of garbage to landfill respectively compared with the compactor (3.7m^3, 2.1T/load). This is due to the different volumes of each vehicle and the high bulk density of Badulla waste (0.31kg/L), meaning that compactors can only achieve small-moderate waste compaction, compared to developed countries where the waste is much "lighter" (e.g. Japan - 0.15kg/L). Compactors have other advantages over tractors, being more manoeuvrable, easier to load, enclosed (resulting in less waste scattering than from open trailers) and faster, reducing travel times during collection and to and from the landfill. However, compactors are more difficult and expensive to maintain. Overall, both tractor/trailers and compactors are considered suitable for Badulla.

2.3.2 Processing and Treatment

None of the garbage collected by BMC is currently taken for processing/treatment.

2.3.3 Final Disposal

Badulla have been disposing of their waste near the racecourse since 1964. As of September 2002, the approximate filled area was 3.0ha, with about 0.6ha of land still available for filling, equivalent to a reserve volume of 9,000m^3, or approximately 1-2 years filling time. Odour, flies, crows and bats, fire and smoke seriously affects nearby households in Greenwood Drive and the Botanical gardens and sportsground due to lack of proper soil cover and burning of deposited waste.

2.4 Resource Recovery

Resource recovery is relatively common, as summarised below.

Table 2-13: Summary of Resource Recovery Initiatives in Badulla

Sector	Comments
Reuse	Many shops selling items for re-use (e.g. shoes, bicycles, umbrellas, mobile phones, paper bags, etc.).
Recycling at source	Very common. 84% of households are visited by someone to collect/buy their reusable/recyclable materials, while 28% of households take some reusable/recyclable items to shops for refund/sale.
Recycling by SWM Labourers	30% of BMC labourers involved, collecting about 40kg/d of glass bottles, cardboard and metals, earning "tea money" (170 Rs/labourer.mth).
Recycling at landfill	Some scavengers collect an estimated 81kg/d of recyclables.
Middlemen	Interview surveys held with 8 middlemen shops found: Established and new businesses: 3 over 8yrs old; 3 only 6mths old. Creating jobs: employ at least 32 people. Recycling wastes: 2.5T/d, 41% from within MMA (1.0T/d). Generating income: purchases (712,000Rs/mth) vs sales of 928,000Rs/mth. Mainly buy high value recyclables: newspapers/exercise books, glass bottles, sacks and plastic containers for reuse; metals, broken glass and battery cases for recycling. Mainly act as retail/wholesale outlets. Main problems: obtaining credit > utilities > high transportation costs > shortage of recyclable materials.
Commercial composting	UVA Province Chamber of Commerce and Industry operated a medium sized compost facility near the BMC disposal site for about 2.5 years until operation was stopped in December 2001. It accepted an average of 8 tractor loads per day (about 50% of Badulla's waste), with the compost being in popular demand. Inspection of the compost facility in September 2002 found that many compost piles were still in place, together with a large amount of reject materials. The site requires rehabilitation.

Refer supporting report for further details.

2.5 Social Aspects

2.5.1 Household Surveys and Interviews

2.5.1.1 Household Public Opinion Survey (POS) Results

A household public opinion survey was conducted in September-October 2002 within BMA in order to prepare a basic socio-economic profile of Badulla's residents and to gain an appreciation of public attitudes towards the current provision of SWM services, desired improvements to these services and their willingness to pay for improved services. The survey covered 120 households, comprising 40

households from two high income (Gangabada Rd, Bandaranayake Mw), two middle income (Higurugamuwa, Deiyannewela) and two low income (Galkanda, Bangalawatta) areas.

