Solid Waste Management in São Paulo: The challenges of sustainability

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Urban sustainability and waste reduction

ONE OF the biggest challenges of modern society is addressing the excessive generation and the environmentally safe disposal of solid waste. The global concern in relation to solid waste, particularly household waste, has increased compared to production growth, inadequate management and lack of disposal areas.

The topic has been a priority since the Rio 92 Conference worldwide, both in rich and poorer countries, as it contributes either directly or indirectly to global warming and climate change. Since Rio 92, new priorities have been incorporated to the sustainable management of solid waste toward a paradigmatic shift that has guided the actions of governments, society and industry. Included in these priorities are the reduction of waste at the generating sources and the reduction of final disposal in the ground; the maximization of reuse, selective collection and recycling, with the socio-productive inclusion of waste pickers and the participation in society; in addition to composting and energy recovery.

According to the World Urban Forum (2002), urban sustainability can be defined from a set of priorities, such as the eradication of poverty, the promotion of equity, the improvement of environmental conditions and the prevention of environmental degradation. It also includes strengthening cultural vitality, social capital and citizenship, as well as inter-relations with regional and global issues such as the greenhouse effect, which is directly related to greenhouse gas emissions from waste production and disposal (McGranahan & Satterthwaite, 2002, IPCC 2011).

The management and improper disposal of solid waste cause environmental impacts such as soil degradation, impairment of water bodies and fountains, intensification of floods, contribution to air pollution, and proliferation of vectors of sanitary importance in urban centers and in waste picking under unsanitary conditions in the streets and final disposal areas (Besen et al., 2010).

It is increasingly evident that the adoption of sustainable production and consumption patterns and the proper management of solid waste can significantly reduce impacts on both the environment and health.

Richer countries that generate larger amounts of waste and garbage have greater management capacity due to a host of factors, including economic resources, environmental concern of the population, and technological development. Cities in developing countries with very rapid urbanization lack financial and administrative capacity to provide infrastructure and essential services like water, sanitation, garbage collection and disposal, and housing, as well as to ensure safety and environmental quality control for the population.

In addition to the significant growth of solid waste generation, there have also been, over the last few years, significant changes in its composition and characteristics and an increase in its hazard rates (WHO, 2010; EPA, 2010). These changes result especially from development models guided by the planned obsolescence of products, disposability and change in consumption patterns based on excessive and superfluous consumption.

The growth and longevity of the population, coupled with intense urbanization and the increased use of new technologies entail the production of huge amounts of waste.

One of the biggest problems in densely urbanized cities, especially in Metropolitan Regions, is the lack of proper waste disposal sites. This is due to the existence of environmentally protected areas and to impacts on the neighborhood of disposal areas. In most landfills there is no proper treatment for leachate (toxic liquid generated by the organic decomposition of waste). As a result of this condition, toxic waste can contaminate the soil and groundwater, while the gases produced in the decomposition process are released into the environment in an uncontrolled way (Gouveia, 1999).

Integrated and sustainable waste management

The integrated and sustainable management of solid (ISWM) includes the reduction of production in generating sources, reuse, selective collection with the inclusion of pickers of recyclable materials, and recycling, in addition to energy recovery (Klunder et al., 2001; Adedipe et al. 2005).

The municipal government is responsible for managing solid waste from collection to final disposal, which should be environmentally safe. The waste produced and not collected is improperly disposed of on streets, rivers, streams and empty lots, and has effects such as siltation of rivers and streams, clogging of storm drains leading to increased flooding during the rainy season, besides the destruction of green areas, stench, proliferation of flies, cockroaches and rats, all with serious direct or indirect consequences for public health.

The 2008 National Basic Sanitation Survey showed that one in three Brazilian municipalities were affected by flooding between 2004 and 2008, due, according to 30.7 percent of these municipalities, to the waste dumped in streets, avenues, lakes, rivers and streams.

Solid waste has several names and different natures, origins and composi-

tions.[1] The management of the different types of waste is provided for in specific laws and implies different systems of collection, treatment and disposal (Besen & Jacobi, 2006). The government, in addition to properly managing the waste from its own activities, should regulate the flow of waste in the municipality.

Table 1 shows the diversity of waste, generating sources, management agents, and existing treatment and disposal modalities. It is noteworthy that although in most developing countries waste is still disposed of in open-air dump sites, this is the worst form of waste disposal, with negative impacts on the environment and public health. In Brazil, in 2008 over 50 percent of the municipalities still disposed of their waste in dump sites.

Public policy on solid waste in Brazil

Aspects related to the legal framework of urban cleaning, especially solid waste management in Brazil, are provided for in the National Basic Sanitation Policy, Law No. 11445 of 2007, in which the solid waste plan must integrate municipal sanitation plans and the National Policy on Solid Waste (PNRS), Law No. 12305 of 2010, regulated by Decree No. 7404 of 2010, which after twenty years in the National Congress established a new regulatory framework for the country.

The National Policy on Solid Waste strengthens the principles of integrated and sustainable waste management. It proposes measures to encourage the formation of public consortia for regionalized management, with the aim to increase the management capacity of municipalities through economies of scale and cost reduction, in case of shared waste collection, treatment and disposal systems. It is innovative in the country in that it proposes shared responsibility for the lifecycle of products and reverse logistics of returned products,[2] prevention, precaution, reduction, reuse and recycling, targets for reducing waste disposal in landfills, and environmentally appropriate disposal of waste in landfills. In terms of urban social and environmental sustainability, it creates mechanisms for inclusion of waste pickers in municipal selective collection systems and enables strengthening the networks of waste pickers associations and establishing regional storage and marketing centers.

