



JAPAN INTERNATIONAL COOPERATION AGENCY
Ministry of Home Affairs, Provincial, District and Local Government
Democratic Socialist Republic of Sri Lanka

THE STUDY ON IMPROVEMENT OF SOLID WASTE MANAGEMENT IN SEEDSARAWATTI NUWARA ELIYA

ACTION PLAN FOR NUWARA ELIYA FINAL REPORT Volume V-7B SUPPORTING REPORT



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Ministry of Home Affairs, Provincial Councils and Local Government
Democratic Socialist Republic of Sri Lanka

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

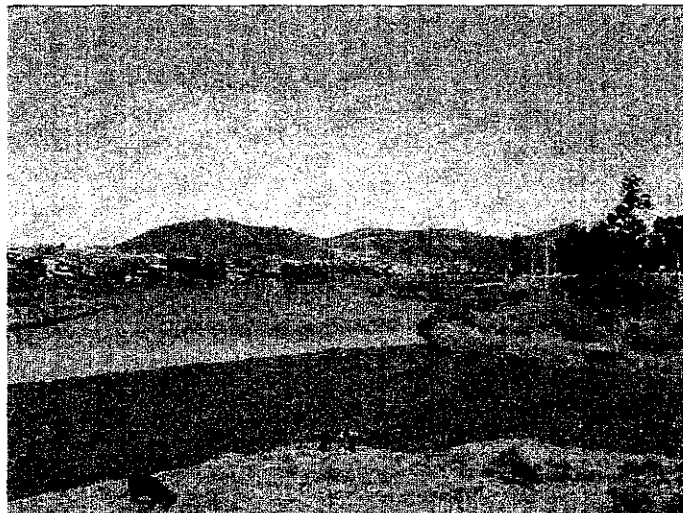
ACTION PLAN FOR NUWARA ELIYA

FINAL REPORT

Volume V-7B

SUPPORTING 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,
Supporting Report.***



1174704[5]

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

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List of Abbreviations

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

Chapter 1
Nuwara Eliya
Waste Stream Data

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Chapter 1 Waste Stream Data

1.1 Introduction

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

1.2 Households

Provisional results of the July 2001 Census give the total population of the NEMA as 25,049 (census result for NEMA) plus an estate population of 2,784 located within the city limits, giving a total population living within NEMA of 27,833. The 2002 population is estimated to be 28,201, based on a population growth rate of 1.32%, which is the average of the 1981-2001 census compound annual growth rate (1.55%) and Urban Development Authority (UDA) projected population growth rate¹ (1.1%).

The floating population in Nuwara Eliya is estimated to be over 7,100². This is influenced by a number of factors including Nuwara Eliya being the administrative capital of the district and having a district hospital; many government and private sector workers in Nuwara Eliya living outside the NEMA limits; many students commuting from outside NEMA to the educational facilities located within Nuwara Eliya; and Nuwara Eliya being a major vegetable trading centre.

The average influx of tourists into Nuwara Eliya is believed to range from 10,000-50,000 per day, especially in long weekends and during holidays, with about 75% of these estimated to be local tourists (UDA, 2002). During the Season (mid-March – late April/early May), this may increase up to 100,000 per day.

Information on household waste generation and management practices was obtained from a survey of 120 households in six different areas of Nuwara Eliya covering two high, two middle and two low income areas. 96% of the surveyed households are located in areas where garbage is collected by NEMC, but only 88% stated they actually use this service. From discussions with NEMC SWM staff, it is estimated that the overall NEMC garbage collection service coverage is 80-90% on a population basis, as there are some other areas of NEMA that were not surveyed that do not receive a garbage collection service at all.

¹ UDA (2002) Nuwara Eliya Draft Development Plan.

² Informal communication from NEMC. This figure is believed to be based on Ceylon Transport Board surveys which are undertaken every six months. However, UDA (2002) quote a much higher figure of 67,000, the origin of which is not known. This latter figure is considered too high, including by the UDA Nuwara Eliya Office. The NEMC figure quoted is considered to be a minimum value.

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

The waste generation rate for Nuwara Eliya was estimated to be 0.498kg/cap.d, this being the average of the Kandy and Matale waste generation rates, as although Nuwara Eliya is a similar sized town to Matale, its per capita generation is believed to be higher due to the high level of agricultural activity within the town. Hence, an intermediate value, between Matale and the much larger city of Kandy was adopted.

Table 1-1: Household Waste Management

Waste Management Method	Households in Survey Area (%)	All Households in NEMA (adjusted %)	Waste Amount (T/d)
Service coverage (%)	95.8	85	
Self-disposal	7.0	9.3	1.31
Discharge for NEMC collection	75.2	66.7	9.37
Home composting	8.1	10.9	1.53
Recycling	1.4	1.9	0.26
Illegal dumping	8.3	11.2	1.57
Total	100.0	100.0	14.04

Notes:

Detailed calculations are set out in "Nuwara Eliya Waste Stream Analysis".

Estimated 2002 population based on a compound growth rate of 1.33% (see Nuwara Eliya Waste Stream Analysis), giving a 2002 population of 28,201.

Total household waste generation = 28,201 persons x 0.498kg/person.d = 14.04T/d.

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

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

1.3 Commercial Sector

1.3.1 Commercial Enterprises

Commercial enterprises covers all commercial operations (e.g. restaurants, bakeries, retail shops, communications centres, banks, hotels, etc.) except for markets, hotels, guesthouses, industries and farms, which are classified as separate categories. This includes government or semi-government enterprises that operate commercial oriented businesses and services (e.g. banks, Post Office, Sri Lanka Telecom, etc.).

According to UDA data³, 23.1ha (1.9%) of NEMA is used for commercial activities, most of which is concentrated in the town centre.

NEMC data gives a total of 504 business enterprises⁴ within NEMA, which is less than the actual number of trade licences, as some trade licences are issued on an activity rather than an enterprise basis.

³ Draft Development Plan Nuwara Eliya, UDA (2000). All area percentages are based on a total area of 1,501ha.

⁴ Excluding hotels, guesthouses, industries and farms.

Business enterprises have been divided into 15% large waste generators (including 12 bakeries, five restaurants, 34 local hotels, five timber/carpentry shops, Main Post Office, Sri Lanka Telecom) and 85% small enterprises, based on NEMC advice.

Limited specific investigations were undertaken for commercial enterprises as part of this study, involving interview surveys of 12 small and 10 large commercial enterprises, covering seven retail shops, five local hotels/restaurants, two supermarkets, bank, hairdresser, two communications centres, three garages, and the Main Post Office. Estimated garbage generation and composition, based on the four most common waste types, are summarized below.

Table 1-2: Commercial Enterprises Waste Generation and Composition

Source	Estimated waste generation (kg/d)	Most common waste types
Small enterprises (12), including two garages	0.5 - 10	Pa > Ca > F/K > PI > Me
Large retail/service (5), including one garage	15 - 85	Pa > F/K > PI > Ca > Te
Local hotels/restaurants (5)	25 - 60	F/K > Pa > PI > Ca > Me

Notes:

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

Waste types: Ca = cardboard, F/K = food/kitchen, Ga = garden, Me = metals, Pa = paper, PI = plastics, Te =textiles.

Commercial waste generation is estimated to be 4.7T/d, based on survey data together with discussions with NEMC Supervisors, giving a waste generation rate of 9.31kg/enterprise.d. Waste generation increases approximately 1-3 times on average during the "Season" (April), festivals (e.g. Deepavali, Thaipongal) and other special occasions.

Seven commercial enterprises (Post Office, hairdresser, two garages and three local hotels) produce small quantities of hazardous waste, comprising a small quantity of tubelights (4 enterprises), batteries (1 enterprise), used razor blades (hairdresser), large batteries (two garages), and spraycans (2 enterprises), all of which are disposed of with their normal garbage.

For the 12 small enterprises, all are covered by the NMC garbage collection service and all use this service for some (3) to all (9) of their garbage, either carrying their garbage directly to a collection vehicle (8) or taking it to a community collection point (4). One small enterprise (commercial bank) burns some of their garbage on-site. Three small enterprises recycle some of their garbage, this being the main method of disposal for Globe Automobile. New Fairline Textiles gives away about 3kg/mth of cardboard to individual collectors on a variable basis; Globe Automobile (garage) sells about 240kg/mth of scrap metal and eight plastic cans/mth⁵; Park Motors sells about 10kg/mth of scrap metal (4Rs/kg), one large battery (75Rs/kg) and 25L of used engine oil.

