



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

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

ACTION PLAN FOR NEGOMBO FINAL REPORT Volume V-6B SUPPORTING REPORT

DECEMBER 2003



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ON IMPROVEMENT
OF SOLID WASTE MANAGEMENT
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IN SRI LANKA**

ACTION PLAN FOR NEGOMBO

FINAL REPORT

Volume V-6B

SUPPORTING REPORT

DECEMBER 2003



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This is Action Plan for Negombo, Supporting Report.



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

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List of Abbreviations

CDA	Community Development Assistant
CDO	Community Development Officer
CEA	Central Environmental Authority
DEO	Divisional Environmental Officer
DF/R	Draft Final Report
EIA	Environmental Impact Assessment
F/S	Feasibility Study
GDP	Gross Domestic Product
IC/R	Inception Report
IDP	Infectious Disease Prevention
IEE	Initial Environmental Examination
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
MOH	Medical Officer of Health
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
NMA	Negombo Municipal Area
NMC	Negombo Municipal Council
O&M	Operation and Maintenance
PDM	Project Design Matrix
PHI	Public Health Inspector
POS	Public Opinion Survey
P/R	Progress Report
S/W	Scope of Work
SWM	Solid Waste Management
WTP	Willingness to Pay

Chapter 1

Negombo Waste Stream Data

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Chapter 1 Waste Stream Data

1.1 Introduction

This section summarises information collected from field investigations carried out between July-August 2002, undertaken primarily to quantify the waste stream for the Negombo Municipal Area (NMA). It complements and provides further information concerning the waste stream data, assists in understanding the present NMA solid waste management (SWM) system and identifies some issues that do or may need to be addressed at some stage in the future.

1.2 Households

Household statistics were obtained from the provisional results of the July 2001 Census. These gave a total population for the NMA of 144,551 people living in 32,122 households, which equates to 4.5 people per household.

Negombo is believed to have a relatively low floating population, with the daily influx of people into the city from outside being offset by the large number of workers leaving the city each day for work at the International Airport, in the Katunayake Free Trade Zone, Ekala Industrial Zone, or in Colombo (~20% of workforce), while an additional 20% of fishermen work outside the city during the off-season (6mths)¹. Based on a working population of 56,710 (UDA Draft Development Plan) of whom 82% are employed and 30% work in fishing, this gives an average of 12,737 people leaving the city each day².

Information on household waste generation and management practices was obtained from a survey of 150 households in six different areas of Negombo and Kochchikade, covering two high, two middle and two low income areas. 96% of the surveyed households are located in areas where the garbage is collected by NMC, but only 52% stated they actually use this service. There are other areas of NMA that do not receive a garbage collection service at all. The overall garbage collection service coverage (population basis) is estimated to be 80-90% in Negombo and 60-75% in Kochchikade, while service coverage in the unsurveyed Thalahena area is 14% (Duwa area only).

Hence, these survey results were adjusted to account for the other parts of the city not provided with a garbage collection service in order to estimate the proportions of garbage disposed of by different means for the entire NMA. The corresponding results are summarized below.

The waste generation rate for Negombo was estimated based on the Kandy value of 0.545kg/cap.d, increased to 0.624kg/cap.d to account for differences in garden waste generation³. In Negombo, mixed collection vehicle garbage comprised 22.8wt% garden waste, compared with 11.7wt% in Kandy. This difference is attributed mainly to higher garden waste generation in Negombo, rather than higher garden

¹ Source = NMC CPHI

² $0.5 \times 0.2 \times (0.3 \times 0.82 \times 56,710) + 0.2 \times 56,710$

³ $0.624 = 0.525 \times (100-11.7)/(100-22.8)$, assuming non-garden waste generation is the same in both cities.

waste collection. This is believed to be due to the different climate and abundance of coconut trees in the coastal belt. Coconut trees produce a lot of palm and leaf waste, while coconut palms are also used by many low income households as roofing and fencing material, which requires regular replacement. The household survey supports garden waste generation being higher in Negombo with 81% of surveyed households indicating they produce garden waste compared with 66% in Kandy and 53% in Matale.

