C.2 Time and Motion Survey

C.2.1 Objectives

The main objective of the survey is to have a better understanding of the current situation of waste collection and transport with the purpose to formulate an appropriate collection and transport plan through the use of indicators derived during this survey.

C.2.2 The Survey Schedule

a. Target vehicles and Areas

The target vehicles were the most widely used vehicles by DIMAUD, the compactors of 11 and 16 yd^3 .

From the discussion between the C/P and the Study Team the following routes were selected for the T&M field studies:

Target Area	Corregimiento	Location and Route1			
Urban Area	Bella Vista	Bella Vista (AN-3-05)			
	Calidonia	 Marañón (AN-01-03) 			
	 Río Abajo 	• Río Abajo (BD-06-01)			
Old Section of the City	San Felipe	San Felipe (AD-03-03)			
Village	Pacora	• 24 de Diciembre, (BD-04-01)			
	Alcalde Díaz	• La Cabima, (BD-05-05)			
Area of Detached	 Juan Díaz 	• Don Bosco, (BN-03-02)			
Houses	 Juan Díaz 	• Radial, (BN-04-02)			
Aggregated Residential	Chorrillo	Chorrillo (AD-03-01)			
Area	San Francisco	Punta Paitilla (BN-01-05)			

Table C-33. Aleas Selected for Time and Motion Survey	Table C-39:	Areas Select	ed for Time	and Motion	Survey
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¹ The routes are classified according to Section of the city (A or B), collection time (D for Daytime and N for Nightime), zone, and route. For example, code No. BD-04-01 implies collection in section B during Daytime, zone 04, and route 01.

b. Schedule for Time and Motion Survey

The survey took place between January 18th, 2002 and February 5th, 2002. The schedule was established to cover all routes three times: at least one Saturday and one Monday, and any other day between Tuesday and Friday. The following table shows the schedule followed by the study.

Route	Capacity of vehicle	No. of vehicle	Day	Time Period
Punta Paitilla	16 yd3	• 1926	• Fri./18/Jan.	• 6:00 pm – 2:00 am
(BN 01-05)		 1909 and 1929 	• Sat./19/Jan.	• 6:00 pm – 2:00 am
		• 1940	Mon./21/Jan.	• 6:00 pm – 2:00 am
Bella Vista	16 yd3	• 239 (2956)	• Sat./19/Jan.	• 6:00 pm – 2:00 am
(AN 03-05)		• 1902	Mon./21/Jan.	• 6:00 pm – 2:00 am
		• 1902	• Tues./22/Jan.	• 6:00 pm – 2:00 am
Rio Abajo	16 yd3	• 1917	• Sat./19/Jan.	• 12:00 noon-8:00 pm
(BD-06-01)		• 1917	Mon./21/Jan.	• 12:00 noon-8:00 pm
		 1932 and 1933 	• Wed./23/Jan.	• 12:00 noon-8:00 pm
 Marañon 	16 yd3	• 1905	• Thu./24/Jan.	 6:00 pm – 2:00 am
(AN 01-03)		• 240 (2957)	• Sat./26/Jan.	• 6:00 pm – 2:00 am
		• 333 (2967)	Mon./28/Jan.	• 6:00 pm – 2:00 am
San Felipe	11 yd3	• 1903	• Fri./25/Jan.	• 6:00 am – 2:00 pm
(AD 03-03)		• 1903	• Sat./26/Jan.	• 6:00 am – 2:00 pm
		• 1903	Mon./28/Jan.	• 6:00 am – 2:00 pm
• 24 de	16 yd3	• 1908	• Sat./26/Jan.	• 6:00 am – 2:00 pm
Diciembre		• 1931	Mon./28/Jan.	• 6:00 am – 2:00 pm
(BD-04-01)		• 1933	• Tue./29/Jan.	• 6:00 am – 2:00 pm
Don Bosco	16 yd3	• 1947	• Sat./26/Jan.	• 6:00 pm – 2:00 am
(BN-03-02)		• 1938	 Mon./28/Jan. 	• 6:00 pm – 2:00 am
		• 1928	• Wed./30/Jan.	 6:00 pm – 2:00 am
Radial	16 yd3	• 1932	• Thu./31/Jan.	• 6:00 pm – 2:00 am
(BN-04-02)		 1934 and 1908 	• Sat./2/Feb.	• 6:00 pm – 2:00 am
		• 1937	 Mon./4/Feb. 	• 6:00 pm – 2:00 am
La Cabima	16 yd3	• 1929	• Fri./1/Feb.	• 6:00 am – 2:00 pm
(BD-05-05)		• 1936	• Sat./2/Feb.	• 6:00 am – 2:00 pm
		• 1936	 Mon./4/Feb. 	• 6:00 am – 2:00 pm
Chorrillo	16 yd3	• 239 (2956) and 1907	• Sat./2/Feb.	• 6:00 am – 2:00 pm
(AD 03-01)		• 239 (2956)	• Mon./4/Feb.	 6:00 am – 2:00 pm
		• 239 (2956)	• Tue./5/Feb.	• 6:00 am – 2:00 pm

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Note: Some days two trucks were used for the same route because the first one was damaged (e.g., Punta Paitilla on the 19th of January when 1909 and 1929 were utilized). The numbers that are shown in parentheses are alternative codes for the same truck.

C.2.3 Survey Record

The study was conducted by following up the collection vehicles selected for each area. A format sheet was prepared to register the following basic information: date, collection area and route, vehicle number and type, capacity, combustible consumption, collection method, collection shift, and crew. Additionally, on the field, time and distance for 7 type of activities were recorded. The activities were:

t ₁ =	initial preparation and maintenance of the vehicle, and washing of the vehicle after collection					
t ₂ =	time and motion from DIMAUD's depot (Carrasquilla or Curundú) to collection area					
$t_3 =$	collection					
$t_4 =$	time and motion from collection area to Final Disposal Site (Cerro Patacon) and vice versa					
$t_5 =$	activities in Cerro Patacon (weighing and unloading)					
$t_6 =$	time and motion from Cerro Patacon to depot					
t ₇ =	other activity not included above, e.g., maintenance in the collection area. In San Felipe, most of the time and distance recorded for this activity was related to activities not planned for that day's collection, for instance, going directly in the morning from the depot to Cerro Patacón because the truck was loaded from the previous night.					

The odometers of the trucks did not work; consequently, the total distance could not be compared between the collection vehicle and the follow up vehicle.

The surveys record does not include information to calculate indicators for the following cases.:

- *Rio Abajo* on the 23rd of January because no weighing data could be obtained; the truck No. 1932 was damaged at the landfill site, and the second trip, the truck No. 1933 was conducted and parked loaded in Carrasquilla after collection.
- *24 de Diciembre* on the 26th of January because truck No. 1928 was damaged and replaced by truck No. 1908; however, data for the second truck was included.
- *24 de Diciembre* on the 28th of January because the truck No. 1931 was damaged in the collection area after 1.35 hrs. of collection work; no weighing data was available.
- *Chorrillo* on the 2nd of February because the truck No. 239 went directly to Patacon to dispose waste collected from the previous night and was damaged; however, information from the truck No. 1907 which replaced it that day was included in the records.
- *Radial* on the 2nd of February because the truck No. 1934 was damaged after 2.4 hrs. of collection and no weighing data is available; however, information from the truck No. 1908 which replaced it was included in the records.

