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The challenge of solid waste collection in precarious settlements in São Paulo, Brazil

Veronica Rosaria Polzer, Maria Augusta Justi Pisani

ABSTRACT

This article aims to analyze the problems and possible solutions to the implementation of a basic sanitation infrastructure, especially the solid waste collection in poor class occupations in the city of São Paulo, Brazil. The manner in which the urban accesses are structured in the Favela of Heliopolis, with dimensions and configuration insufficient, do not allow access to motorized vehicles, leading to unconventional solutions in legally urbanized areas of the city. The collection of the waste is adapted to existing conditions. Local workers collect waste door to door and transfer the material to a large container accessible to trucks. The method used for this study considers the literature survey, obtaining primary data from the Municipality of São Paulo and field surveys. The results provide technical and practical information that will help other needy communities with the processes of implementation of a solid waste management plan, covering the activities of collecting recyclables, organic waste, sorting and proper disposal of materials for reusing, recycling, composting and recovering energy. The recommendation of this study is that only the refuse should be destined to final disposal of landfills.

Keywords: Solid waste management, municipal solid waste, urban sustainability, basic sanitation

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INTRODUCTION

The city of São Paulo, as most major Brazilian metropolitan areas, currently faces problems related to its urban complex, a reflection of inequality in income distribution in the country and discontinuity between the development and implementation of its infrastructure projects. The government does not appear to be concerned with issues related to environmental management and basic sanitation, especially in relation to solid waste. These problems are aggravated further in places of illegal occupation, such as slums and squatter settlements. There is not adequate infrastructure in these areas and the mobility is affected by the lack of suitable access through streets and sidewalks. This situation hinders activities such as garbage collection, maintenance and expansion of water, gas, telephone, power and sewer supplies and circulation of ambulance service, among other activities.

The National Survey of Basic Sanitation provided in 2008 by IBGE - Brazilian Institute of Geography and Statistics – stated that over 50% of Brazilian municipalities allocates their solid waste in open dumps [1].

In 2013, the country generated approximately 76 million tons of waste, of which 29 million were allocated to dumps and controlled landfills, a type of improved dump; 40 million tons were disposed in landfills; and the remaining, 7 million tons were left to be collected [2]. Most non-collected solid waste is dumped by people in unoccupied land, rivers and public areas. The main challenge is to avoid this irregular disposal by expanding garbage collection to areas where this activity is not conducted properly. Normally, most illegal waste disposal points are present in areas hard to access such as slums.

The municipality of São Paulo grew quickly yet chaotically due to economic cycles, especially the coffee (1840–1930), and become the country's financial center [3]. According to Calderoni [4], in 1869 the garbage collection has begun in the city, conducted from door to door. Three years later, the first census of 1872 [5] stated the city had 31,385 inhabitants. In the following census, in 1890, the city reached 64,934 inhabitants; the population doubled in only eight years. One hundred years later the city had grown to more than 8 million and in 2010 reached 11,253,503 and the estimate for 2014 was 11,895,893 inhabitants.

According to the City Hall of São Paulo, in 2012, 1,631 slums were identified in the municipality, and it is estimated that there are 393,447 households in these sites, with a population exceeding 1,500,000 inhabitants [6]. According to the IBGE [7], the city of São Paulo including its metropolitan area corresponds to a region that has more people living in the favela's condition in Brazil, reaching 2.1 million. In addition, there are around 2,000 households in areas contaminated by dumps.

In this scenario, recyclable material collection and recycling are indispensable tools. They reduce the volume of solid waste disposed of in landfills, generate income and employment for the people, drive the economy by encouraging recycling industries and also provide benefits to the environment and public health. Communities can use the opportunity to establish a central plant of sorting and treatment of solid waste within their territory, generating jobs and income for their inhabitants.