Table 1-1: Household Waste Management

Item	H'hold Survey Data	Statistics (2001)				NMA - Estimated for 2002
		Negombo + Kochchikade	Duwa	Thalahena (Other)	Total NMA	
Population (2001)	~750	81,001 + 40,641 = 121,642	3,198	19,711	144,551	146,864
Service coverage (%)	96	79	100	0	69	69
Method	Waste Management (%)					Amount (T/d)
Self-disposal	40.8	47.8	25.8	59.4	48.9	44.8
Discharge for MMC collection	45.1	35.7	45.1	0	31.0	28.4
Home composting	4.8	5.6	4.8	8.7	6.0	5.5
Recycling	2.7	3.1	2.7	4.9	3.4	3.1
Illegal dumping	6.6	7.8	21.6	27.1	10.7	9.8
Total	100.0	100.0	100.0	100.0	100.0	91.6

Notes:

Detailed calculations are set out in "Negombo Waste Stream Analysis". Note that the Duwa and Thalahena illegal dumping % has been increased, while the self-disposal % has been decreased by the same amount to account for illegal dumping being expected to be much more common in these areas due to the absence of any garbage collection service and their proximity to both the lagoon and sea.

Estimated 2002 population based on a compound growth rate of 1.6% (see "Negombo Waste Stream Analysis").

Total household waste generation = 146,864 persons x 0.624kg/person.d = 91.6T/d.

Waste amounts disposed of by different means calculated using total waste generation x adjusted percentages in above table, which relate to the entire NMA.

Household waste is expected to be mainly organic, as in Kandy and Matale, but with a higher proportion of garden waste.

1.3 Commercial Sector

1.3.1 Commercial Enterprises

Commercial enterprises covers all commercial operations (e.g. restaurants, bakeries, retail shops, communications centres, banks, hotels, etc.) except for markets, which is classified as a separate category. This includes government or semi-government enterprises that operate commercial oriented businesses and services (e.g. banks, Post Office, Water Board, etc.)

According to UDA data⁴, 71ha (3.1%) of NMA (Negombo and Kochchikade only) is used for commercial activities, excluding hotels, most of which is concentrated in the Negombo and Kochchikade town centres. No additional commercial land use data was available for Thalahena but commercial activity in this area is believed to be relatively small.

⁴ Draft Development Plan Negombo MC (1999).

NMC data gives a total of 2,086 “business centres” within NMA, which is roughly consistent with individual trade licence data for the Negombo, Kochchikade and Thalahena areas. Excluding 487 market stalls, 25 tourist hotels and 139 industries whose waste is discussed under separate categories, this gives a total of 1,360 commercial enterprises. These comprise ~123 bakeries, pastry shops, “small hotels” (cafeterias/canteens) and restaurants, the Super Market in Greens Rd (184 mainly retail shops), an estimated 40 large waste generators (e.g. Main Post Office) and 1,013 small enterprises.

Limited specific investigations were undertaken for commercial enterprises as part of this study, involving interview surveys of 18 small and 12 large commercial enterprises, covering 10 retail/wholesale shops, 10 small hotels/restaurants, two hairdressers, a pharmacy, tailor, communications centre, bank, grinding mill, plant nursery and the Main and a Sub Post Office. Estimated garbage generation and composition, based on the four most common waste types, are summarized below.

Table 1-2: Commercial Enterprises Waste Generation and Composition

Source	Estimated waste generation (kg/d)	Most common waste types
Small enterprises (18), including one small hotel	0.2 – 10	PI > Pa > F/K > Ca > In
Large retail/wholesale/ service (3)	1 - 165	Pa/PI > F/K
Small hotels/restaurants (9)	10 – 100	F/K > Pa/Ca > PI

Notes:

Waste generation amounts were estimated by the survey respondents. Such estimates are generally not very accurate, but give an indication of the amount of waste generated.

Waste types: Ca = cardboard, F/K = food/kitchen, In = inerts, Pa = paper, PI = plastics.

Commercial waste generation is estimated to be 13.5T/d, based on survey data together with discussions with NMC Supervisors, giving a waste generation rate of 9.9kg/enterprise.d.

Waste generation increases approximately 0.5-3 times on average during festivals/ special occasions.

Three commercial enterprises produce very small quantities of hazardous waste, comprising ~150-200 razor blades per month from two hairdressers and a small quantity of aerosol cans from a furniture retail shop, all of which are disposed of with their normal garbage.

