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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 THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

ACTION PLAN FOR GAMPAHA
FINAL REPORT
Volume V-3A
MAIN REPORT

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ACTION PLAN FOR GAMPAHA

FINAL REPORT

Volume V-3A

MAIN REPORT

DECEMBER 2003

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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

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List of Abbreviations

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
GMA	Gampaha Municipal Area
GMC	Gampaha Municipal Council
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
HCW	Healthcare waste
HHCW	Hazardous healthcare waste
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
SCP	Sustainable Cities Programme
SPHI	Senior Public Health Inspector
SLILG	Sri Lankan Institute of Local Governance
S/W	Scope of Work
SWM	Solid Waste Management
WGR	Waste Generation Rate
WTP	Willingness to Pay

Chapter 1 Background Conditions

1.1 Introduction

This plan was prepared by Gampaha Municipal Council (GMC) by itself, with JICA's technical assistance. Any decisions in this study were made by GMC.

1.2 Basic Fact Sheet

1.0	**General Data**	
1.1	Province	Western Province
1.2	District	Gampaha District
1.3	Local Authority Status	Municipal Council
1.4	Location	About 30km north-east of Colombo
1.5	Description	Newly created city at relative low elevation, with undulating terrain, rich vegetation and reasonable rainfall.
1.6	Gampaha Municipal Area (GMA)	37.4 Km^2
1.7	No. of Council members	18
2.0	**Socio-Economic Data**	
2.1	Total Population (2001)	57,429 (2002 estimate = 58,577)
2.2	Daily Floating Population	40,000-80,000
2.3	Average Population Density	15.4 persons/ha (2001)
2.4	Population Growth Rate	2.0% (1981-2001 compound average growth rate for Gampaha district)
2.5	Number of Households (2001)	15,222
2.6	Family Size	3.8
3.0	**Overall Gampaha Municipal Council (GMC) Data**	
3.1	Total Cadre (2002)	195
3.2	Total Budget Expenditure (2002)	36,791,000 Rs
4.0	**Solid Waste Management (SWM)**	
4.1	Collection Amount (2002)	9.6T/d (3,504T/year)
4.2	Budget SWM Expenditure (2002)	10,010,000
4.3	Cadre for SWM works (2002)	72
4.4	Ratio of SWM workers to all employees	36.9%
4.5	Ratio of SWM to total expenditure	27.2%
4.6	SWM expenditure per capita	174 Rs/person
4.7	SWM expenditure per tonne waste	2,857Rs/tonne

1.3 Natural and Social Conditions

The Gampaha Municipal Area (GMA) was created in April 2002, combining Gampaha, Yakkala and Bandiyamulla into a single municipality. Hence, it is unusual in nature, comprising a conventional town (Gampaha) and commercial ribbon development along the very busy Colombo-Kandy road, a mix of urban and semi-rural residential areas and moderate industrial activity, especially in Yakkala.

It is a commercial and service centre, having a major railway station and hospital, three busy commercial areas, a large number of schools and reputable tuition classes drawing students from other areas. The Wikkarama Arrachchi Ayurveda Vidyayatanaya (WAAV), a small ayurvedic college and maternity hospital is also located in Yakkala.

Gampaha is also located in an area of high population growth, with average population growth for the Gampaha district over 1981-2001 averaging 2.0%p.a.

1.4 Main Implications to SWM

- SWM service provision needs to be of a high quality due to Gampaha being a large and rapidly growing city, its commercial/service nature and the large floating population.
- Many of the newly added areas to the city are not provided with a garbage collection service. Most of these areas are likely to want a garbage collection service in the future, especially as they become more urbanized and once GMC charges them taxes.
- The unusual nature of GMA, comprising a mixture of urban and semi-rural residential, three commercial and industrial areas, spread over a wide area, poses challenges for providing SWM services to each area.
- Garden waste generation is likely to be high, due to the large number of trees and home gardens in GMA.

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 (2002) are summarised in this section while additional waste stream details are given in the supporting report.

2.1.1 Waste Stream Terminology

The terms used in the waste stream model adopted for GMA 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 for collection either within the property of the source itself (e.g. hotels, some institutions and industries), 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 city).
Direct Haulage	Part or all of the waste generated by different sources is transported directly by them to the official disposal site.
Collection	Waste discharged by a source is collected by Gampaha Municipal Council (GMC) for transportation to the final disposal site.
Transfer	Part or all of the waste collected by GMC is transferred from a smaller vehicle to a larger one at a designated place – i.e. transfer station.
Disposal	Waste collected by GMC 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 GMC, 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" (public spaces, road and drain/canal 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	Waste from the Gampaha Public market and Sunday Pola at Yakkala, which sell a high proportion of vegetables, fruit, meat and/or fish.
Institutions	Wastes from schools, other education centres, hospitals, GMC, central and provincial government offices, police, prison and religious places. Hospital waste includes some hazardous items as discussed further under hazardous/special waste and in Section 1.3.
Industries	Wastes from garment factories (6), desiccated coconut mills (2), sawmills (13), and other industries (12).
Other	• Waste from public spaces (e.g. parks, playgrounds, sportsgrounds, etc.). • Road/drain/canal cleaning waste collected by GMC.
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc. These wastes are not usually handled by GMC 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 Gampaha.

2.1.3 Waste Generation

2.1.3.1 Waste Generation Rates

Waste generation rates (see table below) 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 0.451kg/cap.d was adopted for GMA, based on Matale survey data and taking into account the unusual nature of GMA, having mixed Urban Council and Pradeshiya Sabha characteristics. The selected waste generation rate is consistent with other Sri Lanka data [2] for urban councils (0.45 – 0.65kg/cap.d) and Pradeshiya Sabhas (0.20-0.45kg/cap.d).
- Commercial waste generation was estimated to be 4.5T/d (8.5% of MSW) from around 545 business enterprises (8.34kg/enterprise.d), based on survey data for a mixture of large and small waste generators within the Gampaha, Yakkala and Mirrriswatta commercial areas, GMC trade licence statistics and GMC collection zone data. This is considered realistic, as GMA has a relatively high number of local hotels[3], bakeries and other large waste generators, together with a relatively high floating population[4] (40,000-80,000).
- Market waste generation (0.92T/d, 1.7% of MSW) is based on estimates for the Gampaha public market and Yakkala Sunday Pola within GMA, expressed as a daily average and equates to a market waste generation rate of 4.99kg/stall.d. This is considered reasonable. Market waste generation is relatively low, as there is only one public market within GMA, while the Yakkala Pola is only held

[2] UNEP (2001), State of the Environment Sri Lanka 2001
[3] Local hotels = canteens, small eating places, etc.

once per week. There are several other Pola held outside GMA limits that are visited by GMA residents (e.g. Balummahara Pola, near Mirrriswatta).

- Industrial waste generation (14.2T/d, 27% of MSW) is high, primarily due to large quantities of waste generated by two desiccated coconut mills and 13 sawmills in GMA
- Hazardous waste generation is relatively small, comprising typical everyday items (e.g. spraycans, batteries, fluorescent tubes, old drugs (pharmacies) and razor blades (hairdressers), etc.) which are disposed with normal garbage. However, St Jude Industries (Coir Mill) produces around 55kg/mth of sulphur containing wastes.
- Significant quantities of hazardous healthcare wastes are produced by the Gampaha Base Hospital, while the other two hospitals within GMA produce much smaller amounts of such wastes. Total hazardous healthcare waste generation is estimated to be about 0.43T/mth of clinical wastes/body parts, 0.21T/mth of placentas, 0.48T/mth of sharps, 0.03T/mth of other wastes (e.g. paint tins, mercury thermometers, discarded medicines, aerosol containers, etc.) and a small amount of highly infectious wastes.
- Total MSW generation is 53.7T/d, equivalent to 0.92kg/cap.d. Waste generation by source is shown in the following figure.

Table 2-3: Estimated Waste Generation Quantities

Source	Waste Generation Data			Waste Generation		
	WGR	WGR Unit	No of Units	Amount (T/d)		%
Residential	0.451	Kg/person.d	58,577	26.42	26.42	49.3
Commercial	8.34	Kg/trade licence.d	545	4.54	4.54	8.5
Markets	4.99	Kg/stall.d	184	0.92	0.92	1.7
Institutions:						
• Schools	0.084	Kg/(students+staff).d	27,822	2.32		
• Other Educ.	0.134	Kg/(students+staff).d	17,235	2.30		
• WAAV (ayurvedic college/hospital)	1.37	Kg/(students+staff+ patients).d	988	1.36		
• Hospitals	0.316	Kg/(patients+staff).d	2,717	0.86		
• Govt offices	0.157	Kg/worker.d	1,585	0.25		
• Religious	1.01	Kg/clergy.d	120	0.12	7.21	13.4
Industries:						
• Garment factories	0.194	Kg/worker.d	2,815	0.55		
• Coconut mills	30.9	Kg/worker.d	230	7.11		
• Sawmills	397	Kg/sawmill.d	13	5.16		
• Other	117	Kg/industry.d	12	1.41	14.22	26.5
Other:						
• Parks	0.11	T/d	N/a	0.11		
• Road/drain cleaning	0.28	T/d	N/a	0.28	0.38	0.7
Total	0.92	Kg/person.d		53.70	53.70	100.0

Notes: N/a = not applicable, WGR = waste generation rate

[4] No actual data. Estimated from discussions with the GMC SPHI.

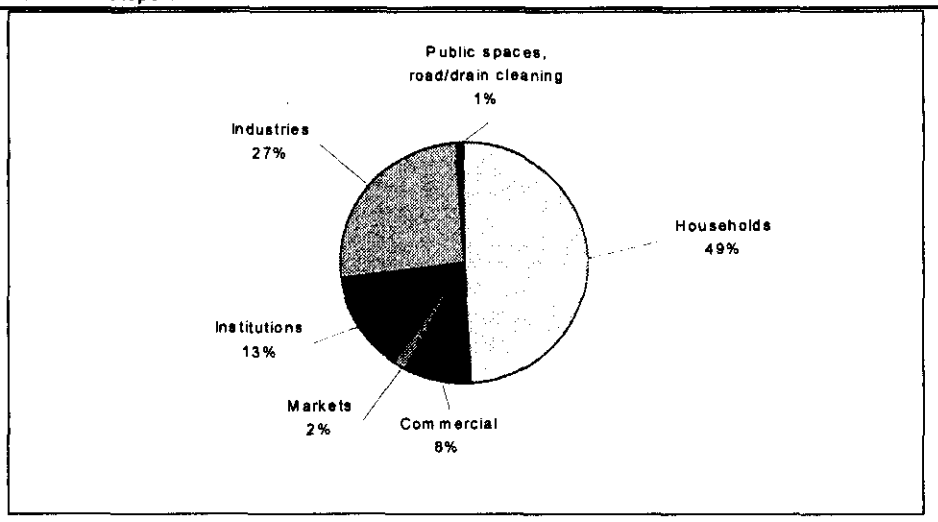


Figure 2-1: GMA Waste Generation by Source

2.1.3.2 Factors Affecting Waste Generation

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

- Waste generation from commercial enterprises, industries and institutions increases approximately 1-3 times on average during festivals and other special occasions (e.g. weddings and weekends for hotels/reception halls, "special orders" for garment factories, school festivals/sports meets, etc.).
- Market waste generation shows some variations on festival occasions, increasing by 1.5-2.0 times during the Sinhala/Tamil New Year and Christmas.