Table1 – Characteristics of solid waste and management thereof

Solid waste	Generating sources	Waste produced	Actor in charge	Treatment and final disposal
Household (RSD)	Houses, buildings, companies, schools	Leftover food, spoiled products, bathroom waste, packaging paper, glass, metal, plastic, Styrofoam, Tetra Pak, batteries, electronics, diapers and others	Municipality	1. Sanitary landfill 2. Recyclables sorting plant 3. Composting plant 4. Dump site
Commercial Small generator	Shops, bars, restaurants, companies	Paper and plastic packaging, leftover food and others	Municipality defines the amount	1. Sanitary landfill 2. Selective collection sorting plant 3. Dump site
Large generator (larger amounts)	Shops, bars, restaurants, companies	Paper and plastic packaging, leftover food and others	Generator	1. Sanitary landfill 2. Recyclables sorting plant 3. Dump site
Public	Sweeping and pruning	Dust, leaves, paper and others	Municipality	1. Sanitary landfill 2. Composting plant 3. Dump site
Health Services (RSS)	Hospitals, clinics, offices, laboratories, others	Group A - biological: blood, tissues, organs, clinical test waste and others Group B - Chemical: lamps, expired and banned drugs, thermometers, sharps and others Group C – radioactive materials; Group D – common; uncontaminated; paper, plastic, glass, and others	Municipality and generator	1. Incineration 2. Dump site 3. Sanitary landfill 4. Septic ditch 5. Microwave 6. Autoclave 7. Recyclables sorting plant
Industrial	Industrial	Ash, sludge, oils, alkalines or acids, plastics, paper, wood, fibers, slag and others	Generator	1. Industrial landfill 2. Dump site
Ports, airports, terminals	Ports, airports, terminals	Septic waste, leftover food, toiletries and others	Generator	1. Incineration 2. Sanitary landfill 3. Dump site
Agricultural	Agriculture	Pesticide containers, tires and oils, packaging of veterinary medicines, plastics and others	Generator	Empty packaging plant of Inpev3
Civil Construction (RCC)	Residential and commercial construction and remodeling	Wood, cement, blocks, nails, plaster, paint, cans, ceramics, stone, sand and others	Generator Municipality Small and large generators	1. Eco-point 2. Transshipment and sorting area (ATT) 3. Recycling Area 4. RCC landfill 5. Dump site

Prepared by the authors. *Sources:* Sinduscon (2005), EPA (2010), Cetesb (2010) and Inpev (2011).

To set higher recycling targets and generate jobs in the recycling and selective collection supply chain for waste pickers, the PNRS provides for sectoral agreements to be signed between the government and the business sector. These are intended to enable the reverse logistics and implement and make selective collection universal in Brazilian municipalities. Through specific regulation, a program should also be implemented aimed to improve the working conditions and opportunities for the social and economic inclusion of waste pickers.

The law requires, within two years from its regulation, the development of federal, state and municipal level solid waste plans that eradicate dump sites and set gradual reduction, reuse and recycling targets, with a view to reducing the amount of waste sent for disposal on the ground. Access to federal funds earmarked for solid waste management will be conditional on submission of the aforementioned plans.

The Interministerial Steering Committee was established early in 2011 for the implementation of reverse logistics systems. The purpose is to ensure the reuse, recycling or collection of solid waste by the industry concerned. To this end, we sectoral agreements will be signed with various production chains. Thus, manufacturers, distributors, retailers and consumers should share responsibility for the waste produced.

The solid waste scenario in Brazil

In Brazil, the provision of urban waste management services is a problem far from being solved. However, there have been improvements in some indicators.

The provision of household waste collection services to the population in urban areas is close to being universal, having increased from 79 percent in 2000 to 97.8 percent in 2008 (IBGE, 2010). Solid waste collection is becoming increasingly privatized, and the number of companies affiliated to the Brazilian Association of Public Cleaning and Special Waste Companies (ABRELPE) increased from 45 in 2000 to 92 in 2009, which collected about 183,000 tons of waste daily in 2009.

The average generation of urban solid waste in the country, according to projections by the SNIS (2010) of ABRELPE (2009), ranges from 1 to 1.15 kg per capita/day, which is close to the standard of European Union member countries, whose average is 1.2 kg per capita / day. According to ABRELPE, while the population grew only one percent between 2008 and 2009, the generation per capita of household waste showed a real increase of 6.6 percent, thus evincing the absence of actions aimed to minimize waste generation (ABRELPE, 2009).

The country generated more than 57 million tons of solid waste in 2009, up 7.7percent over the previous year. State capitals and cities with population over 500,000 accounted for the generation of nearly 23 million tons of urban solid waste daily (ABRELPE, 2009).

Photo by Paulo Liebert /Agencia Estado - 12/09/2009

Landslide in Santa Madalena Slum (Sapopemba neighborhood), East Zone of São Paulo.

Organic matter generated in households accounts for more than 50 percent of the total waste collected and disposed of in sanitary landfills, of which only 3 percent is used in composting processes (CEMPRE, 2010). Decomposing organic matter - which often originates from food waste - when disposed of in sanitary landfills releases greenhouse gases and contributes to global warming and climate change.

The final disposal of solid waste in sanitary landfills has increased over the past years in the country (IBGE, 2010). While in 2000, 17.3 percent of municipalities disposed of their waste in sanitary landfills, in 2008 this number increased to 27.7 percent. However, about half of the 5,564 Brazilian municipalities still dispose of their waste in dump sites, and the percentage of cities with controlled landfills remained virtually stagnant for eight years - 22.3 percent (2000) and 22.5 percent (2008). The increased reduction of disposal in dump sites recorded between 2000 and 2008 is due to the fact that the 13 largest cities with population over one million collect over 35 percent off all urban waste in the country and have appropriate disposal sites.

In turn, landfills in large cities are becoming increasingly full, and the waste is carried for long distances, as is the case of the Metropolitan Region of São Paulo shown on the map in Figure 1. In the city of São Paulo they travel between 15 and 30 km to their final disposal site.