Following tables show the most important results from the surveys:

	Activity in hours and their Percentages							Total
Type of Area	T1	T2	Т3	T4	T5	T6	T7	
Aggregated Residential (hrs.)	3.2	1.0	23.1	9.5	3.7	2.2	2.4	45.0
Percentage (%)	7%	2%	51%	21%	8%	5%	5%	100%
Detached houses (hrs.)	0.6	2.9	23.1	5.9	1.9	1.4	2.1	37.9
Percentage (%)	2%	8%	61%	16%	5%	4%	5%	100%
Urban (hrs.)	2.6	1.4	39.0	6.5	2.8	2.5	4.6	59.2
Percentage (%)	4%	2%	66%	11%	5%	4%	8%	100%
Old Section of the City (hrs.)	2.8	0.9	4.3	1.2	0.8	1.0	3.5	14.4
Percentage (%)	19%	6%	30%	9%	5%	7%	24%	100%
Village (hrs.)	2.6	3.0	19.2	6.2	1.9	2.0	1.2	36.1
Percentage (%)	7%	8%	53%	17%	5%	6%	3%	100%
Grand Total (hrs.)	11.8	9.1	108.8	29.3	11.1	9.0	13.6	192.7
Percentage (%)	6%	5%	56%	15%	6%	5%	7%	100%

Table C-41: Time Elapsed for Each Activity and Type of Area

Table C-42: Distance Traveled During Each Activity, Type of Area, and Number of
Trips

Type of Area	Number		Activity in Kilometers						
Type of Area	of Trips	T1	T2	Т3	T4	T5	T6	T7	TOLAI
Aggregated Residential	14	0.0	34.7	57.7	304.8	40.5	75.0	39.1	551.8
Detached houses	10	0.0	71.4	85.3	270.6	24.3	63.0	17.6	532.2
Urban	15	0.0	32.4	140.0	248.7	35.1	104.3	36.3	596.8
Old Section of the city	3	0.0	24.9	24.4	44.3	10.8	43.4	15.0	162.8
Village	7	0.0	110.2	91.8	222.7	16.2	53.8	9.9	504.6
Total	49	0.0	273.6	399.2	1,091.1	126.9	339.5	117.9	2,348.2

Disposal Amount (Tons)						
Type of Area	Route	Day	Trips	Total (Tons)		
Aggregated Residential	Chorrillo	02-Feb-02	1	4.23		
		04-Feb-02	2	12.73		
		05-Feb-02	2	8.72		
	Punta Paitilla	18-Jan-02	3	14.28		
		19-Jan-02	3	12.65		
		21-Jan-02	3	14.95		
Detached houses	Don Bosco	26-Jan-02	2	7.22		
		28-Jan-02	2	10.92		
		30-Jan-02	1	6.03		
	Radial	01-Feb-02	2	6.45		
		02-Feb-02	1	2.97		
		04-Feb-02	2	8.01		
Urban area	Bella Vista	19-Jan-02	2	10.45		
		21-Jan-02	2	11.84		
		22-Jan-02	2	12.51		
	Marañón	24-Jan-02	2	12.56		
		26-Jan-02	2	11.07		
		28-Jan-02	2	13.73		
	Rio Abajo	19-Jan-02	1	7.37		
		21-Jan-02	1	8.08		
		23-Jan-02	1	4.69		
Old Section of the City	San Felipe	25-Jan-02	1	1.89		
		26-Jan-02	1	3.43		
		28-Jan-02	1	2.28		
Village	24 de Diciembre	26-Jan-02	1	5.45		
		28-Jan-02	0	0.00		
		29-Jan-02	2	8.51		
	La Cabima	01-Feb-02	1	5.14		
		02-Feb-02	1	4.60		
		04-Feb-02	2	11.11		
Grand Total			49	243.87		

Table C-43: Disposal Amount for Every Area Selected for Time and Motion

C.2.4 Findings

The results obtained in this study are compared with indicators suggested by CEPIS and previous studies in order to evaluate the collection service. CEPIS management tools are used by this study because they are derived from experiences in Latin America. They can be used as a starting point for comparison until indicators that suit better the conditions of Panama are developed.

a. Kg/Collection Time Indicator

This indicator reflects implicitly the type of infrastructure, population density, collection method, number of collection workers, vehicle characteristics, collection schedule, etc.¹ The results are shown in the following table.

	Kg/Collection Time (hrs) Indicator ^a
Type of Area	
Aggregated Residential	2,928
Detached Houses	1,798
Urban	2,369
Old Section of the city	1,749
Village	1,809
Total	2,242
Comparison	
San Salvador, small Compact. ^b	1,998
Suggested range by CEPIS	2,300-2,600

Table C-44: Comparative Table of Kg/Collection Time Indicator

^a Includes only time t₃ or collection time

^b The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador, JICA, 2000

The highest performance for this indicator is found in the Aggregated Residential area and the lowest one in the Old Section of the City.

Taking into account that the collection method is currently similar in all the areas (mixed collection), it is understandable that this indicator is mostly affected by population density. The lowest values are found in the least populated areas (Village and Detached Houses) and the highest in the most populated areas (Aggregated Residential and Urban). The Old Section of the City is a special case because it is less clear the reason for a low indicator value. The area is similar to the aggregated residential area which is made of Punta Paitilla and Chorrillo routes; however, its indicator is similar to Detached Houses and Village areas.

¹ Indicadores para el Gerenciamiento del Servicio de Limpieza Pública, CEPIS

Consequently, a more detailed breakdown of the areas is required. The following table shows the results of the breakdown.

	Trips	Tons	Kg/Trip	t ₃	hrs/trip	Kg/hour
San Felipe	3	7.6	2,533	4.3	1.4	1,767
Chorrillo	5	25.7	5,140	12.2	2.4	2,107
Punta Paitilla	9	41.9	4,656	10.9	1.2	3,844

Table C-45: Breakdown for Aggregated Residential Area and Old Section of the City

The previous table shows that Chorrillo and San Felipe indicators are similar; the two sectors have in common that they belong to the daytime shift. On the other hand, Punta Paitilla is part of the Nighttime shift. Consequently, it is possible that the first two routes might be affected by daytime traffic.

The Old Section of the City has an indicator that is lower than values found in other countries in the region and the value suggested by CEPIS. The performance indicator suggests that there is room to improve on the route design and schedule collection in the Old Section.

b. Kg/Trip Indicator

This indicator reflects if the routes have been designed properly and also helps to prevent overload on the vehicles.²

	Kg/Trip Indicator		
Type of Area			
Aggregated Residential	4,826		
Detached Houses	4,160		
Urban	6,153		
Old Section of the city	2,533		
Village	4,973		
Total	4,977		
Comparison			
San Salvador, small Compact ^a	5,295		
Suggested range by CEPIS ^b	6,000-7,000 for 14 m ³ trucks		
Currented range by CEDIS Adjusted	5,200-6,100 for 12 m ³ trucks		
Suggested range by CEPIS Adjusted	3,600-4,800 for 8 m ³ trucks		

Table C-46: Comparative Table of Kg/Trip Indicator

^a The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador, Kokusai Kogyo, 2000

^b The suggested range is for 14 m³ trucks

² Indicadores para el Gerenciamiento del Servicio de Limpieza Pública, CEPIS

Generally, the indicator values fall below the recommended values; only the Urban area shows a value within the recommended CEPIS adjusted values. The Old Section of the City (the only sector serviced by a 8 m³ truck, all others are serviced by a 12 m³ trucks) presents a low value which confirms the low performance found in that area. On the other hand, the Aggregated Residential area shows an uncharacteristic low performance which suggests that further improvement is possible in the area by modifying the collection type (use of container) because a door to door collection in such aggregated area might not be the most efficient type of collection.

Low performance for this indicator could also be due to bulk density difference. It was observed that Panama produces a considerable amount of paper and plastic compared to other Latin American countries as the following table shows.

