

Solid Waste Management Evaluation Report: Current Practices, Data Collected, and Recommendations

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The information provided in this report is based on the observations and data collected as part of two independent projects: a feasibility assessment for an inter-lodge recycling system, and a composting system pilot project. This report is a summary of observations and data collected during the 2-week period in which the projects were carried out at Reserva Amazónica (RA), from 1/8/09-14/8/09. It includes a description of current waste management practices observed, waste characterization data collected, and soil nutrient/pH data collected. It also includes recommendations for modifications to current practices that could facilitate more effective separation and allocation of the solid waste produced.

Current Practices

Based on a tour of the waste management system at RA, and observation over the period of the study, the current practices in inorganic and organic waste management are summarized below.

Inorganic:

- Disposal Overview
 - The majority of the inorganic waste produced in RA is collected and taken to Puerto Maldonado (PEM) on a weekly basis
 - Waste is taken to PEM by boat every Friday afternoon
 - Waste is taken to PEM landfill by truck every Saturday morning in one or two trips, depending on quantity
- Area Specific Separation and Collection Practices
 - Public Areas
 - Two locations with 5 categories of separation
 - Locations: Ecocenter; walkway from dining room to guest rooms
 - Categories: glass, plastic, metal, paper, organic
 - One location with 3 categories of separation
 - Locations: outside of dining area
 - Categories: glass, plastic, metal
 - Size of bins: ~10 L, capacity for 7 plastic bottles
 - Emptied once a day
 - Plastic, metal, paper, and organic waste from public areas is combined after separation
 - No waste bins for non-recyclable items near separation bins
 - Guest Rooms
 - No separation
 - Two waste bins per room, one in bathroom and one in sleeping area
 - Size of bins: ~10 L

- Emptied daily
 - Major source of plastic bottles and batteries in land-filled waste stream
- Personnel Living Quarters
 - No separation
 - Groups of ~4 individuals in charge of cleaning and trash collection their area
 - Periodic inspections of rooms
- Kitchen
 - 4 categories of separation inside kitchen
 - Categories: organic, paper, plastic, metal
 - Size of bins: ~75 L
 - Organic material separated and given to pig farmers or collected in pits (see *Organic*)
 - Paper, plastic, and metal all combined after initial separation and taken to central point of waste collection
 - 4 bins for separation outside of kitchen
 - one used to collect glass
 - other three unclearly marked or used
- Material Specific Separation and Collection Practices
 - Cardboard
 - Approximately 31 kg of cardboard were discarded a week*
 - Approx. 18 kg were separated and burned
 - Approx. 13 kg of which were unseparated and land-filled
 - Glass
 - Separated throughout lodge, mainly in large bins behind kitchen
 - Bottles classified as "returnable" collected and returned to Puerto Maldonado and exchanged for filled bottles
 - All other glass collected at lodge in large pits next to organic waste pits. This glass is used in construction through mixing with cement.
 - In waste characterization conducted, two weeks of data yielded an average of 16.25 L, or 4.75 kg of unbroken glass in one week. This accounted for 1% by volume and 2% by weight of the total waste stream in that week
 - Metal
 - Virtually all aluminum cans come from kitchen waste
 - Collected separately in bag, then mixed in with other kitchen waste
 - Other miscellaneous metal made up a small proportion of waste stream (week 1 data: 1 kg; 12.5 L)
 - Batteries
 - Approximately 6.7 kg of alkaline batteries were unseparated and land-filled a week*
 - Some battery separation carried out in housekeeping office
 - Some batteries set in cement during construction in the past
 - Current battery separation and disposal protocol unclear

- Tourist awareness
 - o No specific protocol for explaining current waste management system or proper methods of separation and disposal to tourists
- Personnel awareness
 - o Variable understanding and uncertainty in personnel of the details of the current waste management system (i.e. final destination of recyclable and non-recyclable waste products)

Organic:

- Disposal Overview
 - o Pig farmers (chancheros) come daily to collect organic waste; amount taken by pig farmers can range from 50-100%
 - o Remainder of food waste that pig farmers do not take is put into three large pits behind the staff quarters
 - o First two pits are full and no longer receive food waste, third is current disposal site
 - o Size of pits: approximately 26.7 cubic meters (4.45 m X 3 m X ~2 m)
- Separated organic waste
 - o Kitchen disposes of organic waste in designated containers
 - o Public Areas have small containers for organic waste (see *Inorganic*)
 - o Contamination: In 30 liters of soil taken from each of the oldest pits, 29 pieces of plastic trash were found—this level of contamination is too high to use the soil for compost
- Unseparated organic waste
 - o Very little organic waste enters the inorganic waste stream. In the waste characterization conducted, 15 L, or 6 kg, of organic waste were sent to Puerto Maldonado in one week. This made up only 1% by volume and 3% by weight of the total waste stream. In comparison, 68% of the waste that reaches the Puerto Maldonado landfill is organic material (Estrada et al. 2007).

Waste Characterization

A small-scale waste characterization¹ was carried out as part of this project. A waste characterization, or waste audit, is a method of measuring the quantity and composition of the waste stream from a given source (Diaz et al. 1993, p 33). The data generated by a waste characterization facilitate the development and implementation of waste management strategies that are more specifically suited to actual

- construction waste was discounted from the data
- all waste set aside to be burned was discounted from the data (e.g. cardboard, wood scraps)
- total weight a lower estimate, as all liquid was emptied out of recyclable bottles prior to weighing

WEEK 1: Complete Characterization

A complete waste characterization was carried out in the first week. All waste collected in that week and sent to the Puerto Maldonado landfill was sorted into one of the ten categories described below, weighed, and its volume measured. This complete characterization was carried out the week of 1/8/09-7/8/09.

Totals:

Weight: **219.5 kg**

Volume: **2892.5 L**

Bottles: **~655** (34 bottles/kilo)

Weight/person:

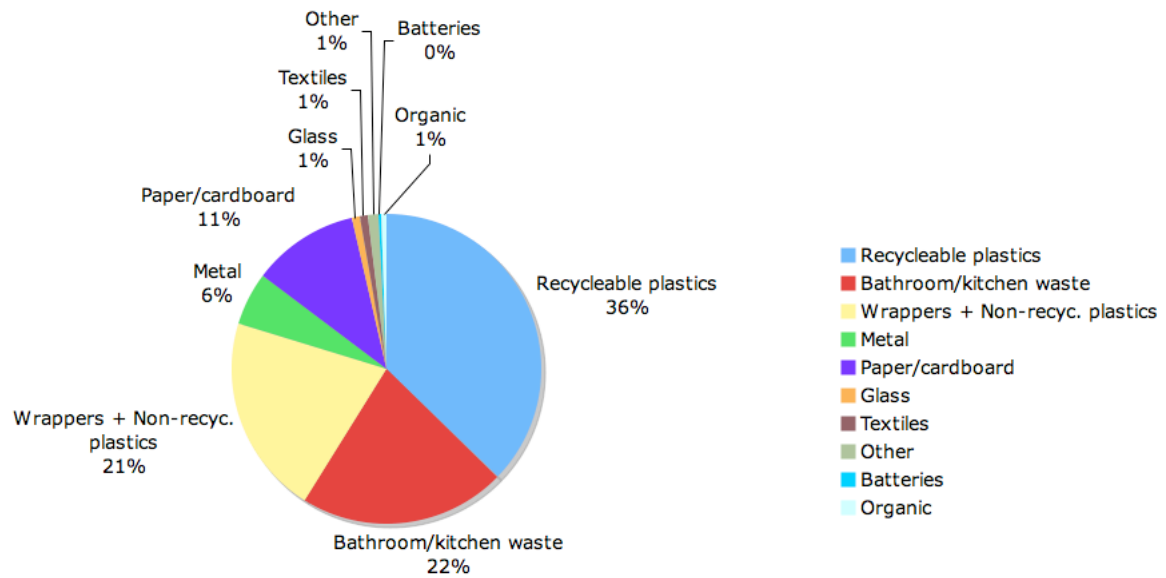
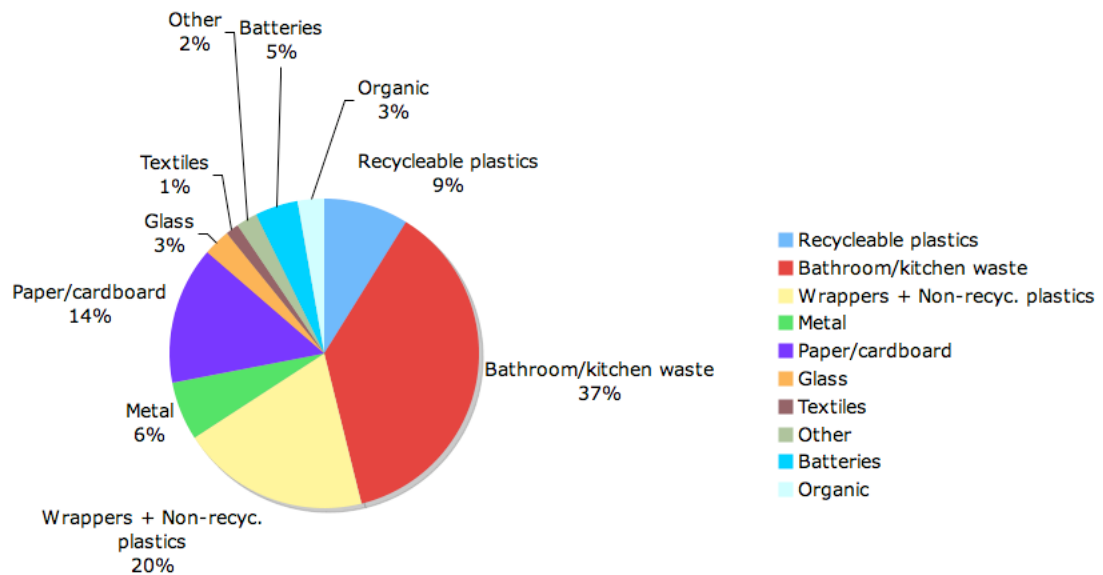
Volume/person:

Bottles/person:

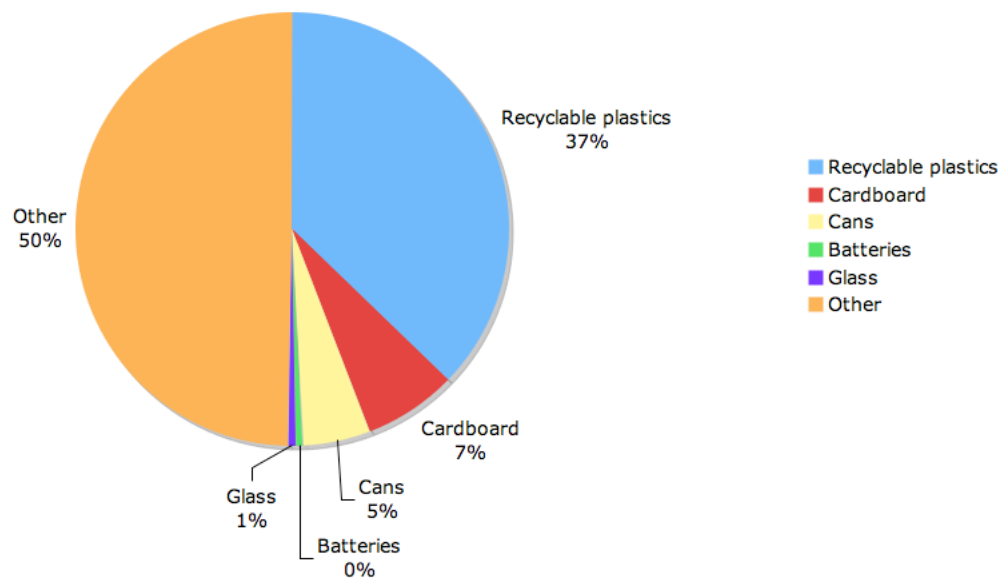
¹ The data presented do not represent an average or a statistically representative sample of the waste stream, but rather a random sample of the waste stream during peak season.

