Table 1-5 : Hospital General Statistics and Waste Generation

Hospital	Type	No of Beds	Bed occup-ancy (%)	Out-patients (no/d)	Clinical patients (no/d)	Staff	Waste composition	Normal waste (kg/d)	Clinical waste (kg/mth)	Body parts (kg/mth)	Sharps (per month)	Highly infectious (/mth)	Other
Kandy General	Govt	2003	93	879	1,426	2,700	F/K > Hz > Pa	2,700	900	ND	65 boxes	60 boxes	DM, MT, P, AC, R (R: 30kg/mth)
Peradeniya Teaching	Govt	830	80	782	580	1,400	F/K > P > M > Ga > Hz	1,200	600	450	600 kg	360 kg	DM, MT, P, AC
Peradeniya Dental	Govt	36	100	150	60	130	F/K > P > Pl > Ga	198	25	10-15	No = 55	Small	Chemicals (265L/ mth)
Katugastota District	Govt	45	96	450	450	48	F/K > P > Pl > Hz	132	5	Small	ND	0	ND
Kandy Nursing Homes	Private	24	100	55	0	80	Ga > F/K > Hz	49	Small	5-6	15-20 kg	0	ND
Lakeside Adventist	Private	35	80	150	0	82	Not ranked	96	Small	ND	ND	ND	ND
Kandy Private	Private	35	100	25	0	100	F/K > Gl > Ga > P	83	Small	2	ND	0	MT
Suwasevana	Private	100	90	75	0	250	F/K > P > Pl > O > Hz	276	Small	30	No = 600	ND	ND
Total		3,108		2,566	2,516	4,790		4,734	> 1,530	>500	>700 kg	>400 kg	Small

Notes:

1. Data for hospitals obtained from interviews with relevant staff members of each institute.
2. Average total number of beds occupied = Sum of (number of beds x bed occupancy rate) for all hospitals = 2783
3. Other : F/K = food/kitchen waste, Hz = healthcare hazardous waste, P = paper, Pl = plastic, Gl = glass, Ga = garden, O = other; ND = no data, DM = discarded medicines, T = mercury thermometers, P = paint, AC = aerosol cans, R = radioactive waste.
4. An accuracy check has only been made on the amount of normal waste, with survey data being amended based on KMC waste collection data.

Table 1-6 : Hospital Waste Disposal Practices

Hospital	Normal waste	Clinical waste	Body Parts and/or placentas	Sharps	Highly infectious	Other	WW-TP	Incin-erator	Comm-ents
Kandy General	Collected by Care Kleen except for plastic, glass and metal bottles/ containers sold by tender & 30kg/d kitchen waste to Ampitiya seminary piggery	Specimens/ cultures autoclaved and disposed of as normal waste; IV sets, blood bags and HIV-suspected material burned in pit on-site	Body parts buried at Mahaiyawa cemetery; placentas collected by KMC Conservancy tractor	Collected separately in cardboard boxes and burned daily	As for clinical waste	As for normal waste	Yes[1]	No	Incinerator desired
Peradeniya Teaching	Collected by KMC except for 30kg/d kitchen waste to university piggery; plastic, glass and metal bottles/ containers and coconut shells sold by tender; garden waste burned/ open dumped	IV sets, saline and blood bottles stored burned and covered with soil 3 times/wk	Body parts, biopsies and placentas buried on site	Collected separately in cardboard boxes; stored, burned and covered with soil 3 times/wk	As for clinical waste	Discarded drugs and nuclear medicines burned	Yes[2]	No[3]	Incinerator desired
Peradeniya Dental	Collected by KMC	Incinerated				Collected/ incinerated	Yes	Yes	Chimney too low
Katugastota District	Collected by KMC	Burned			None	No data	No	No	Incinerator desired
Kandy Nursing Home	Collected by KMC	Wrapped in polythene bags and discharged with normal waste			None	No data	No	No	
Lakeside Adventist	Collected by KMC except for some plastic waste which is burnt on-site and minor recycling, with some plastic containers being returned to suppliers	All specimens and cultures autoclaved, then disposed of as normal waste or buried on site	Taken to cemetery for burial	Collected separately in cardboard boxes; burnt (Remi NB-01 needle burner) and disposed of as normal waste	See comments for clinical waste	No data	No[4]	No	
Kandy Private	Collected by KMC or burned	Burned and buried			None	No data	No	No	
Suwasevana	Collected by KMC or burned	Burned or incinerated				Collected or burned/ incinerated	No	Yes	

Notes: 1 = WWTP (wastewater treatment plant) is present but no longer functioning; 2 = Sedimentation tank is out of service with alternative tank being used on a temporary basis; 3 = Peradeniya Teaching Hospital used to have an incinerator but this was abandoned about 2-3 years ago and is now overgrown; 4 = KMC has indicated they will not approve the hospital's expansion plans unless they install a WWTP.

1.4.6 Government Offices

Government offices in Kandy are divided into three categories: central government departments (27 offices), provincial council ministries and authorities (42 offices) and KMC, the total number of associated workers being 5,472. Interview surveys were conducted with five of these institutes[15]. Estimated waste generation ranged from 10-630kg/d, with paper being the most common waste type, followed by food/kitchen waste, garden waste and plastic.

- Three institutions use the KMC/Care Kleen garbage collection service, with this being the only method of disposal for two offices, while the Department of Agriculture, situated within Peradeniya University, also burns/buries some of its garbage on site and gives its food/kitchen waste to the university piggery
- The two other government offices burn/bury all of their garbage on site.

This data gives a government office waste generation rate of 0.245kg/worker.d and amount of 1.3T/d, with 82% of government office waste being collected by KMC/Care Kleen, 13% burned/buried on site and 5% recycled (mainly food/kitchen waste for pig food).

1.4.7 Religious Institutes

The total number of religious institutes in Kandy is approximately 114, comprising 70 buddhist temples and other institutes, 17 mosques, 12 churches, Carmelite convent and 14 hindu temples (kovils), with an associated 721 resident religious workers (e.g. monks, priests, etc.). Buddhist temples and institutes include the Sri Dalada Maligawa (Temple of the Sacred Tooth Relic), the Malwatta and Asgiriya Viharas, two of the most important Buddhist monasteries in Sri Lanka, and a number of large meditation/training centres (Sri Subodharama Buddhist Centre (39 resident monks), Sri Jemson International Buddhist Meditation Centre (11 resident monks), Sri Dhammarathana Bikku Training Institution (22 resident monks) and Sri Jinendraramaya (40 resident monks). Interview surveys were conducted with five of these institutes believed to be significant waste generators.

Waste generation was estimated to range from 30-450kg/d, the largest waste generator by far being the Sri Dalada Maligawa, which has 105 resident monks and an average of 20,000 visitors per day. Various institutes indicated waste generation increases 3-4 times during Poya days and other religious festivals.

Food/kitchen waste is the most common waste type, followed by garden waste, paper and inerts. Much of the garden waste is discarded decorations made from young coconut leaves or flowers given as temple offerings, while inerts mainly comprises broken clay pots.

Three of these institutes, including the Sri Dalada Maligawa (Tooth Temple), discharge all of their waste for collection by KMC/Care Kleen. The Carmel Convent recycles some of its waste and composts its

[15] Two additional government enterprises (Main Postal Complex and Institute of Fundamental Studies) were surveyed but their results have not been included as these places are not consistent with the definition of government offices used here.

garden waste, while discharging the remainder of its waste for collection by KMC or burning/burying it on site. One other religious institute burns and/or buries all of its waste on site.

Based on this data, total waste generation is estimated to be 2.2T/d[16], with all of the Tooth Temple's waste being collected by Care Kleen, while for all other religious institutes/temples within the KMA, it is assumed that 78% of their waste is collected by KMC/Carekleen, 17% is burned/buried on site, 3% recycled and 3% composted.

1.4.8 Forces

The term "Forces" has been used to describe the Army, Prisons and Police. This sector includes some large waste generators situated within the KMA, including the Second Singha Regiment Headquarters (300 resident staff), Army Training College (200 resident staff), Bogambara Prison (325 staff and 2,200 inmates), Remand prison (100 staff and 500 inmates) and the Kandy Police Station (200 staff).

Waste generation is estimated to range from 50-388kg/d, with food/kitchen waste being the most common waste type, followed by garden waste, glass/inerts and then paper. The Police and Army produce about five times more waste during Esala Perahera, where large numbers of additional staff are temporarily deployed in the city.

Total waste generation is estimated to be 1.0T/d (0.24kg/worker.d). All institutes discharge their waste for collection by KMC/Carekleen (95% of total Forces garbage), except for the Army Training College which burns/buries all of its waste on site.

UDA development plans for Kandy propose relocating both the Bogambara and Remand prisons from the central city area to Pallekele and Getambe respectively, with these sites then being redeveloped for commercial and public uses.

1.5 Industries

Kandy contains relatively few industries, with industrial land use accounting for only 17ha in 1999 (0.6% of total land area), while the city's proposed development plan only allows for the development of welding/lathe workshops and service industries[17].