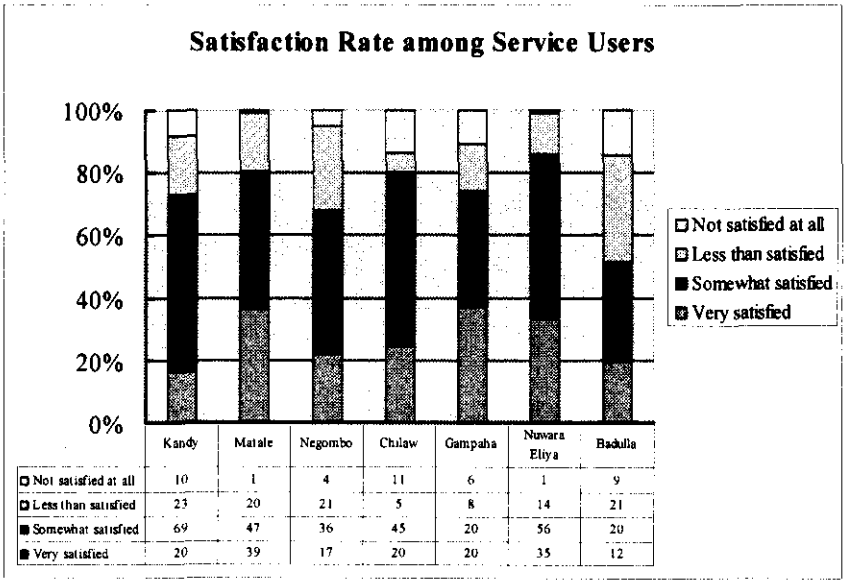
80% of the surveyed population is Sinhalese, 10% Muslim and 10% Tamil. Data on the average number of people per household and monthly income is tabulated below.

Table 2-14: General Household Data

Item	Low income	Middle income	High income	Overall
Average number of people per household	4.6	4.8	4.7	4.7
Average monthly household income (Rs/household)	6,060	8,906	20,175	
Average monthly income (Rs/person)	1,317	1,875	4,293	

Key survey results related to SWM are summarised here.

- 97 (81%) of surveyed households are provided with a collection service by BMC, of whom 52%[4] stated they use this service. Only 10% of surveyed households are very satisfied with present SWM service provision, while 17% are somewhat satisfied (total = 33% or 63% of stated service users). Area-wise data shows less satisfaction in middle income areas. The overall satisfaction rate is lowest among the seven study towns.



	Kandy	Matale	Negombo	Chilaw	Gampaha	Nuwara Eliya	Badulla
Not satisfied at all	10	1	4	11	6	1	9
Less than satisfied	23	20	21	5	8	14	21
Somewhat satisfied	69	47	36	45	20	56	20
Very satisfied	20	39	17	20	20	35	12

Figure 2-6: Waste Collection Service Users' Satisfaction Rate

- Household's main waste discharge methods are shown below. The most common methods are discharging their garbage at a specified place for collection (43%), burning/burying their waste within their own premises (41%) and open dumping outside their premises (9%).

[4] Does not quite tally with "main waste discharge" method data, due to some people saying they use the BMC service but then later saying they open dump their waste outside their premises.

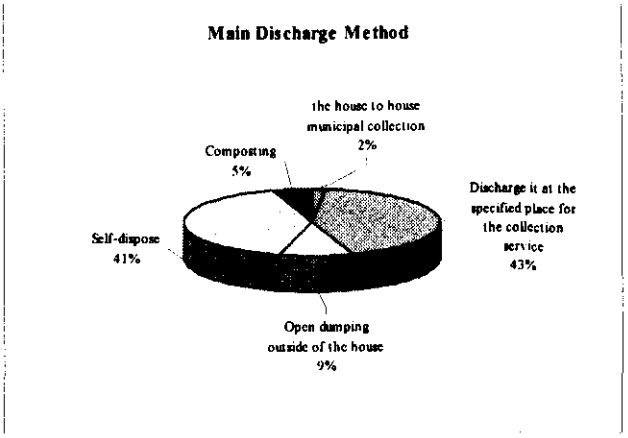


Figure 2-7: Common Waste Discharge Methods

- Although only 4% of surveyed households receive a daily garbage collection service, 38 households (61% of 62 households using the BMC service) discharge their wastes daily. The discrepancy between these figures explains the large amount of discarded waste seen on many streets around Badulla.
- In general, adult female members handle waste in 87% of surveyed households.
- 79% of surveyed households are willing to cooperate with source separation for recycling, with the middle income group showing the strongest support. However, 101 (84%) households are called on by someone who comes to collect their reusable or recyclable materials (mainly certain kinds of bottles and paper, especially newspaper). Hence, an informal recycling system is already very active. Interestingly, 46 of these 101 households do not sell any materials to these recyclers, the main reasons being the recyclers only buy selected materials, or offer much lower prices for selected bottles than shop deposit prices, and not wanting to allow unknown people onto their premises for security reasons.
- Only 8 (7%) households have ever discussed proper garbage discharge methods at the community level.
- Over 90% of surveyed households appreciate the necessity for SWM awareness programmes.
- The average WTP (willingness to pay) for improved SWM services is 47Rs/month per household.