For the large enterprises, nine utilize the NEMC garbage collection service for the disposal of most (4) to all (5) of their garbage. One enterprise (Main Post Office burns/buries most of its garbage on-site. Five enterprises recycle various materials comprising Cargills Food City (20kg/mth cardboard), the

Main Post Office (5kg/mth paper), CWE (1,125kg/mth cardboard, 2.5kg/mth paper, 600 polysacks/gunny bags⁵), Remarko Restaurant (60 plastic cans and 300 polythene bags) and De Silva Food Centre (60 glass bottles, 50 polysacks, 20 plastic cans per mth).

Based on this information, it is estimated that 82.3% of commercial waste is collected by NEMC, 5.9% is disposed of on-site primarily by burning (e.g. paper waste) and 11.8% is recycled.

1.3.2 Markets

Nuwara Eliya has one main public market (Central market) and a large weekly Pola held on Sundays. Market and pola details are given below.

Table 1-3: Public Markets Details

Market	Number of stalls		SW collection/ disposal
	Description	Total	
Central	11 meat/fish/chicken, 9 vegetable/fruits, 15 goods, 19 other	54	Collection and disposal by NEMC
Sunday Pola	Mainly fruit/vegetable.	1,000	
Total		1,054	
Total (equivalent number of daily stalls)		197	

Note: Stall numbers are based on currently functioning market stalls, as determined during JICA field surveys. Another five stalls at the Central market are either closed or being used as stores.

Overall market waste generation is estimated to be 2.1T/d, from an equivalent number of 197 daily stalls, with all market waste being collected by NEMC. Further market and pola details are given in the following sub-sections.

NEMC's slaughterhouse is located at Nanuoya, outside NEMA limits. About six cows are killed here per day and 5-6 goats per week. Daily waste generation is about 15-20kg, with animal dung being collected by individuals, while very small quantities of other animal waste (e.g. bones, etc.) are buried on-site. The slaughterhouse has a wastewater disposal problem, but a proper drainage system has been proposed to address this.

1.3.2.1 Central Market

The central market is located in the Main Bazaar area and is open seven days/wk, excluding Poya days, from 8am-8:30pm. It comprises a total of 54 active stalls and produces about 5-6 handcarts/d of market waste on Monday-Friday and 8-10 handcarts/d on Saturday-Sunday.

Market waste generation is estimated to be 780kg/d (14.4kg/stall.d) with fruit/vegetable waste being the most common waste type, followed by fish/meat and paper/cardboard waste. Waste generation increases approximately two times during Christmas and three times during the April season. Recycling from the market is negligible.

⁵ Survey recycling data reduced by 20% to match stated waste generation.

The market is cleaned by seven labourers under a market kangani and market supervisor with approximately 67% of labourers working on the day shift (8am-5pm) and 33% during the night shift (12am-8pm). Some market traders place their waste in plastic bins, but most simply discharge it on the ground. Market waste is collected by handcart and taken to one of two stationary trailers near the market.

The market supervisor said there are no problems with the current market waste management system. However, the system could be improved through encouraging recycling and possibly using a compactor for waste collection in this area. He also considers that traders would be willing to separate their waste at source if requested, but separate waste storage bins would be required in this case.



Central Market – left: fish stall; right – stationary trailers near market used for commercial area and market waste.

1.3.2.2 Sunday Pola

The Sunday Pola is located behind the NEMC Office, off Hill St. It comprises ~1,000 stalls, including 20 permanent and 175 temporary constructed stalls, while most other traders set up their stalls on the ground. Some traders bring their produce and set up their stalls by Saturday noon, with people beginning to buy produce on Saturday afternoon. Hence, in reality the Pola runs from about 12am Sat to 7pm Sun.

The Pola generates a large amount of waste, estimated to be 9.4T (4.0 tractor loads and 1 lorry load) by NEMC Supervisors. This is equivalent to 1.35T/d from 197 daily stalls, or 9.4kg/stall.d.

All stalls store their garbage on the spot, with NEMC cleaning the Pola on Monday using eight labourers (some from other zones), making 15-25 small piles of garbage, which are subsequently collected by the lorry/tractor on Monday-Tuesday.

⁶ Survey recycling data reduced by 50% to match stated waste generation.

The main problem with pola waste management is the large quantity of waste generated in a short time. Ideally, all pola waste should be collected on Monday, but due to a vehicle shortage, this would mean diverting another vehicle from its regular collection route in order to do this.

JICA inspection of the pola area one Monday lunchtime found a significant number of waste piles, with some of the pola waste having been partially burnt on site (see photos below). However, NEMC labourers said that it is generally not possible to burn the pola waste due to its high moisture content.



Pola market waste

According to the CPHI, over 50% of pola waste is banana leaves used for transporting produce to market. NEMC is planning to introduce a fine system for banana leaf waste and to waive the entrance fee for any lorries not using banana leaves.

1.3.3 Hotels and Guesthouses

Hotels and guesthouses make up 21ha (1.40%) of the NEMA (UDA, 2000). These comprise eight tourist hotels and around 50 guesthouses. All eight tourist hotels and nine of the guesthouses were surveyed as part of this study, while additional staff and guest numbers, waste generation and disposal practices information was obtained for the other guesthouses by NEMC on JICA's behalf.

Hotel/guesthouse waste generation was estimated to range from 1-600kg/d, with food/kitchen waste being the most common waste type, followed by garden, paper, plastic and glass waste. Waste generation increases by around 3-5 times during long weekends, the Season (April) and on other holiday/festival/special occasions. Some guesthouses/hotels reported up to a 5-10 times increase in waste generation during such times.

1.3.3.1 Hotels

The eight tourist hotels employ an average of 536 staff, while average guest numbers are 323. Average hotel waste generation was estimated to be 1.38T/d, equivalent to 1.61kg/(guests+staff.d).

Six of the hotels utilize the NEMC garbage collection service as their main method of garbage disposal, while another uses it as a secondary method. Five burn/bury some of their garbage, this being the main

disposal method for one hotel. Six hotels recycle some of their waste, this being the main disposal method for Galway Forest Lodge. Recycling is a significant activity with major recyclers being:

- The Grand Hotel: 400kg/d of food/kitchen waste to its own piggery; 120kg/mth of plastics, 24kg/mth of paper.
- The Nazareth Farm collects around 210kg/d of food/kitchen wastes for pig food from the Hill Club (100kg/d), Galway Forest Lodge (70kg/d), Ceybank Rest (25kg/d) and Glendower Hotel (15kg/d).
- The Hill Club also recycles 500 bottles and 150 large plastic cans monthly.
- The Windsor Hotel recycles 200 bottles and 20 large plastic cans/mth.
- St Andrews Hotel recycles 50kg/mth of metal/paper/plastic and 500 bottles/mth.
- The Galway Forest Lodge, Ceybank Rest and Glendower Hotels all recycle small-medium quantities of plastic/metal containers, glass bottles and some paper.

Three hotels also compost some of their waste, the Hotel Tree of Life composting around 60kg/mth of food/kitchen waste, while St Andrews Hotel and Ceybank Rest each compost around 5kg/mth of garden waste.

Based on this information, it is estimated that 37.7% of hotel waste is collected by NEMC, 14.1% is disposed of on-site, 48.0% is recycled and 0.2% composted.

1.3.3.2 Guesthouses

The nine guesthouses⁷ surveyed by JICA employ an average of 132 staff, while average guest numbers are 76. Corresponding numbers for all 50 guesthouses are approximately 312 staff and 325 guests respectively.

Guesthouse waste generation was estimated to be 429kg/d for all 50 guesthouses, equivalent to 0.67kg/(staff+guests).d.

Seven of the JICA surveyed guesthouses utilize the NEMC garbage collection service as their only (2) or main (5) method of garbage disposal. Six burn/bury some (4), most (1) or all (1) of their garbage on-site. Five are involved in recycling a total of 43kg/mth paper and 87 bottles/mth while the Clifton Inn composts around 200kg/mth of garden waste for its own use.

Most other guesthouses utilize the NEMC collection service, except for Ascot Guesthouse and the New Keena Hotel, who give most of their garbage to the Nazareth Farm for recycling and the Tourist Board Holiday Inn, which composts most of its garbage on-site.

Based on this information, it is estimated that 63.8% of guesthouse waste is collected by NEMC, 19.9% is disposed of on-site, 3.8% is recycled and 12.5% composted.