Most of these enterprises discharge their garbage for collection by NMC, except for a few places that burn some or all of their waste on site (e.g. Main Post Office, Sheree Land Restaurant). The National Savings Bank and the Greens Rd Super Market recycle about 275kg/mth and 150kg/mth of cardboard respectively, while two small hotels/restaurants give away about 340kg/mth of food/kitchen waste for animal feed. Several other places sell recyclable items (glass/plastic bottles/containers, tins to individual collectors on monthly basis.

Based on this information, it was estimated that 92.1% of commercial waste is collected by NMC, 4.2% is disposed of on-site primarily by burning (e.g. paper waste) and 3.7% is recycled.

1.3.2 Markets

Negambo has five main (four public and one private) meat/fish, fruit and vegetable markets. Two are located in Negambo city centre, one near the beach (fish market, Wella Veediya), while the Kochchikade Central Market is situated in Kochchikade town centre. The main fish market, “Lellama”, is located in Pitipana. These markets mainly produce organic waste. They comprise a total number of 962 active stalls. There are five “Pola” located in Kamachchodae, Greens Rd, Kochchikade and Munnakkaraya (Aliya pola and another small pola) (refer following two tables).

The Super Market, located in Negambo city centre, has been included in the “commercial enterprises” category, due to it comprising mainly retail shops selling goods rather than fresh meat, fish, fruit or vegetables. It contains a total of 184 active stalls.

There is also one public slaughterhouse at Thaladuwa Rd. The slaughterhouse is very small, as most of Negombo’s meat is brought into the city from outside. Hence slaughterhouse waste generation is assumed to be negligible.

Table 1-3: Public and Private Markets Details

Market	Number of stalls					SW collection/ disposal
	Meat /fish	Veg/ fruit	Goods	Other	Total	
Lellama fish market :						
Wholesale	100	0	0	0	100	Disposed into lagoon
Retail	300	0	0	0	300	
Dudley Senanayake Central market	0	100	60	4	164	NMC
Fish market (Wella Veediya, beach)	125	30	3	15	173	15kg/d disposed to sea, 30kg collected once/wk by NMC; some recycling
Bandula market (private)	79	80	7	1	167	NMC; minor recycling
Kochchikade Central market	24	11	8	15	58	NMC
Total	628	221	78	35	962	
Super Market, Greens Rd	0	0	116	68	184	NMC; some recycling

Notes:

Stall numbers are based on currently functioning market stalls, as determined during JICA field surveys. Stall space is available at some of these markets but is not currently being utilized, including:

Dudley Senanayake central market: 10 additional stalls currently closed.

Kochchikade central market: 8 stalls are currently closed.

Table 1-4: Pola Details

Pola	Number of stalls					SW Collection
	Meat /fish	Veg/ Fruit	Good	Other	Total	
Kamachchodae (Sun & Wed)	23	300	300	5	628	Mon/Thu by NMC, Tue/Sat-own collection
Greens Rd night pola (Sat)	0	100	350	0	450	NMC
Kochchikade pola (Sun)	Not known				325	NMC
Aliya Pola (daily)	0	23	0	0	23	NMC
Munnakkaraya pola (daily)	0	10	0	0	10	NMC
Total	23	433	650	5	1436	

Notes: Stall numbers are based on currently functioning stalls, as determined during JICA field surveys and information from the market supervisors. 10 additional stall spaces are available at Kamachchodae Pola but not currently being utilized. Some information was obtained from the NMC revenue section. Greens Rd, Kamachchodae and Kochchikade polas have been leased by tender for one year.

An average 5,163kg/d of market waste is generated by all of the permanent markets, of which 3,045kg/d is collected by NMC tractor. The Lellama fish market disposes about 1-3T/day of fish waste into the lagoon, as they do not receive a collection service, while the Wella Veediya fish market only has their waste collected once per week, resulting in them disposing about 75% of it (15kg/d) into the sea. About 100kg/d of fish waste is recycled from the Lellama fish market for crab food, while around 50kg/d is collected from the Badula market on an irregular basis for pig food.

There are five "pola" in Negombo. Pola waste generation averages 3,484kg/d, but varies during the week, ranging from 627-9,870kg/d, as three of the Pola are only open 1-2 days/week (refer sub-sections for waste generation details for each Pola). All Pola waste is collected by NMC.

Total market waste generation, is estimated to be 8.7T/d, of which 75.5% is collected by NMC, 23.3% illegally dumped and 1.2% recycled.

