

Table 1-10: UCC SWM Waste Disposal Average Trip and Tonnage Data

Zone	Vehicle	Number of Trips – 12-18 Aug, 2002									Tonnage	
		12 M	13 Tu	14 W	15 Th	16 F	17 Sa	18 Su	Tot	Avg	T/wk	T/d
1	Lorry	2	2	2	3	2	2	0	13	1.9	11	1.5
2	4WT	2.5	2	2	2	2	1	0	11.5	1.6	12	1.8
	2WT	2	2	2	1.5	2	1	0	10.5	1.5	6	0.9
3	4WT	4	4	5	4	5	4	2	28	4.0	30	4.3
	HC (2)	5	8	7	7	7	4	2	40	5.7	5	0.7
4	Lorry	0	0	0	0	0	0	2	2	0.3	2	0.2
	4WT	3	2	3	3	3	2	2	18	2.6	19	2.8
	2WT	4	4	4	4	3	2	0	21	3.0	12	1.7
	Handcart	3	2.5	4	4	4	2	0	19.5	2.8	2	0.3
5+6	4WT	3	3	3	2.5	2.5	2	0	16	2.3	17	2.5
Special	Lorry	1	1	1	1	1	1	1	7	1.0	6	0.8
	4WT	1	1	1	1	1	1	0	6	0.9	6	0.9
	HC (2)	10	10	10	10	10	10	10	70	10	8	1.2
Total		40.5	41.5	44	43	43	32	19	263	37.5	137	19.6
Total to disposal	Lorry (1)	3	3	3	4	3	3	3	22	3.1	18	2.6
	4WT (4)	13.5	12	14	13	14	10	4	79.5	11.4	86	12.2
	2WT (2)	6	6	6	5.5	5	3	0	31.5	4.5	18	2.6
	HC (3)	8	10.5	11	11	11	6	2	59.5	8.5	7	1.0
	Total	30.5	31.5	34	33	33	22	9	193	27.5	129	18.4
HC (transfer only)		10	10	10	10	10	10	10	70	10	8	1.2

Note: HC = handcart, 2WT = two wheel tractor, 4WT = four wheel tractor

Monthly tonnage data is illustrated below.

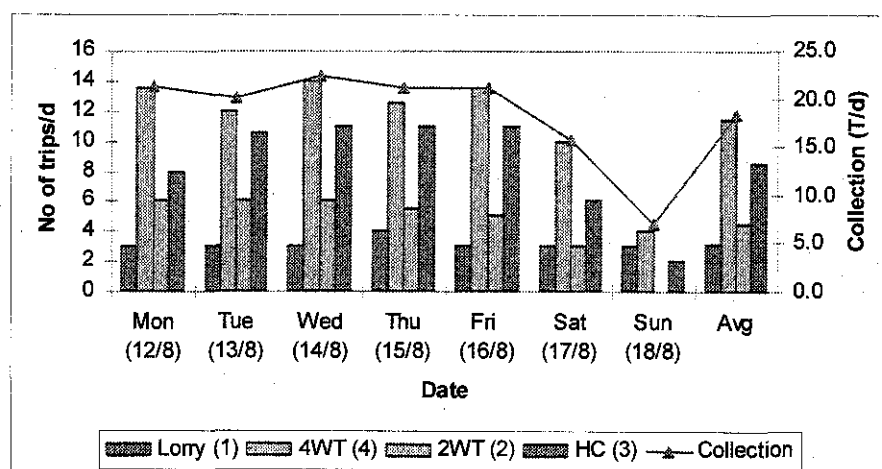


Figure 1-1: Chilaw Collection Vehicle Trips and Collection Quantities

Some key points from this data are summarized below:

- The average number of trips<sup>13</sup> undertaken by different vehicles during this period is:

<sup>13</sup> Two handcarts collecting waste and transferring it to a stationary trailer have not been included in this trip data (UCC data indicates they make an average of 5 trips/HC.d).

- Lorry: 3.1 trips/d.
- Four wheel tractor (4 vehicles): 11.4 trips/d or 2.8trips/4WT.d.
- Two wheel tractor (2 vehicles): 4.5 trips/d or 2.3trips/2WT.d.
- Handcart (3 taking waste to disposal): 8.5trips/d or 2.8trips/HC.d.
- The average daily tonnage of waste collected for disposal during this period is 18.4T/d. This is considerably higher than expected, but UCC explained that waste collection quantities were much higher than normal during this week due to a number of factors:
- The annual Munneswaram festival took place during this period, with an associated large influx of visitors to Chilaw. Typically waste generation increases by 25-30% during festival times, with increased waste generation during the Munneswaram festival being at the high end of this range.
  - Schools were closed during this week, resulting in increased household waste generation and decreased school generation, the former outweighing the latter.
  - Zone 4 waste was higher than normal due to large quantities of garden waste (mainly coconut palm waste) being discharged by households during this week, which were collected by UCC.
  - Sunday waste generation was elevated, this being attributed to government offices being on holiday during Saturday.

It is also possible that these figures may be slightly inflated, as UCC does not have a formal waste collection vehicle trips recording system, with this data being extracted from UCC Supervisors' diaries.

These factors resulted in an extra 4WT being deployed (borrowed from Industry section) during this week for waste collection, while some other vehicles did more trips than normal.

Taking these factors into account, normal waste collection is estimated to be 11.9T/d, with the Munneswaram festival accounting for 30% extra waste (3.5T/d) and the school/government worker holidays and zone 4 garden waste factors accounting for 10% extra waste (1.2T/d). Trip inflation is believed to account for 14.5% extra waste (1.7T/d), this figure being arrived at by comparison with the estimated amount of waste discharged for collection from CUA of 11.9T/d. This equates to an overall MSW service coverage of 54% (= collection/generation).

## 1.9 Resource Recovery

The UCC recycling/on-site composting system is illustrated below, while recycling quantities have been summarised previously. This section provides a summary of the recycling sector within CUA in relation to centralised composting, middlemen and industries.