According to KMC statistics and additional information obtained during field surveys, industrial activity in Kandy comprises:

- Ceylon Tobacco Company (CTC) Ltd (tobacco processing).
- Several small scale metal work and welding workshops.
- Six garment industries.
- Seven timber industries.
- Ten concrete workshops.

[16] Waste generation rate of 4.3kg/clergy.d for Tooth Temple and 2.8kg/clergy.d for other religious places.

- Two quarries.
- Nine small industries (1 fruit drinks, 1 toffee, 3 batik, 4 arts and crafts).

Interview surveys were conducted with CTC, three small garment factories and the seven timber industries, while additional information was obtained from KMC for a fourth garment factory[18]. Waste generation and composition data is tabulated below.

Table 1-7 : Industries Waste Generation and Composition

Source	Number of Workers	Estimated Waste generation (kg/d)	Most common waste types
Ceylon Tobacco Co (1)	200	602	F/K > In > Pa
Garment Factories (4)	123 (3 factories only)	109 (5-80)	Te ~ F/K > Pa/Ga
Timber industries (7)	Not known	1,160	Sawdust, woodchips

Notes:
1. CTC waste generation amount based on Gohagoda landfill trips data, with CTC having made 89 trips to Gohagoda over the last 12 months (2.47T/load).
2. Garment and timber industries waste generation amounts were estimated by survey respondents.
3. Waste types: F/K = food/kitchen, Pa = paper/cardboard, Te = textiles, Ga = garden, In = inerts.

CTC transports its own garbage directly to Gohagoda, making around 7.4 trips/mth. It also undertakes garbage management from the surrounds outside its factory. Three garment factories have their garbage collected by KMC, while the fourth burns/buries it's garbage on site.

The timber industries comprise one sawmill, while the others are timber depots, furniture makers or carpentry shops. Only the sawmill produces significant quantities of sawdust and woodchips, amounting to 24 and 1 T/mth respectively, with the sawdust currently either being burnt or given to mushroom farmers, while the woodchips are given away for firewood. They are willing to give all these wastes to KMC for free.

The five timber depots, carpentry shops and furniture makers produce from 0.6 – 2.9 T/mth of sawdust and woodchip wastes. Most of this sawdust is currently burnt, while woodchips are generally given away for free or sold for use as firewood. All of these enterprises are willing to give their wastes to KMC for free or sale at a reasonable price. Additional information on timber industry waste is tabulated below.

[17] UDA (2001), Development Plan for Urban Development Area of Kandy
[18] The two other garment factories could not be located.

Table 1-8 : Timber Processing Industries Survey Results

Timber Industry Name and Location (Respondent)	Waste Quantities (T/month)		Waste disposal	Willing to give/sell to MMC for composting	Comments
	Sawdust	Woodchips			
N.D. Wijethunga, Kurunegala Rd (not stated)	1.0	0.5	Sawdust is burnt while wood chips are sold at 60Rs/50kg.	Willing to give all sawdust for free and to sell all woodchips at 60Rs/50kg.	Timber depots, carpentry shops, and/or furniture makers
M.H. Sugathadasa and Company, 47 Kurunegala Rd (Mr Karunarathna, Manager; tel 08 499216)	1.5	~1.0	Sawdust is burnt while woodchips are sold at 35Rs/50kg.	Willing to sell sawdust at a reasonable price and woodchips at 35Rs/50kg.	
New Mulgampola Timber Depot, 14/34A William Gopallawa Mw, Suduhumpola (Mr Jayarathna, Manager; tel 074 474 232)	0.2	0.4	Gives sawdust and woodchips to neighbours and workers.	Willing to sell sawdust at a reasonable price and woodchips at 60Rs/50kg.	
Samantha Timber Depot, 86 Katugastota Rd (Mr Upali, Owner; tel 08 225483)	2.4	0.5	Sawdust is burnt while woodchips are given to workers.	Willing to give all wastes to KMC for free.	
Weerakoody & Company, 745 Peradeniya Rd, Mulgampola (Mr Weerakoody, Manager; tel 08 228115)	0.8-1.0	1.0	Sawdust and woodchips are given to neighbours, police and home for elders.	Willing to give all wastes to KMC for free.	
Marle & Sons, 101 Katugastota Rd (Mr KWCK Gunasena, Owner; tel 08 227613)	0.6	0.9	Sawdust is burnt, while woodchips are sold at 10 Rs/10kg	Willing to give all sawdust to KMC for free and to sell all woodchips at 2000Rs/load.	Marle: can assist with transport
Katugastota Sawmill, Ranawana Rd (Mr AA Rahim, Manager; tel 08 498262)	24.0	1.0	Sawdust is burnt or given to mushroom farmers, while woodchips are given away free for firewood.	Willing to give all wastes to KMC for free.	Sawmill
Total	30.5-30.7	5.3			

Notes: Loads refers to four wheel tractor loads unless otherwise stated. Loads data was converted to tonnes for tractors based on information supplied by survey respondents, with one load of sawdust being equivalent to 0.75T and one load of woodchips to 0.9-1.0 T.

1.6 Other Waste

Other waste within Kandy has been divided into sections:

- IDP (infectious disease prevention) waste, collected mainly from drain cleaning and weeding.
- Botanical Gardens waste.
- Other.

1.6.1 IDP Waste

IDP waste generation was estimated based on IDP tractors making an average of 57 trips/mth to the Gohagoda landfill site over the period May 2001-April 2002, giving a waste generation and disposal amount of 3.5T/d.

1.6.2 Botanical Gardens

The Botanical Gardens occupies an area of 60ha in Peradeniya and hosts around 1.2 million visitors per year. It comes under the Ministry of Agriculture, with income from entry fees and sales going to the Treasury, from which it is given an operating budget[19]. It is responsible for waste collection and disposal for all garden waste and garbage produced within the Gardens, while KMC collects garbage from the carpark area and associated cafeteria. People entering the Gardens are asked by way of a sign not to bring polythene bags into the garden.

Solid waste management is the Foreman's responsibility, with 106 permanent and 36 contract labourers employed for garden maintenance, including waste collection, treatment and disposal. Two four wheel tractors are used for garden waste collection, collecting around 5 tractor loads per day of garden waste, equivalent to around 2.6T/d (3.0m^3 capacity x 175% full x 100kg/m^3). This comprises mainly grass and leaves. Garden waste production may increase by up to two times during June-September, with particularly high quantities of grass waste being produced. During this period, they will sometimes exchange some grass waste with the university for animal dung.

Grass and leaves are composted in small piles in an open, bare soil area with no roof but partially shaded by nearby tall trees and bamboo. The piles are turned once after about 2-3 weeks, with "leaf mould" being harvested after around 3 months. This is mainly used within the gardens, with any excess leaf mould being bagged and sold at 50Rs/2kg bag in the new Sales Centre. According to sales staff, they are currently selling around 25-50 bags/d.

There is another composting area (~320m^2), comprising an old gravel pit, where grass waste is also composted, using the same method as described above.

[19] According to the foreman, this budget is not sufficient for them to be able to pay KMC for garbage collection.

Large garden waste (branches, etc.) and excess grass is disposed of in an open dump site approximately 100m long by 10m wide (current portion in use is about 10-20% of this area) located on the banks of the Mahaweli Ganga.

A mini-tractor collects normal garbage from public dustbins, offices, etc., collecting around 0.5 bins/d, equivalent to around 0.33T/d (0.5 x 2.16m^3/bin x 300kg/m^3). Peak normal garbage production is around 1 bin/d. This garbage is disposed of by open dumping in another area along the banks of the Mahaweli Ganga, which is about 40m long by 10m wide, with the average filling depth being 3m. A large proportion of recyclable waste was visible amongst recently discarded garbage (e.g. plastic lunch containers, al cans, PET water bottles, etc.). According to the foreman, this area has been used for about 20 years.

Botanical Gardens: Top left – collection of garden waste; top right – garden waste composting area; bottom left – inorganic waste open dumping area; bottom right – high proportion of recyclables present amongst inorganic waste.

1.6.3 Other

Inspection of Gohagoda records over the 12 month period May 2001-April 2002, showed that a total of 18 tractor trips were made to the landfill over this time by other parties, including the Ceylon Electricity Board (4 trips) and various unidentified private parties (14 trips). These trips are estimated to be equivalent to 31kg/d which is very small, while only two of the trips were made in the second six months of this period. For these reasons, these additional trips have been ignored, it being assumed that they are already included in the other waste generation estimates made.

1.7 Recycling

1.7.1 General

Informal reuse and recycling is relatively active in Kandy, with there being many shops in the city selling used items and/or recyclables for a wide range of purposes, including:

- Shops selling used shoes, bags, bikes, umbrellas, books, mobile phones, tyres, etc.
- Waste paper is used for making paper bags for wrapping purposes (e.g. medicines, food, small goods, etc.).
- Glass and PET bottles are sold as containers for local products (e.g. sauce).
- Empty metal tins are used to make the metal support that secures broom bristles to broomsticks (ekel brooms) or for making toys and other items (e.g. buckets).
- Micro-enterprises use old bulbs and empty cans to make small lamps for sale.
- Coconut shells are used to make activated carbon or ladles or ornaments for sale to tourists.