Projects of energy recovery from the use of household solid waste disposed of in sanitary landfills have also become, since the Johannesburg Summit in 2002, a business opportunity as Clean Development Mechanisms (CDM). Thus, developed countries fund pollution reduction projects to meet their carbon emission reduction targets (Goldenberg, 2003).

In Brazil, the number of landfills that implement these projects is growing, with emphasis on the two public landfills in the city of São Paulo - Bandeirantes and São João. In the country, until January 31, 2011 of the 496 CDM project activities carried out in different sectors, 36 consisted of sanitary landfills (Brazil, 2011).

Civil construction waste also represents a major environmental problem, especially because of its improper disposal into streams, vacant lots and roadsides. In medium and large cities in Brazil, this type of waste accounts for over 50 percent of the total generation of urban waste. Studies show that in some municipalities, formal construction account for 15 percent to 30 percent of the overall amount of construction and demolition waste, and 75 percent comes from informal events, construction works, renovations and demolitions carried out in general by the dwellers themselves (Sinduscon, 2005).

It is up to the municipalities to develop integrated management plans that include: a) Municipal Management Program (for small waste generators); b) Management Project for construction works (for the approval of projects of large waste generators). These projects should characterize the waste and indicate sorting, packaging, transportation and disposal procedures (CONAMA Resolution. 307 of July 2002).

The provision of selective collection services by Brazilian municipalities has improved. However, it is still far below the levels required to effectively reduce the amount of potentially recyclable waste that is still disposed of in landfills or dump sites and the resulting impacts. Note that the first initiatives in Brazil date back to 1989 and that the absence of more than twenty years of a national solid waste policy and of political will from municipal governments has generated an environmental liability of controlled dumps and landfills. Add to that the need to build new landfills due to the exhaustion of the useful life of most of the existing ones.

Selective waste collection has increased from 58 municipalities that provided the service in 1989 to 451 in 2000, and 994 were identified in 2008. In 653 municipalities, selective collection is operated by the municipality together with waste pickers organized into cooperatives and associations, and in 279 municipalities by individual waste pickers (IBGE, 2010).[4] This growth results especially from federal policy, in which the prevailing selective collection model is based on the municipalities' ability to provide formal selective collection services by hiring waste picker organizations (Besen, 2011; Dias, 2009). However, 8,533 waste pickers were identified, including 152 children below 14 years of age working routinely in about 70 dump sites and / or landfills (SNIS, 2010).

There are no official data on the amount of Health Care Waste (RSS) generated in Brazil and its final destination. The collection carried out by most municipalities is partial, which contributes significantly to this lack of knowledge. However, an important indicator is that in the sample of municipalities identified by the SNIS (2010), in over 90 percent of them a differentiated collection of RSS, which is essential in the case of RSS that causes a great impact on the environment and health.

As for the final disposal of RSS in the country: 35.1 percent is incinerated; 5.8 percent is autoclaved;[5] 11.5 percent is disposed of in septic ditches; 26 percent in landfills; 13.2 percent in dump sites; and 5.8 percent is microwaved (ABRELPE, 2009). Although federal regulations provide for the need to treat certain classes of health care waste prior to its final disposal, many municipalities still dispose of this type of waste in sanitary landfills, controlled landfills and dump sites without prior treatment, thus representing a risk to public health and to the health of workers involved in related activities.

Scenario in the Metropolitan Region of São Paulo (MRSP)

Metropolitan Brazil includes 35 metropolitan regions and three integrated regions - 444 municipalities in 22 Brazilian units of the federation in the five greater regions. These territories are home to 87.4 million people who account for 45.7 percent of the country's overall population (Observatory of the Metropolis, 2011).

The Metropolitan Region of São Paulo, with its 19.7 million inhabitants, of whom 11 million live in the municipality of São Paulo, is the largest in Brazil and one of the largest urban clusters in the world. Formed by 39 municipalities,

it comprises the state capital and 38 neighboring municipalities, and is responsible for an estimated[6] production of 16,233 tons of solid waste per day, or nearly six million tons per year. This amount corresponds to about 10 percent of the waste collected in the country, and the municipality of São Paulo is responsible for generating more than 62.5 percent of this waste (Besen, 2011).

The absence of a metropolitan waste planning and management structure is one of the factors that hinder integrated and coordinated action between the municipalities that could reduce environmental and financial costs.

As for collection coverage, in 2000 only five municipalities in the MRSP had coverage below 90 percent (IBGE, 2002).

Household waste generation per capita in the MRSP is estimated at an average of 0.8 kg / day, whereas in the municipality of São Paulo it is about 1 kg / day (Besen, 2011).

A differential of the MRSP in relation to the other metropolitan regions is the eradication of disposal in dump sites, as shown on the map in Figure 1. However, of the estimated 5236.6 tons of household waste generated each day in the 38 municipalities (since São Paulo disposes of its waste under appropriate conditions), 2.0658,6 tons / day (39.3 percent) are still being disposed of under controlled conditions.[7]

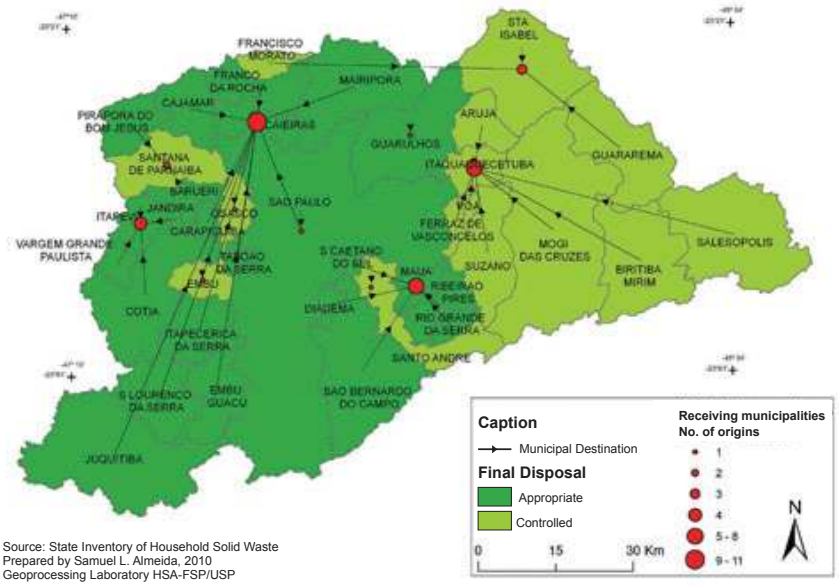
The number of municipalities that dispose of their waste in sanitary landfills located in other municipalities increased from 23 in 2005 to 32 in 2009. As shown on the map in Figure 1, 23 of the 39 municipalities dispose of their waste in other municipalities.[8]

