Annex 9

Scavenging Survey

9 Scavenging Survey

9.1 Objectives

- to understand the present role of scavengers in SWM for DSM.
- to understand the system of scavenging in DSM and at which points of the waste stream scavenging occurs.
- to understand the organisation of scavengers and their present working conditions.
- to estimate the amount recycled by scavengers at different points of the waste stream.
- to facilitate prediction of the social impact of the Master Plan on scavengers.

9.2 Content

The following surveys were conducted:

- Scavenger Attendance Survey (SAS) at the Vingunguti disposal site.
- Scavenger Interview Survey (SIS) at the Vingunguti disposal site.
- Middleman Interview Survey (MIS) at Vingunguti disposal site.
- Scavenging Waste Amount Survey (SWAS) at Vingunguti disposal site.
- Scavenger Interview Survey (SIS) with scavengers at other places in DSM.

Discussions concerning scavenging were also held with the DCC Vingunguti disposal site staff.

9.3 Scavenger Attendance Survey at Vingunguti

The Scavenger Attendance Survey (SAS) was carried out for a period of 7 days from Tuesday, 18 June 1996 to Monday, 24 June 1996 by DCC disposal site staff. The attendance was recorded three times per day between 0800-1100 (morning), 1300-1600 (afternoon) and 1745-1830 (evening). Scavengers were also asked to state which materials they collect.

9.3.1 Results

The scavenger attendance survey results are shown in Table 9-1 and Figure 9-1.

Table 9-1: Attendance Survey Results

Time	Day and Date						
	Tues 18/6	Wed 19/6	Thu 20/6	Fri 21/6	Sat 22/6	Sun 23/6	Mon 24/6
morning	92	61	68	54	46	46	51
afternoon	51	35	58	44	40	28	34
evening	23	33	39	45	32	31	30
Total	166	129	165	143	118	105	115
Average	55.3	43	55	47.7	39.3	35	38.3

Note: Overall average is 45

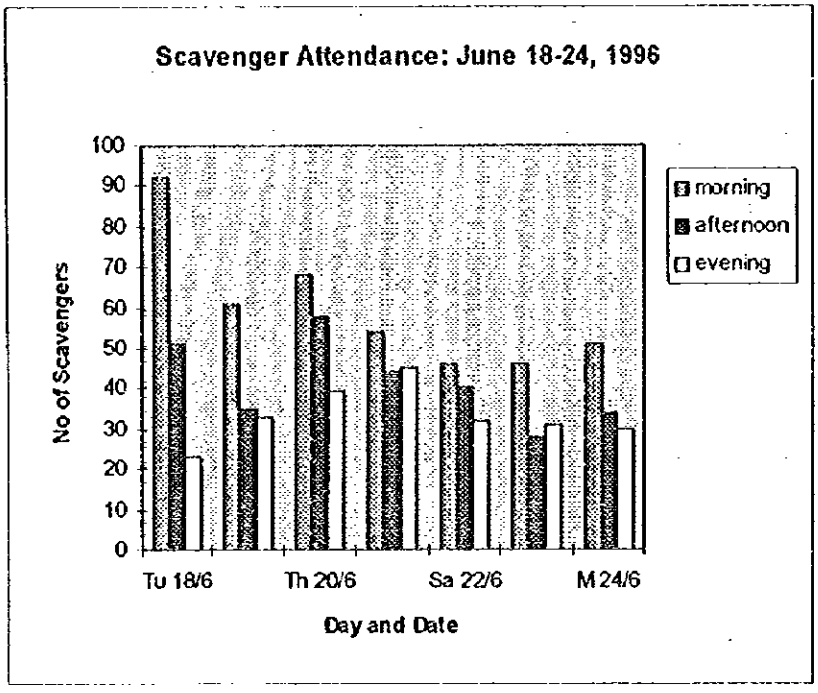


Figure 9-1: Scavenger Attendance at Vingunguti Disposal Site, June 1996

These results show that attendance is generally highest in the morning and lowest in the evening. The average attendance was 60, 41 and 33 during the morning, afternoon and evening respectively. The average overall attendance was 45 with an estimated error of +/-10%, this being the average number of scavengers present throughout the whole day (i.e. permanent scavengers).

The attendance was unusually high on the first morning of the survey. No reasonable explanation for this result has been obtained.

A total of 294 different names were recorded over this 7 day period, 240 of them were male and 54 female. Of these, a large number are part-time scavengers. For example, there were 98 people whose attendance was only recorded once during the 7 day survey period.

9.3.2 Items Collected

The different items collected were categorised into four groups according to the number of scavengers collecting each item, as listed below in Table 9-2.

Table 9-2: Numbers of Scavengers collecting Different Items

Collection Category	Number of Scavengers collecting these items	Items
Very high	140-200	cans/tins; paper (mainly boxes)
High	80-110	glass bottles; other metals (i.e. not cans/tins); plastic bottles; sacks
Medium	30-50	food leftovers; cereal/rice husks; wire mesh; wooden materials
Low	0-20	other glass (i.e. not bottles); plastic sheets; paints; sawdust; textiles; tyres

9.4 Scavenger Interview Survey at Vingunguti

Thirty permanent scavengers were interviewed by disposal site staff using a set questionnaire. The questionnaire and detailed survey results are shown in section 9.9.1.

9.4.1 Results

A summary of the results follows:

1. Twenty-seven interviewees were male and three were female.
2. All interviewees stated:

- scavenging was their only job;
- they work for themselves;
- they spend more than 25 days per month scavenging;
- there is a large demand for all items sorted;
- they sell the sorted material to middlemen, mainly in the Vingunguti area but one scavenger sells items to middlemen in the city centre while another sells cereal/rice husks at Mbezi some distance away.

3. The other results from this questionnaire are presented graphically in Figure 9-2 - Figure 9-5. The main points are summarised below:

- 80% of scavengers are aged from 20-39.
- 60% have been doing this type of work for 6-12 years and 17% for over 12 years.
- 90% work 8-12 hours per day and 6% for over 12 hours per day.
- 60% have a monthly income in the range 6,000-10,000 Tsh; the average income being 11,500/- per month.

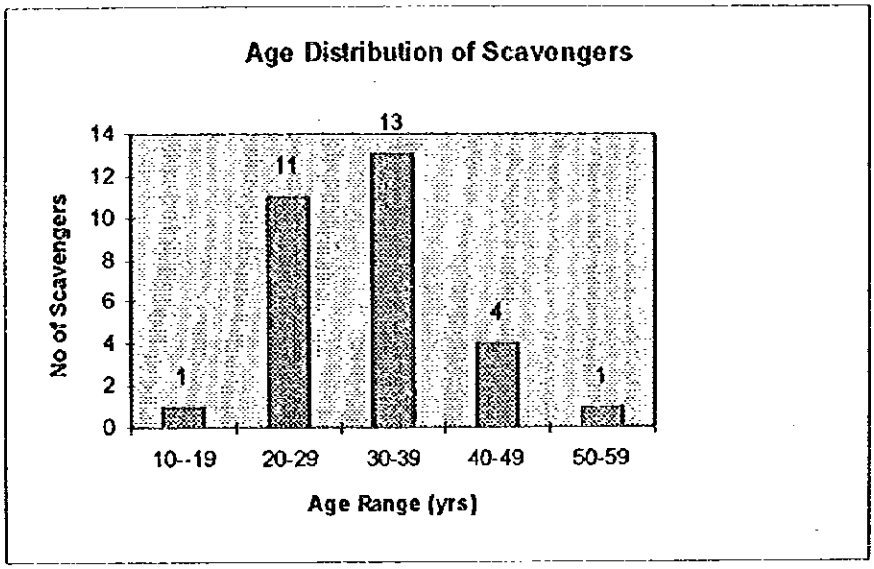


Figure 9-2: Scavenger Age Distribution at Vingunguti Disposal Site

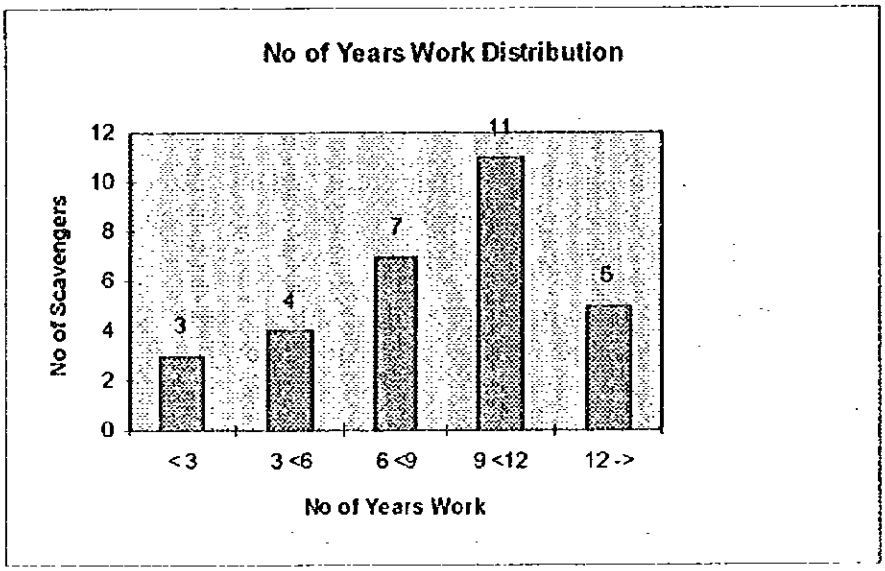


Figure 9-3: Distribution in Working Years of Scavengers at Vingunguti Disposal Site

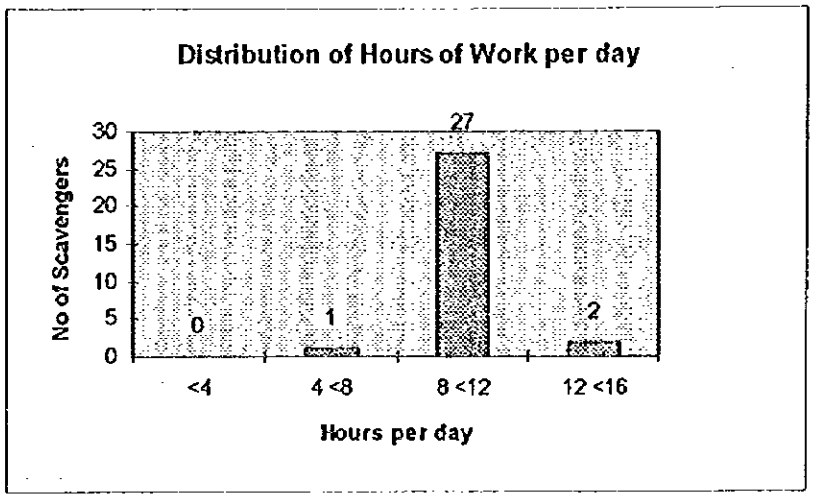


Figure 9-4: Distribution in Daily Working Hours of Scavengers at Vingunguti Disposal Site

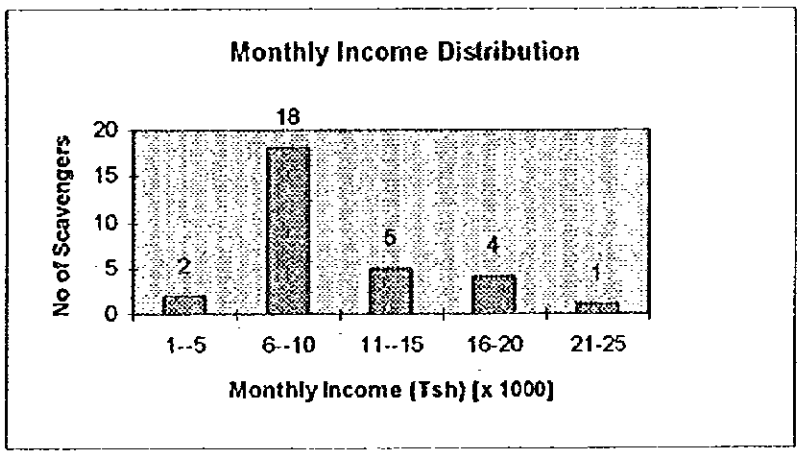


Figure 9-5: Distribution in Monthly Income of Scavengers at Vingunguti Disposal Site

There are some provisos that need to be stated concerning the reliability of this data. The majority of scavengers have minimal education and their existence is based on survival from one day to the next. Hence, the accuracy of some of their responses is questionable. For example, some scavengers did not know their exact age. Similarly, a more realistic estimate of the average number of days worked per month by scavengers is thought to be "greater than 20 days" and not "greater than 25 days" as all of the interviewees stated.

The estimation of monthly income was also difficult for many scavengers. This may partially be due to an unwillingness to state the actual figure but can also be explained by the "hand to mouth" nature of their existence; in other words, as money is earned, most of it is spent immediately. Similarly, although the items collected by each scavenger are weighed on sale to the middlemen the amount of items collected daily is variable and hence estimation of a daily quantity of waste collected for each item was difficult.

In fact, in 19 cases the incomes stated by scavengers do not correlate well with incomes calculated based on stated quantities of items collected per day and selling price,

suggesting that either the quantity or income or possibly both are not correct. Thus, the accuracy of the responses for income and quantities collected is assumed to be +/- 30% **(error = 30%).**

9.4.2 Estimation of Amounts of Different Recyclable Items Collected

As 90% of the scavenger interviewed work 8-12 hrs/day, estimation of the total amount of each item scavenged must be based on the average number of scavengers present throughout the day.

As all but one scavenger interviewed collects 3-7 different items, the total quantities of different items scavenged was assessed using each interviewees' stated collected quantities rather than income.

The number of scavengers collecting each item and the total quantities collected by the interviewed scavengers based on their estimations are shown in Table 9-3. This data has been used to estimate the total quantity of each item collected by permanent scavengers as follows:

$$\text{(Tot. qty. of each item)} = \text{(qty. of each item collected by all scavengers interviewed)} \times \frac{\text{avg. no of scavengers (45)}}{\text{no of scavengers interviewed}}$$

The results of this calculation are also shown in Table 9-3. Taking the errors in the different quantities into account, the error in the total quantity is 30% + 10% = 40%.

Table 9-3: Estimated Quantities of Different Items Collected by Scavengers

Item	glass bottle	can/tin	cereal husk	other metal	paper (box)	plas -tic	paint	sack	tyre	wood	Tot.
No. collecting each item	19	24	1	19	25	17	1	25	1	11	
Estimated quantity of item collected	58	88	200	108	837	41	4	84	10	98	1528
Estimated total quantity of item collected	87	132	200	162	1256	62	6	126	15	147	2193

Note: the husks total was not multiplied as this was considered to be an abnormally high amount to be collected by one person daily.

The average daily amount of collected items per scavenger is 48.7 kg/person/d.

These results are compared with those obtained from MIS and SWAS in annex 8.

9.4.3 Selling Prices

Scavengers were also asked about selling prices of collected items. These results are described in section 9.5.3.

9.4.4 Problems

The scavengers interviewed were asked to describe any problems they experienced in this work. Their responses are summarised in Table 9-4.

Table 9-4: Problems experienced by Scavengers at Vingunguti Disposal Site

Nature of Problem	Number of Scavengers affected
Risk of Injury	20
Lack of tools for work	19
Lack of clean drinking water	14
Lack of clean water for washing	5
Working in the hot sun	4
Lack of Health Service/First Aid	2
Lack of Medical treatment due to inability to pay for it	1
Breathing bad air	1

9.5 Discussions with DCC Vingunguti Disposal Site Staff

Discussions were held with DCC disposal site staff at Vingunguti in order to gain a better understanding of the scavenging system, the organisation and working conditions of scavengers and the range of items collected, selling prices and subsequent uses.

9.5.1 Organisation and Working Conditions

There is no formal organisation representing the scavengers at Vingunguti. A small group of permanent scavengers would like to start an organisation but they have experienced some difficulty in getting other scavengers to agree to pay a regular small financial contribution for this purpose.

Although scavenging is not officially permitted at the Vingunguti disposal site, DCC does not discourage nor prevent scavenging here. However, it is DCC disposal site policy to chase children away who are seen scavenging here.

During the long wet season (April and May), the number of scavengers drops by around 20-30%.

Most of the scavengers at Vingunguti only scavenge at this site and have little contact with scavengers working in other parts of the city.

There are a small number of scavengers who live on the disposal site in makeshift huts, particularly during the dry season.

9.5.2 The Scavenging System

There are a number of places at the Vingunguti disposal site where recyclable materials are removed from waste brought for disposal. Some of the refuse truck crews, particularly those of Multinet, do some sorting of the waste in their trucks at the time of loading, with recyclable items, especially boxes, being placed at one side. They stop at 1-2 places near the disposal site entrance to offload these materials, to waiting scavengers/middlemen.

However, most scavenging takes place within the disposal site immediately after a refuse vehicle has discharged its load. Almost all scavengers work individually and it is estimated that at least 90% of them sell the materials they collect to middlemen, who live nearby in Vingunguti. Some of the middlemen purchase recycled materials at the disposal site and then transport them to their homes by handcart. Most middlemen

however, operate from their homes with scavengers bringing materials to them. The materials are stored here and subsequently sold.

The remaining 10% of scavengers sell the collected items directly to individuals at Vingunguti or to individuals/middlemen at other places or use the items themselves to make things. For example, one scavenger uses pieces of sacks, cloths, sponge, wool, etc. that he collects to make mattresses which he sells for 1,500/- ea. Another collects metal scraps and uses them to make charcoal stoves. Both these scavengers were not interviewed in SIS.

9.5.3 Range of Materials Collected, Selling prices and some Uses

The main materials collected by scavengers and purchased by middlemen are cans/tins, glass bottles, other metal, paper (boxes), plastic bottles, sacks and wooden materials. This is consistent with the SAS results, previously shown in Table 9-2, where these items were all grouped in the medium, high and very high collection categories. These items can be found in relatively large quantities, compared with the other items previously listed.

The selling prices of these items and variation in selling price over the last 12 months are tabulated in Table 9-5.

Table 9-5: Selling prices for the main items collected and their variability over the last 12 months

Source: DCC disposal site staff

Date	Selling Prices of Collected Materials to Middlemen (Tsh)						
	cans/tins	glass bottles	other metal	paper (boxes)	plastic bottles	sacks	wood
up to 31 Dec 1995	2/- ea.	3/- ea.	5/- per kg	5/- per kg	2/- ea.	20/- ea.	
1 Jan-15 May 1996	2/- ea.	5/- ea.	7/- per kg	10/- per kg	2.5/- ea.	35/- ea.	
15 May 1996 onwards	3/- ea.	10/- ea.	10/- per kg	15/- per kg	3/- ea.	50/- ea.	20/- per kg

Notes: 1) the current selling prices stated in Table 9-5 are consistent with prices stated by the scavengers interviewed in SIS.
2) the current selling price of plastic bottles varies with the size of the bottle and is 3/-, 5/- or 10/- ea. This also applies to tins. Beer cans and small tins are sold for 3/- ea.; larger tins fetch higher prices (15/- and above). Most large sacks sell for 50/- ea. while smaller sacks may be sold for 20/- ea.
3) the selling prices of other items, quoted by only 1 interviewee in each case, are: cereal/rice husks: 20/- per kg; paint: 100/- per kg and tyres: 20/- per kg.
4) Other items collected (plastic sheets, sawdust, textiles and wire mesh) have no fixed price, being sold for whatever amount can be obtained.

When food leftovers are dumped, some scavengers will collect leftover meat, chicken and fish for cooking and eating themselves. Livestock owners in the immediate vicinity of the dump are informed if other foodstuffs are brought and will then come to collect the food themselves for free.

Husks tend to be dumped in relatively large quantities but infrequently. These are sold to people raising livestock and sometimes may be transported for sale as far away as Mbezi, where there is a large concentration of livestock owners. Similarly, sawdust, which is

dumped in smaller quantities than husks, is sold to livestock owners for use as ground cover.

Sacks may also be sold to households. Often, bits of sack are salvaged from the waste and sewn together to make a complete sack which is then sold to charcoal vendors. Incomplete sacks are also used as roofs and walls of small kiosks, outside toilets and bathing areas. Plastic sheets are also used for this purpose and for providing temporary shelter, especially by petty traders. These are also collected in small quantities.

Very small quantities of glass (excluding bottles), paint, textiles, vehicle tyres and wire mesh are collected. These are normally sold to nearby residents at whatever price they are able to obtain. The paint collected consists of reject products from local factories. This is mixed with other paint by the scavengers and resold to unsuspecting customers. Textiles may be used to make mattresses.