1.7.2 At Source

This section focuses on household recycling at source, as recycling at source from other waste generators has previously been described.

Household at source recycling was estimated from the household survey results (150 households), with the relevant results being tabulated below. These indicate that 83% of households have recyclables collected from them by individual collectors, 31% take some recyclables to shops for refund/sale and 16% compost kitchen and/or garden waste.

Table 1-9 : Household Survey Recycling Results Summary

Waste Type	Composting	Individual collects from House	Resident takes to shop
Yes	24	124	47
No	126	26	103
Food/kitchen	10	0	0
Garden/wood	14	1	1
Paper	0	80	21
Plastic	0	6	2
Glass	0	98	41
Metal	0	64	5
Textile	0	23	2
Leather/rubber	0	0	1
Other	0	3	1

The total amount of materials recycled or composted from households at source was estimated using this data together with household waste composition data, KMA garbage collection service coverage of 75% and assuming an 80% recycling/composting rate. This gives household home composting and recycling quantities of 4.0T/d (6.7% of total household waste generation) and 2.5T/d (4.2%) respectively. It is difficult to verify how realistic these values are, particularly in the case of home composting. However,

the middlemen survey indicated around 1.1T/d of recyclable materials purchased by them originate directly from households. As many recyclable materials collected from homes are expected to be taken to other places (e.g. paper bag making enterprises) rather than just middlemen, the recycling quantity estimate is considered reasonable.

1.7.3 During Collection

The collection worker survey found that four out of 25 KMC labourers and three out of eight Care Kleen labourers interviewed are involved in recycling during collection. The higher percentage of Care Kleen labourers is most probably directly related to the central city area serviced by Care Kleen being a much more lucrative area for collecting recyclables.

These seven labourers collect an estimated total of 369kg/mth, comprising mainly bottles (380 in number, 251 kg[20]), cardboard and various metals, earning an average of 141-224 Rs/mth, as tabulated below. Total quantities of recyclables recovered during collection are estimated to be 3,290kg/mth (3,394 bottles and 1,054kg/mth of cardboard and metals).

Table 1-10 : Recyclable Materials Recovered by Collection Workers

Item	No of labourers collecting		Quantity (kg/mth)	Price	Total Quantity (kg/mth)
	KMC	Care Kleen			
Bottles	3	3	(No = 380) 251	0.5-3.0 Rs ea	(No = 3,394) 2,240
Cardboard	0	1	90	3 Rs/kg	804
Ferrous metal	2	1	18	3-5 Rs/kg	161
Metal can	1	0	2	25 Rs/kg	18
Aluminium	2	1	6	50-70 Rs/kg	54
Brass	1	1	1.5	80 Rs/kg	13
Copper	1	0	0.5	60 Rs/kg	4
Total	4	3	369		
Average earnings	141 Rs/mth	224 Rs/mth			
No of interviewees	25	8			
Total	222	72			3,294 kg (includes 3,394 bottles)

Notes:
1. KMC labourers = 205 normal + 17 temporarily assigned from IDP duties.
2. Total quantity/mth = (222+72)/(25+8)x survey quantity.

1.7.4 At Final Disposal Site

Further recycling takes place at the Gohagoda landfill, mainly by KMC labourers and/or members of their families. At least nine people from seven different households are thought to be involved in salvaging recyclable items from the landfill, the total number possibly being 2-3 times higher than this.

[20] Average bottle weight = 0.66kg, obtained by measuring a mixture of 10 arrack and beer bottles, these being the most common bottles recycled.

Table 1-11 : Recyclable Materials Collected at the Landfill

Item	Number of Collectors	Quantity	Quantity (kg/d)	Price
Bottles	>2	800 bottles/mth	18	1.5 Rs ea
Polythene	>1	ND	ND	ND
Plastic	>1	ND	ND	ND
Metal cans/tins	>2	2-3 tonnes per fortnight	179	ND
Organic wastes for Animal Feed	>4	15 polysacks/day	450	N/A
Coconut shells	>2	25 polysacks/wk	56	0.2 Rs ea.
Bone	ND		ND	ND
Total			702	

Notes:
1. ND = no data, N/A = not applicable.
2. 1 polysack holds about 160-200 coconut shells (half nuts), which weigh an average of 87.5g ea (average weight, measured by weighing 40 shells).

The total quantity of materials recycled at the landfill is estimated to be 702kg/d, based on disposal site interview survey results and information provided by the landfill manager.

Collectors (middlemen) come to these scavengers' houses to buy bottles and coconut shells, while metal cans/tins are taken directly to middlemen/small enterprises for sale. Bones (from decayed slaughterhouse waste) are sold as fertilizer. Most of the animal feed goes to some piggeries located close to the landfill. Around 10 households allow their stock to graze daily on the landfill for food, comprising a total of 22 cows, 29 goats, 32 pigs and 5 chickens.

One of the survey respondents (KMC Sanitary Supervisor) indicated that he, together with seven colleagues, had tried to compost around four tractor loads of waste per day for around 2-3 months, but have now discontinued this venture due to lack of support from KMC.

1.8 Disposal Quantities

Trips data and corresponding disposal quantities determined from Gohagoda landfill records over the 12 month period, May 2001 to April 2002 inclusive, are attached in appendix form. This data is summarized in the following two tables and illustrated below.

Table 1-12 : KMC SWM and Gully Sucker Waste Disposal Trip Data – May 2001 to April 2002

Location	Area	Vehicle	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Sum	Mth avg	Daily avg
Inside KMA	Care Kleen (zone 1A)	Tractor	135	70	119	190	114	116	119	101	139	141	133	105	1482	124	4.1
		Small C	73	107	114	48	70	31	60	44	59	92	67	39	804	67	2.2
		Large C	67	98	55	96	79	109	69	87	79	37	71	85	932	78	2.6
	KMC (zones 1B-5)	Tractor	400	399	297	317	426.5	322	304	367	440	418	433	424	4548	379	12.5
		Perad C	59	60	77	60	58	60	60	57	60	49	58	55	713	59	2.0
		Katug C	0	0	96	98	0	89	88	0	0	0	0	0	371	31	1.0
	Markets	Tractor	101	104	113	115	113	110	103	117	159	120	130	144	1429	119	3.9
	IDP	Tractors	57	44	63	75	32	112	141	36	39	36	14	30	679	57	1.9
	Others	Tractors	21	30	87	49	17	10	10	3	5	13	8	4	257	21	0.7
	Sub-total		913	912	1021	1048	909.5	959	954	812	980	906	914	886	11215	935	30.7
	Conservancy	Tractor (buckets)	27 (184)	22 (141)	24 (157)	29 (187)	27 (155)	30 (179)	30 (179)	29 (168)	31 (194)	25 (152)	31 (193)	27 (172)	332 (2061)	28 (172)	0.9 (5.6)
	Total trips		940	934	1045	1077	936.5	989	984	841	1011	931	945	913	11547	962	31.6
Outside KMA	Harrispatuwa PS	Tractor	40	42	38	41	38	34	34	30	35	34	32	29	427	36	1.2
	Bata	Tractor	5	1	4	6	4	4	4	5	1	5	0	2	41	3	0.1
Total trips to landfill		No	985	977	1087	1124	978.5	1027	1022	876	1047	970	977	944	12015	1001	32.9
Liquid wastes		Gully sucker	131	166	133	130	91	104	119	110	132	130	115	109	1470	123	4.0
Daily average trips	Within KMA	No	30.3	31.1	33.7	34.7	31.2	31.9	32.8	27.1	32.6	33.3	30.5	30.4			31.6
	To landfill	No	31.8	32.6	35.1	36.3	32.6	33.1	34.1	28.3	33.8	34.6	31.5	31.5			32.9
	Gully sucker	*No*	*4.2*	*5.5*	*4.3*	*4.2*	*3.0*	*3.4*	*4.0*	*3.5*	*4.3*	*4.6*	*3.7*	*3.6*			4.0

Notes:

1. C = compactor
2. *Conservancy tractor trips shown followed by number of buckets in brackets.*
3. Daily average trips per month (bottom three rows) based on number of days per month.

