

Annex D

Time and Motion Survey

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D Time and Motion Survey

D.1 Objectives

The survey aimed to obtain the following information of the collection and haulage in order to analyze their efficiency:

- unit time required to perform each task, e.g., preparation of vehicles to operate, collection, haulage to landfill, etc.,
- unit distance of each task, and
- weight of waste collected.

D.2 The Survey Schedule

a. Target Vehicles and Areas

Compactor trucks donated by the Japanese government in 1989¹ and 1996² occupy a major number of collection vehicles working in the Study Area. Also, some municipalities utilize dump trucks as collection vehicles. Namely, collection vehicles in the Study Area can be categorized as follows:

- **Large compactor truck** which has a winch for 2m³ container. 18yd³ (14m³) truck is typical.
- **Small compactor truck** which has no winch for the container. 11yd³ (8m³) and 16yd³ (12m³) are representative trucks.
- **Dump truck** which is not manufactured specifically for waste collection work, but used in some municipalities due to its convenience of multipurpose use.

On the other hand, currently 10 municipalities haul their waste to the Mariona transfer site and/or Nejapa Landfill. In order to analyze influence of distance to them on the collection and haulage, the Study Area was divided into four parts, i.e., central, west, east and north districts according to the categorization by OPAMSS.

Taking into account the type of collection vehicles and location of the municipalities, 10 collection routes were finally selected (See Table D-1).

Table D-1: Targeted Areas and Vehicles for the Time and Motion Survey

District	Municipality	Type of truck		
		Large compactor	Small compactor	Dump truck
Central	San Salvador	x		
	Ayutuxtepeque		x	
West	Nueva S. S	x	x	x
	Antigo Cuscatlan			x
East	Soyapango	x	x	
North	Apopa	x	x	

¹ A 1988 Japanese fiscal year's project

² A 1994 Japanese fiscal year's project

b. Survey Schedule

The site survey was conducted from 7th to 22nd of February 2000. The survey was carried out for 3 days for each route. In total, 30 days of collection and haulage works were recorded.

Table D-2: Schedule of Time and Motion Survey

District	Municipality	Type of vehicle	Collection route	Equip. No.	Date	Day	No.
Central	San Salvador	Large (18yd ³)	2.1	63	07-Feb	Mon	1
				58	16-Feb	Wed	2
				26	18-Feb	Fri	3
West	Nueva S.S.	Large (18yd ³)	Pinares	2	08-Feb	Tue	4
				2	10-Feb	Thu	5
				2	12-Feb	Sat	6
East	Soyapango	Large (18yd ³)	Montes	19	16-Feb	Wed	7
				19	18-Feb	Fri	8
				19	21-Feb	Mon	9
North	Apopa	Large (18yd ³)	4	10	07-Feb	Mon	10
				10	16-Feb	Wed	11
				10	17-Feb	Thu	12
Central	Ayutuxtepeque	Small (16yd ³)	Central	3	09-Feb	Wed	13
				3	10-Feb	Thu	14
				3	11-Feb	Fri	15
West	Nueva S.S.	Small (11yd ³)	Alpes	19	08-Feb	Tue	16
				19	10-Feb	Thu	17
				19	12-Feb	Sat	18
East	Soyapango	Small (11yd ³)	Sierra	26	12-Feb	Sat	19
				26	17-Feb	Thu	20
				26	22-Feb	Tue	21
North	Apopa	Small (11yd ³)	3	13	07-Feb	Mon	22
				13	16-Feb	Wed	23
				13	17-Feb	Thu	24
-	Nueva S.S.	Dump (12m ³)	Fabricas	16	08-Feb	Tue	25
				14	10-Feb	Thu	26
				14	12-Feb	Sat	27
-	A. Cuscatlan	Dump (16m ³)	Sultana	8	11-Feb	Fri	28
				8	17-Feb	Thu	29
				8	18-Feb	Fri	30

D.3 Survey Records

In this survey unit time of each task was defined as below, and times and distances corresponding to the tasks were recorded.

- t1: time for preparation, inspection, cleansing of vehicles
- t2: time for moving to a collection area from a depot,
- t3: time for waste collection
- t4: time for haulage to a landfill (Nejapa or Espiga)/transfer site (Mariona) from a collection area and vice versa
- t5: time at the landfill/transfer site
- t6: time for other activities than waste collection and transport

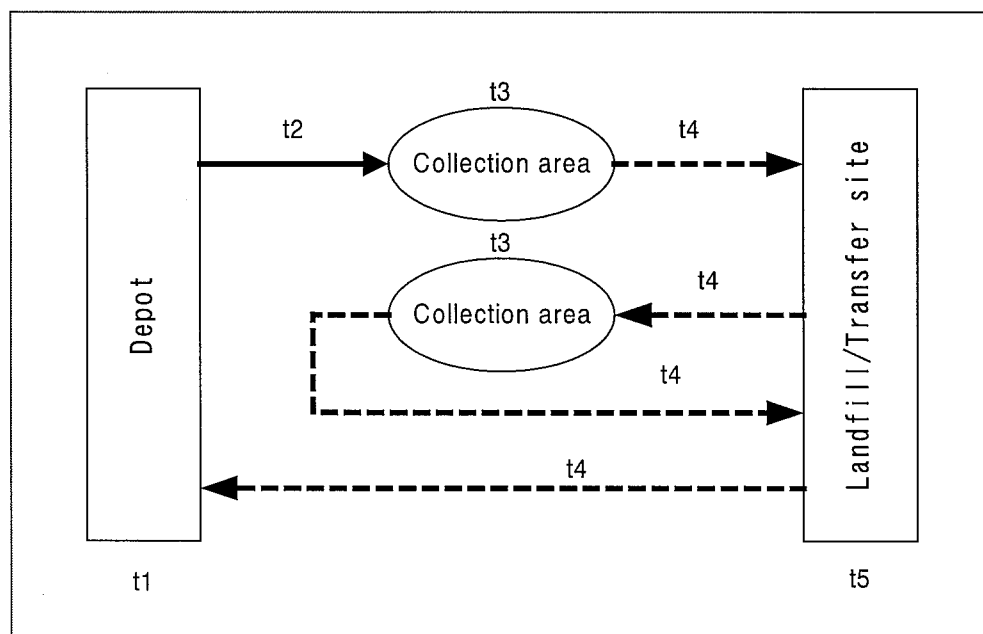


Figure D-1: Time and Distance to be Recorded

Table D-3: T&M Survey Records (1)