9.6 Vingunguti Middleman Interview Survey (MIS)

MIS is part of both the recycling and scavenger surveys. The MIS results have been included in this section, primarily because estimates of the amounts of different items collected by middlemen made from the MIS results provide an alternative method for predicting the amounts of different items collected by scavengers from the disposal site; this being one of the main objectives of the scavenger survey. Some understanding of how the scavengers and middlemen interact at Vingunguti is also gained.

The MIS consisted of an interview survey of eleven middlemen operating in the immediate vicinity of Vingunguti disposal site and was carried out by DCC disposal site staff and study team members using a set questionnaire. The questionnaire and the detailed survey results are shown in section 9.9.2.

9.6.1 Results

The results are summarised below and illustrated in Figure 9-6 - Figure 9-10.

1. Seven of the middlemen interviewed were male and four were female.
2. this is a full-time job for eight of the middlemen; two of the other three have secondary, minor jobs and the third is a student at UDSM.
3. all middlemen work for themselves. However, there are nine middlemen (seven of whom were interviewed) dealing with paper who cooperate for the collection of paper only. According to their agreement, they have set up a roster which allows each of the nine members to collect paper from Vingunguti for 2 days in every 3 weeks. Once the paper is collected, each middlemen then independently arranges storage, transport and sale of their paper.
4. Four middlemen work more than 25 days per month. Five of the seven members of the paper group work 0-5 days per month and the remaining two middlemen work 11-15 and 16-20 days respectively. All work 8-12 hours per day (Figure 9-6).
5. Seven middlemen have been doing this work for less than 3 years, one for 3-6 years, one for 6-9 years and two for over 12 years.

6. the income distribution is shown in Figure 9-7. The average income is 27,300/- per month.

7. the main source of materials for all middlemen is scavengers from the Vingunguti disposal site (Figure 9-8). One buys a small amount of materials from restaurants/hotels and refuse truck workers and another from households and refuse truck workers.

8. Seven of the middlemen, especially those dealing with paper, require a truck for transporting the materials collected to their customers (Figure 9-9). Three use handcarts to transport small quantities of materials, mainly from the disposal site itself to their depots (usually within the premises of their house). At least four use casual labour for various tasks, particularly weighing and sorting. Cleaning, baling and transporting operations are also carried out by some middlemen. One has a milling machine which is used to grind food leftovers to make feed for his livestock.

9. Eight of the middlemen sell directly to factories (Figure 9-10); one sells aluminium/steel scrap to a large scale dealer who stores these scraps in a warehouse prior to sale; two sell directly to small workshops. Individuals also buy some items from middlemen, particularly sacks and wood.

10. There is a large demand for all recyclable materials.

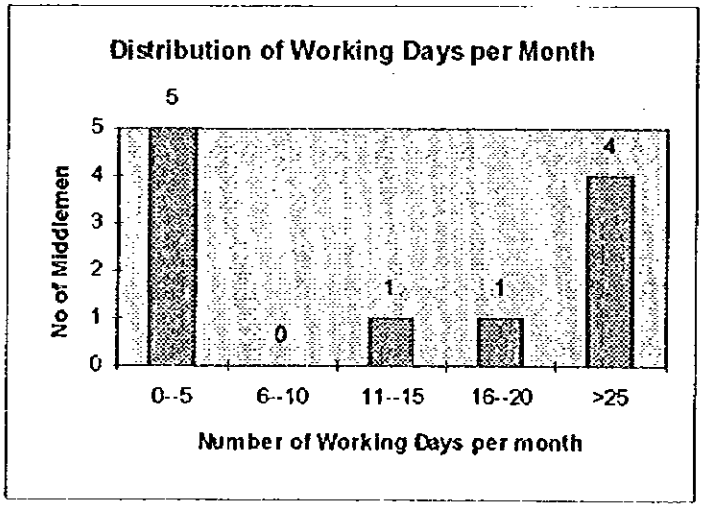


Figure 9-6: Distribution in Working Days per Month for Middlemen at Vingunguti Disposal Site

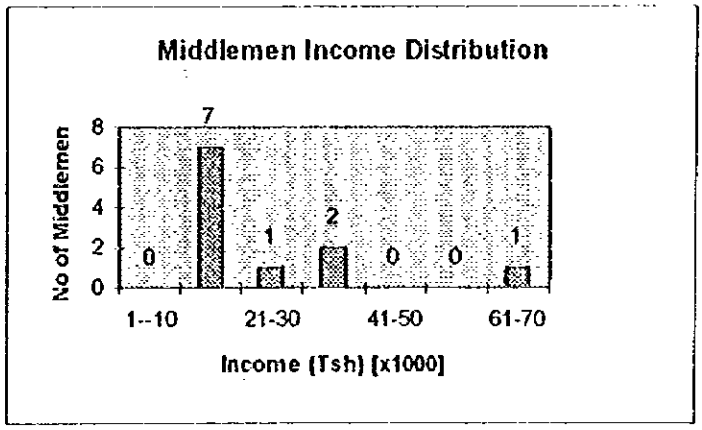


Figure 9-7: Distribution in Monthly Income for Middlemen at Vingunguti Disposal Site

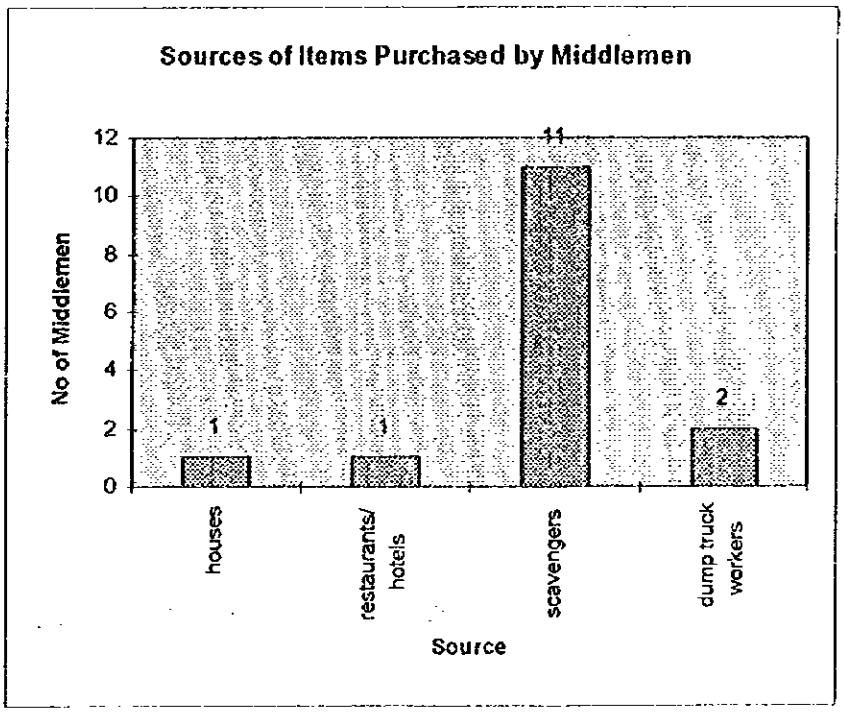


Figure 9-8: Sources of Recyclable Items for Middlemen at Vingunguti Disposal Site

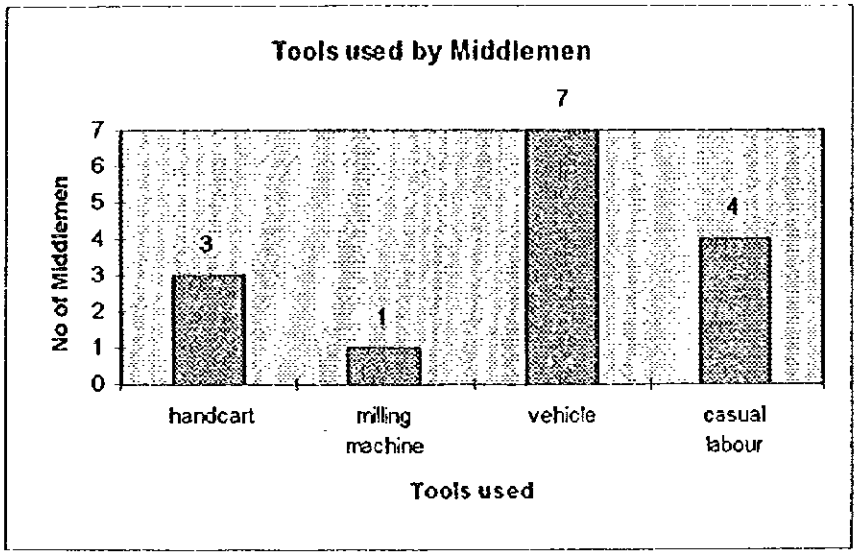


Figure 9-9: Tools used by Middlemen in their work at Vingunguti Disposal Site

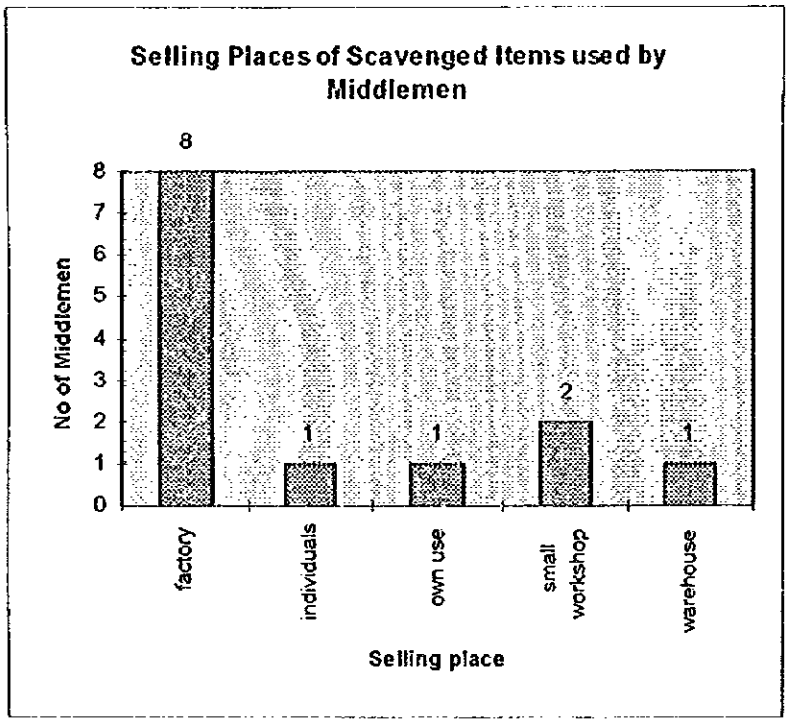


Figure 9-10: Selling Places of Scavenged Materials used by Middlemen at Vingunguti Disposal Site

9.6.2 Estimated Amounts of Different Recyclable Items Collected

The total amounts of different materials recycled per day from the Vingunguti disposal site may be calculated from the middlemen's estimates of daily amounts collected. However this involves a number of assumptions:

- at least 90% of the scavengers sell materials directly to middlemen at Vingunguti.

- The middlemen located and interviewed represent at least 90% of all middlemen operating in the Vinguguti area. This is not true, except probably for other metals and paper, for which we have interviewed 5 and 7 middlemen dealing in these items respectively. For other materials, 3 and 2 middlemen dealing in cans/tins and wood respectively were interviewed and only one for each of glass bottles, food leftovers, plastics and sacks.
- The estimates of the quantities of these materials collected per day by middlemen are accurate. In reality we were told that the quantities collected do fluctuate so that only rough estimates could be made. In addition, the stated incomes do not correlate well with the incomes calculated using quantities collected, buying and selling prices.

Hence, reasonable estimates of quantities can be made only for other metals and paper. The cans/tins and wood figures will also be indicative of the true values but will underestimate these values. The food figure may also be reliable as the one middleman located lives on the boundary of the disposal site, raises a large number of livestock and is thought to collect the bulk of the food which is disposed. However, the quantities of plastics and sacks obtained are considered to be gross underestimates of the true quantities. All the survey results are presented in Table 9-6 below for completeness.

These results are compared with those obtained from SIS and SWAS in annex 8.

Table 9-6: Estimation of Total Quantities of Different Items Collected

Item	glass bottle	can/ tin	food leftovers	other metal	paper (box)	plas -tic	sack	wood	other	total
No of Middlemen buying each item	1	3	1	5	7	1	1	2	1	
Estimated quantity of each item collected	not spec-ified	92-102	67	280-420	1430	3.1	7.3	82-108	33	2082
Estimated total quantity of each item collected	----	114 - 126	83	346-519	1765	3.8	9.0	101-133	41	
Average Quantity	----	120	83	433	1765	3.8	9.0	117	41	2572

Notes: 1) The paper figure is based on all 9 members of the paper group and not just the 7 interviewed. All interviewees stated 3-4 tonnes of paper can be collected during the two days allocated to them over a 3 week period. These figures converted to a daily basis equate to 143-191 kg/day.
2) No middlemen were found dealing in cereal/rice husks, other glass, paint, textiles, tyres and wire mesh. It is assumed that very small quantities of these items are collected and that they are sold directly to households or used by scavengers themselves except for cereal/rice husks which are sold to livestock owners.
3) The estimation of total amounts of items is done by multiplying the survey results by 100/90 x 100/90 to take into account the first two assumptions stated above.
4) other = car batteries.

9.6.3 Middlemen's Buying and Selling Prices

The buying and selling prices for different items are tabulated in Table 9-7.

Table 9-7: Middlemen Buying and Selling Prices at Vingunguti Disposal site

Item	Unit	Price (Tsh)		No. of middlemen stating each price
		Buying	Selling	
glass bottles	---	not specified	not specified	1
cans and tins	kg	150/-	200/-	1
	kg	200/-	250/-	1
	ea.	3/-	4/-	1
car batteries	kg	30/-	35/-	1
other metals	kg	10/-	15/-	1
	kg	10/-	20/-	2
	kg	10/-	25/-	1
paper (boxes)	kg	15/-	25/-	7
plastic bottles	ea.	3/-	6/-	1
sacks	ea.	50/-	100/-	1

Note: the price of wood is variable as it is usually bought by the piece. The buying price ranges from 100/- upwards per piece and the mark-up is approximately 100%.

9.6.4 Problems

The middlemen interviewed were asked to describe any problems they experienced in this work. Their responses are summarised in Table 9-8.

Table 9-8: Problems experienced by Middlemen at Vingunguti Disposal Site

Nature of Problem	No. of middlemen affected
Lack of capital	2
Lack of adequate storage facilities	2
Lack of reliable market for paper	2
Lack of market for cans/tins and other metals	1
Unsatisfactory selling price for cans/tins and other metal	1
Some scavengers try to cheat them by placing heavy worthless items amongst materials to be weighed	1

9.7 Scavenger Waste Amount Survey

This survey was carried out for two days from 23-24 July at the Vingunguti disposal site by two study assistants in close cooperation with DCC disposal site staff. This survey was primarily conducted to reconcile the differences in the estimated quantities of different items recycled daily from Vingunguti disposal site calculated from the SIS and MIS results. The objectives were:

- to record the different types of materials collected by scavengers; including any bulky items.
- to quantify the amount of different types of materials that are collected by scavengers each day.
- to relate the types and amounts of materials collected during the survey period to the sources and quantity of waste dumped daily.

9.7.1 Methodology

There are two main points where scavengers collect recyclable materials. The main point is where refuse vehicles offload all their waste at the working face ("tipface") within the disposal site and this is where most of the scavengers work. There is a second point near the entrance to the disposal site ("entrance point") where a middleman and some scavengers operate from. Many refuse trucks, especially those of DCC and Multinet, stop here to offload some recyclable materials that have already been sorted by the dump truck crew. Both these places were surveyed as explained below.

1. A weighing station was set up near the tipface. This was permanently staffed by 1-2 study assistants from 0830-1900 during the two day period of the survey.
2. DCC disposal site staff liaised with the scavengers to obtain their cooperation for the survey. Each scavenger was instructed to pass the weighing station as they left the disposal site with their collected materials. Their materials were sorted into different categories, weighed and then returned to them.
3. DCC disposal site staff liaised with the scavengers/middleman working at the entrance point who agreed to give us a copy of their collection data at the end of each day.
4. DCC disposal site and Multinet records were also obtained for the number of trucks and other vehicles bringing waste for disposal during the two day period of the survey. The origin and estimated quantity of waste brought by each vehicle was recorded.

9.7.2 Results

The amounts and types of waste materials collected by scavengers at the two offloading points: the tipface (tipf.) and entrance point (entr.) are shown in Table 9-9. The types of materials were classified using the same categories as in SIS.

Table 9-9: Amounts of each Type of Waste Material collected by scavengers/middlemen

Tues, 23 July

Item	bo	ct	fo	hu	me	pa	pl	pt	sa	te	wo	oth	TOT
Tipf.	87.5	156.4	2.8	32.5	173.0	348.1	50.2	60.4	12.6	8.8	139.4	32.9	1104.6
Entr.	0.0	64.0	0.0	0.0	70.0	0.0	14.4	0.0	0.0	0.0	60.0	*1	208.4
Tot.	87.5	220.4	2.8	32.5	243.0	348.1	64.6	60.4	12.6	8.8	199.4	32.9	1313.0

Wed, 24 July

Item	bo	ct	fo	hu	me	pa	pl	pt	sa	te	wo	oth	TOT
Tipf.	59.7	78.5	7.6	117.0	122	118.5	5.2	7.2	21.8	6.0	75.1	25.0	533.6
Entr.	5.0	30.0	0.0	0.0	16.0	0	3.0	0.0	0.0	0.0	245.0	0.0	299.0
Tot.	64.7	108.5	7.6	117.0	28.2	118.5	8.2	7.2	21.8	6.0	320.1	25.0	832.6

Avg.	76.1	164.5	5.2	74.8	135.6	233.3	36.4	33.8	17.2	7.4	259.8	29.0	1072.8

Note: 1) *1 - Some bulky items were collected at the entrance site; namely, a small fridge (1.5x0.5x0.5m), a gas stove (1.5 x 0.5 x 0.5m) and two wooden tables. Of these items, only the weights of the wooden tables have been included in the above table. [Fridges, stoves and other similar items are usually examined first to see if it is feasible to repair them. If not, then they are usually sold as scrap].

2) Other is mainly charcoal and coconut remains but also includes small rubber hosepipes, electrical wiring, small nails, razor blades, paper clips and ceramic items.

Table 9-10 contains the data for the number of trips, tonnage of waste brought for disposal during the survey period and the sources of waste.

Table 9-10: Vingunguti disposal site data

Tues, 23 July

Source: DCC disposal site staff; Multinet office

Vehicle	No of Trips	Estimated Waste Quantity (tonnes)	Source/Type of Waste
DCC	28	112	market (Tandale)
Multinet	28	84	all 10 wards except Mikocheni + 2 trips from IPS (office waste)
Private:			
KMC	3	6	market (Kariakoo)
NBC	1	7	paper
TCC	2	5	kitchen(from residential workers)
THA	4	16	grasses cuttings/sweepings
business	1	1	household
business	1	1	sawdust
business	1	1	garage and grass cuttings/sweepings
Total	69	233	

Wed, 24 July

Vehicle	No of Trips	Estimated Waste Quantity (tonnes)	Source/Type of Waste
DCC	27	108	market (Tandale) + 3 trips from IPS (office waste)
Multinet	31	93	all 10 wards except Mikocheni
Private:			
KMC	3	6	market (Kariakoo)
NBC	1	7	paper
TCC	3	9	
THA	1	4	grass cuttings/sweepings
TTCL	1	3	paper
business	1	1	grasses
business	1	1	garage
business	1	3	grass and paper
business	1	2	household
Total	71	237	

Note: KMC = Kariakoo Market Corporation; NBC = National Bank of Commerce; TCC = Tanzania Cigarette Company; THA = Tanzania Harbours Authority; TTCL = Tanzania Telecommunications Company Limited.

9.7.3 Discussion

There was a noticeable difference in the amounts of recycled materials collected on the two days of the survey. The study assistants observed that the number of scavengers working at the tipface on the second day was 50-70% of the number present on the first day and this may be one reason for the reduction in the amount of waste materials

collected. However, it is more probable that the number of scavengers was reduced because there were fewer recyclable materials to collect on the second day.

Secondly, the quantity of recycled materials available for collection depends upon the quantities and types of waste brought for disposal. However, Table 9-10 shows that the quantities and types of waste disposed of on both days are very similar.

The data obtained from the middleman was incomplete and thought to significantly underestimate the actual amounts collected at the entrance point. It is suspected that his weighing scales are calibrated to read 5-10% below the true weight of an item. Some amendments were made to this data based on observations made by the study assistants on the quantities of materials collected at this point. Despite these changes, it is still thought that the stated figures are underestimates.