⁷ The Nuwara Eliya Golf Club was included in this category as it also offers accommodation.

1.4 Institutions

Investigations for this category focused on hospital waste, primarily due to the hazardous nature of some hospital waste (e.g. clinical waste, sharps, body parts). Interviews were also conducted with some schools, other educational institutes, government offices, forces (police, army camp) and religious places in order to estimate the amount and composition of waste generated by these sectors.

1.4.1 General

According to UDA data, 78.2ha (5.1%) of NEMC is used by public and semi-public institutions, while an additional 9.0ha (0.60%) is designated for religious activities. Interview survey results for institutional waste generation and composition data are set out in Table 4.

Table 1-4: Institutional Waste Generation and Composition

Source	Waste generation (kg/d)	Most common waste types
Schools (5)	6-100	Pa > Ga > F/K > PI
Other educational institutes (3)	8-300	Ga > F/K > Pa > Sw > Te
Hospitals (3)	5-390	F/K > Pa > HH > Ca=PI
Government offices (5)	3-10	Pa > F/K > Ga > In > Ca
Forces (2)	25-200	F/K > Pa > Ga
Religious (1)	10-50	Ga > PI > F/K > Pa

Notes:

Waste types: Ca = cardboard, F/K = food/kitchen, Ga = garden, HH = healthcare hazardous, In = inerts, Of = other, Pa = paper, PI = plastics, Sw =sawdust, Te =textiles.

The number of institutes shown here in brackets differs in some cases from the number mentioned in the text below, because the above numbers refer to complete interview surveys that were conducted, while the number in the text may be greater than this due to additional statistical/waste stream information obtained from NEMC.

Institutional waste generation increases approximately 1-2 times on average during festival times (e.g. Deepavali, Thaipongal) and other special occasions.

Three schools, one government office, the Singha Regiment Third Billet, Patthini Amman Kovil and Victoria Park produce very small quantities of hazardous wastes (batteries and tubelights).

1.4.2 Schools

Nuwara Eliya has a total of 18 schools, including four Type 1AB⁸ schools, two Type 1C schools, five Type 2 schools, five primary schools, one international secondary school and one private secondary school. Another international school is scheduled to open in early 2003. The total estimated number of students and school staff are 10,188 and 627 respectively, giving a combined total of 10,815 students and staff. The student population amounts to 38% of the total 2002 NEMA population (28,201). These schools serve a large catchment area than the town, with 32% of students coming from outside NEMA (UDA, 2000).

⁸ Type 1AB = Years 1-13 (sometimes 6-13) with A level science/commerce/arts; Type 1C = Years 1-13 (sometimes 6-13) with A level commerce/arts; Type 2 = Years 1-11 (up to O-level only); Type 3 = Years 1-5 (sometimes 9) primary.

Interview surveys were conducted with six schools⁹, making up 63% of the total NEMA schools' staff and student population. Three of these five schools burn/bury/place in a pit all of their garbage on-site while two discharge all their garbage for collection by NEMC. None of the surveyed schools currently recycle or compost any of their waste.

Based on this data, total school waste generation was estimated to be 0.23T/d (0.021kg/(students+staff).d), with 11.2% of this waste collected by NEMC and 88.8% burned/buried on-site.

1.4.3 Other Educational Institutes

Nuwara Eliya has a number of other educational institutes, comprising the Forest College, Technical College, Gamini Dissanayake Foundation, Cultural Centre and SOS Childrens Village. Together, these institutes are estimated to comprise 949 students and 141 staff, giving a total of 1,090 staff and students.

Three of these five institutes were surveyed. Three of these burn/bury some (1), most (1) or all (1) of their garbage on-site, while two discharge most (1) or some (1) of their garbage for collection by NEMC. The SOS Children's Village recycles around 25kg/mth of paper.

Total other educational institutes waste generation was estimated to be 0.36T/d, equivalent to 0.328kg/(staff+students).d, with 89.7% of this waste being disposed of on-site, 9.6% collected by NEMC and 0.7% recycled.

1.4.4 Hospitals

There are three main hospitals within NEMA – Nuwara Eliya Base Hospital, Cooperative Hospital and Ideal Hospital Pvt Ltd¹⁰ - as well as a number of medical centres/dispensaries. The main survey findings for these three hospitals only, including hospital statistical data are set out in the following two tables and summarized below:

- The combined hospital facilities in Nuwara Eliya are:
 - A total of 289 beds.
 - Average bed occupancy equivalent to 366 beds per day (127%).
 - Average total clinical and outpatients of 1,003 patients per day.
 - Total staff of 328.

Corresponding hospital waste generation is estimated to be 0.51T/d, equivalent to 0.301kg/(staff+patients).d.

- Food/kitchen waste is the most common waste type, followed by paper, healthcare hazardous waste and cardboard/plastic waste. Healthcare hazardous waste was listed as the most common waste type by the Ideal Hospital.

⁹ Good Shepherd convent sinhala and tamil schools were surveyed together.

- Most normal waste is collected by NEMC, except for small quantities of paper, plastic/glass bottles/containers and coconuts recycled by the Nuwara Eliya Base Hospital, as described further below, while Cooperative Hospital burns some of its normal garbage on-site.
- Currently, the Base Hospital discharges its clinical waste for collection by NEMC, while body parts, placentas, sharps and highly infectious wastes are burned/buried on-site. The Ideal Hospital discharges very small quantities of clinical waste for collection by NEMC, while the Cooperative hospital burns/buries clinical waste and sharps on-site.
- The Base Hospital has a relatively new incinerator but this is not used due to its inappropriate location, proximity to staff living quarters, and inadequate height. They have also recently acquired an autoclave but have yet to start using this.
- The Base Hospital reuses waste containers. For example saline and penicillin bottles are reused as containers for blood and urine specimen collection, while cardboard boxes are used as sharps storage containers.
- The Base hospital has banned people bringing polythene into the hospital. However, polythene bags are used for dispensing medicines to patients and observation during JICA field investigations suggests the polythene ban is not being strictly enforced.
- The Base hospital recycles some of their used paper, plastic/glass containers/bottles and coconut shells. Glass/plastic/metal containers/bottles are generally stored on-site and sold by auction at approximately yearly intervals, while paper is collected by the Hospital Welfare Society. Coconuts are collected by the hospital caterer with 200Rs/mth deducted from catering contract payments. Indicative data on the quantities of materials recycled was obtained from the Base Hospital, showing they recycle around 40 25L plastic cans and 14 24L metal cans per 3-6 months, 2kg/mth of paper and 20 coconuts per day. No quantities data was available for plastic containers, glass bottles and penicillin vials. Total recycling was estimated to be 7.8kg/d.
- Ideal Hospital pays garbage collection workers an unofficial collection fee of 600Rs/yr.
- Both the Base and Cooperative hospitals are not satisfied with the present waste collection system, the main reasons being garbage collection/sweeping is not properly done (2) and a lack of recycling (2). The Base Hospital also identified problems with handling hospital hazardous waste and complained about the irregularity of the NEMC collection service, with garbage sometimes remaining uncollected for several days. They do not have a Hospital PHI and said that inspections by NEMC PHIs are very infrequent.
- Desired SWM improvements ranked in descending order are (numbers shown are weighted average ranks (WAR) for desired improvements)
 - Improved garbage discharge system 7.0

