



## **Integrated Management of Urban Solid Waste in Municipality of Paty do Alferes**

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**ABSTRACT:** From 2010 on, with the approval of the National Policy for Basic Sanitation and the National Policy for Solid Waste, the topic of solid waste has gained visibility and has been widely discussed. However, one can see that, in most Brazilian municipalities, urban solid waste management has been very far from reaching satisfying results. This paper assesses the Integrated Management of Urban Solid Waste in Paty do Alferes, a municipality located in the state of Rio de Janeiro, and analyzes the operability of the Sorting and Composting Unit set in that municipality. To that end, bibliographical reviews, as well as field researches, data collection and interviews with the people involved in the process, were performed. It was possible to identify weak and strong spots in the municipality's Integrated Solid Waste Management and in the structures and operation of Barro Branco's Sorting and Composting Plant. As a result for Paty do Alferes, it was noted that there is an immediate need for an elaboration of a Municipal Plan for Integrated Management of Urban Solid Waste suitable for the reality of the city in question, which enables the setting of goals and programs for the continuous improvement of services. As for the Barro Branco's Sorting and Composting Plant, it has been concluded that the deficient planning, along with a weak supervision from the government and the lack of technical knowledge from the people in charge of the running of the plant, has made its operation inefficient, causing it to be shut down.

**Keywords** *Solid Waste; Integrated Management of Urban Solid Waste; Sorting and Composting Unit.*

## 1. INTRODUCTION

The integrated management of urban solid waste is of great importance to maintaining public health and the environment. The setting of policies suitable for the local reality ensures efficient performance of services, right choice of type of treatment and environmentally appropriate final disposal.

Since 2010, with the regulation of Federal Law nº 11.445 (National Policy for Basic Sanitation) and Federal Law nº 12.305 (National Policy for Solid Waste), the guidelines concerning solid waste management and the responsibilities of its generators and the government became clearly defined, providing extensive discussions and the implementation of classes and seminars all over the country.

The National Policy for Solid Waste provides for the goals, instruments and guidelines regarding solid waste management, both its generators and the government's responsibilities and the applicable economic instruments. Among the goals presented in the above-mentioned law, it's important to point out:

- Reduction of waste consumption and generation, encouragement towards recycling, reutilization, treatment and appropriate disposal of refuse;
- Support to the recycling industry, inciting the use of products made of recyclable raw materials;
- Perfecting of technical team for working with solid waste; and
- Promotion of the engagement of scavengers and associations in actions that involve shared responsibility for the products' life cycle.

This law also reaffirms that social participation is mandatory and essential in all steps of the elaboration process of solid waste plans (national, state and municipal), thus intending for the programs and plans to represent the real local and the people's need, in addition to determining that these plans be publicized in all social spheres.

Specifically for the municipalities, the Federal Law nº 12.305 establishes that the elaboration of the Municipal Plan for Integrated Solid Waste Management is mandatory and that it shall include, among other items, the following minimal content:

- Presentation of the municipality's solid waste status, such as its origin, volume, characterization, and implemented destination and disposal;
- Defined routines and operational specifications for services of urban cleaning and solid waste treatment and destination;
- Trainings and classes to qualify the technical personnel related to the services' implementation and operation;
- Promotion of people's awareness regarding environmental education aiming waste Reduction, reutilization and recycling;
- Reduction, reutilization, selective collection, recycling, and so forth, goals, with the purpose of reducing the amount of refuse sent to environmentally appropriate final disposal;
- Definition of measures for the control and inspection of services related to solid waste management; and
- Delimitation of related environmental liabilities and the measures to mitigate them.

Lastly, the National Policy for Solid Waste determines the prohibition of improper methods of final destination and disposal of solid waste or refuse, such as throwing and burning outdoors or disposal in bodies of water.

In the municipal sphere, it is common to find vague instructions without any definitions for actions and the proper planning regarding the theme, however, after the setting of the Municipal Plans for Integrated Solid Waste Management, a progress in that area was expected.

Due to this new scenery, a great expectation of improvement has been created, but Brazil's current panorama has a long way to go before reaching the universalization standards. Below are some numbers from year 2014:

- Generation of solid waste in Brazil was of approximately 78.6 million tons, representing an increase of 2.9% relative to 2013 (ABRELPE, 2015);
- Evolution of the collection service coverage all over the nation was of only 0.2% relative to 2013, reaching 90.6% (ABRELPE, 2015); and
- Only 58.4% of waste collected in the country had proper destination (ABRELPE, 2015).

And, also, for the state of Rio de Janeiro:

- Only 17.6% of the municipalities had a Solid Waste Plan (BRASIL, 2014);
- 70.3% of the municipalities showed themselves to have an improper control of collection services (BRASIL, 2014); and
- 66% of the municipalities presented problems in the infrastructure of waste final destination locations (BRASIL, 2014).