With proper infrastructure, the community can develop an ecologically closed loop, collecting and treating solid waste produced on site, then selling to recycling companies. This is also an economic cycle, which will cause benefits beyond the environmental aspects. These actions bring many advantages to the local society and can serve as a model for other communities, positioning the municipality towards sustainable development.

Basic Sanitation and Solid Waste Management in São Paulo

The issue of basic sanitation and in particular integrated solid waste management, are public policies that generally received little attention from municipalities. According to IBGE [7], about 40% of Brazilian households still do not have sewage collection, and only 38% of collected waste water receives some treatment; the rest is discharged into the environment. About 20 tons of solid waste are not collected every day. Considering only the collected waste in 2013, around 42% of waste was disposed of in dumps and controlled landfills and 58% was directed to landfills [2].

According to the City Hall of São Paulo, the city generates an average of 18,000 tons of waste daily, of which 10,000 tons originate from households. The remainder belongs to health care facilities, street fairs, street sweeping and tree trimming, among others. Collection and disposal of waste in São Paulo is performed by two companies, Loga and Ecourbis, which together serve a population exceeding 11 million inhabitants and cover an area of 1.523 km^2. The community of Heliopolis, the context of this study, is located in the service area of Ecourbis [8].

The solid waste collected is sent to three existing transfer stations (Vergueiro, Santo Amaro, and Ponte Pequena). These intermediate places receive the solid waste and transfer the material to larger trucks—three times the size of a regular urban truck. These vehicles carry waste directly to the landfill. In São Paulo, CLT (Treatment Center East) is the only public landfill in operation and receives 50% of the waste collected. Another part of waste is forwarded to another municipality, a private landfill in Caieiras [8].

The collection of household waste in São Paulo city usually occurs at night, when garbage trucks can travel with less traffic. For recyclable materials, a selective collection occurs during the day, although it is not fully working in the city. Excluded from this collection, a vast majority of citizens do not separate their waste at home, mixing organic waste with recyclable material. This makes the process of sorting and recycling after collection practically impossible. Those citizens who are not covered by the selective collection but want to separate the recyclables at home and allocate them correctly can alternatively seek a recycling center. Another alternative is to use the services of a PEV (point of voluntary delivery), a stationary container located inside some stores, supermarkets or institution that collects and donates the material to cooperatives.

A strategy for improve the system was developed by the company responsible for collection in difficult access areas: first, collectors pass door to door pushing a small waste collector trolley. Then, these carts are sent to a stationary container in a location where it can be accessed by a truck. Collectors hired to work in slum areas are

mostly people from the community who know the region and therefore have facility to cover the entire site. The advantage of this system is that waste collection door to door decreases the illegal dumping in vacant lots, public space, streams and other water bodies.

These workers must pass through narrow paths, pushing a trolley. Sometimes, there are obstacles as bumpy terrain, steps and steep ramps. In some places, it is nearly impossible to overcome these barriers and residents must go to a stationary container. Despite these issues, the door to door waste collection covers most parts of the community.

Furthermore, a new automatic buried container has been tested. It has a sensor built in and an alarm that goes off when the maximum capacity is reached, signaling the need to be exchanged with an empty container. Each community member gets a card that allows them to open the lid to deposit the waste [9]. The advantages of this system are that the solid waste is shielded from view, animals, and weather, and causes no discomfort to the population due to the bad smell and insects. So far, the system has been designed for common waste (refuse). The next step is to also provide containers for organic and recyclable waste, ensuring that these materials will be separated at the source and therefore have the appropriate destination.

The concept of refuse materials, which are those that have exhausted all possibilities for reuse, recovery, recycling and composting, and thus their final destination is landfill, was brought up by PNRS, (National Policy of Solid Waste) [10]. Waste, by contrast, can be reused, recycled and composted, and so return to the economic cycle. If all the waste produced in a residence was separated correctly to be reused, recycled or composted, very little refuse would be produced. Indeed, that is the ultimate goal of PNRS, which describes the best hierarchy for the waste management: first, reduce waste at the source, that is ceasing or minimizing to generate waste; then reuse, followed by recycling and composting and ultimately disposal in landfills, for waste, which cannot be recycled or composted.