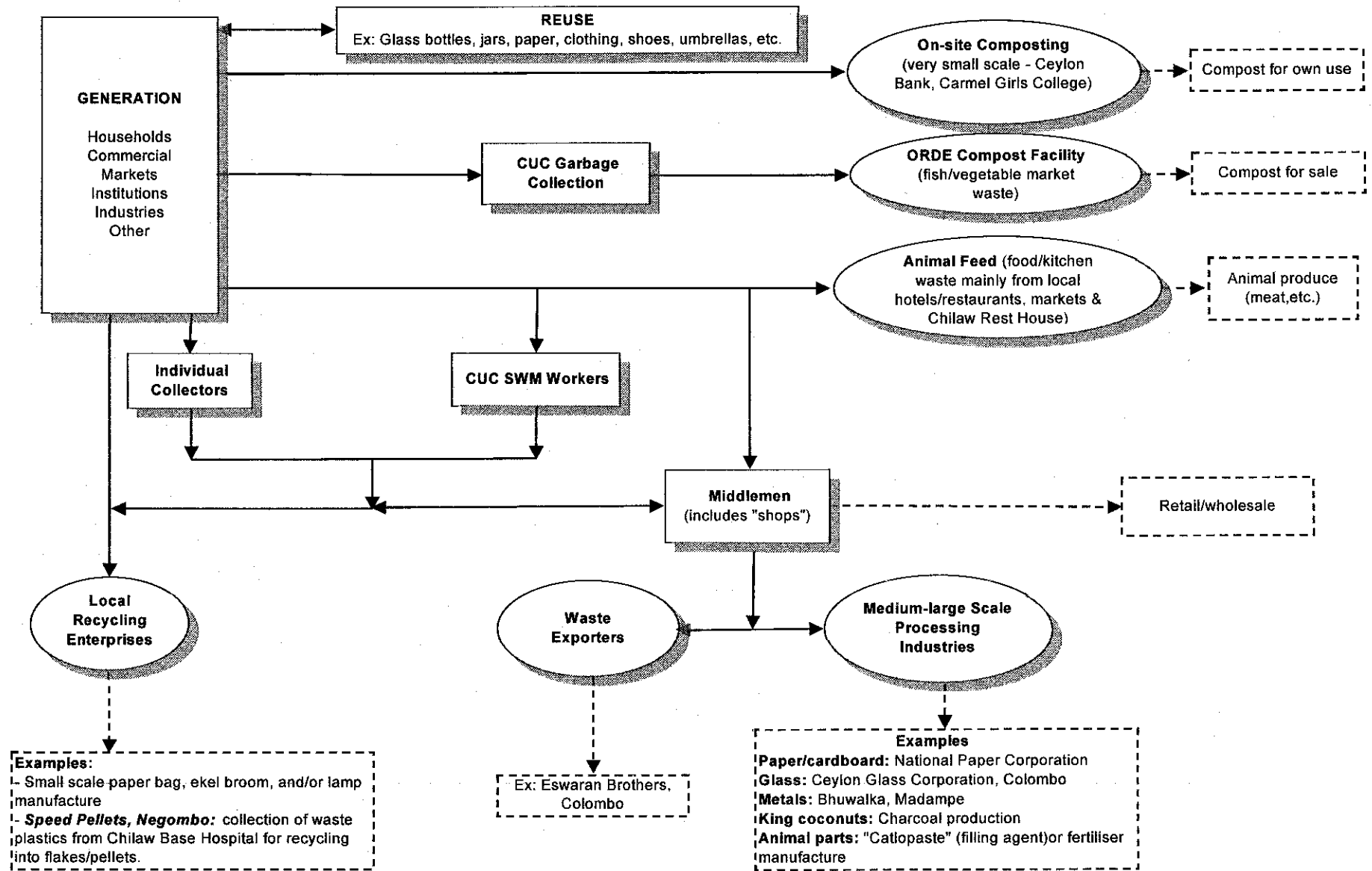


Figure 1-2: CUA Recycling/Composting System

### 1.9.1 Middlemen

Five middlemen operating within the CUA were identified and interviewed as part of this study. General information on these businesses is tabulated below and summarised here.

Table 1-11: Middlemen General Information

Business Name	Manager/Owner, Address	Years of operation	Total Employees		Recyclables <sup>3</sup> (Rs/mth)	
			Total	FTE	Purchases	Sales
MM1: M Lafar	151 Jayabima, Chilaw	10	1	1.4	33,830	54,409
MM2: D Wargaraja	159 Puttalam Rd, Thimbila, Jayabima	0.75	1	1.0	10,210	14,023
MM3: Sarona Stores	38 Lake Rd, Chilaw	12	3	0.8	12,360	14,012
MM4: Thanagawelu Stores	77 Puttalam Rd, Chilaw	30	16	19.0	49,996	60,250
MM5: Rejina Stores	9 Corea Mw, Chilaw	25	4	3.0	173,499	221,499
Total			25	25.2	279,894	364,193

**Notes:**

1. The number of full-time equivalent (FTE) staff is based on a normal working month in the private sector of 8h/d x 26d/mth = 208h/mth.
2. Recyclable materials purchases and sales costs were calculated based on the average quantity of each item collected and sold per month and the average purchase and sales prices.
3. NA = no answer.

All of them are primarily involved in the collection and selling of recyclable materials, with four having been in business for 10 or more years and one for 0.75yrs. At least 25 people (managers/owners, full and part-time workers) are employed by these businesses, representing 25.2 full-time equivalent jobs.

Their estimated monthly expenditure on purchasing recyclable materials is 280,000Rs/mth, which shows that the scale of these operations is significant. Corresponding estimated monthly income from the sale of recyclable materials is 364,000Rs/mth, representing a markup of 30%. Respondents were generally reluctant to give total expenditure and income information, while other data obtained is not considered very reliable, particularly in four cases where stated income and/or expenditure were less than the corresponding recyclable purchases and sales figures. The overall net income quoted by businesses ranged from 5,000-15,000 Rs/mth. This is considered a minimum value, for the reasons explained here.

Most of the recyclable materials are brought to them by individuals (4), other middlemen (2) or collected by their own workers (2). Their demand for all recyclable materials is generally stable. The supply is greater than the demand for plastics and variable for most other materials. Polythene (soft plastic) is not collected by any of the middlemen surveyed.

The main sources of most materials is set out in the following table and summarised below:

- Households are the main source of broken glass, glass bottles and batteries and significant sources of plastics, bags/sacks, paper/cardboard and metals.

- Hotels<sup>14</sup> are important sources of glass bottles.
- Commercial enterprises are the main source of bags/sacks.
- Government offices are the main source of paper/cardboard, while some paper/cardboard is also collected from schools.
- Industries are the main source of plastics and metals and a significant source of batteries.
- Garages ("other" response) are a significant source of metals and batteries.

No middlemen in Chilaw indicated they collect any recyclables from the hospitals in the town. However, Speed Pallets, a small plastics/polythene recycling factory in Negombo recycles some of the Chilaw Base Hospital's plastic waste through a personal contact.

Table 1-12: Main Sources of Recyclable Materials

Item	Plastic	Bags/ sacks	Paper/ card- board	Broken glass	Glass Bottles	Metals	Batt- eries	Overall (within CUA)
No collecting these items	3	5	5	1	5	5	5	
No of responses	3	5	5	1	5	5	5	
<b>Main Sources (%)</b>								
Households	21.1	20.0	36.7	100	58.8	37.6	76.2	63.6
Hotels	0.0	1.7	0.0	0	41.2	0.0	0.0	10.1
Commercial enterprises	0.0	74.5	0.0	0	0.0	0.1	0.0	4.7
Government offices	0.0	0.0	54.3	0	0.0	0.0	0.0	6.7
Schools	0.0	0.0	8.7	0	0.0	0.0	0.0	1.1
Industries	78.9	3.7	0.0	0	0.0	55.1	17.6	9.9
Other (mainly garages)	0.0	0.0	0.4	0	0.0	7.1	6.2	4.0
Total	100.0	100.0	100.0	100	100.0	100.0	100.0	100.0

**Notes:**

1. Above values are average percentages calculated from the survey data, taking into account the relative quantities of materials purchased by different middlemen.
2. The final column estimates the proportion of recyclable materials collected from different sources within CUA only, assuming 80%, 90%, 100%, 100% 15% and 40% of materials from hotels, commercial enterprises, government offices, schools, industries and garages are obtained from inside CUA respectively, with the proportion of materials being obtained from households being calculated by difference so as to get an overall rate of 52% for materials collected within CUA.

Around 52% of these materials are collected from within the CUA, 41% within the Puttalam district and 7% within the Western Province<sup>15</sup>.

The total quantities of materials recycled by these middlemen<sup>16</sup> are summarised in the following table in terms of the material types adopted for this Study, amounting to 0.68T/d, while the table after that provides further details, including purchase and sale prices. Adjusting this total to allow for an estimated 52% of these materials being collected from within the CUA gives a recycling amount of

<sup>14</sup> It is assumed hotels includes local hotels (canteens/small restaurants) as there are very few hotels and guesthouses offering accommodation in and around Chilaw.

<sup>15</sup> Percentages are weighted averages, taking into account the relative quantities of materials collected by different middlemen.

<sup>16</sup> As determined from survey interviews. No independent check was made on the accuracy of these quantities.

0.35T/d, of which 0.22T/d is estimated to come from households. The household survey indicated that 1.3% of household waste is recycled, which amounts to 0.16T/d, slightly lower than the value derived from the middleman survey.

Table 1-13: Total Quantities of Different Materials Recycled

Materials	Monthly Quantity	Daily Quantity (kg/d)	Comments
Plastics	415 containers and 7263 bags/sacks = 726kg/mth	23.9	Containers are generally sold for reuse and consequently have not been included in the daily recycling amount. Bags are either sold for reuse or transported to factories for re-processing. Hence, they have been included in the recycling amount ; measured weight of 1 polysack = 0.1kg => 726kg.
Paper/ cardboard	1,315kg/mth	43.2	640kg newspaper, 635kg exercise books, 40kg cardboard boxes
Glass	250kg broken glass + 3,241kg bottles = 3,491kg/mth	114.8	Whole bottles are usually beer or arrack bottles; average measured weight = 0.66kg; 4,910 bottles = 3,241kg.
Metals	11,644kg/mth	382.8	9,800kg iron, 920kg copper/brass, 695kg aluminium and 230kg beer cans.
Old battery cases	3,400kg/mth	111.8	Battery cases are drained and then weighed, being recycled primarily for their lead content.
Total	20,575kg/mth	676.4	
Total collected from within CUA	10,683kg/mth	351.2	Adjusted total to account for 52% of these materials being collected from within CUA.