No.	Trip	Cap.	Collection amount (kg)	Landfill /transfer site	Nos. of worker*
1	1	14m ³	6,011	Mariona	4
	2	14m ³	5,212	Mariona	4
2	1	14m ³	5,457	Mariona	4
	2	14m ³	3,360	Nejapa	4
3	1	14m ³	8,190	Mariona	4
4	1	14m ³	6,792	Mariona	4
5	1	14m ³	3,986	Mariona	4
6	1	14m ³	4,585	Mariona	4
7	1	14m ³	9,461	Mariona	4
8	1	14m ³	6,165	Mariona	4
	2	14m ³	7,446	Nejapa	4
9	1	14m ³	8,653	Mariona	4
	2	14m ³	6,728	Nejapa	4
10	1	14m ³	8,009	Nejapa	4
	2	14m ³	6,302	Nejapa	4
11	1	14m ³	7,881	Nejapa	4
12	1	14m ³	5,811	Nejapa	4
13	1	12m ³	3,078	Nejapa	4
14	1	12m ³	4,140	Nejapa	4
15	1	12m ³	5,139	Nejapa	4
16	1	8m ³	6,292	Mariona	4
17	1	8m ³	5,194	Mariona	4
18	1	8m ³	5,139	Mariona	4
19	1	8m ³	5,457	Mariona	4
20	1	8m ³	5,848	Mariona	4
21	1	8m ³	4,885	Mariona	4
	2	8m ³	6,111	Mariona	4
22	1	8m ³	5,266	Nejapa	4
	2	8m ³	5,775	Nejapa	4
23	1	8m ³	6,111	Nejapa	4
24	1	8m ³	5,693	Nejapa	4
25	1	12m ³	1,870	Mariona	3
26	1	12m ³	2,443	Mariona	3
27	1	12m ³	2,371	Mariona	3
28	1	16m ³	5,661	Espiga	4
29	1	16m ³	5,661	Espiga	4
30	1	16m ³	5,661	Espiga	4

Note: * excluding a driver.

Table D-4: T&M Survey Records (2) Unit Time

Unit: hour

No.	t1	t2	t3	t4	t5	t6	Total
1	0.0483	0.2681	2.4998	2.2357	0.1510	0.0119	5.2148
2	0.0558	0.1481	2.7967	1.8510	0.2235	0.0803	5.1554
3	0.1239	0.1511	2.5968	0.9919	0.1797	0.0114	4.0548
4	1.3194	0.1036	2.6651	1.7828	0.2467	0.2047	6.3223
5	0.3722	0.0917	2.8964	2.2031	0.8167	0.3770	6.7571
6	0.2181	0.0992	2.4175	2.4878	0.2611	1.7747	7.2584
7	0.5306	0.1783	3.1670	1.3882	0.2034	0.3565	5.8240
8	0.4289	0.2389	3.7780	2.8112	0.2803	0.2047	7.7420
9	0.4780	0.2151	4.0615	2.8310	0.2048	0.2625	8.0529
10	0.1372	0.0328	5.5776	1.8239	0.3786	0.6500	8.6001
11	0.1431	0.0547	5.2880	0.7145	0.2134	0.6616	7.0753
12	0.0517	0.0489	4.1642	0.7700	0.1261	0.6185	5.7794
13	0.2334	0.0751	4.0717	0.8923	0.3589	0.0415	5.6729
14	0.2690	0.0000	2.6967	0.9662	0.2570	1.5718	5.7607
15	0.3002	0.1008	2.6794	1.2704	0.0229	0.7233	5.0970
16	0.3459	0.0806	2.3247	1.6153	0.2333	0.6333	5.2331
17	0.3750	0.1019	2.8229	1.6000	0.1333	0.6334	5.6665
18	0.5854	0.0614	2.8580	1.5837	0.1833	1.3948	6.6666
19	0.0875	0.0825	1.8855	1.0689	0.2120	0.7336	4.0700
20	0.2230	0.1578	3.3781	1.0073	0.1040	0.4322	5.3024
21	0.1653	0.0930	2.3313	2.3079	0.2481	1.7745	6.9201
22	0.2611	0.0511	4.5099	1.5258	0.6978	0.3703	7.4160
23	0.5042	0.0808	3.7353	0.7034	0.1433	0.8804	6.0474
24	0.1889	0.0547	3.7996	0.6353	0.1608	0.5821	5.4214
25	0.1339	0.0917	3.1291	1.9897	0.2569	0.5086	6.1099
26	0.2950	0.0961	2.3942	1.9353	0.2842	0.5253	5.5301
27	0.1483	0.1131	2.1793	2.2292	0.2630	0.5330	5.4659
28	0.4131	0.0736	3.3111	1.2047	0.2056	0.3767	5.5848
29	0.4968	0.0783	4.1717	1.1120	0.2086	0.9858	7.0532
30	0.3262	0.0392	3.2003	1.0969	0.2397	0.8641	5.7664

Table D-5: T&M Survey Records (3) Unit Distance

Unit: km

No.	t1	t2	t3	t4	t5	t6	Total
1	0.00	1.00	13.40	70.70	2.30	0.00	87.40
2	0.00	4.50	9.40	77.30	1.40	0.00	92.60
3	0.00	1.15	14.90	29.10	0.50	0.30	45.95
4	0.00	1.61	9.66	85.29	3.22	1.61	101.39
5	1.61	0.00	16.10	70.81	4.83	1.61	94.96
6	1.61	1.61	8.05	86.90	3.22	1.61	103.00
7	0.00	3.00	9.00	45.00	1.00	0.00	58.00
8	0.00	4.00	9.00	101.00	3.00	0.00	117.00
9	0.00	3.00	10.00	102.00	2.00	0.00	117.00
10	0.00	0.40	24.20	55.80	3.00	1.30	84.70
11	0.00	0.40	16.00	27.60	1.60	0.00	45.60
12	0.00	0.40	13.30	27.80	1.40	0.00	42.90
13	0.00	0.20	13.70	34.90	6.50	0.50	55.80
14	0.00	0.00	7.10	38.70	5.60	2.50	53.90
15	0.00	0.90	10.70	46.30	0.60	0.70	59.20
16	1.60	1.30	6.70	68.70	1.80	0.10	80.20
17	1.80	1.10	6.40	71.00	0.00	0.00	80.30
18	1.80	1.10	7.10	70.50	0.00	0.00	80.50
19	0.00	1.70	3.80	28.80	1.10	0.20	35.60
20	0.00	2.10	11.60	36.50	0.30	2.90	53.40
21	0.00	1.50	4.10	58.10	1.10	2.40	67.20
22	0.00	0.60	11.00	47.90	2.60	0.40	62.50
23	0.00	0.60	10.60	28.50	1.90	3.20	44.80
24	0.00	0.90	11.50	27.80	1.90	0.40	42.50
25	0.00	3.00	4.73	74.90	1.00	1.00	84.63
26	0.00	4.00	4.73	75.00	1.00	0.00	84.73
27	0.00	4.00	4.68	75.00	1.00	0.00	84.68
28	0.00	0.80	6.12	81.20	0.00	0.00	88.12
29	1.50	1.60	6.80	80.70	0.00	4.00	94.60
30	0.00	0.80	5.90	80.70	0.00	1.00	88.40

D.4 Findings

Findings of the survey are discussed in view of vehicle type and in view of collection area.

a. In View of Vehicle Type

Table D-6 and Figure D-2 shows that the dump truck takes more time for one trip, about 6 hours, than the compactor truck, less than 5 hours. It can clearly be seen that the dump truck spends more time on collection, because the dump truck is not specifically manufactured for waste collection.