Market waste generation shows some seasonal changes, increasing by 50% at the Wella Veediya fish market and by 10% at the Lellama fish market at certain times of the year. Market waste generation may increase by 50-100% during the festival season.

Additional information on markets and the slaughterhouse is set out in the following sub-sections.

1.3.2.1 Lellama Fish Market

This market is mainly a wholesale market, comprising 300 wholesale and 100 retail stalls. The market is open six days per week, from 3am-11am. The market land is owned by St. Mary's Church and the market is managed by the Negombo South Fisheries Cooperative Society. This society is responsible for waste collection and cleaning within the market. They employ one Market Inspector and two labourers from 7.30am - 5.00pm for this purpose.

The market produces 1,000-3,000kg/day of waste, with an additional 100kg/d being recycled as crab food.

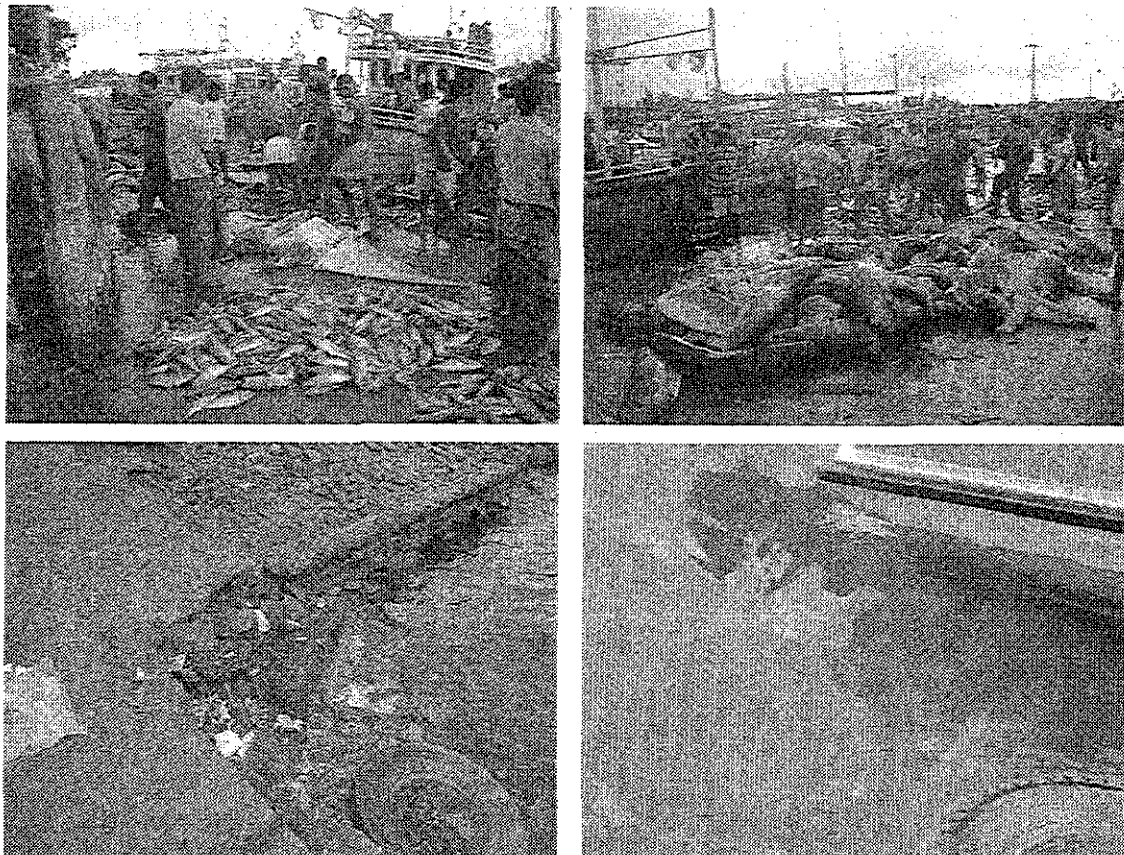
The labourers clean and wash the market after 11am, discharging the waste to the lagoon. The market has no piped water supply and they rely on a pump to extract groundwater for market use.

Market garbage collection problems include:

- Disposal of their garbage to the lagoon. The Cooperative Society would like to improve their present disposal method, preferably being provided with a garbage collection service by NMC.
- No continuous water supply, as although they have a pump, the more often breaks down due to irresponsible use by fishermen. They would like a pipeborne water supply, which is cheaper and easier to handle.