Another source of underestimation of the amount of materials collected is that there are many scavengers working at the tipface and it was difficult to ensure that all of them passed the weighing station on their exit from the tipface. There are many other small paths leading away from the tipface which they can follow.

1,000 tonnes of spoilt maize had been dumped at the disposal site approximately a week before the survey was conducted. Some scavengers were collecting some of the maize during the survey period and 106.5 kg of husks collected on the second day consisted of maize. Hence the husks figure may be higher than normal.

In conclusion, the two day period is considered to be too short to be able to obtain representative data. If this survey is performed again, it should be conducted over a longer period of time and a number of modifications should be made to the methodology based on experience gained from the present survey.

However, the average amounts of different items collected from the disposal site can be used as a lower limit on the amounts of waste materials that are collected daily. These average amounts for different items are compared with the results from the SIS and MIS surveys in annex 8.

9.8 Scavenger Interview Survey at Other Places

There are many other places around the city where scavengers may collect materials for recycling. These include:

- scavenging of materials from waste disposal pits and waste dumped outside in residential areas;
- scavenging of materials from waste collection points;
- scavenging from illegal dumps.

During the selection of sampling points for WACS and during the illegal dumping survey, efforts were made to locate scavengers and to interview them where possible.

Only one scavenger was interviewed collecting materials from waste dumped outside. This was in the central city area. Another scavenger was found collecting materials from a point where Multinet collects waste in the central city area and interviewed. At various times, other scavengers were seen scavenging from waste heaps outside in different parts of the city, especially the higher income areas, and also from Multinet collection

points but they were not interviewed. Questioning of residents during WACS also confirmed that such scavengers are common.

However, the highest proportion of scavenging outside of the Vingunguti disposal site takes place at illegal dump sites around the city. 11 scavengers were found and interviewed at various illegal dump sites: Jangwani 1 and 2 on Morogoro Road, along Rashid Kawawa Rd, Gerezani Rd, Mwananyamala, Buguruni and Mbagala Kizinga. Residents living near these illegal dump sites stated that most scavenging takes place early in the morning with scavengers searching for recyclable items that have been dumped during the night. However, scavengers can be seen at these points at most times during the day.

9.8.1 Results

The results of the interviews with these 13 scavengers are presented in section 9.9.1, summarised below and illustrated in Figure 9-11- Figure 9-16:

1. all thirteen scavengers interviewed were male
2. scavenging was the only job for seven of them. Three have another job and three were teenagers who should be at school (Figure 9-11).
3. twelve work for themselves. The remaining scavenger is one of the teenagers who works for his mother.
4. this type of scavenging seems to be more of a part-time activity than at Vingunguti with seven scavengers working less than 10 days per month and four less than 4 hours per day. This is consistent with three of the scavengers being teenagers and three having other jobs. (Figure 9-12 and Figure 9-13).
5. eight (>60%) have been doing this work for less than 3 years (Figure 9-14).
6. the income range is higher than that of the scavengers at Vingunguti. Seven people have an income of over 20,000/- per month and the average income is 27,800/- (Figure 9-15). (Note: one did not state their income)
7. there is a large demand for most of the items sorted.
8. twelve of the scavengers sell the sorted materials to 6 different places (Figure 9-16). Three sell to individuals on a "whoever passes by" basis; three sell solely to middlemen (scrap metal, paper); one sells to both middlemen and small workshops (scrap metal), two sell solely to small workshops (e.g. DASICO, SIDO), one sells paper directly to Kibo paper factory; one sells wood for cooking purposes to women running market canteens and one sells glass bottles to a shop which fills them with oil and then sells them. The thirteenth scavenger uses the cans/tins collected himself to make small kerosene lamps. This situation is quite different to Vingunguti where most of the sorted material is sold to middlemen nearby.
9. The most common materials collected are cans and tins, glass bottles, paper (boxes) and other metals. Wood is also collected in reasonable amounts but surprisingly, only one person stated that they collect plastic bottles. The results of the interviews would suggest that small quantities of cereal/rice husks, food leftovers, paint, sacks, sawdust, textiles and tyres are collected by scavengers.

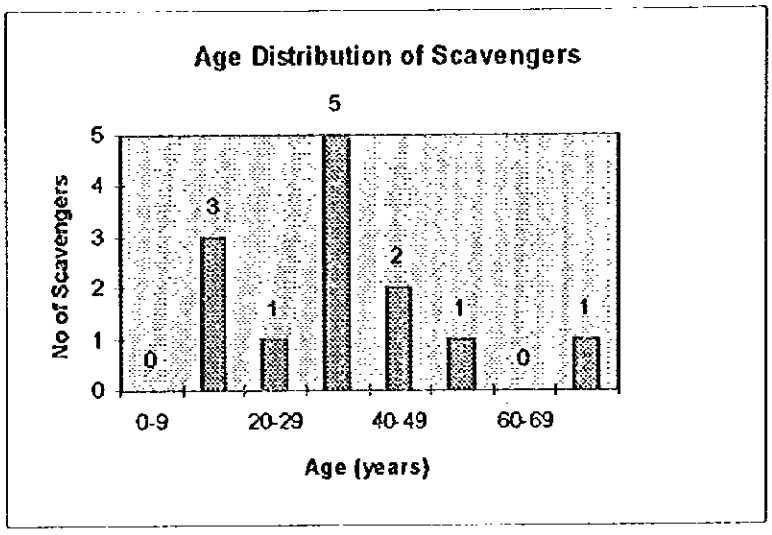


Figure 9-11: Age Distribution of Scavengers working outside of Vingunguti Disposal Site

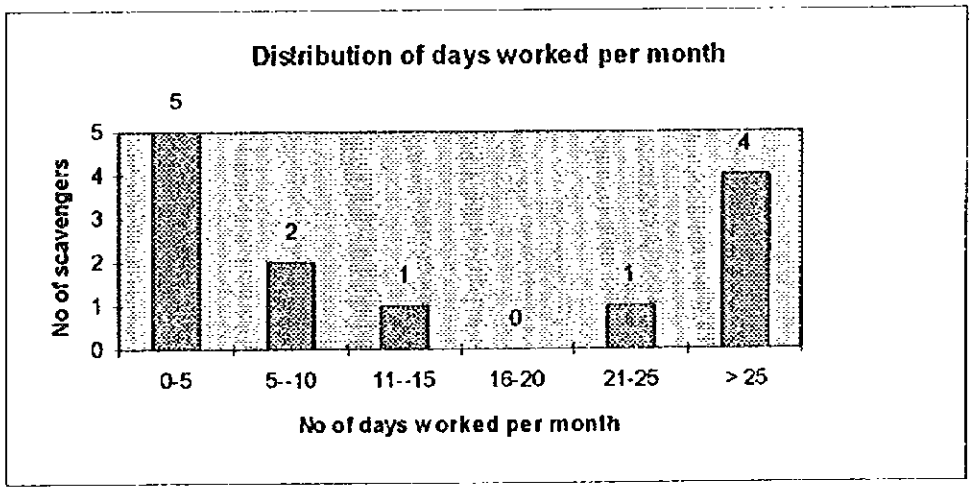


Figure 9-12: Distribution in Working days per Month for Scavengers working outside of Vingunguti Disposal Site

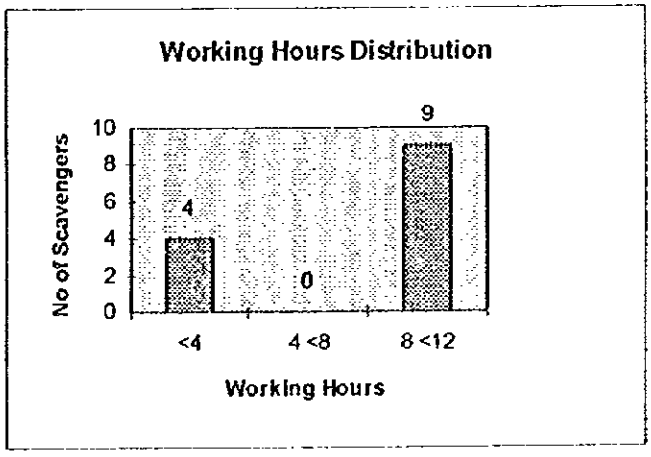


Figure 9-13: Distribution in Working Hours for Scavengers working outside of Vingunguti Disposal Site

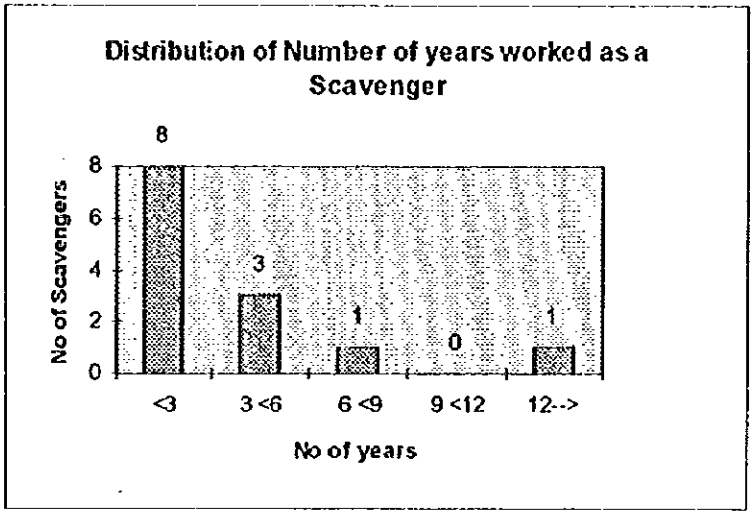


Figure 9-14: Distribution in Number of Years Work as a Scavenger, for Scavengers outside of Vingunguti Disposal Site

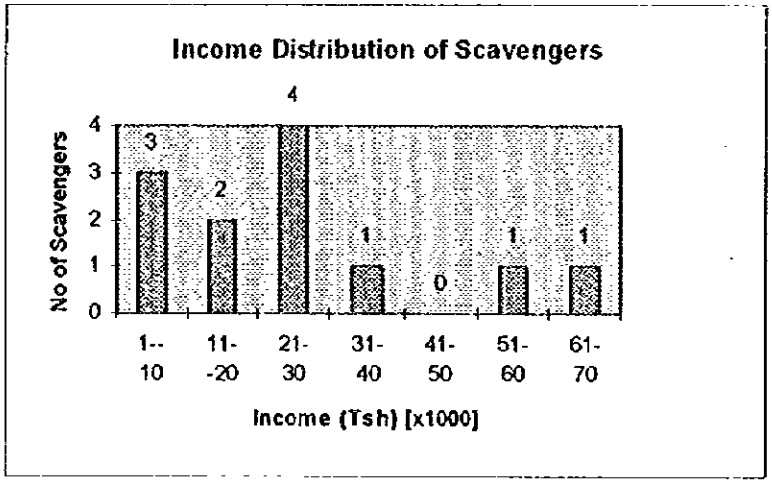


Figure 9-15: Income Distribution for Scavengers Operating outside of Vingunguti Disposal Site

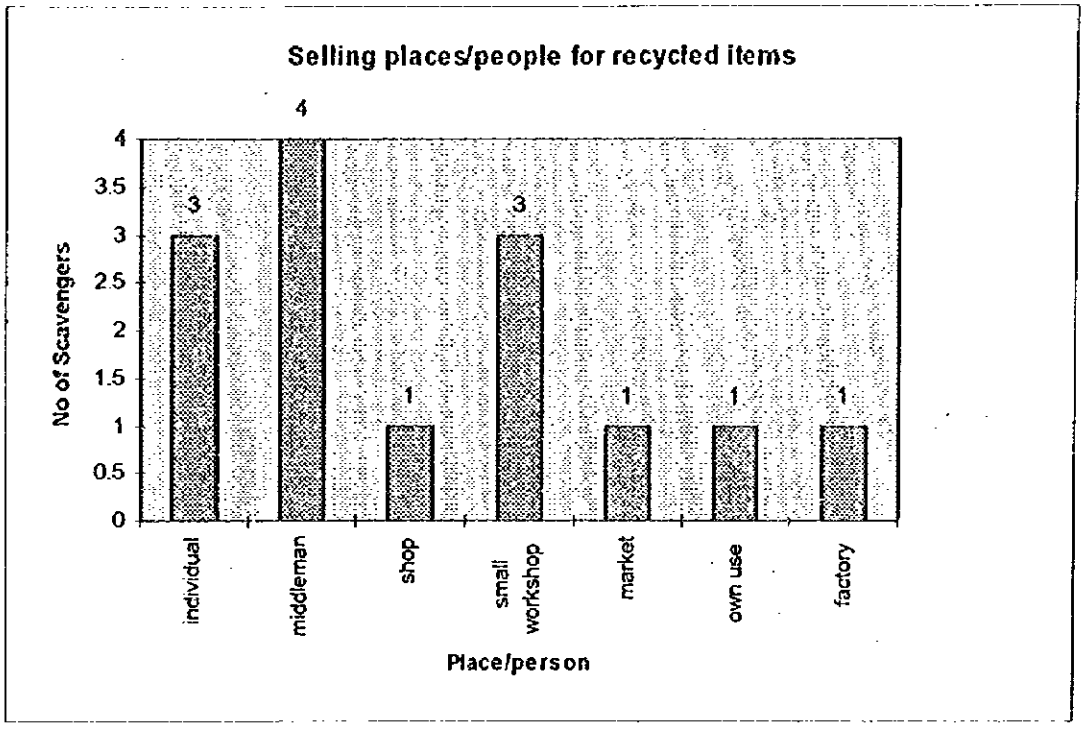


Figure 9-16: Selling Places of Items collected by Scavengers working outside of Vingunguti Disposal Site

9.8.2 Quantities Collected and Selling Prices

The quantities collected and selling prices of different items are tabulated below, together with the number of scavengers collecting each item and quoting each price.

Table 9-11: Collected Quantities of different items and selling prices at various places in DSM outside of Vingunguti Disposal Site

Material	Collected Quantities		Selling price	No. of scavengers quoting this price	Vingunguti prices
	No. of scavengers collecting item	kg			
glass bottles	4	25	10-25/- ea. 10/- per kg	2 1	10/- ea.
cans and tins	5	48	10/- ea. (small) 30/- ea. (paint) 25-30/- ea. 80/- per kg 250-300/- per kg	1 1 1 1 1 (large tins)	3/- ea.
cereal/rice husks	1	6	167/- per kg	1	20/- per kg
other metal	2	410	20/- per kg	1	10/- per kg
paper (boxes)	4	217	15/- per kg 40-50/- per box	1 2	15/- per kg
plastic bottles	1	1	20-25/- ea.	2	3-10/- ea.
sacks	1	3	50-70/- ea.	1	50/- ea.
wood	1	2	----	----	----
Total		712			

As with the Vingunguti data, the same provisos apply concerning income and quantities of materials collected by the scavengers. The daily amount of collected items per scavenger is 54.8 kg/person/d. The total amounts of different items collected by scavengers are not used to estimate the total amounts of waste recycled for different materials in this case as the sample size is too small and the total number of scavengers operating at different places throughout the city is not known.

There is much more variation in selling prices offered than at Vingunguti (also included in the table for comparison) and hence those prices quoted by one person only should be treated with caution. Generally, prices are higher than those at Vingunguti.

9.8.3 Problems faced by Scavengers

The common problems experienced by these scavengers are summarised in Table 9-12.

Table 9-12: Problems faced by Scavengers

Description of Problem	No. of Scavengers affected
Lack of suitable materials for recycling	3
Lack of equipment (gloves, etc.)	2
Walking long distances	2
Feeling ashamed	2
Risk of injury	1
Lack of market for paper	1
Walking long distances pushing a handcart	1
Lack of market if people realise materials for sale originate from dumps	1
Competition	1

9.9 Detailed Survey Data

9.9.1 Scavenger Interview Survey (SIS)

The SIS questionnaire is shown below and the results are presented in Table 9-13 and Table 9-14 for scavengers at Vingunguti and other places respectively.

Scavenger Questionnaire

Q-1. What is your sex?

a) Male b) Female

Q-2. How old are you?

a) 0 - 9 b) 10 - 19 c) 20 - 29
d) 30 - 39 e) 40 - 49 f) 50 - 59
g) 60 - 69 h) 70 or more

Q-3. How many years have you been a scavenger?

a) less than 3 years. b) 3 years or more but less than 6 years.
c) 6 years or more but less than 9 years. d) 9 years or more but less than 12 years.
e) 12 years or more.

Q-4. How many jobs do you have?

a) scavenging only. b) scavenging and other jobs.
If you answered "yes" to (b), what are the other jobs that you do?

Q-5. How many days per month do you work as a scavenger?

a) 0 - 5 days. b) 6 - 10 days. c) 11- 15 days.
d) 16 - 20 days. e) 21 - 25 days. f) more than 25 days.

Q-6. How many hours per day do you work as a scavenger?

a) less than 4 hours. b) 4 hours or more but less than 8.
c) 8 hours or more but less than 12. d) 12 hours or more but less than 16.
e) 16 hours or more but less than 20. f) 20 hours or more.

Q-7. What are your normal working hours per week?

Q-8. Who do you work for:

a) yourself. b) another person. c) cooperative.
d) company. e) other (specify).

Q-9. How much do you earn per month as a scavenger?

Q-10a. How many kg of each of the following types of materials do you sell each day?

Q-10b. What is the selling price of these different types of materials?

Item	Amount Sold (kg/d)	Selling price (Tsh/kg)
bo: glass bottles		
ct: cans/tins		
fo: food leftovers		
hu: cereal/rice husks		
me: other metals		
pa paper (boxes)		
pl: plastic		
pt: paint		
sa: sacks		
te: textiles (rags, sponge, etc.)		
wm: wire mesh		
wo: wood		
other (specify)		

Q-11. Is the price of sorted material stable? Yes/No/Don't know

Q-12. Is the demand for sorted material limited? Yes/No/Don't know

Item	Stable Price	Limited Demand
bo: glass bottles		
ct: cans/tins		
fo: food leftovers		
hu: cereal/rice husks		
me: other metals		
pa: paper (boxes)		
pl: plastic		
pt: paint		
sa: sacks		
te: textiles (rags, sponge, etc.)		
wm: wire mesh		
wo: wood		
other (specify)		

Q-13. Where and to whom do you sell the sorted materials?

Buyer	Yes/No	Where?
a) Residents		
b) Middleman		
c) Market Trader		
d) Recycling factory		
e) Producer		
f) Other (specify)		

Q-14. Please describe problems concerning scavenging work if you have any.