In this context, an assessment was performed on the solid waste management in the municipality of Paty do Alferes through an analysis of the domiciliary solid waste collection, transportation, treatment and destination system.

Paty do Alferes, chosen as case study of the present paper, is located in the south of Rio de Janeiro state, has a predominantly urban population (79.5%) of 26,359 residents (IBGE, 2010), a municipal human development index in the average range of development and a poverty index equal to 40.65% (TCE-RJ, 2014).

Just like most of Brazilian municipalities, Paty do Alferes deals with several issues concerning basic sanitation and specially services related to urban solid waste management.

The place, however, stands out for its initiative to implement a Sorting and Composting Plant (SCP). The Barro Branco SCP had its operation shutdown early, which was also subjected to analysis in this paper.

From waste management analysis and the assessment of the SCP's operational routines, it was possible to understand the city's difficulties on the subject. This methodology can be equally applied to other municipalities with the same characteristics, so as to support in diagnosing the solid waste status and in creating the Municipal Plans for Integrated Solid Waste Management.

## **1.1 Methodology**

To enable the analyses and assessments of this paper, between June and September 2015, we performed bibliographical reviews, field visits and interviews with the president of the Scavengers Association and the city hall employees involved in the process.

Along with these interviews and visits, it was possible to collect existing documentation from tenders, projects and the SCP's operation.

The compilation of this information enabled the assessment of both the municipality and the SCP's solid waste management.

## **2. PATY DO ALFERES AND ITS URBAN SOLID WASTE**

### **2.1 The municipality**

Paty do Alferes, emancipated in 1989, holds a great agricultural production of tomatoes, from where its title of largest producer in the state and third in the country comes. (VALLENGE, 2014). Its total revenue was of R\$ 69 million (roughly 218 million dollars) in 2013, the 61st biggest revenue in the state of Rio de Janeiro (TCE-RJ, 2014). It is located 119 km (roughly 74 miles) from the city of Rio de Janeiro (VALLENGE, 2014).

In 2010, according to the Brazilian Institute of Geography and Statistics (IBGE, 2010), it had 26,359 predominantly urban residents. Among the 8,002 permanent households, 3,337 of them had their garbage collection performed directly through the cleaning service, 3,780 had it through cleaning service dumpster, and 885 through burning or burying of its garbage or by throwing it in wastelands, among other unsuitable possibilities.

In 2012, the Court of Accounts of the State of Rio de Janeiro audited the state's municipalities with the purpose of assessing aspects related to planning and quality of urban solid waste collection and final destination services. Regarding the municipality in question, the following was found: improper planning for solid waste management, lack of solid waste management plan, and improper control and provision of solid waste collection services.

### **2.2 Analysis of integrated urban solid waste management**

During field inspections and technical visits, we observed that waste storing is performed by the population by using garbage bags and/or plastic shopping bags. We also noted that trashcans were set in several households, preventing materials from being dragged by the rain, or bags from being damaged by animals.

In addition, in the most populated and commercial districts, which generate a bigger amount of waste, such as downtown, the city hall has set small containers, as can be seen in Figure 1, to facilitate storing, preventing the material from being abandoned in an inappropriate location and a large amount of waste from being exposed, causing negative visual impact.



Figure 1 - Example of containers used in Paty do Alferes

Solid waste collection service is performed by the municipality itself by using 2 compactor trucks, 1 dump truck and 20 employees directly involved in this step. We did not find any evidence of complaints about this service; however, we observed that there isn't a defined collection routine and that there are no records of the urban solid waste collection schedule being followed.

Selective collection is performed only in Parque Barcellos district (door to door) and downtown with the use of volunteer delivery points. The Paty do Alferes' Association of Environmentally Friendly Scavengers is responsible for collecting, sorting and selling the recycled material. Selective collection began March 2014, when an agreement was sealed between the City Hall and the Association to this end. Today, the Association is paid R\$ 8,000 (roughly 25,000 dollars)/month to perform this service.

According to measurement bulletins provided by the city hall, in January 2015, a total of 7,420 kg (16,358 lbs.) of material were recycled, with paper and cardboard being among the main ones. The city hall and the Association do not have a control of the amount of material collected by the Association.

The rest of the material collected by the city hall is transported to an area that works as a transshipment station. However, that area does not have a license to operate as such.

The place used by the Association for selective collection and for the transshipment of the material collected by the city hall is the same area where the Sorting and Composting Plant used to operate.

In this area, the waste is transferred to larger dumpsters and transported to the licensed landfill located in the municipality of Nova Iguaçu. Since 2013, this service is performed by Própria Ambiental and there is waste manifest record that proves its proper destination.

