



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 TOWNS
IN SRI LANKA**

**ACTION PLAN FOR NUWARA ELIYA
FINAL REPORT
Volume V-7A
MAIN REPORT**



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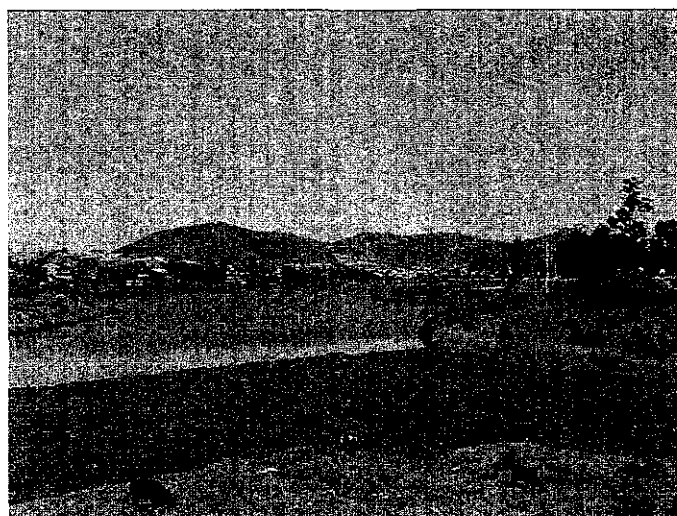
ACTION PLAN FOR NUWARA ELIYA

FINAL REPORT

Volume V-7A

MAIN REPORT

DECEMBER 2003



KOKUSAI KOGYO CO.,LTD.

List of Volumes

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V-7B	Action Plan for Nuwara Eliya, Supporting Report

***This is Action Plan for Nuwara Eliya,
which consists of
Main Report (English),
Main Report (Sinhalese),
and References(English).***

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
CPHI	Chief Public Health Inspector
CEA	Central Environmental Authority
DEA	Divisional Environmental Assistant
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
MGTP	Management Plan
M/M	Minutes of Meeting
MOHALG	Ministry of Home Affairs, Provincial Councils and Local Government
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGO	Non-Governmental Organisation
NEMA	Nuwara Eliya Municipal Area
NEMC	Nuwara Eliya 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
SLILG	Sri Lankan Institute of Local Governance
SWM	Solid Waste Management
WGR	Waste Generation Rate
WTP	Willingness to Pay

Chapter 1 Background Conditions

1.1 Introduction

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

1.2 Basic Fact Sheet

1.0 General Data

1.1	Province	Province
1.2	District	Nuwara Eliya District
1.3	Local Authority Status	Municipal Council
1.4	Location	Central highlands, 180km west of Colombo
1.5	Description	Located in a basin surrounded by steep hills; 1,900m in elevation.
1.6	Nuwara Eliya Municipal Area (NEMA)	15.01 Km ²
1.7	No. of Council Wards	10

2.0 Socio-Economic Data

2.1	Total Population (2001)	27,833 (2002 estimate = 28,201)
2.2	Daily Floating Population	Over 7,200
2.3	Average Population Density	18.5 persons/ha
2.4	Population Growth Rate	1.32% p.a.
2.5	Number of Households (2001)	7,258
2.6	Family Size	3.8

3.0 Overall Nuwara Eliya Municipal Council (NEMC) Data

3.1	Total Cadre (2002)	402
3.2	Total Budget Expenditure (2002)	72,975,000

4.0 Solid Waste Management (SWM)

4.1	Collection Amount (2002)	15.9T/d (5,804 tonnes/year)
4.2	Budget SWM Expenditure (2002)	13,795,000
4.3	Cadre for SWM works (2002)	90
4.4	Ratio of SWM workers to all workers	22.4%
4.5	Ratio of SWM to total expenditure	18.9%
4.6	SWM expenditure per capita	489 Rs/person
4.7	SWM expenditure per tonne waste	2,377 Rs/tonne

1.3 Natural and Social Conditions

Nuwara Eliya is an important town in the Central Highlands of Sri Lanka, being the administrative, commercial and educational centre of the Nuwara Eliya district and with a large Base Hospital. It also plays a major role as a vegetable exchange centre, with agricultural activities featuring prominently within the city and surrounding areas.

Nationally, it is very important as a tourism and recreational area, with as many as 10,000-50,000 local and overseas tourists visiting the city during holidays and long weekends, while visitor numbers may be even higher during the "season" (mid-March to mid-May).

Nuwara Eliya is known for its cool climate and plentiful rainfall, there being nearly 200 days of rain per year, with monthly rainfall exceeding 150mm in all months except for January to April.

Its permanent population is relatively dispersed over a large area, including people living in some very steep areas, while 90% of NEMC and Provincial Council roads are in poor condition with deep potholes and irregular surfaces.

1.4 Main Implications for SWM

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

- SWM services should be of a high quality, due to Nuwara Eliya being a very popular tourist city.
- The influx of visitors during holidays, long weekends and the season creates great demands on SWM and other Council services. It can also be difficult to get the cooperation of this large visitor population in SWM.
- The dispersed nature of the population, steep terrain in some areas and poor conditions of the roads poses challenges for SWM, with different discharge and collection systems possibly being needed for different areas.
- Garden waste generation may also be high due to Nuwara Eliya's climate and the abundant vegetation, plants and trees throughout the city and the high level of agricultural activities.
- The high rainfall means that garbage discharge, storage, collection and transportation systems will need to be protected from the rain.
- The surrounding steep topography and plentiful rainfall can generate a large amount of soil sediment that enters the city's drains requiring regular removal to avoid blockages.

Chapter 2 Current SWM Condition

2.1 Current Waste Stream

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

2.1.1 Waste Stream Terminology

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

Table 2-1 : Waste Stream Terminology

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

2.1.2 Waste Sources

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

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

Table 2-2: Main Waste Generation Sources

Source	Description
Household	Waste generated from domestic activities, including food preparation, cleaning, fuel burning, yard sweeping, gardening and other miscellaneous household wastes (e.g. old clothing, appliances, etc.).
Commercial	Wastes generated by trade, service and some manufacturing enterprises, excluding markets, hotels, guesthouses, industries and farms (covered separately).
Markets	Waste from markets selling a high proportion of vegetables, fruit, meat and/or fish (i.e. Central market, Sunday Pola).
Hotels	Waste from the eight tourist hotels within NEMA.
Guesthouses	Waste from the approximately 50 guesthouses within NEMA.
Institutions	Wastes from schools, other educational institutes, hospitals, government offices (including NEMC), forces (police, police shooting training centre, army camp) and religious places. Hospital waste includes some hazardous items as discussed further below.
Industries	Wastes from garment (2) and eyelash (2) factories and polythene bags manufacturer. Pedro Tea Estate waste was excluded from this study as it is located on the town boundary, while the Ceylon Brewery, located within NEMA limits, is now closed.
Farms	Wastes from major agricultural farms within NEMA, comprising Nazareth Farm, Seetha Eliya government farm and Huejay International (cutflower greenhouse operation)
Other	<ul style="list-style-type: none"> • Waste from Victoria Park and Racecourse (Golf course included under guesthouses). • Road/drain cleaning waste, collected by NEMC labourers.
Construction and demolition	Wastes originating from construction, rehabilitation and demolition activities, etc. These wastes are not usually handled by NEMC but are dealt with by the contractors involved. Typically, they are used as clean fill on other sites or in low-lying areas. Hence, they are not considered further in this Study.
Hazardous (Special)	Hazardous wastes originating from various sources, including household items (e.g. batteries, spray cans, etc.). These are described separately for each category, as appropriate. The management of sharps, clinical, body parts and highly infectious wastes from hospitals is a major concern in Nuwara Eliya.

2.1.3 Waste Generation

2.1.3.1 Waste Generation Rates

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

- The average household waste generation rate was estimated to be 0.498kg/cap.d, this being the average of the measured waste generation rates for Matale and Kandy.
- Commercial waste generation is 4.69T/d (16% of MSW), with the commercial waste generation rate being moderately high (9.31kg/enterprise.d). These quantities were determined from survey data for a mixture of large and small waste commercial waste generators, together with NEMC trade licence/enterprise data. They are considered realistic, being supported by observations of business activities within NEMC, the high value being attributed to the numerous restaurants, local hotels², bakeries and other large waste generators within NEMA and the large numbers of visitors passing through the town.
- Market waste generation (2.13T/d, 7.4% of MSW) is based on estimates for the central market and Sunday pola within NEMA and equates to a market waste generation rate of 10.8kg/stall.d. This is considered reasonable, the waste generation rate being relatively high but consistent with that obtained from other towns/cities.

² Local hotels = canteens, small eating places, etc.

- Hazardous waste generation is relatively small, comprising typical everyday items (e.g. spraycans, batteries, fluorescent tubes, razor blades (hairdressers)) which are disposed with normal garbage. However, there are some places that produce larger quantities of hazardous wastes including the Grand Hotel (10kg/mth of tubelights, 5kg/mth of batteries), the Hill Club (five tubelights, 25 spraycans per mth), Seetha Eliya Agricultural farm (175 pesticides cans/bottles per yr) and Huejay International (50 pesticide containers/bottles per mth).
- Small-moderate quantities of healthcare hazardous wastes are produced by the Nuwara Eliya Base Hospital, with the other two hospitals within Nuwara Eliya producing very small amounts of such wastes. Total hazardous healthcare waste generation is estimated to be approximately 26kg/mth of clinical wastes, 62kg/mth of body parts and placentas, 200kg/mth of sharps and a small quantity of highly infectious wastes.
- Total MSW generation is 28.8T/d, equivalent to 1.02kg/cap.d. Waste generation by source is illustrated below.

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

Source	Waste Generation Data			Waste Generation		
	WGR	WGR Unit	No of Units	Amount (T/d)	%	
Residential	0.498	Kg/person.d	28,201	14.04	14.04	48.8
Commercial	9.31	Kg/enterprise.d	504	4.69	4.69	16.3
Markets	10.8	Kg/stall.d	197	2.13	2.13	7.4
Hotels	1.61	Kg/(staff+guests.d)	859	1.38	1.38	4.8
Guesthouses	0.67	Kg/(staff+guests.d)	637	0.43	0.43	1.5
Institutions:						
• Schools	0.021	Kg/(students+staff).d	10,815	0.23		
• Other education	0.328	Kg/(students+staff).d	1,090	0.36		
• Hospitals	0.301	Kg/(patients+staff).d	1,696	0.51		
• Govt offices	0.094	Kg/worker.d	1,745	0.16		
• Forces	0.23	T/d		0.23		
• Religious	1.38	Kg/clergy.d	121	0.17	1.65	5.7
Industries	0.567	Kg/worker.d	2,047	1.16	1.16	4.0
Farms	6.45	Kg/worker.d	391	2.52	2.52	8.8
Other:						
• Parks/Racecourse	2.71	Kg/worker.d	139	0.38		
• Road/drain cleaning	0.41	T/d		0.41	0.79	2.7
Total	1.02	Kg/person.d	28,201	28.79	28.79	100.0

Notes: WGR = waste generation rate

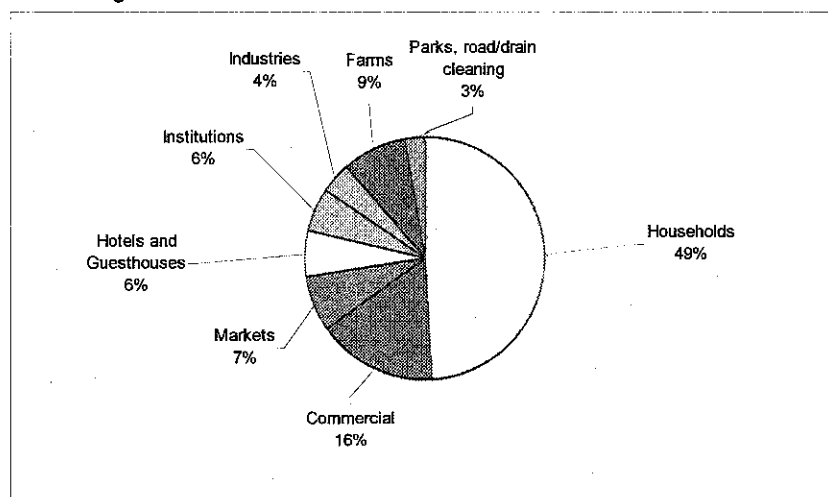


Figure 2-1: NEMA Waste Generation by Source (2002)

2.1.3.2 Factors Affecting Waste Generation

The main factors affecting waste generation in Nuwara Eliya are summarised below:

- Commercial, market, hotel and guesthouse waste generation increases approximately 2-4 times on average during weekends, the “Season” (mid-March to the end of April) (guesthouses/hotels), festival times (e.g. Deepavali, Thaipongal) and other special occasions. Some guesthouses/hotels reported a 5-10 times increase in waste generation during long weekends and the season.
- Institutional waste generation also increases during festival times.