**Notes:**

1. Refer the following table for further details.
2. Daily quantities calculated from monthly data by multiplying by 12/365.

Most enterprises act mainly as retail/wholesale outlets, onselling the recycled materials directly from their shops to individuals or commercial enterprises, although two transport metals directly to Bhuwarka, an Indian owned scrap steel processing factory in Madampe, ~12km away.

Table 1-14: Quantities of Recyclable Materials collected by Middlemen and Corresponding Purchase and Sales Prices

Material	Units	MM	MM	MM	MM	MM	Total			
		1	2	3	4	5	Quan- -tity	Purch- -ase price	Sales price	Units
Plastics										
Containers	No/mth		15	50	0	350	415	10-600	15-650	Rs ea
Various bags	No/mth	4,500	1,100	150	13	1,500	7,263	3.5-4.3	5.8-7.5	Rs ea
Paper										
Old newspaper	Kg/mth	50	15	25	50	500	640	10-15	12-20	Rs/kg
Old exercise books	Kg/mth	50	10	25	50	500	635	3-5	6-8	Rs/kg
Cardboard	Kg/mth	40					40	2	3	Rs/kg
Bottles										
Broken glass	Kg/mth				250		250	1	2	Rs/kg
Arrack, beer other bottles	No/mth	225	135	50	500	4,000	4,910	2.75-5.0	3.8-7.0	Rs ea
Metals										
Aluminium	Kg/mth	60	10	25	300	300	695	40-70	50-75	Rs/kg
Beer cans	Kg/mth	10	2	3	15	200	230	20-25	24-35	Rs/kg
Copper/brass	Kg/mth	65	27	28	100	700	920	50-80	55-95	Rs/kg
Ferrous	Kg/mth	500	250	50	3,000	6,000	9,800	5.0-7.5	6.0-8.5	Rs/kg
Old battery cases	Kg/mth	300	50	50	2,000	1,000	3,400	5-10	6.5-12	Rs/kg

The main costs incurred by these businesses in their recycling activities and the associated main problems are summarised in the following two tables respectively.

Table 1-15: Main Costs

Main Costs	Rank				Wt. Avg.
	1	2	3	4	
Buying recyclable materials	5	0	0	0	12.5
Transportation	0	4	0	1	9.0
Utilities	0	0	3	1	6.0
Labour	0	0	2	1	4.0
Land/building rental	0	1	0	1	3.5

Table 1-16: Main Problems

Main Problems	Rank				Wt. Avg.
	1	2	3	4	
Shortage of Recyclable Materials	5	0	0	0	12.5
High transportation costs	0	2	1	1	7.0
Difficulties in obtaining credit	0	1	1	0	4.0
High land/building rental costs	0	1	0	2	4.0
Loss of market	0	1	1	0	3.5

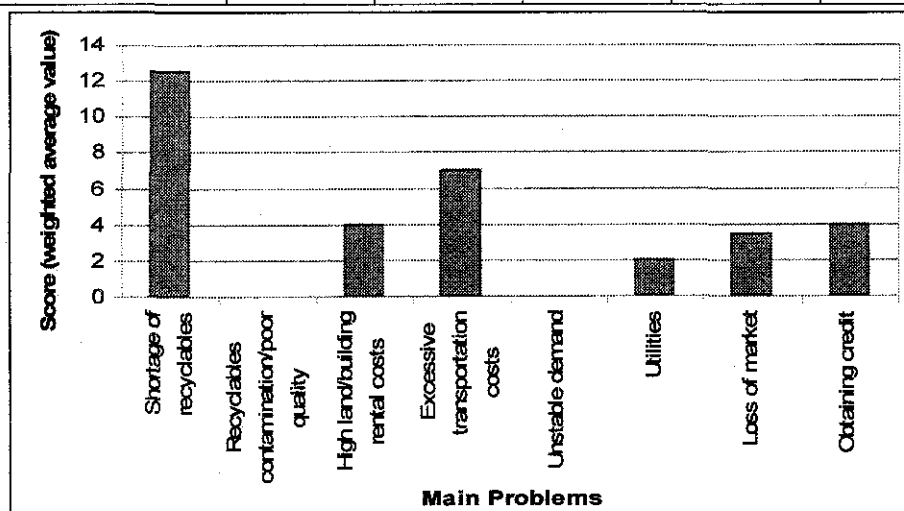


Figure 1-3: Main Problems Faced by Middlemen in Chilaw



*Rejina Stores, Corea Rd, Chilaw*



## 1.9.2 ORDE Compost Facility

The Organisation for Resource Development and Environment (ORDE) has been operating a medium scale composting facility at Munneswaram, near Chilaw since June 2001. It was constructed at a total cost of 1,854,350Rs, with a grant from the Ministry of the Environment.

The compost facility comprises a "Colas"<sup>17</sup> composting pad with corrugated iron roof of about 40x37m<sup>2</sup>, divided into 13 lines and six rows, together with a small roofed post-composting process and storage area and small office. It was designed so that each day a new compost pile would be prepared, approximately 2.7x2.7m<sup>2</sup> x 0.6m high, occupying the first row of line 1 on day 1, line 2 on day 2, etc. On the 14<sup>th</sup> day, when piles are present in the first row of all lines, the pile in line 1 would be turned into row 2, following which a new pile would be constructed in row 1. This system is continued, so that piles are progressively turned from one row to the next every two weeks, so that by the end of 84days, a pile will have reached row 6 and be ready for harvesting.

Water is added to the piles, generally only during the first stage of composting (i.e. row 1), resulting in no leachate being produced during composting. There is no formal curing stage included within the composting process, although some informal curing does occur during compost storage prior to sale.

Compost facility equipment comprises a vibrating screen table, trommel screen and fan. Labourers are provided with boots and gloves and generally use the gloves but do not like wearing the boots.

The existing compost plant was designed to handle around 10 tractor loads of waste per day (around 4T/d of compostable materials) based on the following labour requirements:

- |                              |               |
|------------------------------|---------------|
| • Pre-sorting and sieving    | 8 labourers   |
| • Composting                 | 3 labourers   |
| • Final processing (sieving) | 3 labourers   |
| • Bagging and distribution   | 2 labourers   |
| • Supervision                | 2 Supervisors |

Associated total monthly staff expenditure was approximately Rs83,000, with about Rs300-350 being spent on pre-sorting each tractor load of waste.

The compost facility successfully processed a significant proportion of Chilaw's garbage from June-November 2001 using 26 labourers. During this five month period, the facility received 269 four wheel tractor loads and 188 two wheel tractor loads of waste, which was broadly categorised into "market" and "other" wastes as shown below.

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<sup>17</sup> Colas = mixture for tarring roads.

Table 1-17: Composition of Waste Handled by ORDE from May 2001 – Jan 2002

Waste Type	Market Waste	Other Waste
Compostable	300-400 kg	250-300 kg
Comba (king coconut shells)	175-225 shells (15-20 kg)	100-150 shells (8.8-13 kg)
Hard wood, paper, textiles	150-200 kg	200-250 kg
Sand/gravel	250-300 kg	300-350 kg
Plastics/polythene bags	5-10kg	10-25 kg
Total	720 – 930 kg	769 – 938 kg

**Note:** Composition for one full four wheel tractor load. Weight of one shell (i.e. half a nut) = 87.5g, based on the measured weight of one bag containing 40 shells.

From February 2002 until early 2003, the facility was only accepting one tractor load/d of fish/vegetable market waste and employing six labourers for all composting tasks. This change was mainly due to economic reasons, with ORDE not being able to sell all of the compost produced and hence not able to meet its costs, particularly labourers' salaries. Since then, when Nature Care took over operations, it has been receiving between 3-10 tractor loads per day.