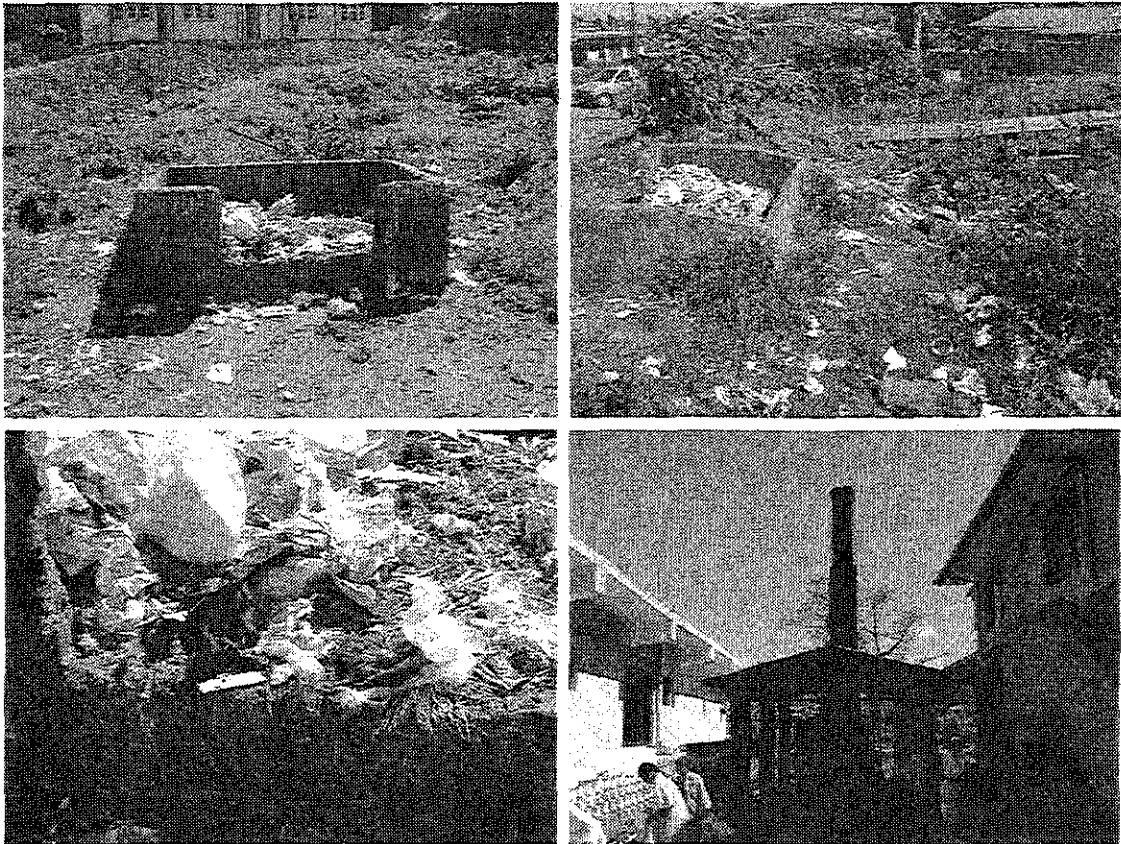
¹⁰ Ideal Hospital should possibly be categorized more as a medical centre as it has no bed or clinical patient facilities.

- Improved collection and disposal of hospital hazardous waste 5.5
- More reliable garbage collection service 4.0
- Greater recycling/composting of garbage 2.0

The Base Hospital would also like an incinerator and a covered trailer for garbage transport, while it considers their existing bin is inadequate.

- No hospitals were willing to pay for improved garbage collection services.
- All hospitals are very willing to cooperate in separating their waste into different categories for recycling.

It should be noted that the base hospital is located on marshy land and is slowly sinking, resulting in some buildings being abandoned. A new 10MRs hospital has been proposed for Nuwara Eliya, comprising 545 beds with maternal and child care units. Funding for the new hospital is currently being sought from Japan under their grant aid scheme, while NEMC has to provide a site. NEMC have indicated that they have reached an agreement with the brewery company, whose brewery is now closed in Nuwara Eliya, to procure their land in exchange for NEMC giving them some other land. However, the hospital authorities have not been officially informed of this.



Nuwara Eliya Base Hospital: Top – hospital bin located outside hospital premises next to byroad; bottom left – blood stained bandages present amongst normal waste in the hospital bin.

1.4.5 Government Offices

There are approximately 38 central and provincial government departments/ministries/authorities with offices in NEMA, excluding the Forces who are discussed separately below. These offices, together with NEMC employ approximately 1,745 workers. Interview surveys were conducted with five of these offices.

Four of the five offices surveyed discharge most (2) to all (2) of their garbage for NEMC collection, while three burn/bury most (1) to some (2) of their garbage on-site. The Divisional Forest Office recycles around 10kg/mth of paper.

Total government office waste generation is estimated to be 0.16T/d (0.094kg/worker.d), with 73.1% of this waste collected by NEMC, 25.8% burned/buried on-site and 1.0% recycled.

1.4.6 Forces

The Forces in NEMA comprises the Police, Third Singha Regiment Army Camp and Police Shooting Training Centre. Both the Police and Army Camp were surveyed, while the Police Shooting Training Centre is only used during training sessions, with no people staying there full-time. Hence, waste generation from the Training Centre was assumed to be negligible.

Table 1-5: Hospital General Statistics and Waste Generation

Hospital	Type	No of Beds	Bed occupancy (%)	Out-patients (no/d)	Clinical patients (no/d)	Staff	Waste composition	Normal waste (kg/d)	Clinical waste (kg/mth)	Body parts (kg/mth)	Sharps (kg/mth)	Highly infect-ious	Other
Base Hospital	Govt	265	129	431	460	304	F/K>Pa>Pl>Ca>GI>HH	482	25	BP: 25 Plac: 37	200	Small	0
Cooperative Hospital	Semi-govt	24	100	12	45	14	F/K>Pa>HH>Ca>Ga	5	Small	BP: 0 Plac: Small	Small	0	Small
Ideal hospital	Private	0	0	55	0	10	HH>F/K>Pl>Ca>Pa	7.5	1	0	0	0	2.5
Total		289	127	498	505	328		494.5	26	62	200	Small	2.5

Notes:

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

Average total number of beds occupied = Sum of (number of beds x bed occupancy rate) for all hospitals = 366.

Waste types: BP = body parts, Ca = cardboard, Clin = clinical waste, F/K = food/kitchen waste, Ga = garden, GI = glass, HH = healthcare hazardous waste, O = other, P = paper, Plac = placenta, PI = plastic. NA = no answer.

An accuracy check has only been made on the amount of normal waste, with survey data being amended based on NEMC data, as required.

Table 1-6: Hospital Waste Disposal Practices

Hospital	Normal waste	Clinical waste	Body Parts and/or placentas	Sharps	Highly infectious	Other	WWTP	Incinerator	Comments
Base Hospital	Collected by NEMC except for some recycling of paper, plastic/glass/metal containers/bottles and coconut shells.	Discharged for collection by NEMC	Body parts and placentas are buried on-site.	Burned on site	Burned on site	Not relevant	Yes (see note)	Yes (see note)	Would like new incinerator, covered trailer and new bin
Cooperative Hospital	Collected by NEMC, with some garbage burnt on-site.	Burnt/buried on-site	Placentas: NA	Buried on-site	Not applicable	Collected by NEMC	No	No	
Ideal Hospital	Collected by NEMC.	Collected by NEMC	Not applicable	Not applicable	Not applicable	Collected by NEMC	No	No	

Note: The Base Hospital has a relatively new incinerator but this is not used due to its inappropriate location. It also has a wastewater treatment plant (WWTP) but this had been abandoned for some time.

The Police discharges most of its waste for NEMC collection but also recycles around 210kg/mth of food/kitchen waste which is fed to the dogs at the police kennels. The Army Camp burns/buries over half of garbage on-site but also recycles 2kg/mth of paper and 2,250kg/mth of food/kitchen waste which is collected by the Nazareth Farm for pig food.

Total Forces waste generation was estimated to be 0.23T/d, with 55.5% of this being disposed of on-site, 36.5% recycled and 8.0% collected by NEMC.

1.4.7 Religious Places

The total number of religious places within NEMA is approximately 27, comprising nine Buddhist temples, eight hindu kovils, two mosques and eight churches. The associated number of religious workers is estimated to be 121.

Both the Ashokaramaya and Muththu Mari Amman Kovil were surveyed, with Ashokaramaya burning/burying all of its garbage on-site while Muththu Mari Amman Kovil discharges all of its garbage for collection by NEMC. Waste generation from the kovil was relatively high (10kg/clergy.d) compared with 0.77kg/clergy.d from the temple. Hence, an average waste generation rate of 1.01kg/clergy.d, based on Kandy and Matale data was applied to the other religious places, giving total estimated religious waste generation of 0.17T/d, equivalent to 1.38kg/clergy.d. 16.7% of religious places waste is estimated to be disposed of on-site, while 83.3% is discharged for NEMC collection.

1.5 Industries

According to UDA data, industrial land use constitutes 13.4ha (0.9%) of total land use within NEMA, while tea estates make up another 229ha (15.5%).

Seven industries were identified within NEMA comprising two garment factories, two eyelash production factories, a polythene bag manufacturer, Ceylon Brewery and Pedro Tea Estate. The brewery is now closed, while the two eyelashes factories are part of the same company. Hence, surveys were conducted with all active industries, except for the smaller of the two eyelashes factories, for which waste stream details were obtained by telephone. Pedro Tea Estate data was subsequently excluded from the survey data due to it being located on the NEMA boundary and disposing of most of its waste on or near to the factory site.