According to ABRELPE (2009), there are eight private sanitary landfills in the MRSP, which receive about 13,500 tons / day of municipal solid waste, accounting for 57.5 percent of the total waste disposed of in private sanitary landfills in Brazil.

In 2010, 29 municipalities in the MRSP (74.4 percent) had selective collection, and in only seven the system served 100 percent of the urban area (Figure 2).

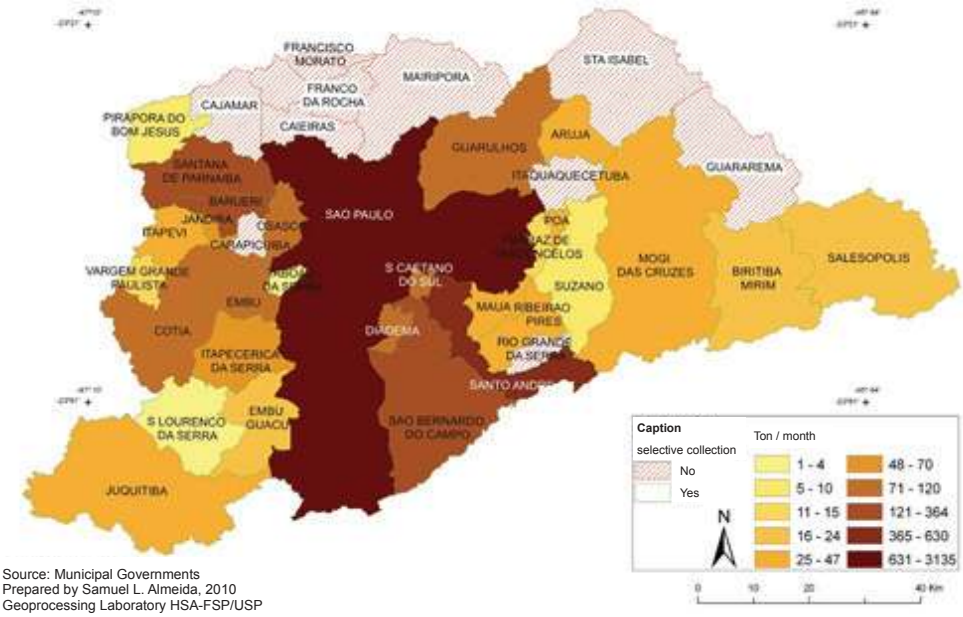
In 28 of them the service was provided in partnership with waste picker organizations. Formal selective collection involved 2,206 waste pickers in these 28 municipalities, of which 1,045 worked in São Paulo and 1,161 in the other 27 cities. Although the percentage of recyclable materials sent to recycling companies by waste picker organizations has increased, most still comes from informal picking carried out in poor conditions in urban streets (Besen, 2011).

Environmental constraints in 54 percent of the metropolitan territory located in watershed protection areas, hinder the installation of waste treatment or disposal equipment, causing waste to be transported to increasingly distant areas, at higher costs for the municipalities. Ten of the 39 municipalities of the MRSP have more than 75 percent of their territory included in the Alto Tietê Watershed Protection Area, and in six municipalities this figure is 50 percent (Besen & Jacobi, 2006).



Source: Besen (2011). Based on data from the State inventory of household solid waste (Cetesb, 2010).

Figure 1 – Map with destination and final disposal conditions of household waste, 2009.



Source: Besen (2011). Based on data provided by the municipalities, March 2010.

Figure 2 – Map of selective collection in the Metropolitan Region of São Paulo, March 2010.

The municipality of São Paulo: advances and setbacks

The city of São Paulo, one of the 39 municipalities of the Metropolitan Region of São Paulo and its 11 million inhabitants account for almost 58 percent of the region's overall population. In recent decades the city has experienced negative growth rates in the central areas, on the one hand, where the population is already consolidated and on the other, population growth in outlying areas, thus compounding the challenges of solid waste management.

In terms of municipal budget, 5.3 percent are invested in public cleaning services in the city of São Paulo and about 3.3 percent in the management of urban solid waste. Of the overall municipal budget, R$725 million per year are spent in the collection of municipal waste, which is totally private (SNIS, 2010). According to Selur / ABLP (2010), the per capita spending on urban sanitation services in the city of São Paulo is R$73.63, far below that of other global cities like Tokyo (R$1,036.48), Mexico City (R$ 632.32), and New York (R$ 239.56).

The Secretariat of Public Works and Services, through the Department of Urban Cleaning (Limpurb), is responsible for managing urban cleaning services in the city: collection of health care, household and selective waste, street sweeping, cleaning of monuments and stairways and removal of debris.

Over 17,000 tons of urban waste are collected in the city each day - including debris and waste from other city cleaning services - of which 12,400 tons are from homes and open markets (PMSP, 2011a).[9]

The collection of household and health care waste and recyclable materials is carried out by two concessionaires, Loga and Ecourbis. In addition to collection, these companies are responsible for the operation of the three transshipment areas (Ponte Pequena, Vergueiro and Santo Amaro)[10] as well as of two public sanitary landfills - Bandeirantes and São João.