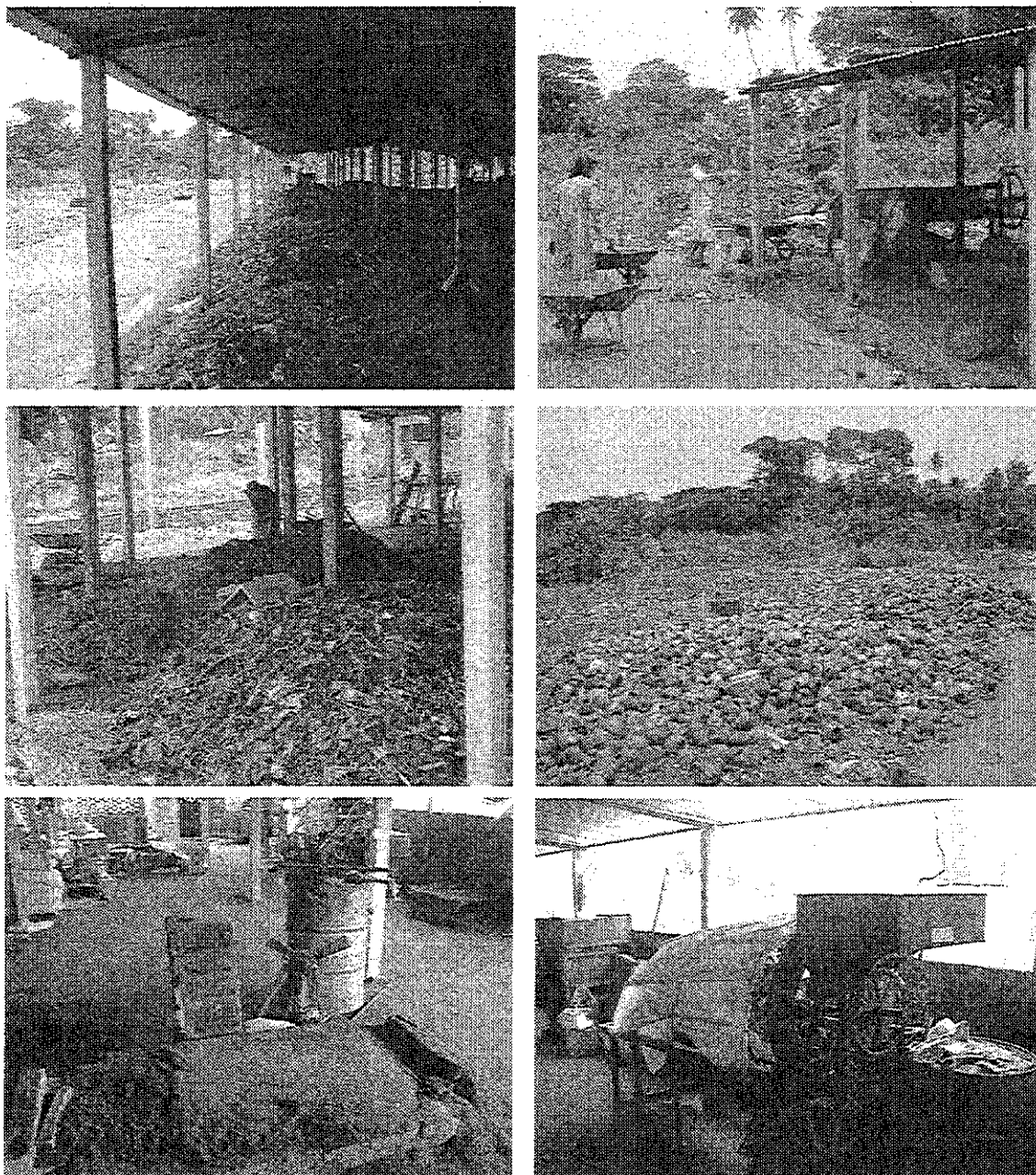
UCC delivers mixed market waste to the compost facility daily, except for Sunday and holidays, it being about 3km from the fish/vegetable market to the compost facility. The incoming mixed waste is first sorted, with king coconut shells, polythene/plastics and tins being removed manually, while the vibrating screen table is used to separate inerts (e.g. sand, soil) and other fine materials from organic compostable matter.

The tins are sold, while the plastics/polythene are either burnt (dirty materials) or bagged and stockpiled for future sale (clean materials). The fine inert material also contain some fish waste (scales) and is left to decay for some time, following which it is sold as a construction material.

The king coconuts are dried and burned, the ash being mixed with cow dung, fresh leaves and water and sprayed over the piles. If king coconut ash is not available, sawdust ash is used instead. Rice straw is also added to the piles. These materials are added to improve the final compost quality and to control odour and flies.

Following composting, in accordance with the process previously described (except for fewer lines being used), the vibrating screen table is used in combination with a fan for sieving of the compost, to remove oversize particles (screen) and inert materials (fan). The resulting compost is then bagged in 2, 5 and 25 kg bags and sold at 10Rs/kg, with a 20% discount being given to shop owners. They currently sell their compost mainly to nurseries and some hardware shops, including around 2T/mth to Kalpitiya Fertiliser shop.

According to ORDE, about 125-200kg of compost is produced from one tractor load of waste (i.e. 300-400kg of compostable materials), whilst additional reject materials comprise ~125kg and around 125-200kg of materials (mainly water and carbon dioxide) are lost due to evaporation.



*ORDE Compost Facility: Top left: Row 1, showing the compost piles in each line; top right – manual and vibrating table pre-sorting area; middle left – construction of compost piles; middle right – king coconuts being dried for burning; bottom left – screened compost, showing the small fan used to separate compost and inert particles; bottom right – trommel screen not currently used.*

These claims were checked using data for 15 July –5 Aug 2002 supplied by ORDE. After adjusting this data to account for days with incomplete data, analysis showed that during this 22 day period, ORDE received an average of 809kg/d of market waste (1 tractor load/d), comprising 405kg/d of compostable materials (50%), 16kg/d king coconuts (1.9%), 249kg/d sand (31%), 123kg/d of combustible materials (15%), 13kg/d of plastics/polythene (1.6%), and 3.6kg/d of tins (0.4%). During the same time, average

compost production was 127kg/d<sup>18</sup>, equivalent to 16% of total inputs or 31% of compostable inputs. Hence, compost production is consistent with ORDE's claims, while the market waste breakdown is consistent with the data in the above table.

About 1-2 samples of compost are tested per month for quality by the Department of Crop Science, Peradeniya University<sup>19</sup>. Average results for 11 samples are summarised below.

Table 1-18: ORDE Compost Facility – Compost Quality Results

Parameter	Units	Average	Std Deviation	Range
pH		7.7	0.5	6.9 – 8.6
Organic matter	%	24.7	4.2	18.3 – 30.8
Organic carbon	%	13.4	3.6	5.2 – 17.8
Cation Exchange Capacity (CEC)	cmol/kg soil	82.1	43.8	39.3 – 200.8
Moisture	%	37.5	8.2	25.1 – 49.9
Density	kg/m <sup>3</sup>	0.49	0.24	0.36 – 0.56
Total Nitrogen	mg N/kg DM	13.8	4.0	4.5 – 19.8
Phosphorus	mg P/kg DM	3.18	0.34	2.7 – 3.6
Potassium	mg/kg DM	123	197	3.4 – 459
Sodium	mg/kg DM	414	723	1.3 – 1,890
Calcium	mg/kg DM	779	1,346	2.5 – 3,420

**Note:** Results of 11 samples taken between 27 Aug 2001 to 19 Jun 2002; DM = dry matter (refer Appendix A for details).

Expenditure and income details for the first six months of 2002 are set out in the following table and illustrated below, showing that despite scaling back operation, they are still running at a loss. However, the situation seems to have improved since May, with the monthly deficit being much less due to significantly increased compost sales. This is mainly a result of seasonal variations in compost demand, with demand from coconut and paddy cultivators being high for several months following harvesting in April and again in October-November.