Table D-6: Collection Time per Trip in Vehicle Type

Task	Time (hours)			Proportion (%)		
	Large compactor	Small compactor	Dump truck	Large compactor	Small compactor	Dump truck
t1	0.23	0.25	0.30	5.0%	5.1%	5.1%
t2	0.10	0.07	0.08	2.2%	1.4%	1.4%
t3	2.47	2.65	3.06	53.9%	53.5%	51.7%
t4	1.29	1.08	1.59	28.2%	21.8%	26.9%
t5	0.19	0.20	0.24	4.1%	4.0%	4.1%
t6	0.31	0.70	0.63	6.8%	14.1%	10.6%
Total	4.58	4.95	5.92	100.0%	100.0%	100.0%

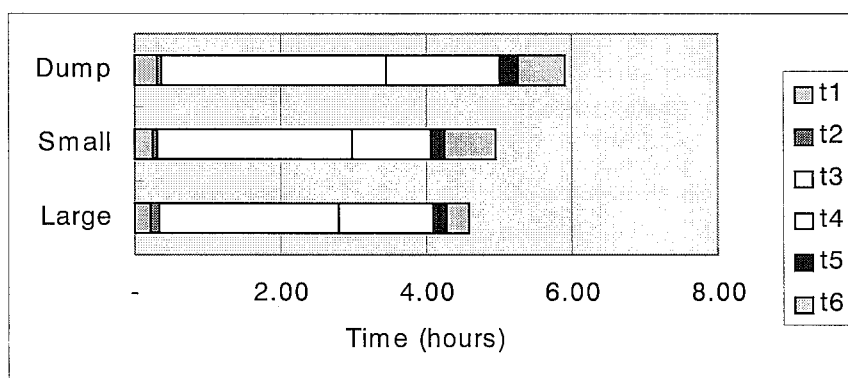


Figure D-2: Collection Time per Trip in Vehicle Type

Table D-7 and Figure D-3 show that unevenness of collection amount in kg. There is considerable unevenness, more than double, in each type of vehicles (large 3,360-9,461 kg/trip; small 3,078-6,292 kg/trip; dump 1,870-5,661 kg/trip). Specifications of the compactor trucks say that the maximum payload for the 18yd³-compactor truck is 7,500 kg, and the 11yd³-compactor truck is 4,500 kg. The average of large compactor's collection amount (6,474 kg; 86% of the payload) is less than its payload, however, the maximum collection amount (9,461 kg; 126%) fairly exceeds it. As for the small compactor truck, even its average (5,295 kg; 118%) considerably exceeds the payload. The maximum collection amount of the small compactor truck (6,292 kg; 140%) is extremely beyond its payload. Therefore, the small compactor truck has a more chance to be damaged by the over load than the large compactor truck.

Table D-7: Collection Amount per Trip in Vehicle Type

Type	Maximum	Minimum	Average
Large compactor	9,461	3,360	6,474
Small compactor	6,292	3,078	5,295
Dump truck	5,661	1,870	3,945

Unit: kg

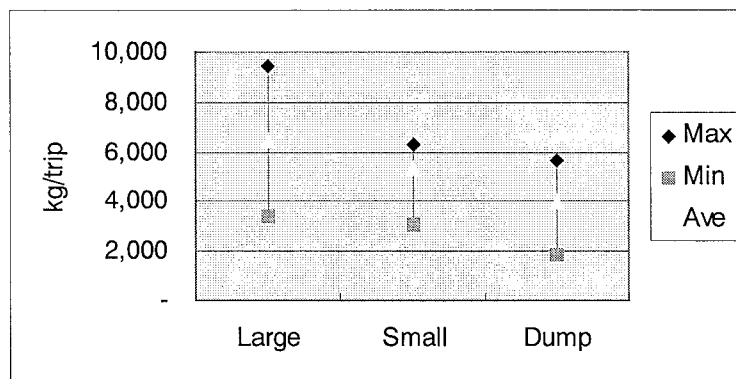


Figure D-3: Collection Amount per Trip in Vehicle Type

Figure D-4 shows that difference of collection amount between 1st trip and 2nd trip of the large compactor. It can be known that the 1st trip tends to collect more waste than 2nd trip, and the 1st trip has large unevenness.

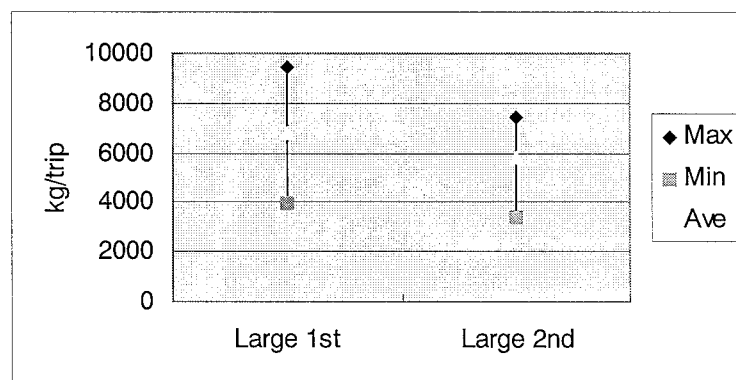


Figure D-4: Collection Amount in 1st Trip and 2nd Trip

Table D-8 and Figure D-5 show average collection amount per hour according to the type of vehicles. The productivity of the large compactor truck is the highest (2,621 kg/hour), the small compactor truck (1,988 kg/hour) follows it and the dump truck shows the lowest productivity (1,289 kg/hour) in the collection work.

Table D-8: Collection Amount per Hour in Vehicle Type

Item	Large compactor	Small compactor	Dump truck
kg/trip	6,474	5,295	3,945
t3(hr)	2.47	2.65	3.06
kg/hr	2,621	1,998	1,289

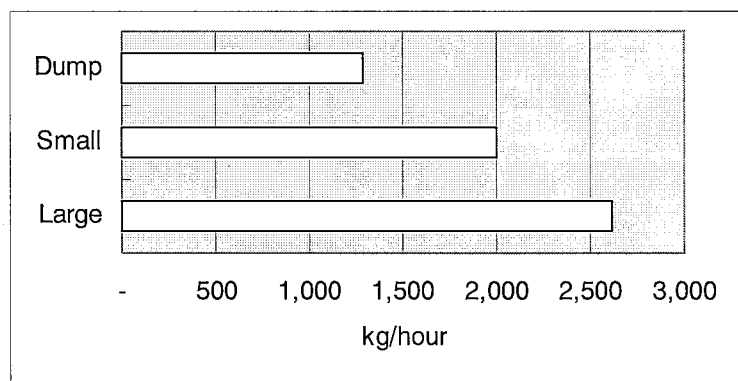


Figure D-5: Collection Amount per Hour in Vehicle Type

Table D-9 and Figure D-6 show productivity of collection workers according to the type of vehicles. Same as the productivity of the vehicles, the worker's productivity of the large compactor truck is the highest (655 kg/hour/worker), the small compactor truck (500 kg/hour/worker) follows it and the dump truck shows the lowest (368 kg/hour/worker). The number of workers for the small compactor truck, 4 persons that is the same as for the large compactor truck, may be too large.