Next to this market, there is another fish market which opens after 2p.m. Sea St Church owns this market, which is managed by the United Fisheries Society. This market was not surveyed as their waste

is also disposed to the lagoon, together with Lellama market waste. Hence, it was assumed that the 1-3T/d of waste generated at Lellama market also includes waste from this market.



Lellama market – waste generation and discharge

1.3.2.2 Dudley Senanayake Central Market

This market comprises 164 mainly retail stalls. It is open seven days per week, from 5.30am–8pm. NMC is responsible for waste collection and cleaning within the market. They employ two Market Inspectors (Supervisors) and three labourers in two shifts for this purpose. The morning shift involves one labourer, while two labourers work on the evening shift, which begins at 2pm. Around 800kg/d of market waste is collected by NMC tractor the following morning. The market supervisor is satisfied with the present waste management system.

1.3.2.3 Wella Veediya Fish Market

This market is a wholesale/retail fish market, comprising 173 stalls. It is open six days per week, from 7am–2pm. This market is managed by the Sea St Church. NMC clean the market but only collect about 30kg of waste once a week, employing one labourer for this purpose. Hence, another 15kg/d of fish waste is discharged to the sea, due to the low frequency of the NMC collection service.

1.3.2.4 Bandula Market

This is a private retail market, comprising around 167 stalls. It is open seven days/wk from 6.30-8pm except on Sundays (10.30am-3pm). NMC is responsible for collecting waste from the market, but the owner employs one Market Supervisor and one labourer for cleaning and waste collection within the market.

There is a concrete collection bin located in the fish section, which the labourer discharges market waste into. NMC collects about 640kg/d of waste from here and also does drain cleaning. About 50kg/mth of fish/vegetable waste is collected by a piggery farmer. The traders are satisfied with the present waste collection system.

1.3.2.5 Kochchikade Central Market

This market is mainly a retail market, comprising 58 stalls. It is open seven days per week, from 6am-8.30pm. It produces about 1,600kg of waste per day. The Kochchikade Sub-Office of NMC is responsible for cleaning and waste collection within the market. There are four half barrels in the market for waste discharge. The labourers wash the fish section every night, while NMC collects waste twice daily. The market supervisor is satisfied with the present waste management system.

1.3.2.6 Kamachchodae Pola

The Kamachchodae Pola is held twice weekly, on Wednesdays and Sundays from 5am to around 3pm. This comprises 628 stalls (additional 10 stalls are currently closed). Waste generation is 6,400kg/day. This Pola has been leased for a one year period for 42,021Rs/day on Wednesdays and 67,253Rs/day for Sundays.



1.3.2.7 Greens Rd Night Pola

The Greens Rd night pola is held on Saturdays from 5am to 10pm. It comprises 450 stalls and generates 4000kg/day of waste. This is also leased for a one year period for 44,100Rs/day.

1.3.2.8 Kochchikade Pola

The Kochchikade pola is held on Sundays from 4am to 2pm. It comprises about 300-350 stalls and generates about 3,200kg/day. It has been leased for a one year period for 34,965Rs/day.

1.3.2.9 Other Pola

Two daily pola, the Aliya Pola and another small pola at Munnakkaraya, generate about 528kg/day and 99kg/day respectively.

1.3.2.10 Slaughterhouse

Negombo has a small public slaughterhouse that is open from 6am-6pm. Only one-two butchers slaughter their meat here, with most traders bringing meat into the city from outside. One Supervisor certifies any meat killed here as suitable for human consumption, while two labourers are employed for cleaning (one from 6am-2pm, one from 10am-6pm). Some people collect animal manure from the slaughterhouse for use as manure. An early morning visit to the slaughterhouse found it to be locked with no one present. Due to the small scale of its activities, waste from the slaughterhouse has been assumed to be negligible.

1.3.3 Tourist Hotels

1.3.3.1 Waste Stream Data

UDA data indicates 18.3ha (0.80%) of Negombo and Kochchikade is allocated for hotels. There are approximately 25 tourist hotels⁵ within NMA, all located in Negombo or Kochchikade. 21 of these were interviewed as part of this study. They employ 1,276 staff on average, while guest numbers increase from an average of 611 guests/d to a peak of 1,687 guests/d, the peak season generally running from Nov/Dec to Apr/May. Total guests and staff are estimated to be 1,887/day.