There are difficulties and constraints in the implementation of selective collection in the city as a whole, and in slum areas these issues are even greater. The first hurdle to be overcome is to ensure that all rubbish is collected so that it is not illegally discharged in vacant lots, streams and rivers, for example. Thus, until now, the selective collection remained in the background, and composting was not even mentioned in the public policies projects. According to CEMPRE [11], more than 50% of the waste generated by the low-income population is organic; hence, urban composting would be a great destination for this material and would generate income and jobs.

According to Movimento Nacional dos Catadores de Materials (NMNCR), National Movement of Scavengers of Recyclable Material [12], it is estimated that there are between 600,000 and 1 million scavengers in Brazil. About 9% are working in cooperatives, 11% are in the process of association and the remaining 80% work autonomously and informally. As in São Paulo is registered 1,200 scavengers associated with cooperatives, it is possible that the total number of scavengers in the city is around 12,000. One of the premises of PNRS [10] is the inclusion of this labor in the integrated solid waste management plan, so the implementation of the recyclable materials collection would be the first step to be taken.

To ensure that the solid waste has the correct destination, the separation of these materials should be done at the source, which means that citizens need to properly separate recyclables and organics from refuse at home. Once the recyclables are contaminated by other waste, they lose value and start to be considered as refuse by scavengers. The scavenger often collects recyclable materials in dumps or on the streets, eventually rescuing any item that can be commercialized. It is a degrading situation, both for the scavenger, who could rescue the already separated material at the origin or work in a cooperative, and for society, which fails to receive the economic, social and environmental benefits the selective collection, recycling and composting could bring.

Another aspect that needs to be worked on in parallel with the deployment of infrastructure for collection and treatment of waste is the environmental education of the residents. Once the citizen understands the economic, social and environmental benefits of recycling and composting, it becomes possible to put into practice projects contained in the integrated management of solid waste plan for a particular community or region.

The state government has a key role in the implementation of projects and campaigns aimed at increasing environmental awareness in society. The awareness can be raised through actions such as: including seminars and courses on solid waste management in public schools; promoting public hearings with the participation of neighborhood associations, universities and other public agencies; and encouraging the integration of other public policies so that the problem may be viewed holistically. Those actions combined with the proper infrastructure can turn the project into reality, and a plan for solid waste management in a community would succeed.

Favela of Heliópolis

The favela of Heliópolis came in 1970, when the City Hall provided temporary accommodation for favela residents of Vila Prudente and Vergueiro with the objective of paving new avenues and streets in these regions. However, these temporary constructions have become permanent and encouraged a large number of homeless to build on the glebe. From the 1980s, the history of Heliópolis was marked by legal disputes among land grabbers, who wanted to sell irregular plots of land. One of the most striking events was the mobilization of

the residents who organized themselves even during the military dictatorship, to fight against their expulsion. The construction boom in the city and the arrival of many immigrants, especially refugees from the drought in northeastern Brazil, increased the initial population [13].

Today, the current population is roughly 120,000 inhabitants distributed in 14 plots along the territory with a total area of one km² (Figure 1) [14] and more than 18,000 households. According to the Union of Nucleus, Associations and Residents Societies of Heliópolis and São João Clímaco [15], the community has 3,000 commercial establishments and services in addition to institutions of education and health. The Basic Sanitation Company of São Paulo (SABESP) states that in 2014 was 100% of the residents was supplied with drinking water and 77% of sewage was collected. Other infrastructure, such as paved streets also surpassed 70%. Notwithstanding, most of the streets are paved, there is only one bus stop in the slum, opposite the hospital, due to the narrowness of the roads. In addition, the street lighting was installed throughout the neighborhood [15]. According to the Department of Services, nearly 100% of the favela have street lighting. Even with the door to door waste collection there are still many points of illegal disposal of solid waste, which is not only composed of organic and recyclable materials, but also for construction and demolition waste, furniture, dead animals and others [16].