2.1.4 Waste Stream Breakdown

2.1.4.1 Field Investigation Results

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

Table 2-4: Waste Stream Field Investigation Results

Source	Recovery/Disposal Method (%)	Waste Generation Rates/Quantities Calculations
Households	Discharge = 66.7% ID = 11.2% Compost = 10.9% OSD = 9.3% Recycling = 1.9%	Household survey results, modified to account for an estimated 85% garbage collection service coverage in NEMA.
Commercial (22 small and large waste generators surveyed)	Discharge = 82.3%	NEMC collects some (7) to all (12) garbage from 19 places.
	Recycling = 11.8%	Moderate recycling activity - mainly paper/cardboard (1,156kg/mth) and metals (250kg/mth) + some polysacks, plastic/glass bottles/containers.
	OSD = 5.9%	Two places burn some garbage on-site, including Main Post Office.
Markets	Discharge = 100%	All central market and pola waste is collected by NEMC.
Hotels (8 hotels surveyed)	Recycling = 48.0%	Six hotels recycle some waste. This is the main disposal method for Galway Forest Lodge. The most significant recyclers are the Grand Hotel (400kg/d of food/kitchen waste to own piggery, 120kg/mth of plastics, 24kg/mth of paper) and Hill Club (100kg/d food/kitchen waste to the Nazareth Farm piggery, 500 bottles/mth and 150 plastic cans per mth). Refer supporting report for further details.
	Discharge = 37.7%	Seven use the NEMC garbage collection service as their main (6) or secondary (1) disposal method.
	OSD = 14.1%	Five burn/bury some (4) – most (1) of their garbage.
	Compost = 0.2%	Three hotels compost some of their waste - the Hotel Tree of Life (60kg/mth of food/kitchen waste), St Andrews Hotel and Ceybank Rest (both 5kg/mth of garden waste).
Guesthouses (total = 41; 9 surveyed)	Discharge = 63.8%	Seven guesthouses use the NEMC collection service for most (5) to all (2) waste + all but two of other 41 guesthouses (NEMC data).
	OSD = 19.9%	Six burn/bury some (4), most (1) or all (1) of their garbage on-site.
	Compost = 12.5%	Clifton Inn composts around 200kg/mth of garden waste for its own use, while the Tourist Holiday Board Inn composts its waste on-site.
	Recycling = 3.8%	Five recycle a total of 43kg/mth paper and 87 bottles/mth + the Nazareth Farm collects the New Keena Hotel's waste.
Schools (6 schools surveyed)	OSD = 88.8%	Three schools surveyed (63% of total NEMA school population) burn/bury/place in a pit all of their garbage on-site.
	Discharge = 11.2%	Two discharge all their garbage for collection by NEMC.
Other educational institutes (5)	OSD = 89.7%	Three places burn/bury some (1), most (1) or all (1) of their waste.
	Discharge = 9.6%	Two discharge some-most of their garbage for NEMC collection.
	Recycling = 0.7%	The SOS Children's Village recycles around 25kg/mth of paper.
Hospitals (3 = Base,	Discharge = 96.8%	Most non-risk healthcare waste (HCW) is collected by NEMC from the three surveyed hospitals. Both Base and Ideal Hospitals discharge clinical waste for collection by NEMC.

Source	Recovery/Disposal Method (%)	Waste Generation Rates/Quantities Calculations
Cooperative, (ideal)	OSD = 1.7%	Cooperative Hospital burns some of its non-risk HCW and burns/buries clinical waste and sharps on-site. Base hospital burns/buries body parts, placentas, sharps and highly infectious wastes on-site. It has an incinerator but this is not used due to its inappropriate location and inadequate height.
	Recycling = 1.5%	Base hospital recycles small quantities of paper, plastic/glass bottles/containers and coconuts (~7.8kg/d).
Government offices (total = ~40)	Discharge = 73.1%	Four of five offices surveyed discharge most (2) to all (2) of their garbage for NEMC collection.
	OSD = 25.8%	Three burn/bury most (1) to some (2) of their garbage on-site.
	Recycling = 1.0%	The Divisional Forest Office recycles around 10kg/mth of paper.
Forces (Police, Army camp)	OSD = 55.5%	The Army Camp burns/buries over half of garbage on-site
	Recycling = 36.5%	Police recycle around 210kg/mth of food/kitchen waste as dog food at the police kennels, while Nazareth farm collects 2,250kg/mth of food/kitchen waste from the Army camp for pig food.
	Discharge = 8.0%	The Police discharge most of their waste for NEMC.
Religious Places (approx. 27)	Discharge = 83.3%	Two main places surveyed. Ashokaramaya burns/buries all of its garbage on-site while Muththu Mari Amman Kovil discharges all of its garbage for NEMC collection.
	OSD = 16.7%	
Industries (2 garment, 2 eyelashes and 1 polythene bag manufacturing factories)	Discharge = 44.4%	Three industries discharge all (1) or most (2) of their garbage for NEMC collection.
	OSD = 28.9%	Three burn/bury some of their garbage on-site, including Birdwear.
	Recycling = 13.8%	Birdwear recycles 1,000kg/mth paper/cardboard, 210kg/mth plastic, 50kgmth metals and 600kg/mth textiles. Winter World Garment recycles 1,000kg/mth of textiles. S.S. International (main eyelashes factory) recycles 450kg/mth of polythene. Robin Polypack recycles 1,500kg/mth of polythene.
	Direct haul = 12.9%	Birdwear directly haul ~ 1 tractor load/wk to NEMC disposal site.
Farms	OSD = 40.3%	Nazareth and Seetha Eliya farms dispose of some waste on site, while Huejay International (cutflower greenhouse operation) disposes most of its waste on-site.
	Direct haul = 27.3%	Nazareth Farm directly hauls about 1 tractor load/wk of garbage to NEMC disposal site, while Huejay takes the occasional tractor load.
	Compost = 26.4%	Seetha Eliya farm composts most of its waste (7,500kg food/kitchen, 2,000kg garden, 9,000kg animal waste monthly). Nazareth farm composts 50kg/d of garden/animal waste.
	Recycling = 5.9%	Nazareth farm recycles 100 bottles, 150kg metals and 150kg of food/kitchen waste for animal feed monthly, while Huejay also recycles around one lorry load/yr of polythene.
Parks and green spaces	Discharge = 50.3%	Victoria Park is cleaned by the NEMC Works Department. It composts about 100kg food/kitchen and 600kg garden waste monthly, whilst it directly hauls about 5 tractor loads/yr to NEMC disposal site. Other Park waste is either collected by NEMC or disposed of on-site. Racecourse: one handcart per day is dumped into the nearby stream; 1.33 handcarts are collected by NEMC and taken to disposal site.
	Recycling = 31.9%	
	OSD = 8.8%	
	Compost = 6.3%	
Road/drain cleaning	Discharge = 50%	Road/drain cleaning waste is assumed to either be disposed of close to the point of removal (50%) or collected by NEMC (50%).
	OSD = 50%	

Notes: OSD = on-site disposal, comp = on-site composting, disch = discharge for collection, recy = recycling at source, ID = illegal dumping.

2.1.4.2 Recycling at Other Points of the Waste Stream

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

- **Following discharge**, individuals (scavengers) may sift through discharged waste prior to collection, recovering items of value to them for reuse/recycling. The amount of recyclables recovered in this manner is assumed to be negligible due to the large number of individuals collecting recyclables directly from households (50% of surveyed households) and other places (i.e.

at source), rather than following discharge; the widespread practice of households taking recyclable materials to shops (28% of surveyed households); and very few people observed doing this.

- **During collection**, an estimated 30% of NEMC workers salvage bottles and various kinds of metals from the collected waste for sale. About 39kg/d of materials are believed to be recovered in this manner, based on survey interviews with 38% of NEMC workers.
- **At the final disposal site**, the five NEMC labourers working there are all involved in recycling, collecting around 117kg/d of bottles, broken glass, tins and coconuts. In addition, about seven women each collect 1-2 polysacks of textile scraps from the Interfashion (INCO) tractor which is currently coming to the disposal site about 1-2 times per week. Two men also collect paper from the same source. This textile and paper recycling are estimated to comprise 39kg/d and 3.5kg/d respectively. Hence, total recycling at the final disposal site is 160kg/d..
- **Recycling at any illegal dumping sites** was estimated to be 35kg/d from the NEMC disposal site recycling quantity, based on the relative proportions of waste brought for final disposal and illegally dumped.

This gives a total quantity of materials recycled at places other than at source of 234kg/d, equivalent to 0.8% of total waste generation.

Some materials are taken directly to middlemen for recycling by individual collectors and NEMC labourers. Based on interviews with five middlemen in the city, the total amount of materials recovered in this manner from within NEMA is estimated to be 0.38T/d.

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

Table 2-5: Summary of Recycling Data

Material	No of Households (from survey of 150 houses)		Recycling Quantities (kg/d)	
	Give to individual collectors	Take to shop	During collection	Collected by middlemen
Paper/cardboard	18	5	0	22.4
Plastic	0	0	0	12.4
Glass	47	23	22.8	59.6
Metal	11	0	2.5	198.7
Battery cases	0	0	0	58.0
Total	52	28	25.3	351.2

Note: Although 102 households are visited by individual collectors, only 60 actually give recyclable materials to these collectors. Glass collected by middlemen and labourers at the disposal site includes both bottles and broken glass.

2.1.4.3 Collection and Disposal Quantities

Current collection quantities have been determined from JICA trip-count survey data at the final disposal site collected over the seven day period: 12-18 September 2002, while additional data for March and August 2002 obtained from NEMC was also analysed. This data has been converted to tonnes, as shown below, using measured vehicle capacities (m³) for four wheel tractor trailers and the lorry, filling factors based on JICA field observations and typical density data.