2.5.1.2 Findings from Focus Group Discussions

Two focus group discussions were held in Katupelellagama and Deyyannewela in early October, 2002 in order to obtain a deeper appreciation of public attitudes to SWM service provision in two quite different settings (refer supporting report for details).

In Katupelellagama, located on the BMC boundary, water supply was the main problem, while SWM was not a problem, although they do not receive a municipal service. In contrast, Deyyannewela, which has a typical urban setting with many small houses without gardens, receives an infrequent garbage collection service and the unsanitary conditions near the concrete public bins was the main concern. In

addition, poor condition of the drainage system was a serious problem in Deyyannewela, with the residents sometimes cleaning the drains themselves.

2.5.2 Commercial/Industrial and Institutional Survey Results

Interview surveys were conducted with 60 commercial/industrial and institutional places within BMA in September-October 2002. Key survey results are summarized below.

- 50 (83%) enterprises are provided with a garbage collection service by BMC. 47 (78%) use this service, 10 (21%) of whom are satisfied with it. The main reasons for dissatisfaction relate to the garbage discharge system being poor, garbage collection/sweeping is irregular, not done properly, or too low in frequency, or the collection point is too far away. The Lanka Nursing Home is also concerned about hazardous healthcare waste management.
- The five most desired improvements to garbage collection and disposal are an improved discharge system, public education, shorter distance to collection point, greater recycling/composting and a more reliable service. Improved collection and disposal of hazardous healthcare waste was also of concern to the General Hospital.
- 18 (30%) places supported the introduction of an individual garbage collection fee, while 41 (68%) places indicated an average WTP of 487Rs/mth (range = 100 to 1,200Rs/mth).
- 60 (100%) enterprises believed recycling is necessary, with 54 (90%) enterprises being either very willing (52) or somewhat willing (2) to cooperate in separating their garbage at source, while two are doing this already.
- Eight (13%) enterprises are willing to undertake on-site composting, while two are doing so already. However, the majority (50, 83%) of enterprises are not in favour, mainly due to a lack of space on site (30) and it taking too much time (21).
- 60 (100%) enterprises consider a campaign to raise peoples' awareness for maintaining a cleaner city and environment is very necessary.
- The most common additional comments received related to a need for public education/awareness raising (16), widespread support for recycling (15), polythene should be banned (9) and daily cleaning (6). The Colombo Commercial Engineering Co. offered technical assistance to produce energy from waste, including household biogas units.

2.5.3 Attitudes of Cleansing Workers

2.5.3.1 Present BMC Cleansing Works Labour Force

As of September 2002, BMC had 76 permanent labourers and no casual labourers of whom 38% are Tamil, 59% Sinhalese and 3% Muslim. 75% are male labourers. Their work is closely controlled by so-called "supervisors". In BMC, there are 4 such supervisors, categorized into two different types - Chief Health Supervisor (Pradana Saukiya Paripalaka) (1) and Health Supervisors (Saukiya Paripalaka) (3). None of them have been promoted from cleansing workers.

2.5.3.2 Findings from Cleansing Workers Survey

A questionnaire survey was conducted among 30 BMC cleansing workers in early October 2002, in order to obtain a basic socio-economic profile of cleansing workers and an appreciation of their working conditions. Analysis of the survey data shows:

- 37% of the surveyed population is Tamil and 63% Sinhalese.
- The average number of members per household is 5.1 persons.
- The average monthly income is 8,136Rs and 1,606Rs per household and person respectively. This is higher than the average low income figure, but a little less than the average middle income figures found in the household public opinion survey.
- The average number of years of work is 16.1 years (at least 16yrs for Sinhalese workers).
- Either the mother or father of 47% of surveyed workers also worked as a cleansing worker.
- Difficulties and dissatisfaction with their work are as follows.