One of the major challenges regarding the collection of solid waste in the community is the fact that it is composed of several staircases and narrow alleys (Figure 2) [17], hampering the circulation and access to housing units. These sites are accessed by manual collectors employed by the concessionaire because the streets have insufficient width to allow public sanitation vehicles to pass through. The collectors use adapted trolleys to access the alleys and make the door to door collection. As an alternative to the collection door to door, there is the option to bring the waste to collection points.

These collection points are usually located in the area of transition between the community and the formal city. They consist of containers, often emptied by the concessionaire. The citizen needs to walk down to the containers if they do not deliver their waste during collection or in its absence. The access and mobility difficulty, however, combined with the population's lack of environmental awareness prompts the residents to throw away waste in open areas, even in regions already urbanized with architecture and good quality access (Figure 3) [17]. Therefore, irregular waste disposal is common in communities due to the lack of infrastructure necessary for solid waste collection.

The challenge of large Brazilian cities like São Paulo is to put into practice basic sanitation projects and plans for integrated management of solid waste, which exist but are not implemented in their entirety or still have many deficiencies and need revision. During this process, it is important to consider the differences and unique needs of each borough, neighborhood or community. In the case of São Paulo, the city's needs make the implementation process complex.

Most solid waste collected in São Paulo, including in the Heliópolis community, could be diverted from landfills and open dumps if there were effective programs on separate collection of recyclables and reverse logistics in order to recover this material and still generate income and employment for the population. Furthermore, the organic waste could be assigned for composting. With these improvements, would be a little of refuse grounded, extending the life of the landfills and preserving the environment.

The local government should offer tax incentives for recycling industries to expand this market and broaden the system of reverse logistics. Furthermore, to ensure that more recyclables may increasingly be diverted from dumps and landfills, taking another destination and returning to the economic cycle. Public policies need to

Figure 1: Location of Heliópolis Favela.
Source: [14].

Figure 2: Stairways and alleys of Heliópolis.
Source: [17].

Figure 3: Municipal solid waste (MSW) accumulated on the sidewalks around the SABESP II, residential buildings, designed by architect Ruy Ohtake.
Source: [17].

prioritize a long-term plan over short-run actions and set a budget that considers the entire life cycle of solid waste. This would result in savings, demanding a smaller need of investments in health care due to fewer people being contaminated by untreated waste, in addition to recycling benefits.

Moreover, the state government must ensure and expand environmental education policies especially in schools, community centers and public spaces through classes, lectures, advertisements on TV, in newspapers and magazines, and billboards around the public places. Thus, the citizen should be constantly exposed to information about proper disposal of waste, or better, how to reduce and prevent the generation of more waste. Through conscious citizens, the city will be cleaner, the waste will have the correct destination and everyone will be part of the integrated solid waste management. The clear role of each agent from the government, producers, dealers, collectors and residents in general can define the success of the project.

It is critical that the steps for implementing a plan for solid waste management are fully met. To this end, the composition of the solid waste produced on site should be considered, in order to ensure that it has the proper treatment and destination. Based on the diagnosis, the solutions to be implemented will be more easily achieved, bringing economic, social and environmental benefits to the community. It is important to add that acting in this way, the municipality or the community will be complying with the National Policy of Solid Waste Law [10]. Environmental education and active participation of the community, separating waste at home correctly and receiving instructions from the municipality are inherent to the successful implementation of these public policies.

Municiple Solid Waste in Heliópolis: Reality and Possibilities

Illegal discharge of waste in slum areas is a serious problem as it threatens public health through contamination of soil, air, groundwater and other water bodies. Household collection only is not enough because these areas have a large production of demolition and construction waste that is discarded anywhere, as well as furniture, appliances and other waste classified as special waste.