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

Vehicle	Vehicle Registration	Trailer	Volume (m ³)	Fill factor (%)	Tonnage (T)
NEMC 4WT	49-9427	T-18588	6.31	0.62	1.52
		T-17105	5.89	0.72	1.66
		46-1794	7.22	0.46	1.30
		Average	6.47	0.61	1.53
	49-9428	T-17103	5.78	0.80	1.79
	49-9429	T-17104	5.83	0.72	1.63
	37-0959	T-18589	6.04	0.81	1.90
Average		6.18	0.70	1.58	
NEMC Lorry	27-4934	N/a	6.63	1.19	3.07
NEMC Works 4WT	Various	Various	2.26	0.95	0.84
Nazareth Farm 4WT	36-5368	Not recorded	3.46	0.71	0.95
Interfashion 4WT	36-9273	INCO-1	7.06	0.98	0.69
Interfashion 4WT	36-9273	INCO-2	2.16	1.35	1.14
Huejay International Tractor	49-9273	Not recorded	3.25	0.75	0.95

Notes:

1. Actual vehicle dimensions are given in the supporting report. NEMC uses the following trips to tonnage conversion factors: 1 4WT = 2T, 1 lorry = 4T, both of which are on the high side.
2. Density data: 390kg/m³ for four wheel tractor trailers and the lorry, based on WACS survey data for NEMC collection vehicles³ (390kg/m³), which is consistent with an in-situ waste density of 390kg/m³ for a large four wheel tractor trailer (6.3m³), measured by weighbridge in Colombo in Jul-Aug 2002. The extracted waste density is higher than that measured in other study towns, this being attributed to the garbage containing more moisture than in other towns due to the wet Nuwara Eliya climate and weather conditions during the survey period.

Current collection quantities were estimated from the NEMC disposal amount (15.9T/d), allowing for the small amount of recycling that occurs during collection (0.04T/d), giving a collection amount of 15.9T/d. The difference between the amount of waste discharged for collection (17.8T/d) and the amount actually collected is 1.9T/d, equivalent to about 1.22 four wheel tractor loads. This amount is assumed to represent waste that is illegally dumped (in addition to that already counted), waste that is discharged for collection but never collected, or waste that is collected and then disposed of at places other than the NEMC disposal site. It has been added to the illegal dumping amount.

2.1.5 Waste Stream

Waste stream data for Nuwara Eliya is presented below.

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

Table 2-7: Waste Stream Breakdown

Source	On-site disposal	On-site compost	Dis-charge	Recy-cling	Illegal dumping	Direct Haulage	Gene-ration
Household	1.31	1.53	9.37	0.26	1.57	0.00	14.04
Commercial	0.28	0.00	3.86	0.55	0.00	0.00	4.69
Markets	0.00	0.00	2.13	0.00	0.00	0.00	2.13
Hotels	0.20	0.00	0.52	0.66	0.00	0.00	1.38
Guesthouses	0.09	0.05	0.27	0.02	0.00	0.00	0.43
Institutions:							
• Schools	0.20	0.00	0.03	0.00	0.00	0.00	0.23
• Other Educ.	0.32	0.00	0.03	0.00	0.00	0.00	0.36
• Hospitals	0.01	0.00	0.49	0.01	0.00	0.00	0.51
• Govt offices	0.04	0.00	0.12	0.00	0.00	0.00	0.16
• Forces	0.12	0.00	0.02	0.08	0.00	0.00	0.23
• Religious	0.03	0.00	0.14	0.00	0.00	0.00	0.17
Industries	0.34	0.00	0.52	0.16	0.00	0.15	1.16
Farms	1.02	0.67	0.00	0.15	0.00	0.69	2.52
Other:							
• Parks	0.03	0.02	0.13	0.00	0.18	0.01	0.38
• Roads/drains	0.21	0.00	0.21	0.00	0.00	0.00	0.41
Sub-total	4.19	2.28	17.83	1.90	1.74	0.85	28.79
	Collection						
Recycling during collection			-0.04	+0.04			
Adjustment			-1.93		1.93		
Adjusted sub-totals	4.19	2.28	15.87	1.94	3.68	0.85	28.79
Recycling at:	Disposal						
- disposal sites			-0.16	+0.16			
- illegal dump sites				+0.04	-0.04		
Total	4.19	2.28	15.71	2.13	3.64	0.85	28.79
%	14.5	7.9	54.6	7.4	12.6	2.9	100.0

The waste stream shows us:

- Most waste (17.8T/d, 62%) is discharged for NEMC collection and disposal, while 16.6T/d is disposed of to landfill.
- On-site disposal is the second most common disposal method (4.2T/d, 15%). This is appropriate in some parts of Nuwara Eliya (e.g. houses with large properties, institutions).
- Illegal dumping is also very common (3.6T/d, 12.6%). This should be eliminated in the future.
- Resource recovery, via on-site composting (2.3T/d, 7.9%) and recycling (2.1T/d, 7.4%) are both significant. They should be promoted further in the future.

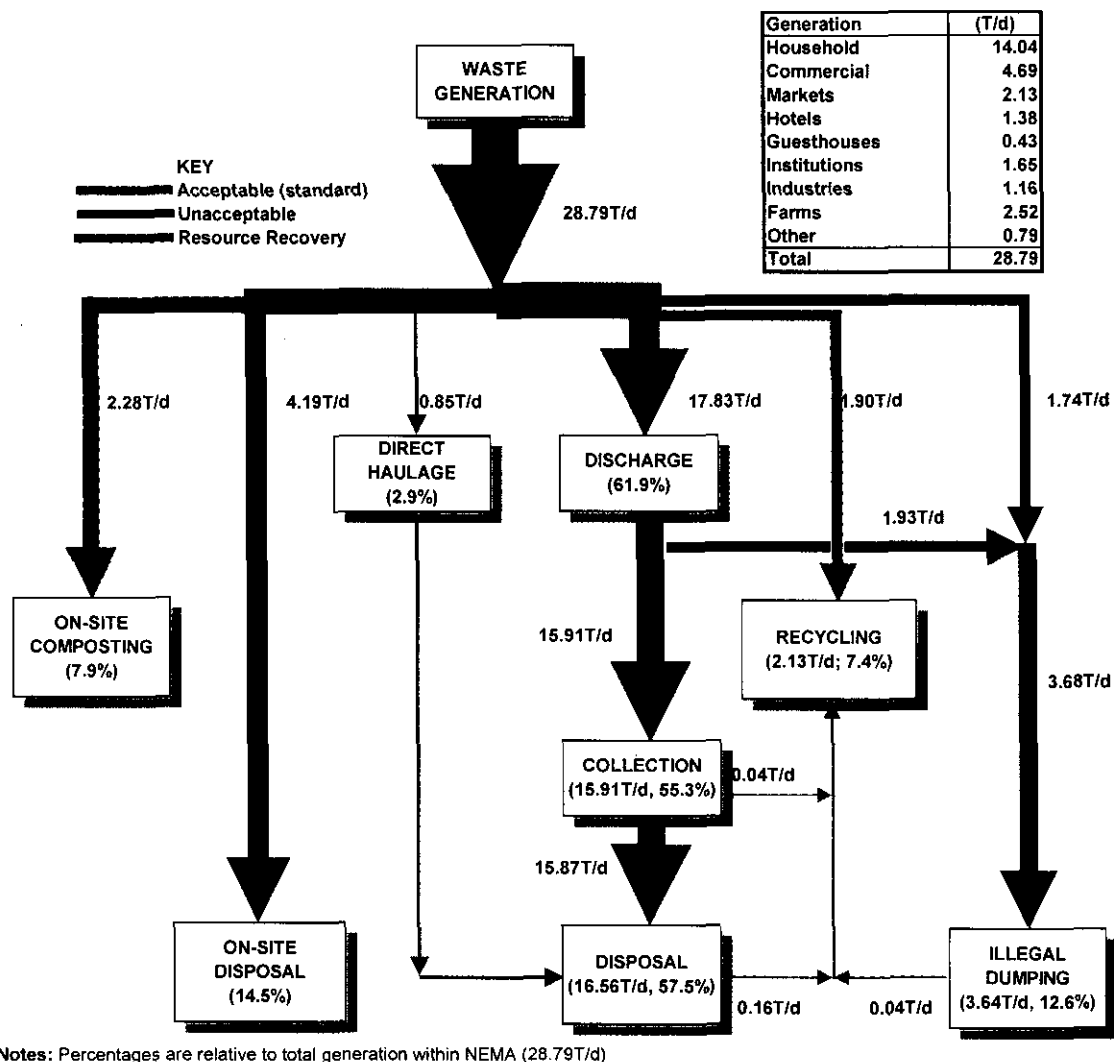


Figure 2-2: NEMC – Current Waste Stream

2.1.6 Breakdown of Waste Discharge Amount

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

- The amount of organic materials that can be composted is about 12.8T/d (77% of waste), excluding paper.
- Higher value recyclables (glass, hard plastic and metal) account for only 1.9% of the waste to disposal (0.0-0.1T/d), indicating almost all of these items are already being recycled.
- Lower value recyclables (paper, textiles, soft plastic) account for 17.7% of the waste to disposal with both soft plastic and paper being present in reasonable quantities (0.9-1.8T/d), indicating the recycling rates of these items are lower. Of these materials, paper has the most (but still limited) potential for increased recycling, particularly if it can be sorted at source and collected separately. Otherwise, once mixed with other garbage, it becomes contaminated and is much more difficult and expensive to recycle.
- The measured waste bulk density is very light, only 0.39 kg/L, this being due to the large proportion of kitchen waste and the weather conditions at the time of sampling.

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

Survey Items	Categories	Percentage	Disposal amount (T/d)
Physical composition (wet base)	Kitchen waste	71.6%	11.9
	Grass & wood	5.7%	0.9
	Paper	11.1%	1.8
	Textile	1.2%	0.2
	Soft plastic	5.4%	0.9
	Hard plastic	0.3%	0.0
	Leather & rubber	0.1%	0.0
	Metal	0.7%	0.1
	Glass	0.9%	0.1
	Ceramic & stone	2.7%	0.4
	Others	0.3%	0.0
		Total	100.0%
Bulk density		0.39kg/l	

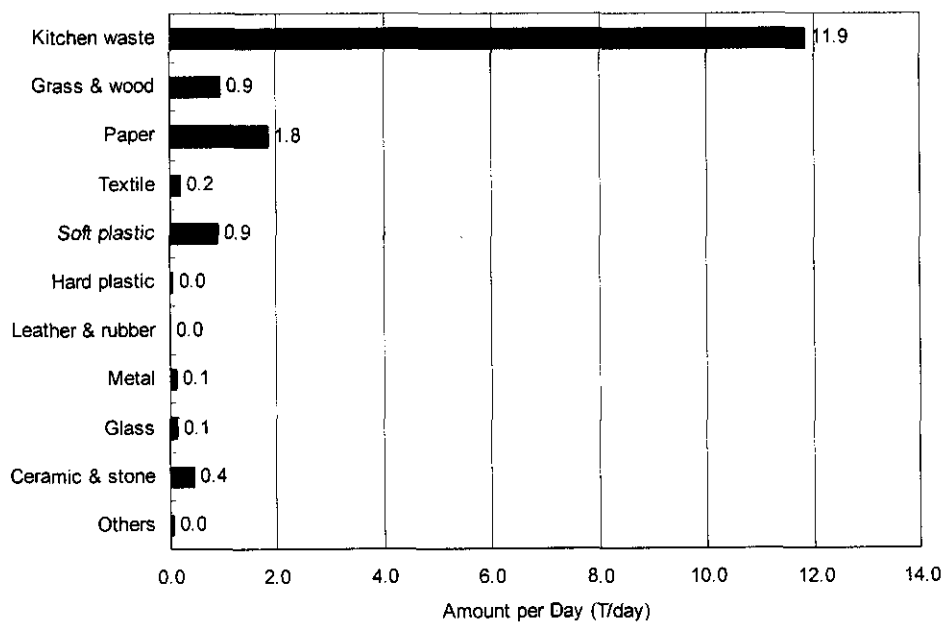


Figure 2-3: Daily Amount to Disposal (2002)

2.2 NEMC Waste Management Institutional Setting

The Health Department of NEMC is responsible for waste management within NEMA. Specific responsibilities include:

- Collection of MSW within NEMA, including the planning of collection routes and daily scheduling of garbage collection vehicles.
- Transportation of the collected MSW to the final disposal sites.
- Cleaning and garbage removal from public markets.
- Septic tank and toilet emptying services.
- Road and drain cleaning⁴.
- Collection of any SWM fees levied for the services provided.