According to the measurement bulletins data relative to the period between 05/25/2015 and 06/23/2015, approximately 363 tons of garbage were collected, resulting in an average of 12.1 tons of garbage per day. The city hall paid around R\$ 100,000 (roughly 316,000 dollars)/month for this service.

In addition to recycling, which is performed in only two districts, since 2014, no other forms of treatment are carried out.

The city does not have a Municipal Plan for Integrated Solid Waste Management, as well as no other document that includes information such as solid waste origin, volume, characterization, rules for transportation and other steps of its management.

In addition, there are no technical qualification programs or actions for implementation of this plan or for environmental education that promotes solid waste non-generation, reduction, reutilization and recycling.

Neither are no definitions concerning the reduction, reutilization, selective collection, recycling, and so forth, goals with the purpose of reducing the amount of refuse sent to environmentally appropriate final disposal;

### **2.3 Analysis of Barro Branco's Sorting and Composting Plant**

During data gathering in the city hall's archives, Barro Branco Sorting Unit's Basic Project was provided. This project, elaborated by the Federal University of Viçosa - MG, was sized to receive up to 15 tons/day of urban solid waste, a future population of 30,000 residents and a 20 years lifespan.

The project presents the units' sizing, showing that they can withstand the estimated amount of waste generated in the municipality; however, we did not find any evidence of a proper characterization of this material being performed, which is one of the most important items for the study of the economic and financial viability of a SCP.

All the structures anticipated in the basic project were built, except for the refuse ditch.

Although there are records that show that the SCP began to work in 2006, its Operating License was only issued in 2009, valid through 2014. However, several conditions in the license were not fulfilled, such as presenting an activity follow-up report that includes photographic account and a spreadsheet for the amount of waste received, sorted and composted, and not allowing that raw urban waste to remain in the plant area for more than 24 hours.

Between the beginning of its operation, in 2006, and the plant's closing, in 2013, three companies were hired to run the unit.

As soon as 2009, it was necessary, on an emergency basis, to hire the services of Central de Tratamento de Resíduos Nova Iguaçu S/A (Nova Iguaçu Waste Treatment Center S/A) to receive, treat and dispose the solid waste, since it was not being sorted, and a big amount of raw material built up in the SCP's courtyard.

Again in 2013, under the management of Paty do Alferes' Entrepreneurs, Environmental Agents and Recyclers Cooperative — a company comprised of old scavengers from the municipality — the situation repeated itself, and the city hall decided to shut down the plant.



Figure 2 – Evidence of big amount of raw materials built up in the SCP's courtyard.

Since during the technical visits the SCP was no longer in operation, it was not possible to follow its routine, so all the information presented from here on was obtained through the interviews performed.

Table 1 – Analysis of the Sorting and Composting Unit's operational routine

| SCP's service | Frequency | Routine   | C | NC | NI |
|---------------|-----------|---|---|----|----|
| Waste Receipt | Daily     | To alternate the days of selective collection and common collection receipt.  |   | x  |    |
|               |           | To receive the selective collection material in the plant's receipt area for a pre-sorting.   |   | x  |    |
|               |           | To send, right after pre-sorting, the selective collection's dry waste to specific bays, and the wet waste to be sorted.  |   | x  |    |
|               |           | To weigh and write down, after their separation, the dry and wet waste, for monitoring.   |   |    | x  |
|               |           | To receive, in this area, domiciliary and commercial waste only.  |   |    | x  |
|               |           | To cover with a tarp the garbage that may not have been processed on the day of collection.   |   |    | x  |
| Sorting       | Daily     | To promote strict separation of garbage components.   |   | x  |    |
|               |           | To prevent the separated components from dropping on the floor.   |   |    | x  |
|               |           | To properly distribute the sorted material;   | x |    |    |
|               |           | To weigh the full drums before sending its content to the final destination.  |   | x  |    |
| Composting    | Daily     | To check windrow humidity.  |   |    | x  |
|               |           | To identify the windrows with numbered signs.   |   |    | x  |
|               |           | To read and write down the windrows' daily temperature during active degradation phase (90 days) and the maturation phase (30 days) until the completion of the 120-day composting cycle. |   |    | x  |
|               |           | To promote aeration at each plowing, every 3 days.  |   |    | x  |
|               |           | To remove, during plowing, inert material present in the windrow.   |   |    | x  |
|               |           | To check for nutrients essential to the process.  |   |    | x  |
|               |           | To ensure that the size of the particles to be composted be no more than 5 cm (about 2 inches).   |   |    | x  |