Table 1-13 : KMC SWM Tonnage and Gully Sucker Waste Disposal Volume Data – May 2001 to April 2002

Location	Area	Unit	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Sum	Mth avg	Daily avg
Inside KMA	Care Kleen	T	781	828	787	980	772	812	720	713	809	716	779	703	9400	783	25.8
	KMC	T	1022	1022	1028	1037	1079	1030	988	945	1113	1039	1093	1066	12463	1039	34.1
	Markets	T	250	257	280	285	280	272	255	289	393	297	322	356	3534	295	9.7
	IDP	T	108	83	119	142	61	212	267	68	74	68	27	57	1284	107	3.5
	Others	T	39	64	192	152	36	21	20	4.9	8.6	31	16	7.4	591	49	1.6
	Conservancy	T	2.8	2.1	2.4	2.8	2.3	2.7	2.7	2.5	2.9	2.3	2.9	2.6	31	2.6	0.1
	Total	T	2203	2090	2407	2598	2229	2349	2253	2023	2401	2152	2239	2192	27304	2275	74.8
Outside KMA	Harrispatuwa PS	T	89	93	84	91	84	75	75	66	78	75	71	64	945	79	2.6
	Bata	T	3.6	0.7	2.9	4.3	2.9	2.9	2.9	3.6	0.7	3.6	0	1.4	30	2.5	0.1
Total		T	2296	2351	2495	2693	2316	2427	2331	2092	2479	2231	2310	2258	28728	2357	77.5
Liquid wastes		m^3	726	920	737	720	504	576	660	610	732	720	637	604	8146	679	22.3
Daily average	Within KMA	T/d	71.1	75.2	77.7	83.8	74.3	75.8	75.1	65.3	77.4	76.9	72.2	73.1			74.8
	To landfill	T/d	74.0	78.4	80.5	86.9	77.2	78.3	77.7	67.5	80.0	79.7	74.5	75.3			77.5
	Gully sucker	m^3/d	23.4	30.7	23.8	23.2	16.8	18.6	22.0	19.7	23.6	25.7	20.6	20.1			22.3

Notes:

1. Garbage collection vehicle load to tonnage conversion factors: Care Kleen, Harrispattuwa and Ceylon Tobacco Co tractors = 1.9 T/load, KMC tractor = 1.8 T/load, KMC market tractor = 2.1 T/load, IDP tractor = 1.9 T/load, Le Kandyan Hotel tractor = 1.2 T/load, Bata tractor = 0.7 T/load, Care Kleen large compactor = 5.0 T/load, Care Kleen small and KMC compactor = 2.3 T/load.
2. Gully sucker trip to volume conversion factor = 5,540 L/trip.

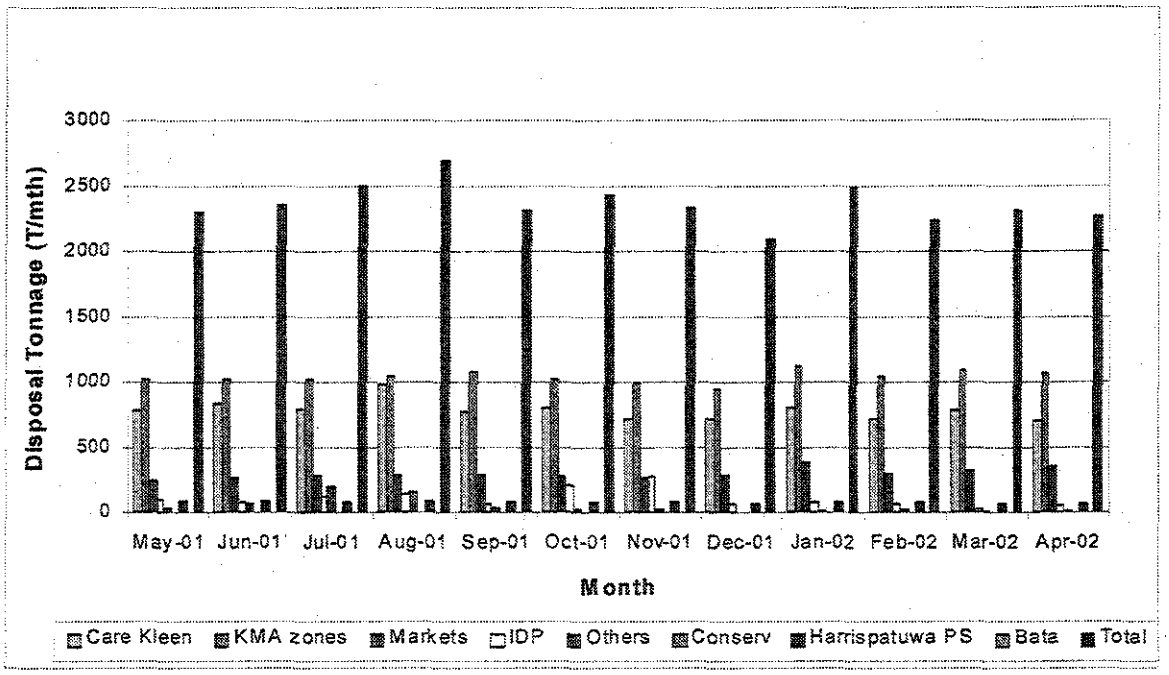


Figure 1-1: Gohagoda Landfill – Final Disposal Quantities

Some key points from this data are summarized below:

- The total number of trips in 1994 was 6,769, while during 1999 it was 10,814, representing an increase of 12% p.a. (JICA Expert Report, 1999). The attached appendix shows that during May 2001 – April 2002, the total number of trips was 12,015, meaning that a further increase of 5.6% p.a. has taken place since 1999. This recent increase may partly be attributed to the privatisation of the central city area, resulting in better collection performance in this area, from where about 34% of the total city's garbage is now collected.
- Most of the trips to the landfill originate from within KMA comprising an average of 31.6 trips/d, while trips from outside the KMA make up 1.3 trips/d, brought by Harrispattuwa P.S. (majority) and Bata Shoe Co., giving a total of 32.9 trips/d.
- The average number of trips from within KMA shows some monthly variations, ranging from 27.1 to 34.7 trips/d. The highest number of monthly trips over this 12 month period were recorded during July-August (33.7-34.7 trips/d). The Esala Perahera festival takes place over a 10 day period around this time. In 2001, it ran from 23 July to 6 August, with the daily number of trips over this period increasing to around 40-51 trips/day.
- The average daily tonnage of waste brought to the disposal site from within KMA is 74.8T/d, including 0.6T/d of waste directly hauled to Gohagoda by private vehicles (CTC, LeKandyan Resorts). An additional 2.7T/d is received from outside the KMA.
- Carekleen are bringing an average of 26T/d of garbage to the landfill from Zone 1A using three collection vehicles compared with KMC's 34T/d of garbage, using 10 vehicles from zones 1B to 5.
- Gully sucker waste amounts to around $22m^3$/d.

1.9 Resource Recovery

The KMA recycling/on-site composting system is shown in Figure 1-2, while recycling quantities have previously been summarised. As there are currently no centralised composting facilities within Kandy, this section summarises the recycling sector within KMA in relation to middlemen, NGOs, piggeries and Tri-Star Plastic Industries. More details are given in appendix form.

1.9.1 Middlemen

Twelve middlemen operating within the KMA were identified and interviewed as part of this study. General information on these businesses is tabulated below. All of them are primarily involved in the collection and selling of recyclable materials, with nine having been in business for 15-45 years, with the other three businesses all having started within the last 8-12 months. A total of 33 people (managers/owners, full and part-time workers) are employed by these businesses, representing 24.7 full-time equivalent jobs.

Table 1-14 : Middlemen General Information

Business Name	Manager/Owner, Address	Years of oper-ation	Total Workers		Recyclables[3] (Rs/mth)	
			Total	FTE	Purch-ases	Sales
MM1: Not known	K Kanagasundari, 314 Matale Rd, Katugastota	1	2	1.5	>22,700	>28,500
MM2: Sarvo Traders	K Saravana, 69 Katugastota Rd, Kandy	1	3	1.4	>10,350	>14,325
MM3: Susila Stores	SS Ganeshan, 25 Katugastota Rd, Kandy	15	2	1.3	>25,900	>38,070
MM4: Kamala Stores	M Pupalan, 495 Peradeniya Rd, Kandy	20	4	2.6	>38,700	>45,700
MM5: Ganei Stores	HMM Ashrop Alli, 4 Matale Rd, Kandy	40	3	1.4	>16,100	>22,000
MM6: Parana Yakada Kadaya	G Nisardeen, 57 King St, Kandy	45	1	1.0	>2,500	>4,000
MM7: New Vijaya Metal	GA Sami, 229 Colombo St, Kandy	0.67	1	1.0	>33,300	>53,300
MM8: New Kala Traders	KP Muttusami, 211/4 Colombo St, Kandy	17	1	0.9	>20,075	>25,675
MM9: Akka Kade[1]	P Puwana, 51/3 Yatinuwara St, Kandy	20	4	2.7	>13,080	>18,330
MM10: Sinniya Stores	P Ganeswarem, 56 Yatinuwara St, Kandy	40	2	2.4	>55,750	>69,775
MM11: S.A. Traders	ASM Ishak, 55 Yatinuwara St, Kandy	27	4	4.6	>105,200	>119,200
MM12: Jeewa Trading Co	R Sammugeraja, 35 Aliyagiya Mw, Kandy	20	6	3.9	>45,000	>75,000
Total			33	24.7	>388,655	>513,875

Notes:
1. Akka Kade is the name by which this business is known rather than its formal name.
2. The number of full-time equivalent (FTE) staff is based on a normal working month in the private sector of 8h/d x 26d/mth = 208h/mth.