⁴ Drain and street cleaning comes under Infectious Disease Prevention (IDP) Services.

- Enforcement of local ordinances and national laws related to SWM.
- Implementation of waste minimization, recycling, public education/awareness, etc.

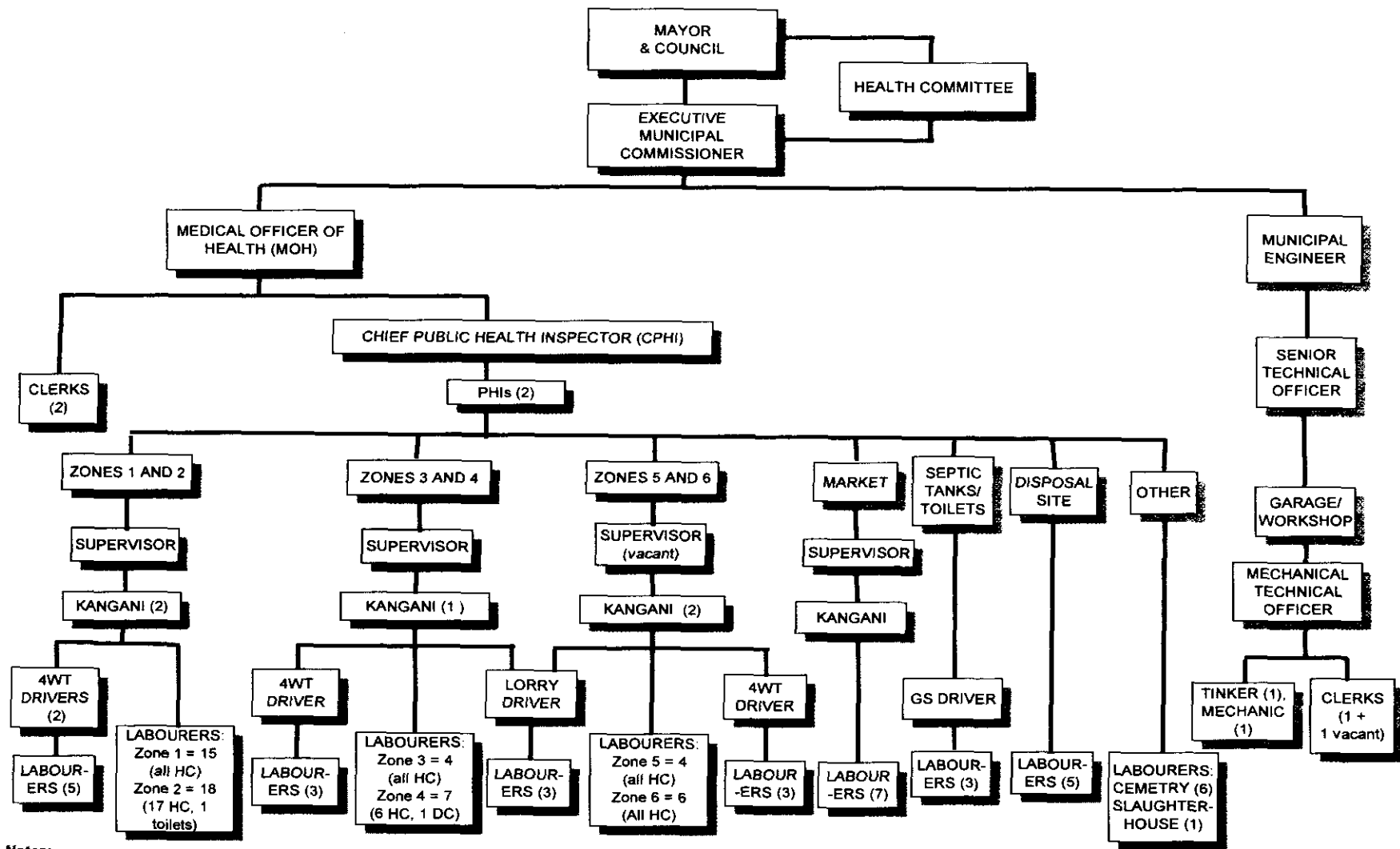
The Works department is responsible for the cleaning of public spaces (e.g. parks)

2.2.1 Organisational Structure

The waste management organizational structure, as of September 2002, is shown below. The Chief PHI (CPHI) has overall responsibility for all of NEMC's waste management activities, including SWM. Beneath him, there are two PHIs who have specific responsibility for waste management works in wards 1-5 and 6-10⁵. At the next organizational level, there are three Supervisors (Senior Supervisor or Overseer) and two others) and below them six Kangani (sub-supervisors), each responsible for different waste management areas of the town, as set out in the following table. Beneath them, there are six drivers and 90 labourers who are assigned to different areas.

Actual NEMC waste management labour strength is 118 (65 permanent and 53 casual), comprising 82 male and 36 female workers, of whom 102 are tamil, 13 sinhalese and three others. As discussed later, NEMC operates a 7day/wk, 8h/d garbage collection service, while most labourers work 5.5d/wk. Hence, a maximum of 90 labourers work at any one time, with the additional 28 labourers doing some shifts as required. There are also two health clerks. NEMC's allocated cadre for labourers is 90, but they have a special order for January-April allowing them to employ another 15 labourers during this period.

⁵ These are electoral wards which are not directly related to the SWM zones subsequently described. For example, both PHIs look after different parts of the same zone that come under different wards.



- Notes:**
1. 4WT = four wheel tractor, GS = gully sucker, PHI = Public Health Inspector
 2. Zone 1 and 2 4WT has two labourers rather than three due to stationary trailers being used in these zones.

Figure 2-4: NEMC Waste Management Organisational Chart

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

Area	PHI	Super- visors	Kan- gani	Labourers			Collection Points		Hand- carts	4WT	Lorry	GS	Public Toilets	
				Tasks	Perm	Temp	Total	Perm						Temp
Zone 1 (Babarakale)	3	1 (Overseer)	1	15HC	10	5	15	29	5	6	2		3	
Zone 2 (city area)			1	17HC, 1 toilets	15	3	18	15	9	7			2	
Zone 3 (HaddonHill)		1	0	4HC	2	2	4	10	6	1	1		2	
Zone 4 (Kalukale)			1	6HC 2x(Pr+2SW), DC	1	6	7	28	9	2			1	
Zone 5 (Hawa Eliya)		0	1	4HC (Pr, DC, 2SW)	1	3	4	23	13	1	1		0	
Zone 6 (Mahinda Mw)		0	1	6HC (also do DC+SW)	2	4	6	38	10	3			0	
Market		1	1		6	1	7						1	
Septic tanks/ Toilets/IDP					3	0	3					1		
Cemetery					4	2	6							
Disposal site					5	0	5							
Tractors					5 x Z1+2 4WT; 3 each for other 4WTs			2	9	11				
Tata Lorry					0	3	3							
Slaughterhouse					1	0	1							
NEMC Total			6	6		52	38	90	143	52	19	4	1	9
Allocated cadre							90							

Notes:

1. DC = drain cleaner, PHI = Public Health Inspector, SW = sweeper, GB = gully bowser, Tr= tractor, 4WT = four wheel tractor.
2. The Senior labourer at the disposal site acts as the site supervisor.

2.2.2 Waste Management Equipment

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

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

Vehicles/ equipment	No	Use (Capacity)	Approx. life (yrs)
Handcarts	23	SWM collection, road sweeping, drain cleaning	2-3
Four wheel tractors	4	SWM	5-15
4WT Trailers	6	SWM collection	4-8
Tata lorry	1	SWM collection	8-12
Compactor (reconditioned)	1	SWM collection	3-9
Gully sucker (7,000L)	1	Public toilets/ septic tank emptying	10-12
JCB Backhoe	1	Disposal site + other tasks	8-12

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

Table 2-11 : Vehicle Labourer and Equipment Details

Vehicle/Task	Labourers	Equipment
Handcart (HC)	2-3	2-3 ekel brooms, 1 sorondi
4WT	3	Fork, 1-2 ekel brooms
Lorry	3	Ekel broom, fork (used to have rake)
Compactor	3	Not specified
Gully sucker	2	Not specified
Sweepers	Generally part of	Ekel broom
Drain cleaners	HC crew	Mamoti (hoe), sorondi

Notes:

1. Uniforms, gloves and aprons are no longer issued by NEMC. During the time and motion study, some labourers stated they buy gloves themselves.
2. A "sorondi" is a metal hook attached to the end of a long stick, which is primarily used to remove plastic bags, king coconut shells, etc. from drains.

2.2.3 NEMC Waste Management Services Labour Force and Equipment

2.2.3.1 SWM (Garbage) Collection, Street and Drain Cleaning

NEMC's normal garbage collection labour force and equipment comprises:

- 20 handcarts, four 4WTs (four wheel tractors), one Tata lorry and one reconditioned compactor (currently out of service). NEMC has another 11 handcarts available on standby.
- Three PHIs, three Supervisors, six Kangani and five drivers, with 59 labourers normally being assigned to garbage collection tasks on any one day. The total labour strength is greater than this due to the seven day collection service operated by NEMC.
- Road sweeping and drain cleaning works are generally undertaken by handcart labourers.
- During January-April, up to 15 additional labourers may be deployed, as required.

2.2.3.2 Markets

Garbage collection and cleaning of Nuwara Eliya's central market is administered by the Health Department, with there being one Supervisor, one Kangani and seven labourers employed for this

purpose. Market waste is transferred by handcart to one of two stationary trailers parked near the market from where it is collected by a four wheel tractor and taken to the disposal site.

Sunday Pola waste is collected by eight NEMC labourers (from zone 2 and elsewhere) on Monday and made into small piles. These piles are gradually collected during Monday-Tuesday and taken to the disposal site by lorry/tractor, depending on vehicle availability.

2.2.3.3 Septic Tank, Toilet Emptying and IDP Services

These services include:

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

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

- Nine public toilets.
- One gully sucker.
- Three labourers.

Gully sucker waste is generally discharged into a pit at the NEMC disposal site.

2.2.4 SWM Costs

NEMC's 2002 budget costs, tabulated below, show that 19%% of NEMC's budgeted expenditure was allocated to SWM. This is mainly due to the high number of NEMC employees engaged in SWM works (22% of total). These results are slightly lower than in other study towns, with SWM expenditure accounting for an average of 22% (range = 13-35%) of LA budgeted expenditure and SWM workers an average of 29% (range = 22-37%) of all Council workers, by cadre.

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

Item	SWM	NMC Total	SWM as % of Total
Budget Expenditure (million Rs)	13,795,000	72,975,000	18.9
NEMC Employees (by cadre)	90	402	22.4

2.2.5 Waste Collection/Disposal Fees

2.2.5.1 SWM Collection/Disposal Fees

No one currently pays NEMC any formal garbage collection or disposal fees, nor does NEMC have any set fees for separate garden waste collection.

Gully bowser income for the first nine months of 2002 averaged 35,840Rs/mth (range = 19,440-63,982Rs/mth).

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

- 3% of 120 households surveyed pay an average of 47Rs/yr "small allowance".

- 25% of 68 enterprises surveyed pay an average of 3,025Rs/yr (range = 120 to 14,400Rs/yr), not counting St Andrews Hotel, which is believed to give garbage collection workers 50Rs/worker every two days.