								Unit: gm./lt.
Category	City	Asunción, Paraguay ¹	Managua, Nicaragua ²	Tegucigalpa , Honduras ³	Adana- Mersin, Turkey ⁴	San Salvador, El Salvador⁵	On-Nuch, Thailand ⁶	Panama Dry Season ⁷
	High Income	220	200	200	300	198	140	140
Residential	Middle Income				250-270	202	140	160
	Low Income				330-360	207	150	160
Commorgial	Restaurant	340	320	NA	410-470	353	NA	200
Commercial	Others	70	40	NA	60-90	60	NA	60
Institutional		90	250	NA	40-80	85	NA	60
Market		360	280	250	340-370	335	NA	170
Road sweeping		NA	160	NA	130-210	172	NA	90

Table	C-47.	Bulk	Densit	Com	narison
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¹JICA, 1994, "The Study on the Solid Waste Management for the Metropolitan Area of Asuncion in the Republic of Paraguay"
 ²JICA, 1994, "The Study on the Solid Waste Management System of the City of Managua in the Republic of Nicaragua".
 ³JICA, 1997, "The Study on the Solid Waste Management of the Urban Area of Tegucigalpa's Central District in the Republic of Honduras".

⁴JICA, 2000, "The Study on Regional Solid Waste Management for Adana-Mersin in the Republic of Turkey"

⁵ JICA, 2000 "The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador".

⁶ JBIC, 2001, "JBIC Special Assistance For Project Formation (SAPROF Phase 1) For Solid Waste Management at On-Nuch" ⁷JICA, 2002, "The Study on Solid Waste Management Plan for Municipality of Panama in the Republic of Panama".

The low bulk density is clearly the result of a larger amount of lighter material (paper and plastic) in the waste composition for the case of Panama and On-Nuch, Thailand. The following table reflects the waste composition for the different previous cases.

Composition	Asunción	Managua	Tegucigalpa	Adana-Mersin, Turkey	San Salvador	On-Nuch	Panama Dry Season
Combustible	71.1	75.1	82.4	89.71-93.15	93.4-95.5	55.9-58.3	12.6-55.0
Kitchen Waste	36.6	34.8	47.2	63.01-64.41	57.6-66.0	9.5-10.7	9.0-53.6
Papers	6.4	5.4	11.5	14.80-18.42	13.0-18.5	1.0-1.7	0.0-7.3
Textiles	1.3	1.9	2.8	1.62-2.60	1.1-2.5	1.8-6.9	0.3-28.7
Grass, Wood, Bamboo	22.2	27.1	7.1	2.18-2.66	2.7-16.8	15.0-18.7	7.7-14.5
Plastics	3.9	3.9	11.6	5.92-6.69	5.8-12.1	0.1-0.5	0.0-3.6
Rubber, leather	0.7	2.0	2.2	0.25-0.30	0.0-1.5		
Incombustible	28.9	24.9	17.6	6.85-10.29	4.5-6.6		
Metals	1.3	1.7	1.9	1.25-1.40	1.1-1.3	1.4-1.7	1.3-13.6
Bottles, glass	3.1	2.9	3.5	3.08	1.3-3.7	5.5-6.6	2.8-11.8
Ceramics and soil	2.5	8.1	12.1	1.38-2.17	0.2-0.7	0.0-0.3	0.0-13.3
Others	22.0	12.2	0.1	1.14-3.64	1.1-1.7	0.0-0.1	0.0-0.7

Table C-48	Waste Con	nnosition C	omnarison
		iposition o	ompanson

The low indicator value (Kg/trip) might be due to different bulk density. However, bulk density between low and high income in Panama is negligible, but the difference of indicator is substantial between the urban area and rests of areas (more than 1,000 Kg/trip). Additionally, difference in bulk density is very different between San Salvador and Panama; however, the San Salvador, Aggregated Residential, Detached Houses, and Village areas show values below the indicator value, whereas the Urban area values' fall within the indicator range.

Moreover, the technical specification by Heil for their Model F-400 recommends compaction performance specification of "up to 800 Lbs. per yd³". For the 8 m³ truck, the recommended performance would be 4,000 Kg maximum capacity; on the other hand, for the 12 m³ truck, the recommended performance would be 5,818 Kg maximum capacity. Both values fall within CEPIS adjusted recommended range of values which should confirm the validity of CEPIS adjusted values. In any event, the suggested range by CEPIS Adjusted values is an attainable indicator which does not seem to be decisively affected by bulk density.

c. Kg/Km of Collection Indicator

In this indicator, it is considered implicitly population density, collection method, storage, routing, frequency and number of workers.³

	Kgs./km. Indicator
Type of Area	
Aggregated Residential	1,172
Detached Houses	488
Urban	659
Old Section of the city	311
Village	379
Total	611
Comparison	
San Salvador, small Compact. ^a	587-1,278
Suggested range by CEPIS ^b	500-600

^a The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador, Kokusai Kogyo, 2000

^b Suggested range for a population density of 16,345 pers./km.², service with 43% daily frequency and 57% every other day, 3 crew members, and collection on the curbside.

The population density factor is important for this indicator as it was for the Kg/hour indicator. However, this indicator also reflects the need to check collection frequency for less populated areas. Additionally, the Old Section of the City still follows the same pattern of low performance values.

d. Kg/Worker/Trip or Kg/Worker/hr Indicators

This indicator considers implicitly collection method, storage, age and physical fitness of collection workers, type of vehicles, and number of trips.⁴

	Workers/trip	Kg/worker/trip	Kg/worker/hr.
Type of Area			
Aggregated Residential	3.0	1,608	976
Detached Houses	2.8	1,485	642
Urban	2.8	2,197	846
Old Section of the city	2.0	1,266	875
Village	2.7	1,832	667
Total	2.8	1,780	802
Comparison			
San Salvador, small Compact. ^a			587-1,278
Suggested range by CEPIS ^b		2,250-2,500	

Table C-50: Comparative Table of Kg/Worker/Trip or Kg/Worker/hr Indicator

^a The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador, Kokusai Kogyo, 2000

^b CEPIS suggests an indicator of 4.5 -5 tons/worker/day for a compactor of 14 m³ and 2 trips/day

³ Indicadores para el Gerenciamiento del Servicio de Limpieza Pública, CEPIS

⁴ Indicadores para el Gerenciamiento del Servicio de Limpieza Pública, CEPIS

It is difficult to establish a comparison by using the CEPIS parameter because it considers compactors of 14 m³ and this study only considered trucks of 8 and 12 m³. However, if the comparison is made with San Salvador, their performance is generally better because the high value 1,278 Kg/worker/hr could only be found in the eastern part of the study area, the other 3 sectors of the study area (Central, West, and North) have values smaller than 600 Kg/worker/trip. Consequently, the number of members in the crew and their physical fitness can be considered satisfactory.

e. Kg/Total kilometers Indicator

This indicator considers implicitly population density, collection method, storage, frequency, routing, and crew number. Compared to the Kg/km of Collection indicator, the main difference might be defined by the distance to discharge (transfer station or sanitary landfill).⁵

	Kgs./Total km. Indicator
Type of Area	
Aggregated Residential	122
Detached Houses	78
Urban	155
Old Section of the city	47
Village	69
Total	104
Comparison	
Suggested range by CEPIS	100-150 Kgs./total kilometers

Table C-51: Comparative Table of Kgs/total kilometers Indicator

The lowest values are found again in the Detached Houses and Village areas. The sanitary landfill is located on the western part of the district; the two areas mentioned previously are located in the eastern/northern part of the district. Consequently, the low values in the two areas might be the result of longer haulage distance. Again, the Old Section of the City is a special case; the low value might be due mostly to the small amount of waste collected in the area.

f. Comments

Overall, Aggregated Residential and Urban areas show higher performance; on the other hand, Detached Houses, Village, and Old Section of the City show the lowest performance. General comments by area are shown in the following paragraphs.

⁵ Indicadores para el Gerenciamiento del Servicio de Limpieza Pública, CEPIS

Aggregated residential area

The indicator values fall within the recommended values and usually are the highest among all the areas, except for the indicator Kgs/trip. Consequently, the performance is good overall, but there is room for improvement by reviewing the routes design and making sure the collection vehicles are used optimally. Additionally, it is important to note that the high performance in this area is due mainly to Punta Paitilla route; the Chorrillo's values are lower. As it was mentioned previously, Chorrillo's value is closer to San Felipe than to Punta Paitilla because the first two belong to daytime shift and the second one to the nighttime shift. Consequently, the performance of Chorrillo and San Felipe might be affected by daytime traffic.