The major impediments to the establishment of an integrated management plan for slum areas are the access difficulties and deployment of equipment necessary for the plan to succeed. To remedy these situations, some interventions must be achieved to ensure the complete operation of solid waste management such as:

a) Traffic system: The precarious access should be improved to ensure the movement of residents and to allow for waste collection and other public services such as firefighter safety, etc. In addition, streets are important enabling underpass infrastructure such as water, sewer, telephone, gas, and other facilities. As the density of occupation does not allow for pathways with formal dimensions without the removal of many families, other solutions should be deployed for the solid waste collection, with the support of educational campaigns and training;
b) Network of sewage: All sewage must be collected and destined to a treatment plant where clean and treated water can be returned to the rivers and streams;
c) Drinking water: All homes must have drinking water. This would hinder the spread of diseases like cholera, infectious diarrhea, leptospirosis, hepatitis, among others. As mentioned, all households in the slum of Heliópolis have potable water. However, not all communities of São Paulo do;
d) Drainage network: All rainwater should be stored and reused for irrigation as well as other non-potable purposes, to reduce the consumption and wasting of drinking water;
e) Solid waste: All waste must be collected and destined for recycling, composting and reuse. Only the refuse should be directed to waste-to-energy facilities or landfills;
f) Landscaping: Trees and bushes should be planted on the sidewalks, creating green areas and parks brings the community a place for meetings, entertainment, increasing living standards and yet minimizing the occurrence of floods and illegal points of waste disposal;
g) Housing units and temporary accommodation: During the interventions, the homeless population should stay in temporary places while waiting for

the completion of construction. Then, they can move to permanent residences;

h) Areas of leisure and sport: These areas are important to allow the inhabitants have options to practice sports and to participate in other activities during leisure time. If the youth create a bond with their community and respect the space, they are more likely to be aware of the importance of keeping the environment and surroundings clean;

i) Community center: It should be the first facility built so people may become aware and can be guided on interventions. In addition, this place works as a meeting place for lectures and discussions about the interventions in the area and issues related to public health and the environment.

Hence, the management of solid waste in slum areas is a public policy issue that should be developed in conjunction with the policies to ensure citizens have greater quality of life, dignity and respect. Through these interventions is possible to deploy an integrated solid waste management plan and achieve the goals of this plan, which is firstly the correct disposal of waste.

Some steps are necessary to follow (in accordance with the flowchart (Figure 4) [18]), to understand the current situation of solid waste management in a particular location and to deploy solutions that meet the community's need. The first step is to perform a diagnosis based on the number of dwellings, inhabitants and the gravimetric analysis of solid waste produced on site. Thus, in the second step, it is possible to understand the types of solid waste generated and identify in the solid waste management plan the best ways to collect and the most appropriate types of treatment. The third step is to assess the logistics of waste collection within the community, anticipating the needs for each type of material. The fourth step is to separate and treat each material in order to they have the appropriate destination (reuse, recycling or biological treatment). For this step, it is necessary to install equipment that will treat these materials to prepare them for the next phase. There are even special materials that must be evaluated separately the treatment and disposal. The fifth step is the commercialization of the materials treated, including recycled waste for industries that will use it as raw material and organic compost, which can be used as a fertilizer and biogas.

The proposal considered in this study is based on data from ARUP [19], which produced a specific report on waste composition in the favela of Heliópolis, and CEMPRE [11], which presents in its report the average waste produced by a typical Brazilian according to their income level. Based on these figures, it is possible to calculate the volume of waste generated and the areas required for sorting and for storing for sale. Considering that every Brazilian inhabitant produces on average one kg of waste per day, the favela of Heliópolis produces roughly of 120 tons daily. According to a diagnosis from ARUP [19], the waste composition of the low-income population is characterized as follows: 65% organic (food waste); 19% plastic; 12% paper; 2% metals; and 2% glass. As a representative parcel of the solid waste is composed partly of organic waste, this material could be forwarded to composting facilities. This can generate income for the population because the compost as well as recyclable materials can be sold.