  First: Lack of protective clothing such as gloves, boots, etc.

  Second: Vehicle often breaks down

  Third: Insufficient wage

  Fourth: Not enough tools for collection work

  Fourth: Improper discharge of waste by people

  Sixth: Unsanitary waste such as human waste is mixed in with other waste

  Among these six issues, the first, third and fourth ones seem to be genuine difficulties directly affecting their work. Addressing these issues may help to improve SWM service provision.
- When work related difficulties arise, only 63% of surveyed workers talk to a supervisor first.

These findings illustrate that BMC waste collection work is not dominated by Tamil labourers, unlike in Nuwara Eliya, which has a similar historical background as a centre of tea production. This applies at least to the last 16 years and might reflect the fact that the poor in BMA have been attracted to waste collection work regardless of their ethnicity due to limited job opportunities. The relationship between supervisors and workers is not as close as found in other study towns, which may be because the supervision capacity of BMC is quite low at present.

2.5.4 Awareness Programmes and Environmental Education

Currently, the BMC Health Department, NGOs and schools are the main groups undertaking SWM awareness and environmental education programmes.

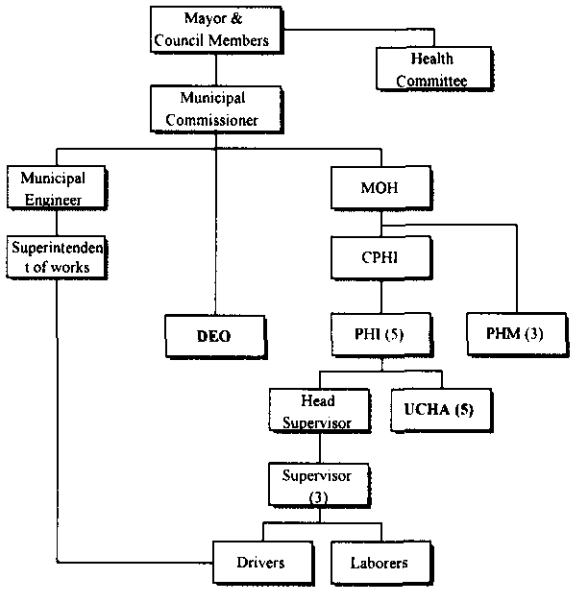
2.5.4.1 BMC Involvement

As in Kandy and Matale, the current organizational arrangement for community-based activities grew out of UNICEF's Urban Basic Service Programme, which began in the early 1990's. At present, five

Community Health Assistants (UCHAs)[5], supervised by the MOH and CPHI, work in a variety of activities that require community participation, including pre-school improvements, micro-finance, income generation training activities, etc. They regularly visit two Community Development Councils[6] and ten women's societies mainly in low income areas, acting as a link between BMC and these communities.

In addition, these UCHAs are playing an active role in SWM, complementing the present weak supervision system. (e.g. supervision of night collection shift in the city centre from 2-9pm on a rotating monthly basis, promotion of pit composting system as part of JOCV programme, sale of plastic dustbins to shops[7]).

Badulla Municipal Council
Organizational Arangement for the Solid Waste Managment



MOH: Medical Officer of Health
DEO: Divisional Environmental Officer
CPHI: Chief Public Health Inspector
PHI: Public Health Inspector
PHM: Pulibi Health Midwife
(or called as Family Health Service Officer)
UCHA: Community Health Assistants
who were introduced with the Unicef program

Figure 2-8: BMC Health Department Organisational Chart (excluding SWM Details)

BMC also has one Divisional Environmental Officer (DEO)[8], who organizes school environmental education programmes (see later). Although the DEO has been stationed here since 1997, an Environment Committee has not yet been formed in BMC.