It has to be noted that collection vehicles in this area spend proportionally less time in collection and more time in haulage than those vehicles in detached houses area. This might seem contradictory because Detached house areas are located farther from the landfill site than Aggregated Residential areas; however, this can be explained by the fact that vehicles in the aggregated residential areas made in average over 2.3 trips per shift surveyed while Detached Houses vehicle made only 1.67 trips per shift surveyed.

Detached Houses area

The indicators values are lower than recommended values. This is consistent with a disperse housing area with daily collection service, and located at a considerable distance from the disposal facility. The complete collection system should be reviewed (disposal type, collection schedule and frequency, equipment used, etc.).

<u>Urban area</u>

All the indicators' values fall within the recommended values. Overall there is a good performance. The indicator closer to the lower limit of the recommended values is Kg/hours. As a result, additional improvement might be possible by reviewing the collection method (container, door to door, etc.) and schedule.

Old Section of the City

All indicators' values, except Kg./worker/hr., are lower than recommended values. This is interesting considering that the Old Section of the City is more similar in characteristics to Aggregated Residential and Urban areas than Detached Houses and Village areas; however, the indicator values for the Old Section are closer to the former ones (Detached Houses and Village areas).

Consequently, all the collection system should be reviewed (disposal type, collection schedule and frequency, equipment used, etc.). Among the most interesting low indicator values is *Kgs./total kms*. because this area is not so distant from the disposal site; for this specific case, the value only emphasizes the small amount of waste hauled to a moderate distance for disposal.

<u>Village area</u>

This area has similar characteristics to the detached areas. The result is the same; the indicators' values are generally lower than the recommended values.

C.3 Public Opinion Survey

Public Opinion Survey (POS) on municipal SWM in the Study Area was conducted in January and February 2002.

C.3.1 Objectives

The survey aimed to clarify:

- present waste discharge conditions and manners,
- opinion of the residents and business establishments regarding solid waste management services, and
- their needs and demands to the services.

C.3.2 Number of Samples

384 households and 60 business establishments were chosen from all over the Study Area as samples.

a. Households

a.1 Sample Size

The number of samples required to make them represent the current population of 708,438 (in 2000) at more than 95% probability is 384. The survey took this sample size.

a.2 Selection of Samples

Samples were selected over the Study Area with taking into account distribution of income level (See Table C-52) and population in each corregimiento (See Table C-53).

Income level	Ratio (%)
Low income (less than \$480/month)	43
Middle income (\$481-\$2,200/mont)	46
High income (more than \$2,200/month)	11
Total	100

Table C-52: Distribution of Households according to Income Level

Source: Contraloria General de la Republica, National Census of Population and Households 2000 (Panama District)

No.	Corregimiento	Nos. of Sample	Percent
1	San Felipe	5	1%
2	El Chorrillo	14	4%
3	Santa Ana	12	3%
4	Calidonia	12	3%
5	Curundu	10	3%
6	Betania	27	7%
7	Bella Vista	17	4%
8	Pueblo Nuevo	12	3%
9	San Francisco	22	6%
10	Parque Lefevre	22	6%
11	Rio Abajo	17	4%
12	Juan Diaz	45	12%
13	Pedregal	23	6%
14	Tocumen	42	11%
15	Pacora	29	8%
16	San Martin	0	0%
17	Las Cumbres	46	12%
18	Chilibre	22	6%
19	Ancon	7	2%
	Total	384	100%

b. Institutions

60 business establishments were selected as samples for the survey (See Table C-54).

Category of Sample	Nos. of Sample
Market	5
University	2
Large scale office	20
Shop	20
Factory	10
General hospital	3
Total	60

Table C-54: Samples of Business Establishments

C.3.3 Formulation of Questionnaire

The Study Team prepared the original questionnaire. Through discussion and consultation with the counterparts and a local contractor, which conducted this field survey, the draft questionnaire was modified and finalized to meet the actual conditions of the Study Area.

a. Residents

The questionnaire for households are consisted of 8 categories (55 questions):

- 1) General questions; gender, frequency of exposure to the mass media, number of residents, etc.
- 2) Present situation of public services; access to public services (water supply, sewerage, electricity, etc.), demand for improvement of the services
- Discharge of waste; discharge manner, type of container used, animal scavenging, etc.
- 4) Waste collection services; satisfaction with the service, reasons of dissatisfaction, frequency of the service, etc.
- 5) Recycling and waste reduction; willingness to cooperate with separate collection, necessity of recycling in the Study Area, present situation of recycling, etc.
- 6) Financial matters; fees for public services, amount of collection fee, satisfaction/dissatisfaction with the collection fee, etc.
- 7) Tariff system; tariff (based on electricity, water consumption, etc.), billing system (with electricity, water supply, etc.), etc.
- 8) Public cooperation and education; knowledge about waste treatment, willingness to cooperate with a campaign on sanitation/environment improvement, etc.

b. Business Establishments

b.1 Markets, Universities, Large-scale offices and Shops

The questionnaire for markets, universities, large-scale offices and shops are consisted of 6 categories (38 questions):

 General questions; type of business, number of employees, type of waste generated, etc.,

- Waste storage, discharge, collection and disposal; manner of storage and discharge, frequency of the collection service, direct haulage, etc.
- Recycling and waste reduction; current situation of recycling, type of waste recycled, etc.
- 4) Financial matters; amount of collection fee, satisfaction/dissatisfaction with the collection fee, etc.
- 5) Public cooperation and education; willingness to cooperate with a campaign on sanitation/environment improvement, etc.
- 6) Problem about SWM; prioritization of problems about SWM

b.2 Factories

The questionnaire for factories are consisted of 6 categories (40 questions):

- General questions; type of business, number of employees, type of waste generated, etc.,
- Waste storage, discharge, collection and disposal; manner of storage and discharge, frequency of the collection service, direct haulage, etc.
- Recycling and waste reduction; current situation of recycling, type of waste recycled, etc.
- 4) Financial matters; amount of collection fee, satisfaction/dissatisfaction with the collection fee, etc.
- 5) Public cooperation and education; willingness to cooperate with a campaign on sanitation/environment improvement, etc.
- 6) Problem about SWM; prioritization of problems about SWM

b.3 Hospitals

The questionnaire for hospitals are consisted of 4categories (68 questions):

- 1) General questions; number of beds, evaluation of the present system
- 2) Medical and general waste management; training and instructions, storage, waste generation amount, waste treatment, discharge, collection, in house collection system

- 3) Financial matter; collection service fee, fees for public utilities,
- 4) Cooperation for waste management; intention to cooperate

C.3.4 Results of the Survey

The results are presented in Annex.

C.3.5 Findings

a. Residents

General Issues

Female occupies a large part of interviewees, 72%, in the survey. Many interviewees get news through radio, TV and newspapers every day. This shows that the residents are considerably concerned with state with society. Average size of household in the study area is 4.4 persons/household. More than half of interviewees have their own houses. What is noteworthy in the study area is that 55% do not have garden and 35% have small gardens that are less than $100m^2$. The other issue to be mentioned is that considerably large part of households have immigrated into the study area (15% replied that they have been living in the study area for less than 5 years).

Present Situation of Public Services

Infrastructures such as water supply, electricity and roads are well developed and considerably large part of residents benefit from them. 96% are connected with water supply, 98% has electricity and 66% has access roads of asphalt pavement. Further more, 49% are connected to sewer pipes and 37% has septic tanks.

In order to receive those public services, residents pay 33 US\$/month/household for electricity, 40US\$ for transport, 39US\$ for telephone, 16US\$ for water supply and 4US\$ for waste collection service. As average household income is 920US\$/month/household, fee for electricity occupies 3.6% of the income, traffic 4.3%, telephone 4.2%, water supply 1.7% and waste collection service 0.4%.