2.2.6 SWM Bylaws

Standard Sri Lankan SWM by-laws are in place, most of which are very old and out-of-date. By-law enforcement is poor with many people following illegal practices.

Residents used to be fined by NEMC for discharging garden waste outside their premises but this has now stopped, partly due to practical difficulties associated with catching people doing this as a lot of garden waste is discharged at night-time.

There is a fine system for stray ponies being on the road, as pony dung is relatively common along the roadside and in public places around the racecourse area. Any stray ponies are detained by NEMC, with the owner being charged an instant fine of 500Rs, plus an additional 200Rs/d fine for each day NEMC has to look after the ponies.

2.2.7 NEMC Workshop

The mechanical workshop is responsible for routine maintenance and repairs of NEMC vehicles. The workshop is primarily managed by the Mechanical Technical Officer, who comes under the City Engineer and Senior Technical Officer, both of whom have other duties in addition to vehicle maintenance. It employs a tinker (panel beater), mechanic, and one clerk⁶.

Workshop facilities and equipment are relatively basic, comprising mainly gas welding equipment and some other minor items (e.g. drill, anvil and vice). They are only able to undertake small vehicle repairs/maintenance works due to a lack of equipment and skilled labour. More complex repairs, including engine problems are done by the private sector. A proposal has been put forward for NEMC to expand the workshop capacity, both in terms of human resources and equipment, so that more vehicle repairs can be undertaken on-site.

At least three quotations must be obtained for any repairs referred to the private sector, with the approval process varying according to the value of the works.

- For repairs up to 20,000Rs, the NEMC Engineer can give direct approval.
- For repairs up to 100,000Rs, the Municipal Commissioner can give direct approval.
- For repairs up to 500,000Rs, the Mayor can give direct approval.
- For repairs over 500,000Rs, these must be approved by the Council and Finance Committee.

The Engineer, Commissioner and Mayor approval limits are considerably higher than in other study towns, with Council staff indicating this is because they trust these senior NEMC officials.

⁶ The cadre specifies two clerks but only position is currently filled.

Repairs/maintenance undertaken by the private sector may take two weeks or longer, depending on the nature of the works.

NEMC estimated about 280,000Rs/yr is spent on the maintenance of SWM vehicles⁷.

2.3 SWM System Components

2.3.1 Discharge, Collection and Transportation

2.3.1.1 SWM Collection Zones

Nuwara Eliya is divided into six zones for SWM, road sweeping and drain cleaning purposes. Field investigations found that the NEMC garbage collection service covers ~80-90% of Nuwara Eliya on a population basis. An average service coverage of 85% has been adopted for this study.

2.3.1.2 NEMC SWM Discharge System

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

- At the roadside for primary collection by handcart followed by transfer to one of around 143 permanent concrete bins located around the town. Three stationary trailers are also placed near the market (2) and library (1) for use by handcarts working in zones 1 and 2.
- Directly to these concrete bins/collection points. This is the main method of disposal for most residents and many commercial enterprises and institutions.
- At the roadside. About 52 temporary collection points have been identified where there is no bin, but which are used by residents and other waste generators for garbage discharge.

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

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

Overall garden waste generation within Nuwara Eliya is considered moderate. However, high amounts of garden waste are generated in Lady McCallum Drive, St Andrews Drive, Waterfield Rd, Rahula Mw and Gamunu Rd and in zone 4. This garden waste is typically discharged illegally at public collection points or at the roadside for subsequent collection by NEMC. Often, it is burnt at such places, while NEMC tries to collect garden waste approximately weekly. Building waste is also commonly present at such places.

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

2.3.1.3 NEMC SWM Collection System

a. Collection System

Garbage is collected from these informal and formal collection points, handcarts (if met by chance) and directly from the discharger in accordance with the details set out in the supporting report. Garbage is usually collected daily (most areas) or every second day.

Most of the collection vehicle labourers use polysacks for loading garbage. The polysack is spread on the ground, with garbage being placed on top of it by one labourer using an ekel broom or fork, following which two other labourers lift the sack and throw its load into the vehicle.

Garbage collection by vehicle is difficult in some steep areas, where it is difficult to push handcarts and tractors/lorries cannot turn around easily.

Time and motion studies undertaken by the Study team for a four wheel tractor and the lorry in September 2002 found that it took these vehicles 3h 21min and 3h47min to complete one round, with loading making up 47 and 54% of the round time respectively.

b. NEMC Collection Vehicle Unit Costs

NEMC collection vehicle unit costs were calculated for handcarts, tractors and the lorry using actual trips (September 12-18, 2002) and cost data supplied by NEMC, supplemented by data from other sources where necessary. These costs are illustrated below.

This data shows:

- Handcart costs are reasonable (751Rs/T) for two labourers doing five trips/d. However costs increase significantly if the number of trips is less than this, or more labourers are used, the maximum unit cost being 1,858Rs/T for three labourers and three trips/d.
- Four wheel tractor unit costs are better than those for the lorry, primarily due to the greater number of trips the tractor is able to complete on average each day.
- Compactor unit costs are slightly better than the tractor but the compactor data is not considered very reliable as it has been out of service for virtually the entire last 12 months.
- In relative terms, tractor and compactor unit costs are reasonable while lorry costs are high compared with other study towns.

⁷ 80% of Health department vehicles workshop budget of 350,000Rs.

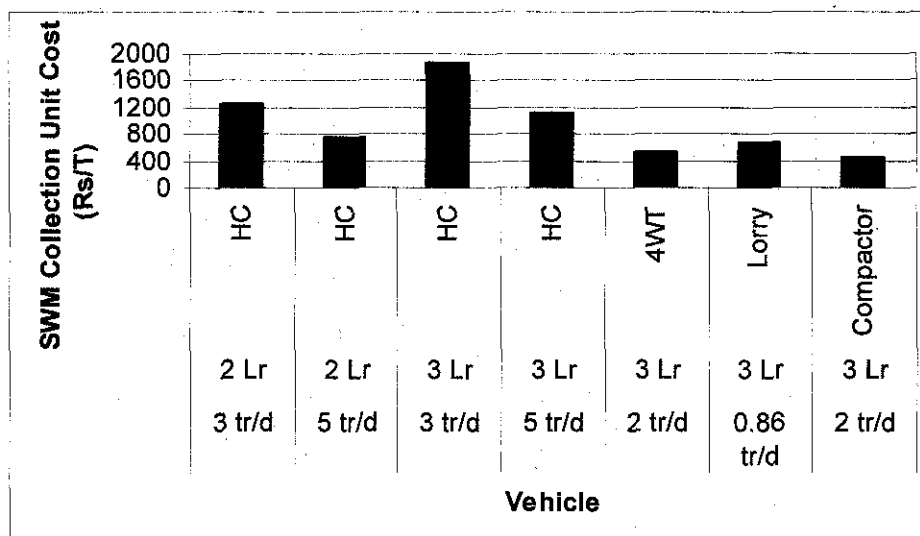


Figure 2-5: NEMC Garbage Collection Vehicles – 2002 Unit Costs

c. Assessment

The present garbage collection system involves some wasted effort. For example, handcarts undertake primary collection and then discharge their loads into concrete bins from where they must be loaded again into collection vehicles. Many concrete bins are poorly designed. This system results in garbage being double handled, loading taking a long time, while both handcarts and collection vehicles often traverse the same routes.

Another major problem is that many of the SWM collection vehicles are relatively old (average age = 5-6.5yrs) and require frequent maintenance. Vehicle repairs/maintenance often takes a long time, especially for the compactor due to delays in obtaining spare parts.

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

JICA studies indicate that both NEMC tractor/trailers (5.8-7.2m³) and the compactor (3.7m³) carry similar amounts of garbage to landfill (1.5-1.9T/load versus 2.2T/load). This is due to the different volumes of each vehicle and the high bulk density of Nuwara Eliya waste (0.39kg/L), meaning that compactors can only achieve small-moderate waste compaction, compared to developed countries where the waste is much “lighter” (e.g. Japan - 0.15kg/L). Compactors have other advantages over tractors, being more manoeuvrable, easier to load, enclosed (resulting in less waste scattering than from open trailers) and faster, reducing travel times during collection and to and from the landfill. However, compactors are more difficult and expensive to maintain. Overall, both tractor/trailers and compactors are considered suitable for Nuwara Eliya.

2.3.2 Processing and Treatment

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

2.3.3 Final Disposal

The most serious solid waste problem in Nuwara Eliya is the poor condition of the landfill.

Waste is taken for final disposal to the Moon Plains landfill site, located in a forest reserve, about 6km from the Nuwara Eliya town centre. Garbage is currently just dumped into a valley within the forest reserve from the access road, without any environmental protection measures being taken, causing the following adverse impacts on the surrounding environment:

- Many large trees near to the landfill are dying due to fire caused by burning of the deposited waste.
- Leachate, generated by the deposited waste, is detrimentally affecting the shallow groundwater in this area and could possibly affect the water quality in the Bomuraella reservoir, located downgradient of the landfill site.
- The number of stray dogs near the site, which sometimes attack people, is increasing.
- There are many pests, especially flies, at the landfill site.

The most serious threat posed by present landfill operation is the strong possibility of an extensive forest fire caused by deposited waste catching fire or being deliberately burnt.

2.4 Resource Recovery

Resource recovery is relatively common within Nuwara Eliya, as summarised below.

Table 2-13: Summary of Resource Recovery Initiatives in Nuwara Eliya

Sector	Comments
Reuse	Many shops selling items for re-use (e.g. shoes, bicycles, umbrellas, mobile phones, paper bags, etc.).
Recycling at source	Very common. 68% of households are visited by someone to collect/buy their reusable/recyclable materials, while 28% of households take some reusable/recyclable items to shops for refund/sale.
Recycling by SWM Labourers	30% of MC labourers involved, collecting about 39kg/d of glass bottles and metals, while MMC disposal site labourers collect about 117kg/d of broken glass, tins and coconut shells, earning "tea money" (171Rs/labourer.month).
Other recycling at disposal site	About seven women and two men collect 1-2 sacks of textile scraps and paper respectively from Interfashion tractor (about 43kg/d).
Middlemen	Interview surveys held with 5 middlemen shops found: Established businesses: all over 12yrs old; 3 over 30yrs. Creating jobs: employ at least 12 people. Recycling wastes: 0.45T/d, 86% from within MMA (0.38T/d). Generating income: purchases (181,000Rs/mth) vs sales of 222,000Rs/mth. Mainly buy high value recyclables: newspapers/exercise books, glass bottles, sacks and plastic containers for reuse; metals, broken glass and battery cases for recycling. Mainly sell these items locally or to other middlemen 50-70km away. Main problems: utilities costs > high transportation costs > shortage of recyclable materials.
Home composting	NEMC have distributed some home compost barrels within Nuwara Eliya over the last 2-3 years. JICA survey of 25% of 80 households with compost barrels in Nawagangoda and Hawa Eliya in Augsut 2002 found 18 out of 20 households will still using the bins, with average compost production amounting to 14.6kg/household.month (60% reduction in waste to disposal).
Piggeries	Two major piggeries in Nuwara Eliya: Narareth Farm: 40 pigs, 8 cows and other animals; collects about 285kg/d of food-kitchen waste from four tourist hotels and the army camp within Nuwara Eliya and another 150kg/d from the Tea Factory Hotel outside NEMA.

Sector	Comments
	Grand Hotel piggery: 95 pigs and 32 cows; collects about 500kg/d of food/kitchen waste from the Grand Hotel
Farm composting	Seetha Eliya farm produces about 20T/month of compost for its own use from grass, cow dung and crop residues, while 115 households on the farm compost their own food/kitchen waste. Nazareth Farm composts around 50kg/d of garden/animal waste for their own use.