2.1.4 Waste Stream Breakdown

2.1.4.1 Field Investigation Results

Field investigation results on the proportions of waste being disposed 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

Source	Recovery/Disposal Method (%)	Waste Generation Rates/Quantities Calculations
Households	OSD = 67.2% Discharge = 18.7% ID = 8.6% Recycle = 2.9% Compost = 2.6%	Household survey results, modified to account for an estimated 49% garbage collection service coverage in GMA.
Commercial	Discharge = 53.7%	Most commercial waste is collected by GMC.
	Recycling = 29.2%	Significant recycling of cardboard and food/kitchen waste for animal feed, plus smaller quantities of glass bottles and broken glass.
	OSD = 12.9%	Some commercial places burn a lot of their waste.
	DH = 4.3%	Keels Supermarket, using own vehicle.
Markets	Discharge = 84.6%	GMC collects Gampaha market and some Yakkala pola waste.
	OSD = 14.3%	About 70% of Yakkala Pola waste is believed to be burnt within the Pola grounds (GMC transfer station) before collection.
	Recycling = 1.1%	Minor scavenging of some recyclable materials (assumed to be 10kg/d) from Gampaha public market.

Source	Recovery/Disposal Method (%)	Waste Generation Rates/Quantities Calculations
Schools	OSD = 49.7%	Five of eight schools surveyed (69% of total GMA school population) burn/bury all (1), most (2), or some (2) of their garbage on-site.
	Discharge = 49.6%	Five schools have all (1) or most (4) garbage collected by GMC.
	ID = 0.3%	Gothami College dumps some waste at an unspecified location.
	Compost = 0.2%	Two schools compost 105kg/mth of garden waste.
	Recycling = 0.2%	Four schools recycle 112kg/mth of waste paper/books.
Other educational	OSD = 81.6% Discharge = 18.3%	Assumed percentages based on school data, and limited survey data; one tuition class burns/buries all its garbage on-site; most of the Technical College's garbage is collected by GMC, except some is burnt on-site and 6.3kg/mth of metals are recycled.
WAAV	OSD = 100%	Wikkrama Arrachchi Ayurveda Vidyayatanaya (WAAV) (ayurvedic college & hospital), located in Yakkala, privatised its waste collection around mid-August 2002, following which all its waste is burnt on-site (mainly organic – garden, kitchen and paper waste).
Hospitals	OSD = 57.2%	Base Hospital burns ~70% of normal waste on-site. Most of its hazardous healthcare wastes (HHCW) are burnt/buried on-site. Arogya Hospital transports its HHCW (small amount) to a private incinerator in Kochchikade for disposal. Co-operative Hospital burns very small quantities of clinical and sharps waste on-site.
	Discharge = 35.7%	Most normal waste from the Arogya and Co-operative hospitals and about 30% of Base hospital waste is collected by GMC.
	Recycling = 6.0%	Some recycling by all three hospitals: cardboard, plastic/metal containers, polythene, glass, bottles, coconut shells, saline bottles.
	DH = 1.1%	Base hospital post-mortem waste and placentas are taken to the cemetery for burial.
Government offices	Discharge = 70.2%	Three out of six surveyed offices have all (2) or most (1) of their garbage collected by GMC.
	OSD = 29.7%	Two burn most (1) or some (1) of their garbage on-site.
	Recycling = 0.2%	Divisional Education Office recycles ~5kg/mth of waste paper.
Religious places	Discharge = 50% OSD = 50%	Assumed data based on one survey (all waste burnt/buried on-site), Kandy/Matale survey data, locations of the different places and the poor GMC garbage service coverage in the Yakkala area.
Garment factories	Discharge = 38.2%	Four of the six factories surveyed have most (3) or some (1) of their garbage collected by GMC.
	Recycling = 36.7%	Five factories recycle most (2) or some (3) waste, mainly comprising 3,230kg/mth paper/cardboard waste, ~2,240kg/mth food/kitchen waste for animal feed, 300kg/mth metal and 215kg/mth plastics
	OSD = 25.2%	Four factories burn/bury most (1) or some (3) of their garbage on-site
Dessicated coconut mills	OSD = 47.5%	One of two mills surveyed disposes most of its waste on-site.
	Recycling = 39.9%	One mill recycles 300,000-375,000 coconut shells/mth and 27,000kg/mth of "polkurutu" (inner layer of coconut). The other recycles 300,000 coconut shells/mth (used to make charcoal), 1,800kg/mth of polkurutu and 3,000 broken nuts/mth
	ID = 10.1%	One mill illegally disposes some of its waste to vacant land.
	Discharge = 2.5%	One mills has some residual waste collected by GMC.
Sawmills	Recycling = 83.8%	All five sawmills surveyed give away or sell most (4) to all (1) of their sawdust, woodchips and bark wastes (13 mills within GMA in total).
	OSD = 16.2%	Four sawmills burn some (2) or all (2) sawdust/woodchips on-site.
Other Industries	OSD = 77.2%	Three of six other industries surveyed burn most garbage on-site.
	Recycling = 15.6%	Four industries recycle some waste materials, comprising mainly 2,025kg/mth of cardboard, 1,000kg/mth of coconut fibre, 100-150kg/mth broken glass and 130kg/mth metals.
	Discharge = 7.2%	Three discharge most (1) to all (2) of their waste for GMC collection.
Public spaces	Discharge = 50% OSD = 50%	Waste from public spaces is assumed to either be disposed of on-site (50%) or collected by GMC (50%).
Road/drain cleaning	Discharge = 50% OSD = 50%	Road and drain cleanings are assumed to either be disposed of near to the point of removal (50%) or collected by GMC (50%).

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

2.1.4.2 Recycling at Other Points of the Waste Stream

In addition to recycling at source, recycling occurs 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 individual collectors visiting households to collect recyclables (81% of 150 surveyed households[5]) and other places (i.e. at source), rather than following discharge; the widespread practice of households taking recyclable materials to shops (21% of surveyed households), and very few people observed doing this.
- **During collection**, an estimated 23% of GMC workers salvage bottles and metals from the collected waste for sale. About 43kg/d of materials are recovered in this manner, based on survey interviews with 42% of GMC workers.
- No scavengers are believed to collect recyclables from the GMC or Yakkala Pola transfer stations.
- Neither of the two GMC labourers working at the final disposal site are believed to collect recyclable materials there, while there are also no outsiders (i.e. scavengers) working at this location, primarily due to its remoteness and location on private land. Hence, recycling at this point is assumed to be zero.
- A nominal allowance of 50kg/d has been allowed for materials recovered from illegal dumping sites scattered throughout GMA.

This gives a total quantity of materials recycled at places other than at source of 93kg/d, equivalent to 0.2% of total waste generation.

Some materials are taken directly to middlemen for recycling by waste generators, individual collectors and GMC labourers. Based on interviews with six middlemen in the city, the total amount of materials recovered in this manner from within GMA is estimated to be 2.8T/d, which is consistent with total at source recycling estimated from survey data (2.6T/d, excluding sawmill and coconut mill recycling).

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

Table 2-5: Summary of Recycling Data

Material	No of Households (from survey of 150 houses)		Recycling Quantities (kg/d)	
	Give to individual collectors	Take to shop	During collection	Collected by middlemen
Organic wastes	1	0	0	0
Paper/cardboard	35	11	0	227
Plastic	1	0	0	2
Glass	64	23	26.4	109
Metal	8	1	16.4	2,314
Battery cases	0	0	0	116
Total	73	32	42.8	2,768

Notes:

[5] The survey indicated that only 49% of households actually give recyclables to these collectors.

1. Iron is by far the most common type of metal collected by middlemen, with aluminium, copper/brass and beer cans being the main other metals.
2. Paper/cardboard collected by middlemen comprises mainly cardboard, followed by white paper, exercise books, newspaper and cement bags, most of which are collected by the National Paper Company Agent in Gampaha.
3. Glass collected by middlemen includes both broken glass (38kg) and glass bottles (71kg).
4. Super Plastics and Super Steel purchase about 33kg/d and 160kg/d of waste plastics and scrap iron respectively from within GMA from individuals, factories, garbage collection workers and middlemen. This plastic waste is largely additional to that collected by the middlemen, while the scrap iron may be included in the middlemen figures. These quantities have not been added to the recycling amount as the plastics quantity is small and to avoid any possible double counting of scrap metal.

2.1.4.3 Collection and Disposal Quantities

Current disposal quantities have been determined from GMC records of the number of vehicle trips to the disposal site during January and July 2002 and a JICA survey over a continuous seven day period from 8-14 August 2002. This data has been converted to tonnes, as shown below, using measured vehicle capacities (m^3), filling factors based on JICA survey data and typical density data.

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

Vehicle	Volume (m^3)	Density (kg/m^3)	Fill factor (%)	Tonnage (T)
Handcart (2)	Gampaha: 0.39 Yakkala: 0.54	246	95	0.091 0.125
2WT (3)	3.01 (2.81-3.33)	246	82.5 (80-85)	0.61 (0.57-0.68)
4WT Trailer (4)	5.92 (5.26-6.32)	246	92 (75-100)	1.33 (1.13 – 1.51)
Hospital trailer (1)	5.77	246	50	0.71

Notes:
1. Actual vehicle dimensions are given in the supporting report.
2. The number of vehicles measured in each category is shown in the first column in brackets.
3. Volumes, fill factors and tonnages are given as average (range).
4. GMC conversion factors: Handcart = 0.25T/load, 2WT = 0.75T/load, 4WT = 2.5T/load
5. Density data: $246kg/m^3$ for GMC trailers, based on JICA survey data for GMC collection vehicles[6] ($150kg/m^3$), an in-situ waste density of $390kg/m^3$ for a large four wheel tractor trailer ($6.3m^3$), measured by weighbridge in Colombo in Jul-Aug 2002 and comparative data from other study towns.

The current GMC collection quantity of 9.6T/d was estimated from the GMA disposal amount (8.4T/d), allowing for an additional 1.2T/d[7] which is collected but disposed of by burning on-site at the Yakkala Pola transfer station, rather than taken to final disposal, and the small amount of recycling that occurs during collection (0.04T/d). This collection amount corresponds to an overall MSW service coverage of 18%[8].

The difference between the amount of waste discharged for collection and the amount actually collected is 1.35T/d, equivalent to about one four wheel tractor loads/d. This amount is assumed to represent waste that is discharged for collection but never collected, or waste that is collected and then disposed of at places other than the official disposal site. It has been added to the illegal dumping amount.

[6] The JICA survey result represents the average density of composite samples of garbage extracted from different collection vehicles daily over a four day period.
[7] Waste discharged at Yakkala Pola transfer station = 2 x 2WT loads/d @ 0.61T/load + 3.5 (3-4) handcarts/d @ 0.125T/load + Sunday Pola waste of (1.30T/d)/7days = 1.85T/d, of which 70% of the 2WT/handcart waste is assumed to be burnt on-site rather than taken to the final disposal site.
[8] Collected garbage/(generated garbage - direct hauled garbage) within GMA; i.e. 9.6/(53.6-0.2)x100%

2.1.5 Waste Stream

Waste stream data for Gampaha is presented below.