2.5.4.2 Involvement of NGOs and Other Organisations

There are several NGOs working in the environmental and community development fields in Badulla. One of these is Uva Praja Arthika Sanvardene Viyapruthiya, established by a former UCHA. Another one is Sanasa, usually known as a micro-finance institution, but working here on environmental

[5] U prefix indicates CHAs of UNICEF origin, as described above.
[6] Eight originally established under same UNICEF programme.
[7] As of September 2002, 140 bins had been sold at 360Rs each. However, this scheme has not been very successful, due to BMC's failure to send collection vehicles punctually.
[8] The Central Environmental Authority (CEA) has appointed DEOs to each district and division and selected local authorities.

protection and soil conservation, the environmental activity being initiated by the society Chairperson, a school vice-principal. These NGOs have experience in working with BMC.

2.5.4.3 School Environmental Education Programme

Environmental education programmes have been developed by the Central Environmental Authority (CEA) since its establishment in 1980. CEA has introduced two nationwide school programs, namely the "Environmental Pioneer Brigade (EPB)" programme for secondary schools in 1984 and the "Eco Clubs" for primary schools in 2001, with the DEO playing an active role in promoting these activities in Badulla. At present, 12 out of 17 schools are actively participating in EPB programs in BMA, the most active school being Dhammananda Vidyalaya.

The CEA has also appointed "Commissioners", by selecting some teachers to be Environmental Commissioners and Assistant Environmental Commissioners in each district. In BMA, the District Commissioner is from Bandarawela Kuda Kusum Vidyalaya and the Assistant Commissioner from Dhammananda Vidyalya.

This experience and resources (both schools and teachers) should be fully utilised for any future environmental education programmes focusing on SWM.

Chapter 3 Assessment of the Current SWM Condition

3.1 Healthy Aspects

3.1.1 Good Performance by BMC in Some Areas

BMC's SWM performance is good in a number of areas, including:

- Good SWM "service coverage" of 80-90%.
- Reasonable four wheel tractor collection vehicle performance and costs, for a two shift system.
- UCHAs play an active role in SWM.

3.1.2 Resource Recovery is Working Well

Many resource recovery initiatives are currently operating within Badulla, most of which are based on traditional values/approaches and represent important social capital. These include:

- "Aparade" is in common use, but requires promotion.
- Many people involved in reuse activities (e.g. shoe repairs, umbrella repairs, etc.).
- An excellent traditional recycling system, involving households and other waste generators, individual collectors (Bothal pathara karaya) and middlemen. Most high value recyclables (metals, glass bottles, battery cases, plastic containers, newspapers/exercise books) are recovered via this system, leaving mainly low value recyclables in the garbage taken to disposal. However, both the individual collectors and the middlemen operate largely on their own and do not currently have any close contact with BMC.
- On-site composting accounts for about 1.9T/d (4.6%) of generated waste which is significant.

These initiatives should be supported while additional measures should be implemented to further promote waste minimisation.

3.2 SWM Issues

3.2.1 Very Serious Issues

3.2.1.1 Institutional and Organisational Strengthening Urgently Needed

The main institutional and organisational issues related to SWM within Badulla are:

- The current SWM management structure does not reflect the significance of SWM within BMC. It should be much stronger, with more authority being given to the responsible people and adequate human, facilities and financial resources allocated for SWM works because many BMC employees are engaged in SWM works, while BMC spends a lot (but possibly not enough) of its budget on SWM (e.g. 2002 budget: 25% of BMC staff (about 84 employees) working in SWM by cadre; 7.7M Rs allocated to SWM (13% of total budget)).
- A shortage of senior staff dedicated to SWM works, while the inter-disciplinary nature of SWM makes it difficult for one person to handle SWM alone.

- A lack of short, medium and long term development plans. Goals, objectives and associated measures for improving SWM are not discussed, approved and implemented, resulting in a system where most staff focus on addressing day to day issues and activities are uncoordinated, often leading to confusion and poor motivation.
- Lack of proper supervision, with only the Senior Overseer being active in his job.
- Poor labourer management, with absenteeism running at around 15%, while some labourers go home early, some suffer from poor health and/or work under the influence of alcohol.
- Poor cooperation from other departments involved indirectly in SWM (e.g. long delays for vehicle repairs).
- Poor public-LA relations, characterised by a lack of clear instructions to the public detailing citizens' responsibilities, waste discharge rules, fines, etc. Existing by-laws need to be strengthened and vigorously enforced, while political intervention is also a serious problem.
- High SWM expenditure.
- Difficulties in finding out how much money is actually spent on SWM and the SWM cost breakdown (e.g. administration, collection, disposal, etc.).