Table D-9: Collection Amount per Hour per Worker in Vehicle Type

Item	Large compactor	Small compactor	Dump truck
kg/trip	6,474	5,295	3,945
t3 (hr)	2.47	2.65	3.06
kg/hr	2,621	1,998	1,289
Nos. of worker	4	4	3.5
kg/hr/worker	655	500	368

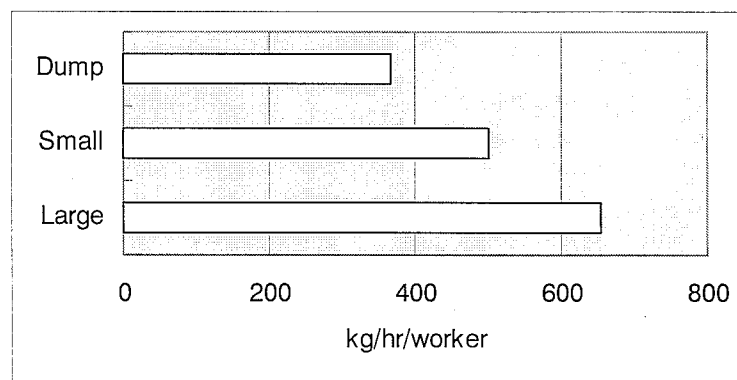


Figure D-6: Collection Amount per Hour per Worker in Vehicle Type

According to the findings above, the large compactor truck is the most efficient. It can be said that it is preferable to use the large compactor truck if conditions of collection routes allow to use it, e.g., collection routes are wide enough for it to pass.

b. In View of Location

In order to analyze influence of distance to the landfill (Nejapa) and the transfer site (Mariona) on waste collection, the data were compared according to the districts. The data discussed here do not include of the dump trucks because only the western district has them.

Table D-10 and Figure D-7 show that the west needs more time for one trip (6.32 hours) than the other districts (3.87, 4.21 and 5.04 hours for the central, east and north respectively), especially a longer time is required for haulage (1.88 hours for the west; 1.03, 1.27 and 0.77 for the central, east and north respectively). Table D-11 and Figure D-8 clearly indicate the reason why the west is required a long time for the haulage, the haulage distance is more than 70km per trip. On the other hand, the northern district can share more time for collection due to its proximity to the landfill and the transfer site (the haulage distance is 26.93 km).

Table D-10: Collection Time per Trip According to District

Task	Time (hours)				Proportion (%)			
	Central	West	East	North	Central	West	East	North
t1	0.13	0.54	0.21	0.16	3.4%	8.5%	5.0%	3.2%
t2	0.09	0.09	0.11	0.04	2.3%	1.4%	2.6%	0.8%
t3	2.17	2.66	2.07	3.38	56.1%	42.1%	49.2%	67.1%
t4	1.03	1.88	1.27	0.77	26.6%	29.7%	30.2%	15.3%
t5	0.15	0.31	0.14	0.22	3.9%	4.9%	3.3%	4.4%
t6	0.31	0.84	0.42	0.47	8.0%	13.3%	10.0%	9.3%
Total	3.87	6.32	4.21	5.04	100.0%	100.0%	100.0%	100.0%

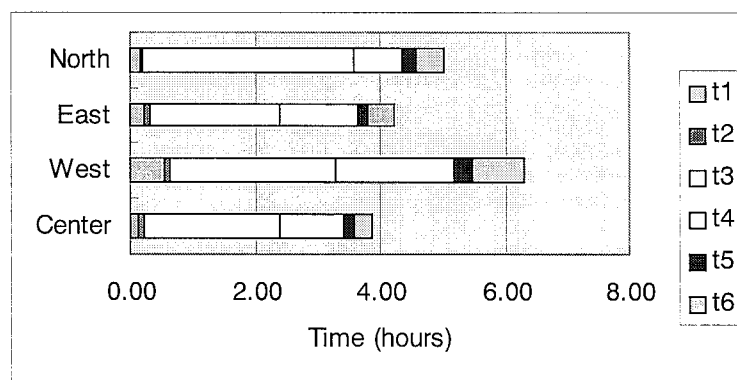


Figure D-7: Collection Time per Trip According to District

Table D-11: Distance per Trip According to District

Task	Distance (km)				Proportion (%)			
	Central	West	East	North	Central	West	East	North
t1	-	1.40	-	-	0.0%	1.6%	0.0%	0.0%
t2	0.97	1.12	1.70	0.41	2.0%	1.2%	3.4%	1.0%
t3	8.65	9.00	5.28	10.83	17.5%	10.0%	10.6%	26.8%
t4	37.13	75.53	41.27	26.93	75.2%	83.9%	82.9%	66.7%
t5	2.11	2.18	0.94	1.55	4.3%	2.4%	1.9%	3.8%
t6	0.50	0.82	0.61	0.66	1.0%	0.9%	1.2%	1.6%
Total	49.36	90.06	49.80	40.38	100.0%	100.0%	100.0%	100.0%

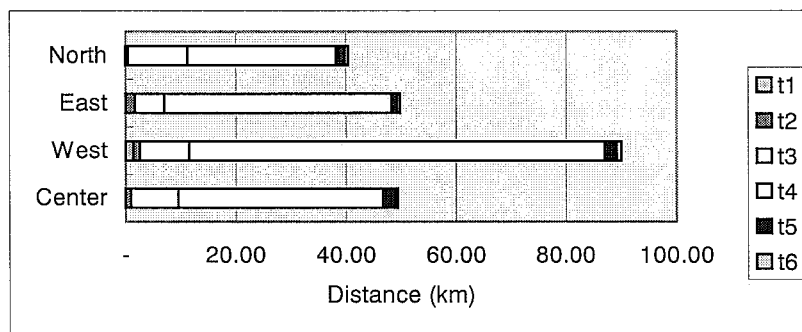


Figure D-8: Distance per Trip According to District

Table D-12 and Figure D-9 show the productivity of collection work, that is how much of waste is collected per hour (2,338 kg/hour, 2,005 kg/hour, 3,261kg/hour and 1,880kg/hour in the central, west, east and north respectively). Table D-13 and Figure D-9 show the collection amount per km of collection route. There is a relation between them, i.e., the larger collection amount per km, the larger collection amount per hour. However, it can also be seen that the collection work in the central is more efficient because the collection amount per km is almost the same as the west and north (about 600 kg/km), but collection amount per hour in the central is higher than the others. This would show that the collection route improvement, which has been conducted by San Salvador itself (the plan of it began in September 1999 and the execution started February 2000), is working well.

The collection area in the east is densely populated area. This is also known from Table D-13 and Figure D-10.