Table 1-19: ORDE Compost Facility – Income and Expenditure

Month	Compost production (kg/mth)	Income (Rs)			Expenditure (Rs)	Profit/Loss (Rs)
		Compost sales	Other sales (sand, etc.)	Total		
Jan	2,382	19,057	0	19,058	34,801	-15,744
Feb	3,210	25,678	0	25,678	43,201	-17,523
Mar	1,775	14,203	0	14,203	34,698	-20,495
Apr	1,582	12,656	145	12,801	35,355	-22,554
May	4,485	35,879	160	36,039	45,345	-9,306
Jun	4,868	38,942	135	39,077	47,492	-8,415
Total	18,302	146,416	440	146,856	240,891	-94,036
Average	3,050	24,403	73	24,476	40,149	-15,673

<sup>18</sup> The compost produced during this time relates to waste inputs received before this period and hence the two sets of data are not directly comparable.

<sup>19</sup> Testing cost is free; ORDE only has to pay for sample transportation.

**Notes:**

1. Compost production estimated from sales figures based on a sales price of 8Rs/kg.
2. Two supervisors are employed, one mainly being responsible for marketing, while the other supervises the compost facility.
3. Cow dung (12.9Rs/kg) is collected from about 2-3km away. Straw (14Rs/kg) is collected by compost facility labourers from paddy fields using a hired vehicle.
4. Average expenditure estimated to be
 

Two Supervisors @ 5,000Rs/mth =	10,000Rs
Six Labourers @ 4,000Rs/mth =	24,000Rs
Generator running costs = 104h/mth @25Rs/h =	2,600Rs
Maintenance =	0Rs
Amendments =	400Rs
<b>Total =</b>	<b>37,000Rs</b>

 Other: Bagging = 4.96Rs/2kg bag, 8.26Rs/5kg bag (total not specified); University consultant fees: 6,000Rs/visit (three visits since May 2001)

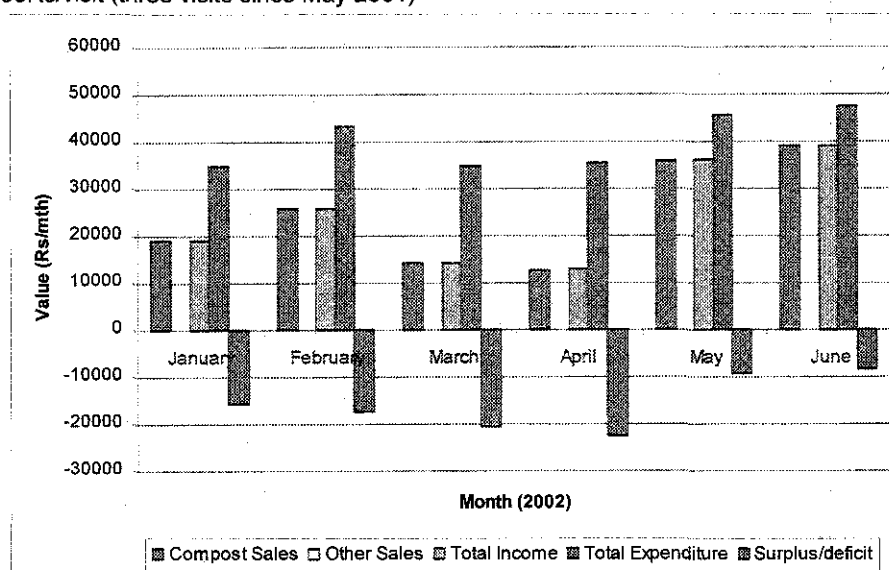


Figure 1-4: Income vs Expenditure – January to June 2002

ORDE's most serious problem is difficulties in finding a market for their compost. Early marketing efforts included giving 20-25 farmers 15kg samples of compost for free and offering them free advice on how to use this compost. However, none of these farmer contacted them for information and none have come back for more compost. Part of this problem is due to competition with chemical based fertilisers which yield quick returns, compared with compost whose benefits on soil fertility are apparent on a much longer term basis. They also face competition from compost made from coir in combination with chemical additives, which is being sold at a lower price than their compost.

Their second most serious problem is meeting their monthly costs, particularly labourers' salaries, this being directly related to the marketing issue.

Their third most serious problem relates to the time and cost involved in sorting out mixed market waste into compostable and non-compostable materials. Typically, it takes 3-4 labourers around 3-4 hours to sort one tractor load of waste per day at a cost of around 350Rs per tractor load.

Other problems include:

- No cooperation or assistance from local or central government or other sources. Currently, ORDE receives no financial support from UCC either in the form of a “gate fee” per tractor load of waste or direct subsidy. Previously, they requested 40,000Rs/mth subsidy in order to take all UCC’s waste but this request was turned down by the Western Province Chief Minister.
- Although they have a trommel screen, this is currently not used as all of their permanent labourers are female and it is difficult for them to lift the compost into the loading bin of the trommel screen. In addition, the trommel screen can not be used in combination with the fan for the final removal of inert materials. This means that the vibrating screen table is used both for initial sorting and final sieving, which involves relocating it from the waste reception section of the compost facility to the compost sieving section and then shifting it back again, as required to complete both tasks.
- Some problems with disposing of reject waste materials.

ORDE have prepared a “wish list” of essential and optional equipment requests which they consider are required to enable the facility to run at near its optimum capacity (i.e. 10 tractor loads/d). These are listed below:

Essential items:

• Incinerator for refuse materials	200,000
• Road repair/construction	15,000
• Pre-sorting machine	35,000
• Building repairs	20,000
• Safety equipment and tools	20,000
<b>Total</b>	<b>290,000</b>

Optional items:

• Shed for pre-sorting area	250,000
• Conveyor belt system	Not costed
• Generator or electricity supply	Not costed
• Front end loader	Not costed
• Vehicle to transport/distribute compost	Not costed

### 1.9.3 Bhuwalka Steel Industry Sri Lanka Ltd

Bhuwalka Steel Industry Sri Lanka Ltd (Bhuwalka) is a scrap metal processing factory, located in Suduwella, near Madampe. It is owned by an Indian company and has been in operation for two years. It processes various kinds of steel scrap (e.g. used steel bars, windows, cars, roofing iron, etc.) containing up to 1% carbon, with restrictions being imposed on acceptability from 0.3% to 1% carbon as follows:

- Steel scrap with less than 0.3% carbon – 100% acceptance.
- Steep scrap with 0.3-0.5% carbon – 15% acceptance.

- Steel scrap with 0.5-1.0% carbon – 5% acceptance.

Bhuwalka buy about 2,200T/mth of scrap steel at 8,000-10,000Rs/T, depending on the scrap quality, from around 25 middlemen from all over Sri Lanka, including Chilaw, Gampaha (Ananda Kumar), Negombo, Matale (Thushanta Traders), Kandy (Mr Manoharan), Nuwara Eliya, Anuradhapura, Colombo, Matara and Trincomalee. About 60% of this scrap steel comes from industry, 25-30% from commercial enterprises and 10-15% from households. The supply of scrap steel is variable.

Bhuwalka currently employs around eight senior managerial staff, 10 middle managerial staff, ~400 full-time workers (160 Indian and 240 Sri lankan) and ~20 casual labourers in two 12 hour shifts. Under an agreement signed with the previous government, the Indian staffs are training local counterparts and are gradually being repatriated to India and replaced with additional local staff.

The factory manufactures about 2,000 T/mth of cold twisted deformed steel reinforcing rods (TOR steel) from the scrap steel, with ~6-7% of scrap being lost in the production process as slag. They sell around 70% of their production each month (1,400T) to about 40 dealers all over Sri Lanka at 36,000Rs/T, the remaining rods being stockpiled for future sale. Demand for the TOR steel rods is medium.

Slag from the production process is landfilled, while filter bag waste, which is high in lead, is stabilised by mixing with cement and then disposed of together with the slag.

Total operating costs, based on data supplied by their Head Office in Colombo, amount to about 32M Rs/mth, the main costs being labour, utilities and other raw materials followed by scrap steel purchases (estimated to be 18.4M Rs/mth from purchases data). Net income, according to their Head Office, is 0.5M Rs/mth. However, sales quantities and prices indicates their sales revenue should be around 50.4M Rs/mth, meaning the net income could be as high as 18.4M Rs. It is considered that the actual net income will be somewhere between these two figures: 0.5–18.4M Rs/mth.

Their main problems are a shortage of scrap steel for processing, contamination/poor quality of the scrap steel and utilities problems. They would like to see scrap steel availability increase.