Hotel waste generation was estimated to range from 5-700kg/d, giving a total waste generation of 4.1T/d, equivalent to 2.2kg/(guests+staff).d. Waste generation may increase by 0.5-2 times during the peak season and on special occasions (e.g. weddings, parties, conferences).

Food/kitchen and garden waste are by far the most common waste types, followed by paper and plastics. 14 hotels produce relatively small quantities of hazardous wastes, comprising aerosol cans, batteries and fluorescent tubelights, although Browns Beach Hotel stated they produce around 40 fluorescent tubelights, 500 light bulbs and 30 batteries per month.

Survey data indicates a wide variety of waste management and disposal methods are used by the hotels, as summarized below:

- 12 hotels have their food/kitchen waste collected from their premises by a number of pig farmers. Dilini Farm collects most to all of seven hotel's garbage, taking the food/kitchen waste to their piggery, together with some recyclables, while discharging the residual waste at a NMC collection point. The total pig food collected from all hotels is estimated to be 893kg/d.
- Nine of the surveyed hotels recycle small to moderate quantities of plastic/glass bottles/containers. The total quantity of materials recycled in this manner from all hotels is estimated to be 101kg/d.

- Four of the surveyed hotels do on-site composting, mainly of garden and food/kitchen waste, the total quantity of materials composted from all hotels being around 20kg/d.
- Five of the surveyed hotels burn/bury a significant proportion of their total garbage on-site, with total on-site disposal being around 497kg/d.
- The Hotel Association tractor collects ~1T/d of garbage from member hotels for direct haulage to the disposal site.
- All other hotel garbage is collected by NMC and taken to the disposal site.

Based on this data, it is estimated that 37.1% of hotel waste is collected by NMC, 24.5% is recycled (mainly food/kitchen waste for pig food), 0.5% is composted, 12.2% is disposed of by burning/burial on-site and 25.7% is taken directly to the disposal site by the Hotel Association tractor.

1.3.3.2 Negombo Hotel Association

The Negombo Hotel Association comprises 16 tourist hotels, 12 of which are located within NMC limits (Golden Star, Camelot Beach, Sunset Beach, Browns Beach, Sunflower Beach, Blue Oceanic, Royal Oceanic, Goldi Sands, Star Beach, Topaz Beach, Catamaran and Club Seaspray) while four are situated outside the city (Raewan Beach (Marawila), Club Dolphin (Waikkal), Farm Village (Uswatakeyyawa) and Ranweli Holiday Village (Waikkal)).

They have their own four wheel tractor and enclosed trailer, which they use for beach cleaning, together with collecting some garbage from member hotels. They started this service, due to dissatisfaction with the garbage collection/cleaning service provided by NMC to the tourist hotels and in the beach area, which is a popular area for tourist and locals.

They employ one driver and two labourers, with the garbage being taken directly to the Kochchikade landfill for disposal. According to the JICA survey, this tractor makes an average of 0.9 trips/d to the disposal site (1.37T/d⁶). Total operating costs amount to about 30,000Rs/mth, which are partly met by a 500Rs/mth garbage collection fee, paid by member hotels.

1.4 Institutions

In this category, the focus of our investigations was on hospital waste, primarily due to the hazardous nature of some of the waste (e.g. clinical, waste, sharps, body parts) generated by this sector. Interviews were also conducted with some schools, other educational institutes, Prison and government offices (including police) in order to estimate the amount and composition of waste generated by these sectors.

1.4.1 General

Interview survey results for institutional waste generation and composition data are set out below.

⁵ Some tourist guesthouses are included in this total.

⁶ Estimated breakdown: 1.04T/d from hotels inside NMA, 0.12T/d of beach litter, and 0.2T/d from hotels outside NMA.

Table 1-5: Institutional Waste Generation and Composition

Source	Waste generation (kg/d)	Most common waste types
Schools (5) and other educational institutes (2)	15-268	F/K > Ga > Pa/Ca
Hospitals (5)	10-509	Pa > PI > Ca > F/K > Ga > HH
Prison (1)	536	F/K > Ga > In
Government offices, including police (5)	1-30	Ga > F/K > Pa/Ca

Notes:

Waste types: Ca = cardboard, F/K = food/kitchen, Ga = garden, Pa = paper, PI = plastics, HH = healthcare hazardous waste, In = inerts.