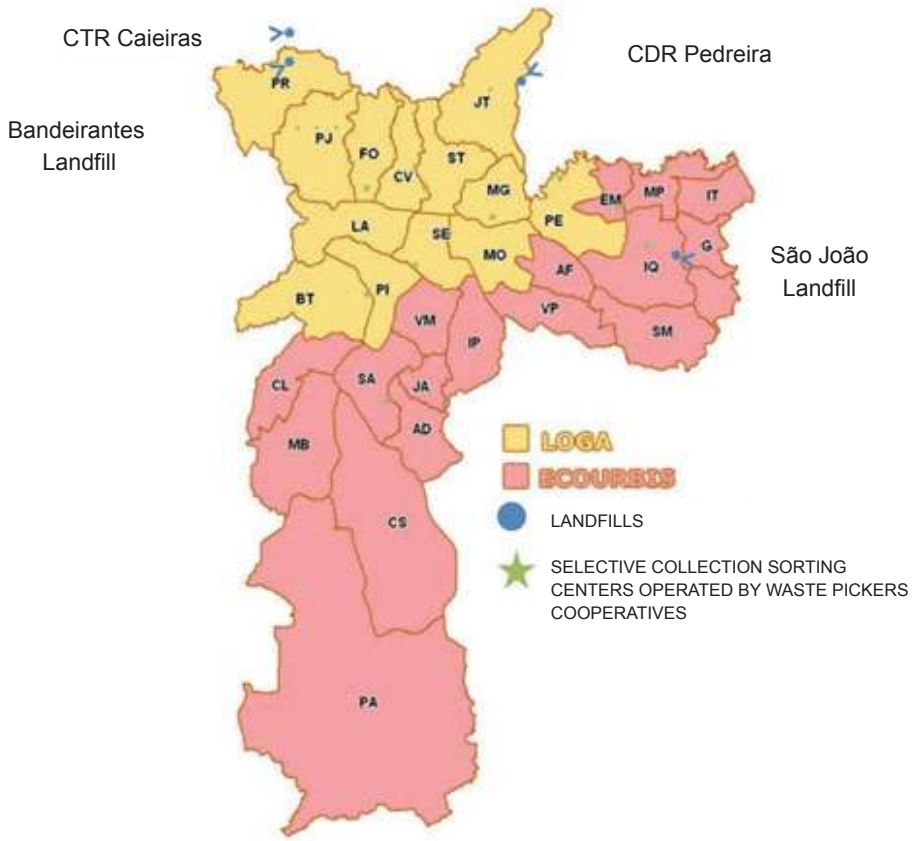
Since December 2002, solid waste management has been given a concession for a period of up to twenty years. At the time of the contract, the administration considered this the best alternative to ensure the necessary investments in the system, especially in regard to final disposal, treatment and selective collection. Since the introduction of contracts, the collection of household waste has been independent of the collection of waste from sweeping and other public cleaning services.

The concession includes investment in the implementation of new sanitary landfills, transshipment units and composting plants in the landfills to be built. It also includes selective collection, containerization of household collection, sorting centers and differentiated collection in slums. The concession system has led to the unification of the various services previously provided by different companies into two contracts of twenty years each, in order to promote gains of scale and logistics for the companies.

The concession contract was signed based on the premise that its sustainability would be achieved by charging a specific public cleaning tariff that was

implemented in 2003. The tariff was proportional to the amount of waste generated per household. The tariff was divided into different ranges depending on each region, and calculated based on the average amount of waste collected in that region (Jacobi & Viveiros, 2006). However, this tariff was abolished in 2006 for political reasons, and the impact of this measure has since then compromised the quality of the services provided. What is observed is that the amount of solid waste in the streets has increased, investments in selective collection and expansion of recycling plants for the 31 boroughs has remained stagnant, and because of the exhaustion of the useful life of the existing landfills, the collection and final disposal of urban waste has burdened the administration with high logistics and transportation costs.

Collection in the city has been divided into two sectors as shown on the map in Figure 3.



Sources: Prepared by the authors. Polis Institute (2009), Municipality of São Paulo (2011a).

Figure 3 – Map of collection of household and health care waste and recyclable materials, location of sanitary landfills and selective collection sorting centers in the municipality of São Paulo.

The first sector, operated by the Loga consortium, comprises the boroughs of the North, West, Central and Penha zones. In the first sector, about six thousand tons of household waste is collected and some 6.1 million people (1.6 million households) are served. Most of this waste collected is sent to the waste disposal center, CDR Pedreira, operated by the Estre Environmental company and located in Guarulhos.

The second sector, operated by Ecourbis, comprises the boroughs of the South and East zones and serves 4.2 million people (1.2 million households). From this sector, six thousand tons of household waste is sent each day to the waste treatment plant, CTR Caieiras, the largest in Latin America and operated by Essencis Environmental Solutions, which is controlled by the Solvi and Camargo Corrêa groups.

Since late 2004, the city of São Paulo has no longer had incinerators and the two composting plants were closed down due to inefficiency, technological obsolescence, impacts of odors, and pollution in the vicinity.

The two public sanitary landfills in the city were disabled - Bandeirantes in March 2007, and São João in October 2009.

All the urban waste is sent to two private sanitary landfills, the Waste Disposal Center, CDR Pedreira (Estre Environmental), located in the municipality of São Paulo, and the Waste Treatment Plant, CTR Caieiras (Essencis), located in the municipality of Caieiras.

One of the advances in solid waste management in the city of São Paulo was the implementation of methane capturing and recovery systems in the Bandeirantes and São João public sanitary landfills for electricity generation. Through these systems, the recovery of areas and the implementation of an electricity generation system can be economically feasible through the sale of carbon credits resulting from the reduction of carbon emissions into the atmosphere.