Notes:

1. Refer supporting report for further details.
2. Recommended future improvements for home composting from the JICA survey include: consider the use of a non-rusting, better designed composting system (e.g. barrel/bin or other); do not force householders into getting a compost barrel, unless they really want one; provide education/training to households particularly over the first 3-6 months, with ongoing support being available to households requesting it; consider providing compost barrels to households for free or at a subsidized rate – the latter option is considered more appropriate.

2.5 Social Aspects

2.5.1 Household Surveys and Interviews

a. Household Public Opinion Survey (POS) Results

A public opinion survey was conducted in the second half of September 2002 within NEMA in order to prepare a basic socio-economic profile of the Nuwara Eliya's residents and to gain an appreciation of public attitudes towards the current provision of SWM services, desired improvements to those services and their willingness to pay for improved services. The survey covered 120 households, comprising forty households from two high income (Waterfield Drive, Piyathissapura), two middle income (Mahinda Mw, Gamunupura) and two low income (Hawa Eliya MC line, PWD Line in Kandy Rd) areas.

44% of the surveyed population are Sinhalese, 48% Tamil, 4% Muslim and 3% other (Malay, Korean and Canadian). Data on the average number of people per household and monthly income is set out below.

Table 2-14: General Household Data

Item	Low income	Middle income	High income	Overall
Average number of people per household	5.2	5.5	4.7	5.1
Average monthly household income (Rs/household)	6,614	11,469	16,800	
Average monthly income (Rs/person)	1,272	2,085	3,613	

Note: Household members means those who live together in one household and not necessarily family members. For example, servants in high income households are included as household members.

Key survey results related to SWM are summarised here:

- 96% of surveyed households are provided with a garbage collection service by NEMC, of whom 88% stated they use this service⁸. 29% of surveyed households (33% of those using the NEMC collection service) are very satisfied with it, while 47% (52% of service users) are somewhat

⁸ Does not quite tally with "main waste discharge" method data, due to some people saying they use the NEMC service but then later saying they open dump their waste outside their premises.

satisfied. Area-wise data shows least satisfaction in middle income areas. The overall satisfaction rate is highest among the seven study towns.

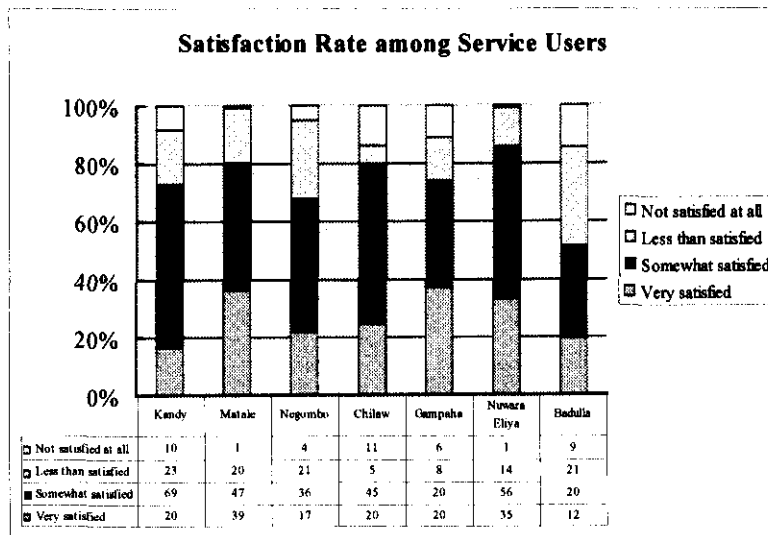


Figure 2-6: Waste Collection Service Users' Satisfaction Rate

- Main garbage discharge methods are shown below. 87% utilize the NEMC collection service, with discharge of waste at a specified place for NEMC collection being the most common method (81%). The other 13% dispose of their waste either by burning/burial within their own premises, composting or dumping it illegally outside of their houses.

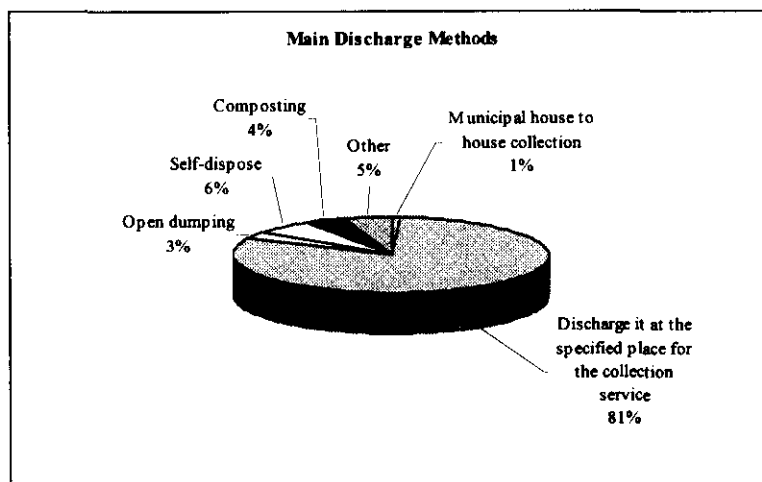


Figure 2-7: Common Waste Discharge Methods

- As for the NEMC collection frequency, 24 (20%) households receive a daily service, 21 (18%) more than four times per week and 54 (45%) 2-3 times per week. Hence, 99 (83%) households receive the service more than 2-3 times per week. This contrasts with peoples' discharge behaviour, as 63 (53%) households discharge their waste daily. The discrepancy between these figures explains why the public garbage bins in Nuwara Eliya are seldom, if ever, empty and the many animals searching for food in them.
- In general, adult female members handle waste in 61% of surveyed households.

- Only 92 (77%) households are willing to cooperate with source separation for recycling, this being the lowest willingness rate among the seven study towns. However, 102 (85%) households are called on by someone who comes to collect their reusable or recyclable materials (mainly certain kinds of bottles and paper, especially newspaper). This shows that an informal recycling system is already very active.
- Interestingly, 42 of these 102 households do not sell any materials for a variety of reasons including the recyclers buy only selected materials, they buy selected bottles at a much lower price than the deposit price in shops, it is not advisable to allow any unknown people onto their premises for security reasons, etc.
- Only 6 (5%) households have ever discussed proper garbage discharge method at the community level.
- 107 (89%) households have received some health and environmental education or information relating to solid waste. The two most common sources are mass media such as newspaper, radio/TV programmes and schools.
- 116 (97%) surveyed households appreciate the necessity for SWM awareness programmes.
- The average WTP (willingness to pay) for improved SWM services is 55Rs/month per household.

b. Findings from Community Awareness Meetings

Two focus group discussions were held on 10th and 29th of October, 2002 in Mahinda Mw and Mahagastota, in order to gain a deeper appreciation of public attitudes to SWM service provision. The focus group discussions, together with the household survey results, revealed that animal problems around the public collection bins and peoples' discharge behaviour are the main problems in Mahinda Mw, which basically has a daily collection service. In contrast, provision of a collection service and construction of public bins are the main concerns of the Mahagasthota residents, who currently have no collection service. These results show that SWM related problems are found both in areas with and without a collection service. Specific solutions need to be found for different problems. However, it is clear, that the introduction of proper discharge rules and a reliable collection service will go a long way towards solving such problems.

2.5.2 Commercial/Industrial and Institutional Survey Results

Interview surveys were conducted with 68 commercial/industrial and institutional places during September 2002. Key survey results are summarized below.

- 51 (75%) enterprises are provided with a garbage collection service by NEMC. 50 (74%) use this service, 21 (42%) of whom are satisfied with it. The main reasons for dissatisfaction are the discharge system is poor (23), garbage collection/sweeping is not done properly (18), is too low in frequency (16), or is irregular (15). The Base Hospital is also concerned about the handling and disposal of hazardous healthcare wastes.

- The five most desired improvements to garbage collection/disposal in descending order are an improved discharge system, followed by public education, greater recycling/composting, a shorter distance to collection points and improved garbage collection frequency. Improved hazardous healthcare waste management is also of concern to all three hospitals.
- 11 (16%) places supported the introduction of an individual garbage collection fee, while 32 (47%) places indicated an average WTP of 518Rs/mth (range = 25 to 2,000Rs/mth).
- 67 (99%) enterprises believed recycling is necessary, with 57 (84%) enterprises being either very willing (55) or somewhat willing (2) to cooperate in separating their garbage at source, while three are doing this already.
- Ten (15%) enterprises are willing to undertake on-site composting, while nine are doing so already. However, the majority (49, 72%) of enterprises are not in favour, mainly due to a lack of space on site (27) and it taking too much time (11).
- 68 (100%) enterprises consider a campaign to raise peoples' awareness for maintaining a cleaner city and environment is very necessary.
- The most common other comments relate to a need for public education/awareness raising (13), widespread support for recycling (12), improve the existing SWM system (5) and start recycling programmes/projects/facilities (5).

2.5.3 Attitudes of Cleansing Workers

2.5.3.1 NEMC Labour Force

As of September 2002, NEMC had 118 labourers, comprising 65 permanent and 53 casual labourers. Of these 87% were Tamil, 10% Sinhalese and 3% Muslim, while 69% were male. These workers are controlled by both supervisors called "Saukiya Sulu Paripalaka" and head labourers called "Kangani", meaning overseer in Tamil. This threefold supervision system, first by Kanganis, secondly by supervisors and overall by PHIs is unique to NEMC⁹. At present, five supervisors, including two acting supervisors officially categorized as Kangani, and six Kanganis, including two acting Kanganis officially categorized as labourers, are supervising the work of NEMC labourers. Only one Saukiya Sulu Paripalaka was recruited directly as a supervisor. All other supervisors and Kanganis have been promoted from health labourers.

2.5.3.2 Findings from the Cleansing Workers Survey

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

- 83% of the surveyed population is Tamil and 17% Sinhalese.
- The average number of members per household is 5.9 persons.

- The average monthly income 10,974Rs/household and 1,860Rs/person. This is higher than the average low income figures, but a little less than the average middle income figures obtained in the household public opinion survey.
- The average number of years of work is 10.6 years.
- Either the mother or father of 67% of surveyed workers also worked as a cleansing worker.
- Difficulties and dissatisfactions with their work are as follows.
 - First: Lack of protective clothing such as gloves, boots, etc.
 - Second: Insufficient wage
 - Third: Improper discharge of waste by people
 - Fourth: Unsanitary waste such as human waste is mixed in with other waste
 - Fifth: Not enough tools for collection work
 - Sixth: Health problemsAmong these issues, the first, third and fourth ones seem to be genuine difficulties directly affecting their work. Addressing these issues may help to improve SWM service provision.
- When work related difficulties arise, as many as 87% of workers talk to supervisors while 10% talk to minor supervisors (Kanganis) first. None of them talk directly to PHIs.

2.5.3.3 Findings from the Labour Line Survey

A questionnaire survey was conducted among 50 households in the Municipal Labour Line in Hawa Eliya¹⁰ in order to obtain a socio-economic profile of its residents who are assumed to be descendants of Tamil immigrant labourers from the colonial period. The survey data shows:

- 49 (82%) of surveyed households are Tamil, 8 (16%) Sinhalese and 1 (2%) Muslim.
- 36 (72%) of surveyed households are Hindu, 8 (16%) Buddhist, 5 (10%) Christian and 1 (2%) follow Islam.
- The average number of household members is 5.6 persons, which is higher than the 5.1 persons average figure found in the Nuwara Eliya POS of 120 households.
- The average monthly income is 8,670Rs per household and 1,559Rs/person. These are both higher than the average low income figure but less than the average middle income figure found in the household public opinion survey.
- The average number of people who work in each household is 2.0 persons.
- As many as 28 persons (28% of those who have some income source) work as NEMC cleansing workers, this being the most common income source amongst surveyed households. Other common jobs include work in private business and vegetable cultivation as unskilled laborers.
- 31 (62%) households live in separate houses, 15 (30%) in single line rooms and 4 (8%) live in back-to-back line rooms.

