STEPHY Publishers

Global Scientific Research in Environmental Science

Review Article

Urban Social Waste and Urban Solid Waste in Brazil: Problems, Consequences and Possible Solutions

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Abstract

Brazil is a country of continental dimensions, with a surface area of 8,510,296km^2, which is distributed among 26 federal states and a federal district. However, due to an extremely unequal income distribution, one of the major social problems that the country still faces is urban segregation, experienced by a large part of its almost 212 million inhabitants, who still find severe problems with housing, public transportation, security, health, employment, education and infrastructure, especially with regard tothe process of collecting and the treatment of waste generated. In the case of solid urban waste (SUW), approximately 190,000tons are produced daily, which implies a per capita production rate of 0.90kg(inhab.day)$^{-1}$. Of the total generated, a fraction greater than 90% (w/w) is collected and, of this fraction, a percentage of 25% is still disposed of in open dumps, generating environmental impacts of different magnitudes. In addition, of the quantity of SUW generated in Brazil, about 55% (w/w) corresponds to putrescible organic matter, which could be fully used as an alternative source of energy (methane gas, for example), which normally does not occur. In these terms, Brazil becomes a country with strong social, economic and public health problems, and with regard to basic sanitation, there are still great demands, especially when considering the collection and treatment of the various types of waste generated.

Keywords: Poverty, Sanitation, Environment, Public cleaning, Environmental sustainability.

Introduction

Social and economic indicators of Brazil

The Federative Republic of Brazil is formed by the union of 26 federal states, 5.570 municipalities and one Federal District. The Brazilian population was estimated at 211.755.592 in habitants and of the 26 states, São Paulo is the most populous with 46.289.333 in habitants, followed by Minas Gerais, with an estimated population of 21.292.666, and Rio de Janeiro, with population of 17.366.189in habitants. Therefore, considering the four states in the Southeast region of Brazil (in addition to those already mentioned, there is also the state of Espírito Santo, with 4.064.052 in habitants), the resident population is 42%, with an urbanization rate of 93%. On the other hand, the Northeast region is the second most populous, concentrating 27.1% of the country's total population and, of the nine states and 1.794 municipalities (32.2% of all Brazilian municipalities), the most populous are the states of Bahia, Pernambuco and Ceará. The South, North and Midwest geographic regions, in turn, are much less populous and account for 14.2; 8.7 and 7.6% of the Brazilian population, respectively. The populations residing in the Brazilian municipalities are quite variable, especially those in the cities of São Paulo and Rio de Janeiro, which are larger than that of many countries on the European continent and Latin America and the Caribbean, for example. On the other hand, there are Brazilian municipalities with a population of less than 2,000 inhabitants, and this creates certain types of problems with regard to public management and services of a social, economic and environmental nature.

According to the ranking established by the UN, the Brazilian Human Development Index (HDI) is 0.759, making the country occupy the 79th position among the 189 countries studied and indicating that Brazil has a high human development index. Analyzing

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Received: 15 January, 2021 **Published:** 17 February, 2021

Citation: Valderi Duarte Leite, José TS, Catarina SAC. Urban Social Waste and Urban Solid Waste in Brazil: Problems, Consequences and Possible Solutions. *Glob Scient Res Env Sci*. 2021;1(2):1–4. DOI: 10.53902/GSRES.2021.01.000509

Brazil's HDI in the context of South American countries, it ranks fifth in the HDI. In relation to the Municipal Human Development Index (MHDI), which works on three major social dimensions (life expectancy, education and income), Brazilian municipalities have very variable MHDI, which justifies the latent social inequalities and consequently the challenges to be faced. Such challenges are portrayed on several fronts, especially with regard to education, health and unemployment. In other words, in general, Brazil has a high human development HDI, however, in relation to the HDI, human development indexes vary from 0.86 (considered as high human development index) to 0.49 (considered a very low human development index), confirming the inequality already described.