Discharge of Waste

Almost of residents receive waste collection service in manner of curbside or container collection. Small number of residents exercise burning (8%) and burying (1%) waste. Most of residents use plastic bag as recipient of waste (365/384). It should be noted that about half of the interviewees suffer from animal scavenging (sometimes 18%, often 29%).

Waste Collection Services

92% of residents receive waste collection service. The rest, 8%, who do not have collection service are found in Pueblo Nuevo (3), Parque Lefevre (3), Tocumen (1), Pacora (4), Las Cumbres (17) and Chilibre (3). Municipality (DIMAUD) practices important role in the waste collection service. 338 out of 384 interviewees (88%) answered that the municipal collectors pick up their waste. Curbside collection is the principal manner (69%) followed by container collection (20%).

Corregimiento	Yes	No
01 San Felipe	5	-
02 El Chorrillo	14	-
03 Santa Ana	12	_
04 Calidonia	12	-
05 Curundu	10	-
06 Betania	27	-
07 Bella Vista	17	-
08 Pueblo Nuevo	9	3
09 San Francisco	22	-
10 Parque Lefevre	19	3
11 Rio Abajo	17	-
12 Juan Diaz	45	-
13 Pedregal	23	-
14 Tocumen	41	1
15 Pacora	25	4
17 Las Cumbres	29	17
18 Chilibre	19	3
19 Ancon	7	-
Total	353	31

Table C-55: Do you have waste collection service?

Although DIMAUD is trying to provide the citizens with daily waste collection service, the results of survey show that this is not necessarily carried out for the whole citizens. As Figure C-3 shows, there are regional disparities in the frequencies. The service is provided more frequently to Reverted, Southwestern, Central, Eastern and Northern areas in the order named. Reverted area was incorporated in collection areas after Panama Canal had returned

to Panama from USA in 1999. The area still has small population, then, it is too early to evaluate the waste collection service in the area. In the rest of areas than Reverted, the more frequent collection service is provided to where the higher population density is found. This is rational in its own way, because highly populated areas generate more waste.

However, as Figure C-4 shows, it is conjectured that collection frequencies of twice or three times week would not be planed and it would happen accidentally. Especially, the collection service is likely to be unpunctual in Eastern and Northern. This might be caused by troubles in other areas such as vehicles failure and traffic congestion.

70% of residents (very satisfied 31%, satisfied 39%) of the study area are satisfied with the present waste collection service. This shows that DIMAUD waste collection service considerably meets with demand of the residents. As Figure C-5 shows, it is conjectured that higher quality of collection service is provided to the Central.



Figure C-3: Collection Frequency



Figure C-4: Punctuality of Collection Service



Figure C-5: Degree of Satisfaction with Collection Service

Recycling and waste reduction

84% replied that they are willing to cooperate with separate collection that is necessary for recycling. 86% also replied that recycling is necessary in the study area. These may imply that the residents are satisfied with the present waste collection service and sense necessities of recycling and resource conservation.

The results revealed that recycling activities are not common practice in the study area. Only 13% (48 household) replied that someone comes to their houses to collect or buy recyclable/reusable materials. Most frequently collected or sold materials are bottles (32/48) and aluminum cans (29/48).

Regarding composting, 13% answered that they make compost from their kitchen waste. In the study area, 55% do not have garden and 35% have small garden (less than 100m²). This may imply that there would be small demands for compost.

Financial Matters and Tariff system

60% replied that they are satisfied with the present tariff system (because it is cheap 21%, appropriate 38% and cheap and appropriate 1%). 40% are dissatisfied with the tariff as they feel it is expensive.

The results revealed that the average willingness to pay for waste collection service was US\$ 6.07/month/household. Meanwhile, the present tariff system requires the residents to pay about 5 to 12 US\$ for the service (about 2 to 6 US\$ for low income, about 7 to 8 US\$ for middle income and 10 to 12 for high income). Comparing these figures, it can be said that willingness to pay is lower than the actual payment. The results also revealed that average income of the residents is US\$ 920.48/month/household. The willingness to pay of US\$ 6.07 is about 0.7% of the income and actual tariff is about 0.8% (supposing that tariff of middle-income, US\$ 7.5, is representative). In general, it is said that waste collection and disposal fee is between 0.75% and 1.7% of income in middle-income countries⁶. The willingness to pay in the study area is at the bottom of the range and the actual tariff is in the range. Consequently, it could be said that the actual tariff for the residents would be appropriate and not be far from the willingness to pay.

The residents prefer being imposed waste collection fee at waste amount (43%, 165/384) to other manners such as at land property, electricity, income and water consumed. As for manner of billing, 48% replied that they accept independent direct billing, 43% accept joint billing with water supply, and few people accept joint billing with income tax, property tax, electricity and telephone. According to the results, it seems for the residents to set fee at waste amount discharged and to bill independently are reasonable, however, the residents would also accept the present billing system, joint billing with water supply.

⁶ Sandora Cointreau-Levine, December 1991, Conceptual Issues and Experiences in Developing Countries

Public Cooperation and Education

Only 31% have been given education or guidance about proper handling and discharge of waste. 60% of the residents of the 31% have gotten such knowledge from their family member and only 23% of them have received such education at schools. Considerable number of residents, 98%, thinks that environmental and sanitary education is necessary at schools.

As for a campaign to raise the citizens' awareness on environment, 97% think that it is necessity and 48% (186/384) think that municipality should take such action, and 93% showed their willingness to cooperate to such activities.

Conclusion

Issues that must be noted out of the findings so far are the following.

- Major part of the residents do not have gardens (55%) or have small gardens that less than 100m²(35%). And only 13% make compost from their kitchen waste. Accordingly, a market of compost may be small at present and in the near future.
- Great number of the residents (92%) is covered with waste collection service. DIMAUD plays critical role in provision of the service (88% receive municipal waste collection service).
- DIMAUD tries to provide the residents with daily waste collection service. However, the results revealed that the whole residents do not necessarily receive such service. From this fact, it is conjectured that required capacity to conduct the daily waste collection service is beyond the present waste collection capacity of DIMAUD.
- Central, Southwestern and Reverted seem to receive higher quality of waste collection service than Eastern and Northern. Therefore, there would be a room to improve the service in the areas.
- The present tariff and billing system seem to be acceptable for the residents.
- The residents seem to be satisfied with the collection service and begin to be acquainted with necessity of recycling and resource conservation.
- The residents feel necessity of environmental education at schools and campaign to raise citizens' awareness on environment. Municipality is expected to act main role in the activities, and the residents have willingness to cooperate with such activities.

b. Business Establishments

b.1 Markets, Universities, Large-scale offices and Shops

General Issues

47 business establishments that are subjects of the survey are various, i.e., from less than 10 employees to more than 100, from less than 50 m² of floor area to more than $1,000m^2$ and from less than US\$100,000 of annual sales to more than US\$3,000,000. Principal wastes discharged from them are paper (32 establishments), plastic (31), cardboard (36), aluminum (11), woods (24) and food waste (24).

Waste Storage, Discharge, Collection and Disposal

Considerable number of them (39) receives municipal waste collection service, however 17 out of them also benefit from private waste collection service due to exiguous collection frequency.

40 business establishments replied that they are satisfied with the collection service, although there are differences in degree of satisfaction.

Almost all business establishments (43) recognize that their waste is disposed in the municipal landfill.

Recycling and Waste Reduction

Majority (27) separates waste for recycling. They sell off such recyclable materials to other business establishments (7) and junkman's (5). This makes out that there is a recyclable material market. Prevailing recyclable materials are paper (15 business establishments), cardboard (15) and plastic (8).

42 business establishments replied that recycling is necessary. However, 39 are opposed to increase of waste collection fee due to introduction of recycling.

Financial Matters

Amount of waste collection fee that the business establishments pay at present are various between 167 and 4,700US\$/month depending of their sizes. 12 feel that the fee is expensive and 17 think that it is appropriate.