In the Bandeirantes Landfill, the project was implemented in 2004, with the capacity to generate 175,000 MW per year and avoid the emission of eight million tons of carbon dioxide by 2012. The Biogás company invested about R$30 million in the Bandeirantes Landfill.

In the São João Landfill, the project started in 2008 has the capacity to generate 200,000 MW per year, the equivalent to the consumption of a city of 400,000 inhabitants, through 16 generating units, and avoid the emission of 800,000 tons per year of gas dioxide equivalent. The Biogás company invested about R$50 million in the São João Landfill (*Brazilian Journal of Bioenergy,* 2010, p.8).

The municipality of São Paulo holds 50 percent of the emission reductions generated by the project. Carbon credits have been traded in two auctions in 2007 and 2008, generating R$71 million for the city, which is responsible for the sale and invested the resources in projects in the vicinity of the landfills.

These initiatives are in agreement with measures to reduce the impact of

global warming and greenhouse effect on the city. According to the *Inventory of greenhouse gas emissions in the municipality of São Paulo,* the final disposal of solid waste contributed 23.5 percent of the CO_2 and CH_4 emissions from socio-economic activities in the city (PMSP, 2005).

The challenge of selective collection with the inclusion of waste pickers

The model of Solidary Selective Collection Program of the Municipality of São Paulo was established in 2003, based on the inclusion of waste pickers organizations in the management of recyclables sorting centers. In late 2004, 15 sorting centers had already been established in public areas and were operated by waste pickers. The expectation was to implement 31 centers, one in each borough, provided for in the concession contract, and increase the creation of jobs through the inclusion of other organized groups of waste pickers who worked in the city (more than 70 at the time). This, however, never occurred.

In this context, and without the resources of the solid waste tariff, which was revoked in 2005, there was an impact on the municipal government's ability to manage and maintain the quality of the services provided, and to advance in the consolidation of selective collection with the inclusion of waste pickers. In 2005 there were 94 organized groups of waste pickers in the city, but only 15 percent were linked to the municipality's sorting centers.

The current amounts diverted from the landfill by the official selective collection program - the equivalent of 120 tons per day - represent about one percent of the total amount collected daily in the city, or 3.6 percent (considering only 30 percent of household waste as being recyclable, which is a conservative estimate). And it should also be pointed out that of the 292 trucks contracted to collect garbage in the capital, only 20 (7 percent) are used in selective collection (Bizzotto et al., 2010).

Financially, selective collection in the city of São Paulo in 2010 cost R$192.00 per ton, or the equivalent of R$23,040.00 / day and R$691.200 / month (Cempre, 2010). While the municipal government invests around R$725 million / year (SNIS, 2010), or approximately R$60 million a month in waste collection, transportation and burial, in addition to waste from raw materials that ends up being buried rather than returning to the productive cycle, a negligible 0.001 percent of that amount is invested in selective collection. Insignificant investments lead to insufficient results, considering the potential of recyclable materials produced by a global city with consumption patterns similar to those of developed countries.

The inefficiency and low coverage of selective collection in São Paulo entails economic losses estimated at R$749 million annually. More than one million tons of paper, cardboard, plastic, glass, steel and aluminum are mixed to conventional garbage and buried, when they could be sorted and sent for recycling (IPEA, 2010).

The National Movement of Waste Pickers (MNCR) estimates that there

are 20,000 waste pickers and over 100 waste pickers organizations working in the city. According to the Municipal Secretariat of Social Assistance and Development (SMADS), in 2005 waste pickers accounted for 31 percent of the homeless population (Silva & Ribeiro, 2009).

Most waste pickers work independently in poor health and safety conditions in the streets of São Paulo. Household waste is disposed of in the street for collection in plastic bags, most of them with a capacity between 30 and 100 liters, but often people dispose of reusable materials such as newspapers and cardboard separately. The vast majority of waste pickers use carts or wagons and carry an average of 500 kg, which can reach as much as 800 kg, and collect waste in residential and commercial areas that dispose of a higher amount of recyclable materials (Polis Institute, 2009). Some groups of waste pickers use trucks for the collection.

A factor that interferes negatively in selective collection in the city is clandestine collection by trucks in poor maintenance conditions and no occupational safety, called «big bats». These trucks run daily, while official selective collection is carried out once a week. They circulate at high speed, filled with recyclable materials, dropping open solid waste bags and dirt on the streets. This clandestine collection reduces the production of waste pickers cooperatives.

In late 2009, the municipal government of São Paulo undertook to establish 51 recyclable material sorting centers by the end of 2010, but this never happened. The 20 existing sorting centers are operated by cooperatives of waste pickers of recyclable materials that have agreements with the municipal government and work in 74 districts of the municipality. The collection of recyclables is carried out by concessionaires and centers. The cooperatives are paid with the resources obtained from the sale of recyclable materials. There is no payment for services rendered to the municipality. The average income of co-op waste pickers at the sorting centers of the municipality is R$800.00 (U$ 400,00), which is the equivalent of just over 1.5 minimum wage.

It is important to point out that the private sector has developed several selective collection initiatives in the city, such as the the large supermarket chain Pão de Açúcar, which was a pioneer in the provision of containers for the disposal of materials sorted for recycling in its supermarket chain and in partnership with waste picker organizations. This initiative is now followed by virtually all large supermarkets and most mid-sized ones. In this type of program, people sort the materials in their homes and take them to the disposal site, usually when they go shopping.

Advances in the management of civil construction waste

The civil construction waste generated in constructions, demolitions and renovations of buildings or homes, when disposed of illegally on avenues, streets and squares, causes floods and deprive the population of areas that could be used for leisure and recreation.

Photo by Patricia Santos/Agencia Estado -12.07.2007

Garbage piled up on the bank of the Pinheiros River in São Paulo, due to rain.