It is worth mentioning, however, that of the 100Brazilian municipalities with the highest MHDI, only the municipality of Fernando de Noronha (Pernambuco) appears in this ranking, fully demonstrating that the smallest MHDIs are in the municipalities of the Northeast and North regions of Brazil. Therefore, taking into account the human development indexes of several Brazilian municipalities, it can be seen that there is a great social inequality, which can be understood as the relationships established within any society, in view of determining a place for the unequal, whether for economic reasons, colour, race, gender, belief, etc. In Brazil, the problem of social inequality has been perpetuated throughout our existence as a society, and in the last three years it has intensified in a rampant and frightening way. Social inequality is responsible for limiting people to basic constitutionally established rights, such as the right to quality public education, quality health, decent work, housing, accurate information, basic sanitation and the right to come and go without being overshadowed by the owners of speculative financial capital.

Thus, although Brazil is in the extract of the largest Gross Domestic Product (GDP) in the world, it is the 8th country with the highest index of social and economic inequalities in the world. The UN still emphasizes that the main causes of social inequality are the lack of access to quality education, unfair fiscal policy, low wages, lack of access to quality health services, decent housing, basic sanitation and affordable, quality urban mobility. For this reason, social inequality in Brazil always experienced and has experienced, especially in recent years, poverty, misery, unemployment, slums, malnutrition, marginalization and violence. However, if on the one hand the main responsible for social inequality, mainly in undeveloped countries or in precarious development stage, it is the anti-democratic and elite public policy, on the other hand, Income Concentration also has its prominent role. According to IBGE, the monthly income of 1% of the richest population in Brazil is around 34 times higher than the 50% of the poorest population. Furthermore, in that same year, the income of 5% of the poorest population was reduced by 3%, while that of the population in the extract of the richest 1% increased by 8%. The verification of this data is reflected in the Gini Index, which in 2018 reached the level of 0.59, reaffirming the growth of social inequality and consequently the significant amount of urban social waste. It is worth mentioning that the citizen is considered poor when he receives on average up to US$5.00 per day or something around R$28.00. For those who have an average income of up to US$1.90 per day or R$10.60, they are considered to be in a state of absolute or miserable poverty. In the Northeast and North regions of Brazil 40% of the poor in Brazil are settled and, of this amount, 7.4% are in a state of misery.[1]

A quarter of the Brazilian population, something around 57million people, is considered poor, given that they have an income of around R$12.00 per day, thus fitting into the situation of poverty. In an even worse situation of social and economic vulnerability are 13.4million Brazilians with an income below R$4.50per day, fitting in the situation of extreme poverty. Therefore, applying Equation 1 to estimate these two fractions of Brazilians, it appears that in quantitative terms the urban social waste in Brazil (QRSoU) is 70.4 million people, or 33.3% of the total population.

$$QRSoU = N^{o}poor + N^{o}miserable \quad (1)$$

Where: N^{o}poor-number of poor; N^{o}miserable-number of miserable people.

These data only corroborate the fact that, in Brazil, there are no safe and permanent social protection policies, and that this absence in all government spheres contributes significantly to the reduction of the size of the State, implying a high concentration of income and, consequently, in an increase in the number of people living below the poverty line. In addition, part of the most underserved population has been forcibly migrating into the arms of the parallel state, which has grown dramatically in most major Brazilian cities and has been consolidated within the social and economic structure of Brazil.

Urban cleaning services

Public cleaning services are the responsibility of the municipalities and the role of the Federal Government is to guide the guiding legal framework and, in some situations, contribute to the opening of financial credits for the construction and installation of some treatment units, taking into account, most of the time, political criteria at the expense of technical criteria. In relation to solid urban waste (SUW), the regular collection service serves 98.8% of the urban population and 92.1% of the total population. As for selective collection, the diagnosis indicated the presence of the service in 1.322 or 38.1% of the municipalities in Brazil, being provided door-to-door in 1.135municipalities, which represent 37.8% of the country's urban population.

According to Andrade and Ferreira,[2] the government must also manage the collection of solid waste at the source, that is, it must can direct and encourage selective collection aiming at the recycling of inorganic material, as well as the composting of putrescible material. In this line, it is worth mentioning the formal participation of waste pickers in selective collection in partnership with the government, which were responsible for 30.7% of the total tons collected selectively in 2018. According to the survey, 1.232waste picker organizations were identified in the country, distributed by 827municipalities, with more than 27thousand waste pickers linked to associations or cooperatives. However, this is still not a

reality across the country. Small centres still need incentives and, mainly, investments in the sanitation sector, including for the most basic procedures.