C – In Conformity; NC – Not in Conformity; NI – Not Informed

Table 1 (continued) – Analysis of the Sorting and Composting Unit's operational routine

| SCP's service            | Frequency             | Routine  | C | NC | NI |
|--------------------------|-----------------------|--|---|----|----|
| Composting               | Monthly               | To get rid of flies, by covering the new windrows with a layer of maturated compost and by spraying insecticide in the chutes. |   |    | x  |
|                          |                       | To remove any vegetation produced on the windrows.   |   |    | x  |
|                          |                       | To check the waterproofing conditions of the courtyard floor and the expansion joints.   |   |    | x  |
|                          |                       | To test the functioning of the tap and hose that supply the composting courtyard, and replace them if necessary.               |   |    | x  |
| Maturated compost        | Weekly                | To sift the maturated compost obtained during the week and properly store it.  | x |    |    |
|                          |                       | To stock this compost in places with waterproof floor and a ceiling, preferably isolated, preventing animals from getting in.  | x |    |    |
|                          | Semiannually/Annually | To send the materials retained on the sieve to be buried in the refuse ditches.  |   |    | x  |
|                          |                       | To collect and send 1 kg (2.2 lbs.) of maturated compost to lab analysis.  |   |    | x  |
| Recycling                | Daily                 | To organize and stack the bundles per type of material.  |   |    | x  |
|                          | Semiannually/Annually | To check the floors' waterproofing conditions.   |   |    | x  |
| Applicable to all steps. | Daily                 | To strictly wear PPEs.   |   |    | x  |
|                          |                       | To prevent pets from entering the location.  |   |    | x  |
|                          |                       | To sweep the area after the end of activities.   |   |    | x  |
|                          | Monthly               | To wash, with detergent and disinfectant, the receipt area and the pit where the sorting table is.                             |   |    | x  |
|                          |                       | To clean the gutters and the draining chutes.  |   |    | x  |
|                          |                       | To replace the damaged drums.  |   |    | x  |
|                          |                       | To perform maintenance on the plant's mechanized components.   |   |    | x  |

C – In Conformity; NC – Not in Conformity; NI – Not Informed

## 2.4 Results

Regarding the integrated management of urban solid waste, it was possible to conclude that:

- The waste storing is properly performed by the population;
- The selective collection needs to be gradually expanded to the rest of the municipality and, for that, it will be necessary to invest in qualification and publicity, as well as hard work to raise people's awareness;
- There are no collection routines established or records of the performance of this service, showing frailty of control and knowledge by the municipality when it comes to its waste; and
- It is crucial that the transfer station be licensed and, for that, it will be necessary that the area's drainage system be in conformity.

As for the Barro Branco SCP, the following critical points were observed:



- A proper waste characterization (gravimetric composition, specific weight, humidity content, etc.) supported by the verification of the plant's technical and financial viability was not performed;
- Due to the nonexistence of selective collection during the period the plant operated, the material was sorted in its raw condition, making the process very expensive and prone to flaws;
- The raw material came contaminated with refuse (diapers, tampons, needles, and so on), risking the health of everyone involved in the sorting and composting process and of possible receptors of the matured compost and recycled material; and
- Non-qualified personnel were hired to manage the plant.

### 3. CONCLUSION

As a conclusion from the analysis of the integrated urban solid waste management in Paty do Alferes, we can say that many investments will be necessary for it to be totally in conformity with the current legislation, encompassing all issues, from waste classification to its final destination.

As an initial step, it is essential that the elaboration of the Municipal Plan for Integrated Solid Waste Management be performed in coherence with the local reality and with definition of feasible goals and programs.

It is advisable for the selective collection to be gradually expanded and, for that, it will be necessary to create programs to properly raise people's awareness.

One of the aggravating circumstances for the plant's bankruptcy was the city hall's lack of preparation to define and encourage recycling programs for the people, a key factor to guarantee success in a sorting and composting plant, since the people's awareness and their relationship with the garbage is of main importance.

Another big impact in the plant's operation was the replacement of the people in charge of the unit's running and maintenance, pointing out that the city hall should plan an operation that keeps a service continuity, thus preventing management rotation that changes concepts and redefines standards.

In the agreement sealed between the Cooperative and the city hall, the former was completely responsible for the waste, exempting the latter from any control or action over the process. However, since the Cooperative is comprised of former scavengers — professionals not very qualified for proper waste management — a bigger control and participation from the city hall showed to be necessary.

Lastly, we can conclude that a planning, absent in most municipal administrations, is essential in any matter of public administration.

What would be really genuine would be a project that rose from the people's urges and that was handled by the people, even if indirectly. The administration is the government's duty, but the existence of a co-management that began in each person's residence would prove to be efficient, from collection to environmentally appropriate final destination, which is the goal of the elaboration of the Municipal Plan for Integrated Solid Waste Management.

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