Table 2-7: Waste Stream Breakdown (2002)

Source	On-site disposal	On-site Compost	Dis-charge	Recy-cling	Illegal Dumping	Direct Haulage	Gene-ration
Household	17.75	0.69	4.94	0.78	2.26	0.00	26.42
Commercial	0.59	0.00	2.44	1.32	0.00	0.19	4.54
Markets	0.13	0.00	0.78	0.01	0.00	0.00	0.92
Institutions:							
- Schools	1.15	0.01	1.15	0.01	0.01	0.00	2.32
- Other Education	1.88	0.00	0.42	0.00	0.00	0.00	2.30
- WAAV	1.36	0.00	0.00	0.00	0.00	0.00	1.36
- Hospitals	0.49	0.00	0.31	0.05	0.00	0.01	0.86
- Govt offices	0.07	0.00	0.17	0.00	0.00	0.00	0.25
- Religious	0.06	0.00	0.06	0.00	0.00	0.00	0.12
Industries:							
- Garment factories	0.14	0.00	0.21	0.20	0.00	0.00	0.55
- Coconut Mills	3.38	0.00	0.18	2.84	0.72	0.00	7.11
- Sawmills	0.83	0.00	0.00	4.33	0.00	0.00	5.56
- Other	1.09	0.00	0.10	0.22	0.00	0.00	1.41
Other:							
- Parks	0.05	0.00	0.05	0.00	0.00	0.00	0.11
- Roads/drains	0.14	0.00	0.14	0.00	0.00	0.00	0.28
Sub-total	29.10	0.70	10.95	9.76	2.99	0.20	53.70
Collection							
Recycling at discharge			-0.00	+0.00			
Recycling during collection			-0.04	+0.04			
Adjust to account for actual collection			-1.35		+1.35		
Adjusted sub-totals	29.06	0.70	9.56	9.80	4.33	0.20	53.70
Disposal							
On-site disposal at Yakkala Transfer Station (burning)	+1.16		-1.16				
Recycling at disposal			-0.00	+0.00			
Recycling at illegal dumping sites				+0.05	-0.05		
Total	30.26	0.70	8.40	9.85	4.28	0.20	53.70
%	56.4	1.3	15.6	18.3	8.0	0.4	100.0

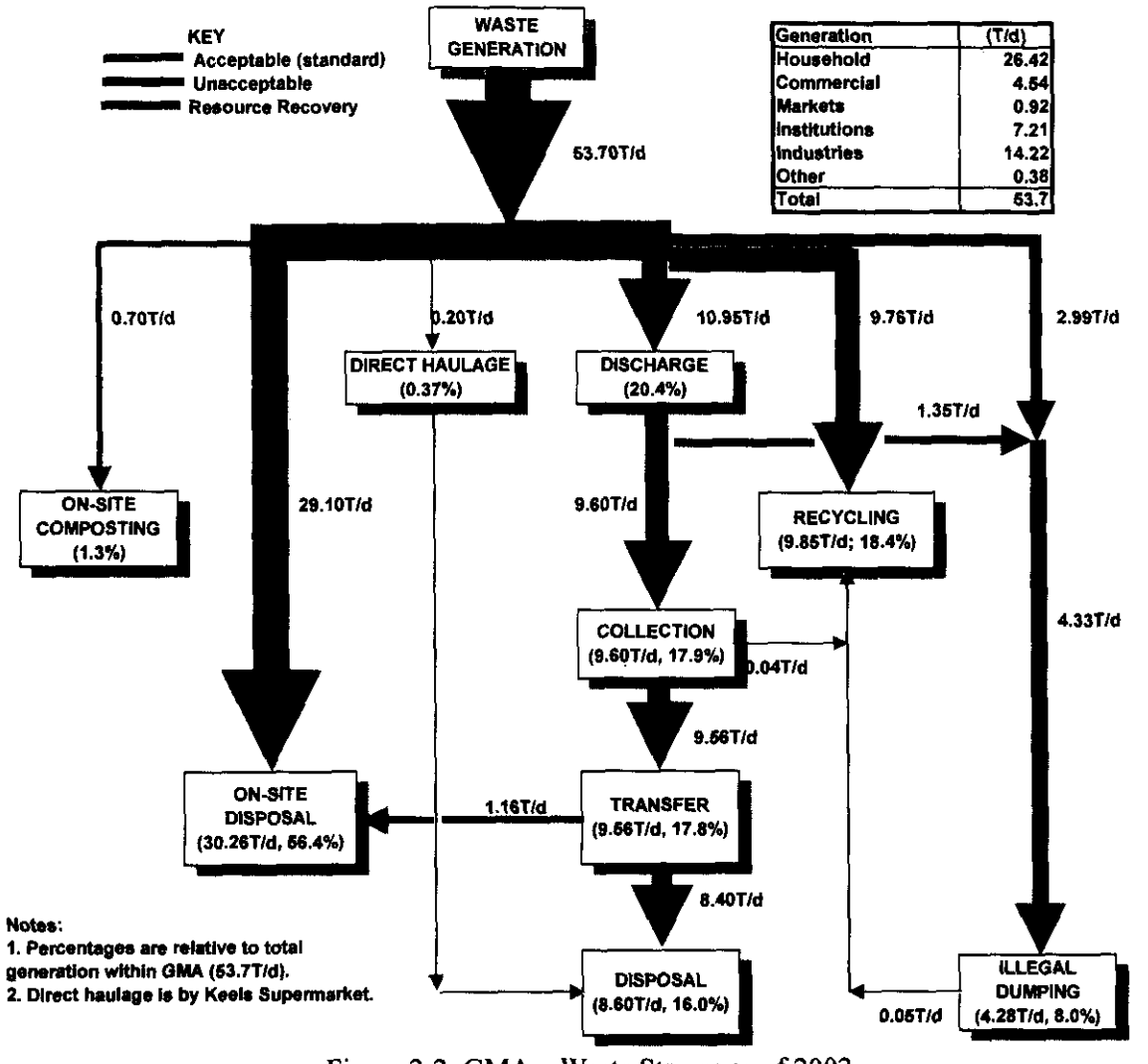


Figure 2-2: GMA – Waste Stream as of 2002

The waste stream shows us:

- Most waste is currently disposed of on-site (30T/d, 56%), mainly due to many of the newly attached areas not receiving a garbage collection service. This is appropriate in many parts of Gampaha (e.g. houses with large premises, institutions) and should be encouraged.
- 11T/d (20%) is currently discharged for collection by GMC, which is relatively small. As Gampaha becomes more urbanized and especially if GMC provides garbage collection services to any newly added areas, the amount of waste to disposal can be expected to increase significantly, resulting in significant increases in GMC's SWM costs. Hence, careful thought needs to be given to expanding SWM collection services.
- Illegal dumping is relatively common (4.3T/d, 8%). This should be eliminated in the future.
- Resource recovery, mainly via recycling (9.9T/d, 18%) is very significant, particularly of industrial waste. Both recycling and on-site composting should be promoted further in the future.

2.1.6 Waste Physical Composition

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

- The amount of organic materials that can be composted is about 6.1T/d (72% of waste), excluding paper.
- Higher value recyclables (glass, hard plastic and metal) account for only 3.0% of the waste to disposal (0.0-0.1T/d), indicating almost all of these items are already being recycled.
- Lower value recyclables (paper, textiles, soft plastic) account for 22.3% of the waste to disposal with both soft plastic and paper being present in reasonable quantities (0.6-1.2T/d), indicating the recycling rates of these items are lower. 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.
- The measured waste bulk density is very light, only 0.15 kg/L, this being attributed partly to drying of waste during transfer.

Table 2-8: Amounts of Waste to Disposal

Survey items	Category	Value	Amount (T/d)
Physical composition (wet base)	Kitchen	57.3%	4.9
	Grass & wood	15.2%	1.3
	Paper	14.3%	1.2
	Textile	1.5%	0.1
	Soft plastic	6.5%	0.6
	Hard plastic	1.2%	0.1
	Leather & rubber	0.4%	0.0
	Metal	0.5%	0.0
	Glass	1.3%	0.1
	Ceramic & stone	1.2%	0.1
	Others	0.6%	0.1
	Total	100.0%	8.6
Bulk density		0.15 kg/litre	

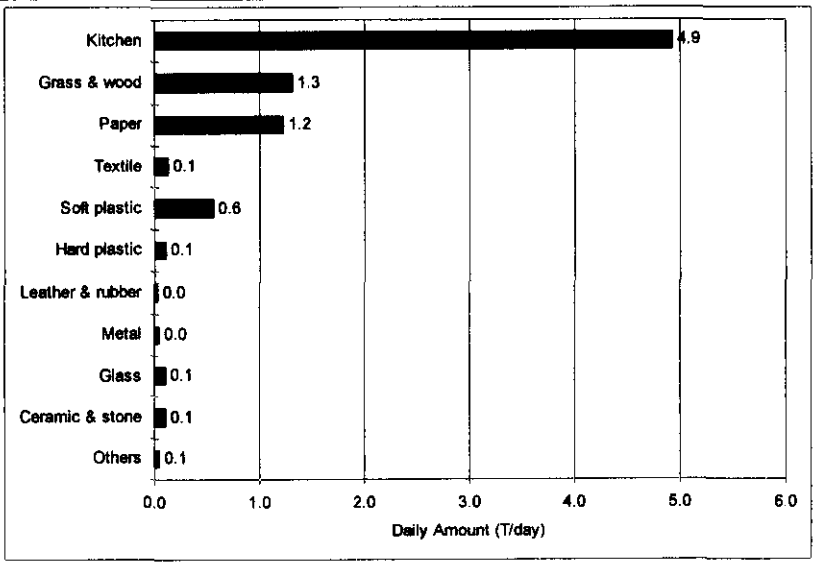


Figure 2-3: Daily Amount to Disposal (2002)

2.2 GMC Waste Management Institutional Setting

The Health Department of GMC is responsible for waste management within GMA. Specific responsibilities include:

- Collection of MSW within GMA, including the planning of collection routes and daily scheduling of garbage collection vehicles.
- Transportation of the collected MSW to the final disposal site.
- Operation and management of the existing final disposal site at Henegama.
- Cleaning and garbage removal from the Gampaha public market and Yakkala Pola.
- Septic tank and toilet emptying services.
- Street and drain/canal cleaning[9].
- 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.