Categories used:

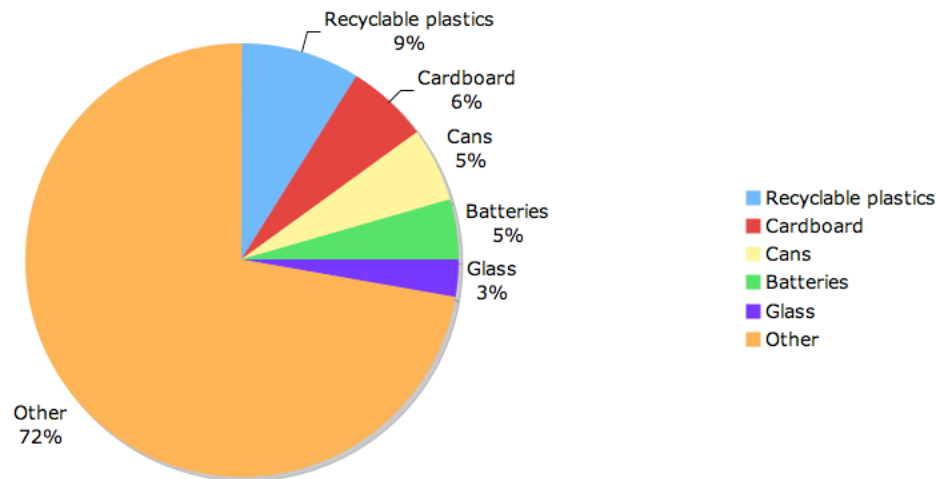
| Category | Description |
|------------------------------------|--|
| Paper/Cardboard | Dry or mostly dry white and brown paper; magazines; newspaper; corrugated boxes |
| Bathroom/kitchen waste | ~80% paper towels, napkins, and toilet paper; other miscellaneous bathroom waste |
| Recyclable plastics | All #1 plastic bottles, majority 500 ml San Luis water bottles |
| Wrappers + Non-recyclable plastics | Included #2 plastics (e.g. yogurt bottles), plastic bags, saran wrap, candy and food wrappers, mixed material packaging (e.g. toothpaste bottles, cigarette packets). Most variable category |
| Glass | All unbroken glass objects, Included some "retornable" (refillable) bottles accidentally discarded |
| Metal | Aluminum cans, aluminum foil, metal lids, spray cans springs, etc |
| Textiles | Included clothing, shoes, rags, rope |
| Other | Umbrellas, ceramics, pencils, etc |
| Batteries | Alkaline batteries of all sizes |
| Organic | Any food or plant items |

Waste Characterization (by volume) 8/1/09 - 8/7/09**Waste Characterization (by weight) 8/1/09-8/7/09**

Recyclables Characterization (by volume) 8/1/09-8/7/09



Recyclables Characterization (by weight) 8/1/09-8/7/09



1 WEEK AVERAGE: Condensed Characterization

A more condensed set of data was collected for the full two weeks, only separating recyclable bottles, cans, glass bottles, cardboard, and batteries from other materials. The data presented below is an average from the two weeks of data from 1/8/09-14/8/09.