Table 9-13: Vingunguti Scavenger Interview Survey Results

Name	Sex	Age	No of years work	No of jobs	days per month	Hours per day	Hours of work	work for?	income per month	Estimated Qty. of Items Collected										sta-ble price	dem-and	Sell to:	Sell at:	No. of prob.
										bo kg	ct kg	hu kg	me kg	pa kg	pl kg	pt kg	sa kg	ty kg	wo kg					
Abdala Ally	M	20-29	6 <9	1	> 25	8 <12	0800-1800	self	8,000	2	5		1	28			4			Y	L	Mid	V	0
Abdala Athumani	M	30-39	3 <6	1	> 25	12 <16	—	self	10,000		4			40			3			Y	L	Mid	var	6
Ally Ally	M	20-29	9 <12	1	> 25	8 <12	0800-1830	self	22,000		3			45	3		2			Y	L	Mid	V	3
Ally Mohamed	M	40-49	9 <12	1	> 25	8 <12	0800-1700	self	10,000				5			4		10		Y	L	Mid	V	2
Athuman Kassim	M	30-39	12 ->	1	> 25	8 <12	0715-1740	self	5,000	3	3		2	70	2		3		3	Y	L	Mid	V	3
Fabian Hevod	M	40-49	12 ->	1	> 25	8 <12	0800-1730	self	15,000		3		1				2			Y	L	Mid	V	0
Flora Njau	F	20-29	<3	1	> 25	4 <8	0800-1430	self	5,000					20						Y	L	Mid	V	1
Halfan Zege	M	30-39	6 <9	1	> 25	8 <12	0800-1630	self	20,000	3	4			50	2		2			Y	L	Mid	V	1
Hamisi Ramadhani	M	20-29	6 <9	1	> 25	8 <12	0700-1740	self	10,000	2	3		5	20			7			Y	L	Mid	V	2
Heziron Paulo	M	20-29	<3	1	> 25	8 <12	0730-1800	self	12,000		3			15	2		3		3	Y	L	Mid	V	3
Juma Hussein	M	20-29	9 <12	1	> 25	8 <12	0800-1730	self	10,000	3	5		3	20	2		5		5	Y	L	Mid	V	3
Jumanne Athumani	M	30-39	12 ->	1	> 25	8 <12	0700-1800	self	15,000	3	2		2	5	1		3			Y	L	Mid	V	3
Latifa Mfaume	F	10--19	<3	1	> 25	8 <12	0730-1700	self	6,000		10				6		4			Y	L	Mid	V	1
Mkomwa Abdala	M	40-49	6 <9	1	> 25	8 <12	0800-1700	self	10,000	4				7			2		3	Y	L	Mid	V	2
Mohamed Maupa	M	20-29	9 <12	1	> 25	8 <12	0720-1750	self	7,000	3	4		7	30						Y	L	Mid	V	4
Omary Hamisi	M	20-29	9 <12	1	> 25	12 <16	0700-1850	self	20,000	2	2		4	30	3		2		2	Y	L	Mid	V	4
Omary Shabani	M	30-39	3 <6	1	> 25	8 <12	0700-1830	self	18,000	3	2		5	30						Y	L	Mid	V	0
Rajabu Kondo	M	20-29	9 <12	1	> 25	8 <12	0800-1800	self	9,000	2	2		3	40	1		2			Y	L	Mid	V	1
Ramadhan Ally	M	20-29	9 <12	1	> 25	8 <12	0730-1800	self	10,000	4	6			40	2		3		6	Y	L	Mid	V	3
Robert Salehe	M	30-39	9 <12	1	> 25	8 <12	0800-1800	self	10,000	3	2		4	30	2		3		6	Y	L	Mid	V	3
Said Mohamed	M	20-29	3 <6	1	> 25	8 <12	0700-1740	self	10,000	2	5		6	50	4		4			Y	L	Mid	V	2
Said Omary	M	50-59	9 <12	1	> 25	8 <12	0700-1800	self	10,000		1		10	50			10			Y	L	Mid	V	3
Said Omary	M	30-39	12 ->	1	> 25	8 <12	0700-1740	self	10,000	3	1			30	2		3		10	Y	L	Mid	V	2
Seleman Halfani	M	30-39	12 ->	1	> 25	8 <12	0800-1800	self	10,000	3	4			20	3		5		4	Y	L	Mid	V	2
Sultani Salum	M	40-49	9 <12	1	> 25	8 <12	0700-1800	self	7,000				7	10			3			Y	L	Mid	V	2
Yahaya Abdala	M	30-39	9 <12	1	> 25	8 <12	0700-1730	self	15,000	3	2		5	70	2		3		6	Y	L	Mid	V	3
Zena Mohamed	F	30-39	3 <6	1	> 25	8 <12	—	self	15,000		10				3		2			Y	L	Mid	V,C	2
									Total	58	88	200	108	837	41	4	84	10	98					

Notes: 1) bo = glass bottle; ct = cans/tins; hu = cereal/rice husks;
me = other metal; pa = paper(boxes); pl = plastic bottles; pt = paint; sa = sacks; ty = tyres; wo = wooden materials
2) C = city centre; F = female; L = large; M = male; Mb = Mbezi; Mid = middleman; prob. = problem; var = various; Y = Yes

Table 9-14: Scavenger Interview Survey Results (other places)

Loc-ation	Sex	Age	yrs of work	No of jobs	days per month	Hours per day	Hours of work	work for?	income per month	Estimated Quantities of Items Collected											stable	demand	Sell to:	Sell at:	no. of prob.	note
										bo kg	ct kg	fo kg	hu kg	me kg	pa kg	pl kg	sa kg	wm kg	wo kg	oth kg						
RK	M	10--19	<3	1	5--10	8 <12	0700-1600	self	30,000					400							y	l	mi/w	ka	1	*1
Ja1	M	10--19	<3	1	0-5	< 4	1330-1700	oth	20,000				6								y	l	i	ma	1	*2
Ja1	M	30-39	3 <6	1	> 25	8 <12	0900-1800	self	70,000						140-210						y	l	mi	mt	0	*3
Ja1	M	30-39	<3	1	0-5	8 <12	0600-1800	self	35,000		20-30										y	l	w	ge	0	*4
Ja1	M	50-59	>12	1	> 25	8 <12	0700-1830	self	25,000					y					y	y	y	l	mi	vi	0	*5
Ja2	M	20-29	<3	1	0-5	8 <12	0800-1800	self	28,000	2.8											y	l	s	bu	1	*6
Ger	M	40-49	3 <6	1	> 25	8 <12	0700-1800	self	60,000		10--15								2		y	l	m	ge	2	*7
MK	M	> 70	<3	1	> 25	8 <12	1000-1730	self	unstated	0.8	1.2					0.6				y	y	s	i	mb	1	*8
MK	M	30-39	<3	2	0-5	8 <12	0700-1800	self	20,000						33						y	m	f	vi	1	*9
CC	M	40-49	3 <6	1	21-25	8 <12	0600-1600	self	<10,000		0.9	s			6					y	y	s/m	i	a	4	*10
CC	M	30-39	6 <9	2	11--15	<4	any time	self	10,000	0.8-1.6				10	3		3	0.5			y	m	w	ge	3	*11
Bu	M	10--19	<3	1	0-5	<4	1000-1200	self	1,000	20											y	m	mi	bu	1	*12
Mw	M	30-39	<3	2	5--10	<4	not stated	self	25,000		5.5-10										y	l	o	—	0	*13
									TOTAL	24.4-25.2	38-57		6	410	182-252	0.6	3	0.5	2						

Key: 1) Location: RK=Rashid Kawawa Rd; Ja=Jangwani; Ger=Gerezani Rd; MK=Mbagala Kizinga; CC=city centre; Bu=Buguruni; Mw=Mwananyamai
2) Sex: M=male; F=female
3) Items: bo=glass bottle; ct=cans/tins; fo=food leftovers; hu=cereal/rice husks; me=other metal; pa=paper(boxes); pl=plastic; sa=sacks; wm=wire mesh; wo=wooden materials; oth=other
4) Stable price: y=yes 5) Demand: l=large; m=medium; s=small 6) Selling place(sell to): f =factory; i=individual; mi=middleman; m=market; o=other; s=shop; w=small workshop
7) Selling place(sell at): a=any; ka=Kariakoo, ma=Makuti, mb=Mbagala, mt=Mtoni, vi=Vingunguti

Notes: *1 is young boy still at school so usually scavenges waste during the weekends only (8 days/month).
*2 is young boy who said he scavenges only on Sat and works for his mother. Stated income suggests he works >5 days/month.
*3 stated income of 15,000-20,000/wk; sells to middleman at Mtoni who sells to Kibo Paper Factory.
*4 stated income of 30,000-40,000 per month is inconsistent with 0-5 days work per month.
*5 has been scavenging since 1961; visits various sites collecting items himself(Ja, Vi, CC) & some youths doing other work at these sites (e.g. cutting stones) also collect items for him - he pays them for each item; the price depending upon the item's quality (approx. 100-200/- ea.); he sells these items to Scrap dealers at Vetinary (approx. 50-100% markup); quantities of collected items variable - not estimated; oth=textiles & paint.
*6 bottles are sold to shop owners who use them as containers for oil which is sold.
*7 collected wood is sold to small canteens for firewood.
*8 second job is selling cassava (part-time);other = tyres; demand for all items is small (very small for tyres); sells to individuals who pass by.
*9 second job is a tradesman at SIDO; he sells paper to Kibo Paper factory.
*10 starts work early to avoid being seen by relatives and to find the best items; others = nails and skins; the demand for fo, pa, nails and skins is small and for metals medium. He sells the items he collects to individuals anywhere.
*11 second job is splitting concrete; income ranges from 5,000-15,000/month from scavenging; me is sold at Relwe, Gerezani.
*12 student; also collects from Ja1 and Vi dumps.
*13 uses tins collected himself to make little kerosene lamps.

9.9.2 Middleman Interview Survey (MIS)

The MIS questionnaire is shown below and the results are presented in Table 9-15.

Middleman Questionnaire

1. What is your sex?

a) male b) female.

2. How old are you?

a) 0 - 9 b) 10 - 19 c) 20 - 29
d) 30 - 39 e) 40 - 49 f) 50 - 59
g) 60 - 69 h) 70 or more

3. How many years have you been doing this work?

a) less than 3 years b) 3 years or more but less than 6 years
c) 6 years or more but less than 9 years d) 9 years or more but less than 12 years
e) 12 years or more

4. How many jobs do you have?

a) middleman only b) middleman and other (specify)

5. How many days per month do you work as a middleman?

a) 0 - 5 days b) 6 - 10 days c) 11 - 15 days
d) 16 - 20 days e) 21 - 25 days f) 25 days or more

6. How many hours per day do you work as a middleman?

a) less than 4 hours b) 4 hours or more but less than 8
c) 8 hours or more but less than 12 d) 12 hours or more but less than 16
e) 16 hours or more but less than 20 f) 20 hours or more

7. What are your normal working hours per week?

8. Who do you work for?

a) yourself b) another person
c) a cooperative d) a company
e) another (specify)

If you work for a cooperative or company what is its name and how many employees does it have?

9. How much do you earn per month as a middleman?

10. How do you collect the recycled materials?

a) from scavengers at disposal sites b) from household recyclable materials collectors
c) from waste collectors d) from houses
e) from shops, hotels, offices, etc. f) from others (specify)

11. What equipment do you use? (e.g. dump truck, dryer, grinder, etc.).

12. In which area(s) do you work?

a) Vingunguti dump
b) in residential areas of the city (specify)
c) in the central city area
d) other (specify)

13. What materials do you collect?

a) glass bottles
b) cans/tins
c) food leftovers
d) other glass
e) other metals
f) paper (boxes)
g) plastic
h) sacks
i) wood
j) other (specify)

14. Do you do anything with the materials which you collect before sale to another party? e.g. washing, cleaning, sorting

15. Who do you sell these recycled materials to?

a) residents
b) hawkers/petty traders
c) retail shops
d) recycling factories
e) producers
f) other (specify)

16. Fill in the table below with your answers to the following questions:

a. What quantity do you collect of each of the materials per week (or month)?
b. What price (per unit) do you pay for each of the materials you buy?
c. What price do you sell each of the materials for?
d. Is the price of recycled material stable?
e. Is there a steady demand for these recycled materials?

Item	Quantity	Price (per unit)		Stable?	Steady Demand?
	units/time	Buy	Sell	Yes/No	Yes/No
bo: glass bottles					
ct: cans/tins					
fo: food leftovers					
gl: other glass					
pa: paper (boxes)					
pl: plastic					
sa: sacks					
wo: wood					
other (specify)					

17. Please describe any problems concerning the work of a middleman if you have any?

Table 9-15: Vingunguti Middlemen Interview Survey Results

Name	Sex	Age	yrs of work	no of jobs	days per month	hrs per day	work for?	income per month	source of items	Tools used	Pl.	Estimated Quantities of Items Collected									proc ess ing	sell at:	st ab le	de ma nd	no of prob	note
												bo kg	ct kg	fo kg	me kg	pa kg	pl kg	sa kg	wo kg	oth kg						
B.Mkude	M	50-59	12->	2	> 25	8--12	self	65,000	h,s,w	m,v,w	Vi			67	33-67	191					s	f,o	y	l	0	*1
G.Shayo	F	30-39	<3	1	0--5	8--12	self	15,000	s		Vi					191					s	f	--	--	0	*2
G.Mbando	M	20-29	3 <6	2	>25	8--12	self	30,000	s,w	h,w	Vi		71		71-142						s	w	y	l	2	*3
H.Mnsho	M	40-49	<3	1	> 25	8--12	self	20,000	s	h	Vi	?	19-29		10		3.1	7.3	10		c,s	i,s	y	l/m	1	*4
J.Zuberi	M	30-39	<3	1	11--15	8--12	self	15,000	s	h	Vi								72-108			s	--	--	2	*5
M.Mkude	F	30-39	6 <9	1	16--20	8--12	self	20,000	s	v	Vi					191					s	f	y	l	1	*6
M.Mbaruku	M	20-29	<3	1	0--5	8--12	self	20,000	s	v	Vi					191					s	f	y	l	0	*6
P.Ntani	F	30-39	<3	1	0--5	8--12	self	15,000	s	v	Vi					143					s	f	--	l	1	*6
S.Mbamba	M	60-69	12->	1	>25	8--12	self	40,000	s	v,w	Vi		2		100-133					33	s	f	y	l	1	*7
Y.Chuma	M	40-49	<3	1	0--5	8--12	self	20,000	s	v	Vi				67	191					s	f	y	l/m	0	*8
Z.Mbegu	F	40-49	<3	2	0--5	8--12	self	40,000	s	v	Vi					143					s	f	y	l	1	*9
unknown							self		s	v	Vi					191					s	f				*10
unknown							self		s	v	Vi					191					s	f				*10
										Total			92-102	67	281-419	1432	3.1	7.3	82-108	33						

Notes: 1) Sources of Items: h = houses; r = restaurants/hotels; s = scavengers; w = dump truck workers
2) Tools used: h = handcart; m = milling machine; v = vehicle; w = workers (according to need)
3) Items Collected: bo=glass bottles; ct=cans/tins; fo=food leftovers; me=other metal; pa=paper(boxes); pl=plastics; sa=sacks; wo=wood; oth=other
4) Pl. = work location: Vi = Vingunguti 5) Stable price (stable): y =yes 6) Demand: l = large; m = medium 7) Processing (process): c =clean; s = sort
8) number of problems = no of prob 9) Selling place (sell at):f = factories; i = individuals; o = own use; s = small workshops; w = warehouses

*1 second job is livestock (chicken, goat, pig) raising; one in group of 9 paper middlemen who cooperate for paper collection; food leftovers are ground and fed to livestock; metal to factories like M.M. Integrated Steel Mills.
*2 one of group of 9 co-operating paper middlemen
*3 student at UDSM; works > 25 days/month when not at UDSM; most of collected aluminium is in the form of cans; sells the iron/aluminium scraps to a trader who stores them in a godown before sale to various factories.
*4 works together with relative; sa & wo are sold to nearby residents (used for toilet/shower cubical walls & firewood respectively); ct, me & pl are sold to small workshops; there is a large demand for ct; medium for me & pl
*5 wood is sold to furniture workshops
*6 one of group of 9 co-operating paper middlemen
*7 materials sold to Steelcast & M.M. Integrated Steel Mills; is licensed scrap dealer with 2 shops (Kigogo, Vingunguti); other = car batteries
*8 one of group of 9 co-operating paper middlemen; there is a large demand for pa; medium for me
*9 one of group of 9 co-operating paper middlemen; second job is selling food
*10 not interviewed but in group of 9 co-operating paper middlemen - amounts of paper collected by them will be the same as other group members

Annex 10

Recycling Survey

10 Recycling Survey

This section deals with the survey on the recycling system in DSM. It is divided into five parts: the first gives a breakdown of each type of waste generated; the second deals with the recycling of all types of waste items at source (i.e. generation); the third briefly summarises recycling that occurs at other points of the waste stream (discharge, illegal dumping, final disposal); the fourth estimates the total amounts of the major waste items recycled at source and by scavenging while the fifth describes the recycling system for the main items recycled and suggests some measures that could be taken to assist recycling in each case.

The objectives of this work were:

- to understand the present recycling system including recent trends and problems;
- to enable the impact of the Master Plan on recycling to be forecast;
- to suggest some measures which could be taken to improve recycling.

The following comments apply to the recycling system in general:

- the recycling system is complex as there are a large number of individuals, businesses, organisations, industries, etc. involved in recycling but there is no formal body or organisation coordinating these activities in the city, apart from some small scale initiatives and contacts between the different parties involved.
- this description is mainly qualitative, giving a general idea of the main waste items recycled, the different parties involved and how the system works.

10.1 Breakdown of Waste Generated by Type

An approximate breakdown of the waste generated was estimated using WACS composition data by calculating an overall weighted average waste composition and hence obtaining generation amounts for each type of waste as shown in Table 10-1.

Table 10-1: Breakdown of Waste Generated by Type

Discharge Source	Waste (t/d)	kitchen waste	paper	textile	plastic	grass/ wood	leather/ rubber	metal	glass	ceram/ stone	other	total
H'hold(avg.)	1416.3	0.4203	0.0312	0.0120	0.0218	0.2530	0.0083	0.0197	0.0353	0.0035	0.1944	1.00
Restaurant	13.7	0.9339	0.0187	0.0120	0.0171	0.0076	0.0000	0.0047	0.0058	0.0001	0.0000	1.00
Hotel	1.6	0.0921	0.7145	0.0258	0.0608	0.0092	0.0000	0.0405	0.0331	0.0074	0.0166	1.00
Other	12	0.0076	0.7157	0.0254	0.0838	0.0152	0.0051	0.0533	0.0000	0.0051	0.0888	1.00
Institution	10.7	0.0921	0.7145	0.0258	0.0608	0.0092	0.0000	0.0405	0.0331	0.0074	0.0166	1.00
Market	33.9	0.5955	0.0318	0.0050	0.0085	0.2718	0.0000	0.0006	0.0025	0.0022	0.0821	1.00
St. sweep	1.3	0.2301	0.1753	0.0125	0.0640	0.1897	0.0236	0.0246	0.0101	0.0091	0.2610	1.00
Inf. Sect.	282.7	0.5955	0.0318	0.0050	0.0085	0.2718	0.0000	0.0006	0.0025	0.0022	0.0821	1.00
Avg. comp.	1772.2	0.4503	0.0407	0.0110	0.0201	0.2511	0.0071	0.0165	0.0290	0.0033	0.1709	1.00
Gen. amt.		798.1	72.1	19.4	35.7	445.0	12.6	29.3	51.4	5.9	302.9	1772.2

Note: 1) Institutional and market composition data is used for hotel and informal sector waste respectively.
2) H'hold = household; St. sweep = street sweeping; Inf. Sect. = Informal Sector; ceram = ceramic; Avg. comp. = average composition; gen. amt. = generation amount

These generation amounts give an estimate of the maximum amount of different types of waste produced by WACS sources that could be recycled. Practically, not all waste produced for any one type will be suitable for recycling. Furthermore, this analysis does not consider the large amounts of waste produced by other sources outside the scope of this study which are recycled.

10.2 Recycling at Source

Recycling at source has been split into two groups; namely:

- internal recycling: the reuse/recycling of waste within the premises of the source;
- external recycling: donation/sale of recyclable waste items outside of the sources' premises to individual collectors, shops, etc.

The methodology and results are presented below.

10.2.1 Methodology

Two methods were used to identify the recycling collection system for waste items directly from generation sources:

- Disposal Interview Survey (DIS): Representatives of each of the WACS sampling points were asked whether they recycle any waste items internally and/or externally. Discussions were also held with Tanzanian colleagues about recycling practices. A further 14 commercial enterprises (shops, offices, restaurants) and 1 institution/office in the city centre that were not WACS sampling points were also included in this Survey in order to obtain more representative data.
- Interview Survey: any door-to-door collectors of waste items located as well as scavengers, middlemen and representatives of small and large industries involved in recycling were interviewed about their collection methods and sources of raw materials.

10.2.2 Internal Recycling Results

The practice of reuse/recycling of items within the home is very common throughout Dar es Salaam and Tanzania in general. Some examples are given below:

- empty glass bottles are washed and reused to store oil, honey, etc.;
- empty plastic bottles are washed and used for storing drinking water in;
- newspapers are used for wrapping items, covering school exercise books and lighting fires;
- food waste is fed to livestock or used, together with garden waste, to make compost;
- empty cooking oil and paint tins are used for pot plant containers;
- old tyres are used to mark property boundaries and to prevent cars parking on private property;
- people take plastic and paper bags with them to the market to put their shopping in.

Of these practices, only the amount of garden waste composted could be estimated using POS results, giving a figure of 74.1 t/d.

The majority of waste generators in other generation categories do not practice internal recycling on a significant scale. However, some internal recycling does occur as the following examples illustrate:

- reuse of paper and boxes by offices, institutions and commercial enterprises;
- composting of garden waste from institutions and hotels with large gardens and from public gardens.

Internal recycling within factories is briefly discussed where relevant in section 1.4.

10.2.3 External Recycling Results

10.2.3.1Households

The amount estimated to be externally recycled from households was 39.9 t/d. 17 of the 60 households surveyed (28%) regularly give away items for recycling which is consistent with the POS results where 31% of household interviewees stated they give away/sell waste items for recycling. Another 7 households have seen door-to door collectors of recyclable waste items operating in their areas but do not give/sell items to them. 22 of these 24 households are in urban and semi-urban areas, suggesting that very few collectors are working in rural areas.

The main items requested are glass bottles, newspapers, magazines, aluminium and steel tins which is also consistent with POS results[1] . The majority of households sell these items with only 5 of the 17 households giving them away. Selling prices vary considerably. Newspapers/magazines are sold for 100-500/- per kg. Most newspapers are subsequently sold by the collectors to market traders and informal sector operators for wrapping goods in. Magazines in good condition may be sold second hand. Soda and beer bottles are sold at 25/- and 50/- per bottle respectively while the smaller cosmetics/medicine bottles can fetch up to 300/- per bottle[2]. Large 3 l tins can fetch 300/- each.