2.2.1 Organisational Structure

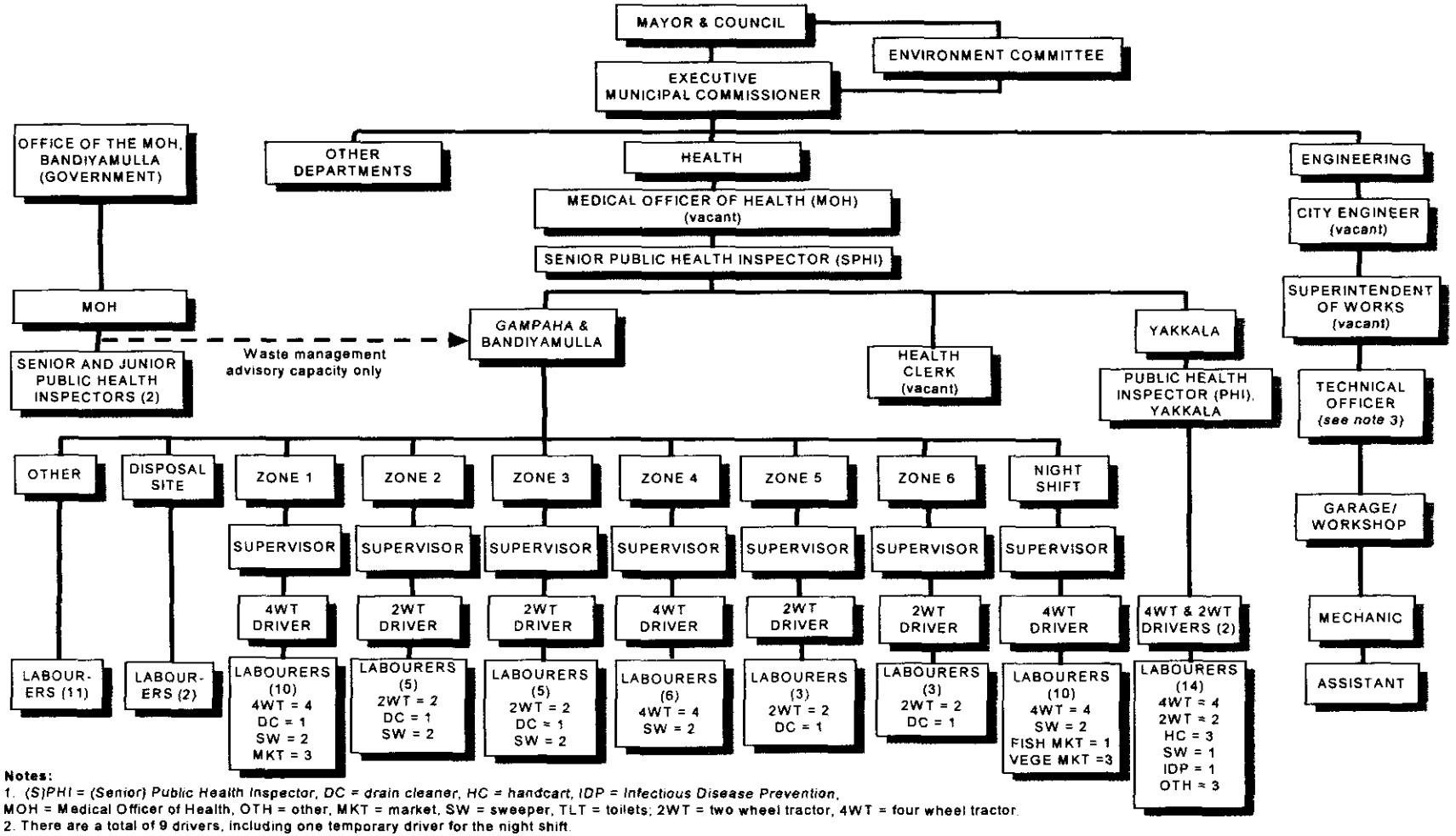
GMA was only created in April 2002, when Gampaha Urban Council was made into Gampaha Municipal Council, incorporating the three areas of Gampaha, Bandiyamulla and Yakkala.

The current waste management organizational structure (as of August 2002) is shown in the following figure. GMA is divided into three Public Health Inspector (PHI) Zones - Gampaha town (GMC Office), Yakkala (Yakkala Sub-office) and Bandiyamulla (Medical Officer of Health (MOH) office), with waste management activities being organised based on seven zones – six covering Gampaha and Bandiyamulla and one for Yakkala.

The GMC MOH position is currently vacant. Hence, the GMC Senior Public Health Inspector (SPHI) has overall responsibility for all of GMC's waste management activities, including SWM. He also has specific responsibility for waste management in the Gampaha and Bandiyamulla areas. The Bandiyamulla MOH Office (government office), through the MOH, Senior and Junior PHIs there, acts in an advisory capacity only on waste management issues in this area.

The Yakkala PHI is largely responsible for waste management activities in the Yakkala area. He has only been assigned to this work since 1 August 2002. Between April – August 2002, the Revenue officer at the GMC Yakkala Sub-office "looked after" waste management activities in this area.

[9] Drain and street cleaning comes under Infectious Disease Prevention (IDP) Services.



Notes:
1. *(S)PHI = (Senior) Public Health Inspector, DC = drain cleaner, HC = handcart, IDP = Infectious Disease Prevention,*
MOH = Medical Officer of Health, OTH = other, MKT = market, SW = sweeper, TLT = toilets; 2WT = two wheel tractor, 4WT = four wheel tractor.
2. There are a total of 9 drivers, including one temporary driver for the night shift.
3. GMC currently has two technical officers due to the City Engineer and Superintendant of Works positions being vacant, one of whom is responsible for the garage/workshop.
4. The Yakkala PHI comes under the MOH, Bandiyamulla and the SPHI.

Figure 2-4: GMC Waste Management Organisational Chart

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

Area	PHI	Supervisors	Drivers	Labourers		Collection Points		Hand-carts	Vehicles	Public Toilets
				Duties	Total	Perm	Temp			
Zone 1	Gampaha SPHI	1 (also does Z4)	1	4 Tr, 2 Sw, 1 DC, 3 mkt	10	0	0	2	4WT	3
Zone 2	(Bandiyamulla MOH Office acts in advisory capacity only for Bandiyamulla area)	1	1	2 Tr, 2 Sw, 1 DC	5	0	0	0	2WT	1
Zone 3		1	1	2 Tr, 2 Sw, 1 DC	5	1	7	0	2WT	0
Zone 4		1	1	4 Tr, 2 Sw	6	1 (TS)	0	0	4WT	1
Zone 5		1	1	2 Tr, 1 DC	3	0	13	0	2WT	0
Zone 6		1	1	2 Tr, 1 DC	3	0	4	0	2WT	0
Night shift (Zone 1 + parts of zones 2-4)			1 (temp)	4 Tr, 2 Sw, 1 fish mkt, 3 vege mkt	10	Included in other zones	Included in other zones	1	4WT + trailer in front of market	Included in other zones
Yakkala	Yakkala PHI	0	2 (both labrs)	6 Trs, 3 HC, 1 Sw, 1 IDP, 3 other	16 (incl 2 drs)	1 (Pola TS)	2	1	1 4WT, 1 2WT, 1 WB	1
Disposal site	Gamp SPHI	0	N/a		2	N/a	N/a	0	0	N/a
Other	Gamp SPHI	0	N/a	See note 2	11	N/a	N/a	0	1 GB	N/a
GMC Total	2	5	7 (excl 2 labrs)		71	3	26	3	4 4WT, 5 2WT, 1 GB, 1 WB	6
Cadre	2	4	7		85					

Notes:

1. (S)PHI = (Senior) Public Health Inspector, DC = drain cleaner, GB = gully bowser, IDP = infectious disease prevention (mainly oil/pesticide spraying), mkt = market, MOH = Medical Officer of Health, Sw = sweeper, Tr = tractor labourers, TS = transfer station., WB = wheelbarrow, 2WT = two wheel tractor, 4WT = four wheel tractor.
2. Zone 1 Supervisor also covers zone 4.
3. Others: cleaning Orutota Rd public toilets (2), office labourers/peons (2), cleaning of vegetable market, fire brigade, community hall and pre-school toilets (included under vege market), Ja Ela bus stand (2), Colombo Rd bus stand (1), stopping pavement fish sellers (1), drain cleaners (4), IDP pesticide spraying (1) (total = 13 but only 11 deployed on any one day). In Yakkala, other = toilets/pola cleaning (1), Mirriswatta cleaning (1).
4. Public toilets: Zone 1: 2 at market (1 each in fish and vegetable sections), 1 at Colombo Rd bus stand; Zone 2: 1 at Ja Ela bus stand; Zone 4: 1 at library; 1 in Yakkala.
5. Handcarts are used in the public market (1), Siri Kurasa/Market Sts (1), Yakkala town (1), with one on standby.

In Gampaha/Bandiyamulla, there are five Supervisors at the next organisational level, each responsible for different areas of Gampaha/Bandiyamulla, as set out in the following table. Yakkala does not have this organisational level, with the Yakkala PHI undertaking this supervisory role directly. Beneath them, there are seven drivers and 71 labourers (two of whom are drivers in Yakkala) assigned to different areas and tasks. There should also be one health clerk but this position is currently vacant.

GMC's allocated cadre for labourers is 85 (70 for Gampaha/Bandiyamulla and 15 for Yakkala).

The Environment Committee serves as an advisory committee to the Council, dealing with all health issues, including SWM. It comprises a wide range of GMC staff including the Municipal Commissioner, Secretary, SPHI, Community Development Officer, Environment Officer, heads of various GMC departments and three Council members. This committee meets approximately monthly and is relatively active.

2.2.2 Waste Management Equipment

Current waste management vehicle fleet and supporting equipment details are summarized in the following table, together with vehicle lifetimes estimated by GMC staff.

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

Vehicles/ equipment	No	Use (Capacity)	Approx. Life (years)
Handcarts (0.39-0.54m^3)	4	3 - SWM collection, road and drain cleaning 1 – standby	3
Two wheel tractor (2WT) (2.8-3.3m^3)	6	5 – SWM 1 – out of service	15-20
Four wheel tractors (4WT)	5	4 - SWM 1 – gully bowser	15-20
4WT Trailers (5.3-6.3m^3)	6	4 – SWM; 2 – out of service	8-10
Gully bowser	1	Septic tank/public toilets emptying (4m^3)	10-12

Note: A backhoe is hired approximately monthly at a cost of 925Rs/m.h for digging trenches for the disposal of garbage at the final disposal site.

2.2.3 *GMC Waste Management Services Labour Force and Equipment*

2.2.3.1 SWM (Garbage) Collection

GMC's collection labour force and equipment comprises:

- One wheelbarrow, three handcarts, five two wheel tractors (2WTs), four four wheel tractors (4WTs) and four associated trailers.
- Five Supervisors, seven drivers, and 71 labourers (including two drivers); of whom 61 are permanent and 10 casual staff and 52 are tamil, 16 sinhalese and one mixed (excluding two drivers) [10].

Garbage collection crew and labourer equipment details are summarised below.

Table 2-11: Vehicle Labourer and Equipment Details

[10] Gampaha = 51 permanent + 4 casual (total pool of 20 casual workers to draw from), Yakkala = 10 permanent + 6 casual (as at Oct 2002). Gampaha = 40 sinhala and 15 tamil; Yakkala = 12 sinhala, 1 tamil and 1 mixed.

Vehicle	Labourers	Equipment
Handcart	2-3	Ekel broom, small basket
2WT	2	Gampaha: 2 small baskets, 1 fork (sometimes), 1 ekel broom; Yakkala: ekel broom, rake
4WT	4	Fork (sometimes), ekel broom, 1-2 large baskets, 2-4 small baskets
Sweeper	Not applicable	Ekel broom
Drain cleaner	Not applicable	Big basket, mamoti, brush

Note: Labourers are not normally issued with gloves and boots, other than for drain cleaning. However, these are available as standby equipment, together with raincoats, for issue on rainy days. Only older labourers have uniforms, with no uniforms having been issued to labourers for at least one year. However, the SPHI said that some aprons have recently been ordered for labourer use.

2.2.3.2 Gampaha Public Market and Yakkala Pola

Garbage collection and cleaning of the Gampaha Public Market and Yakkala Pola is administered by the Health Department. Gampaha public market is cleaned by three labourers during the day and four labourers at night, when the fish section is washed down. During the day, waste is taken by handcart to the transfer station near GMC, while at night-time it is placed into a stationary trailer, parked overnight near the market, with this being collected the following morning and taken for disposal.

The Yakkala Pola, held on Sundays, is usually cleaned by two, sometimes three, GMC labourers on Monday and Tuesday following the Pola.

2.2.3.3 IDP, Road and Drain Cleaning

Two labourers are assigned to IDP duties, one each in Gampaha/Bandiyamulla and Yakkala, involving spraying pesticides/oil for mosquito control.