# Chapter 2

## UCC SWM System – Additional Details



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## Chapter 2 UCC SWM System – Additional Details

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

### 2.1 Waste Management Equipment – Detailed Data

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

Vehicles/ equipment	No	Use (Capacity)	Registration	Registration date	Cost	Approx. Life (yrs)
Handcarts	5	SWM collection, road and drain cleaning	Not applicable	Not applicable	4,500-11 ,000	3-5yrs
Two wheel tractor	2	2 – SWM	73-1899 NWGA-2469	13/10/1988 2/8/2000	74,500 127,000	15-20yrs
Four wheel tractors (4WT)	5	3 – SWM 2 – Works (road construction/ maintenance)	37-8986 49-1039 49-3965 270-0894 NWGH-5202	9/3/1992 24/6/1993 19/4/1995 7/1/1999 20/6/2001	597,500 641,000 685,000 945,000 650,000	15-20yrs
4WT Trailers	6	4 – SWM 2 – Works (road construction/ maintenance)	46-3794 46-6086 46-7128 67-2328 67-3765 NWGJ-0206	9/3/1992 5/9/1994 25/4/1995 28/1/1999 14/7/2000 29/8/2001	92,500 78,750 105,750 85,500 110,000 115,000	8-10yrs
ELF 350 lorry	1	Mainly SWM, but also various other tasks.	42-4764	22/8/1990	575,700	10-20yrs
Gully bowser	1	Septic tank/public toilets emptying	46-8143	2/9/1995	634,000	10-12yrs
Water bowser	1	Water delivery	NWGH-3384	13/6/2001	313,197	10-12yrs

**Notes:**

1. Most handcarts were bought 5-6 years ago at a cost of 4,500Rs. Current handcart costs = 10,000-12,000Rs.
2. Tractor lifetime is based on the age of actual tractors still in service, the oldest tractor being 14years old. Tractors should be able to be used for at least 10 years, if maintained well.
3. Trailers require repairs after two years, but can last up to 8-10years, if maintained well.

### 2.2 Waste Collection/Disposal Fees

Gully bowser charges are summarized in Table 2-2.

Table 2-2: Gully Sucker Collection Charges

Location	Septic tank capacity (L)	No of gully bowser loads	Travel distance (km)	Gully Bowser Charge (Rs)
Within UCC	20,000	3	≤ 1.6	1,500
	6,000	2		1,000
	3,400	1		750
	1,700	1		650
Outside UCC	20,000	3	1.6 - 3.2	2,000
	6,000	2		1,350
	3,400	1		950
	1,700	1		750

**Note:** Rates were set in 1996 and are for septic tanks/latrines, excluding tax.

## 2.3 SWM Discharge/Collection – Additional Information

### 2.3.1 SWM Collection Zones

Important characteristics of Chilaw's SWM collection zones are summarised below.