The Civil Construction Waste (RCC) management policy in São Paulo is pioneer and has been advancing. Implemented by the Integrated Construction Waste and Bulky Waste Management Plan (Law No. 14.803/2008), which meets the guidelines of Resolution No. 307/2002 of the National Council for the Environment (CONAMA), the policy promoted the increased availability of areas for the regular disposal of construction and demolition waste from large and small generators, and facilitated and encouraged the recycling of these materials.

Large generators such as construction companies are adopting waste management programs that include amounts generated and final disposal, and submitting them to the municipal government, under the civil construction licensing process. Small generators, in turn, cannot dispose of debris on streets and public spaces. In conventional household collection, the city collects a maximum of 50 kg of rubbles / day per property, provided that these are properly packaged. Above this amount, the generator itself should arrange for the removal by contracting companies operating dump trucks registered with the municipal administration and capable of demonstrating that the rubbles have actually been disposed of in properly licensed construction waste landfills.

Citizens have the alternative of sending waste to one of the eco-points located in various regions of the city, or to the Stations of Voluntary Delivery of Unserviceable Materials, which are units intended for the free daily disposal of up to 1 m^3 (one cubic meter) of debris, wood , tree trimmings and large objects.

The eco-points experienced management and maintenance problems, when waste was found piling up in the surroundings of many of them. It was found that five of them were disabled - four in the South Zone, the second most populous region in the city. Other complaints from citizens were also reported, such as failure to advertise the service, in addition to irregular working hours and the refusal of the eco-points to accept plaster, asbestos shingles and tires. Between May 2009 and June 2010, the municipality paid about R$17 million (U$ 9,5 million) to subcontractors for carrying debris. The money, as published by the *Jornal da Tarde* newspaper (8.31.2010), would be enough to build 141 eco-points, which cost on average R$120,000 (U$60,000) each. The municipal government claimed that these figures could also refer to the removal of debris from the eco-points, since there is no allocation in the budget for street collection alone.

There are five Transshipment and Screening Areas (ATT) for the recycling of RCC in different regions of the city. In these, the materials collected are sorted, mineral debris (concrete, mortar, masonry, etc.) is sent to inert waste landfills, waste is taken to sanitary landfills and reusable waste is sold.

Another important advance is Decree No. 48075 of 2006, which determines the use of recycled aggregates from civil construction waste in pavement and maintenance works of streets in the municipality of São Paulo. According to experts, the reuse of RCC generates savings of up to 40 percent compared to

regular asphalt. However, the scale of implementation of this sustainable initiative in a city the size of São Paulo is still small in relation to the possibilities.

Government and health care waste

All small generators (pharmacies, clinics, schools, medical offices, etc.) and large generators (hospitals, emergency rooms and outpatient clinics) are registered with the Department of Urban Cleaning (Limpurb). About 95 tons of health care waste are generated daily (PMSP, 2011b). In addition to waste, dead animals collected from veterinary clinics, kept in zoonosis centers and found on the streets are collected for specific treatment.[11]

Generators must prepare a Health Care Waste Management Plan (PGRSS) based on the characteristics of the waste generated. The PGRSS to be developed must be consistent with applicable federal, state and municipal rules and also in accordance with institutional biosafety procedures for waste collection, transportation and final disposal.

As for the treatment and final disposal of this waste, the city of São Paulo has a treatment plant that uses electrothermal deactivation[12] (ETD) for group A, which comprises waste hazardous to public health and the environment due to the presence of biological agents (hospital waste). After this treatment, the waste acquires the same characteristics of household waste and is disposed of in sanitary landfills. Group B waste, which includes chemotherapy drugs, pharmaceutical waste and other hazardous materials is incinerated. The waste is sent to private hazardous waste landfills.

Group C waste, which comprises radioactive waste or waste contaminated with radionuclides from clinical laboratories, nuclear medicine and radiotherapy units follows federal rules. Dead animals whose cause of death is unknown, those sacrificed by euthanasia or with infectious diseases are incinerated.

Final remarks

Technical, economic and institutional issues make it difficult for Brazilian municipalities to conduct an integrated and sustainable management of the waste under their responsibility, such as urban, civil construction and health care waste produced by the municipalities themselves.

One of the unsolved aspects is the financial unsustainability of the services provided. In Brazil, more than 50 percent of municipalities do not charge for urban cleaning services, and when they do, the money collected is insufficient to cover the costs of providing the services.

It is considered impossible, especially in Brazilian metropolis, to achieve more efficient and sustainable management without charging a socially just tariff for the services provided, as well as in other services such as water, sewer and energy. It is understood that charging a tariff proportional to the amounts generated is also an important factor of awareness and education of citizens to reduce both the amounts produced and wastefulness.

The federal government is investing increasingly in the construction of sanitary landfills and energy recovery, sorting and composting plants, infrastructure, and training for waste picker organizations. However, the Brazilian reality requires a great commitment from municipal managers in choosing appropriate low cost solutions and technologies compatible with the local context, and in implementing selective collection with fair remuneration for the service rendered by waste pickers.

The scenario in the city of São Paulo shows that investments from the municipal administration are not in tune with the sustainable and integrated management of municipal solid waste when it comes to household waste, and that this issue needs to be addressed in its urban sustainability, environmental and financial dimensions.

This means that it is not enough to solve problems related to the remuneration of collection and final disposal contracts and send the waste to properly licensed private sanitary landfills. It is necessary to define strategies to promote waste reduction in generating sources through permanent environmental education, selective collection with the inclusion of waste pickers and targets for reducing waste disposal in the ground, through a comprehensive integrated management plan agreed upon with society. The city of São Paulo, given its centrality in the metropolitan context, also requires a municipal waste management policy and plan coordinated with a metropolitan plan. The challenges to evolve from the current situation of lack of policy, strategies and a planning vision for solving the waste management issue require concrete actions and political will of the administration.