Road and drain/canal cleaning are normally undertaken by 16 designated street sweepers and drain cleaners in the Gampaha/Bandiyamulla areas, sometimes working in association with a handcart. However, labourer absenteeism usually results in the actual number of road sweepers and drain cleaners being much less than this, as labourers are usually only assigned to sweeping/drain cleaning, if sufficient labourers have come to work to undertake other specified duties. For example, Zone 3 typically has two sweepers for only two days/week and a drain cleaner for three days/wk; Zone 5 generally only has a sweeper and drain cleaner for one day/wk, while Zone 6 has two sweepers and a drain cleaner only for two days/wk, instead of each zone having five of these workers assigned to them daily (excluding Sundays). This means these zones have an average of 15 (50%) actual sweeping/drain cleaning working days/wk, compared with an allocated 30 working days.

In Yakkala, one sweeper is assigned to the Yakkala town area and one cleaner to Mirrriswatta town. Additional road/drain cleaning is undertaken by handcart labourers (Yakkala town area) and four wheel tractor labourers (Mirrriswatta area).

2.2.3.4 Septic Tank and Toilet Emptying Services

These services include:

- The management and maintenance of public toilets.

- The provision of gully bowser services within the city and to some areas outside the city on request.

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

- Six public toilets.
- One gully bowser and one four wheel tractor (for towing this bowser).
- Approximately three labourers, covering toilet cleaning and gully bowser duties. There are also two market labourers who clean some toilets as part of their duties.

Gully bowser waste is disposed of to two places: Henegama (trips from Gampaha) and Nelligohamula (trips from Yakkala).

2.2.4 SWM Costs

GMC's 2002 budget costs, tabulated below, show that 27% of GMC's budgeted expenditure was allocated to SWM. This is mainly due to the high number of GMC employees engaged in SWM works (37% of total). These results are on the high side compared with other study towns, with SWM expenditure accounting for an average of 22.0% (range = 13-35%) of local authority budgeted expenditure and SWM workers an average of 29% (range = 22-37%) of all Council workers, by cadre.

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

Item	SWM	GMC Total	SWM as % of Total
Budget Expenditure (million Rs)	10,010	36,791	27.2
GMC Employees (by cadre)	72	195	36.9

2.2.5 Waste Collection/Disposal Fees

2.2.5.1 SWM Collection/Disposal Fees

No waste generators currently pay official fees for garbage collection or disposal, nor does GMC have any set fees for separate garden waste collection.

Gully sucker revenue during 2001 amounted to 86,250Rs, ranging from 0 – 21,000 Rs/mth.

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

- 9 (6%) of 150 households surveyed pay an average of 51Rs/yr "small allowance" or 50Rs/yr "reward".
- 13 (22%) of 60 commercial/industrial and institutional places surveyed pay an average of 1,485Rs/yr (range = 50 (small shop) to 7,200Rs/yr (garment factory)).

2.2.6 SWM Bylaws

Standard Sri Lankan SWM by-laws are in place. By-law enforcement is poor with many people following illegal practices.

2.2.7 GMC Workshop

The mechanical workshop is responsible for the maintenance and repair of GMC's vehicle fleet, which includes 11 waste management vehicles. The workshop is managed by the Technical Officer. It

employs one mechanic and one assistant. Workshop equipment comprises only electric welding plant and small spare parts (e.g. fan belt, nails, etc.).

The approval system for procurement of spare parts varies according to the repair cost:

- For spare parts up to 500Rs, the Technical Officer can give direct approval.
- For all spare parts over 500Rs, the Municipal Commissioner must give direct approval, with spare parts then being ordered via a formal procedure, which involves obtaining quotes from a number of suppliers.

Quotations/tenders are sought from the private sector for repairs that are beyond the capacity of their workshop, according to the value of the works. The approval process for such works is as follows:

- For repairs up to 50,000Rs, the Municipal Commissioner can give direct approval, although typically the Commissioner refers such requests to the Financial Committee for approval, or if they involve tendering, to the Tender Committee.
- For repairs up to 100,000Rs, the Mayor can give direct approval, although again such requests are typically referred to either the Financial or Tender Committee, as appropriate.

These procedures result in long delays while repairs are undertaken, especially for spare parts over 500Rs and repairs beyond the workshop's capacity.

GMC estimate that about 80% of the total workshop budget of 438,000Rs is spent on the maintenance of SWM vehicles.

2.3 SWM Status

2.3.1 Discharge, Collection and Transportation

2.3.1.1 SWM Collection Zones

The city is divided into seven zones for SWM purposes. Field investigations and discussions with GMC staff found that the GMC garbage collection service (population basis) covers 55-80% of Gampaha and Bandiyamulla and 25-50% of Yakkala, which gives an overall service coverage of 49%.

2.3.1.2 GMC SWM Discharge System

Most waste generators using the GMC collection service discharge their mixed garbage by one of the following methods:

- At the roadside, there being a minimum of 26 temporary collection points of this nature, as well as a large number of small piles of garbage along many roads simply placed outside peoples' houses. This is by far the most common method of waste discharge.
- Directly to a permanent collection point (concrete bin), there being only one of these in Gampaha (near Gothami College) plus a reasonable number in Yakkala.

Often the garbage is discharged directly onto the ground, although some residents do use plastic bags, buckets or dustbins. A small number of residents and some commercial enterprises give their garbage directly to the collection vehicle (e.g. parts of Zones 5 and 6), while some commercial/industrial enterprises and institutions have their garbage collected directly from their premises. Further details are given in the supporting report.

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

Large amounts of garden waste are produced in GMA, which is often discharged illegally at the roadside, or near garbage collection points, or in other public places for collection by GMC. Usually, garden waste is burnt at such places, while building waste is also commonly present. Many drains are also full of or blocked with garbage, creating nuisance and health problems.

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

2.3.1.3 GMC SWM Collection System

a. Collection System

Garbage is collected from these informal and formal collection points and directly from the discharger as set out in the supporting report. The collection frequency ranges from:

- Twice daily - Gampaha commercial area: zone 1 and parts of zones 2, 3 and 4.
- Daily - most of zones 2, 3, 4 and 5 and along the main roads in zones 6 and in Yakkala.
- Alternate days – e.g. many areas in zone 6.
- Once-twice weekly – e.g. many of the newly added areas, including all areas in Yakkala serviced by a two wheel tractor.

Primary collection is by:

- Handcart, at the public market and along Siri Kurasa/Market St in Gampaha (two handcarts) and in Yakkala town (one handcart).
- Two wheel tractor in zones 2, 3, 5, 6 and some mainly residential areas of Yakkala.
- Four wheel tractor in zone 4, most of zone 1 and along the main roads in Yakkala during the day and in the Gampaha commercial area at night (zones 1 and parts of zones 2, 3 and 4).

In Gampaha, the two handcarts and two wheel tractors discharge their loads manually at the GMC transfer station, next to the GMC Office, usually in the morning, while at night-time, handcart waste is discharged directly to a stationary trailer parked near the market. Four wheel tractors transport their loads directly to the final disposal site at Henegama. After completing one load, one or both of the four wheel tractors will go to the transfer station, arriving there generally after 1pm. Deposited garbage is

then loaded manually into the tractor trailers by a team of up to 10 labourers and then transported to the Henegama disposal site. Typically, it takes four labourers about one hour to fully load a trailer.

In Yakkala, the handcart and two wheel tractor discharge their loads manually to the transfer station at the Yakkala Pola grounds, while market waste from the Sunday Pola is discharged directly to the transfer station. Usually about 70% of tractor/handcart waste is burnt here, with Pola and residual waste being taken to the Henegema disposal site by four wheel tractor.

Time and motion studies undertaken by JICA in August 2002 found that the Yakkala two wheel tractor took 2h12min to complete one collection round, including 18min manual unloading time, while a Gampaha four wheel tractor took 3h42min to complete one round, including 75min travel time to and from the disposal site. Loading made up 49-55% of total round time, which is significant.

b. GMC Collection Vehicle Unit Costs

GMC collection vehicle unit costs were calculated for handcarts and tractors using actual cost data supplied by GMC, supplemented by information from other sources where necessary. These costs are illustrated below (details in supporting report).

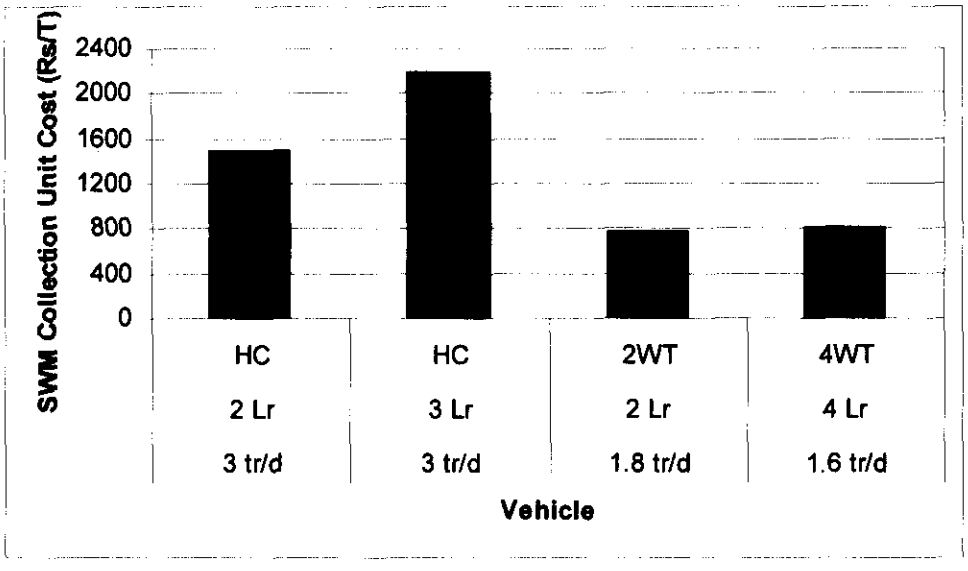


Figure 2-5: GMC Garbage Collection Vehicles – Current Unit Costs (2002)

This data shows:

- Handcarts are by far the most expensive means of collecting garbage, with unit costs of 1,482-2,185Rs/T with 2-3 labourers doing three trips per day.
- Both two wheel (764Rs/T and four wheel (799Rs/T) tractor unit costs are considered high, primarily due to the low number of trips completed each day (1.8 and 1.6 respectively).

c. Assessment

The present garbage collection system involves a lot of wasted effort. Garbage collection labourers spend a lot of time loading garbage discharged on the ground into vehicles. Two wheel tractors undertake ~58% of primary collection, whilst handcarts contribute another 11%, meaning ~69% of

collected waste is double handled, being manually loaded, then unloaded and loaded again at transfer stations, before being taken for final disposal.

Another major problem is that the collection vehicles are getting old (average age: two wheel tractor = 9.3yrs, four wheel tractor = 10.8yrs, trailer = 9.0yrs) and often breakdown., while repairs take a long time.

The high costs indicate there is considerable potential for reducing handcart and tractor unit costs by decreasing the number of labourers, increasing the number of daily trips and improving the collection efficiency.

2.3.2 Processing and Treatment

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

2.3.3 Final Disposal

The current disposal site at Henegema[11] is a coconut plantation on private land. GMC originally used this for landfilling from January 2000 – July 2002. During this time, they used a JCB excavator to periodically dig trenches, which were then filled with waste and covered with soil manually. This was the best example of landfilling practice observed in the seven study towns.