Due to the complexity of the slums, the best alternative is to create specific onsite areas for the receiving, sorting and storing recyclable materials and for the composting of organic waste and a central area for receiving special materials for reuse (Figure 5) [18]. By inserting these treatment units within the community, it will be possible to reduce transport and to provide greater awareness and participation of the residents in the correct separation of waste, generating employment and income for local people who will work along the solid waste management chain.

To obtain maximum efficiency in separation and correct disposal of solid waste, the population should be served by three specific collections: food waste, recyclables and refuse. The frequency of collections may vary because it is difficult to access the households and thus to carry out door to door collection. The collection of recyclables can be done once a week because they are dry and clean materials that people can store in their residences. For this to work, the population must be informed about the need to clean and to dry the containers containing liquids and food inside. Also, they would be recommended to reduce the volume of plastic packaging by compressing them and dismantling paper boxes. All these actions would assist the collection and transportation of this material to the sorting center.

The refuse and food waste can be collected together but packaged separately. Food waste can be allocated in paper bags, distributed to the community for free whereas

Figure 4: Flowchart step by step to implement an integrated solid waste management plan.
Source: [18].

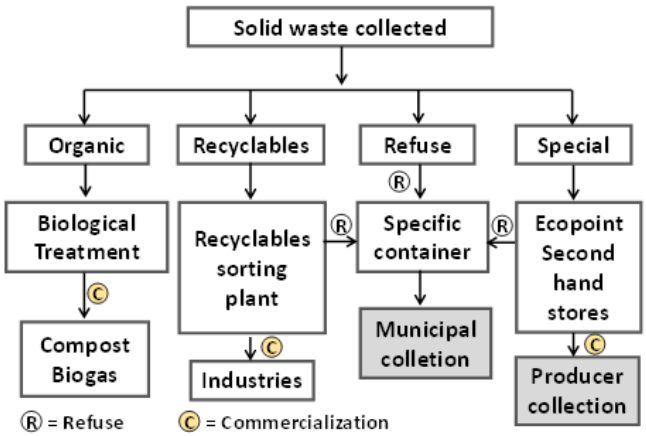

Figure 5: Flowchart of solid waste in Heliopolis Favela.
Source: [18].

a black plastic bag can be used for refuse. With this distinction between two types of waste and with internal separation in the collector trolley, it is possible to collect both materials at the same time, three times a week.

Families can alternatively deposit their waste in specific containers, without waiting for collection. These containers must be placed in strategic locations to facilitate access by the truck that will take them to their destinations. The organic fraction collected would be sent to central biological treatment and the recyclable materials would be taken to the local sorting center. These two facilities should be within or very near the community, facilitating transport and operation. Regarding refuse, the municipality may collect directly from the container through a truck. This material could be sent to thermal treatments instead of a landfill, generating renewable energy.

For organic waste (food waste), it is necessary to build a composting facility to receive all the material. This type of waste is 65% of household waste, the largest fraction generated by the low-income population. Heliópolis produces around 78 tons per day [19] of organic waste that could be composted. The generated compost could be used in landscaping and erosion control in the community or sold. Today, there are modern techniques and equipment that accelerate the composting process. The compost can be prepared from 2 months to a few days depending on the technique used. Furthermore, it is also possible through anaerobic digestion techniques to degrade the organic matter, creating biogas and fertilizers. Biogas can be used for the benefit of the community, fueling stoves or as fuel for vehicles employed in the collection and transportation of materials. The excess biogas can be commercialized to industries and the government.