A city the size of São Paulo should join other global cities in developing innovative ways for managing very significant amounts of waste, and this implies reducing disposal in the ground, making selective collection universal, with the inclusion of waste pickers, encouraging recycling, and holding citizens co-responsible through educational campaigns in the media.

It is observed that the municipal government, by reducing revenue through the elimination of the waste tariff, has also reduced the possibilities of having more budgetary resources for selective collection.

The lack of areas for final disposal is a global problem, and São Paulo is no exception. On the other hand, eliminating a tariff equivalent to an estimated amount of waste produced precludes any possibility of holding citizens co-responsible. What is observed is that, although there has been an increase in public awareness, people in general have little information about the destination of their waste; and little room to decide on how to better manage it. Furthermore, there are no institutional forums for dialogue between the municipal government and universities and non-governmental organizations working in solid waste management for the construction of a management model for the city.

It is essential to emphasize that in the logic of sustainability, the possibility of using methane from landfills for power generation and sale of carbon credits

in the global market should not be used as a justification for maintaining unsustainable patterns of production and consumption, and the practice of burying waste in the ground. Burying should be used as a last resort and only for the portion that cannot be recovered and recycled, as provided for in the National Solid Waste Policy. Incineration is not a sustainable solution because it does not contribute to change consumption patterns, create jobs and involve the population in waste management.

There are, however, barriers associated with vested private economic interests which, in turn, are part of a vicious cycle that hampers breaking the logic based on contracts that prioritize collection, transshipment and burial to the detriment of a broader and more comprehensive selective collection.

Currently, the challenge is to reverse the prevailing logic and invest increasingly in reducing overproduction and wastefulness, as well as in promoting selective collection and composting, and less on final disposal.

In São Paulo, there is already a large number of organized waste pickers. The expansion of selective collection is urgent and strategic and may in the future, if conducted properly, with transparency and dialogue with stakeholders, represent an opportunity to reduce the costs of the city with these services, create thousands of jobs and promote greater co-responsibility of citizens for urban cleaning and sustainability.

Notes

1 According to the model established by NBR 10004 (ABNT, 2004), waste is classified into two different classes: 1) Class I - Hazardous: that which, because of its physical, chemical or infectious properties can pose risks to public health and / or to the environment when improperly managed. To be included in Class I, waste should be contained in Annex A or B of NBR 10004 or have one or more of the following characteristics: ignitability, corrosivity, reactivity, toxicity and pathogenicity. 2) Class II - Non-Hazardous waste, subdivided into: (A) Inert: Waste that can impair the potability of water; and (B) non-inert: waste that has no water-soluble constituents and therefore does not impair the potability of water.

2 The PNRS proposes shared responsibility for the lifecycle of products as a set of individualized and joint duties of manufacturers, importers, distributors and traders, consumers and holders of public urban cleaning and solid waste management concessions to minimize the amount of solid waste and other waste generated, as well as to reduce impacts on human health and environmental quality resulting from the lifecycle of products.

3 The National Institute for Processing Empty Containers (Inpev) is a nonprofit, private legal entity founded by manufacturers of pesticides and private entities representing the agricultural production chain. The Institute represents the pesticides manufacturing industry as regards compliance with legislation (Law No. 9.974/00), and is therefore responsible for the transportation of empty containers from receiving units to final destination sites (recycling or incineration) and also for the environmentally appropriate disposal of these materials.

4 The advance has occurred mainly in the South and Southeast, where 46 percent and 32.4 percent of the municipalities, respectively, reported having selective collection in the entire municipality (IBGE, 2010). Municipalities with selective collection service sorted primarily paper and / or cardboard, plastic, glass and metal (ferrous and non-ferrous materials), and the main buyers of these materials were recycling traders (53.9 percent), recycling industries (19.4percent), charities (12.1 percent) and others (18.3 percent).

5 Autoclaving is a thermal treatment very much used in a hospital environment and consists in maintaining the contaminated material at a high temperature through contact with water vapor for a period of time sufficient to destroy all pathogens. It is used to sterilize various types of hospital supplies (Fiocruz, 2011).

6 Estimates based on data from the Abrelpe Overview (2009), the *State Inventory of Solid Household Waste* of Cetesb (2009) and the municipal government of São Paulo (Besen, 2011).

7 Controlled final disposal means that not all engineering requirements necessary for a safe disposal are met. This poses risks to the environment and public health, since, before excessive rainfall these areas can quickly turn into garbage dumps.

8 Seven municipalities dispose of their waste in area located in the municipality of Itaquaquecetuba, in situations deemed controlled, and five in Mauá, in situations deemed appropriate.

9 Other data on urban cleaning: about 300 tons/day of waste from street sweeping; 95 tons/day of health care waste; 4,000 tons/day of civil construction waste.

10 Transshipments are intermediate points of destination of waste collected in the city. Created because of the distance between the collection area and the landfill, in these stations the garbage is unloaded from waste balers and loaded into trucks that transport it to the landfill. The estimated amount of waste in the transshipments of São Paulo is about 1.2 million ton / day.

11 According to Resolution by the National Health Surveillance Agency (ANVISA) - RDC No. 306 of December 7, 2004, the management of health care waste (RSS) consists of a set of management procedures. These are implemented to minimize the production of health care waste, ensure safe and efficient transport, with the protection of workers and the preservation of public health and the environment.

12 Consists in crushing the material and then heating it in a procedure similar to that of the household microwave oven.

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Abstract – This paper presents the scenario related to urban solid waste in Brazil, in the Metropolitan Region of São Paulo and in the city of São Paulo, pointing out the main advances, setbacks and challenges. The emphasis is on the important role of the universalization of selective waste collection with the inclusion of waste pickers of recyclable materials within the city of São Paulo as a strategy to promote socio-environmental urban sustainability.

Keywords: Solid waste management, Selective waste collection, Waste pickers, Urban solid waste public policies, Urban sustainability.

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