However, in July 2002, the plantation owner requested GMC to stop disposal, as the coconut plantation had received enough waste as fertilizer for the coconuts. GMC subsequently shifted to another site, but only discharged waste there for a short period before the landowner requested them to stop filling, due to the associated nuisance (flies, odour, etc.). They have now moved back to the Henegama coconut plantation but are currently simply discharging waste on to the ground in areas which have previously been filled without applying soil cover.

This is causing some negative impacts on nearby village people and plantation workers, including odour, flies, other pests and crows.

[11] Garbage from Yakkala used to be taken to a low lying, marshy site at Weeragula for disposal. This site was used for about three years, with soil cover being applied approximately weekly. Dumping at this site stopped in April 2002 following public protests and due to Yakkala becoming part of GMC.

2.4 Resource Recovery

There are a wide range of resource recovery initiatives in Gampaha, as summarised below.

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

Item	Comments
Reuse	Many shops and micro-enterprises selling items for re-use (e.g. shoes, bicycles, umbrellas, paper bags, etc.).
Recycling at source	Common. 81% of households are visited by someone to collect/buy their reusable/recyclable materials, while 21% of households take some reusable/recyclable items to shops for refund/sale.
Recycling by SWM Labourers	23% of GMC workers involved; collect 43kg/d of glass bottles and metal; earn "tea money" (69 Rs/labourer.mth).
Middlemen (including National Paper Corporation agent)	Interview surveys held with 6 middlemen shops, found: Established businesses: all but one in operation for 3yrs; four over 10yrs old. Creating jobs: employ at least 21 people. Recycling wastes: 5.7T/d, 48% from within GMA (2.8T/d). Generating income: purchases of 2.79M Rs/mth; sales of 3.32M Rs/mth. Mainly buy high value recyclables: clean paper, glass bottles, sacks and plastic containers for reuse; metals, broken glass and battery cases for recycling. Main problems: shortage of recyclables > utilities > high land/building rental costs.
Home composting	GMC has distributed at least 170 home compost barrels for free to residents requesting them since 1999 and five barrels to each of seven schools in Dec 2001-Jan 2002. The MOH, Bandiyamulla, has distributed concrete compost barrels to four schools in June 2002. Gampaha Pradeshiya Sabha also sold some compost bins to residents in Chandanegana, Yakkala in August 2002 (now part of GMA). The effectiveness of these programmes is not known, although residents are continuing to request compost bins from GMC.
Food/kitchen waste for animal feed	Relatively common throughout GMA. Examples include the Green Garden Hotel (900kg/mth) and garment factories (2,240kg/mth).
Super Plastics	Located on Kandy Rd, Yakkala, has been in operation for 5yrs and employs 16 workers. It recycles about 20T/mth of plastic and polythene wastes into pellets and other products (broom parts, gully trap covers, antenna parts, etc.). Most waste plastics obtained from industry (75%), Katunayake arport (15%), commercial (5%) and hospital (5%) sources, with 95% of their materials coming from outside GMA. Main problems = obtaining credit > utilities costs > high land/building rental costs > shortage of recyclables.
Super Steel Industries	Located on Kandy Rd, Yakkala, has been in operation for 15yrs and employs 16 workers. It recycles about 12T/mth of ferrous scrap metal into a wide range of vehicle parts. Metal scrap comes mainly from commercial (95%) places and households (5%), with 40% of these materials coming from within GMA. Main problems = obtaining credit > utilities problems > high land/building rental costs > high transportation costs.
St Jude Industries	Coir processing.
Dessicated Coconut Mills	Recycle most of their waste coconuts, with one mill making charcoal from some of its waste coconuts.

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 Results

A public opinion survey was conducted in the second half of August 2002 within GMA in order to prepare a basic socio-economic profile of Gampaha's residents and to gain an appreciation of public attitudes towards the current provision of SWM services, desired improvements to those services and their willingness to pay for improved services. The survey covered 150 households, comprising fifty households from three high income (Werellawatta, Gajaba Rd and Kalagedihena), two middle income (Keenagahalanda Watta, Pahalagama) and two low income (Suhada Mw, Indigolla) areas. Of these

seven areas, Werellawatta, Kalagedihena, Keenagahalanda watta and Indigolla are newly attached areas to GMA.

96% of the surveyed population are Sinhalese and 4% Tamil. Data on the average number of people per household and monthly income is set out below.

Table 2-14: General Household Data

Item	Low income	Middle income	High income	Overall
Average number of people per household[12]	4.6	4.2	4.4	4.4
Average monthly household income (Rs/household)	5,484	10,114	21,334	
Average monthly income (Rs/person)	1,182	2,385	4,871	

Key survey results related to SWM are summarised here:

- Only 98 (65%) surveyed households live in areas where there is a GMC garbage collection service, of whom 54 (36%) stated they use this service[13]. 47 (50%) of households in newly attached area have never had a garbage collection service (some parts of Werellawatta, Gajaba Rd. and all of Indigolla).
- Only 20 (13%) households are very satisfied with the present garbage collection service, while 20 (24%) are somewhat satisfied. The overall satisfaction rate is about average compared with other study towns.

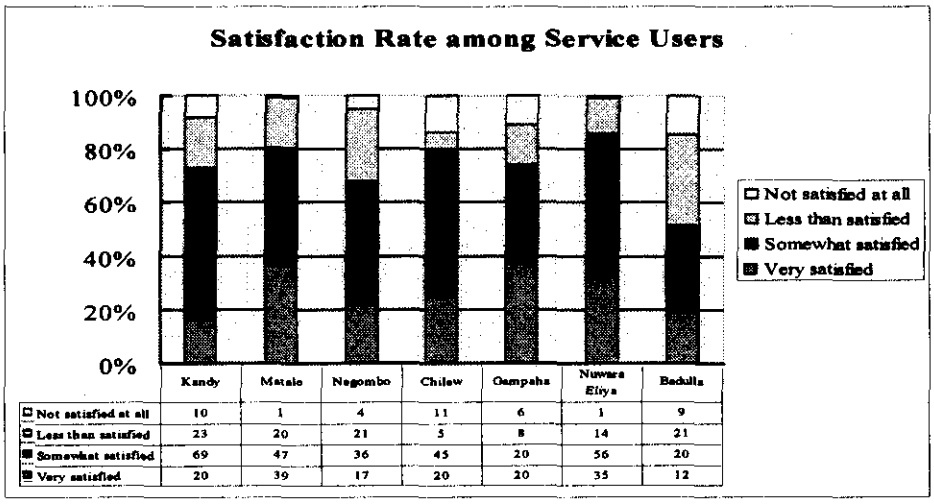


Figure 2-6: Waste Collection Service Users' Satisfaction Rate

- Around 97 (65%) households dispose of their waste by on-site burning or burial, while only 44 (29%) use the GMC collection service, 16 (11%) carrying their garbage to a specified collection point, while 28 (19%) discharge their garbage for house-to-house collection.

[12] Household members mean those who live together in one household and share the living expenses, and doesn't necessarily mean family members.
[13] Does not quite tally with "main waste discharge" method data, due to some people saying they use the NMC service but then later saying they open dump their waste outside their premises.

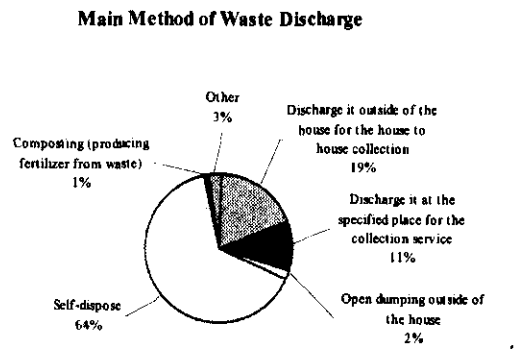


Figure 2-7: Common Waste Discharge Methods

- As for the GMC garbage collection frequency, 25 (17%) only receive a garbage collection service once per week, two receive it 2-3 times per week, seven (6%) more than four times per week, and 17 (11%) daily. This contrasts with people's discharge behavior, as 42 households (77% of 44 households using the GMC service) discharge their wastes as soon as they are generated or daily. The discrepancy between these figures explains the large amount of discarded waste present on many streets within Gampaha.

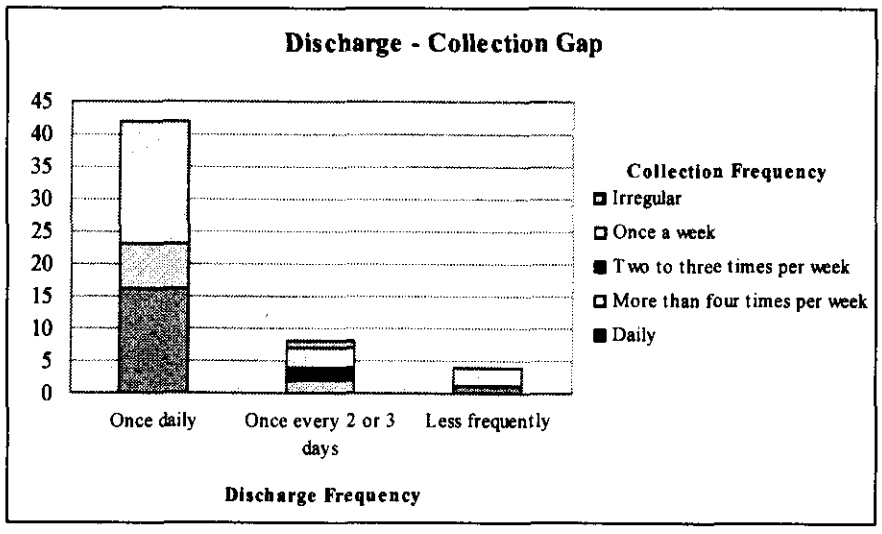


Figure 2-8: Common Waste Discharge Methods

- In general, adult female members handle waste in 89% of surveyed households.
- Almost 90% of surveyed households are very much or somewhat willing to cooperate with source separation for recycling. However, about 122 (81%) households are called on by someone who comes to collect their reusable or recyclable materials (mainly glass and paper, especially newspapers), showing that an informal recycling system is already very active. Surprisingly, 49 of these 122 households do not sell any recyclables to the household collectors.

- Only 35 households (23%) have ever discussed proper garbage discharge methods at the community level.
- More than 95% of surveyed households appreciate the necessity for SWM awareness programmes.
- The average WTP (willingness to pay) for improved SWM is 66Rs/month per household.

2.5.1.2 Findings from Focus Group Discussion

A focus group discussion was held to obtain a deeper appreciation of public attitudes to SWM service provision in September 2002 in the Suhada Mw area. This discussion revealed several problems faced by this community, namely the low frequency of the garbage collection service, the insufficient number of public collection bins and the bad condition of the drainage system. Suggested counter-measures included increasing the number of collection workers, constructing more bins and cleaning up the drainage system more often by municipal labourers but not any community-based measures such as Shramadana. As for the discharge frequency, people consider it difficult to keep garbage, especially food wastes, for a few days within their premises. However, some participants suggested that they could do this if they use buckets with lids and the collection vehicle comes punctually.

These observations, together with the household survey results, reveal that though many people dispose of their wastes within their premises in GMA, quite a lot of people who use the municipal collection service discharge their wastes without following any particular rules, leading to frustrating in the community.