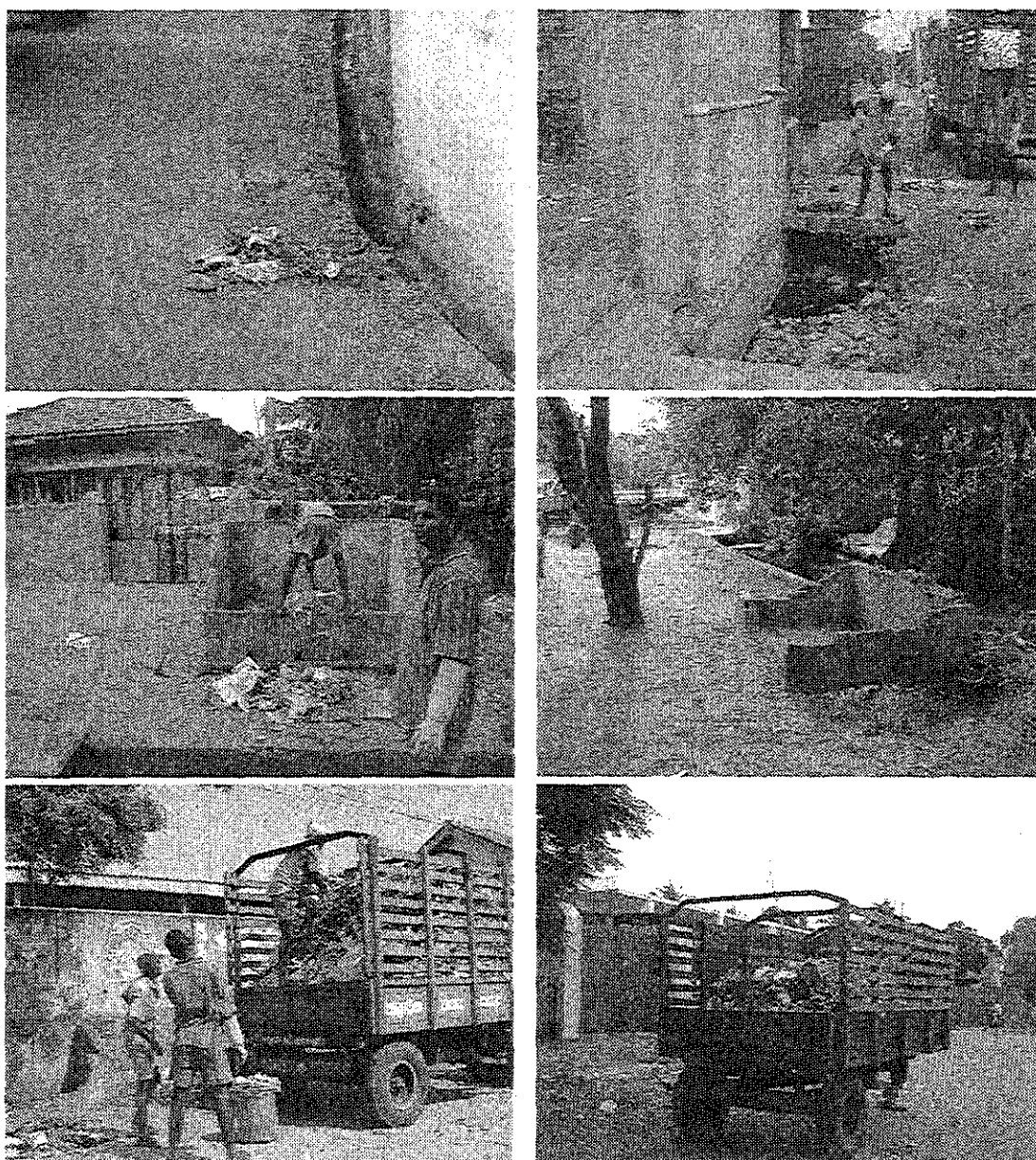
Table 2-3: SWM Collection Zones

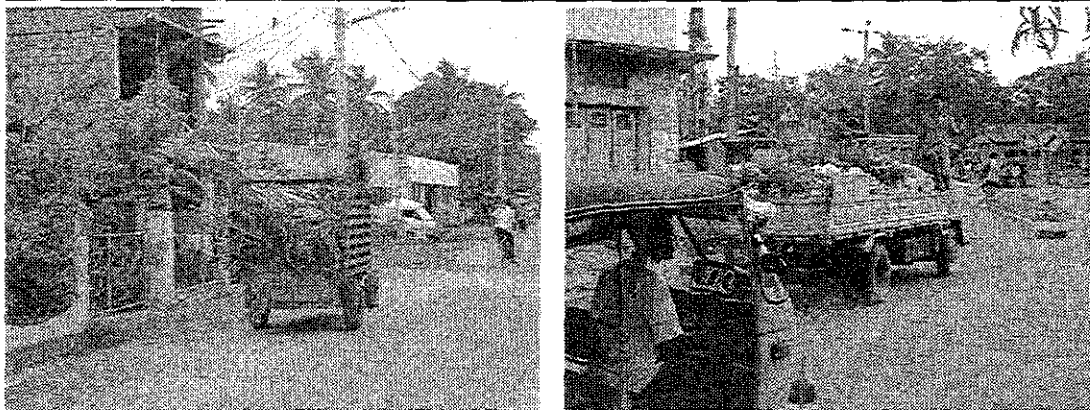
Zone	Area
1	<ul style="list-style-type: none"> <li>Area bounded by Kurunegala Rd to the north, Colombo Rd to the west, Ranaviru Mw to the south and east (UC limits).</li> <li>Mainly residential.</li> <li>Lorry used to collect garbage in this zone, after doing the early morning collection in the special zone.</li> </ul>
2	<ul style="list-style-type: none"> <li>Area bounded by Fraser St to the north, Goods Shed Rd to the west, Colombo Rd to the east and UC limits to the south.</li> <li>Mainly residential.</li> <li>Large waste producers include the Base Hospital, Vijaya College and the retail market.</li> <li>Most of the commercial area (Bazaar area) is covered by the Special Zone.</li> <li>Residents of Lanciya and Corea Wattas tend to discharge their garbage anywhere, rather than using the collection points.</li> <li>Handcart waste is discharged to the stationary trailer located in this zone. Tractor waste is taken to whichever disposal site is currently being used – currently Mykkulama, outside the city limits.</li> </ul>
3	<ul style="list-style-type: none"> <li>Area bounded by UC limits to the north, Lagoon and Canal Rd to the west, Puttalam Rd to the east and Fraser St to the south.</li> <li>Mainly residential, with a significant concentration of schools in the Jetty St/Fraser St area.</li> <li>Large waste producers include six schools (St Marys Boys College, St Marys Primary School, St Bernadette Tamil College, Bishop Edmund Pieris College, Nassriya College, Carmel Central Girls College), Keels supermarket and Bata Shoe Co.</li> <li>The handcarts dispose their waste at the site of an old coir factory, filling in a pit along Canal Rd. The tractor disposes its waste at Wattakkaliya.</li> </ul>
4	<ul style="list-style-type: none"> <li>Area bounded by UC limits to the north and east, Puttalam Rd to the west and Kurunegala Rd to the south.</li> <li>Mainly residential.</li> <li>Large waste producers include Silva, Nisamiya, Muththu, Mannar and Siripala local hotels, St Marys Nursing Home, Dr Titus dispensary, Sri Lanka Telecom, Master Motors (garage) and UCC.</li> <li>The bus stand area is covered by the Special Zone.</li> <li>The handcarts dispose their waste as per zone 3 handcarts. Two wheel tractor waste is taken to Wattawana Rd, outside the city limits.</li> </ul>
5+6	<ul style="list-style-type: none"> <li>Zone 5 = area bounded by sea to north and west, lagoon to east and Jail Rd/Chilaw Rest house to the south.</li> <li>Zone 6 = area bounded by Jail Rd/Chilaw Rest House to the north, sea to west, lagoon to east and UC limits to the south.</li> <li>Mainly residential, including some densely populated, low income housing areas.</li> <li>Large waste producers include Neil Marine Boatyard and the Police.</li> <li>Fish and vegetable market area is covered by the Special Zone.</li> <li>Residents discharge their garbage at collection points, at the roadside, or dump it in the sea and lagoon. A large amount of old coconut palm roofing is discharged for collection in this area.</li> <li>Collected garbage is disposed to an open area at the northern end of zone 5 near the cemetery. This area has been used for about 1.5yrs.</li> <li>Another area was previously used on private land in Welihena (southern end of zone 6) for final disposal. Dumping stopped here last month, due to the available space having been fully utilised.</li> </ul>

Zone	Area
Special	<ul style="list-style-type: none"> <li>Mainly covers the Chilaw commercial area including the fish/vegetable markets, Bazaar, Bus stand and Bridge St areas.</li> <li>Two handcarts work mainly in the Bazaar and Bus stand area, transferring their loads to a stationary trailer located near the Church in Corea Mw, which is emptied daily by the zone 2 tractor.</li> <li>The lorry collects garbage from the Bazaar area in the morning until ~9:30am.</li> <li>Fish and vegetable market waste is stored temporarily in a permanent CP near the Chilaw Rest House. It is collected from here by a 4WT from Mon-Sat and taken to the ORDE compost facility.</li> <li>Other waste from this zone is taken to a number of disposal sites, the main one being at Wattakkaliya.</li> <li>In 1989, ~3,000-6,000 black garbage bags were distributed along Bridge St and in the Bazaar area. This trial was a failure as people did not use the bags properly, while some labourers also took the bags for their own use.</li> </ul>

Notes: Current SWM system status as at August 2002.

### 2.3.2 Sample Photos of the Garbage Discharge and Collection System





*Some examples of Chilaw's waste discharge and collection system: Top left – small piles of garbage discharged at roadside; top right - plastic waste from the Base Hospital bin floating in the town's drains; upper middle: left – unloading concrete bin; right – partially demolished bin; lower middle: left – the trailer design makes it difficult to utilise its full capacity; right – stationary trailer in zone 2; bottom – Two wheel tractor and lorry.*

### **2.3.3 Garbage Collection Daily Routine**

Zones 1-6 working hours are from 6:30-12am and 1-4pm on Monday to Friday and from 6:30am-12am on Saturday. Garbage is only collected from the Base Hospital, retail market, two churches and some permanent collection points on Sunday using temporary labourers.

The Special Zone operates a two shift system, with labourers working from 5-9am and then again from 4-7pm. 22 labourers work both shifts, while an additional five labourers from other zones are assigned to the afternoon shift (as overtime).

Each morning, a roll call is taken by the Senior Supervisor (Overseer) at the UCC Office, following which drivers and labourers are assigned their work for the day, this being recorded on a day sheet, which is checked/signed off by the Overseer at the end of the day. Another roll call is taken at 1pm.

All garbage collection vehicles and trailers are parked near the UCC office, while handcarts are generally parked near their working areas.

Supervisors are expected to use their own transport (usually personal bicycle) for inspecting their zones. They are not reimbursed for any work related bicycle expenses.

Supervisors record the number of loads collected by each vehicle, including handcarts, in their zone in their personal diaries. This data is not compiled to determine the total number of daily trips and corresponding daily garbage volumes and tonnages. There is also no means of cross-checking the accuracy of this data, as no trip records are kept at any of the numerous final disposal sites used by UCC.

Drivers must complete a "running chart" record book, including the date, journey description, start and finish odometer readings, trip distance (km), time in/out and fuel and oil purchases. These records must be signed daily by the Chief Clerk.

Drivers must purchase diesel from public petrol sheds, as the UCC does not have a diesel store. This involves requesting the Officer in Charge of Vehicles (OICV), who checks and balances the running chart (based on 5 litres fuel consumption per metre.hour). The request is then referred to the Secretary, who certifies it and passes it on to the Chief Clerk for checking. The vehicle can then proceed to a public petrol shed with the OICV and fill up with diesel. The diesel tanks of all tractors are locked at the end of each day, with the keys being kept by the OICV.

### 2.3.4 Time and Motion Data

UCC time and motion study results from August 2002 are tabulated below.

Table 2-4: Time and Motion Study Summary

Item	Tractor
Zone	2
Start Time	07:05
Time for 1 <sup>st</sup> collection round	188min
Travel to landfill	15min
Unloading at landfill	5min
Return from landfill	15min
Time at end of 1 <sup>st</sup> round	10:48
Total 1 <sup>st</sup> round loading time	162min
Total 1 <sup>st</sup> round time	223min
1 <sup>st</sup> round loading time (% of total time)	73%

**Notes:**

1. It took 45min to load garbage into the tractor at the retail market temporary collection point. Other bin loading times are typically 6-21min, depending on the size of the bin and the amount of garbage in it.
2. The tractor returned to UCC at the end of the first round, where the labourers took tea before beginning the second round (normal practice). The tea break time was 35min.
3. Timing was continued for part of the second round, until the Base hospital bin had been emptied. This took 35min.

### 2.3.5 UCC Collection Vehicle Unit Costs

UCC collection vehicle unit costs were calculated for handcarts, tractors and the lorry using actual trips (Aug 8-14, 2002) and cost data supplied by UCC, supplemented by data from other sources where necessary. These costs are tabulated below.