Table D-12: Collection Amount per Hour According to District

Item	Central	West	East	North
kg/trip	5,074	5,332	6,750	6,356
t3(hr)	2.17	2.66	2.07	3.38
kg/hr	2,338	2,005	3,261	1,880

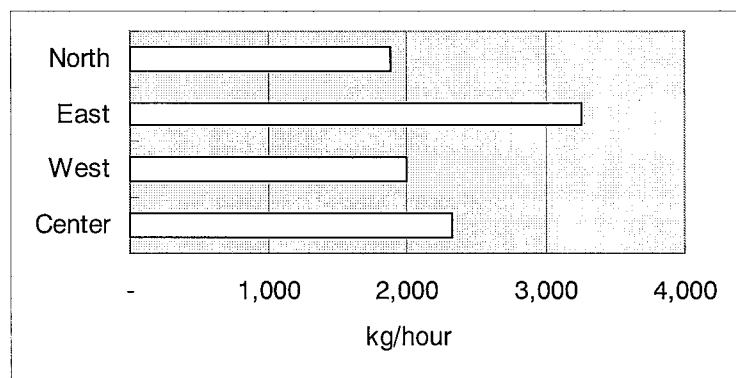


Figure D-9: Collection Amount per Hour According to District

Table D-13: Collection Amount per Km of Collection Route

Item	Central	West	East	North
kg/trip	5,074	5,332	6,750	6,356
t3(km)	8.65	9.00	5.28	10.83
kg/km	587	592	1,278	587

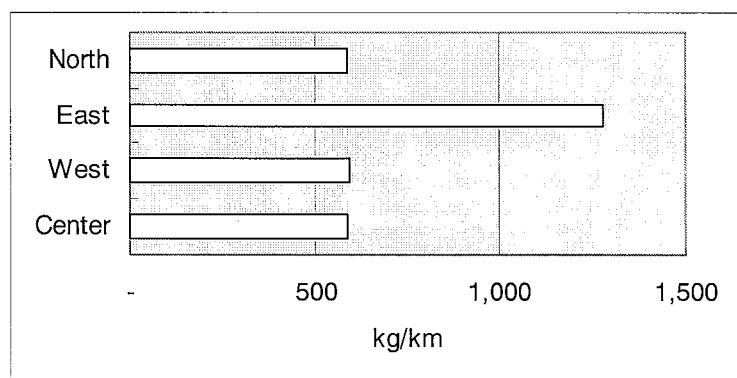


Figure D-10: Collection Amount per Km of Collection Route

According to the findings above, it is clearly seen that the distance to the landfill/transfer sites largely affects on the collection time. As for the productivity of the collection work, although the samples are small, it can be said that the collection work in the central district may be more efficient than in the others.

Annex E

Recycle Market Survey

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E Recycle Market Survey

E.1 Objectives

The surveys investigated present markets and potential demands for recycled materials, particularly compost and other valuables that would be generated by the technical alternatives to be proposed in the M/P.

The size of the markets and the prices of reusable articles are the main survey items since they could influence the selection of alternatives.

Information on items such as bottles, cans, papers, plastic and compost was investigated by interviewing waste picker, private collectors and recycling companies and by using existing data.

E.2 Methodology

a. Targets of Survey

The survey targets are following sectors.

- Informal sector
 - Waste picker
 - Private collector
 - Middlemen
- Formal sector
 - Recycling companies
 - Compost producer

b. Samples

The survey carried out for 22 samples. Table E-1 shows outline of surveyed samples.

Table E-1: Outline of Samples

No.	Name	Type of activity	Main product
01	Waste picker	Waste picking	-
02	Waste picker	Waste picking	-
03	Waste picker	Waste picking	-
04	Waste picker	Waste picking	-
05	Waste picker	Waste picking	-
06	Middleman	Brokerage	-
07	PROCOMES	Private Collectors	-
08	Vidrios y Latas	Private Collectors	-
09	Industrias y Destilería "El Muñeco"	Recycling Company	Re-use Bottle
10	Destilería LIZA, S.A. de C.V.	Recycling Company	Re-use Bottle
11	Fabrica de Vidrio (sin nombre)	Recycling Company	Recycled glass
12	HISPALIA, S.A. de C.V.	Recycling Company	Paper

No.	Name	Type of activity	Main product
13	Cartotécnica Centroamericana, S.A.	Recycling Company	Paper
14	MOLPASA (Molde de Panamá, S.A.)	Recycling Company	Paper
15	REPACESA	Recycling Company	Paper
16	CORINCA	Recycling Company	Steel
17	ACERO, S.A.	Recycling Company	Steel
18	INDRESA, S.A.	Recycling Company	Steel
19	SIDERURGICA SALVADOREÑA TINETTI, S.A. de C.V.	Recycling Company	Steel
20	La Constancia, S.A.	Recycling Company	Aluminum
21	Fundidora Elmos, S.A de C.V.	Recycling Company	Aluminum
22	SALVAPLASTICS, S.A. de C.V.	Recycling Company	Plastic

c. Survey Item

The survey items are as follows.

- General information of company (number of employee, type of company, established year, annual sales amount, main products or services)
- Major products and shipping item
- Profile of the major client (size of company, sales price and amount, etc.)
- Profile of the major supplier (type of supplier, type of material, original cost, supply amount)
- Processing method
- Opinion (cooperation of recycle activities, trend of production amount, etc.)

E.3 Results of Survey

E.3.1 Supplier

a. Waste Picker

Waste pickers are the main segregators of recyclable products in municipal dumping sites.

They sell the products to local middlemen that are also found in the same municipal dumping site. They can work individually although in general terms the work is conducted by the family group, which is formed by 3 to 6 members that contribute in the collection and selection of municipal wastes.

In the case of San Salvador metropolitan area (AMSS), in the “Mariona dumping site” located at the intersection of the street to Mariona and the road that leads from Apopa to Nejapa, waste pickers wait for the collection trucks to discharge the load. It confirmed that the main recyclable products are: aluminum cans, paper, iron and glass bottles (transparent and dark).

After the products are collected and classified they are sold to wholesale collectors within the dumping site or to middlemen. Table E-2 summarizes the items collected, the sale prices and the amounts gathered per week per scavenger.

Table E-2: Sale Price and Amount in Mariona Dumping Site

Name of material	Sale price		Collection amount	
Used aluminum can	4.40 to 5.28	colones/kg	16.82 to 72.72	kg/week
Used paper	0.55	colones/kg	68.18 to 90.90	kg/week
Used iron	0.44	colones/kg	127.26	kg/day
Used glass bottle	0.25 to 1.60	colones/bottle	not specified	

Currently, the perception by waste pickers is that they are being deprived from their work sources, because as from the construction of the new sanitary landfill in Nejapa the garbage discharged in the old dumping site belongs to residential houses, whereas the wastes from big companies is carried to the landfill. As a consequence, their revenues are decreasing day after day. This situation directly affects their survival, which in turn leads to a conflict between waste pickers and the managers of the sanitary landfill.

During the visit to Mariona dumping site a great distrust by waste pickers towards any strange person entering the site was observed. They think they will be deprived from their working sources and some of them think they should be compensated due to the economic loss caused by the decrease of solid wastes.

Another problem faced by waste pickers is represented by middlemen, since they pay them an inferior price to which corresponds truly to the material collected; to the extent that materials such as iron, glass pots and plastics are not collected because the price received is very low and the effort to collect them is considerable. For this reason, they only collect paper and aluminum cans. This contributes to the fact that a greater amount of waste is disposed of, and many of the latter could be recycled if the price paid for them compensated the effort performed.

In summary, a considerable number of waste pickers that do not agree with the policies of the new waste processing enterprise, waste pickers request a compensation of 15,000 colones to be able to be relocate in other places.

b. Middleman

Local middlemen buy items from scavengers inside the dumping site to resell them to intermediary wholesalers or directly to the purchasing companies.

The activity of middlemen is practically familiar, since all their members contact the scavengers for the purchase of the recyclable material classified by them. Table E-3 shows purchase price of each item.