Three of the five surveyed industries discharge all (1) or most (2) of their garbage for NEMC collection, while three burn/bury some of their garbage on-site. This includes Birdwear Interfashion, who usually burn most of their waste on-site in their own incinerator, while directly hauling about one tractor load per week to the NEMC disposal site and recycling 1,000kg/mth paper/cardboard, 210kg/mth plastic, 50kgmth metals and 600kg/mth textiles. However, their incinerator is currently out of service but should be repaired within the next three months. Hence, they currently dispose of most of their waste by

direct haulage to the NEMC disposal site. Their normal waste management practice has been adopted for the waste stream, rather than their current temporary mode of operation.

Three other industries are involved in recycling. Winter World Garment Pvt Ltd recycles 1,000kg/mth of textiles; S.S. International Ltd (main eyelashes factory) recycles 450kg/mth of polythene and Robin Polypack Pvt Ltd recycles 1,500kg/mth of polythene.

Total industry waste generation from 2,047 workers was estimated to be 1.16T/d (0.567kg/worker.d), of which 44.4% is collected by NEMC, 28.9% disposed of on-site, 13.8% recycled and 12.9% directly hauled to the landfill.

1.6 Farms

According to UDA data, agricultural activities occupy 475ha (31.1%) of NEMA, where agriculture activities includes any vegetable plots larger than 20 perches and greenhouse operations (e.g. Huejay International). Only the waste generated by major farming operations within NEMA has been included within this study, given the prominence of the agricultural sector within Nuwara Eliya. These farms comprise Nazareth Farm, Huejay International and Seetha Eliya government agricultural farm.

Nazareth Farm directly hauls about one tractor load per week of garbage to the NEMC disposal site, whilst also disposing of some waste on site, recycling 100 bottles, 150kg metals and 150kg of food/kitchen waste for animal feed monthly and composting 50kg/d of garden/animal waste for their own use.

Huejay International (cut flower greenhouse operation) disposes of most of its waste on-site taking the occasional lorry load to the NEMC disposal site, whilst also recycling around one lorry load of polythene per year.

Seetha Eliya agricultural farm composts most of its waste, comprising around 7,500kg/mth of food/kitchen waste, 2000kg/mth of garden waste, 9,000kg/mth of animal waste and 8kg/mth of paper waste. This represents a significant composting operation. Some other waste is also buried on-site.

Total waste generation from these three major farming operations is estimated to be 2.47T/d, with 40.3% of this waste being disposed of on-site, 26.4% composted, 5.0% recycled and 27.3% directly hauled to the NEMC disposal site.

1.7 Other Waste

Other waste accounts for waste collected from public places such as parks, streets, drains and canals and from other "informal" sources that are not registered with the relevant authorities and hence not included in official statistics. It may also include some of the waste that is illegally dumped around the town and subsequently collected by NEMC.

1.7.1 Parks and Green Spaces

According to UDA (2000) data, parks/playgrounds make up 46.0ha (3.1%) of NEMA, while cemeteries comprise another 3.0ha (0.20%).

Apart from the Golf Club which has been covered under guesthouses, there are two additional major green areas within NEMA, namely Victoria Park and the Race course.

Victoria Park is cleaned by the NEMC Works Department. It composts about 100kg/mth of food/kitchen waste, 600kg/mth of garden waste and small quantities of paper waste, whilst directly hauling about five tractor loads per year to the NEMC disposal site. Other waste is either collected by NEMC or disposed of on-site.

The Racecourse and associated grounds are private land, administered by the Turf Club. About two handcarts per day of garbage are collected from the Racecourse, one of which is collected by NEMC, while the other is illegally dumped into the nearby stream. The Racecourse grounds generate about 36kg/d of garbage which is collected by NEMC.

Overall park waste generation amounts to 0.38T/d of which 8.8% is disposed of on-site, 6.3% is composted, 50.3% is collected by NEMC, 31.9% is illegally dumped and 2.6% directly hauled to the NEMC disposal site.

1.7.2 Road/Drain Cleaning

NEMC data gives the total length of roads and drains within NEMA that are cleaned by the Council as 60.2km and 23.4km respectively. NEMC has 20 handcarts with handcart labourers normally undertaking road sweeping and drain cleaning duties in addition to garbage collection. NEMC staff could not actually estimate the amount of road/drain cleaning waste produced each day. Instead, assuming 10% of these roads/drains are cleaned daily and using road sweeping waste generation estimates from other JICA studies, road/drain cleaning waste was estimated to be 0.41T/d. This equates to each of the 20 handcarts cleaning an average of 250m of road per day and 97m of drains. Furthermore, it was assumed that 50% of road/drain cleanings were simply deposited at the side of the road/drains, while the remaining 50% is collected by NEMC and taken for disposal, the latter being equivalent to about 2.5 handcart loads/d.

1.8 Recycling

1.8.1 General

Informal reuse and recycling is relatively active in Nuwara Eliya, with there being several shops in the town selling used items and/or recyclables such as used newspapers/exercise books, bottles, containers, tins, shoes, bags, bikes, umbrellas, books, etc. These may be used for a wide range of purposes, including:

- Waste paper may be used to make paper bags for wrapping purposes (e.g. medicines, food, small goods, etc.).
- Glass and PET bottles may be used as containers for local products (e.g. sauce).
- Empty metal tins may be used to make the metal support that secures broom bristles to the broomstick (ekel broom) or for making toys and other items (e.g. buckets).

In addition, textile scraps originating from garment factories are collected by women at the NEMC disposal site and used to make cushions, pillows, etc.

1.8.2 At Source

This section focuses on household recycling at source, as recycling at source from other waste generators has previously been described. Household at source recycling was estimated from the household survey results (120 households), with the relevant results being summarized below. These indicate that 50% of households have recyclables collected from them by individual collectors, 28% take some recyclables to shops for refund/sale, while no surveyed households compost kitchen and/or garden waste.

Table 1-7: Household Survey Recycling Results Summary

Waste Type	Composting	Individual collects from House	Resident takes to shop
Yes	20	60	33
No	100	60	87
Food/kitchen	18	0	0
Garden/wood	19	0	0
Paper/cardboard	0	12	5
Plastic	N/a	1	0
Glass	N/a	57	29
Metal	N/a	6	0
Textile	N/a	2	0

Notes:

The household survey indicated that 102 households are visited by individual collectors but only 60 households actually give recyclable materials to these collectors.

N/a = not applicable.

The total amount of materials recycled from households at source was estimated using this data together with estimated household waste composition data, 85% average NEMC garbage collection service coverage and assuming a 90% recycling rate. This gives a household recycling quantity of 0.26T/d (1.91% of total household waste generation).

The middleman survey indicated around 0.095T/d of recyclable materials purchased by them originate directly from households. As many recyclable materials collected from homes are expected to be taken to other places (e.g. paper bag making enterprises) rather than just middlemen, the household recycling quantity estimate of 0.26T/d is considered reasonable.

1.8.3 During Collection

Both handcart and collection vehicle workers collect recyclable materials in Nuwara Eliya, which they generally sell to middlemen within the town. The collection worker survey found that nine out of 30

labourers interviewed are involved in recycling. These nine labourers collect an estimated total of 436kg/mth, comprising mainly bottles (332kg, 503 in number¹¹), metal cans (78kg) and smaller quantities of other metals (14kg), iron (6kg), aluminium (4.8kg) and brass (2kg), earning an average of 171Rs/labourer.mth, as set out below. Total quantities of recyclable recovered during collection by all SWM labourers are estimated to be 1,164kg/mth.

Table 1-8: Recyclable Materials Recovered by Collection Workers

Item	Collection Worker Survey			Estimated Total Quantity (kg/mth)
	No of labourers collecting	Quantity (kg/mth)	Price	
Bottles	9	332	0.5-5.0Rs ea	884
Iron	2	6.0	2-3 Rs/kg	16.0
Metal can	2	78	1.5-2.0 Rs/kg	208
Aluminium	4	4.8	35-50 Rs/kg	12.7
Brass	1	2.0	60 Rs/kg	5.3
Other metal	2	14.0	1.5-4.0 Rs/kg	37.3
Total	9	436.4		1164
Average earnings (Rs/labourer/mth)	171			

Notes:

No of labourers interviewed = 30, while total NEMC SWM labourers + drivers = 80, excluding septic tank/toilet, cemetery, disposal site and slaughterhouse labourers.