2.5.2 Commercial/Industrial and Institutional Survey Results

Key survey results for 60 commercial/industrial and institutional places located within the Gampaha, Yakkala and Mirrriswatta areas of GMA are summarized in this section:

- 43 (72%) enterprises are provided with a garbage collection service by GMC, with 41 (68%) of these using this service. 13 of the 17 enterprises not receiving a service would like one.
- 30 (73%) of the 41 enterprises using the garbage collection service are not satisfied with it. The main reasons for dissatisfaction are the garbage discharge system is poor (26), garbage collection/sweeping is too low in frequency (22), is not done properly (18), is irregular (17) or the collection point is too far away (17) or the collection time is too early or late (17). The Base Hospital is also concerned about the handling and disposal of hazardous healthcare waste.
- The five most desired improvements to garbage collection and disposal in descending order are an improved discharge system, public education, shorter distance to the collection point, more reliable service and greater recycling/composting.
- Nine (15%) supported the introduction of an individual garbage collection fee, while 33 (52%) enterprises indicated an average WTP of 755Rs/mth (range = 30 to 5,000Rs/mth).

- 60 (100%) enterprises believed recycling is necessary, with 47 (78%) enterprises being either very willing (45) or somewhat willing (2) to cooperate in separating their garbage at source, while five are doing this already.
- 13 (22%) enterprises are willing to undertake on-site composting, while two are doing so already. However, the majority (45, 75%) of enterprises are not in favour, mainly due to a lack of space on site (16) and it taking too much time (16).
- 60 (100%) enterprises consider a campaign to raise peoples' awareness for maintaining a cleaner city and environment is either somewhat necessary (59) or very necessary (1).
- The most common other comments relate to widespread support for recycling (13), a need for public education/awareness raising (11), improve the present SWM/cleaning system (4), give/build new permanent bins (3).

2.5.3 Attitudes of Cleansing Workers

2.5.3.1 Present GMC Cleansing Works Labour Force

As of September 2002, GMC had a total of 58 cleansing workers, made up of 51 permanent and seven casual labourers, of whom 74% are Sinhalese and 26% Tamil, while 81% are male. These workers are controlled by so-called "supervisors". In GMC, there are six supervisors categorized into two different types - one Health Assistant Supervisor (Saukiya Upaparipalaka) who acts as a chief supervisor, and five acting Overseers, who are registered as labourers.

2.5.3.2 Findings from the Cleansing Workers Survey

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

- 27% of the surveyed population is Tamil and 73% is Sinhalese.
- The average number of members per household is 4.9 persons.
- The average monthly income is 7,715Rs/household and 1,592Rs/person. This is higher than the average low income figures, but less than the average middle income figures found in the household public opinion survey.
- The average number of years of work is 11.7 years.
- Either the mother or father of 30% 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: Insufficient wage

  Third: Health problems

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

  Fifth: Vehicles often break down

Sixth: *Not enough tools for collection work*

Seventh: Heavier workload due to the improper discharge of waste by people

Among these issues, the 4th to 7th 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, unlike other LAs, only 24% of them talk to supervisors and minor supervisors. Most of them (17 workers) talk directly to the SPHI.

These findings illustrate that cleansing work in GMC is no longer dominated by Tamil labourers. This is similar to the situation in Negombo but very different to that in other LAs studied. It seems that the urban poor have been attracted to cleansing work regardless of their ethnicity. In addition, the close relationship between supervisors and workers observed in all other six study towns is not present in GMC, possibly due to most of the supervisors being political appointees and quite young, or due to them having insufficient supervising capability and hence being trusted by fewer workers.

2.5.4 Awareness Programmes and Environmental Education

Organisational rearrangements have not been completed yet since the upgrading of GMC from an Urban to Municipal Council in April 2002. Hence, there are still not many personnel working on health and environmental issues compared with other Municipal Councils.

2.5.4.1 GMC Involvement

GMC's community-based activities are mainly handled by one Community Development Officer (CDO) and one Divisional Environmental Officer (DEO), who look after environmental and community development programmes respectively.

The CDO has been working in Gampaha since June 1998. At present, various community-based activities are being organized through four Community Boards (Praja Mandala) in Pahalagama, Aluthgama, Titarapitigoda and Sookiriwatta that were established with the help of the CDO. The number of CBOs is going to be expanded soon to cover the new areas added to GMA. Some programmes, such as the distribution of compost barrels to selected communities have been jointly organized by the CDO and the DEO.

In addition to the community-based awareness programmes, the DEO, assigned to GMC by the Central Environmental Authority (CEA) in 2001, organizes school environmental education programmes described later. The DEO can also raise environmental issues at an "Environment, Human Health and City Cleaning Committee", formed within GMC and usually organized by the Municipal Secretary. For example, at this committee's meeting on 27 August 2002, participants discussed drainage problems, water pollution from two factories within GMA, the insufficient number of garbage collection drivers, etc.

Although GMC haven't undertaken a large variety of community-based activities yet, compared with other Municipal Councils due to limited personnel, the relevant officers (mainly PHIs, CDO, DEO) work closely together whenever necessary. They have also not done any activities with NGOs.

2.5.4.2 School Environmental Education Programme

Environmental education programmes have been developed by the CEA since its establishment in 1980. CEA has introduced two nationwide school programs, namely the "Environmental Pioneer Brigade (EPB)" program for secondary schools in 1984 and "Eco Clubs" for primary schools in 2001, with the DEO playing an active role in promoting these programmes.

The EPB programme is voluntary and involves organizing school children into groups of twenty-five. The activities of these groups are based on a five-tier badge system (pioneer, green, silver, gold and presidential). At present, 13 out of 18 schools in GMA have participated in EPB programmes, the most active schools being Bandaranayake National School and Yashodhara Girls' College, while Rathnawali Girls' School has implemented a compost project. Eco Clubs have been formed in five primary schools in the former Gampaha Urban Council Area[14].

The CEA has also appointed selected teachers as "Environmental Commissioners". The District Environmental Commissioner is stationed outside GMA, while a Deputy Environmental Commissioner is from Bandaranayake National College.

[14] Eco Clubs in schools in newly attached areas have not yet been completely reassigned to the DEO in GMC.

Chapter 3 Main Issues

3.1 Healthy Aspects

3.1.1 Good Performance by GMC in Some Areas

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

- Reasonable SWM "service coverage" for Gampaha and Bandiyamulla of 55-80%, but lower service coverage in other newly added areas.
- 74% of households using the garbage collection service are "somewhat" (37%) or "very satisfied" (37%) with it. This satisfaction rate is about average amongst the seven study towns.
- Promotion of home and school composting.
- Use of a transfer station to increase SWM transportation efficiency and reduce costs.
- Good landfilling practice up to July 2002 (but now poor).
- Active Environment committee and a new enthusiasm for SWM.

3.1.2 Waste Minimisation

Many waste minimisation initiatives are currently in operation within Gampaha, many of which are based on traditional values/approaches and represent important social capital. These include:

- "Aparade" is in common use, but requires promotion.
- 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, plastic containers and some paper/cardboard) are recovered via this system, leaving primarily low value recyclables in the garbage taken for final disposal.
- Home composting is small in scale but seems popular.
- National Paper Corporation collection centre near Gampaha town.
- Some small-medium scale recycling factories for plastics and scrap iron.
- Many industries are recycling their wastes.

3.2 Problems

3.2.1 Very Serious Problems

3.2.1.1 Institutional and Organisational Strengthening Urgently Needed

The main institutional issues related to SWM within Gampaha are:

- Current SWM management structure does not reflect the significance of SWM within GMC. It should be much stronger, with more authority being given to the responsible people and adequate human, facility and financial resources allocated for SWM works because many GMC employees are engaged in SWM works, while GMC spends a lot of its budget on SWM (e.g. 2002 budget: 37%

of GMC staff (around 72 employees) working in SWM by cadre; 10M Rs allocated to SWM (22% of total budget)).

- 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.
- Poor labourer management, with absenteeism running at around 10-20%, while some labourers 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.; weak enforcement of bylaws; and political interference.
- 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 and Urgent Need to Find a New Landfill

Proper final disposal is the most important component, required to establish the reliability of SWM works. Current landfilling practice at the Henegama is inadequate, while waste simply being dumped on the ground. Hence, GMC urgently needs to improve landfilling operations at this site and to find another location for landfilling, either at a different area within the coconut plantation or another site.

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 place, resulting in lots of garbage discharged at the roadside, or at communal collection points, causing waste scattering and creating mini-dumps.
- Many animals (goats, dogs, cows, crows, etc.) search for food amongst the garbage, creating poor sanitary conditions.
- Lots of garden and building waste is discharged at the roadside, collection points or on vacant land. Often, garden waste is burnt.
- Many drains are full of or blocked with garbage, causing nuisance or health problems.

Collection and transportation is inefficient and unreliable, being characterised by many collection points, double handling and long loading times, inefficient waste transfer, vehicle breakdowns and repair delays, while many trailers are in poor condition.

These problems, particularly vehicle breakdowns, make it difficult for GMC to keep to scheduled garbage collection times, routes and frequencies.

3.2.2 Serious Problems

3.2.2.1 Processing / Treatment

The main objectives of any processing/treatment technology are to reduce the final amount of waste to disposal. There are currently no centralised garbage processing/treatment (recycling or composting or biogas) facilities within Gampaha other than two small-medium scale private recycling factories, processing polythene and scrap iron waste respectively, primarily from commercial and industrial sources. Considering that the composition of Gampaha waste is very suitable for composting and that the Henegama landfill site is virtually full, GMC should seriously investigate the feasibility of establishing medium-large scale composting or biogas facilities.

3.2.2.2 Increase Public Cooperation through Education/Awareness

Presently, public cooperation with GMC in SWM activities is poor, with many people still discharging their garbage and litter to public places. GMC is partly to blame for this, primarily due to the collection service being unreliable.

Household surveys/interviews conducted during this study indicate that Gampaha's citizens are willing to cooperate with GMC in SWM. They have also realized the importance of public awareness raising and many people are keen on beautifying the town.

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 GMC in this regard, with quite a lot of places indicating a willingness to pay a garbage collection fee.

These observations suggest that the implementation of waste discharge rules together with community based improvement and education/awareness programmes conducted in cooperation with schools, CBOs and other parties should be highly effective both to increase peoples' understanding of the SWM issues facing Gampaha and to encourage public participation in SWM.

3.2.3 Less Serious Problems

Less serious problems are listed below:

- No recording/monitoring of daily SWM work performance.
- No vehicle trip recording system at the disposal site.

- Waste scattering from vehicles during transit.
- Inadequate collection and disposal of hazardous healthcare waste.
- Difficulties encountered by middlemen in obtaining sufficient materials for recycling, utilities problems, high land/building rental costs and obtaining credit.

Chapter 4 Pilot Projects

4.1 Rationale

Assessment of the current SWM situation revealed many serious problems facing SWM in Gampaha. However, although GMC was established in 2002, the transition from Urban to Municipal Council status in terms of human, equipment and financial resources is taking a long time, resulting in GMC currently being relatively weak in these areas. This situation restricted pilot project possibilities, even for capacity building. However, the environmental committee is working quite actively. Therefore, the pilot projects targeted programmes that involve technical improvement measures only and those that the environmental committee could control, whilst some limited managerial capacity strengthening input was also trialed.