As for manner of setting fee, 11 show approval with setting fee corresponding to sales and 19 to waste amount discharged. Meanwhile, almost all of them are opposed to setting fee corresponding to floor area, electricity consumed and number of employees.

Public Cooperation and Education

Almost all business establishments (46) replied that they would cooperate with maintaining sanitation environment of the city. And all of them replied that a campaign to raise citizens' awareness on environment is necessary. In the interview survey to residents, about half of them said that municipality should hold such campaign. Meanwhile, the business establishments think that various organizations should take action in such campaign, i.e., central government (35), municipality (37), Junta Comunal (21) and Junta Local (25).

Conclusion

From the results of the survey, the following can be said.

- Although many business establishments benefit from municipal waste collection service, private waste collection firms are also active. It may be necessary to make sure whether the private firms dispose of waste appropriately.
- Generally, the business establishments are in favor of recycling. However, most of them do not want to accept increase of collection fee due to introduction of recycling. Usually, recycling requires more cost. Therefore, certain activities to promote understanding about this matter will be necessary in the future.
- A recycling market exists at present. There would be a way to encourage recycling based on the market.

b.2 Factories

General Questions

10 factories were subjects to the survey. Types of their businesses are various such as manufacturing of doors, food processing and paper manufacturing. Number of their employees also varies from less than 20 to more than 100 and floor areas are from less than $100m^2$ to more than $1,000m^2$.

Waste Storage, Discharge, Collection and Disposal

Wastes generated from those factories are various, e.g., ash, dust, food, metal, paper, cardboard, plastics, rubber and wastewater. Those wastes are temporarily stored in plastic bags and tanks. Most of factories receive waste collection service every day and their wastes are disposed in the municipal landfill, Cerro Patacon.

Recycling and Waste Reduction

Only three (3) factories separate their waste for recycling, e.g., selling to manufactures and junk mans. However, all of 10 factories said that recycling is necessary right now.

Four (4) factories register amount of chemicals received from outside. Meanwhile, only one (1) factory registers amount of chemicals outgoing.

Financial Matters

Two (2) factories pay US\$200 to 300 per month for municipal waste collection service. Seven (7) factories pay for private collection service. Fees range between US\$13 and US\$700. Three (3) regards the fees expensive, meanwhile five (5) do appropriate.

Willingness to pay for the collection service, in case that it is operated satisfactory, is not so different from the actual payment. It may be because the waste collection service satisfies their demands at a certain extent at present.

All of the factories (10) answered that they prefer being charged collection fee based on amount of waste generated. Six (6) accept independent billing.

Five (5) companies do not want to accept increase of waste collection fee due to introduction of recycling. Three accept 10% increase of the fee. It may say that factories may accept slight increase of the fee, although they generally dislike it.

Public cooperation and education

All of them (10) have willingness to cooperate for keeping the city clean and preserving environment from deterioration. Also, they feel necessity of a campaign to encourage those. Many factories think that the municipality should take such action followed by the central government, schools and private companies. The factories regard unimportance of communities in such actions.

Conclusion

Although it is not able to generalize the results because number of samples was small, the following may be said.

- Some of private waste collection firms are working in a sector of industrial waste.
- Some factories control chemicals that they receive. However, many factories do not care about chemicals outgoing. A system to control movement of chemicals may be necessary in the future to preserve the environment.
- Generally, factories do not want to accept increase of collection fee due to introduction of recycling. However, a certain number of factories may accept if such increase is within 10%.
- Factories regard necessity of recycling and a campaign to encourage it. What is different from the residents' opinions is that factories do not regard communities as important in such campaign.

b.3 Hospitals

Every hospital has a training program for staffs about how to deal with medical waste, carries out separate storage by using special plastic bags and/or containers according to type of waste, and applies some treatment methods such as incineration, chemical disinfection and disinfection by autoclave.

Medical waste discharged from the hospitals are collected by DIMAUD and disposed of in Cerro Patacon landfill.

The results would not represent medical waste management in the study area, as number of samples was limited to three. However, it is conjectured that the hospitals being subjects to this survey would manage medical waste appropriately according to the information.

C.4 Recycle Market Survey

C.4.1 Objectives

The surveys investigated present markets and potential demands for recycled materials, that would be considered in 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, metals, papers and plastic was investigated by interviewing waste picker, and recycling companies and by using existing data.

C.4.2 Methodology

In order to make the survey following two types of main sources were used.

Primary sources	Statistic of the National Accounts, the Republic's General Controller Office.Results of the interviews survey
Secondary sources	 Mollie Brown: "Reciclaje de Panamá", made in the first semester of 1998, for Autoridad de la Región Interoceánica (ARI)
	• Práxedes Castro, <u>Perspective of the recycling in Panama within the</u> <u>context of the environmental cleaning</u> . (Editorial USMA, Panama, 1994)
	 Yolanda Castillo and Mylene Ortega, <u>Diagnosis of the Process of the Sweepings in the Metropolitan Area: Period of 1903 – 1997</u>. 1998. (Graduation Work, Panama University).

a. Targets of Survey

The survey targets are waste picker, middleman and recycling industries.

b. Samples

The survey carried out for 20 samples Table C-56 shows outline of surveyed samples.

No.	Name of company	Main products	
1	Bolsas y Cartuchos de Papel, S.A.		
2	Fibras Panamá, S.A.		
3	Industrias Panameñas de Papel, S.A.	Recycledpaper	
4	Productos Universales de Papel, S.A.		
5	Reciclado de Panamá, S.A.		
6	Aluminio de Panamá, S.A.		
7	Compra y Venta de Metales		
8	Compra y Venta Tabasará, S.A.		
9	Forjas Técnicas, S.A. (FORJATEC)		
10	Fundidora Istmeña, S.A.	Recycled metal	
11	Fundición Yisalex, S.A.		
12	Industrias de Reciclaje, S.A. (INDRESA)		
13	Metal Group Panamá, S.A.		
14	Procesos Ambientales, S.A.		
15	Reciclajes de Metales, S.A. (REIMSA)		
16	Recimetal Panamá, S.A.		
17	Vidrios Panameños, S.A.	Recycled glass	
18	Constructora Vidriera, S.A. (COVISA)		
19	Eco Toner, S.A.	Others	
20	Granja San Fernando	Outera	

Table C-56: Outline of Samples

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.)

C.4.3 Results of the Survey

a. Recycling system

a.1 Recovery Materials

In Panama an ample variety of materials are recovered: aluminum tins, aluminum radiators, radiators of a metal mixture, bronze radiators, aluminum scrap, copper, bronze, batteries, cardboard, paper (of colors and target), newspapers, plastic, glass, fabric, and other waste that can be repaired and be sold.

These recovery materials is mainly from:

- the street waste picker
- waste picker at Cerro Patacon final disposal site and
- others recycle activities.

a.2 Street Waste Picker

The street waste picker s, commonly called "piedreros", make their work bursting the bags of waste deposited on the sidewalks that are gathered by the DIMAUD; also, they extract materials from temporary storage (bin and containers) or collect aluminum tins and glass bottles that are discarded in streets and sidewalks. Official data do not exist about the amount of street waste picker s dedicated to this activity nor their contribution to the recovery of materials, but it must be assume that the contribution is significant. The street waste picker s sell the materials to the nearest purchasing point, within the city.

Vicente González, a street waste picker with many years of experience, recovers clear, bottles, aluminum cans, newspaper and cardboard. In average he recovers 5 bottles daily, 12 pounds of aluminum and 20 pounds of paper. On the other hand, Inocente, in addition to the mentioned materials, also recovers textiles; the daily averages of recovery are similar to those of Vicente: 6 bottles of different kind, 7 pounds of aluminum, 20 pounds of paper and 20 pounds of textiles. These two street waste picker s share the same limitations: little capacity to transport high volume of waste, thus has suggested aid in order to increase the purchasing points, and manual vehicles.