Collection worker survey quantities adjusted from 321kg/mth to 436kg/mth to take into account some no responses for the quantities of recyclables collected.

Total quantity calculated from collection worker survey = $80/30 \times 436 = 1164\text{kg/mth}$.

1.8.4 At Final Disposal

There are five NEMC labourers assigned to the NEMC disposal site. Estimated quantities of recyclable materials collected by them were obtained by directly asking the labourers and then separately the landfill supervisor (senior labourer). Based on this data, landfill worker recycling is estimated to comprise 30bottles/d, 25kg/d of broken glass, 70kg/d of tins and 25-30 coconut shells¹² (half nuts), giving a total of 117kg/d.

Some other people also collect recyclable materials from the Interfashion (INCO) tractor which brings waste from this garment factory to the landfill about 1-2 times per week. About seven women collect 1-2 polysacks each of textile scraps which they use to make bed sheets, pillows, etc., while paper is collected by two men, this being used to make paper bags and for wrapping purposes. The total quantities of textiles and paper recycled in this manner is estimated to be 39kg/d and 3.5kg/d respectively.

This gives a total recycling amount at the final disposal of 160kg/d.

¹¹ Average bottle weight = 0.66kg, obtained by measuring a mixture of 10 arrack and beer bottles, th185se being the most common bottles recycled.

¹² One shell weighs 87.5g based on the measured weight of 40 shells.

1.9 Disposal Quantities

Current trips data and disposal quantities over the seven day period from Sep 12-18, 2002 (JICA survey data) are set out below, together with NEMC landfill site trips data for Mar and Aug 2002.

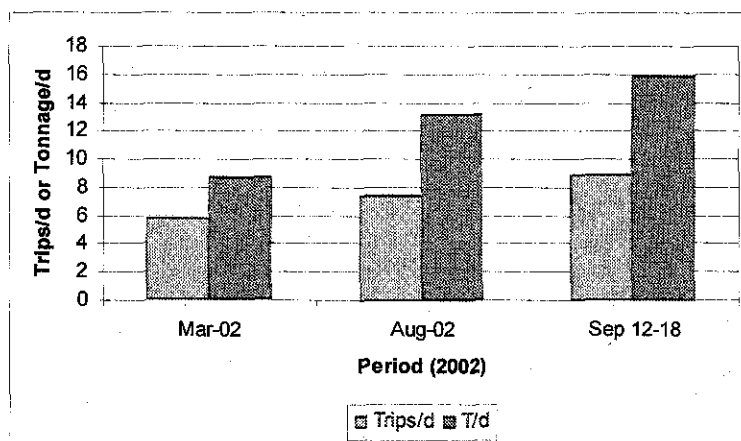


Figure 1-1: NEMC Collection Vehicle Trips and Collection Quantities

Table 1-9: NEMC SWM Waste Disposal Average Trip and Tonnage Data

Vehicle	Registration	Number of Trips – 12-18 Aug, 2002									Tonnage		
		12 Th	13 F	14 Sa	15 Su	16 M	17 Tu	18 W	Tot	Avg	T/wk	T/d	
NEMC 4WT	49-9427	4	3	5	3	3	3	3	24	3.43	36.1	5.2	
	49-9428	2	2	2	2	1	2	1	12	1.71	21.5	3.1	
	49-9429	2	2	1	1	2	1	2	11	1.57	18.0	2.6	
	37-0959	1	1	2	1	2	1	1	9	1.29	17.1	2.4	
NEMC Lorry	27-4934	1	1	0	1	1	1	1	6	0.86	18.4	2.6	
Nazareth Farm	4WT	0	1	0	1	0	0	0	2	0.29	1.9	0.27	
Interfashion (INCO)	4WT + trailer 1	0	0	2	0	0	0	1	3	0.43	2.1	0.30	
	4WT + trailer 2	0	0	1	0	0	0	1	2	0.29	2.3	0.33	
Huejay International	Lorry	0	0	0	0	0	0	1	1	0.14	0.95	0.14	
Total		10	10	13	9	9	8	11	70	10.0	118.3	16.9	
Total to disposal	NEMC 4WT	9	8	10	7	8	7	7	56	8.0	92.7	13.2	
	NEMC Lorry	1	1	0	1	1	1	1	6	0.9	18.4	2.6	
	Private	0	1	3	1	0	0	3	8	1.1	7.2	1.0	

Note: 4WT = four wheel tractor

Some key points from this data are summarized below:

- The JICA survey trips and corresponding tonnages data are significantly higher than NEMC records for March and August 2002 (see above figure), these being the most complete monthly records available for 2002 (20 and 26 days of records respectively). NEMC explained that their trips recording system is not very accurate, with the number of trips generally being under-recorded, while private vehicle trips are not recorded at all. Recording has improved in recent months, resulting in more trips being registered in August. In addition, Nuwara Eliya has a mini-season during the last week of August resulting in increased waste generation during this time, which is verified by inspection of the August daily records. During September 12-16, NEMC undertook additional works, cleaning the MC Rd, Police Lane and Keena Rd areas, which would

have increased waste generation slightly. Taking these factors into account, the JICA survey data is considered most representative of the actual situation and the following discussion relates to the JICA results.

- The average number of trips undertaken by different NEMC vehicles during this period is:
 - Four wheel tractor (49-9427): 3.4 trips/d. This tractor collects the stationary trailer waste, taking three different trailers to the final disposal site at least once each day.
 - Other four wheel tractors: 1.3 – 1.7 trips/d. These tractors take the same trailer to the landfill each day.
 - Lorry: 0.9 trips/d.
- Other private parties directly bringing their garbage to the NEMC disposal site during this time made one (Huejay International), two (Nazareth Farm) and five (Interfashion trailers INCO-1 and INCO-2) trips over the seven day period. This behaviour is generally consistent with waste generator survey data, which indicated both Nazareth Farm and Interfashion normally take about one tractor load per week of garbage to the final disposal site, while Huejay International occasionally takes a tractor load of garbage to the disposal site. Interfashion are currently disposing more of their garbage to the NEMC disposal site, as their own on-site incinerator is temporarily out of service.
- The average daily tonnage of waste brought for disposal by NEMC during this period is 15.9T/d, while private parties contribute another 1.0T/d, giving a total of 16.9T/d. Private party waste disposal tonnages under normal conditions are expected to be around 0.25T/d, meaning the normal total tonnage to disposal should be around 16.2T/d.
- During the Season, which normally runs for about six weeks from 20 March to 30 April¹³, NEMC estimated the amount of collected waste to increase by about 75%. This has not been independently verified due to the absence of any collection or disposal data for this period¹⁴.

¹³ Sometimes it continues for a further 10 days until ~May 10th if the Vesak Poya falls between May 1-10.

¹⁴ Some old collection volume data was obtained from NEMC for 1994, which showed monthly collection averaged 700m³/d or 9.0T/d, while April collection was 2.7 times higher than this. This increase in April waste collection was considered too high by both JICA and NEMC and has not been used here.