Table E-3: Middleman Purchase Price of Each Item

Item	Purchase price
Bottle	2.00 colones/bottle
Aluminum can	2.15 colones/kg
Paper	0.44 colones/kg

They are interested in the purchase of transparent bottles, aluminum cans and paper (newspaper and magazines). The items collected are sold to companies that process

these materials. In the last two years the number of bottles purchased has decreased drastically, because they do not have a good price and demand is not high.

It is important to mention that honey producers, as well as spice sellers and other product sellers in municipal markets use glass and plastic containers already discarded to pack the products that they commercialize.

c. Private Collector

c.1 Association of Communal Projects of El Salvador, PROCOMES

It is a non-governmental organization created in 1998, and integrated by approximately 35 micro-entrepreneurs that work within an specific zone of AMSS.

The work of each micro-entrepreneur consists of the collection of wastes in a certain area, which is later selected and classified as material that can be recycled or material for the sanitary landfill. The first classification is sold to middlemen such as the Salvadoran Recycling Industry (INDRESA) or to recycling companies in variable quantities.

Micro entrepreneurs mainly collect in the housings located at their work places such products as newspapers, bond paper (white), cardboard, aluminum cans, aluminum (window frames), burnt copper, liquor glass bottles, plastic (oil bottles, water bags, recipients, etc.) and iron. Table E-4 shows the materials commonly collected, as well as the main customers and sale prices.

Table E-4: Sales Price

Item		Sales price (colones/kg)	Main customer
Paper	Newspaper	0.44	REPACESA
	Office paper	0.77	REPACESA
	Cardboard	1.10	CARTOTECNICA
Plastic	High density (bottle)	2.20	EL PANDA
	Low density (water bags)	1.32	SALVAPLASTIC
Aluminum	Cans	3.30	INDRESA
	Ingot	3.30	Intermediarios
Steel		0.44 to 0.88	CORINCA
Copper		5.50	-

PROCOMES points out that they have the capacity to select and classify more material than that currently received.

c.2 "Vidrio y Aluminio"

A private company created in 1998; it has five employees and it is interested in the acquisition of glass (mixed bottle), aluminum (cans, thin plates) and paper (newspaper, magazines and cardboard).

Their main customers are small companies. They did not specify the amount of items that they buy or sell; however, the prices paid by this company for glass bottles are 0.10 colones/bottle, 2.00, 0.33 and 0.22 colones/kg for aluminum, paper and plastic respectively.

Their main suppliers are waste collectors and they do not specify the capacity of the enterprise to buy materials; however, they manifested that all raw materials they trade come from recycled materials.

c.3 Micro-enterprises

Micro-enterprises that collect paper, cans and bottles from the surrounding places to the Central Market and La Tiendona refused to provide information, since they feel that the sanitary landfill is a "giant" that can take their job away. They have agreed to standardize the price of purchase of the material obtained and some of them specialize in collecting a single class or brand of containers.

E.3.2 Recycle Industries

a. Glass

These enterprises buy recyclable items and belong to the formal sector; they purchase these products or waste to export them or to incorporate them as raw material to their production process.

a.1 Bottle Reuse Companies

a.1.1 Industrias y Destilerías "El Muñeco"

This company, founded in 1970, is devoted to the production of liquor and bottles the product in returnable glass bottles, since the consumers exchange an empty bottle plus a certain amount of money for one bottle with liquor in liquor stands. This company only trades with its own containers; they do not buy used bottles of other brands of any other glass type, and if new containers are required, these are imported.

a.1.2 Destilería LIZA, S.A. de C.V.

It is devoted to the production of liquor like the Vodka Smirnoff and other brands. Their annual sales add up to 3 million bottles of liquor.

The company buys the Vodka Smirnoff container and the "standard" bottle in its different sizes and in good conditions. Their suppliers are the consumers, waste collectors (micro-enterprises, sweepers, municipal workers of collection teams), middlemen and peddling collectors from whom they buy around 100,000 units per month to a price of 0.75 colones/unit. It is estimated that 28.6% of the total units produced is bottled in reused units.

a.2 Processing Company

There is only one enterprise in the country devoted to the processing of glass. It has no registered name and is located at km. 21 of Comalapa freeway. They produce ornamental handcrafts, fruit bowls, vases, glasses, table and wall lamps, street lamps and so on, by grinding, washing and founding the glass. The price for such articles ranges from 20 to 200 colones per unit. It has 12 employees with a capacity to process one ton/day and it has been working for 25 years.

The company buys bottles and transparent, brown, blue and green broken glass. Its main supplier is Coca Cola and in a smaller degree La Constancia, La Cascada and Ilopania. The approximate price of purchase is 100 colones/ton.

Their main clients are particulars and small-scale merchants. Currently there is no production since a new furnace is being built, which will be operating by middle March of this year.

b. Paper

One of the most important ones is INVERSIONES REPACESA, previously known as Servicios Papeleros Centroamericanos, S.A. or SEPACESA, is devoted to the collection, selection, compacting, cutting and distribution of used paper.

Currently they have gathering centers in the departments of Santa Ana, San Miguel and San Salvador. In these centers paper and cardboard from banks, governmental and private companies, schools, universities, printing companies and houses of neighborhoods in AMSS are collected.

The enterprise has 10 mobile units in AMSS that collect 80% of the material being handled. Besides, private collectors carry newspapers, magazines and all types of paper to the main storage center. The company pays 0.77 colones/kg of mixed paper and 0.22 colones/kg for printed newspaper; if the company directly collects the material, the price paid decreases by 0.05 colones/kg.

According to data gathered in the survey, REPACESA buys around 6,200 tons/year. However, their processing capacity could be five-folded if they had more transportation units and investment on machinery and equipment be increased.

REPACESA is Kimberly Clark's and HISPALIA, S.A. de C.V. supplier, which process paper and cardboard respectively. According to data provided by the person interviewed, Kimberly Clark has an estimated demand for year 2000 of 30,000 to 40,000 tons, whereas REPACESA only covers 50% of the previous demand and the rest is imported mainly from the United States. This fact shows that the paper recycling industry needs to be supplied with additional raw materials, which would help decrease the quantity of wasted paper that are disposed of at the sanitary landfill and in turn generate revenues for a greater number of scavengers families.

The price of sale of the material collected by REPACESA is confidential; however, they stated that in order to determine the sale price they added the collection, purchase, production, administration, freight and utilities cost to such material.

b.1 Recycling Companies

b.1.1 HISPALIA, S.A. de C.V.

The activities performed during the production process are shredding and washing of cardboard, which constitutes the raw material for the elaboration of cardboard products. and that are distributed by bookstores and traders of school stationery.

Their main supplier is REPACESA. According to the survey, HISPALIA, S.A. de C.V. has the capacity to process 168 tons of paper per year, 100% of which comes from waste material. Table E-5 shows some characteristics of the products elaborated, as well as the material.

b.1.2 Cartotécnica Centroamericana, S.A.

It was established in 1965 and it has 725 employees; it is devoted to the production of two paper lines. The first line produces flat paper such as bond paper, notebooks, office stationery, newspaper for printings, gift wrapping paper, bristol board,

envelopes and kraft paper. The second line produces tissue paper (i.e., toilet paper, napkins and towel paper).