3. Recyclable materials purchases and sales costs were calculated based on the average quantity of each item collected and sold per month and the average purchase and sales prices. In all cases, purchases and sales data was incomplete as indicated by ">" above. This means that actual purchases and sales will be higher than indicated above.

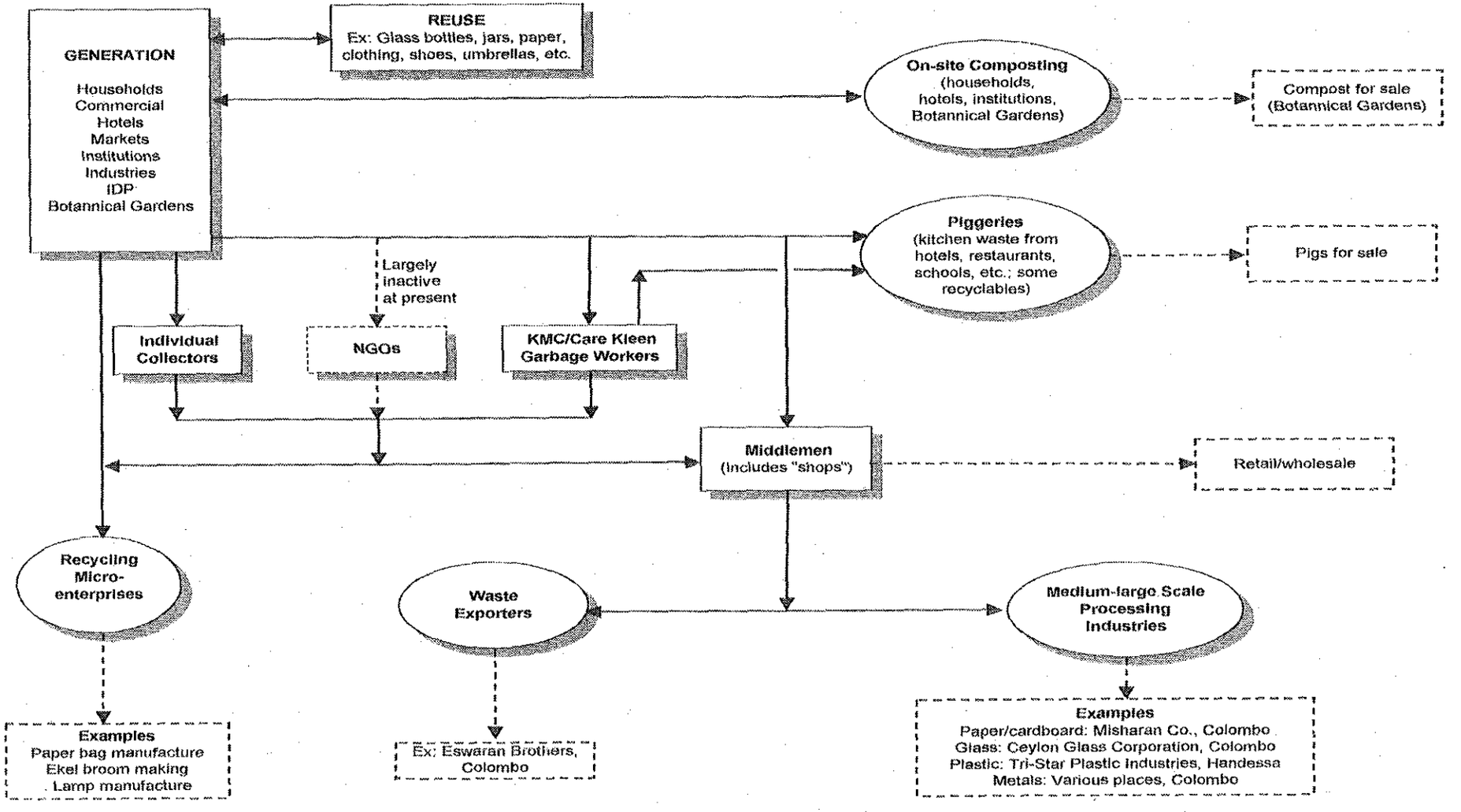


Figure 1-2: KMA Recycling/Composting System

Their estimated monthly expenditure on purchasing recyclable materials is over 388,655 Rs/mth, which shows that the scale of these operations is significant. Corresponding estimated monthly income from the sale of recyclable materials is over 513,875 Rs/mth, representing a markup of 32%. Respondents were generally reluctant to give total expenditure and income information, with three businesses not supplying income details, while other data obtained is not considered very reliable, particularly in four cases where stated income and expenditure were less than the corresponding recyclable purchases and sales figures. The overall net income quoted by businesses ranged from 3,000-20,000 Rs/mth. This is considered a minimum value, for the reasons explained here.

Most of the recyclable materials are brought to them by individuals (11 responses), other middlemen (2 responses), collected by their own workers (2 responses) or by KMC/Care Kleen garbage collection labourers (1 response). Their demand for recyclable materials is generally stable, particularly for paper/cardboard, glass, metals and batteries, while the supply and demand are similar for most materials.

The main sources of most materials is tabulated below and summarised here:

- Households are the primary source for all materials.
- Hotels and hospitals are significant sources of plastics, polythene and bags/sacks.
- Commercial enterprises are a significant source of plastics.
- Industries are a significant source of paper/cardboard, glass and metals.

Table 1-15 : Main Sources of Recyclable Materials

Item	Plastic	Polythene	Bags/ sacks	Paper/ cardboard	Glass	Metals	Batteries	Overall (within KMA)
No of collectors	4	2	3	10	10	12	10	
No of responses	2	1	1	9	9	11	6	
Proportion of Materials Collected from each Source (%)								
Households	32	40	40	43	68	52	95	74
Hotels	16	20	20	0	1	1	0	1.7
Hospitals	8	10	10	0	0	0	0	0.7
Commercial enterprises	19	0	0	2	0	1	0	1.1
Markets	0	0	0	1	2	1	4	2.1
Government offices	0	0	0	0	0	0		1.8
Schools	0	0	0	4	0	0	0	0.0
Industries	0	0	0	43	26	28	0	5.6
Other	24	30	30	7	3	16	1	13
Total	100	100	100	100	100	100	100	100

Notes:

1. Above values are average percentages calculated from the survey data, taking into account the relative quantities of materials purchased by different middlemen, when sufficient data is available to do this.
2. The final column estimates the proportion of recyclable materials collected from different sources within KMA only, assuming 10% of materials from industry are obtained from inside KMA, 80% of materials from other commercial and institutional sources are obtained from inside KMA, with the proportion of materials being obtained from households being calculated by difference so as to get an overall rate of 54% for materials collected within KMA.

Around 54% of these materials are collected from within the KMA, 10% within the Kandy district, 12% within the Central Province, and around 24% from other areas[21].

The total quantities of materials recycled by these middlemen[22] are tabulated below in terms of the material types adopted for this Study, while Table 1-17 provides further details, including purchase and sale prices. This equates to an estimated 1.7T/d. Adjusting this total to allow for additional middlemen operating in the city who were not interviewed and for 54% of these materials being collected from within the KMA gives a recycling amount of 1.5 T/d. The household survey indicated that 3.1% of household waste is recycled, which amounts to 2.6T/d, of which a significant quantity is delivered to these middlemen. The assumption made here is to assume that the household recycling amount already includes materials delivered to the middlemen and hence there is no need to allow for any additional materials recovered by them.

Table 1-16 : Total Quantities of Different Materials Recycled

Materials	Minimum Monthly Quantity	Daily Quantity (kg/d)	Comments
Plastics/ polythene	500kg + 36 barrels/containers + 7,750 bags (mainly polysacks) + = 1,275 kg	43	Relatively small number of barrels/large containers which are generally sold for reuse – hence, not included in daily recycling amount. Bags are either sold for reuse or transported to factories for re-processing – hence, they are included in recycling amount ; measured weight of 1 polysack = 0.1kg => 775kg.
Paper/ cardboard	15.7 T	523	6.4 T old newspaper, >1.3 T old exercise books, > 8 T cardboard
Glass	4.5T broken glass + 21,650 bottles	626	Whole bottles are usually beer or arrack bottles; average measured weight = 0.66kg; 21,650 bottles = 14,289kg.
Metals	13.4T	447	12.7 T ferrous + > 0.44T copper/brass + > 0.25 T aluminium
Old battery cases	1.05T	35	Battery cases are drained and then weighed, being recycled primarily for their lead content.
Total	50.2T	1,674	
Adjusted total	50.2 x 20/12 = 83.7	2,790	There are ~8 other middlemen businesses in KMA that were not surveyed, meaning the total number of middlemen in the city is about 20.
Total collected from KMA	45.2	1,506	54% of recyclable materials collected from within the KMA, according to survey results.

Notes:
1. Refer the following table for further details.
2. Above quantities are minimum quantities, due to the survey purchases data being incomplete.