⁹ In other study towns, twofold supervision by supervisors and PHIs is common.

- As many as 42 households (84% of surveyed households) have lived there more than 15 years but less than 20 years. None of them have lived there for more than 20 years.

These findings illustrate that NEMC cleansing work is historically and still now dominated by Tamil labourers as their inherited work with little change in their working conditions. NEMC actually fosters this by favouring employing children of NEMC cleansing workers, the main reason being that they apply for such jobs with an understanding of the nature of the work and do not have any hesitations about garbage collection work after starting work. When you consider they now receive an additional 2,200Rs/month allowance granted to all government employees since November 2001, their household income level can no longer be considered low income. However, when looking at the living conditions in this area, it has all the features of the urban poor.

2.5.4 Awareness Programmes and Environmental Education

The NEMC Health Department, NGOs and schools are the main groups currently carrying out awareness programmes on environmental issues, including SWM.

2.5.4.1 NEMC Involvement

NEMC's community-based activities are carried out mainly by one Community Development Officer (UCDO¹¹) in the NEMC Health Department. These involve a range of community activities and regular visits to Community Development Councils (CDCs)¹², providing an effective link between the local authority and the communities.

¹⁰ 128 houses (lines) and 165 families, according to NEMC data. However some cleansing workers do not live in this area.

¹¹ Under UNICEF's Urban Basic Service Programme, three community development officers were introduced to NEMC in the early 1990s. One of these is still working in community development.

¹² 21 Community Development Councils still exist, established under the same UNICEF programme, plus 12 women's societies, mainly in low income areas. The main programmes are pre-school improvements, micro-finance, training for income generating activities, etc.

Health Department of Nuwara Eliya Municipal Council
Organizational Chart

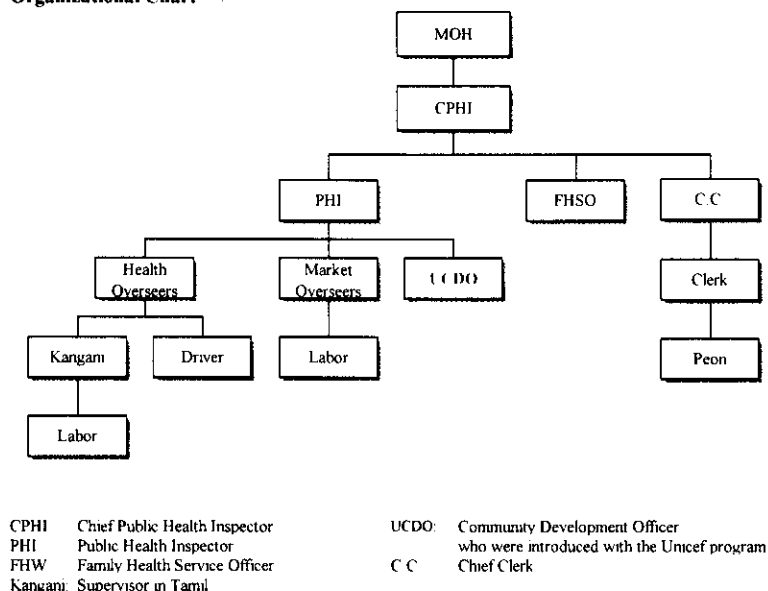


Figure 2-8: Organisational Chart of NEMC (excluding SWM details)

A variety of environmental programmes, including education and awareness programmes have been initiated by the Health Department in collaboration with JOCVs¹³. For example, community-based environmental groups have been established within all 21 CDCs and are carrying out a variety of community based environmental and health programmes (e.g. Shramadana, community-based volunteer cleaning programmes, are held about 40 times per year in NEMA, often involving these groups).

Most Municipal Councils have Divisional Environmental Officers (DEO), assigned to them by the Central Environmental Authority (CEA), who are responsible for organising school environmental education programmes in collaboration with schools. However, NEMC does not have a DEO at present¹⁴. The Environment Committee, formed by the previous DEO had held regular meetings while he was working in NEMC. It then stopped, only to be revived again in August 2002 by the Mayor. Since then, Environment Committee meetings have been held regularly, with all types of environmental issues being discussed (e.g. biodiversity, SWM, etc.).

2.5.4.2 Involvement of NGOs and Other Organizations

There are several NGOs in Nuwara Eliya working in the fields of environmental issues and community development. One of these is the Youth Exploration Society of Sri Lanka (Nuwara Eliya Branch), formed voluntarily by youth who are concerned about various environmental issues. Another is the PALM Foundation, which mainly works with estate communities and surrounding villages. One of their programmes is organic farming.

¹³ Two community development advisors (Ms. M. Tani (2000-02) and Ms. F. Arimizu (2002-04) have worked for NEMC to date.

¹⁴ So far, NEMC has had two DEOs, the second DEO working here until 2001.

2.5.4.3 School Environmental Education Programme

Environmental education programmes have been developed by the CEA since its establishment in 1980. CEA has introduced two nationwide school programmes, namely the "Environmental Pioneer Brigade (EPB)" programme for secondary schools in 1984 and "Eco Clubs" for primary schools in 2001, with DEOs being expected to play an active role in promoting these programmes. However, as NEMC does not currently have a DEO, the DEO stationed at the Divisional Secretariat looks after school programmes in NEMA.

The EPB programme is voluntary and involves organizing school children into groups of twenty-five. The activities of these groups are based on a five-tier badge system (pioneer, green, silver, gold and presidential).

At present, seven out of nine schools are participating in EPB programmes in NEMA, the most active schools being Piyatissa Maha Vidyalaya and Painter Maha Vidyalaya, while Eco Clubs have been formed in four primary schools. According to the DEO, not many schools are as active in this programme as in other areas.

Chapter 3 Assessment of the Current SWM Condition

3.1 Healthy Aspects

3.1.1 Good Performance by MMC in Some Areas

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

- Good SWM "service coverage" of 80-90%.
- Good service usage by waste generators (92%).
- Most household users are somewhat or very satisfied with the MMC collection service (86%).
- Reasonable tractor and compactor collection performance and costs.
- Very successful home composting programme.
- Many parts of the city are clean.
- Lots of initiative – SWM , education, etc.

3.1.2 Resource Recovery is Working Well

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

- "Aparade" is in common use, but requires promotion.
- Many people involved in reuse activities (e.g. shoe repairs, umbrella repairs, etc.).
- An excellent traditional recycling system, involving households and other waste generators, individual collectors (Bothal pathara karaya) and middlemen. Most high value recyclables (metals, glass bottles, battery cases, plastic containers, newspapers/exercise books) are recovered via this system, leaving mainly low value recyclables in the garbage taken to disposal. However, both the individual collectors and the middlemen operate largely on their own and do not currently have any close contact with NEMC.
- On-site composting accounts for about 1.5T/d (11%) of household waste which is significant
- Two major piggeries collect a lot of food/kitchen waste for pig food.

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

3.2 SWM Issues

3.2.1 Very Serious Issues

3.2.1.1 Institutional and Organisational Strengthening Urgently Needed

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

- The current SWM management structure does not reflect the significance of SWM within NEMC. It should be much stronger, with more authority being given to the responsible people and adequate human, facilities and financial resources allocated for SWM works because many NEMC

employees are engaged in SWM works, while NEMC spends a lot of its budget on SWM (e.g. 2002 budget: 22% of MMC staff (about 90 employees) working in SWM by cadre; 13.8M Rs allocated to SWM (19% of total budget)).

- A shortage of senior staff dedicated to SWM works, while the inter-disciplinary nature of SWM makes it difficult for one person to handle SWM alone.
- A lack of short, medium and long term development plans, although various measures for improving SWM have been implemented.
- Poor labourer management, with absenteeism running at around 15-20 labourers per day, while some labourers suffer from poor health and/or work under the influence of alcohol.
- Poor public-LA relations, characterised by a lack of clear instructions to the public detailing citizens' responsibilities, waste discharge rules, fines, etc. Existing by-laws need to be strengthened and vigorously enforced.
- High SWM expenditure.
- Difficulties in finding out how much money is actually spent on SWM and the SWM cost breakdown (e.g. administration, collection, disposal, etc.).

3.2.1.2 Inadequate Final Disposal

Proper final disposal is the most important component required to establish the reliability of SWM works. The Moon Plains landfill is largely being operated as an open dump, with very few environmental protection measures being taken, causing negative social and environmental effects as previously discussed. Hence, there is an urgent need to improve the operation of the landfill.

3.2.1.3 Improvements to Technical System Needed

Current waste discharge and storage is characterised by:

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

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

Collection and transportation is inefficient and unreliable, being characterised by many handcarts and collection points, double handling and long loading times. Garbage collection by handcart and two wheel tractor is expensive and many vehicles are getting old. These problems make it difficult for NEMC to keep to scheduled garbage collection times, routes and frequencies.

3.2.2 Serious Problems

3.2.2.1 Lack of Centralised Processing/Treatment Facilities

The main objectives of any processing/treatment technology are to reduce the final amount of waste to disposal. There are currently no centralised garbage processing/treatment (recycling or composting or biogas) facilities within Nuwara Eliya. Considering that the composition of Nuwara Eliya waste is very suitable for composting, NEMC should seriously investigate the feasibility of introducing medium-large scale composting/biogas facilities.

3.2.2.2 Poor Hazardous Healthcare Waste Management

The storage, collection and transportation of hazardous healthcare wastes, especially from the Base hospital, is currently very poor and needs to be improved. During field investigations, clinical waste was clearly visible amongst normal garbage in the hospital bin - an open sided, unroofed bin, located on public land, outside the hospital grounds, next to a byroad.

3.2.2.3 Increase Public Cooperation through Education/Awareness

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

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

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

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

These observations suggest that immediate education/awareness programmes combined with introduction of waste discharge rules, conducted in cooperation with schools and NGOs should be highly effective both to increase peoples' understanding of the SWM issues facing Nuwara Eliya and to encourage public participation in SWM.

3.2.3 Less Serious Problems

Less serious problems are listed below:

- Stationary trailer collection points are generally of poor design, requiring handcart labourers to discharge their loads by hand, throwing the garbage upwards into the trailers.
- Mechanical problems with the lorry, due to the long length of drains in most areas, illegal septic tank/pit connections, cattle farm effluent discharges, silt-sediment runoff and citizens damming drains so as to be able to use the ponded water for irrigation of their vegetable plots
- Inadequate record keeping, with a high proportion of daily records missing, while actual records seem to under-estimate the actual number of loads and do not include private vehicle trips.
- Difficulties encountered by middlemen associated with high utility and transportation costs, a shortage of materials for recycling, loss of markets and difficulties in obtaining credit.

Chapter 4 SWM Pilot Projects

4.1 Rationale

Compared with other study towns, the waste collection and transportation system is relatively good, while even peoples' waste discharge habits are slightly better. Hence, waste scattering is less than in the other study towns. However, the landfill condition is very bad, as no environmental protection measures are taken at all, smoke is almost always present and many trees are dying. As for public education, NEMC has produced some digital environmental education material but this is hardly used at present, as they have no projector.

The Mayor and SWM staff are all very keen on the improvement of SWM works and have been very cooperative with the Study, while internal coordination within NEMC is very good. Thus, conditions for implementing pilot projects are ideal. Hence, it was decided to implement a wide range of pilot projects, as set out below.