Most of the collectors are male youths, who call 1-2 times per month on average.

10.2.3.2Commercial Enterprises and Institutions

4 of the commercial enterprises and 2 of the restaurants surveyed carry out some external recycling as described in Table 10-2 below. The former mainly recycle paper/boxes while the latter recycle some food waste, bottles, cans/tins.

[1] Table 8-6 of annex 8 summarises the POS recycling results and shows that the percentage of households recycling different items decreases in the order: bottle (glass and plastic), aluminium can, paper, steel tin, metal, glass, plastic, etc.

[2] Several people stated that this high price is because these bottles are used to put fake perfume in and sold to unsuspecting customers at very high prices.

Table 10-2: External Recycling from Commercial Enterprises and Institutions

Type of Establishment	No. of samples	No. giving /selling to collectors	Waste Items Collected	Comments
clothing/ footwear	2	1	boxes, plastic bags, clothes hangers	- includes 1 WACS sampling point
electrical goods	2	0		- includes 1 WACS sampling point
hardware	1	0		- includes 1 WACS sampling point
household items	1	1	boxes	- men with handcarts pass every morning to collect boxes
offices/ institutions	6	0		- includes 5 WACS sampling points - most of these use paper on both sides before disposal
pharmaceutical	2	0		
printing (small scale)	3	0	paper	- includes 1 WACS sampling point - 1 used to sell waste paper to Kibo Paper (DSM) but stopped some time ago due to delays in payment and irregular collection frequency
soft drinks/ alcohol	1	1	bottles, boxes	the owner takes bottles and boxes at the end of each week for recycling
restaurant	5	2	bottles, cans/tins, food	- all 5 were WACS sampling points - people collect bottles/cans/tins from 1 restaurant; another gives away 10-15 kg/d of leftover food to people who collect it for livestock feed
secretarial/ copying	3	0		
stationery/ books	3	1	books, boxes, files, paper	Once annually, these waste items are sold to Kibo Paper (DSM) at 100-200/- per kg
wholesale	1	0		- includes 1 WACS sampling point
TOTAL	30	6		

10.2.3.3Markets

Some market waste is recycled. At Kariakoo and Tandika markets, some grasses and cabbage leaves are taken for cattle feed while at Kisutu market, chicken droppings are taken at no cost by individuals for use as fertiliser. At Kivukoni Ferry market, offal from the fish gutting process is collected, washed, dried and sold for chicken/pig food. However, in terms of the total amount of market waste, the percentage recycled is negligible.

10.2.3.4Door-to-door Collectors[3]

Only two door-to-door collectors were located during this survey. Both were male and collect paper from printing businesses in the Gerezani area on a full-time basis. They each collected relatively small amounts of paper (8-15 kg/d). One sold it to market traders (Kariakoo, Temeke and Tandika markets) for wrapping goods in while the other sold it to middlemen at Tandika, Temeke and Kivukoni Ferry.

The results of interviews with scavengers, middlemen, micro-industries and large industries involved in recycling are discussed in section 9.4.

[3] A door-to-door collector is someone who collects/buys waste items from the generation source before discharge whereas a scavenger is someone who collects items for recycling after discharge, collection or at illegal dumping sites or the final disposal site.

10.3 Recycling at other points of the Waste Stream

10.3.1 Discharge

The recycling waste amount at discharge was estimated to be 3.1 t/d (see annex 8). Although there are many scavengers involved in collecting recyclable materials from discharge points, only two of these were interviewed. The main items collected are likely to be the same as at other places (i.e. cans/tins, other metals, bottles and paper).

10.3.2 Illegal Dump Sites

It was estimated that 10.1 t/d of recyclable materials (see annex 8) are collected from illegal dump sites by the many scavengers that frequent these sites. The most common items collected are cans/tins, glass bottles, paper (boxes) and other metals. Wood is also collected in reasonable amounts. Scavengers dispose of these items in a large number of ways including:

- sale to individuals on a "whoever passes by" basis;
- sale to shops (e.g. glass bottles), market operators (e.g. paper for wrapping goods in, firewood to market canteens) and middlemen (e.g. scrap metal and paper);
- sale to micro-industries (e.g. scrap metal and tins to DASICO);
- sale to large industries (e.g. paper to Kibo Paper ,DSM);
- own use to make small kerosene lamps for sale.

10.3.3 Vingunguti Disposal Site

It was estimated that 2.1 t/d of recyclable materials is collected at Vingunguti (see annex 8) and at least 90% of the scavengers working at Vingunguti sell their collected items to middlemen in the area. The other 10% of scavengers sell the collected items to individuals at Vingunguti or to individuals/middlemen at other places or use them to make things. The main materials collected by scavengers and sold to middlemen are cans/tins, paper (boxes); glass/plastic bottles, metal, sacks, and wood. Other items collected in reasonable amounts include food leftovers and cereal husks while small amounts of plastic sheets, paint, textiles, broken glass, tyres and wire mesh are collected.

10.4 Amounts of Major Waste Items Recycled at Source and by Scavenging

The amounts of the major waste items recycled at source and by scavenging were estimated as follows:

- from generation sources: using POS data for the amounts and different types of waste recycled at source (households, commercial (restaurant and other)) - see annex 8.
- by scavenging: using the measured recycled waste amount at the final disposal site (2.1 t/d) and estimated recycling amounts at discharge (3.1 t/d) and illegal dump sites (10.1 t/d). It was assumed that the composition of the recycled waste at these points was the same and equal to the composition data determined at the final disposal site,

shown in Table 8-15 of annex 8. Hence, the total scavenging recycled waste amount of 15.3 t/d was converted to amounts of major waste items recycled using this composition data.

These results are shown in Table 10-3.

Table 10-3: Recycling Breakdown by Major Waste Items

Unit: t/d

Waste Stream Component	pa	me	bo	wo	fo	ga	oth	Total
Generation:								
Household	1.30	4.17	15.37	2.29	12.36	78.15	0.37	114.01
Restaurants	0.00	0.02	0.02	0.00	0.92	0.00	0.00	0.96
Commercial Others	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20
Scavenging at discharge, illegal dumps and final disposal site	7.93	2.80	0.96	1.28	0.32	0.00	2.02	15.31
Total	**9.43**	**6.99**	**16.35**	**3.57**	**13.60**	**78.15**	**2.39**	**130.48**
%	**7.2**	**5.4**	**12.5**	**2.7**	**10.4**	**59.9**	**1.8**	**99.9**

Note: 1) pa = paper, me = metal (cans/tins and other), bo = glass and plastic bottle, wo = wood, fo = kitchen waste, ga = garden waste, oth = other
2) other includes cereal husks, paint, sacks, textiles, tyres, plastic and glass (not bottles)

10.5 Recycling System for Different Waste Items

The main uses and users of different waste items recycled are summarised in Table 10-4. Only the recycling system for the major items recycled is described in the following sections.

Table 10-4: Uses of Recycled Waste Items

Item	End Use	User
Broken Glass	- reprocessed into bottles/jars - to make security glass barrier on top of concrete walls around premises	- industries (broken bottles only) - bricklayers/construction companies
Metal (cans, tins, etc.)	- reprocessed into billets, ingots, etc. - to make household and other items - to make toys and decorations - cans/tins used for potting plants	- industries - individuals, micro-industries - individuals - residents
Cereals/ Husks	- animal feed	- livestock owners
Drums (50 gal.)	- water barrels - as property boundary markers - storage and transportation of goods	- individuals - individuals, hospitals, schools, etc. - shops, traders, etc.
Food leftovers	- recooked and eaten - animal feed	- scavengers - livestock owners
Glass bottles	- reused	- individuals, shops, petty traders, markets, manufacturers (soft drinks, beer, sauces, etc.)
Paper (sheets, boxes, etc.)	- reprocessed into paper products - to make paper bags - wrapping goods in - printing bus tickets (paper used on 1 side)	- industries - markets, petty traders, micro-industries - markets, petty traders - micro-industries
Paint	- remixed and sold as new paint	- individuals
Plastic bottles	- reuse - making toys, decorations	- individuals, markets, petty traders, shops, etc. - individuals
Plastic sheets	- covering, roofing, wall material	- individuals, petty traders, markets
Sacks	- covering, roofing, wall material - repaired and reused	- individuals, petty traders, markets - individuals, charcoal vendors
Sawdust	- ground cover for animals	- livestock owners
Textiles	- to make cushions, pillows, mattresses	- individuals, micro-industries
Tyres	- to make bushes, sandals, bike brakes - as property boundary markers	- micro-industries - individuals, offices, etc.
Wire mesh	- to make mosquito netting, etc.	- individuals
Wood	- firewood - carpentry/construction	- individuals, canteens - individuals, tradesmen

10.5.1 Methodology

Interviews were conducted with the following groups involved in recycling at different stages of the recycling system:

- generation sources;
- scavengers and middlemen;
- micro-industries and large industries (factories) using recycled materials.

10.5.2 Different Waste Items

10.5.2.1Paper

In this context, paper refers to all types and grades of paper including cardboard, newsprint, magazines, boxes, books and shredded paper.

The amount of paper waste produced by the generation sources in this study is estimated to be 72.1 t/d. (2,160 t/month) in Table 10-1. This does not include large but

unquantified amounts of paper waste generated by manufacturing industries, especially commercial printers, which constitute the bulk of the paper collected by middlemen as explained below. The paper recycling system is illustrated in Figure 10-1 and is explained below.

a. Collectors

The amount of paper waste recycled from households is estimated to be 1.30 t/d (see annex 8). Newspapers and magazines are the main paper items collected from households by waste item collectors. Most newspapers are subsequently sold by the collectors to market operators and petty traders who use them to wrap goods in.

Some commercial enterprises, especially shops, recycle paper/boxes externally and it is estimated that 0.2 t/d is recycled in this way (see annex 8). Collectors regularly come to collect these items from some enterprises with the waste paper/boxes being sold to middlemen, market operators and petty traders. In other cases the waste paper is sold directly to Kibo Paper mill in DSM. However, this factory is slow to make payments and the frequency of paper collection is irregular which has caused some shops to discontinue this practice.

b. Scavengers

Most scavengers collect paper from Vingunguti disposal site or other illegal dumping sites around DSM while a few also collect paper after discharge, especially where there is a waste collection point. The collected waste paper is generally sold to middlemen, but some is also sold directly to Kibo Paper Mill in DSM.

For example, scavengers at Vingunguti disposal site sell at least 90% of the paper collected, which is almost entirely boxes, to middlemen based in the Vingunguti area. 4 of the scavengers interviewed at illegal dumps also collect paper with 3 of these selling the paper to middlemen while the fourth sells it directly to Kibo Paper Mill (DSM).

c. Middlemen

The paper recycling operations of various middlemen interviewed are summarised in Table 10-4. This table shows that the paper middlemen interviewed collect about 300-430 t/month, depending on the season and market condition. If an allowance of 20% is made to account for other middlemen not interviewed, the total collected will be 360-520 t/month.

4 large scale middlemen were located who deal with paper (No. 1-4 in the table). The main source of paper for three of these are commercial printing companies in DSM and it is estimated that 60-70% of the total paper collected by these 3 comes from this source. Offices and shops are their secondary sources of paper/boxes. Two of these also collect paper from individuals, who may themselves be smaller scale middlemen. One collects approximately 15% of his paper from the scavengers at Vingunguti, a much smaller amount of paper from the illegal dumping site at Jangwani 1 and some shredded paper from banks. The fourth operation is a collection depot for the Kibo Paper Mill in Moshi. They use many middlemen who collect paper for them.

All of these operations employ a minimum of 5 workers, usually on a casual basis. These workers are involved in the collection of waste paper and/or sorting, baling and storage operations prior to transportation to the paper factories supplied by the middlemen. 3 of

them stated that the paper supply is very large and far exceeds the demand which varies seasonally. During the wet season, demand is low as the moisture content of the paper is increased. Conversely, demand is high during the dry season.

There are at least another 6 small scale paper middlemen operating in DSM who collect approximately 8 t/month of paper (No. 5 in the table).

There is a group of 9 middlemen (No. 6 in the table) who cooperate for the collection of paper from Vingunguti disposal site. Each middleman then arranges storage, transportation and sale of their paper themselves either to Kibo Paper in DSM or to the Kibo Moshi depot. It is estimated that these middlemen collect an average of 1.1 t/d.

In many markets, there are stalls which buy and resell newspapers, magazines, computing paper, etc. to other market operators and for wrapping goods in. The scale of these middlemen operations is very small relative to the above.

d. Micro-Industries

Details concerning the two paper micro-industries located are given in Table 10-6. These micro-industries make paper bags from cement, milk powder and sugar sacks. One industry is supplied by individuals with these paper sacks; the other collects the paper sacks themselves. In both cases, cement sacks are collected from building sites; milk powder sacks from a milk powder factory and sugar sacks from the Coca-Cola factory in DSM. The second industry also collects a small amount of computer paper from offices in the city for bag manufacture.

Each cement sack (and presumably the other sacks) has 4 layers. These layers are carefully removed and then used to make bags/envelopes of various sizes. Typically 8-12 A4 size bags can be obtained from 1 cement sack. A large amount of paper cutting and trimmings is produced from this operation which is sold to Kibo Paper (DSM) at 20/- Tsh per kg.

Both are long established micro-industries and the interviewees claimed they had worked at each place for about 40 yrs. Most workers work on a full-time basis. The main problems encountered by these enterprises were:

- competition with plastic bags (first micro-industry);
- scarcity of raw materials (sacks) and lack of capital (second micro-industry).

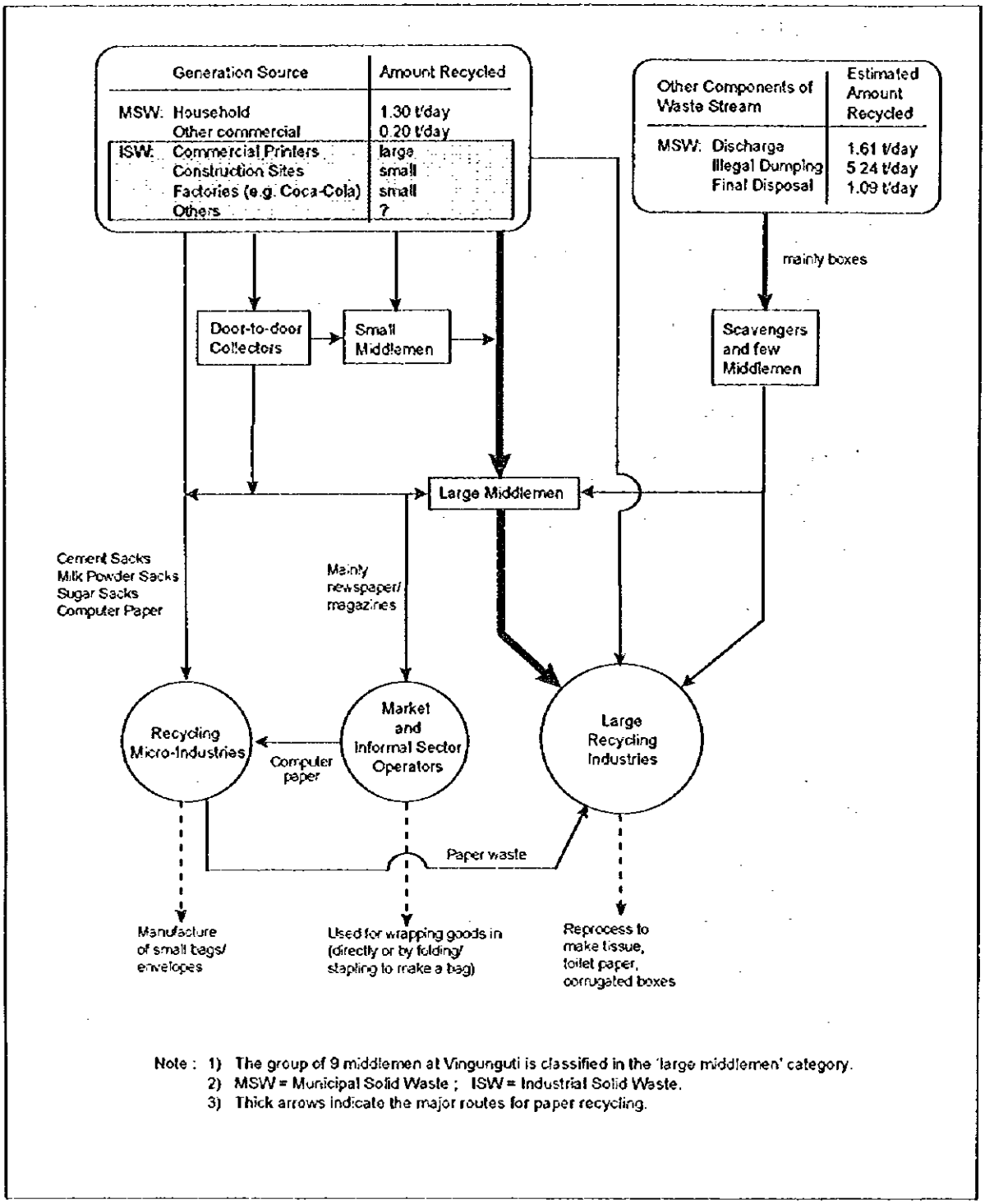


Figure 10-1: The Paper Recycling System in DSM

Table 10-5: Operations of Paper Middlemen

Name	Location	No of Workers	Collected Items	Source	Buying price (Tsh/kg)	Amount (t/month)	Supply	Demand	Customer
1. Mrs Lwabatuza	2 depots; 1 near Selander Bridge; 1 next to Fazal & Co., Chang'ombe Rd	> 5	all types of paper and boxes	commercial printers (main source), offices, shops	10-20/-; but given away by some sources	seasonal; dry: 20-30 wet: 0-5	very large	seasonal; dry: high wet: low	Kibo Paper, Tanpak, Kibo Moshi, Chandaria Ind., Kamongo Ind.
2. Agent for Kibo Moshi	collection depot opposite police station in Buguruni	> 5	kraft waste paper	middlemen	usual: 30/- rarely: 40/-	160	usually sufficient	seasonal; dry: high wet: low	Kibo Moshi
3. Maginga Investments	at home behind Maryland centre, Mwenge	10 (casual)	paper (white, brown)	commercial printers, shops, middlemen, offices	15-30/-	20-40	very large	stable	Kibo Paper, Tanpak, Kibo Moshi, Chandaria Paper, Kamongo Waste Paper Co.
4. Mr Otieno	2 depots; 1 in Vingunguti off Nyerere Rd; 1 near Congo bar, Jangwani	> 20	paper (white, brown, coloured, shredded), cardboard, boxes	commercial printers (60%), scavengers (15%), factories, individuals, banks	25/- (if demand is low, it may drop to 5/-)	variable; now: 30-40; high - 120	very large	highly variable due to lack of stable market	Kibo Paper, Kibo Moshi, Tanpak, industries in Kenya
5.Mr Richard; Jakob; Issac; Roco; Davy; Mashaka	unknown; all small scale paper middle-men based in DSM[4]	?	paper	?	?	8 for each one[1]	?	?	?
6. Group of 9 middlemen at Vingunguti	near Vingunguti Disposal site	> 10	paper (mainly boxes)	scavengers at Vingunguti disposal site	15/-	33[5]	depends on disposed waste;~1-2 t/d	variable	Kibo Paper, Kibo Moshi
TOTAL						min: 296 max: 431			

Table 10-6: Operations of Paper Micro-industries

Name	Location	No of Work-ers	Buying Price (Tsh/unit)	Amount of sacks/bags bought per week	Demand for sacks/ bags	Supply of sacks/ bags	Amount of bags sold per week	Sale Price (Tsh/ bag)	Customer	Demand for bags
1. ---	Dasico, Gerezani	40	sack: 30-40 ea.	8,000-12,000	stable	sufficient	60,000-80,000[1]	20	individuals, markets, shops	medium
2. UMIDA ("Paper Makers of DSM")	near Tanz. Tea Blenders off Gerezani Rd	17	sack: 40 ea.; comp.: 500/kg	sack: 1,950 comp.: 50kg	unstable	insufficie nt	sack: 4,000 comp.: 10,000	sack: 15 comp.: 3	markets, shops, supermarkets	large

[1] The amounts stated seem very large relative to the second industry but the interviewee was confident that these figures were correct.

[4] Source: Mr Otieno

[5] 33 t/month is based on the figure of 1.086 t/d in Section 3.3.1g of IT/R

c. Large Industries

The main large industries and estimated waste paper demands are shown in Table 10-7.