[21] Percentages are weighted averages, taking into account the relative quantities of materials collected by different middlemen.
[22] As determined from survey interviews. No independent check was made on the accuracy of these quantities.

Table 1-17 : Quantities of Recyclable Materials collected by Middlemen and Corresponding Purchase and Sales Prices

Material	Units	MM1:	MM2: Sarvo Traders	MM3: Susila Stores	MM4: Kamala Stores	MM5: Ganei Stores	MM6: Parana Yakada Kadaya	MM7: New Viyaja Metal	MM8: New Kala Traders	MM9: Akka Kade	MM10: Sinnaiya Stores	MM11: SA Traders	MM12: Jeewa Trading Co	Total			
														Quan -tity	Purch -ase price	Sales price	Units
Plastics																	
Mixed, unwashed	Kg/mth	NA												>0	NA	NA	Rs/kg
Containers/ barrels	No/mth			6				5	25					36	~7-11 800	9-~13 800	Rs ea
Polythene																	
Sorted, unwashed	Kg/mth								NA					>0	NA	NA	Rs/kg
Clean, sorted	Kg/mth								NA				500	>500	5	8	Rs/kg
Bags: Poly, Flour, Poultry feed, Sugar	No/mth							5,500	2,250				NA	>7,750	2.5-5.0	5.5-6.5	Rs ea
Paper																	
Old newspapers	Kg/mth		100	350	100	200		300	350	20		5,000	NA	>6,420	12-17	15-20	Rs/kg
Old exercise books	Kg/mth		NA	150	100			NA	NA	30		NA	1,000	>1,280	1.5-5.0	3.5-7.5	Rs/kg
White paper	Kg/mth							NA	NA	NA		NA	NA	>0	NA	NA	Rs/kg
Cardboard/boxes	Kg/mth	NA						NA	NA				8,000	>8,000	3	5.5	Rs/kg
Bottles																	
Beer/ arrack/ other Bottles	No/mth	500	300	2,000	1,400	1,000		200	250	500	13,500	2,000		21,650	2-6	4.5-7.5	Rs ea
Broken glass	Kg/mth	200	300	NA	1,000	1,000		NA	NA	2,000	NA	NA		>4,500	1-2	1.5-3.0	Rs/kg
Metals																	
Aluminium	Kg/mth	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	100	100	>250	50	60-75	Rs/kg
Beer cans	Kg/mth							NA	NA	NA				>0	NA	NA	Rs/kg
Copper/brass	Kg/mth	100	38	50	100	50	NA	NA	NA	NA	NA	100	NA	>438	50-90	90-100	Rs/kg
Ferrous	Kg/mth	1,500	600	1,500	3,000	500	200	1,500	350	1,000	350	200	2,000	12,700	5-12.5	6-20	Rs/kg
Old battery cases	Kg/mth	300	300	NA	NA	50		NA	NA	200		200	NA	>1,050	6-8	9-10	Rs/kg

Note: NA = no answer

Seven enterprises act simply as retail/wholesale outlets, onselling the recycled materials directly from their shops. Five transport different materials directly to factories, particularly metals, with four of these enterprises transporting their recyclables to places in Colombo, approximately 110-120km away, including S.R. Metal and Piter in Wattala (metals), Misharan Co. (paper, cardboard), Raja Stores in Paliyagoda and other small industries (aluminium, copper/brass). One does some pre-processing (e.g. washing, sorting) and one makes small medicine bags from waste paper.

The main costs incurred by these businesses in their recycling activities are summarised below.

Table 1-18 : Middlemen : Main Costs

Main Costs	Rank				
	1	2	3	4	Weighted average
Buying recyclable materials	11	1	0	0	30.0
Labour	0	2	5	0	12.0
Utilities problems (e.g. electricity cuts or cost, no water, etc.)	0	2	2	4	11.5
Loss of market	0	3	2	0	9.5
High land/building rental costs	1	1	1	2	8.0
Contamination/poor quality of recyclable materials	0	2	1	1	7.0

The main problems faced by these businesses are shown below. One of the major problems is gaining access to credit. Commercial banks and government agencies are not keen to lend them money as recycling is considered an "unreliable" business. Instead, they tend to have an informal credit line through their buyers in Colombo, supplying them with materials when they need money. This tends to create a buyers' market. Whilst it is true that prices for recycled materials can change very rapidly, the fact that nine of these enterprises have been in business for 15 or more years and the scale of their operations suggests that they are reasonable lending propositions. Gaining access to credit could assist in giving these businesses more control over the prices paid to them for recycled materials.

Table 1-19 : Middlemen : Main Problems

Main Problems	Rank				
	1	2	3	4	Weighted average
Shortage of Recyclable Materials	6	3	0	0	21
High land/building rental costs	0	6	3	1	18
Difficulties in obtaining credit	2	0	2	3	12
Other	1	0	3	0	7.5
Utilities problems	1	1	0	2	6.5

Note: "Other" included legal problems (police), transportation problems, having to sell items to pay off debts, a difficult job.

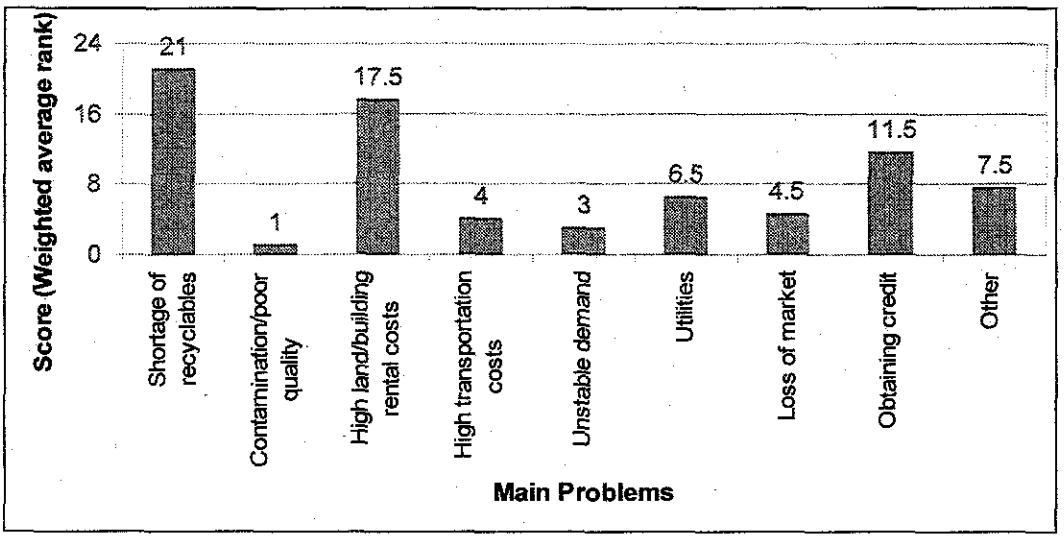


Figure 1-3: Main Problems Faced by Middlemen in Kandy

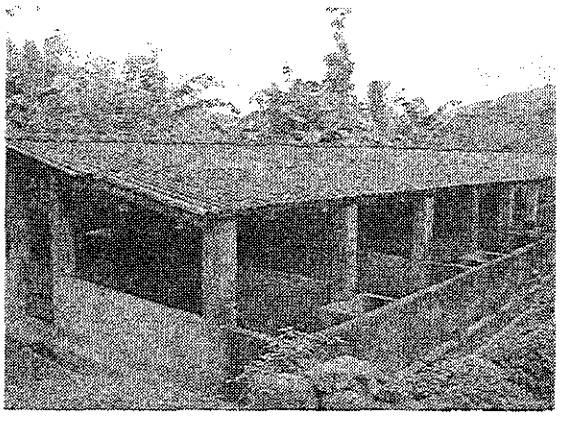
1.9.2 NGOs

There is only one NGO that is currently involved in recycling activities within Kandy - the Centre for Development Alternatives. They started a plastics recycling project in 1998, as part of the Clean River Programme (Pavithra Ganga Programme), but have presently stopped collecting plastics, due to inadequate storage facilities, with their existing storage facility being full of around 3T of plastics. Hence, this link in the recycling system is believed to be largely inactive at present. However, they are continuing awareness programmes, with the cooperation of other NGOs and schools. They hope to be able to resolve their storage problems and would like to establish a plastics processing facility within Kandy due to the high cost of transporting plastics elsewhere for processing and in order to produce higher value pellets, for which they believe there is a ready market.

1.9.3 Piggeries

Some piggeries collect food/kitchen waste from nine hotels, at least one restaurant (Devon), school (Hillwood College), religious institute (Good Shepherd Convent) and government office (Agriculture

Dept) within Kandy, including the Franciscan Brothers, seminary (Ampitiya) and Peradeniya University piggeries.