Regarding the recyclables, it is necessary to create a central plant to sort the recyclable materials where it is possible to benefit and to store the material until it is sold to industries. In the case of Heliópolis, the favela produces 66 tons daily of recyclables, as follows: 22.8 tons of plastic, 14.4 tons of paper, 2.4 tons of metal and 2.4 tons of glass [19]. This material collected in the slum itself could be sold and generate income and employment for local people. It is necessary to create two areas of separation; the first one can be mechanized, with a machine separating the waste into four categories: paper, plastic, metal and glass. In the second area, the waste would be sorted manually into as many as 75 categories. These materials are pressed, packed and stored in places with natural ventilation. When the amount required to sell to the industries is achieved, the material can be sold directly to the recycling companies, without intermediaries, increasing the profits.

The separation of recyclable materials in the sorting plant can reveal that some of the material is actually refuse. The refuse fraction tends to decrease the more the population is aware of sorting guidelines as well as with a more efficient separation process in the second separation area. This refuse have as destination a specific container where the municipality will collect the material and take it to the final destination, which could be a waste-to-energy facility.

In order to minimize illegal discharge, it is necessary to create points of voluntary receipt of construction and demolition waste as well as all types of special wastes that are not part of the household collection, such as batteries, light bulbs, paints and varnishes, etc. The City Hall of São Paulo makes the eco-points, which are spaces scattered across the community, where people can voluntarily deliver their waste. It is available to serve as locations for receiving construction and demolition waste, special waste and also recyclable material, but there are too few points to serve the entire population. In the case of the Heliópolis favela, additional points of illegal waste dumping have already been mapped. Therefore, the ideal would be to turn these places into eco-points that meet the conditions of access and operation to perform sorting and storing waste prior to disposal for recycling industries.

The eco-points ensure the waste has the most appropriate destination. In these places, it is possible to deliver not only recyclable materials, but also those labeled special. Examples of special waste includes construction and demolition waste, furniture, mattresses, appliances, tires, batteries, light bulbs, paints, varnishes, contaminants and other materials in general. A different treatment in order to recycle and to reuse is needed because each material has a specific destination; these materials cannot be included in the recyclable or food waste collection, otherwise they may contaminate and harm the process of recycling and composting.

In the city of São Paulo, on average 4,000 tons of construction and demolition waste is produced daily and in fact this value could be much higher, because it only takes into account the materials that were allocated into landfills and official deposits [11]. This material may be recycled if separated at the source, following the CONAMA resolution 307 [20] that classifies this waste into four classes A to D. This material has great potential for reuse and recycling and has been recovered and recycled in construction in order to achieve points for green certifications, so-called green buildings.

In addition to serving as a delivery point, eco-points may also serve as a local marketing tool for reusing materials from demolition, furniture, toys and other items that could possibly be repaired and sold to the community. This action would promote the reuse of materials and products ensuring that they have their lives prolonged. Consequently, it would also ensure reduction of waste production and the need for extraction of raw materials to manufacture new products.

With treatment and sorting facilities for organic waste, recyclable and special materials combined with the logistics of collection, transportation and marketing it is possible to develop a circular economy within the community, generating jobs and income through integrated solid waste management.

CONCLUSION

Due to the complex urban layout of the slum areas, it is necessary to develop a specific plan for these sites adapted to local conditions that meets the goals of proper solid waste disposal. National laws are well written with respect to the life cycle of waste, but they are inefficient by themselves, what these communities need most is an effective environmental education involving all age groups. The implementation of a solid waste management plan provides an opportunity for the local community to reduce waste at the source through awareness campaigns, and it also brings economic benefits to citizens, generating jobs and income. Residents who separate solid waste at home will notice and are likely to be surprised by the amount of waste produced, a realization that can inspire them to reduce the production of waste material that cannot be composted or recycled.

This requires a change of the current paradigm in Brazil of seeing waste as "garbage," to seeing it as a source of income that also brings environmental benefits for the present and the future of the nation. Such a shift would mean that the population working informally with solid waste could now be incorporated into the system under the law of National Polycy of Solid Waste (PNRS).

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Author Contributions

Veronica Rosaria Polzer – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Maria Augusta Justi Pisani – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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