4.2 Objectives

Item	Components	Objectives
General	As below	Capacity development of GMC staff
Managerial Capacity Strengthening	Assistance in preparing SWM by-laws Assistance in implementing various SWM management tools (control board, monthly report, SWM manual) PHI/Supervisor training Preparation of 10 year SWM Action Plan	Capacity development of GMC staff
Waste Collection improvement	Introduction of bell and kerbside collection Introduction of stationary trailer collection Construction of waste transfer station Associated publicity (6,000 leaflets)	Improvement of garbage discharge, storage, collection and transportation system Improved, more efficient waste transfer Increased public awareness and cooperation
School recycling	Provision of recyclables storage facilities and compost barrels for selected schools	Give hands-on experience to students of recycling activities, encouraging them to make it a part of their lifestyle.
Education	Provision of 6,000 leaflets (as above) Provision of 10 educational banners	Increased public awareness and cooperation

4.3 Description

4.3.1 Managerial Capacity Strengthening

4.3.1.1 Amendment of Model By-laws

GMC received Sinhala copies of the draft model SWM by-laws, prepared by the Sri Lankan Institute of Local Government in cooperation with JICA, in May 2003. These by-laws cover a wide range of issues, including promoting the separation of garbage at source, specifying the responsibilities of both GMC and the public in relation to SWM, the circumstances where garbage collection fees may be applied, fines and enforcement procedures, etc. These by-laws have already been discussed by the GMC Health

committee and copies have been made and distributed to MC members for discussion at their next Council meeting.

4.3.1.2 SWM Management Tools

Three tools have been introduced to GMC for improving SWM management, comprising:

- **Monthly report:** This is divided into two parts – a daily report form for each month and a summary report for each year. All relevant SWM information should be recorded in this report on a daily or monthly basis as appropriate, with it then being used to monitor SWM performance, assess progress against targets and identify required actions to address issues that arise. A draft monthly report was given to GMC, which was then adapted to fit their requirements. This has been partially filled in since September 2003.
- **Control board:** The control board is basically a large white board (up to 5' x 7' in size) with a large scale digitized map of GMA on it. Relevant SWM information should be recorded and updated regularly on the board such as collection zones; collection vehicle routes and frequencies; locations of public garbage bins, stationary trailers, litter bins, large waste generators, public noticeboards, problem areas, etc. The control board format was designed with input from GMC and printed commercially. It has yet to be used.
- **SWM Manual:** The SWM Manual is an Operations tool that outlines necessary SWM works required to be undertaken on a daily, weekly, monthly and annual basis, together with who is responsible for doing such works. It also explains how to use the monthly report and control board, including some suggestions on how to collect the necessary data. A standard format has been provided to GMC which they can then adapt to suit their particular circumstances.

4.3.1.3 PHI/Supervisor Training

PHI/Supervisor training was conducted for GMC PHIs and supervisors, as summarised below.

Table 4-1: PHI/Supervisor Training Summary

Date	Participants (no)	Presentation	Topics
3 Mar	9	Introduction to SWM	Why SWM? (main objectives) Current SWM sanitation conditions in Sri Lanka (discharge and storage) Health and environmental risks associated with SWM Final disposal in Sri Lanka SWM planning data (waste generation, composition, waste stream, converting loads to tonnes)
		SWM – Challenges for Change	SWM – a changing field Reducing waste scattering (discharge rule, litter bins, etc.) Improving garbage collection efficiency Reducing SWM costs
30 Jul	8	Human Resource Training	PHI/supervisor as part of an organisation, part of a team and with an individual job/role Important PHI/supervisor skills
13th Oct	4	Rules and Regulations of SWM	Reviewing existing rules, regulations and model by laws ;which prepared as a part of the study.
	4	Composting	Basic facts on home and large scale composting

Each training session involved some input on the topics indicated above in the form of a powerpoint presentation, combined with group activities at relevant places. The powerpoint presentations were developed based on the actual SWM situation in Sri Lanka, with handouts being given to all participants in English, Sinhala or Tamil, as appropriate. The group activities were based on real life situations relevant to participants' jobs as much as possible (e.g. converting GMC load data to tonnes, designing an improved public garbage bin, dealing with a labourer who refuses to follow orders, dealing with a drunk driver, trying to eliminate garbage piles, etc.).

4.3.1.4 Preparation of 10 Year SWM Action Plan

A 10 year SWM action plan was developed for Gampaha as follows:

- Preparation of a draft SWM Action Plan by JICA in English and Sinhala, which was revised through a series of internal GMC meetings and external meetings with the Study team to produce a final draft.
- Distribution of the final draft Action plan to Council members for discussion and approval.
- Informing a wide range of stakeholders about the Action plan at the second GMC/JICA seminar in November 2003.

4.3.2 Waste Collection Improvement

GMC with JICA, has implemented some pilot projects to improve the current garbage discharge and storage, collection and transportation system since January 2003, including:

- The introduction of a waste discharge rule and bell collection system to selected areas within Gampaha and Yakkala, with these initiatives being publicised by loudspeaker announcements and leaflets. Under this system, people are required to discharge their garbage in containers in accordance with certain rules and a specified collection schedule, bringing their garbage directly out to the collection vehicle when they hear special music being played or, if they are not going to be at home, placing it at the kerbside in a closed container before the specified collection time.
- The provision of two stationary trailers by JICA to GMC.
- The construction of a transfer station within GMC premises. The need for an effective and efficient method for transferring two wheel tractor waste to larger vehicles was identified by GMC as a key SWM issue, as the final disposal site is about 15km from the Gampaha town centre. The transfer station comprises an unloading area and two trailer parking bays at a lower level, so that waste can be transferred directly from primary collection vehicles (handcarts, two wheel tractors) to four wheel tractors. JICA assisted with the design and construction of this facility near the GMC office and it has been in use since June 2003.

4.3.3 School Recycling

Six schools located within GMA were selected to participate in the school recycling project, based on a number of criteria: size of school, location, etc. JICA provided the funds for building recyclable storage facilities, while the Study team conducted awareness programmes to teachers and students at each school. Teachers were appointed to supervise the project at each school, while a system was also set up to monitor the project's success.

From March 2003, students were instructed to collect recyclables (e.g. glass bottles, papers) at home and bring them to school on one or more designated days each month. These were stored at the school and subsequently sold to local middlemen, with the income earned being used to buy necessary items for the schools.

4.3.4 Educational Banners

In addition to the publicity leaflets described above, a series of 10 re-usable educational banners, describing all aspects of SWM with a focus on the situation in Gampaha, have been prepared by GMC in cooperation with the Study team for display in schools and other public places.

4.4 Assessment

4.4.1 General

The Study team has worked closely with many GMC staff and Council members over an eight month period in implementing these pilot projects. One of the biggest benefits of this process, especially through regular progress meetings and preparation of the Action plan, has been a greatly increased awareness amongst those involved on the particular SWM problems facing Gampaha and on GMC's abilities and limitations in providing good SWM services. GMC has gradually become more active in SWM over this period, with the Environment Committee chairman in particular playing a key role. However, implementation of the pilot projects has been hampered by human resource shortages, particularly at the PHI level. Gampaha's SPHI retired in mid-2003 and did not get greatly involved in the pilot projects even though these started in January. A new SPHI started work in July and has played a more active role.

4.4.2 Managerial Capacity Strengthening

4.4.2.1 Model By-laws

The model by-laws have been widely welcomed by GMC staff and Council members, being considered timely and giving GMC much more power to enforce improved SWM.

4.4.2.2 Management Tools

Progress has been slow in implementing the monthly report and control board, primarily due to a shortage of human resources and the retirement of the former SPHI.

The SWM manual was handed over to LAs in October, summarising relevant local information and including feedback from discussions with SWM staff in all LAs, particularly from the supervisor training, monthly report and control board discussions.

4.4.2.3 PHI/Supervisor Training

Most of the participants were very appreciative of the PHI/supervisor training, commenting that the programme was very good - they had gained new ideas, knowledge and a better understanding of SWM. In particular, they enjoyed the group activities that focused on real life situations they have to deal with in their jobs, as well as the opportunity to meet together and discuss issues relevant to their work. For many of the supervisors, it was the first time they had received any such training in their jobs and they supported such training being continued, even if just once per year. Hence, there is clearly a need for more training programmes of this nature for all relevant staff, especially supervisors.

However, the supervisors stressed that most of them are Acting Supervisors, being registered as labourers, with this fact being shown on their ID cards. This lack of official Supervisor status hampers them in their jobs, particularly when it comes to controlling labourers and dealing with the public, and makes it more difficult for them to implement some of the issues covered in the PHI/supervisor training.

4.4.2.4 SWM Action Plan

The GMC SWM Action plan was prepared through an extensive consultation process, involving internal and external meetings and workshops to produce a final Action plan. It has taken a lot of work and involved a wide range of GMC staff and Council members.

However, the real challenge will be in implementing the plan due to human and financial resource constraints and the long time it may take to work through some of the proposed institutional and organisational changes.

4.4.3 Waste Collection Improvement

4.4.3.1 Bell Collection

Initial feedback from the bell collection pilot programme has been encouraging, with the vast majority of the public approving of and supporting the bell collection system, while loading work is now much easier for labourers. The main problem identified to date is the ability of GMC to keep to the collection schedule, due to vehicle problems. A number of measures are being pursued to counter this as part of the Action plan.

Whilst leaflet distribution and community meetings have been useful, curiosity as to what the "new music" is for, has also been an important, informal publicity method.

In summary, the bell collection system:

- Improves city cleanliness, reducing the number of garbage piles and waste scattering.
- Improves public cooperation by clearly showing the public how to discharge their garbage, even though this is more inconvenient for them than their former practices
- Seems to be a good means of introducing kerbside collection.
- Raises public expectations towards SWM and increases their willingness to complain.
- Highlights GMC's ability or lack of it to keep to the garbage collection schedule.
- Increases GMC's commitment to providing a reliable garbage collection service.
- Makes collection labourers' jobs easier.

It is important that as this system becomes well established, GMC should consider how to run the bell collection with minimum resource input from them and maximum public participation, this being one of the key objectives. Practically, this could involve reducing the collection frequency, removing unnecessary public concrete bins in Yakkala, reducing the number of labourers per collection vehicle, using handcarts in essential places only, etc. Many of these issues are addressed in the city's SWM Action plan.

4.4.3.2 Stationary Trailers

The Study team received several complaints about the new trailers from GMC, as their labourers said they are too small, difficult to load from the sides, particularly when over half full, and it is no longer possible for labourers to compact the waste by trampling on it, due to the presence of the roof. They subsequently stopped using these trailers and requested the Study team to modify them to address these problems. This was duly done, the capacity being increased and doors being fitted on the roof. Both trailers are now being used.

4.4.3.3 Waste Transfer Station

GMC has been using the transfer station for some months now without problems, except for:

- GMC has various trailers of different heights, meaning that the transfer station design does not accommodate all of these, with the tops of some trailers being above the loading platform.
- The transfer station has a compacted earth floor, which can become muddy during rainy conditions.

Both of these problems are relatively minor and GMC has achieved considerable improvement in their waste transfer operation.

4.4.4 School Recycling

School visits in early September 2003 found that five out of six schools have sold recyclables twice already while one has sold them only once. Associated income ranges from 400-1,200Rs. Although some schools have faced several difficulties in implementing this project (e.g. untidiness of storage rooms, insufficient cooperation from other teachers), the income derived from it has tended to encourage each school to continue the project. Moreover, the educational importance of this recycling project (See next page) is increasing due to rapid urbanization of the Gampaha district and increasing commercialisation. Hence, it is likely that similar projects could be effectively implemented in other areas.

4.4.5 Educational Banners

The educational banners have been used in one school only to date. They are considered a useful, portable education tool and GMC has been encouraged to use them more often.

Educational leaflet for school recycling: This leaflet has been distributed to participants of seminars.