The number of institutes shown here in brackets may differ in some cases from the number mentioned in the text below. This is because the above number refers to complete interview surveys that were conducted, while the number in the text may be greater than this due to additional information obtained from NMC and/or brief telephone surveys conducted to obtain relevant statistical and waste stream data.

Institutional waste generation increases approximately 0.5-2 times on average, mainly during special functions (e.g. school ceremonies). Three institutions produce very small quantities of hazardous wastes (batteries, aerosol cans).

1.4.2 Schools

Negombo has a total of 37 schools, comprising nine Type 1AB⁷ schools, six Type 1C schools, 15 Type 2 schools and seven Type 3 schools. The total estimated number of students and school staff are 41,360 and 2,273 respectively, giving a combined total of 43,633 students and staff. The student population amounts to 30% of the total 2002 NMA population (146,864).

Interview surveys were conducted with five schools, with additional information obtained from NMC on another school. These six schools include five of the largest schools and their staff and students comprise 35% of the total school population.

Four of these six schools discharge most (2) to all (2) of their garbage for NMC collection, while St Peters College also composts some waste and Maris Stella College burns some garbage on-site. The two other schools burn/bury all their garbage on-site.

This data was assumed representative of waste management practices followed by all schools in Negombo, Kochchikade and Duwa, while for other schools in Thaladena where there is currently no garbage collection service, it was assumed all schools dispose of their garbage on-site.

Based on this data, total school waste generation was estimated to be 3.1T/d, with 73% of this waste collected by NMC, 4.6% composted and 22% burned/buried on-site. This equates to a waste generation rate of 0.071kg/(students+staff).d.

1.4.3 Other Educational Institutes

There are eight other significant educational institutes within NMA, comprising the Science College, Don Bosco Technical College, Kitunana High Education Institute, two international schools and three

⁷ Type 1AB = Years 1-13 (sometimes 6-13) with A level science/commerce/arts; Type 1C = Years 1-13 (sometimes 6-13) with A level commerce/arts; Type 2 = Years 1-11 (up to O-level only).

small institutes. The total estimated number of students and school staff at these eight institutes are 3,734 and 292 respectively, giving a combined total of 4,101.

Interview and telephone surveys were conducted with all eight institutes. Three of these institutes utilize the NMC garbage collection service for most (1) to all (2) of their garbage, while six dispose of some (1), most (1) or all (4) of their garbage on-site. Only one institute, Don Bosco Technical College recycles 300kg/mth of food/kitchen waste for animal feed.

Based on this data, total other educational waste generation was estimated to be 0.18T/d, of which 27.1% is disposed of on-site, 5.6% is recycled and the remaining 67.4% is collected by MMC. This equates to a waste generation rate of 0.044kg/(staff+students).d.

Waste generation was not increased to account for any of the pre-school facilities present within Negombo⁸.

1.4.4 Hospitals

There are five hospitals within NMA area, as well as a number of medical centres/dispensaries. The Maternity Hospital at Thaladena now functions as a Central dispensary. The main survey findings, including hospital statistical data are set out in the following two tables and summarized below:

- The combined hospital facilities in Negombo are :
 - A total of 510 beds.
 - Average bed occupancy equivalent to 452 beds per day (89%).
 - Average total clinical and outpatients of 1,550 patients per day.
 - Total staff of 474.

Corresponding hospital waste generation is estimated to be 0.88T/d, equivalent to 0.356kg/(staff+patients).d.

- Paper is the most common waste type, followed by plastic, cardboard, food/kitchen, garden and hazardous healthcare waste.
- Most normal waste is collected by NMC, except for the Dissanayake Private hospital and Central dispensary (Thaladena), who are not provided with a collection service and dispose of around 64kg/d of their waste mainly by burning.
- Currently, most hazardous healthcare waste is normally disposed of by burning and/or burial on-site, except for the Manthri Nursing Home and Ave Maria Hospital who dispose some-all of their hazardous wastes with normal garbage. However, the Manthri Nursing Home does use a needle burner for sterilizing its sharps before disposal. No hospitals have an incinerator.

⁸ There are at least 12 NMC managed and some additional private pre-schools within NMA.