According to the data obtained, a street waste picker could generate a monthly income (26 days of work) between U\$ 120.00 and U\$ 170.00.

Material	Units or pounds	Amount (\$U)
Glass	5- 10 units	0.25 – 0.50
Aluminum tins	12 - 15 pd.	2.40 - 3.00
Paper	20 – 25 pd.	1 – 1.50
Other (textile, etc.)	20-30 pd.	1 – 1.50
Totals		4.65 - 6.50

Table C-57: Daily Recove	ry Amount of S	Street waste picker
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Source: based on interviews to Street waste picker s, January of 2002

a.3 Waste Picker at Cerro Patacon Final Disposal Site

The waste collected by DIMAUD and other waste collection companies of Panama City and San Miguelito, are disposed of in Cerro Patacón's sanitary landfill, where waste picker (pepenadores) do the recovery work. The recovered materials are sold to representatives of the recycling companies; but mainly to the owners of small factories ("bunker"), located in an area near Cerro Patacón named "Mocambito". The number of "pepenadores" in Cerro Patacón varies, between 300 and 1,000 persons, including children.

a.4 Others Recycle Activities

Different companies from the banking, commercial and industrial sector make the recovery and sale their waste or authorize their employees to do this work. The waste are stored in a determined area awaiting the pass of the vehicles of the recycling companies to come and undertake the corresponding transaction. Generally, the income generated in this activity is shared or given in it's totality to the workers who do the recovery work; also it is destined to financing social activities for the employees. Some educative centers and communitarian organizations, periodically, make activities to recover and sell recyclable material, mainly paper.



COVISA S.A. is a small company created in 1991 that produces glass windows and has 12 employees. The waste of the aluminum moldings (20 kilos monthly) are sold to INDRESA to \$0.35 the kilogram. Possibly the material, that will be finally recycled in the United States, will return to COVISA as imported raw material.

Additionally, an undetermined number of people recover materials at their homes and in urbanized areas, who sell occasionally to purchasing points or directly to the recycling industries.

b. Intermediate Structure

After recovered, the material go through an intermediate structure until arriving at the final consumer.

b.1 Direct Purchase

The recycling companies make the direct purchase of recyclable material to private companies and institutions, sending for such effect, their own vehicles. However, as the separation in the source is made in small scale, the direct purchase does not contribute significant volumes of materials. In addition, when the recycling company makes the direct purchase, the price of purchase will be the lowest of the market, which is not a stimulus to those who recover directly in the source.

An example of this is Fundidora Istmeña, S.A., a company created in 1990 that at the present time has 16 employees. This company produces tablets and also industrial aluminum pieces, copper and bronze, which are sold to government institutions. The company purchase directly from individual suppliers clean, dirty and soft aluminum, bronze and copper.

b.2 Purchasing Points

There are two kinds of purchasing points: those that are established by the recycling industries, and those that are property of small retailers; they are located in Panama District but the main ones are in Cerro Patacón. The points of purchase in the capital city are not permanent, they are opened and closed periodically; some specialize in the purchase of certain



material, but the majority accepts all type of recyclable material. The required investments are minimum: a physical space not very big, the weight and, mainly, availability of cash, since it has to do with retail trade.

The most important purchasing point is located in Cerro Patacón. The main commercialized materials are white paper, newspaper, aluminum cans and wood. The white paper, one of the main materials of buy / sale, is separated and packed in plastic bags by workers who earn a wage of \$5 per day, to have it directly available for the owners of the recycling factories or to the companies of recycling that arrive with their trucks to Cerro Patacón.

b.3 Recycling Factories

The purchase points (except those which are property of the recycling industry) sell the materials gathered together to the factories of recycling in where the workings of cleaning, classification, crushing and packing are made. The workers of these factories are in charge of which the material gathering the requirements demanded by the recycling industry, specially in terms of its purity. Once classified, the material is crushed or compacted, ready for the sale.

The proprietors of these factories must make investments of certain amount, because the costs include payment of wages to the workers, acquisition of machinery for the packing workings and crushing and payment of taxes. Such they consider that the recycling industry does not have capacity to make its work, because this phase of the process is not to him profitable economically. On the other hand, some of these strategic proprietors have established alliance with the purchase points or bunker of Cerro Patacón: sometimes they advance cash to them so that they can conserve the capacity of purchase to pepenadores. In addition, they must pay a municipal tax that depending on the type of business oscillates between 300,00 B / and B / 500,00 monthly ones so that they can operate in Cerro Patacón; this authorization is extended to the proprietors of bunker., providing legal cover to them to its operations.



States and Costa Rica.

PROCESOS AMBIENTALES (Environmental Processes) is an excellent example. This company occupies a central position in the cycle of recycling: it buys white paper, news paper, glass, cardboard and plastic directly, then classified, cleaned, crushed and compacted and resold the recycling industries. Also it exports part of the plastic directly to the United

Another case is the one of **INDRESA**, a company that buys aluminum tins, aluminum scrap iron, glass lead, bottles, bronze, copper, batteries, paper and plastic. **INDRESA** obtains their materials in Cerro Patacón and has a point of purchase in its own facilities. The plastic is sold it to Eco-Platics. The bottles that can be reused are given back to the manufacturers. The glass is sold to Panamefíos Glasses. The metal products are exported.

b.4 The recycling industry Material

The materials classified and without impurities, compacted and baled is sold to the factories of recycling to be put to under different material industrialist processes depending on the type of material. Between the factories of recycling and the industrialists to complicated relation exists: in some cases, it happens with the recycling of the to paper, the industrialists assign to factories one quota monthly minim of 200 tons of waste, because below this volume the factories would operate with losses. But the most conflicting subject is the related one to the prices of the material, which is very determined by the tendencies of the international market. Although the recycling factories successively to transfer the losses in the leaves prices to the purchase points

An example of recycling industry is Vidrios Panameños S.A.. This company initiated operations in 1979 and has 350 workers at the moment. It is the only company that makes glass bottles in Panama; their clients are the embotelladoras companies of drinks and foods, in the national and international scope. It produces bottles of brown color, used generally by the beer companies, those of clear color by the food and gaseous drink companies, and those of green color for other gaseous drink companies. It also produces flat glasses, 480 ton/month of waste glass is bought from Environmental Processes, which means 10% of the used raw material, 60% of the production are destined to the international market (Central America, the United States, Canada and Spain).



Figure C-6: Recycling Structure in the Study Area

c. Final Consumption of Recycled Products

The recycling industry produces raw material for national and international industries, and final products will go to final consumers. Metal is sold in ingots to small industries that make tablets, boards and other articles; whereas an important part of the fused material is exported in ingots. The glass industry founds the material provided by the recycling factories and it uses as raw material to produce glass packages that soon are sold in the national and international market. The paper industry turns the waste into an ample variety of products for the national and international market: also it supplies to national industries that produce paper bags.



An example is Bolsas y Cartuchos de Papel, S.A., which was created in 1950 and at the moment it has 60 employees. This company buys recycled paper in average 4 tons annual from IPEL, S.A. As well, one of its main buyers is the chain of McDonald's restaurants, which uses the bags of recycled paper for the packing of the fast food.

c.1 Metal

Between 1996 and September of 2001, the F.O.B. value of the exports of waste metal ascended to \$U 48.6 million. The greater percentage corresponded to aluminum (79%) and in minor proportion iron and steel, copper, gold and lead as it is observed.

Material	F.O.B. Value (\$U)
Aluminum	38,429,015
Iron and steel	5,817,782
Copper	3,061,028
Gold	1,233,656
Lead	80,113
Total	48,621,594

Table C-58: Waste Metal Export Amount (1996 to 2001)

Source: General Controller, Direction of Statistics and Census. Exports According to Tariff Description and Country of Destiny, 1996, 1997, 1998, 1999, 2000, Sept. 2001.