Categories used:

| Category | Description |
|-------------------------------|---|
| Plastics bottles (recyclable) | All #1 plastic bottles, majority 500 ml San Luis water bottles. |
| Cans (Al) | Aluminum cans, primarily <i>Leche Gloria</i> |
| Glass bottles | All unbroken glass objects |
| Corrugated cardboard | Corrugated cardboard not separated for burning |
| Batteries | All alkaline batteries |
| Other | Non-recyclable plastics, paper, kitchen/bathroom waste, organic waste, textiles, aluminum foil, metal lids, spray cans, springs, other metals |

Totals:

Weight: **191.3 kg**

Volume: **2466.3 L**

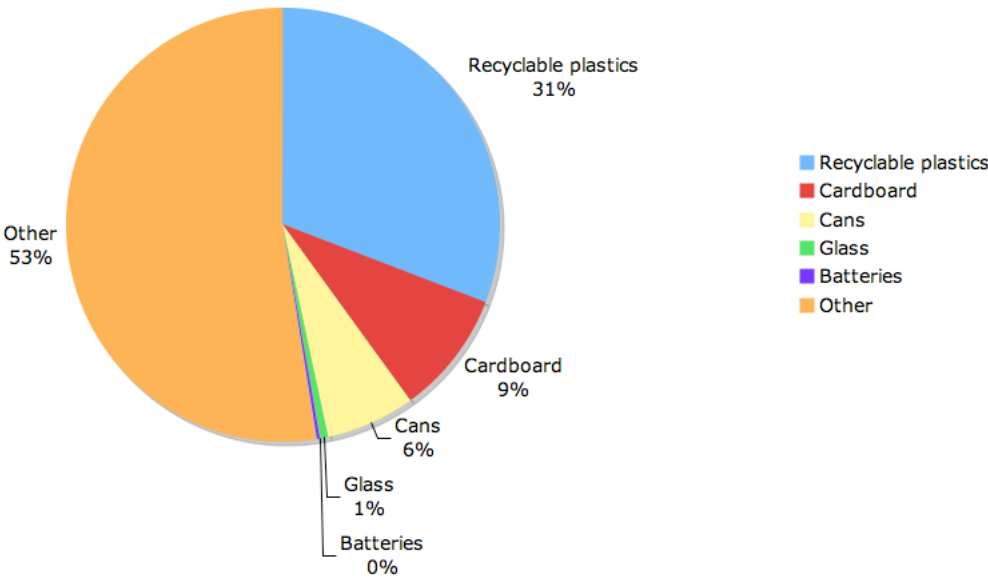
Bottles: ~**476** (34 bottles/kilo)

Weight/person:

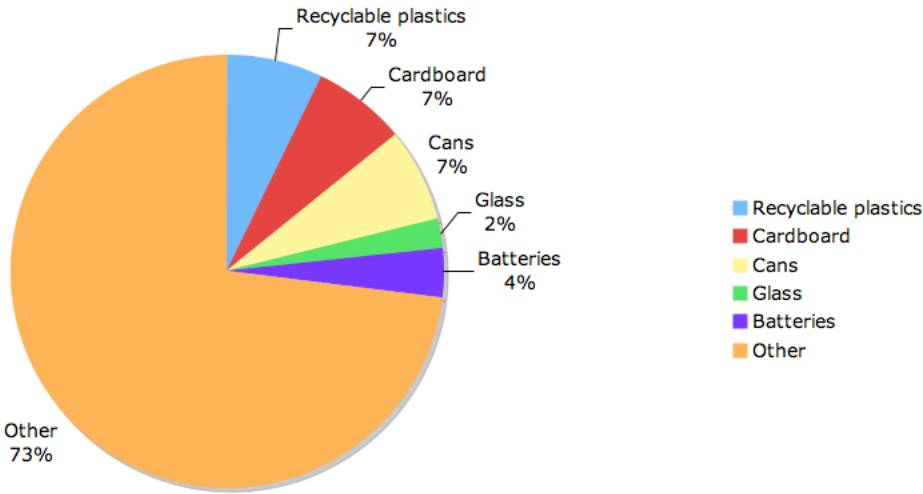
Volume/person:

Bottles/person:

Recyclables Average - August (by volume)



Recyclables Average- August (by weight)



Soil Nutrients:

Adequate nutrients are key to growing healthy plants. In the rainforest, soil is traditionally nutrient-poor because the nutrients are stored in the biomass rather than the earth. Compost, however, is generally extremely nutrient-rich and therefore fertile. Using the Rapitest Soil Test Kit, the nutrient levels of the existing soil and compost soil taken from the oldest pits were tested. A neutral pH is good. The most important nutrient is nitrogen, though phosphorus is a close second and potassium can help plants grow as well. The range of nutrient levels goes from Depleted → Deficient → Adequate → Sufficient → Surplus. If Reserva is interested in revitalizing the botanical garden, a healthy soil source would be a necessary component.

| Type of Soil | pH | Nitrogen | Phosphorus | Potassium |
|------------------|---------------|----------|------------|-----------|
| Existing Topsoil | 6.7 (acidic) | Depleted | Deficient | Surplus |
| Compost Soil | 7.0 (neutral) | Surplus | Adequate | Adequate |

Recommendations:

Inorganic:

- More complete separation
 - o provide larger bins
 - o provide bins in more locations
 - o provide explanation of current separation system to guests at the beginning of their stay
 - o maintain separation of items to Puerto Maldonado
- Contamination prevention
 - o provide bins for regular (non-recyclable) waste in the same location as separation bins
- Participation in the *Proyecto de Recojo de Residuos Sólidos Segregados*
 - o Contact: Ingeniera Patricia Guija
 - o Address: Gerencia de Gestion Ambiental: Anexo 204
 - o Number: Office: 57-12-20
Cell: 982753870
 - o Email: pattyguija@yahoo.com
 - o Project Details: The municipality is willing to collect separated recyclables brought from the lodge to Puerto Maldonado to Puerto Capitanía or Puerto Tambopata. The municipality requires at least one days notice. Recyclable materials collected include plastic bottles, cans, and unbroken glass bottles. The materials will be collected at 161 Loreto until a large enough quantity is accumulated to be sold to a local buyer. Another option for lodges is to deposit the separated materials directly at the site of collection, with the possibility of weighing and recording the amount of material deposited on site. Further details and arrangements can be found communicating directly with Patricia Guija, whose contact information is provided above.

Organic:

- Better separation
 - o Educate those handling organic waste about plastic/metal contamination
 - o Make sure normal trash cans are near organic trash cans for ease of separation
- Reduce amount of organic waste going to landfill
 - o Have large enough bins at many sites
 - o Empty the organic bins in the larger trash cans for organic waste regularly
- Use large-grain filter sieve to extract compost soil from pits
 - o Need to remove banana leaves, bones, large particles
 - o Also need to divert plastic contamination to trash
- If pits can be emptied to use the compost, reuse the cleared pits to continue the process
 - o If not, a reinstallment of the pilot project done by the Asociación de la Agricultura Ecológica (AAE) would be the best option to produce healthy compost
 - Contact: Luis (president)
 - Number: 57 26 62

For more information regarding the aspects of this report pertaining to inorganic waste management, please contact **Susan Rebellon** at **sarebel@gmail.com**. For more information regarding the organic waste management aspects, please contact **Jessica Hinojosa** at **jess7706@gmail.com**.

Works Cited

- Diaz, Luis F., George M. Savage, Linda L. Eggerth, and Clarence G. Golueke. Composting and Recycling Municipal Solid Waste. Boca Raton: Lewis, 1993.
- Estrada, Berioska Q., Rondald Rojas, Jozzy M.Q. Rojas, and Juan F. Rondan. PIGARS, Plan Integral de Gestión Ambiental de Residuos Sólidos Primera Versión. Publication. Municipalidad Provincial de Tambopata, 2007.