4.2 Objectives

An outline of the pilot projects and their main objectives is given below.

Table 4-1 : Outline of Pilot Projects

Item	Components	Objectives
All	As below	Capacity development of NEMC staff
Managerial Capacity Strengthening	Amendment of Model By-laws SWM management tools (control board, monthly report, SWM manual) PHI/Supervisor training Provision of transportation facilities Preparation of 10 year SWM Action Plan	Capacity development of NEMC staff Improved supervision and management of SWM works
Waste Collection improvement	Introduction of bell collection Provision of modified three wheeler for the collection and transportation of hazardous healthcare wastes	Improvement of current garbage discharge, storage, collection and transportation system Improvement of hazardous healthcare waste management Increased public awareness and cooperation
Improvement of Moon Plains landfill site	Construction works to extend landfill lifetime and ensure proper management of site Establishment of Landfill Monitoring Committee	Establishment and operation of a sanitary landfill
Environmental education	Construction of Environmental Education Centre (EEC) Procurement of educational equipment Preparation of environmental education action plan Counterparts training in equipment utilisation and education material production (e.g. banners, leaflets) Use and operation of EEC and on-site education	Capacity development of MMC staff for implementing a sustainable environmental education programme Design and verification of effective education approaches and materials Increased public awareness and cooperation

4.3 Description

4.3.1 Managerial Capacity Strengthening

4.3.1.1 Amendment of Model By-laws

NEMC received copies of the draft model SWM by-laws, prepared by the Sri Lankan Institute of Local Governance (SLILG) in cooperation with JICA, at the end of June 2003. These by-laws cover a wide range of issues, including promoting the separation of garbage at source, specifying the responsibilities of both NEMC and the public in relation to SWM, the circumstances where garbage collection fees may be applied, fines and enforcement procedures, etc. These by-laws have been circulated to NEMC staff and Council members for study and have been discussed at the relevant committee. Following approval by Council, they will be implemented by NEMC as part of the Action plan.

4.3.1.2 SWM Management Tools

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

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

4.3.1.3 PHI/Supervisor Training

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

Table 4-2 : PHI/Supervisor Training Summary

Date	Attendees (no)	Presentation	Topics
30 Jun	14	Introduction to SWM	Why SWM? (main objectives) Current SWM sanitation conditions in Sri Lanka (discharge and storage) Health and environmental risks associated with SWM Final disposal in Sri Lanka SWM planning data (waste generation, composition, waste stream, converting loads to tonnes)
		SWM – Challenges for Change	SWM – a changing field Reducing waste scattering (discharge rule, litter bins, etc.) Improving garbage collection efficiency Reducing SWM costs
28 Jul	15	Human Resource Training	PHI/supervisor as part of an organisation, part of a team and with an individual job/role Important skills Public relations

Each training session involved some input on the topics indicated above in the form of a powerpoint presentation, combined with group activities at relevant places. The powerpoint presentations were developed based on the actual SWM situation in Sri Lanka, with handouts being given to all participants in English, Sinhala or Tamil, as appropriate. The group activities were based on real life situations relevant to participants' jobs as much as possible (e.g. dealing with a labourer who refuses to follow orders or who is threatening personal harm, people who refuse to pay for collection of their garden waste, street traders who attack a labourer, sharps and clinical waste present in normal healthcare waste, etc.).

4.3.1.4 Provision of Transportation Facilities

Five small motorcycles were provided to NEMC by JICA to make it easier for them to supervise SWM works and to do public education/awareness programmes. Some of PHIs and supervisors have been assigned to some of the supervisors, while others ***.

4.3.1.5 Preparation of 10 Year SWM Action Plan

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

- Preparation of a draft SWM Action Plan by JICA, which was revised through NEMC internal discussions and meetings with the Study team to produce a second draft. Essential items to include in the 2004 budget were identified during this process.

4.3.2 Waste Collection Improvement

NEMC, with JICA, is currently implementing a number of pilot projects aimed to improve the current garbage discharge and storage, collection and transportation system, including:

- The introduction of a waste discharge rule and bell collection system in the Nuwara Eliya town centre, with these initiatives being publicised by loudspeaker announcements and leaflets. Under this system, people are required to discharge their garbage in containers (bags, dustbins, etc.) in accordance with certain rules and a specified collection schedule, bringing their garbage directly out

to the collection vehicle when they hear special music being played or, if they are not going to be at home, placing it at the kerbside in a closed container before the specified collection time.

- The provision of a modified three wheeler for the collection and transportation of hazardous healthcare waste.

4.3.3 Improvement of Moon Plains Landfill Site

From January-October 2003, the Study team has been assisting NEMC in upgrading the Moon Plains landfill site. This has involved the following steps:

- Topographical and geological surveys of the site, followed by preparation of a site development and concept plan. This is based on a 191,000m³ semi-aerobic landfill with an estimated lifetime of 20 years. The site will be excavated down to the underlying impermeable bedrock, thus avoiding the need for an expensive liner system, while a leachate collection and treatment system (coconut fibre biological contactor, charcoal filter and wetland) will be installed.
- Preparation and submission of an Initial Environmental Examination (IEE) report to the CEA. Approval of the IEE was obtained in July 2003.
- Handover of the required land to NEMC by the Forestry Department based on a 30year lease agreement. This was obtained in July 2003
- Conduct of awareness programmes about the landfill project at the end of July for residents in the area by NEMC with assistance from the Study team.
- Formation of a landfill monitoring committee, whose task is to inspect and monitor landfilling operations on a regular basis, as described in the Action plan. Monitoring committee members comprise representatives from NEMC (Mayor, Engineer, CPHI, PHI), Forestry department (2), District Secretariat (1), Irrigation department (1), the neighbourhood (monk) and NGO (1). One pre-construction inspection was held to date on 30 June 2003. This was coordinated by NEMC with JICA providing a monitoring checklist for committee members' use and explaining the construction proposals.
- Preliminary and detailed engineering design and costings. Estimated capital costs are 14.6M Rs for the landfill and 6.5M Rs for a bulldozer, while estimated O&M costs are 264Rs/T.
- Site preparation and construction works, as set out below
- Training of relevant NEMC staff in proper landfill operation and maintenance.

Table 4-3 : Moon Plains Landfill Improvement Measures

Measure	Works	Operation
Movable net fence to reduce waste scattering	Construction	O&M
Site preparation works. Including removal of about 780 trees within the landfill footprint	Construction	
Excavation down to underlying bedrock	Construction	
Access road and wheel wash facility	Construction	Extension, O&M
Leachate collection system	Construction	O&M
Leachate and gully sucker treatment systems	Construction	O&M
Landfill gas ventilation system	Construction	Extension, O&M

Measure	Works	Operation
Secure medical waste disposal facility, with gate and perimeter fence	Construction	O&M
Stormwater drainage	Construction	O&M
Monitoring well	Construction	O&M
Control house, bulldozer garage and security features (gate, fence)	Construction	O&M
Educational facility	Construction	O&M
Proper staff allocation, including full-time supervisor, to keep vehicle trip records and control tipping operations		Yes
Use cell method of filling, reducing the "working area" so as to minimise pests, odour, leachate generation, etc.		Yes
Waste compaction by bulldozer		Yes
Daily soil cover to control odour, pests and prevent fire/smoke and waste scattering		Yes
Weekly application of deodoriser to reduce odour		Yes
Weekly pesticide spraying		Yes
Stray dog control (every three months)		Yes
Banning of fires at the landfill		Yes

Note: O&M = operation and maintenance.

These works should be completed by November 2003, after which landfilling operation will be significantly improved, with the site being properly managed, as outlined in the Action Plan.

4.3.4 Environmental Education

With funding from JICA, NEMC has recently established an Environmental Education Centre, which displays information on all aspects of SWM in Nuwara Eliya as well as promoting relevant items (e.g. durable/reusable bags). The unit has appropriate education/training equipment, including a laptop computer and printer, multi-media projector and screen, digital camera, 6,000 educational leaflets and a series of 10 mobile, re-usable educational banners, describing all aspects of SWM with a focus on the situation in Nuwara Eliya for on-site education in schools or public places.

4.4 Assessment

4.4.1 Managerial Capacity Strengthening

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

Management Tools: Progress has been good for implementing the monthly report but slower in the case of control board, primarily due to a shortage of human resources, with key people being involved with their normal works and other components of the JICA pilot projects. The SWM manual was handed over to LAs in October, summarising relevant local information and including feedback from discussions with SWM staff in all LAs, particularly from the supervisor training, monthly report and control board discussions.

PHI/Supervisor Training: All of the participants were very appreciative of the PHI/supervisor training, commenting that the programme was very good - they had gained new ideas, knowledge and a better understanding of SWM. For many of the supervisors, it was the first time they had received any such training in their jobs and they supported such training being continued, even if just once per year.

Transport Facilities: The motorcycles supplied to NEMC are in daily use and are proving very useful to the supervisors. They have made it much easier for the supervisors to undertake field work, particularly monitoring labourers' work performance and checking the cleanliness of the city.

Action plan: Revision of the draft Action plan was largely done by the municipal engineer and CPHI. Hence, it is vital that efforts be made to inform other Council staff and Council members about the Action plan and to get their support so that it can be effectively implemented.

4.4.2 Waste Collection Improvement

4.4.2.1 Bell Collection

Initial feedback from the bell collection pilot project has been encouraging, with the vast majority of the public approving of and supporting the bell collection system, while supervisors, drivers and labourers also like it and the collection time has decreased. Whilst leaflet distribution, public noticeboards and house to house visits have been useful, curiosity as to what the "new music" is for, has also been an important, informal publicity method.

At present, no expansion of the bell collection system is planned, as the dispersed nature of the Nuwara Eliya population means it is not suitable for all parts of the city.

It is important that as this system becomes well established, NEMC should consider how to run the bell collection with *minimum resource input from them and maximum public participation*, this being one of the key objectives. Practically, this should involve, as a first step, reducing the collection frequency, decreasing the number of labourers (handcarts and collection vehicles) and removing unnecessary public bins. These points have been emphasised to NEMC staff.

4.4.2.2 Modified Three Wheeler

The three wheeler has not been used yet (as of 25th September) because the medical waste disposal pit at the landfill site has not been completed. In addition, the on-going strike by hospital staff throughout Sri Lanka is making it difficult for NEMC to get cooperation from the hospital in this project.

4.4.3 Improvement of Moon Plains Landfill Site

Construction upgrading works will soon be completed and NEMC have taken a first important step to improving the operational standards of the Moons Plain landfill through establishing a monitoring committee. The real test will be from when NEMC have to operate the landfill using their own

resources to a much higher standard than previously. Hopefully, NEMC will live up to this task, providing a model for the rest of Sri Lanka to follow.

4.4.4 Environmental Education

The EEC was established on the second floor of the public library at NEMC's request. The library is located along a main road and visited by many children after school to study or read. This location and design of the EEC is suitable for carrying out an effective environmental education programme. In addition, following the delivery of the educational equipment and materials provided by JICA, NEMC was able to provide its trained staff with the resources they were previously lacking and they began their own environmental education programme independently of the study team (e.g. training for vegetable sellers). This initiative on their part seems promising for the development of a sustainable education programme managed and conducted by NEMC.

NEMC staff also involved themselves actively in producing the 10 educational banners, discussing the content of each banner based on the topics suggested by the Study Team and taking many photographs around Nuwara Eliya for use in the banners using their new digital camera. Their own designs were better than those proposed by the Study team, containing simpler, clearer messages. Their ownership rose and their capacity was built through this process. They are utilising the banners, both for environmental education programmes in the EEC and on-site education.