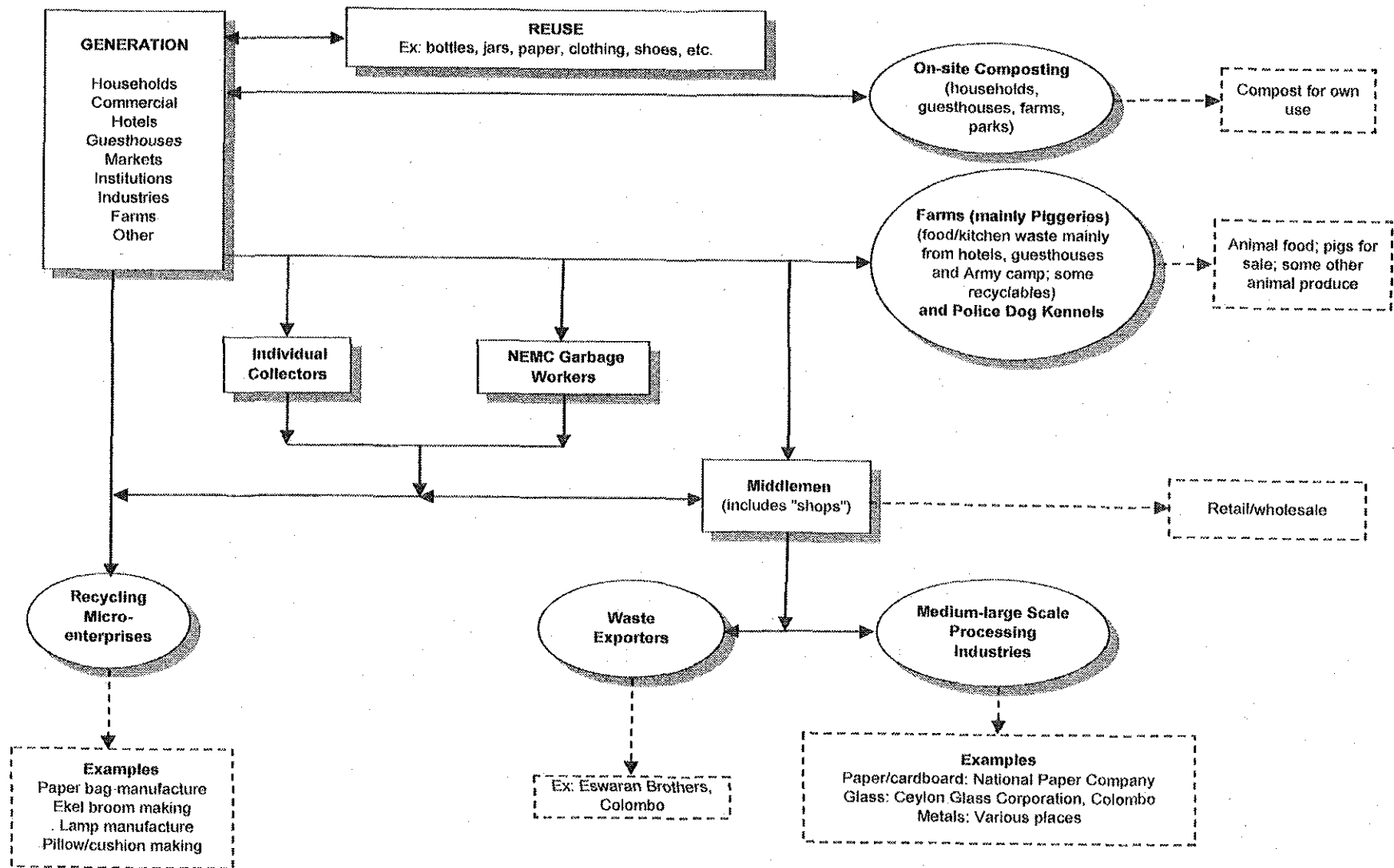


Figure 1-2: NEMA Recycling/Composting System

1.10 Resource Recovery

The NEMC recycling/on-site composting system is illustrated above, while recycling quantities have been summarised previously. This section provides a summary of the recycling sector within NEMA in relation to NGOs, home composting, proposed NEMC source separation scheme, farm composting, piggeries and middlemen.

1.10.1 NGOs

There are a number of non-governmental organisations within Nuwara Eliya that have had some involvement in SWM projects. These include the Rotary Club (provision of dustbins) and Lions Club (provision of compactor).

1.10.2 Home Composting

Some home composting barrels have previously been distributed within Nuwara Eliya, including a pilot project in 2001 involving the distribution of about 40 compost barrels to Nawagamoda.

NEMC are planning to distribute a further 4,000 compost barrels to households in Nuwara Eliya in the near future with partial funding from the Ministry of Natural Resources and the Environment. They currently have 189 large metal compost barrels and 337 small metal compost barrels and the Mayor is planning to purchase another 3,474 barrels to make up the total of 4,000. These bins will be distributed throughout all 10 wards in the town, beginning with 600 barrels in the Mahagastota area. They are also proposing to implement a by-law that will reduce the residential assessment tax for all those using compost barrels and increase it by 10-20% for those who are not using these barrels. Recyclables will be collected once per week by NEMC labourers and sold, with the profit going to NEMC labourers.

They have also given some Jeewa kotu compost bins to schools and may introduce some of these bins to households in areas which do not have a collection service and where sufficient land is available.

Given the scale of these current initiatives and as no systematic evaluation had been undertaken of earlier home compost barrel programmes, JICA conducted a household survey in August 2002 amongst 20 out of 80 households in Nawagamoda and Hawa Eliya (both within NEMA) who had either received or bought a compost barrel (old tar bins of metal construction). The households were selected from a list of compost barrel recipients supplied by the NEMC Community Development Officer. The key survey results are summarized below.

- Surveyed households received the compost barrels 20 months ago on average (range = 12-28 months). 18 (90%) of respondents are still using the compost barrels, while 2 (10%) have stopped using them.
- 19 (95%) of surveyed households (respondents) received some education/information on how to use the barrels.

- The six main reasons why households decided to get a compost barrel are shown below. The three main motivating factors were an initial personal interest in making compost for their own use (85%), concern for the environment (45%) and NEMC staff recommendations (40%).

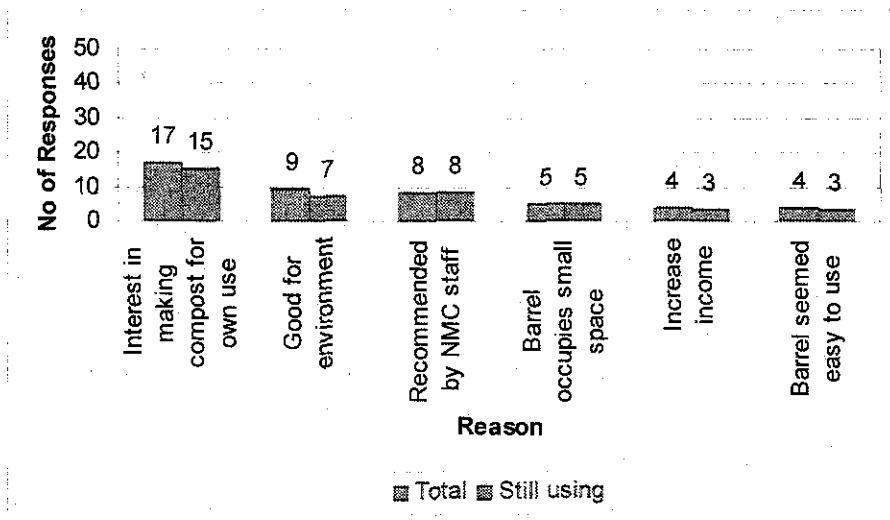


Figure 1-3: Compost Barrel Usage

- Of the two households who have stopped using the barrel, both stopped between 3-6 months, this being around the time when the first compost should be ready for harvesting. The main reasons for these households discontinuing were a lack of knowledge on how to make compost (1), not enough space on site (1), lost interest (1) and the barrel smelled of tar (1).

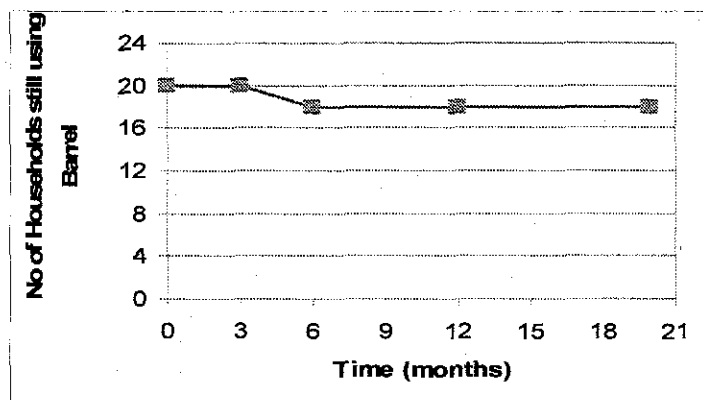


Figure 1-4: Reduction in Households using Compost Barrels with Time

- Average household monthly compost production is 14.6kg for those still using the barrels, and was around 10kg for those who have stopped using them (overall: 14.2kg). Assuming a 66% weight reduction on composting¹⁵, 43kg of organic wastes are required to make 14.6kg of compost. Household monthly waste generation is about 72kg/month (0.498kg/person.d x 4.8 people/household x 30d), meaning that the households still using their compost barrels are reducing their waste to disposal by 60%, which is highly significant. In reality, the actual waste reduction

¹⁵ Dr Basanayake, Peradeniya University, informal communication

will be slightly less than this as seven households add some cow dung to the compost barrel, which is excluded from the calculated household waste generation.