The materials acquired by the company as raw materials are cardboard, waste kraft paper, cotton fiber waste, refuse from the production process and material imported from the United States.

Around 800 to 1000 tons/year of flat paper, of which 15% comes from recycled material.

Regarding toilet paper a 100% white paper is produced, with natural and artificial colors. Natural-colored and artificial colors are obtained from a 100% recyclable material, whereas in the production of 100% white paper between 50 to 100% of raw material comes from recycled items.

Generally speaking, in the whole productive process, including both lines, 80% of the materials come from recycled paper, and the remaining is formed by virgin fiber. Table E-5 shows other features of the company itself.

b.1.3 MOLPASA (Moldes de Panama, S.A.)

This company previously belonged to the Grupo Industrial Diversificado, but it became independent as of January 2000.

They concentrate on the manufacturing of cardboard separators for eggs. Their main raw material is recycled newspaper in approximately 70% and the rest are colorants, antifoam (aluminum hydroxide) and a waterproof compound. The process encompasses the emulsification of the mixture, molding and drying-up. Table E-5 shows the features of this company.

Table E-5: Outline of Paper Recycling Companies

	HISPALIA, CORP. de C.V.	CARTOTECNICA CENTROAMERICANA, S.A.	MOLPASA Moldes de Panama, S.A.
Production process	Shredding and washing	Shredding, Washing and De-inking	Emulsification, Molding and Drying up
Manufactured products	Cardboard products	Notebooks, bond paper, kraft paper, gift wrapping paper, bristol boards, envelopes and other office stationery. Toilet paper, towel paper and napkins.	Egg cardboard separators
Sale price	Varies according to the product	Varies according to the product	0.49 colones/unit
Main customers	Companies in general at national level	Bookstores Population at a national level Paper distributors	In El Salvador 40% of the production is commercialized. The main customers are Avícola Salvadoreña and El Granjero. The remaining 60% is traded at a Central American level.
Products sold	Not specified	Not specified	914.30 tons are produced annually. 365.72 tons per year are commercialized in El Salvador 548.58 tons per year are traded at a Central American level

	HISPALIA, CORP. de C.V.	CARTOTECNICA CENTROAMERICANA, S.A.	MOLPASA Moldes de Panama, S.A.
Raw material	Cardboard	Cardboard Waste from production process Material imported from the United States	Newspaper, Magazines
Main suppliers	REPACESA	Citizens, Industry, Middlemen	Industry La Prensa Gráfica Middlemen (gathering center at the Central Market)
Purchasing price	Not specified	Not specified	1.32 colones/kg
Raw material from recycling (%)	100%	80%	70% newspaper
Amount of material willing to buy	168 tons/year	2,400 tons/year	1,523.83 tons/year of newspaper

c. Iron Recycling Companies

c.1 CORINCA

It is mainly devoted to the selection and casting of steel scrap, and steel bars are their main product.

70% of the scrap that they buy for processing comes from Guatemala, Honduras and Nicaragua, and the rest from domestic suppliers of the informal sector (middlemen, peddling collectors). 40% of their production is dedicated to export (see Table E-6).

c.2 ACERO, S.A.

It is devoted to the selection and casting of steel scrap as the previous company. 70% of the raw material comes from recycling and is bought from different members of the informal sector (middlemen and waste collectors); however, only 10% of it comes from El Salvador, the rest is bought from the Central American area.

Scrap is blended with alloys to obtain what is known as *palanquilla* (billet) that is cut to obtain the iron bars. The latter are distributed in domestic hardware stores and a part is exported (see Table E-6).

c.3 INDRESA, S.A.

This company is devoted to the cleaning and packing of steel and aluminum, which is exported to the United States after being processed; that is why the sale prices vary according to Chicago stock exchange.

On the other hand, the institution is in contact with some non-governmental organizations (NGOs) that support the micro and medium-size enterprises. However, the municipality of San Salvador has not provided any support so far, that is why they ask this entity to cooperate in the treatment of recyclable material (see Table E-6).

c.4 SIDERÚRGICA SALVADOREÑA TINETTI, S.A. de C.V.

It has been operating for around 50 years, but currently it is devoted exclusively to the purchase of steel scrap, which is sold in Guatemala to Guatemala Steel Casting to a price of 0.66 colones/kg.

They consider that the demand of its company increases in the first months of the year because other casting companies like CORINCA begin purchasing material in

April and/or May. The enterprise projects the opening of the laminate section again (see Table E-6).

Table E-6: Outline of Steel Recycling Companies

	CORINCA	ACERO, S.A.	INDRESA, S.A. de C.V.	SIDERURGICA SALVADOREÑA TINETI, S.A. de C.V.
Production process	Selection, Casting	Selection, Casting	Aluminum compaction and washing Steel Compaction	Selection, packing
Manufactured products	Iron bars	Iron bars	Packed material	Packed material
Sales price	3.08 colones/kg	3.19 colones/kg	According to Chicago stock exchange	0.66 colones/kg
Main customers	They distribute their product domestically and Central America	They distribute their product domestically and Central America	All processed material is exported to the United States	Guatemala Steel Casting
Sold amount	1,250,000 quintals/year	33,600 tons/year	1,500 metric tons/year	Not specified Not specified
Raw material	Steel scrap	Steel scrap	Aluminum cans Steel ingot	Steel scrap Steel cans and thin plate
Main suppliers	Informal sector (middleman and waste collectors)	Waste collectors	Imports from Central American area In El Salvador middleman	Citizens, Industry, Waste collectors
Purchasing price	0.55 colones/kg	0.55 colones/kg	4.40 colones/kg (aluminum)	scrap:0.35 col./kg can :0.20 col./kg
Raw material from recycling (%)	70 %	70 %	100 %	100 %
Amount of material willing to buy	Not specified	Variable	Not specified	Not specified

d. Aluminum Recycling Companies

d.1 La Constancia, S.A.

Founded in 1906, it is the leading company in the recycling of aluminum cans. It acts as a recycling middleman by collecting, compacting and baling can to export it abroad, where it is transformed into a new product. The collection activity of aluminum cans with recyclable purposes covers the whole nation, since there exist gathering centers or deposits of La Constancia around the country.

Conducting the survey with this company was really difficult because the control to enter its facilities is very rigorous; however, it was confirmed that the company is only devoted to the collection and compacting of aluminum cans by means of micro-enterprises, informal salespersons and waste collectors.

The current price of purchase is 3.30 colones/kg of cans to private collectors and 4.40 colones/kg to micro-enterprises. The amount purchased was not specified since it is variable and depends on what the suppliers furnish them with.

d.2 Fundidora Elmos, S.A de C.V.

Created in 1966, it is devoted mainly to aluminum, bronze and copper casting for the production of signs, plates and letters. Its customers are small companies and the amount sold to them is not specified.

Raw materials utilized aluminum, bronze and copper ingots, being their main suppliers the waste collectors who are paid 2.20 colones/kg of material collected.

The interviewed person mentioned that the company currently has spare material, reason why they are not buying any material now.

e. Plastic Recycling Company

The main companies within this field are SALVAPLASTIC and EL PANDA. One is detailed next.

e.1 SALVAPLASTICS, S.A. de C.V.