The Franciscan Brothers Piggery is believed to the largest of these three and was visited as part of this study. It is part of a 10ha farm situated at Ukuwela, about 5-10km from Kandy, which has 250 pigs, 40 goats and also grows coffee, coconut, cloves, pepper and other spices. They shifted to this site from Matale in 1994. Around this time, they approached various large restaurants/hotels in Kandy for their food/kitchen wastes for pig feed, with most places readily agreeing to assist them. They now collect food for their pigs for free from 11 hotels and restaurants within and near Kandy: Devon Hotel (Ampitiya), Devon Rest, Devon Restaurant, Earls Regency Hotel (outside city limits), Hilltop Hotel, Hotel Suisse, Kings Park Hotel, Swiss Residence Hotel, Hotel Thilanka and the Topaz and Tourmaline hotels.

They have a small lorry (capacity =2.7m^3) which they send to Kandy daily around 7am to collect kitchen/food waste, the round trip being about 75-80km, with the lorry returning around 3pm. Normally, they collect about 0.5 truckloads of food/kitchen waste (~415kg/d). During the tourist season this may increase to 0.75 truckloads (622kg/d), which is sufficient to feed all their pigs[23]. At other times, they must supplement the pigs' food. Sometimes during the off season, they may also collect market waste, but this is a lower quality food source than hotel/restaurant waste[24].

Two labourers go with this lorry. They must first separate the hotel/restaurant waste into food/kitchen waste and "others", before loading into the lorry. They also collect plastic/glass/metal bottles/containers/cans from these places, paying for these items in some cases (e.g. 1.0-1.5Rs/glass bottle). They also buy old oil containers from hotels (40-60Rs ea.) and collect coconut shells and waste oil for use as fuel.

Over a two week period, the collect around 30 sacks of glass bottles, one sack of aluminum cans, three sacks of plastic containers and some metal (~10-15kg), amounting to a total of ~29kg/d[25]. These items are sold to a company in Kurunegala, with the income of around 1,500Rs/mth being shared amongst the labourers[26].

[23] A big pig can eat around 20L/d (6kg), with it taking around 10 months from them to grow to around 50-60kg, at which time they are sold for slaughter.
[24] Market waste sometimes contains a lot of fish, which the pigs sometimes refuse to eat.
[25] 30 polysacks bottles @10-15kg/sack + 1 sack cans @2kg/sack + 3 sacks plastic @4kg/sack + 12kg metal = 401kg/2weeks..
[26] Selling prices: glass bottle = 1.5Rs ea; broken glass = 1.5Rs/kg; plastic bottle = 1Rs ea., Aluminium can = 30 Rs/kg, scrap metal = 4 Rs/kg.

The piggery's monthly expenditure is around 55,000-60,000 Rs[27], while monthly income is 80,000-100,000 Rs primarily from the sale of pigs (20-25 pigs @ 4,000 Rs ea). Profits from the pig farm are used by the Franciscan Brothers to help run three orphanages in Sri Lanka.

Waste from the pig farms is currently discharged into a number of pits located within the farm, where it is left to settle/decompose, providing fertilizer for the farm.

1.9.4 Tri-Star Plastic Industries

Tri-Star Plastic Industries[28] are located at No 2 Hapugahayatathenne, Handessa, approximately 15km outside of Kandy. The factory occupies around 10 perches of land (250m^2) and has been in operation for 10-12 years. It is managed by two brothers and they employ around 37 full-time workers and 20-25 part-time workers per month (76 equivalent full-time workers).

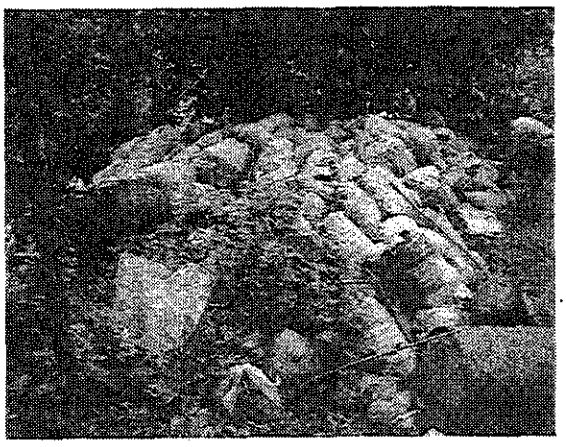
The factory itself is divided into two sections, one of which is currently closed down in order to save costs as recent increases in electricity prices have impacted on the viability of their business[29]. They generally operate the factory in two 12h shifts, running their machines continuously for long periods according to their orders so as to reduce electricity costs, as it takes two hours heating time from off before the pelletiser can be used.

They recycle around 15-20T of clean, sorted plastics (buying price = 12-15Rs/kg), 5T of clean, unsorted polythene (10Rs/kg) and 10T of unwashed unsorted polythene (6-8Rs/kg) and some polysacks per month. These plastics are mainly low density polyethylene (LDPE), high density polyethylene (HDPE) or polypropylene (PP) but also include some nylon.

60-70% of these plastics are obtained from industrial sources, 38-28% from commercial sources (i.e. 98% from commercial/industrial sources) and around 2% from households, with the majority of their plastics being purchased in large quantities by tender from Colombo (60-70%), the remainder coming from Kandy[30] and surrounding areas.

Mixed unwashed plastics are sorted into different types of plastics by experience and then washed manually in large water tanks, with one tonne of mixed, unwashed plastics yielding around 850-900kg of clean plastics, the losses primarily being due to soil, etc. removed during washing. Washing is done on a part-time basis, with one labourer being able to wash around 20-30kg/d, meaning washing costs amount to ~5-10Rs/kg.

[27] Total number of labourers is 4, with the other two working at the piggery. They are paid 3,500 Rs/mth and provided with food.
[28] Al-Haj M.R.M. Minhaj; Tel: 070-801707; mob 071-741362
[29] The building is registered as two separate buildings, being inherited by two brothers from their father, meaning that they have to pay two assessment taxes and have two separate electricity connections for each section of the building.




They have a single pelletiser machine which can process about 1,500kg/d (100-120kg/h) and separate machines[31] for making LDPE (capacity =60kg/h) or HDPE (capacity =30-40kg/h) rolls. They either sell the pellets/rolls or use them to manufacture a range of other products (e.g. bags, bangles, toys, suitcase handles, nursery bags, drinking straws, etc.). Typically, they sell around 5T/mth of pellets (@45-50Rs/kg) and 25T/mth of rolls/products (various prices) to individuals, commercial enterprise and other plastics manufacturing industries located in Colombo (main customers), Kandy, Kurunegala and Matale.

Total monthly expenditure was stated to be around 580,000Rs, while total and net income figures were not provided. However, purchases and sales data indicates a net return on purchases of at least 180,000 Rs/mth (excluding electricity, labour, etc.). Actual monthly expenditure and net income are considered to be higher than these stated figures.

[30] This works out to be around 380kg/d from Kandy and surrounding areas. It is assumed this amount is already included in the other estimates of materials recycled at various places.
[31] These machines were purchased for ~5M Rs, with a loan from Small & Medium Industries.

Their main operating costs are electricity and labour and the costs of buying the waste plastics and other raw materials. For example, they import "masterbadge" – a titanium/calcium carbonate pigment from Taiwan at a cost of 300Rs/kg so as to be able to manufacture different coloured plastic items.

Their biggest problem is the high cost of electricity. Other problems include a shortage of machine operators, while the working space within the factory is very confined, increasing the risk of a possible accident. They believe the government should be trying to encourage recycling based industries by providing some form of subsidies or other incentives, as they are doing a service for the country.

Chapter 2

KMC SWM System – Additional Details

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Chapter 2 KMC SWM System – Additional Details

This section provides supplementary information to that in the main report concerning different aspects of KMC's SWM system. The majority of this data was collected during May – July 2002, with essential items having been updated since then, as stated in the text.

2.1 Waste Management Equipment – Detailed Data

Table 2-1: Waste Management Vehicle Fleet and Supporting Equipment (2003)