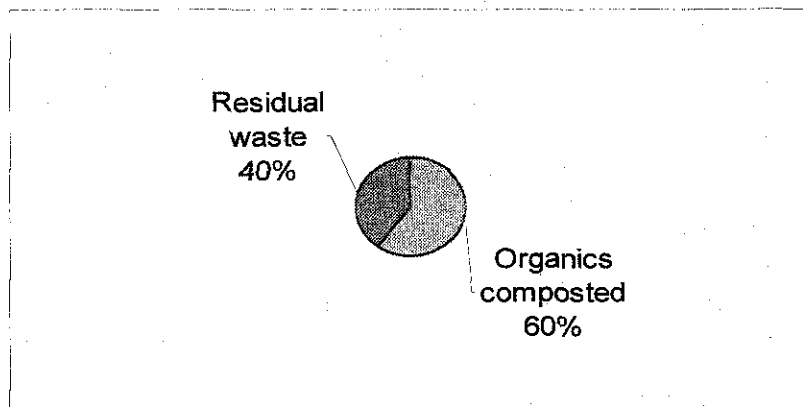


Figure 1-5: Waste Reduction through Home Composting

The main improvements suggested by household members to NEMC's home composting programme are shown below.

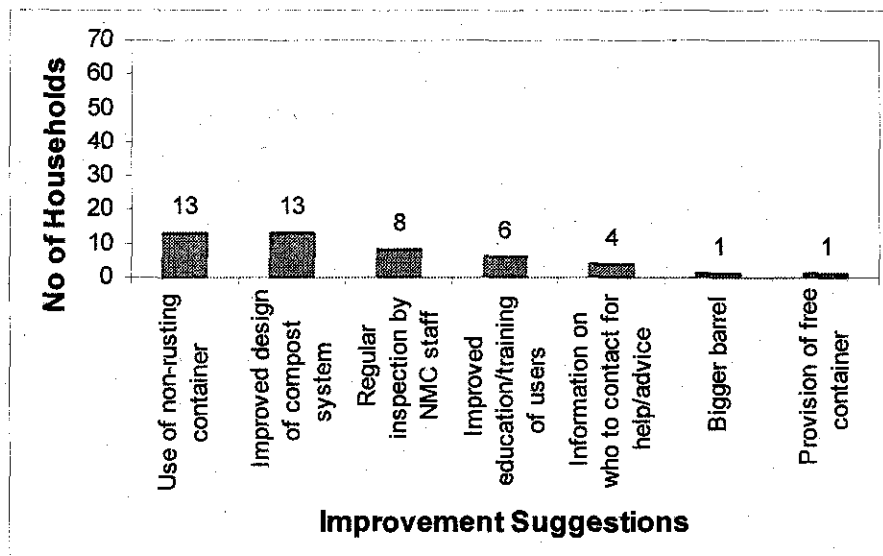


Figure 1-6: Suggested Improvements to NEMC's Home Composting Programme

Overall, these results indicate that the home composting programme has been very successful with 90% of the 20 households surveyed still using the barrels after 20 months. Nevertheless, some important lessons can be learned from this survey for any future home compost barrel programme. Most importantly, any future programme should:

- Use a longer life (ideally non-rusting) composting container (e.g. plastic barrel or concrete bin) and modify the design of the compost barrel so as to minimize water infiltration. As the average bin age is around 20 months, when many metal barrels may be nearing the end of their life due to rusting, it is recommended that NEMC officers should visit a reasonable cross-section of households with compost bins to assess their condition and discuss with residents possible improvements for future home compost system design.

- Focus on residents with a strong personal interest in composting or concern for the environment, or try to develop such an interest in residents through education/awareness raising. Most NEMC residents are believed to have a strong interest in home composting due to the prominent role vegetable growing activities play in many people's lives, this being supported by the household survey which indicated 8% of household waste is being composted, which is significant. Experience from Matale also shows that residents should not be coerced into getting a compost barrel unless they actually want one.
- Provide education/training to households, followed by regular inspections, with ongoing support being available to households requesting it. This is considered to be particularly important during the first 3-6 months, before compost is first produced and when residents are most likely to experience "teething" problems.
- Consider providing compost barrels to households at a subsidized rate, rather than for free, thus requiring households to make some conscious decision to "buy-in" to the composting programme, rather than just being given a free gift.

1.10.3 Source Separation Scheme Promotion

NEMC are also proposing to start a source separation garbage collection scheme in Mahinda Mw. This will involve distributing two small coloured plastic buckets to around 250 households in this area, a green bin for biodegradable waste (as there is no space for on-site composting amongst these households) and a red bin for non-biodegradable waste. Biodegradable waste will be collected daily and non-biodegradable waste weekly. The bins are to be funded by the Rotary Club.

They have already trialed a similar programme amongst tourist hotels, but have not expanded or fully implemented this programme due to a shortage of collection resources.

1.10.4 Farm Composting

Setha Eliya agricultural farm, one of the three farms surveyed within NEMA, runs a significant composting operation. This is a 60ha (150acre) seed potato farm, which has eight polythene tunnels and 50 cattle, the main purpose of the cattle being for cow dung. Every day, they put one tractor load of grass on the ground of the "cattle house" for bedding. Next morning, they collect the grass and cow dung, add any crop residues, mix these materials and make a pile nearby which is normally left for about one month, depending on the availability of labour. They then shift it to another area (about 100m away) and make new piles, which are covered with polythene during wet weather. Normally, about 15 piles are present in this area which they turn every two weeks over a 6-8 week period. Piles range in size and height, while no other materials or additives are added, nor is any special attention given to the composting operation, the labourers working on it when free from other activities.

They produce about 20T/mth of compost, which they use on-site. Compost production is less than their demand, as they cultivate 20ha per season (two seasons per year), each hectare needing around 12.5

tonnes of compost per season. Hence, they buy additional poultry manure from Kurunagela (108km away): 50-75T in January (1st season) and 20 tonnes in Aug-Sep (2nd season) at a cost of 1.25Rs/kg.

Leachate from the first compost piles and cattle urine are collected in a pit and used as fertiliser in their nurseries. In addition, they have a concrete bin (about 2x5m²) which they put cow dung and grass waste into, keeping there for 2.5-3.0 months without turning, after which time they use it as compost.

They have no problems with their present operation and would like to increase their composting capacity. They have enough raw materials for this but insufficient facilities and could benefit from technical and financial assistance (e.g. labour, chopper). In addition, there are about 115 households on the farm who compost their kitchen waste and use it on their home gardens¹⁶.

1.10.5 Piggeries

There are at least two significant piggery farms¹⁷ located within NEMA.

1.10.5.1 The Nazareth Farm Piggery

Nazareth Farm occupies a 7ha site in Hawa Eliya and has been in operation for about 30 years. It employs six workers. They have about 40 pigs and a wide range of other animals including eight cows and bulls, one goat, 35 rabbits and 17 birds of various kinds (chickens, ducks, geese and turkeys).

The collect around 210kg/d of food/kitchen waste for use as pig food for free from four tourist hotels (The Galway Forest Lodge, Hill Club, Ceybank Rest and Glendower Hotel) and another 75kg/d from the Army Camp in Nuwara Eliya, using their own vehicle, a driver and two labourers. In addition, they collect around 150kg of food/kitchen waste 2-3 times per week from the Tea Factory Hotel located 5-10km outside the city limits using a hired vehicle at a cost of Rs200/trip. Only the Tea Factory Hotel separates out their food/kitchen waste from other waste materials, despite Nazareth Farm having asked the hotels and army camp several times to do this.

Their total monthly expenditure for the piggery is around Rs10,000, with the main cost items being transportation, labour, medicine and electricity. They sell about three pigs per month to the Galway Forest Lodge, earning an income of about 15,000Rs/mth. Estimated savings on pig food due to the free supply of food/kitchen waste are 8,000Rs/mth, meaning that if the free food/kitchen waste supply were to cease, it would be difficult for their piggery to survive.

¹⁶ The quantities of waste materials composted stated in the large waste generator survey and waste stream refer to 7,500kg/mth food/kitchen waste (composted by the 115 households), 2000kg/mth garden waste (believed to be mainly crop residues), 9,000kg/mth animal waste (cow dung) and 8kg/mth paper waste. The large quantities of grass referred to above which form the bulk of the composting mixture are not included in the survey data as this is more a raw material added to increase commercial compost production rather than a waste material.

¹⁷ Nazareth Farm said there is another piggery "Cinda", located behind Galway Forest Lodge in Seetha Eliya.