Table 10-7 Estimated Demand for Waste Paper by Large Industries

Industry	Demand (t/month)	
	current	peak
Kibo Paper, DSM	70-100	200
Tanpak Industries, DSM	small	450
Kibo Paper, Moshi	160	> 160
Chandaria Industries, Nairobi	unknown	unknown
Kamongo Industries, Nairobi	unknown	unknown
TOTAL	**230-260 (minimum)**	**810 (minimum)**

Kibo Paper is a government owned factory which currently uses waste paper as its only source of pulp. 80-85% of the paper used is corrugated boxes and 10% is sack kraft paper which is used to manufacture fluting board and test liner board from which corrugated boxes are made. The remaining 5-10% of waste paper used is stationery which is made into core paper. Trims and sheet breaks (about 1-2% of production) from the paper making process are internally recycled.

Middlemen provide them with about 80% of their waste paper, with shops and other businesses providing the remaining 20%. Presently, they collect about 70-100 t/month but when the factory is operating at peak production, the quantity collected can be as high as 200 t/month. Their production rates fluctuate significantly and hence so too does their demand for paper. Reasons for this include reliance on public utility suppliers (TANESCO and NUWA) for electricity and water[6] and cash flow problems.

The yield of paper products from the waste paper raw material is about 90%. Hence, 10 tonnes of waste paper, costing a maximum of 550,000/- to purchase (including transportation costs) will produce about 9 tonnes of paper which is sold at 392,000/- per tonne. Hence, the use of waste paper as a raw material is extremely profitable provided production costs can be minimised (labour, electricity, water, etc.).

Tanpak Industries, owned by the Kenyan company, Chandaria Industries, is a newly established factory and production only started in mid-1996. They use assorted waste paper (white and brown) to make tissue and toilet paper. 100% waste paper is used to make low quality tissue paper while for higher quality tissue, the waste paper is mixed with imported pulp. Current production rates are low as the factory is still being commissioned but when it is in full production, they expect to collect 15 t/day of waste paper for processing. All waste from the factory is dumped. Buying prices and sources of supply for waste paper were not stated.

Some information was also obtained from the DSM depot concerning the Kibo Pulp and Paper Board Mill in Moshi (Kibo Moshi). An average of 160 t/month of waste paper is collected in DSM and transported to the mill in Moshi for reprocessing but it is not known what percentage this constitutes of the total waste paper used at the mill. Offcuts and rejects from the manufacturing process are recycled within the mill.

The buying prices of paper by different factories are shown in Table 10-8.

[6] They did sink 3 boreholes several years ago to achieve some independence from the NUWA supply but only one of these is still operating efficiently.

Table 10-8: Prices paid by Large Paper Industries

Industry Name	Location	Item	Price (Tsh per kg)	Transport provided by Industry
Kibo Paper	DSM	corrugated box sack kraft paper assorted paper	25[1,5] 30[1,4,5] - 40[5] 10[5] - 15[1,5]	No
Tanpak Industries Ltd.	DSM	assorted paper	50[1,3]-100[3]	No
Kibo Pulp and Paper Board Mill	Moshi	all	30[2,4] - 50[1,5] (at DSM depot) 70[4] (at mill)	Yes No
Chandaria Paper Industries	Nairobi, Kenya	other assorted paper newsprint bright white paper	60[4,5] (in Kenya) 90[1] 120[1] 180[1]	No

Note: 1) source: [1] = Mrs. Lwabutaza; [2] = Kibo Moshi depot in DSM; [3] = Maginga Investments; [4] = Mr. Otieno; [5] = Kibo Paper (DSM)
2) Kenyan prices are stated in Tsh based on an exchange rate of 10 Tsh = 1 Ksh.
3) transport cost to Moshi and Nairobi is 60,000/- and 1.2 million Tsh respectively for a 25-30 tonne truck and trailer.

f. Discussion

Comparison of the amounts of waste paper produced (2,160 t/month from WACS generation sources as well as large quantities from commercial printers, etc.), collected by middlemen (360-520 t/month) and estimated industrial demand (810 t/month at peak production, not counting Kenyan industries) shows that there is potential for expansion of paper recycling if the industries using waste paper in Moshi and Nairobi are included. However, if the comparison is limited to DSM, the potential for expansion is small and depends heavily upon the growth in Tanpak's demand.

However, this analysis is somewhat simplistic as it does not take into account the composition of the paper waste (by type/nature) nor the different types of paper each industry uses as raw materials. Furthermore, paper recycling faces some major problems, as described below.

The first major problem is that the demand for waste paper by reprocessing industries is not stable and is subject to considerable variation. For example, in June-July 1996, all of the middlemen interviewed had large stockpiles of waste paper, primarily because most of the large industries using recycled paper were not buying paper. The status of each industry at that time is summarised below:

- Kibo Paper: using about 2 t/d of waste paper compared with peak capacity of 6.7 t/d and has cash flow problems. Many middlemen are still awaiting payment for sales of paper to Kibo made in early 1996.
- Kibo Moshi: they have a large paper stockpile and are not operating due to power problems.
- Tanpak: currently not buying paper; reasons unknown.
- Kenyan Industries: status unknown.

A second major problem is that paper transportation costs to substantial markets in Moshi and Nairobi are prohibitively high, especially in the latter case, discouraging middlemen from selling paper to these sources.

Furthermore, a 30 tonne truck can presently only be filled with 15-20 tonnes of baled paper before its volume capacity is completely utilised. However, if appropriate

equipment was available and the paper could be compressed when baled, virtually the entire 30 tonne capacity could be utilised, making the long distance transportation of paper to Moshi and Nairobi much more profitable.

Possible solutions to these problems include:

- construction of a new industry which would use waste paper as a raw material (e.g. processing of paper into cellulose, manufacture of egg cartons);
- investment in the present paper industries and/or public utilities in Tanzania to improve their performance;
- provision of a number of vehicles that would be available for hire at lower rates than the market rates specifically for use for transporting recycled materials. The lower hire rates can be justified as recycling is reducing the final disposal load and thus disposal costs. These vehicles could be available for transport of paper to Moshi or Kenya.
- provision of at least one compressing baling machine on a rental basis to paper middlemen. Some handcarts could also be made available on a similar basis to assist in the collection of paper from around the city.
- establishment of a recycling fund[7] which people engaged in recycling enterprises could apply to for assistance (grants, low interest loans, etc.).

It is believed that the paper recycling industry could be improved by better co-ordination of paper recycling activities, especially if any of these solutions were to be implemented or expansion was to be considered. The extent of co-operation between the paper middlemen was not evaluated in this survey although they seem to know of each other's existence and some do cooperate to a limited extent such as the group at Vinguguti for paper collection. Of course, being in competition with each other, they may not be very willing to cooperate. Any further investigation should include an assessment of the extent of cooperation and willingness for cooperation amongst paper middlemen.

10.5.2.2Metal

In this context, metal refers to all types of metal including aluminium cans[8], metal tins, iron sheets, vehicle bodies, drums, etc. The amount of metal waste produced by generation sources is estimated to be 29.3 t/d (879 t/month) in Table 10-1, not including large but significant amounts of metal waste obtained from garages (mainly vehicle bodies) and manufacturing/industrial sources (e.g. TRC, THA). The metal recycling system is illustrated in Figure 10-2 and explained below.

a. Collectors

The amount of metal waste (mainly aluminium cans and metal tins) collected from households is estimated to be 4.2 t/d (see annex 8). Most cans/tins are subsequently sold to middlemen or to metalwork micro-industries. A small amount of cans/tins is also obtained from restaurants (estimated to be < 0.2% of restaurant waste).

[7] Before such a fund is established, full investigation of current sources of funding for recycling initiatives within DSM should be made.
[8] only beer is produced in aluminium cans in Tanzania; soft drinks are bottled.

b. Scavengers

Scavengers collect metal from Vingunguti disposal site, illegal dumping sites and after discharge. The collected metal waste is mainly cans/tins and some metal pieces and most of it is sold to middlemen although some is sold to metalwork micro-industries, especially at DASICO or used by scavengers themselves to make items for sale (lamps, stoves, etc.).

c. Middlemen

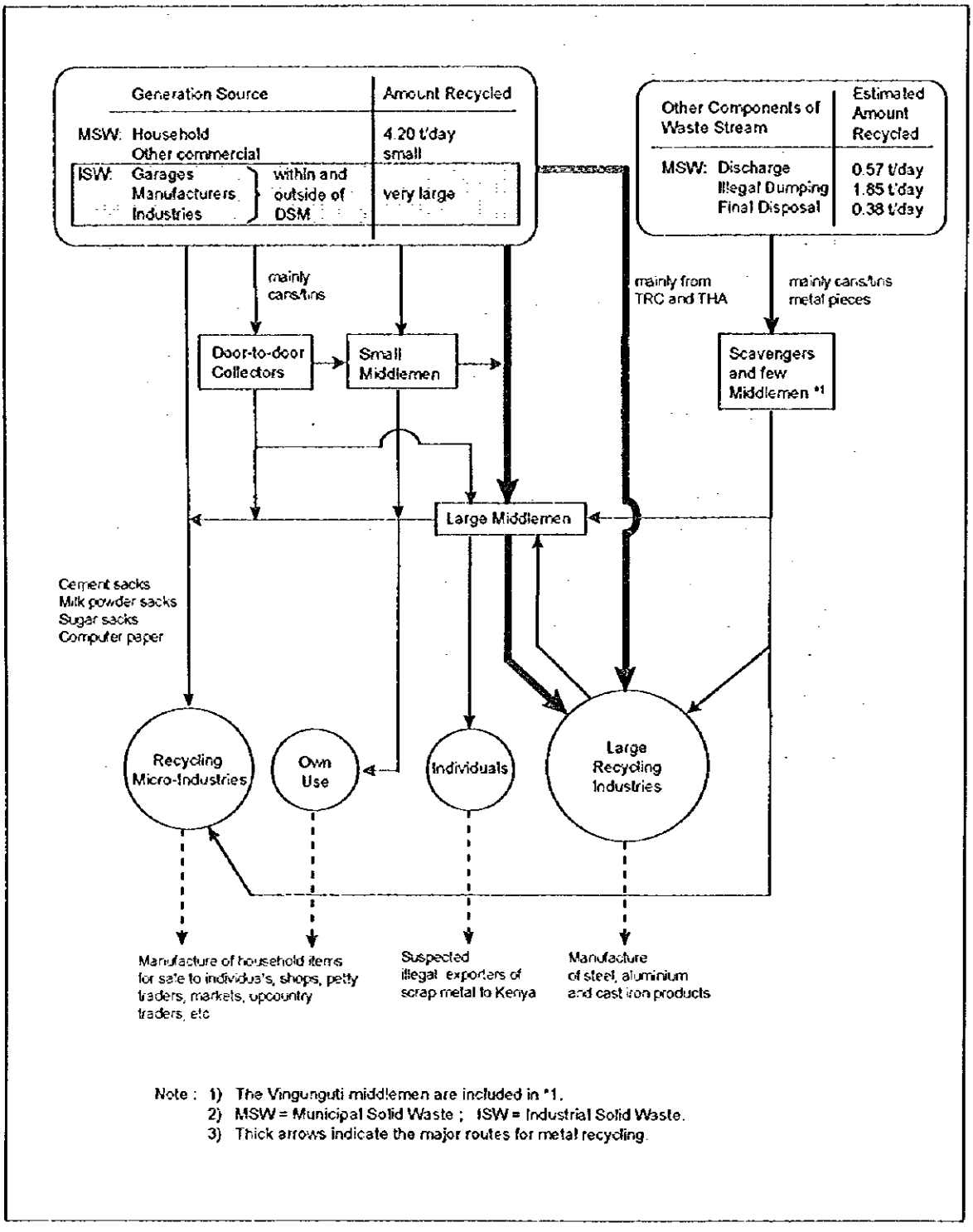
The recycling operations of four metal middlemen are summarised in Table 10-9. The main source of raw materials in each case is steel and aluminium factories in DSM and in other regions of Tanzania. Smaller amounts of scrap are collected directly from source (restaurants, hotels, etc.) or sold to them by collectors and scavengers.

The Mandela Group gives members first priority on the use of scrap metals. The remaining scrap is mainly sold to ALAF while smaller amounts are sold to factories in Mikocheni. The net profit for the entire group from their scrap metal trading activities is approximately 160,000/- per month.

The second cooperative has been operating for a longer period and conducts several activities including carpentry, milling, handcart manufacture using scrap metal and scrap metal trading. The scrap metal business only provides a small proportion of their total income. In the past they resold scrap metals to businesses who exported them to Kenya but the export of scrap metals is now illegal. Currently, they sell scrap to some individuals[9] and also to factories in Mikocheni.

The third group is relatively new and only collects scrap metals by themselves for resale to individuals and factories in DSM. The middlemen at Vingunguti are small dealers in scrap metals and sell them to large middlemen, micro-industries and factories.

[9] However, exporting of scrap metals is still continuing via illegal ('panya') routes. It is suspected that these individuals may be involved in this trade.



Note : 1) The Vingunguti middlemen are included in *1.
2) MSW = Municipal Solid Waste ; ISW = Industrial Solid Waste.
3) Thick arrows indicate the major routes for metal recycling.

Figure 10-2: The Metal Recycling System in DSM

The common problems experienced by these middlemen are listed below.

Problem	No. of middlemen affected (Total no. = 4)
Lack of stable market	3
Lack of scrap metals	2
Lack of capital	2
Large tax increases since 1995	2
Lack of transport	1
Unsatisfactory selling price	1

There are also a number of market operators who buy and resell tins. They are acting as middlemen as discussed further in section 10.5.2.3 (b).

d. Micro-Industries

There are a large number of metalwork micro-industries[10] located throughout DSM, including many using metal waste as raw materials, especially tins and to a lesser extent: drums, iron sheets and car bodies. The results of interviews with representatives from a cross-section of these industries are tabulated in Table 10-10.

Five of these micro-industries produce small kerosene lamps ('vibatari' in swahili) from tins by cutting, shaping, joining and soldering. This appears to be the most common item made by these micro-industries. The tins are obtained by collectors and micro-industry workers from many sources, especially hotels and restaurants but also by scavengers from Vinguguti disposal site and other illegal dumping places. The lamps are very popular for use in households without electricity and also in small street-side restaurants and stalls after dusk.

Most of the other micro-industries interviewed use iron sheets, old/wrecked car bodies, drums and tins to manufacture other products, especially charcoal stoves and some household items such as funnels, sieves, pourers ('kata') and cooking utensils. One micro-industry also makes barbecue grills and 'woks'[11]. Good quality scrap metal sheets (e.g. packaging materials) are obtained by collectors, middlemen and micro-industry workers from factories such as ALAF, Carnaud Metalbox, and IPP. Most of the household items are made from these sheets as they can be easily worked into many shapes and have a smooth finish. Drums, old iron sheets and car bodies are typically used for items not requiring a smooth finish such as woks.

These products are sold in DSM to individuals, kiosks, shops, markets, etc. and in bulk to traders from upcountry. For example, a market operator at Manzese market buys and resells recycled metal items including pourers, sieves, pot holders and funnels. Collectors and middlemen bring these items to him, having bought them from micro-industries in the Gerezani area. Demand for these items is generally low but steady.

All of these micro-industries sell their products at their workplace. The problems faced by them are listed below.

[10] Most of these micro-industries only have male workers although one all women group near the Mwananyamala DCC depot was located.

[11] 'makarai ya ujenzi' in swahili - these are used by labourers for carrying sand and cement on construction sites.

Problem	No. of micro-industries affected (Total no. = 8)
Lack of raw materials (scrap, solder, etc.)	3
Lack of proper tools	2
Lack of capital	2
High cost of raw materials and tools	2
Lack of market	1
Lack of transport	1
Inadequate night security	1
Risk of injury due to sharp objects	1

It is appropriate to describe the activities of DASICO (DSM Small Industries Co-op Society Ltd.) here. DASICO is an organisation of many micro-industries based in the Gerezani area and has about 400 members as well as many trainees. Its activities are divided into 5 sections: carpentry, metalwork (manufacture of charcoal stoves, kerosene lamps, kitchen utensils, etc.), carving, welding/mechanical and paper bag manufacturing. The metalwork and paper sections use predominantly recycled items as raw materials in their work. The paper section has previously been discussed in section 10.5.2.1 (d) and two craftsmen from the metalwork section were interviewed (see Table 10-10).

Each craftsman in the metalwork section is responsible for the procurement of their own raw materials. Approximately 25% of craftsmen use tins in their work and either collect them themselves or buy them from collectors or scavengers. The main sources of tins are hotels, restaurants and dumping sites. This section is a major user of tins in DSM and a major producer of associated recycled products.

e. Large Industries

The operations of large metal recycling industries are summarised in Table 10-11.

There are three major steel mills in DSM: Steelcast (part of ALAF), M.M. Integrated Steel Mills Ltd. and Iron and Steel Ltd. The main sources of scrap metal are dumped/abandoned/wrecked vehicles, railway rolling stock (TRC) and sea vessels (THA). These materials are collected from garages, THA, TRC and other sources within DSM and also upcountry, usually being transported to these factories by middlemen in the latter case. The price of mild steel scrap offered by these companies varies from 25-50 Tsh/kg depending on the condition (i.e. rusting, etc.) and grade (light, commercial, heavy). Significant quantities of slag and other waste materials (e.g. casting sand, used refractories) are produced by each company and these are used by the company itself or given away for road filling, land reclamation and site levelling purposes.

Table 10-9: Operations of Metal Middlemen

Details	Source of recycled items	Collected Items	Buying price (Tsh/unit)	Selling Price (Tsh/unit)	Qty collected (t/month)	Supply & Demand	Uses of recycled items
1) Name: Mandela Group Workers: 29 Location: Vetinary, Nelson Mandela Rd Yrs of operation: 3	Al/steel factories (50%) in DSM	rejected sheets, rods, etc.	?	?	30	S: insuff. D: medium	- use by members. e.g. to make and sell wheelbarrows - sale of scrap metal to ALAF & factories in Mikocheni & individuals
	small companies (30%) in DSM						
	* J.J. Industries -	metal shavings	16-17/kg[1]	25/kg			
	* Gogi Industries -	rejected iron sheets	2,500 ea.	3,000 ea.			
	-	rejected plate sheets	13,000 ea.	18,000 ea.			
	* Remangi Industries -	rejected iron mesh	230 ea.	500 ea.			
	scavengers (20%)	mainly scrap steel	?	?			
2) Name: UWKMVU[2] Workers: 95 Location: Nelson Mandela Rd Yrs of Operation: 9	factories (> 65% - mainly iron/steel); collectors, shops, hotels, scavengers, offices; mainly from DSM but also other regions	scrap metal (iron, steel)	10/kg	15/kg	10-15 70% iron/ steel	S: insuff. D: large	- use by members. e.g. to make handcarts - sale of scrap metal to individuals and factories in DSM
		aluminium (cans, etc.)	80/kg	120/kg	20% Al		
		copper wire	300/kg	400/kg	10% Cu		
3) Name: Bondeni Youth Group Workers: 7 Location: along Mandela Rd Yrs of operation: 4	collect themselves from Al/steel industries in: DSM, Tanga, Morogoro and Tabora	scrap metal (mainly iron/steel) - pipes, roundbars, angle and channel sections	17.5/kg	25-26/kg	0.64-0.85	S: insuff. D: medium	- sale of scrap metals to individuals and factories in DSM
4) Middlemen at Vingunguti No.: 5	almost entirely from scavengers at Vingunguti	mainly cans/tins and some metal pieces	me: 10/kg Al: 150-200 /kg	me: 15-25 /kg Al: 200-250 /kg	me: 7.3 Al: 4.2[3]	S: suffic. D: medium	- sale to scrap dealers, small industries, factories

Note: 1) Abbreviations: insuff. = insufficient; Al = aluminium, Cu = copper, me = metal; yrs = years

2) [1] includes transport cost of 4-5 Tsh/kg; [2] UWKMVU = Umoja wa Wauza Kuni/Mikokoteni na Vifaa vya Ujenzi (Co-operative of Salesmen of Firewood, Handcarts and Construction Materials); [3] The amounts for Al and me are obtained from the tabulated amounts of different items recycled at Vingunguti in Section 3.2.1g by multiplying the daily amounts by 30 to get t/month.