Table 2-5: UCC Collection Vehicle Unit Costs

Item	Handcart		2WT	4WT	Lorry
No of labourers	1	2	2	3	3
Driver	0	0	72,000	72,000	72,000
Labourers	67,200	134,400	134,400	201,600	201,600
Staff equipment	2,940	3,430	4,835	6,265	6,265
Diesel	0	0	17,500	110,000	120,000
Oil	0	0	1,615	3,295	3,295
Repair/maintenance	2,500	2,500	40,000	140,000	150,000
Trailer maintenance	0	0	0	10,000	0
Insurance	0	0	2,160	6,955	6,955
Licence/ registration	0	0	150	150	2,800
Depreciation	1,125	1,125	8643	51,091	52,336
<b>Total (Rs/yr)</b>	<b>73,765</b>	<b>141,455</b>	<b>281,303</b>	<b>601,356</b>	<b>615,251</b>
<b>Average trips/d</b>	<b>2.8-5.0</b>	<b>2.8-5.0</b>	<b>2.3</b>	<b>2.8</b>	<b>3.1</b>
<b>Collection (T/yr)</b>	<b>107-189</b>	<b>107-189</b>	<b>403</b>	<b>955</b>	<b>797</b>
<b>Unit cost (Rs/T)</b>	<b>689-391</b>	<b>1,322-749</b>	<b>698</b>	<b>629</b>	<b>772</b>
Kandy MC (Aug 2002)	1,342-1,983 (2-3Lr, 3.2tr/d)		N/a	496 (4Lr)	N/a
Matale MC (Aug 2002)	501 (1Lr, 4tr/d)		N/a	403 (4Lr)	N/a
Negombo MC (Aug 2002)	1,320-792 (3Lr, 3-5tr/d)		N/a	418 (3Lr)	N/a
Gampaha MC (Aug 2002)	1,482-2,185 (2-3Lr, 3tr/d)		764 (2Lr)	799 (4Lr)	N/a
Nuwara Eliya MC (Sep 02)	1,858-1,115 (3Lr, 3-5Tr/d)		N/a	517 (3Lr)	659 (3Lr)
Badulla MC (Sep 02)	1,865-1,119 (3Lr, 3-5 tr/d)		822 (2Lr)	268-254 (3Lr)	N/a

**Notes:**

1. Lr = labourer, tr = trips, 2WT = two wheel tractor, 4WT = four wheel tractor.
2. Average number of trips per day based on UCC Aug 8-14, 2002 vehicle trip records for handcarts, two wheel tractors (2WTs), four wheel tractors (4WTs) and the lorry.
3. Handcart garbage collection tonnage data based on 2.8-5.0 trips per day for 1-2 labourers, 2.8 trips/d representing the average number of trips for handcarts that take their waste directly to disposal, while 5 trips/d represents the average number of trips for handcarts transferring their loads to the stationary trailer in zone 2.
4. Lorry cost data may not entirely relate to garbage collection duties, as the lorry is sometimes used for other tasks by UCC.
5. Maintenance costs include tyres and tubes.
6. Straight line depreciation has been included, based on the following capital costs and lifetimes: handcart = 4,500Rs, 4yrs; two wheel tractor = 151,250Rs, 17.5yrs (average capital cost of two UCC two wheel tractors currently in service); four wheel tractor = 703,700Rs, 17.5yrs (average capital cost of all five UCC four wheel tractors), tractor trailer = 97,917Rs, 9yrs (average capital cost of all six UCC trailers), lorry = 575,700Rs, 11yrs.

It should be noted that these estimated unit costs are considered to be **low** estimates, as they are based on UCC collection records for the period Aug 8-14, 2002, when collection quantities were considerably higher than normal for a number of natural reasons (e.g. Munneswaram festival) and also due to possible artificial inflation of the data records by an estimated 14.5%. Hence, unit costs calculated under normal conditions using real collection data may be significantly higher than the values tabulated here.

## 2.4 Final Disposal

### 2.4.1 Assessment of Current UCC Landfill Sites

UCC does not have their own permanent landfill site. Instead, they use several different sites on private land within CUA for waste disposal. The lifetime of each site is generally only several months. The locations of UCC disposal sites as of July 2002 are shown below.

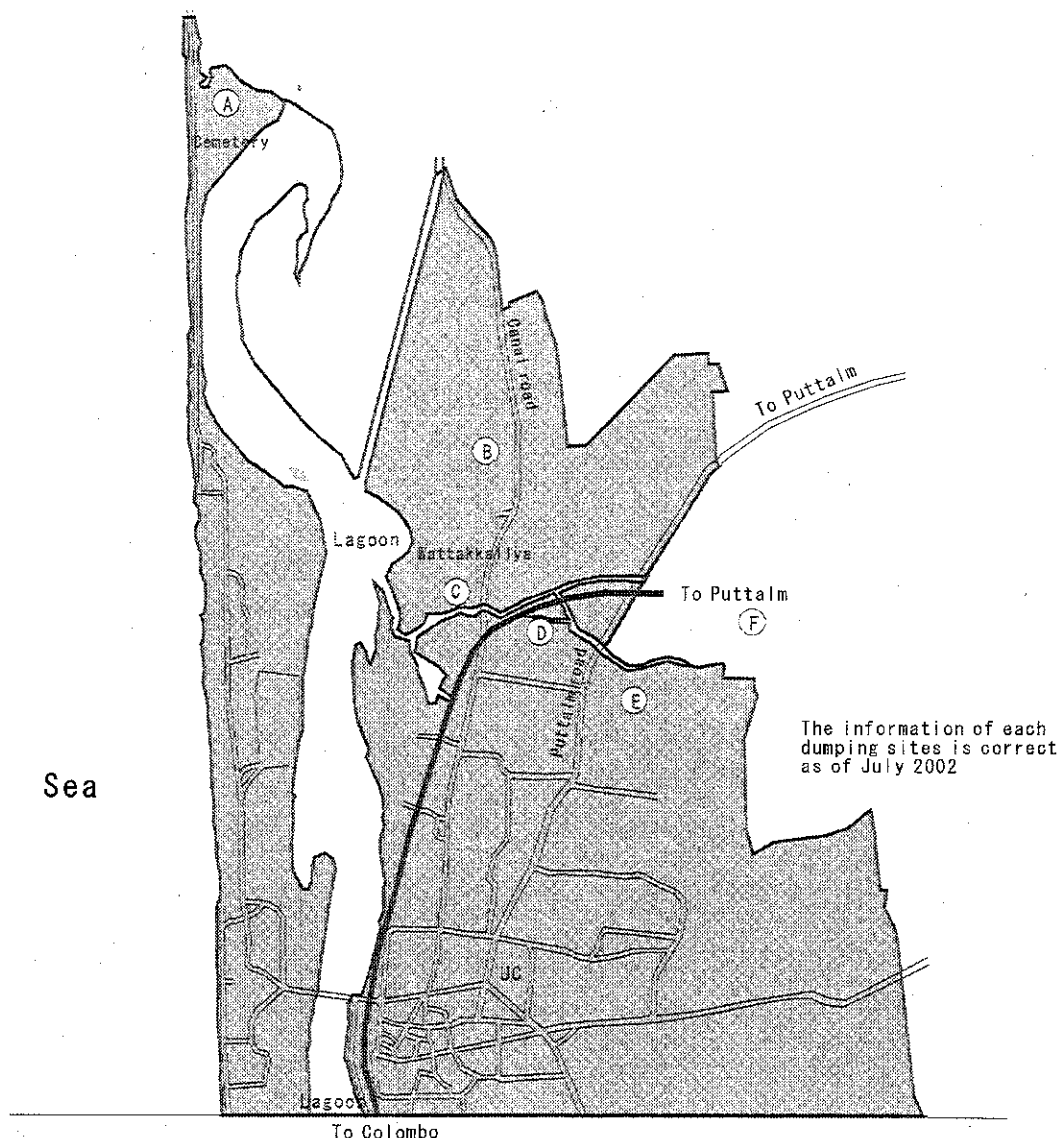


Figure 2-1: Location of Landfill Sites in Chilaw

The conditions at each of these disposal sites was assessed by the Study Team in July 2002. Results of this assessment are tabulated below. Note that the stated discharge amounts are not very accurate as they are based on survey responses. They exceed the actual UCC collection amount by about 100%. However, these discharge amounts give some idea of the relative amounts disposed at different sites.