- Two out of the three hospitals whose waste is collected by NMC are satisfied with the present waste collection system. The Base hospital is not satisfied, mainly complaining about the condition of the NMC trailer they currently use.
- The Base Hospital reuses waste containers. For example:
 - Saline bottles are reused as containers for collecting urine.
 - Penicillin bottles are re-used for blood and urine specimen collection.
 - Cardboard boxes are used as sharps storage containers.
- The Base hospital recycles some of their used plastic/glass/metal containers/bottles and coconut shells. These items are stored and then advertised for sale by auction 2-3 times per year. Indicative data on the quantities of materials sold by tender was obtained from Base Hospital, showing they recycle around 20kg/mth of plastics, 300 saline bottles/mth, 1,500 bottles/mth and 2,400kg/mth of coconut shells. About 240kg/mth of cardboard boxes are reused internally as described above (included in recycling).
- Two hospitals (Manthri and Ave Maria hospitals) pay garbage collection workers an unofficial collection fee ranging from 3,500-6,000Rs/yr.
- Desired SWM improvements ranked in descending order are (numbers shown are weighted average ranks (WAR) for desired improvements):

• Improved garbage discharge system	7.0
• Improved collection frequency	6.0
• Education to change peoples' bad habits	4.0
• Greater recycling/composting of garbage	3.5
• Shorter distance to garbage collection point	3.0
• Inspection of waste management systems in institutes by NMC	2.5
• Improved collection and disposal of hazardous healthcare waste	2.0
- Three hospitals were willing to pay for improved SWM services: Ave Maria Hospital (2,000Rs/mth), Dissanayake Hospital (2,500Rs/mth) and Manthri Nursing Home (2,000Rs/mth).
- All hospitals are very willing to cooperate in separating their waste into different categories for recycling, if requested.

Table 1-6: Hospital General Statistics and Waste Generation

Hospital	Type	No of Beds	Bed occupancy (%)	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
Base Hospital	Govt	437	89	804	325	355	F/K>PI>Ca>Pa>HH	509	1350	Pla -300 Oth - 8	1050kg	Small	Small
Govt Central Dispensary, Thalahena	Govt	4	0	70	100	4	Ga >PI>Pa >F/K>HH	10	4	0	0	0	0
Ave Maria Hospital	Private	40	90	87	30	40	Pa>F/K>GI>Ca>PI> HH	175	Small	NA	NA	Small	0
Dissanayake Hospital	Private	20	90	12	0	50	PI>Pa>Ca>Ga>HH>F/K	54	10	Pla - 4 Oth - 1	20 (no)	Small	0
Manthri Nursing Home	Private	9	98	120	1.7	25	Pa>Ca>PL>HH	10	30	Pla - 4 Oth - 0	Small	0	0
Total		510	89	1093	457	474		758	1,394	Pla - 308 Oth - 9	~1,060 kg	Small	Small

Notes:

Data for hospitals obtained from interviews with relevant staff members of each institute.

Average total number of beds occupied = Sum of (number of beds x bed occupancy rate) for all hospitals = 452.

Waste types: Ca = cardboard, F/K = food/kitchen waste, HH = hazardous healthcare waste, Ga = garden, GI = glass, Oth = other Pa = paper, Pla = placenta, PI = plastic. NA = no answer.

An accuracy check has only been made on the amount of normal waste, with survey data being amended based on NMC Supervisor comments.

Table 1-7: Hospital Waste Disposal Practices

Hospital	Normal waste	Clinical waste	Body Parts and/or placentas	Sharps	Highly infectious	Other	WWTP	Incinerator	Comments
Base Hospital	Collected by NMC except for plastic/glass/metal bottles/containers & coconut shells which are sold by auction, plus some cardboard boxes are reused.	Buried or burned in a cement tank on-site	Body parts and placentas are buried on-site.	Collected separately in cardboard boxes and burned daily	Collected separately and burned daily	Collect separately and burned	Yes	No	Closed trailer desired
Govt. Central Dispensary	Burned and buried on-site	Burned and buried on-site	None	None	None	None	No	No	
Ave Maria Hospital	Collected by NMC or burned	Collected by NMC	Placentas are buried on-site.	Collected by NMC	Collected by NMC	None	No	No	
Dissanayake Hospital	Burned on-site	Burned	Buried on-site	Burned	No answer	None	No	No	
Manthri Nursing Home	Collected by NMC	Collected by NMC	Placentas are buried on site	Collected by NMC	None	None	No	No	