Created since 1983, it is devoted to the production of plastic items such as *guacales* (portable crates), polyducts and containers. The production processes encompass the selection, grinding and heating of raw materials. Their annual sales added up to 100 million colones and the price of the products is variable.

The company mainly buys polyethylene from waste collection micro-enterprises, who are paid 2.00 colones/kg of material and that must be clean. 20% of raw materials used in the production process from recycled material, with a demand of around 270,000 kg/year.

E.3.3 Compost

The market of organic manure or compost is quite restrained, with the participation of the producers themselves and whose demand is limited.

The municipality of San Salvador is executing the compost production project from waste of "La Tiendona" market. This place generates 3.8 tons/day of organic waste, from which 0.5 ton/day of compost are obtained. At the moment this process is being carried out in the surroundings of the former dumping site located on the street to Mariona.

In order to determine the demand and supply of compost in San Salvador area, interviews to technicians whose activity is related to the handling of solid waste were carried out. To achieve this, institutions such as the municipality of San Salvador (Department of Environmental Sanitation), *Manejo Integral de Desechos Sólidos* (MIDES), *Universidad Técnica Latinoamericana* (UTLA), *Centro de Tecnología Apropriada* (CESTA), among others.

These interviews were conducted with the purpose of determining if there were other projects that could be used as a basis for the Study.

Compost is used mainly by the municipality of San Salvador for gardens and green areas that are provided maintenance. Surplus is sold at 40 colones/sack, and yet the price is low the demand is not so much because of the unawareness of its benefits and its chemical composition.

In the beginning it was considered that the limited demand was due to the unawareness of the existence of this product, reason why a survey was conducted in which 15 farmers were visited at their properties in Planos de Renderos, Soyapango, Zapotitán and Huizúcar. They were asked if they had interest in buying compost produced from market waste with a sale price of 40 colones/sack. Answers were as follows:

85% of those interviewed stated that they will not buy the compost because they fear their cultivation was attacked by plagues and diseases transmitted through compost, despite of the fact that they know the benefits of it.

The remaining 15% said that they could buy it as long as the content of nutrients in the compost was analyzed and identified in the sack, such as nitrogen, phosphorus and potassium. The latter was with the purpose of determining the volume of compost needed to substitute a quintal of fertilizers.

A survey among the owners or managers of greenhouses was also conducted; just like the farmers did, they feared plagues and diseases coming from this product, reason why they are not willing to buy it. They affirmed that they have the capacity to produce the compost they require, which they generate from fallen leaves. The sale price of a small bag (2 kg) is 5 colones and they assure that their product meets the demand of all greenhouses and residential gardens.

E.3.4 Opinion of Interviewee

Three questions were asked in the surveys to know the opinion of the actors in the market and the following results were obtained:

93% of the companies say that the recycling industry should cooperate at a national level, and specifically with the municipalities, in the handling of solid waste.

On the other hand, regarding the query about the necessity of some kind of support, 36% of the interviewed mentioned that they require both financial and technical support to improve their productive process, as well as legal advising and fiscal incentives. Only big enterprises such as La Constancia and CORINCA mentioned that they do not need this type of support.

Finally, when questioned about the trend of their production, 42% of the enterprises consider that it is increasing; this group is constituted by iron and steel producers, plastic (SALVAPLASTIC) and the distillery El Muñeco, which only reuses bottles but does not recycle glass. 14.3% affirmed that their production is increasing considerably, such as those big companies as La Constancia of aluminum cans and CARTOTECNICA that recycles cardboard. 28.6% of the enterprises state that their production is stable and 7.1% say that their production is variable.

With the previous data it can be affirmed that the recycling industry is growing, specially the metallurgic, paper, aluminum and plastic one.

E.4 Findings

Table E-7 tries to summarize the market trends of recyclable products. This information is not based on numeric data due to the lack of collaboration by enterprises, which did not provide the figures to establish such them categorically.

However, according to some data provided by them and to different interviews the tendencies followed by the market can be determined.

Table E-7: Expected Trend of Recycle Market

Item		Trend
Paper		Increasing
Glass	Glass	Stable
	Glass bottles	Liquor : Stable
		Others : Decreasing
Metal	Iron	Increasing
	Aluminum	Increasing
Plastic		Stable
Compost		Stable

a. Paper Market

This is one of the items with a greater demand in the market, since the collectors consider that they obtain quite acceptable revenues when selling it. It can be affirmed that this activity has a great future and its trend is increasing, due to that expressed by the companies that buy it.

According to REPACESA, with the current supply of the item only 50% of the national demand is covered; therefore, if the collection is better organized and all the material that can be recycled is better used there would be no currency drain for the purchase of material abroad.

The total demand cannot be quantified due to a lack of information, but the enterprise that demands paper the most is Kimberly Clark, and it is informed that this company will require between 30,000 to 40,000 metric tons of material.

b. Glass Market

b.1 Reuse

This activity is very useful for the El Muñeco distillery because the commercialization is very efficient; the consumers take containers to retail stores and the container is assigned a price when buying the new bottle.

Liza distillery is another company that reuses the containers of Smirnoff Vodka; currently 28.6% of the total of units produced is packed in reused bottles. The enterprise has the capacity to buy more units but the demand does not increase considerably.

b.2 Recycling

The remaining glass bottles do not have an established demand because there is just one glass recycling enterprise in the country and it is small, besides the raw material is supplied mainly by soda companies.

The activity of glass recycling would have a better future if the number of glass recycling enterprises increase, and the reuse of bottles will also increase.

c. Metal market

Metal recycling is an activity that is increasing and can generate revenues for the collectors. The problem is that in the case of iron there exist not many middlemen for the purchase of this product, as some of them affirmed. Besides, since materials are heavy, transportation must be carried out in vehicle and this fact reduces the revenue, the middleman pays less than what is paid at the recycling enterprises and he has to bear the haulage cost.

In summary, if wholesalers authorized by the companies in some collection points existed, people would probably be motivated to collect this product and its sale would be more dynamic implying that the country could supply at least most of what is needed for the production process.

Aluminum is another item with a high demand and, according to its main buyer, they have the capacity to acquire all that is supplied to them. This market in particular tends to increase, and many people on the streets collect this material.

d. Plastic Market

In this activity only primary information by SALVAPLASTIC was obtained. They affirmed that they cannot buy more material because they only have a machine for recycling and their approximate demand of 225,000 kg/month is supplied by the output remainders from several companies.

Meanwhile, as an inquiry is not accepted by EL PANDA that is the largest waste plastic recycling company in the Study Area, whose input amount (waste plastic) and production amount (recycled plastic) was not obtained.

Therefore, the market size for waste plastic recycling in AMSS is not forecast herewith. However, in view of numbers of present plastic recycling companies in AMSS, it could be considered that the present market size of plastic recycling will be maintained in the same scale.

e. Compost

Inquiries to compost consumers suggest that compost demand will not be raised more than that of today due to the inferior quality of the same.

However, if composting is considered not as production of fertilizer/soil conditioners but as reduction measures for SW final disposal, compost can be appreciable as a not-expensive competitive volume reduction process. In addition, the compost produced might be usable as covering materials for landfills.