Vehicles/ equipment	No	Use (Capacity)	Registration	Regis-tration date	Cost	Approx. Life (yrs)
Handcarts	70	SWM collection, road and drain cleaning (0.42m^3, 0.12T)	Not applicable	Not applicable	Current: 8,500	3-5yrs (with repairs)
Four wheel tractors (4WT)	14	5 – SWM 2 – markets 2 – IDP 1 – conservancy 4 – spare (+ 5 scrap, being used for spare parts - included in list)	36-8254 37-1525 37-1526 37-1528 37-5165 37-5685 37-7171 37-8181 37-8593 37-8576 37-8577 49-4578 49-4624 49-4625 49-4626 49-8897 49-8898 270-1207 270-1208	29/2/1980 27/4/1982 27/4/1982 27/4/1982 28/4/1985 19/3/1986 5/12/1988 23/5/1991 20/08/1991 14/11/1991 14/11/1991 30/6/1995 27/7/1995 27/7/1995 27/7/1995 28/10/1997 28/10/1997 10/2/1999 10/2/1999	No data 175,000 175,000 175,000 221,300 215,500 385,500 525,000 525,000 525,000 525,000 655,000 663,500 663,500 663,500 No data No data 964,000 964,000	15-20 yrs
4WT Trailers	17	5 – SWM collection 3 - Central market 1 - Menikkumbura market 1 – Katugastota hospital 1 – Conservancy 2 - drain/street sweepings and tree cuttings (under Works dept) 3- spare 1 – trailer bowser (+ 13 scrap, being used for spare parts/metal, 10 of which are included in list) (mainly 6.7m^3; some 2.1m^3; ~1.9-2.5T, depending on contents)	44-7180 45-4127 45-4169 45-4201 46-0532 46-1003 46-2642 46-2643 46-3392 46-3093 46-3390 46-3391 46-3578 46-3960 46-3961 46-7532 46-7535 46-7537 67-0918 67-0919 67-2584 67-2585 67-2586 67-2587 CPGI-5273 CPGI-5276 CPGI-5277	4/5/1976 28/7/1980 28/7/1980 28/7/1980 29/4/1985 19/3/1986 15/12/1988 15/12/1988 20/12/1989 20/12/1989 13/6/1991 13/6/1991 20/8/1991 26/6/1992 26/6/1992 27/7/1995 27/7/1995 27/7/1995 16/12/1997 16/12/1997 30/3/1999 30/3/1999 30/3/1999 30/3/1999 9/8/2001 9/8/2001 9/8/2001	11,600 26,300 26,300 No data No data No data No data 70,000 No data 57,300 84,000 84,000 No data No data 104,800 No data No data No data No data No data No data No data No data No data 329,250 329,250 329,250	8-10yrs

Vehicles/ equipment	No	Use (Capacity)	Registration	Regis-tration date	Cost	Approx. Life (yrs)
Compactor	5	SWM collection ($3.7m^3$, 2.3T capacity)	47-2904 + 4 others	13/12/1994 Not known	4,080,000 Not known	8-10yrs
Pickup	1	Scavenging Superintendent use	42-6984	10/1/1991	724,000	8-10yrs
Gully suckers	3	Septic tank/public toilets emptying (1 x 3,500 L; 2 x 7,000 L)	42-7551 CPGI-1755 CPGI-2578	10/6/1991 23/7/2001 25/7/2001	2,250,000 4,240,000 6,270,000	8-10yrs
D4C Bulldozer	1	Final disposal site operations (80hp net)		7/9/2001	6,447,000	8-10yrs

Notes:

1. There are four spare tractors, some of which may also be used by the Works Department, if any of their tractors are out of action.
2. Handcart dimensions are 4ft x 2.5ft x 1.5ft. Estimated lifetime was 1 year, without repairs.
1. Average vehicle ages: 4WT = 13.8yrs; trailer = 12.2yrs.
2. Four wheel tractor trailer dimensions are nominally 10ft x 6ft in area and of variable height (e.g. IDP trailer = 1.5ft high; SWM collection = 4ft high).
3. Formerly, an additional small compactor (2T) was hired at a cost of 82,000 Rs/mth and used in the Katugastota area (zone 4). This arrangement has now been terminated.
4. Trailers come with a 1 yr guarantee. Panel boards require replacement every 2-3 yrs. Usually they only patch holes - complete panel board replacement costs ~20,000 Rs.
5. KMC's first compactor was purchased in Dec 1994 and is still in good condition, with the first major repairs only being required last year (replacement of sprocket wheels).
6. Four reconditioned compactors were obtained in July 2002.

2.2 Waste Management Staff and Equipment Breakdown

KMC staff and equipment involved in different aspects of waste management are described here.

2.2.1 *SWM (Garbage) Collection*

KMC's collection labour force and equipment comprises:

- 70 handcarts, five four wheel tractors (4WTs), five $3.7m^3$ compactor trucks and 10 trailers.
- 13 Supervisors.
- 12 drivers (five for 4WTs, five for compactor, one for Scavenging Superintendent vehicle, one for MOH).
- 205 labourers (192 permanent, 13 casual).

2.2.2 Market and Slaughterhouse

Garbage collection and cleaning of Kandy's public markets and slaughterhouse is administered by the KMC Veterinary section, except for the Central Market wholesale section. KMC Veterinary section staff involved in this work are summarized below.

Table 2-2: KMC Veterinary Section Market Waste Management Staff

Location	Position	Number
Overall management	Veterinary Surgeon Market Superintendent	1 1 (vacant)
Central Market	Market Inspector Supervisor Labourers	1 1 10
Menikkumbura Market	Acting Supervisor Labourers	1 11
Other public markets	None	0
Slaughterhouse	Supervisor Labourers	1 3

The Health department is responsible for cleaning of the former Central market wholesale section which is now occupied by a large number of unofficial traders and for the transportation of market garbage from the Central and Menikkumbura markets to the Gohagoda landfill. Corresponding staff and equipment are:

- Central market: one tractor, three trailers (fish market, carpark and pineapple area); one Supervisor and 10 labourers.
- Menikkumbura market: one tractor and one trailer.

2.2.3 Infectious Disease Prevention (IDP) Services

Infectious disease prevention (IDP) services cover pesticide spraying and filling in areas of stagnant water, drain cleaning and weeding, and transportation of sediment, weeds, etc. removed from drains to the disposal site. IDP equipment and staff comprise two tractors and trailers, three supervisors, two tractor drivers and 79 labourers. However, 17 of these labourers are currently assigned to MSW collection, while another 12 serve as peons (office assistants), reducing the actual number of current IDP labourers to 50.

2.2.4 Septic Tank and Toilet Emptying Services

These services include:

- The management and maintenance of public toilets.
- The provision of gully sucker services within the city and to some areas outside the city on request.
- The provision of "Conservancy" services, relating to the collection and disposal of bucket toilet waste, clinical waste from Peradeniya and Kandy General hospitals and some fish/meat waste from Central and Menikkumbura markets.

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

- 37 public toilets, of which 35 are in use with two not yet completed. Three of these are operated by a private contractor. They are also currently building a new public toilet block at the Menikkumbura market.
- Two houses with bucket toilet systems, which require daily emptying.
- Three gully suckers and one "conservancy" tractor (a tractor with a covered trailer which carries waste buckets to the landfill).
- Two supervisors, three gully sucker drivers, one conservancy tractor driver and 29 labourers.

2.3 Waste Collection/Disposal Fees – Additional Information

2.3.1 Waste Disposal Fee Payment System

Any private parties, other than Harispattuwa PS, taking waste to the KMC landfill site at Gohagoda for disposal, must first pay the disposal fee at the KMC office premises, upon which they are issued with a

receipt, which they then present to the landfill office before disposing of their garbage. Generally, they pay for a number of loads at one time, which are then used over the next few months. The main private parties and corresponding trips data are listed below.

Table 2-3: Main Private Parties Taking Garbage Directly to Landfill

Location	Customer	Total loads (May-01 - Apr-02)	Range in monthly loads (loads/mth)
Within Kandy Municipal area	Ceylon Tobacco Co. (CTC)	89	1 – 17
	Le Kandyan Hotel	41	1 – 4
	Ceylon Electricity Board (CEB)	3	0 – 2
Outside Kandy Municipal area	Bata Shoe Factory, Ambattane	34	0 – 6

Notes: Disposal site fees (within KMA) = 300 Rs/load for four wheel tractor and 500 Rs/load for trucks within KMA. Corresponding fees for outside KMA are 400 and 600 Rs/load. Rates exclude GST.

2.3.2 SWM and Gully Sucker Income

Monthly SWM and gully sucker income over the period May 2001 – April 2002 is summarised below, together with gully sucker charges.

Table 2-4: KMC SWM and Gully Sucker Income

Month	SWM Income	Gully sucker income	Total income
May 2001	6,681.5	107,760	114,442
Jun	2,153.5	115,080	117,234
Jul	6,500.0	136,450	142,950
Aug	6,450.0	126,350	132,800
Sep	2,400.0	71,100	73,500
Oct	4,534.0	101,200	105,734
Nov	5,750.0	105,700	111,450
Dec	2,750.0	85,200	87,950
Jan 2002	2,000.0	124,425	126,425
Feb	21,650.0	112,700	134,350
Mar	1,750.0	76,570	78,320
Apr	8,800.0	73,680	82,480
Total	**71,419.0**	**1,236,215**	**1,307,634**

Table 2-5: Gully sucker collection charges

Gully sucker charges	Location	Residential	Business and government	Religious
Small gully sucker (1 x 3,500L)	Within KMA	800 Rs/load	1,500 Rs/load	350 Rs/load
	Outside KMA	1,200 Rs/load + 60Rs/km	2,250 Rs/load + 60Rs/km	500 Rs/load + 60Rs/km
Large gully sucker (2 x 7,000L)	Within KMA	1,000 Rs/load	2,000 Rs/load	500 Rs/load
	Outside KMA	1,500 Rs/load + 60Rs/km	3,000 Rs/load + 60Rs/km	750 Rs/load + 60Rs/km

Notes: Rates are for septic tanks/latrines and exclude GST of 12.5%. Separate rates apply for "wastage water" (greywater): 600 Rs/load and 750Rs/load within and outside the city limits respectively.