Table 10-10: Operations of Metalwork Micro-industries

Name (No. of workers), Location (yrs of work)[1]	Collection and Purchase of Items					Production and Sale of Items				Waste Disposal
	Item	Qty/ week	Price/ item (Tsh)	Supply & Demand	Collection	Products	Qty/ week	Price/ item (Tsh)	Customers and demand for products	
1) — (5), Bug market (>1)	tins	300	5	S: suffic. D: stable	themselves; mainly from nearby/CC hotels	lamps	300	40 R	indiv.; D: large	by handcart
2) — (3), Dasico (14)	tins	1,000	20	S: some shortages D: stable	indiv. (sometimes themselves if shortage) : from Kar/CC hotels	lamps, some other items	lp: 400	50 R 40 W	kiosk operators and traders from upcountry (Mbeya, Iringa); D: medium	by truck hired by Dasico
3) — (1), Mwananya-mala (<3)	tins	> 125	free or 5 if bought	S: suffic. D: stable	himself, from Mwa illegal dump, some-times buys from indiv.	lamps	> 125	50 R	indiv. and shops in area; D: large	not stated
4) UMATA[3] (6), Tabata (16)	car bodies, tins, iron sheets	cr: ? ct: ? is: 20	cr: ? ct: ? is:150-450	S: insuff. D: unstable	themselves; from scrap dealers at Vetinary, Kigogo.	lamps, stoves	lp: ? st: 14	lp: 100 st: 350 W; 600-650 R	indiv. from nearby (retail); shops in Chalinze & Tabata (wholesale); D: medium	dumped near workplace
5) Kilulumo Ushirika[4] (25), Mburahati (14)	car bodies, tins, iron sheets/ rods	cr: ? ct:> 3,000 ir/is: ?	cr:3000 ct: 5 ir/is: ?	S: suffic. D: stable	mainly middlemen and some scavengers from Vingunguti disposal site and some illegal dumps	funnels, lamps, pourers, stoves	fu: ? lp:>600 pr: ? st: ?	fu: ? lp: 45 W pr: ? st: ?	traders from upcountry (Dodmoa, Iringa, Mbeya, Morogoro); D: large (Jul.-Sept.[2]), small (other months)	await collection by DCC as promised
6) — (7), Mbagala Kizinga (6)	car bodies, drums	cr: 2 dr: 10	cr:10000-15000 dr:1000(old)-3000 (new)	S: suffic. D: stable	themselves; cr: from Kigamboni, Temeke, Ubungo, dr: mainly from Tandika market	grills, stoves, woks; repairs	gr & st: 60 wk: 300-420	gr:5000W st.1000W wk: 600W	mainly Indian/Arab shop owners in DSM (wholesale); D: wk - medium; other - large	dispose of waste on-site (illegal dump)
7) — (1), Dasico (16)	iron sheets	20-30	2000	S: suffic. D: variable	himself from factories (Alaf, Metalbox, IPP) and from some indiv./scavengers	stoves	18-25	1200-2500 W; 2000-4000 R	mainly traders from upcountry (Iringa, Mbeya, Ruvuma, Zanzibar) (wholesale); D: large (Jul.-Sept.[2]); small (wet season)	by truck hired by Dasico
8) —. (1), Mtambani market (>10)	car bodies, iron sheets	cr: ? is: 1	cr: ? is: 8000	S: some shortages D: stable	himself from scrap dealers in Gerezani (cr) + Metalbox factory (is)	stoves, repairs	st: 1	st: 2000-3000	indiv.; D: small	market waste collection point

Note:
1) Abbreviation (Item): cr = car bodies; ct = tins (margarine, coffee, milk powder, milk, etc.); dr = drums (usually 50 gal.); ir = iron building rods; is = iron sheets.
2) Abbreviation (Products): fu = funnel; gr = barbecue grill; lp = small kerosene lamp ('kibatari' in swahili); pr = ladle/pourer ('kata') used for pouring water over a person when bathing; st = charcoal stove ('jiko'); wk = wok/container ('makarai ya ujenzi') used by construction labourers for carrying cement in.
3) Miscellaneous abbreviations: D = demand, R = retail, S = supply, W = wholesale; Bug = Buguruni, CC = city centre; Kar = Kariakoo, Mwa = Mwananyamala; indiv. = individual, insuff. = insufficient, qty. = quantity, suffic.= sufficient

1 The first column lists four pieces of information as indicated in the heading. To understand this, consider the fourth entry: UMATA (6), Tabata (16). This means the business is named UMATA; it has 6 workers, is located in Tabata and has been operating for 16 years.
2 Many traders from upcountry come to DSM during these months, towards the end/after the harvest when they have a lot of capital to spend.
3 UMATA = Umoja wa Mafundi wa Majiko Tabata (Co-operative of Stove Makers, Tabata)
4 Kilulumo Ushirika = Mburahati Metal Works and Carpentry Co-operative Society

Table 10-11: Operations of Large Metal Industries

Details	Source of scrap metal	Type of Scrap metal	Buying price (Tsh/kg)	Qty bought (t/month)	Supply & Demand	Use of scrap metal (% scrap constitutes of raw materials)	Waste Production and Disposal
1) Steelcast, Tazara	mainly TRC & THA (DSM); garages (DSM); middlemen (DSM, upcountry)	mainly dumped/ abandoned vehicles (e.g. cars, buses, trucks, railway rolling stock, sea vessels)	medium: 27-30 heavy: 35-40	880-990 (target is 1,320; peak is ~2,000)	S: suffic. D: variable	steel billets (~99%)	slag: ~200-225 t/month; used for road filling & land reclamation
2) M.M. Integrated Steel Mills Ltd, Mikocheni	middlemen (Tanga, Arusha, Mbeya; DSM) forging scraps from UFI (DSM)	mild steel (light, commercial, heavy grades)	good: 45-50 poor: 25-30	650-700	S: suffic. D: stable	mild steel/high tensile steel for construction industry (e.g. building/flat/ construction rods) (>95%)	reject steel products remelted; slag/sand: ~300 t/month; used for road filling & land levelling
3) Iron & Steel Ltd, Mikocheni	middlemen (DSM, upcountry, especially Morogoro); potential future sources are THA, TRC (DSM)	mild steel	50	about 1,250	S: suffic. D: stable	iron bars and rods for construction industry (~95%)	slag: ~13 t/month (estimate); to be used for road filling & land levelling
4) ALUCO, Nyerere Rd, Vingunguti	Al product manufacturers; 6 middlemen companies (DSM)	manufacturing offcuts, trims; soft Al scrap (e.g. beer cans, tins)	400			Al ingots & slabs; manufacture of Al circles and sheets (~20%)	slag: ~10 t/month; dumped at Vingunguti disposal site; some given away to road construction companies
5) NECO, Nyerere Rd, Vingunguti	middlemen (DSM)	mainly cast iron, small quantities of bronze and Al	ci: 50 br: 500 Al: 800	ci: 50 br: 2-3 Al: 0.4	20	S: insuff. D: stable	furnace slag & other wastes dumped on site; small quantities of chips/shavings mainly remelted but some sold to Steelcast, M.M.
6) Tazara Workshops	Tazara rolling stock (i.e. railway locomotives, wagons, etc.)	old/damaged/broken rolling stock and parts (axles, shafts, etc.)	N/A	not known	S: suffic. D: stable	repair and manufacture of spare parts for rolling stock (<35%)	rejects/runners/risers remelted; slag/sand: ~10 t/month given away to construction sites; ~20 t/month metal shavings disposed on site

Note: 1) Abbreviations: Al = aluminium; br = bronze; ci = cast iron; suffic. = sufficient; D = demand, S = supply; ~ = approximately

Steelcast has signed contracts with TRC and THA in 1996 so that most of its scrap steel is supplied by these two sources. Small amounts of scrap steel are also supplied to them by about 6 middlemen based in DSM. The scrap metal, which makes up about 99% of the raw materials, is melted in an electric arc furnace and cast into steel billets. The billets are sold to factories in Mikocheni (DSM), Tanga and Arusha for making building rods and other materials. About 10% of the scrap feedstock is lost in the casting process.

Their production figures are variable. For several months from Oct. 1995, they were operating at full capacity and producing 1,500-2,000 t/month during this period. Their normal production target is 1,200 t/month but typically they only achieve 800-900 t/month. This variability is primarily due to the company's reliance on TANESCO and NUWA for its electricity and water supplies respectively and difficulties in maintaining a regular supply of vital imported materials required for production (e.g. refractories, ferro-alloys, furnace electrodes) due to its slow payment of import bills. Presently, they have a massive scrap stockpile due to low production rates and their scrap collection rates are consequently low.

M.M. Integrated Steel Mills began operation 1.5 yrs ago and produces about 650-700 t/month. They use mild steel scrap, collected for them by middlemen from DSM, Tanga, Moshi and Mbeya as well as forging scraps from UFI[12] (DSM). The scrap is melted and first made into ingots which are then passed through a rolling mill and finally through a series of drawing machines to produce rods of the required thickness. 100 kg of scrap will produce about 85 kg of steel. The technology used is at least 30 yr old and very labour intensive. In terms of process costs, scrap is relatively cheap. Their major costs, in decreasing order, are electricity, labour and imported materials. They use 800 kW/t of steel produced in the furnace and a further 150 kW/t of steel processed in the rolling mill. They are dependent on TANESCO for their electricity supply, which has only been reliable since June 1995 when the Ubungo power station was commissioned. They pump water via their own pipeline to a large water storage tank on site which supplies the factory with water.

The Iron and Steel Ltd. factory was under construction at the time of investigation in July 1996 and was due to begin commissioning in Aug. 1996. Scrap steel collection was already under way. They are also building a steel mill in Mwanza. Their full production target is 40 t/d (about 1,250 t/month) and collection rates will need to be about 48 t/d in order to sustain this, allowing for 20% wastage of scrap in the production process.

This company's investment in two steel factories in Tanzania displays a certain business confidence that was justified as follows:

- There is a large, captive scrap market in Tanzania. Industries are now required by law to find a market for their scrap metals within Tanzania. Formerly, scrap metals were exported from Tanzania to other countries. However, various industries proposed to the government that this practice should be banned and the government agreed, leading to a change in the law about 1.5 yrs ago. Market research conducted by the company has shown that the scrap steel supply in Tanzania should be sufficient to meet their needs for at least the next 5 yrs.
- The market is expanding for steel building rods and bars in Tanzania. Presently, around 70% of iron bars and rods are imported while for angle, channel and I

[12] UFI = Ubungo Farm Implements

sections, the figure is close to 100%. There is a relatively small demand for the latter items in Tanzania while demand is large and growing for building rods and bars.

- The technology required to produce building rods and bars is relatively simple and affordable and hence is appropriate to use in Tanzania.
- The cost of the locally produced bars and rods is competitive with that of their imported equivalents. Locally produced bars/rods should reduce the country's reliance on imported bars/rods.

However, concerns were expressed about the competitiveness of Tanzanian industry relative to Ugandan and Kenyan industry, especially with the revival of the East African community. There is also some competition with South African companies. Electricity is the major expense incurred in making building rods and electricity charges in Tanzania are approximately 1.5 times those in Kenya and Uganda. This company is presently negotiating with TANESCO about reductions in the electricity tariffs for heavy industrial users.

ALUCO (part of ALAF) is virtually the sole user of recycled aluminium cans in DSM. Their scrap comes primarily from 6 middlemen companies: Pwijage Yolada, Chuma Miganiba, KISEC, Mbasa, Bapoo and Tanganyika Scraps Ltd. and secondly from aluminium product manufacturers (trims, offcuts, etc.). The scrap constitutes about 20% of their raw materials and is first made into aluminium ingots (yield ~50%) and then slabs and finally circles and sheets. Several sources stated that ALUCO has cash flow problems and is extremely slow to pay its scrap suppliers.

There are a number of smaller companies which use scrap metal. These are briefly discussed here. NECO and Tazara workshops are similar in size. NECO mainly uses cast iron scrap but also small quantities of bronze and aluminium from which they make a variety of products including manhole covers. Tazara Workshops use old/broken/damaged Tazara rolling stock as their main raw material source from which they repair and manufacture rolling stock spare parts. Recently, they opened their services to outside customers but only a small amount of custom currently comes from external sources. UFI operates a very small furnace but this is mainly used for heat treatment purposes. Small Industries Development Organisation (SIDO) in Vingunguti used to have a foundry which processed scrap metal but this was closed some time ago as it was unprofitable.

There are a number of companies which sell scrap metal waste, such as IPP and Carnaud Metalbox. The latter company manufactures tins (paint, cooking oil, etc.) , bottle tops and battery covers. Most of the scrap metal waste is tin plate waste (~18 t/month) from packaging used on some of its imported materials. Remaining metal waste is production line rejects (e.g. squashed tins, unsealed tins, etc.) and a small amount of copper waste (~1.4 t/month). This scrap is sold to local scrap dealers/middlemen every Fri. morning[13].

f. Discussion

The scrap metal recycling industry is large and active. The proportion of scrap metal obtained from generation sources within the scope of this Study is relatively small,

[13] Formerly, they used to sell scrap to ALAF but have stopped due to long delays in receiving payment from ALAF.

consisting of metal items (especially tins) and aluminium cans, which supply the large micro-industrial sector and ALUCO respectively with the bulk of their raw materials.

The micro-industrial sector is well established. Little change is expected in demand for its products or mode of operation in the short term future. Assistance to this sector could be provided by addressing some of the problems stated in Section 10.5.2.2. (d). Possibilities include:

- provision of a recycling fund which craftsmen could apply to for assistance (grants, low interest loans, etc.);
- provision of a number of handcarts/vehicles that would be available for hire at lower rates than the market rates specifically for use in transporting scrap metals.

The majority of scrap metal used in factories in DSM is obtained from industrial sources mainly in DSM but also from many other parts of the country. The market for scrap has been characterised by a lack of stability due to the problems experienced by industry, especially Steelcast and ALUCO. Reliance on public utility companies for electricity and water and cash flow problems leading to shortages of essential imported raw materials have affected the productivity of these factories and discouraged middlemen from trading in scrap metals. This applies particularly to ALUCO which virtually has a monopoly on the aluminium can recycling market in DSM.

However, improvements in electricity supply provision and the construction of two new private steel mills[14] should help to bring some stability and competition to the market. Demand for scrap metal is expected to increase once the Iron and Steel Ltd. factory in DSM begins operation which could lead to increases in scrap prices.

10.5.2.3Glass

Glass in this context, refers to glass bottles, broken glass, etc. The amount of glass produced by the generation sources within the scope of this study is estimated to be 51.4 t/d (1.5 t/month) in Table 10-1 excluding any glass waste generated by industry. No micro-industries utilising glass as their main resource were located during this survey. Figure 10-3 illustrates the glass recycling system which is explained in the following sections.

a. Collectors and Scavengers

The amount of plastic/glass bottles and other types of glass collected from households is estimated to be 15.4 t/d (~2/3 glass) and 0.13 t/d respectively (see annex 8). Most of the glass waste collected is in the form of bottles which can be washed and then reused. Glass bottles may be sold directly by collectors and scavengers to individuals, shops, petty traders, markets, middlemen, etc.

b. Middlemen

Many markets have a few operators who function as middlemen in that they buy and then resell recycled items such as glass and plastic bottles, paint tins, etc. The activities of one such operator at Buguruni market are listed below. It can be seen that glass bottles are in much greater demand than plastic and metal items.

[14] The two new industries are M.M. Integrated Steel Mills (began 1.5 yrs ago) and now Iron & Steel Ltd.

Item	No. sold/ month	Buying price (Tsh/item)	Sale price (Tsh/item)	Demand
small glass bottle	500-600	5-20	40	variable
glass bottle	200	5-20	40	high
plastic bottle/container	20-30	50	70-100	very variable
small tins	20-30	20	30-40	very variable
paint tins	20-30	30-40	80-100	very variable

Another market operator at Mtambani market sells used glass bottles only. Individuals, mainly youths, collect large quantities of bottles and sell them to him for 15-30/- ea. He suspects they collect most of these bottles from households in the area. Demand is highly variable but on average, he sells around 300-500 bottles per month to market customers for 25-50/- ea. There are a few customers who may buy 200 bottles at one time, presumably for sale to Kioo Ltd.

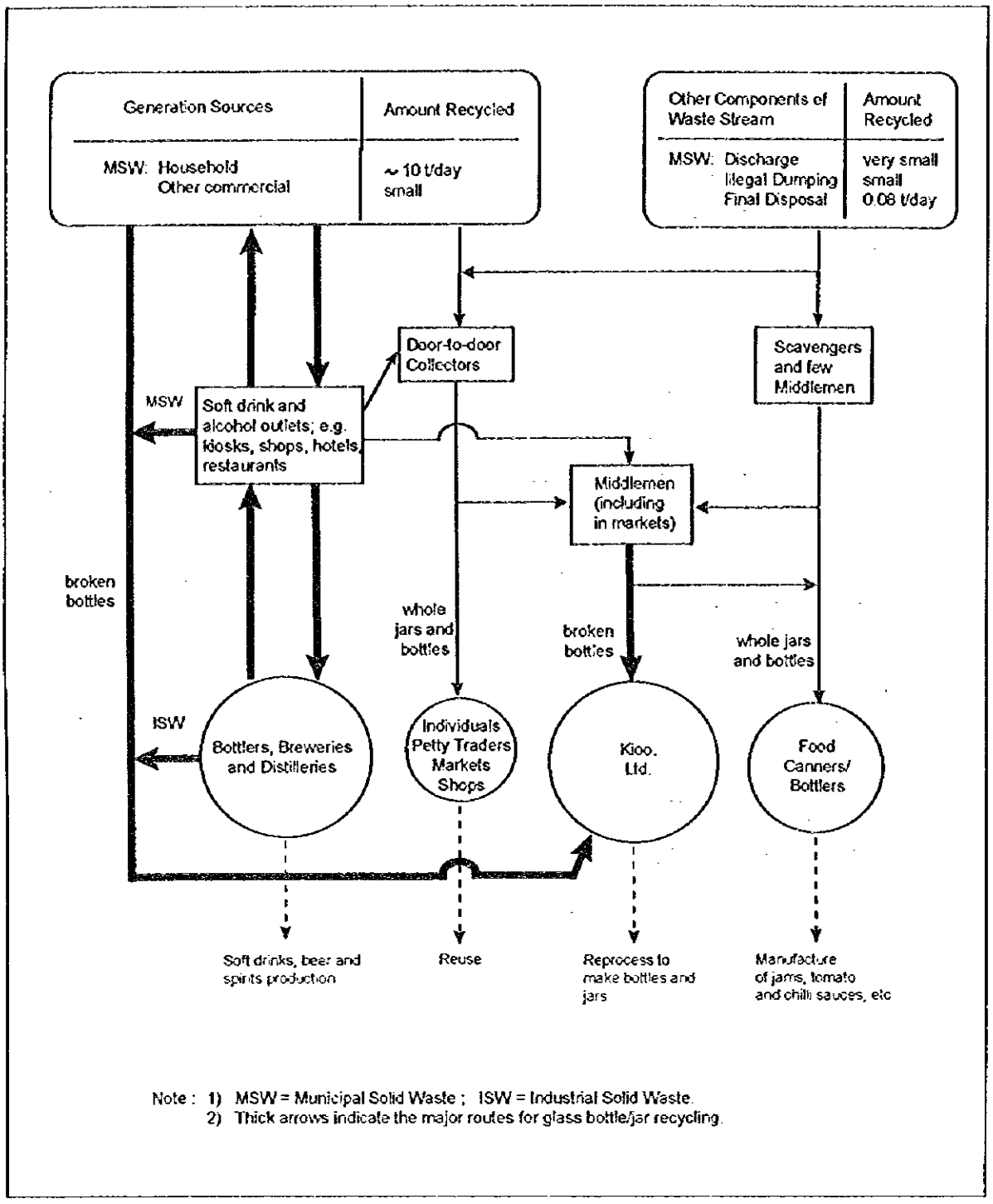
No middlemen dealing directly with Kioo Ltd. or any of the food canning/bottling industries were located.

c. Large Industries

Kioo Ltd. is the only factory in DSM which reprocesses broken bottles into bottles and jars. Their main suppliers are scavengers, middlemen, hotels, bottlers and breweries. Demand is stable and the supply is sufficient. They pay 100/- per kg for broken bottles delivered to the factory and purchase about 200 t/month, equivalent to 20% of their total bottle production. About the same amount of bottles are broken within the factory so that in total, broken bottles constitute 40% of the glass used in production.

Pepsi Bottlers Ltd. and Tanzania Breweries Ltd. were interviewed. Both companies use a deposit/refund system for distributing bottles to their outlets as in most other countries.

Pepsi stated that over 99% of their bottles are returned to them each year. About 480,000 bottles go missing, either being broken or used for other purposes. A further 3.6 million bottles are broken each year within the factory or during circulation to customers. Of this cullet, about 67% is sold to Kioo Ltd. while the remaining 33% is not suitable for sale and is disposed with the other factory waste. The average life of a bottle is 17 rotations.