3.2.1.2 Inadequate Final Disposal

Proper final disposal is the most important component required to establish the reliability of SWM works. The play ground disposal site is operated poorly, with very few, if any, environmental protection measures being taken, while it is almost full. Hence, BMC has a very urgent need to improve operations at the current site and to locate and procure a new landfill site, developing and operating it in a proper manner, whilst at the same time engaging in active public consultation with residents and other relevant stakeholders to get their approval and support for the new landfill.

3.2.1.3 Improvements to Technical System Needed

Current waste discharge and storage is characterised by:

- A lack of public cooperation with many people discharging garbage in any container or none, at any time and any place, resulting in lots of garbage discharged at the roadside, or at public collection points, causing waste scattering and creating mini-dumps.
- Many animals (goats, dogs, cows, crows, etc.) search for food amongst the garbage, further scattering waste and creating poor sanitary conditions.
- Many public bins are poorly designed, being difficult to empty.
- Lots of garden and building waste is discharged at the roadside, collection points or on vacant land. Often, the garden waste is burnt.

The establishment of a proper discharge and storage system is vital.

Collection and transportation is inefficient and unreliable, being characterised by many collection points, double handling and long loading times. Garbage collection by handcart and two wheel tractor is

expensive, while many vehicles are getting old and often breakdown, with repairs taking a long time. These problems, particularly vehicle breakdowns, make it difficult for BMC to keep to scheduled garbage collection times, routes and frequencies.

3.2.2 Serious Problems

3.2.2.1 Lack of Centralised Processing/Treatment Facilities

The main objectives of any processing/treatment technology are to reduce the final amount of waste to disposal. Following operations ceasing at the Chamber of Commerce compost facility, there are now no centralised garbage processing/treatment (recycling or composting or biogas) facilities within Badulla, . Considering that the composition of Badulla waste is very suitable for composting, that its disposal site is almost full and the problems BMC is having securing a suitable and publicly acceptable final disposal site, BMC should seriously investigate the feasibility of introducing medium-large scale composting facilities.

3.2.2.2 Increase Public Cooperation through Education/Awareness

Presently, public cooperation with BMC in SWM activities is poor, with many people still discharging their garbage and litter to public places. BMC is partly to blame for this, due to the collection service being unreliable and a lack of ongoing and systematic waste education, public promotion and information dissemination efforts.

Household surveys/interviews conducted during this study indicate that a proper discharge rule has not yet been established and Badulla's citizens are currently frustrated with the present SWM condition and eager for its improvement. They have also realized the importance of public awareness raising and many people are keen on beautifying the city.

Observations of the central city area suggest that the number of food outlets and restaurants maintaining good sanitary conditions is increasing, which shows that citizens' attitudes towards waste and cleanliness are changing.

Responses from the commercial/institutional and industrial enterprises survey show that there is considerable room for improvement in SWM service provision to these sectors, with stakeholders being willing to cooperate with BMC in this regard, with quite a lot of places indicating a willingness to pay a garbage collection fee.

These observations suggest that immediate education/awareness programmes combined with introduction of waste discharge rules, conducted in cooperation with schools and NGOs should be highly effective both to increase peoples' understanding of the SWM issues facing Badulla and to encourage public participation in SWM. However, such measures will only succeed, if BMC provides a proper and regular garbage collection service to its citizens.

It should be possible to utilise BMC's UCHAs in this work, particularly activities involving social mobilization at the community level (e.g. awareness raising for improving residents' waste discharge practices).

3.2.3 Less Serious Problems

Less serious problems are listed below:

- The relatively high population densities in Zones 1 and 2 and the steep terrain and poor road distribution network in zone 3 pose different SWM challenges in each area, with possibly different solutions being needed.
- Waste scattering from tractors during transit.
- No recording system for vehicle trips or disposal tonnages.
- Difficulties encountered by middlemen in gaining access to credit, high utilities and transportation costs, a shortage of recyclables, load interest and security theft problems, together with a general lack of support from the central government.
- Difficulties encountered in properly disposing of hazardous healthcare waste.