The exports go mainly to the United States and Central and South America, although in the last years the countries of Asia are acquiring a greater importance in the purchase of metal remainders.

c.2 Paper

In Panama a strong demand of recovered paper and cardboard for the recycling exists, because it is cheaper than the virgin paper. The products that are recycle include cuts of paper (leftover of the process of production in plant and printers), paper of used office, newspapers, portfolios of Manila, cardboard, mixture of paper of remainders like lottery tickets, etc.

c.2.1 International Market

The exports of recovered paper went to mainly 4 countries: Colombia, Costa Rica, Venezuela and the United States. Between 1996 and September of 2001, 10,575,252 kg. were exported, distributed as follows: Colombia, 4,373,210 kg; Costa Rica, 4,122,015 kg; Venezuela, 1,257,936 kg, and the United States, 115.190 kgr. A marginal export is registered to Ecuador (19.190 kg) and Peru (22.000 kg).1996 2000.

On the other hand, in the same period, 15.317.536 kg molded pulp packages to carry eggs were exported to seven countries: Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua and Dominican Republic.

						Unit: kg
	1,996	1997	1998	1999	2,000	Total
Total	1,106,034	2,102,045	2,358,856	2,581,635	5,470,894	15,317,536
Costa Rica	185,025	310,438	598,390	648,292	3,420,207	5,693,496
Ecuador		8,740				8,740
El Salvador	165,748	277,170	159,914	421,377	518,661	1,717,377
Guatemala	469,312	702,683	692,262	706,034	951,961	4,427,650
Honduras	1,587	17,780	35,560	22,767	41,560	149,610
Nicaragua	32,420	70,658	53,178	62,229	140,911	400,885
Dominican Republic			819,552	720,936	397,594	1,953,260

Table C-59:Export Amount of Molded Pulp Eggs Package

Source:

General Comtroller, Direction of Statistic and Census, "Exports According to Tariff Description and Country of Destiny, 1996, 1997, 1998, 1999, 2000.

Meanwhile, the volume of the imports of recovered paper and cardboard mainly show a decreasing tendency, because the price is possibly significantly higher, mainly because the recovery of these materials within the country has been increased.

Other important products of export that include paper recycled components are the toilet paper, napkins and towels, produced mainly by Papelera Istmeña S.A..

The behavior of the exports of press paper in coils (rolls) without printing, between 1996 and 2000 was the following:

	1996	1997	1998	1999	2000
Amount (kg)	18,048	173,332	508,483	655,863	663,099
FOB value	25,500	181,116	722,010	801,810	964,902

Table C-60: Export Amount of Rolled Paper

Source: Own processing, Data taken from: General Comtroller, Direction of Statistic and Census, "Exports According to Tariff Description and Country of Destiny, 1996, 1997, 1998, 1999, 2000.

Nevertheless, the exports show a clear depended Costa Rican market.

						unit : kg
	1996	1997	1998	1999	2000	Totals
Costa Rica	18,048	134,470	492,738	611,332	545,663	1,802,251
Honduras					34,890	34890
Dominican Republic				2,683	25,398	28081
Haiti		1,390				1390
El Salvador			26207	7,200		33407
Colombia				18,580	26,650	45230
Cuba					12530	12530

Table C-61: Major Market of Rolled Paper

Source: Own processing, Data taken from: General Comtroller, Direction of Statistic and Census, "Exports According to Tariff Description and Country of Destiny, 1996, 1997, 1998, 1999, 2000.

c.2.2 National Market

Some recycling factories specialize in the recovery, classification and packing of white paper, newspaper and magazines to be sold to the paper industry. According to the owner of Reciclados de Panamá, S.A., the specialization in this material obeys to the fact that cardboard requires of greater physical space and the sale is made in a slower way.

Reciclados de Panamá, S.A., can be consider a typical paper recycling factory. It initiated operations in 1997, it has 10 permanent workers and their annual sales ascend to \$U 360,000. Annually it commercializes (it buys and it sells) 2,400 tons of materials. In the opinion of the owner, it requires to commercialize a minimum of 200 tons monthly in order to maintain a profit yield of his company.

This small company is in a highly competitive sector, controlled in its industrial stage by MOLPASA and Papelera Istmeña. On the one hand, it must guarantee it's "cuota" of purchase of 200 ton/monthly as a minimum, with stable prices; and by another, it must procure the uninterrupted supplying on the part of the recuperators. In order to increase the volumes of storing, Reciclados de Panamá, tried to establish purchasing points in the city, but without success, due to the difficulties to control the handling of daily cash and the weighing one of the material.

Product	Price paid to recovery workers	Sale price to recycling industries
Newspaper	\$ 0.03 /pound	\$ 0.05 /pound
White paper not printed	\$ 0.10 /pound	\$ 0.12 /pound
White paper printed	\$ 0.08 /pound	\$ 0.10 /pound
Colored paper	\$ 0.02 /pound	\$ 0.03 /pound

Table C-62: Purchase and Sales Price of Waste Paper

Source:

Data taken from information given by Reciclados de Panamá, S.A.

The increasing activity of recovery of paper remainders in the banking and commercial sector of the capital is perceived like a factor of competition for several reasons: first, the material can be offered to a lower price, than of the market, and second, stimulates the development – in the industry – of the operations of cleaning and classification, own by the recycling factories, which could reinforce the monopolistic structure of this sector.

c.3 Plastic

Between 1996 and September of 2001, Panama exported 7,799,633 kg (gross weight) of plastic remainders with a F.O.B. value of \$U 1,728,367. Although the exported volume has increased substantially, the international prices have experienced a pronounced fall as of year 2000.

Export country	Amount (kg)	F.O.B. (\$U) VALUE
ARGENTINA	65,000	16,250
CHINA (Continental)	46,000	5,060
CUBA	14,968	5,940
CHILE	1,239,031	333,687
COLOMBIA	8,23,400	235,196
COSTA RICA	3,989,052	749,323
ECUADOR	739,945	161,800
UNITED STATES	142,981	32,708
HONDURAS	150,009	33,897
NICARAGUA	170,245	32,456
PERU	98,967	24,232
EL SALVADOR	97,750	13,212
ISRAEL	184,200	54,000
VENEZUELA	24,000	6,000
MEXICO	440	100
ITALY	13,645	3,000

Table C-63: Plastic Waste Export Amount in 1996 to 2001

Source: General Comptroller, Direction of Statistic and Census, "Exports According to Tariff Description and Country of Destiny, 1996, 1997, 1998, 1999, 2000.

c.4 Glass

In Panama the glass bottles of all forms and sizes are the only class of this material that is recycle, due mainly to the fact that this material is 100% apt for recycling, which means that losses of quality does not exist during the reprocessing stage. Other glasses, like centers pieces for lights, glass for windows and mirrors, cannot be recycle and are considered polluting agents in the process of recycling glass. The energy savings and a smaller depreciation of the machinery is the economic factors that stimulate glass recycling, because the remainders of this material are melted at a much lower temperature. In addition, the glass recovered locally has a lower price than the imported glass.

C.4.4 Findings

Currently, the public sector is not involved in the recycling activity in Panama municipality. Collections of materials generated from the urban area are performed by street waste picker s and waste-pickers in the town and the final respectively. disposal site Then, intermediaries buy those materials and sell to recycling companies who add more value on the materials by selecting, washing and crushing. The recycling companies sell off the materials to the final buyers such as manufacturers.

This recycling activity is commonly seen both in developing and developed countries. As long as people can manage to live on the activity, a recycle market is spontaneously formed although security and sanitary problems of waste-pickers and street waste picker s who directly collect materials remain. However, as economy grows and people's income level increases, this activity gradually loses its attraction.



Actually, in developed countries holding high economic levels, this activity is not practiced because other works with the same labor bring much higher income. This phenomenon gradually occurs as economy and society develop. However, from the point of view of resource preservation and waste reduction, recycling activity is necessary. Therefore, when those performances of street waste picker s and waste-pickers become inactive, positive intervention by the public sector will then be in demand in the recycling activity.