Note : 1) MSW = Municipal Solid Waste ; ISW = Industrial Solid Waste
2) Thick arrows indicate the major routes for glass bottle/jar recycling.

Figure 10-3: The Glass Recycling System in DSM

Tanzania Breweries stated that approximately 98.5% of the 2.5 million bottles circulated to customers each month are returned in usable condition. Another 1.5% of bottles are broken during processing in the factory and the cullet is sold to Kioo Ltd. for reprocessing. The average life of a bottle is 10 rotations.

Coast Canners Ltd. is one of several food canning/bottling industries within DSM. It uses glass jars/bottles for making jams, tomato and chili sauces. The bottles and jars are sold to customers but about 80% of jars/bottles are returned to them, mainly by middlemen who collect them from various sources. About 4,000 jars/bottles are returned each month and they pay 20-30/- ea. depending on the type of jar/bottle. The jars/bottles are sorted by hand, then washed and sterilised by machine prior to reuse. Use of recycled jars/bottles increases their profitability as new jars/bottles are 5 times the price of recycled ones.

All broken jars/bottles are buried in a pit on the factory site and covered. Up until about 2 yrs ago, people used to come to collect broken glass for sale to Kioo Ltd. They investigated the feasibility of selling cullet directly to Kioo but found that transportation costs would exceed the income received from sale of the cullet.

d. Discussion

The glass recycling system is well established, relatively straightforward and appears to suffer from few problems. No significant changes are expected in the short term future although the recent introduction of 1.5 l PET soft drink bottles may affect the soft drink market, MSW composition and recycling industry.

Unfortunately, none of the middlemen who supply Kioo Ltd. or Coast Canners Ltd. were located and hence their input on the recycling system was not received. Despite this lack of data, one possibility for assisting this sector is the provision of a number of handcarts and possibly vehicles that would be available for hire at lower rates than the market rates specifically for use in transporting glass. Alternatively, a recycling fund could be set up that middlemen could apply to for assistance in buying tools and equipment (e.g. handcarts, gloves, etc.).

10.5.2.4Plastic

Plastic in this context covers plastic bottles, sheets, containers, etc. The amount of plastic produced by the generation sources within the scope of this study is estimated to be 35.6 t/d (1.1 t/month) in Table 10-1, excluding any plastic waste generated by industry. No micro-industries using plastic as their main raw material were located during this survey. Figure 10-4 illustrates the plastic recycling system which is explained below.

a. Collectors, Scavengers and Middlemen

The amount of plastic/glass bottle waste and other plastic waste collected from households was estimated to be 15.4 t/d (~1/3 plastic) and 0.17 t/d respectively (see annex 8). Most of the plastic waste collected is in the form of bottles which are washed and then reused. Plastic bottles are sold directly by collectors, scavengers and middlemen to individuals, shops, petty traders and markets. Many markets also have stalls which sell recycled items including plastic bottles as described in section 1.5.2.3 (b).

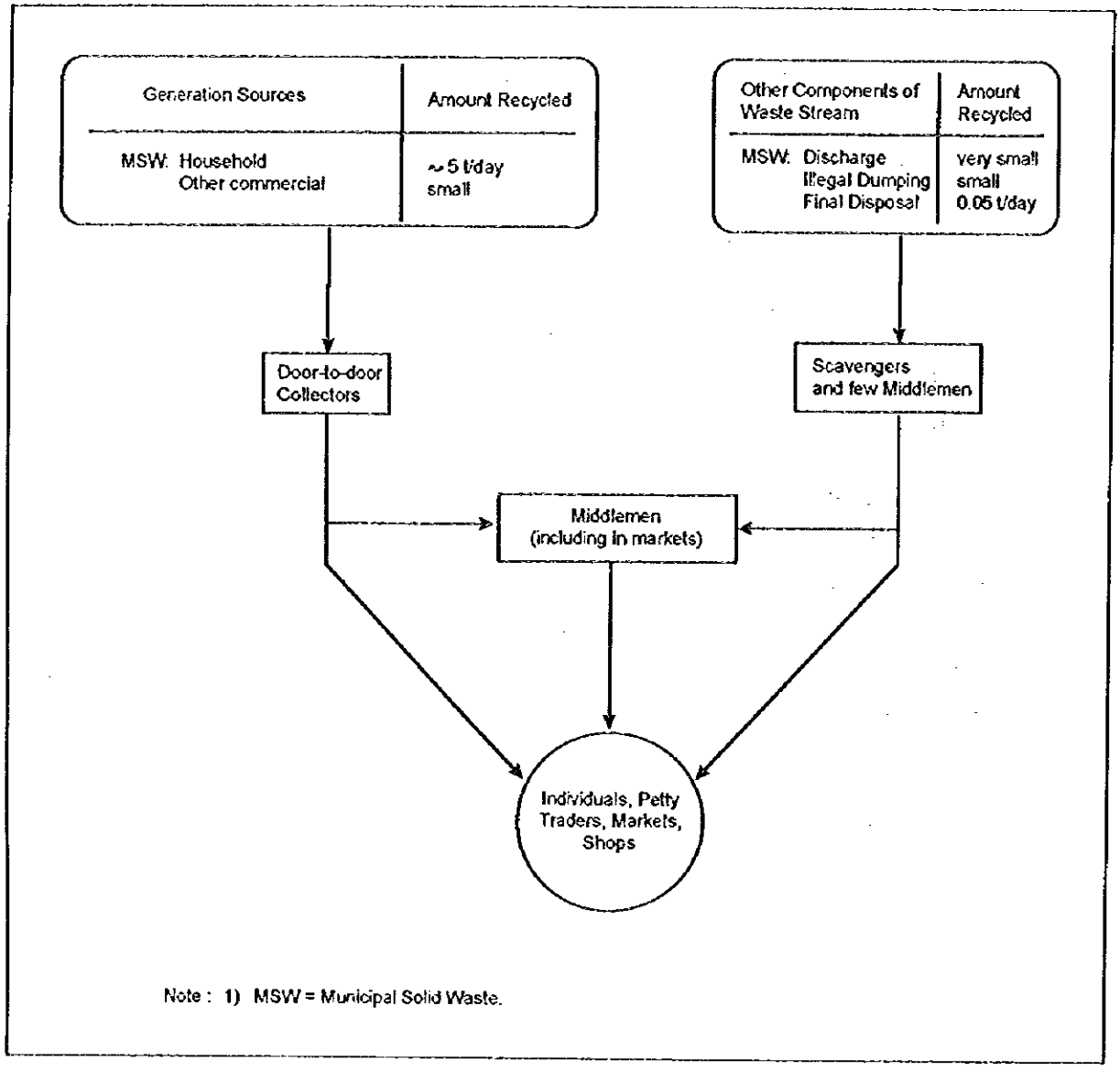


Figure 10-4: The Plastic Recycling System in DSM

b. Large Industries

The two major plastic companies in DSM, Simba Plastics and Tegry Plastics, do not collect any materials for recycling, primarily due to the difficulty of accurately grading plastics, which is vital in order to avoid processing problems. However, both factories recycle some of their production line rejects.

Simba Plastics manufactures a wide range of plastic products including bottles, jars, buckets, jerry cans, pipes, packaging films and blown film. They recycle approximately 2.5 t/month (2.5-3% of production) of rejected materials from their production line. The rejected materials are first crushed, foreign particles are removed and they are then mixed with virgin material for processing into plastic for certain product lines for which such practice is appropriate.

Tegry Plastics manufactures pipes and tubing. Approximately 10% of total production must be reworked or disposed of. Most material is suitable for reworking and is recycled internally while a small percentage of unsuitable material (burned, scorched plastic) is disposed of at Vingunguti disposal site. The factory does have a crushing machine for crushing plastic bottles for recycling into plastic containers but this is not used now as the market is poor and they do not have a container moulding machine.

Two other plastic companies, Plasco and IPL were not interviewed.

c. Discussion

The recycling system for plastic bottles focuses on reuse rather than reprocessing, due to the difficulty in accurately sorting plastics, this being a prerequisite before reprocessing can be done. This system is unlikely to change in the foreseeable future.

However, 1.5 l PET bottles containing soft drinks have recently been introduced for sale in Tanzania. Turnover of this new product is currently relatively small and it is too early to assess their impact on the soft drink market, MSW composition and recycling industry.

If this product proves to be popular, these bottles could be collected for reprocessing and it may be possible to utilise the bottle crushing machine at Tegry Plastics for this purpose. A container moulding machine would also be required in this case.

10.5.2.5Tyres

The amount of rubber/leather waste, which includes tyres, produced by the generation sources within the scope of this study is estimated to be 12.6 t/d (378 t/month) in Table 10-1. However, most tyres are collected from other sources such as garages, transport companies and industry. Figure 10-5 illustrates the tyre recycling system in DSM which is explained below.

a. Collectors, Scavengers and Middlemen

Most used tyres are obtained by collectors and micro-industry workers directly from source although some are collected from dumping sites. There are thought to be few middlemen involved in the tyre recycling industry.

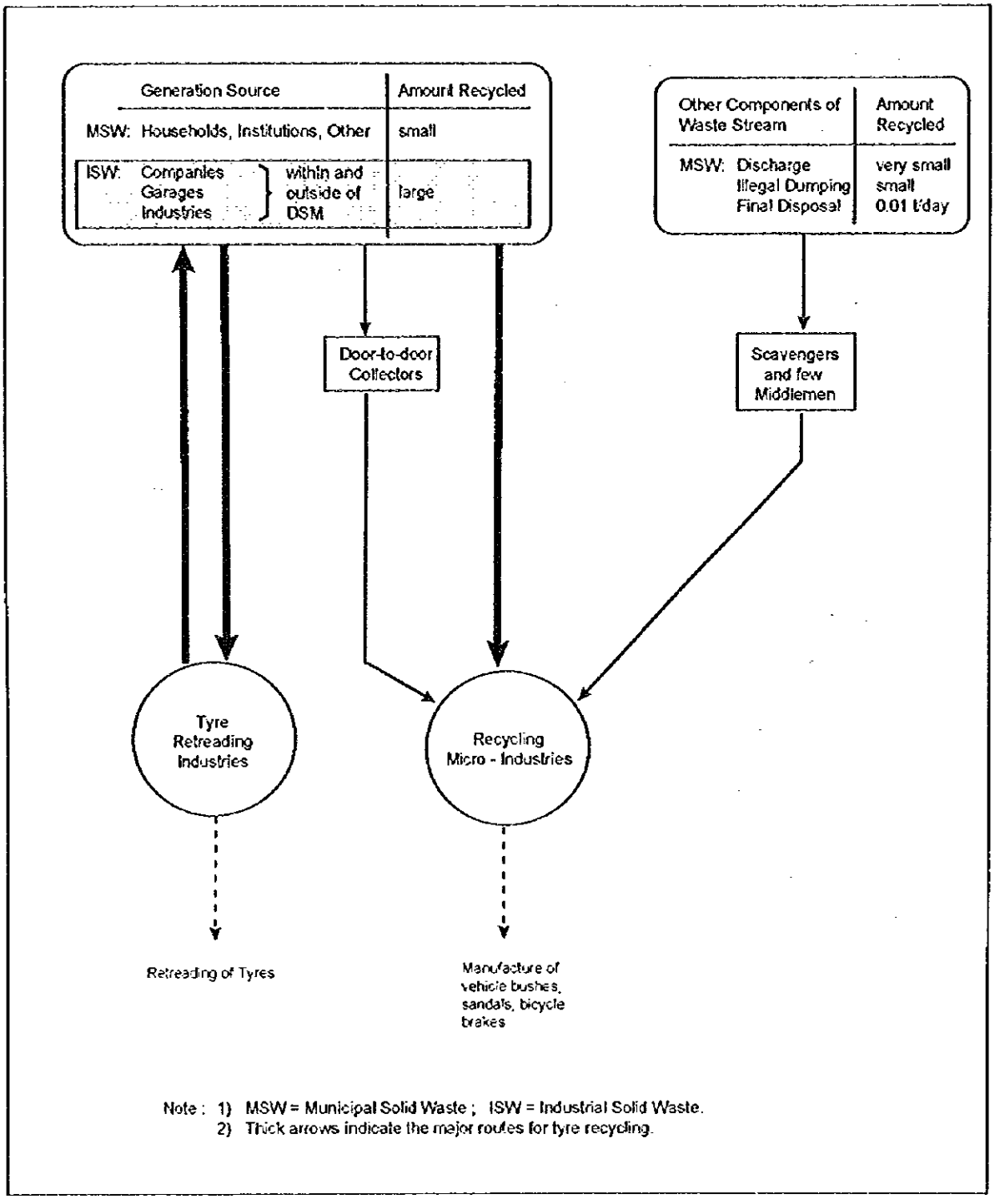


Figure 10-5: The Tyre Recycling System in DSM

b. Micro-Industries

There are many small workshops throughout DSM which use old tyres mainly to make vehicle bushes and some other minor products such as rubber sandals and bicycle brakes. The results of interviews with representatives from two of these businesses are described below and tabulated in Table 10-12.

The first interviewee has been working in this trade for 30 yrs in Moshi, Singida and in DSM since 1980. There are 3 workers and they collect the tyres themselves from various individuals and some companies/institutions. The sandals and bushes manufactured are sold locally and also to traders from other regions (Kondoa, Arusha, Singida) who come to DSM to buy wholesale goods for sale upcountry, especially between Aug.-Sept. Usually, one tyre can make 6 pairs of sandals complete with straps or 11 pairs without straps. Bushes come in different shapes and sizes depending upon the end use (e.g. spring, exhaust pipe, etc.) and hence the sale price is variable. A licence is required for this trade. Handcart operators are paid to remove and dispose of the waste produced, which consists mainly of rubber trimmings and cuttings.

The second business consists of two workers who have been working in this trade since 1980. Individuals collect tyres for them and they make different kinds of bushes, with the tyre waste from this being used to make bicycle brakes. Other rubber waste is burned. For both businesses, the demand for tyres is stable and the supply is usually sufficient. Sometimes they are unable to buy tyres due to their high price and shortage of capital. The purchase of proper tools is also a problem for the same reason.

Table 10-12: Small Workshops for Tyre Recycling

Name (No. of workers), Location	Purchases			Sales		
	Source of tyres	No. of tyres/ month	Price (Tsh/tyre)	Item made	No. sold/ wk	Price (Tsh)
---(3), Rashidi Kawawa Rd	individuals, THA, UDA, DCC	20	500-700	sandals bushes	80 prs 160	250-300 W 350-500 R 200-1,400
Mshimbula Enterprises (2), Kilwa Rd	garages, households	2 (tractor tyres)	10,000	bushes bike brakes	300-400 ?	500 (avg.)

Note: 1) UDA is a bus company; 2) W = wholesale, R = retail;
3) the price of bushes varies depending upon the size and shape.

c. Large Industries

Tyre retreading is a relatively new industry in DSM, but there is a growing demand for this service and retreading is becoming a big business. An interview was conducted with NAS Tyre Services Limited which uses the most advanced technology in East and Central Africa in their DSM operation. Tyres in reasonable condition, with at least 1-2mm of tread and of dimensions 640 x 14 or larger can be retreaded. This excludes car tyres but covers light pickups, minibuses and larger vehicles.

Approximately 45% of tyres retreaded come from DSM while the remainder come from other areas, especially Moshi, Tanga and Mbeya where the company has collection centres. Tyres are brought to DSM, retreaded and then returned directly to the customer. The retreading price is 40% of the cost of a new tyre while the quality is as good as that of a new tyre. They currently retread 500-600 tyres per month but demand is rapidly growing and their 1996 retreading target is almost double that of 1995.

The interviewee knew of at least three other retreading companies in DSM (Treadsetters, Kassam Retreads, Globe) which were estimated to retread a total of over 600 tyres/month.

d. Discussion

The tyre micro-industries are well established and little change is expected in demand for their products or mode of operation in the short term future. Their products are cheap and in popular demand. However, if their used tyre supply is to decrease, then their survival may be threatened.

One factor threatening their supply is the success of the tyre retreading industry which is a new, rapidly growing industry, dominated by private companies and whose share of the used tyre market rise is increasing. However, this factor is offset by a rapid increase in sales of vehicles in Tanzania in recent years which has increased the used tyre supply. The balance between these two factors will determine the impact on the micro-industries.

An appropriate form of micro-industry assistance here could be the establishment of a recycling fund which the micro-enterprises could apply to for assistance (grants, low interest loans, etc.) for purchasing tools and equipment.

10.5.2.6Other

There are a smaller number of other micro-industrial and middlemen enterprises recycling other types of waste items. Typically, these enterprises collect, process (clean, repair, make) and sell items themselves, thus eliminating all other intermediaries between source and customer. Four of these operations are described below.

a. Mattresses

A small group of 16 full-time workers named 'Wito wa Taifa', operating since 1978 and based at Mbagala Kizinga, manufactures mattresses from waste materials. They use various kinds of materials which they collect themselves, including cigarette filter manufacturing waste dumped by Tanzania Cigarette Co. (DSM), blanket remains from blanket manufacturers, sisal from TASCO (DSM) and cotton from Polystar (Morogoro).

The prices of these raw materials and the quantities collected per month are summarised below:

Item	Price (Tsh/unit)	Quantity collected per month
cigarette filter waste	free	1 truckload
blanket remains	?	1/3 truckload
sisal	10,000/- per truckload[1]	1 truckload
cotton - clean	120/- per kg	irregular
- dirty	70/- per kg	

Note: [1] Price of truckload is the same whether it is a 3.5 or 7 tonne truck.

Mattresses made from cigarette filter and blanket remains are sold for 5,000/- ea. while those made from sisal sell for 4,000/- ea. Individuals buy their mattresses from their workshop. Demand is medium and on a good day, they can sell 2 mattresses.

Their main problems are shortage of raw materials and lack of capital, especially to cover transportation costs of cotton from Morogoro and to buy covering material for the mattresses.

b. Drums

There are quite a few small trading businesses (middlemen) around DSM which buy used metal and plastic drums for subsequent resale. The results of interviews with representatives from two of these are described below and in Table 10-13.

The first business has only been operating for 1.5 yrs, employs 6 people and deals in used iron and plastic drums, most of which are 50 gallon in size. They collect the drums themselves mainly from factories in the Chan'gombe area, especially from Bayfield Trading Ltd. These drums are cleaned and then stored on an open area along Nyerere Rd. Individuals come here to buy the drums; the demand is medium and the supply is usually sufficient. The land on which they store the drums is not their property and they have been threatened with eviction several times but as yet no action has been taken. Other problems include lack of capital and high transportation costs for collection of the drums.

The second group has been operating since 1980 and employs 35 people. It is engaged in a number of activities including trading in used drums. Members of the group collect drums themselves mainly from factories in Chan'gombe but also grease drums from shops in Kariakoo. They clean the drums, remove dents and fill holes (by welding) prior to resale. Demand for drums is medium and most of their customers are traders from upcountry. Their main problems are lack of capital, transportation and tools (welding machine, hammers, etc.).

Table 10-13: Trading Businesses (Middlemen) for Drums

Name (No. of workers), Location	Purchases			Sales		
	Source of drums	No. of drums/ month	Price (Tsh/ drum)	Customer	No. sold per month	Price (Tsh)
Nasi Tunajaribu Coop Soc. (6), Nyerere Rd	factories mainly in Chan'gombe area	40	metal: 5,000 plastic: 10,000	individuals	24 (they have a reasonable stockpile)	me: 8,000 pl: 17,000
Tandika General Enterprises (35), Tandika market	factories in Chan'gombe area and shops in Kariakoo	300	6,000	individuals from DSM (10%) and upcountry (90%)	300	7,500-8,500

Note : me = metal; pl = plastic

c. Wood

Most of the wood which is recycled is used by the collectors themselves or sold directly to individuals who use it for firewood or basic carpentry/construction works. However, there are several middlemen enterprises dealing in various items, including wood. One of these is the Nasi Tunajaribu Women's Group which has 64 members and deals in the collection and resale of drums, plastics, wooden pallets and firewood. They have been operating for about 3 yrs and collect wooden pallets (300/- ea.) themselves usually from THA. The supply is limited and sometimes they are only able to buy pallets once every

two months. About 50 pallets per week are resold (700/- ea.) to Mohammed Enterprises and other small Indian businesses in DSM. Any broken irreparable pallets and other pallet waste is made into bundles of firewood which are sold at 50/- per bundle. Their major problem is lack of capital.

d. Discussion

These enterprises occupy a particular niche in the market place and are relatively independent in that they deal directly with their suppliers and customers. Any assistance to this sector should be given on an individual enterprise basis. One appropriate form of assistance would be the establishment of a recycling fund which these enterprises could apply to for assistance (grants, low interest loans, etc.) for purchasing basic tools and equipment.