It is worth mentioning that, despite all the difficulties and often the lack of interest on the part of managers, in 2018, the amount collected was estimated at 62.78tons of household solid waste and waste from public cleaning service, denoting a per capita generation rate of 0.96kg.(in hab.day)$^{-1}$. In addition, a quantity of 124thousand tons were sent for treatment in 70 composting units and 1.05million tons of recyclable waste were sent to 1.030 sorting units installed throughout the national territory. It is also worth mentioning that, in Brazil, of the quantity of SUW collected in 2017, only 1.7million tons went to the selective collection system, denoting that the practice of selective collection of SUW in the country, even showing some advances in the last few years, years, is still at a much lower level than desirable. In this context, it can be estimated that of the total SUW collected in Brazil, approximately 46.68million tons per year were disposed of in landfills, which corresponds to approximately 75% of the total (61.6million tons). In addition, 15.05million tons were disposed of in final disposal units considered inadequate (controlled landfills and dumps), which together correspond to 25% of the total disposed of in the year 2017.

Regarding financial information, the total expenditure of City Halls in the management of urban solid waste in 2017, when apportioned by the urban population, resulted in the amount of R$130.47 per inhabitant, that is, an expense of approximately R$22billion for the management of solid urban waste across the country, employing 333 thousand workers. Even so, the fragility of financial sustainability remains in the sector, since only 47% of the municipalities charge for services, and the amount collected covers only 54.3% of costs. The question that remains is: what could be done with these solid residues, especially those that go to landfills and are in the open, further compromising the environment? In Brazil, in 2010, the National Solid Waste Policy (NSWP) was instituted through Law nº 12.305/2010, considered one of the legal frameworks for the entire process dynamics of solid waste and, in particular, urban solid waste.

The National Solid Waste Policy, established by Decree nº7.404/2010, has as some of its objectives the protection of public health and environmental quality, the non-generation and reuse of waste, as well as the environmentally appropriate final disposal of waste. It is worth stressing, however, that with the legalization of the NSWP, public managers, companies, the scientific community and society in general are co-responsible for framing the premises of Sustainable Development with regard to the management of SUW in Brazil.[3] In other words, everyone must act and contribute to the compliance with the NSWP guidelines, bringing benefits not only to the population, but mainly to the environment. Until this end is achieved, new management, recycling and treatment techniques will not have the expected and necessary effect. In addition, it is important and urgent that there is technical and financial cooperation between the public and private sectors, aiming at the development of scientific and technological research that support the generation of new products, methods, processes and technologies for management, recycling and reuse waste, in addition to treatment and final disposal of waste generated in an environmentally appropriate manner.

Anaerobic digestion of solid waste: a possible solution

Leite et al.[4] and Zago and Barros[5] state that of the SUW produced by the Brazilian population in the last 10years, about 60% (w/w) correspond to fermentable organic matter, while glass and ferrous and non-ferrous materials make up less than 5% (w/w) of the amount. Leite et al.[4] still state that, in Brazil, 71.081 tons of putrescible organic material are produced daily, which are thrown in a landfill and can generate, through anaerobic biological processes (in this case, uncontrolled), methane gas (CH_4), gas carbonic (CO_2) and leachate.[6] Such products have high polluting power, which can be 25times higher than that of domestic sewage, considering only carbonaceous and nitrogenous materials. In addition, there are dozens of tons of organic matter liable to biodegradation that are thrown, without criteria, in dumps, and that cause serious damage to the environment as a whole; as well as fairs and processing industries for derivatives of fruits, vegetables, dairy products, meats, etc., which even release their waste in the open and often do not receive any type of inspection by public agencies. taking into account that Brazil is the world's third largest fruit producer and the third largest vegetable producer in the Americas, and it is responsible for 4.6% of the total volume of fruit produced worldwide, with an estimated harvest of 39.9 million tons,[7] anaerobic (controlled) digestion of this type of material presents itself as an ecologically correct and sustainable alternative.

Although the operation of anaerobic digesters generally takes place at mesophilic temperatures, thermophilic anaerobic digestion can offer several potential advantages, such as increased reaction rate; increasing the biodegradation efficiency of organic matter and, consequently, the production of biogas; improvement in solid-liquid separation and enzyme activity; low energy requirements, greater stability; increased elimination of pathogenic microorganisms, in addition to a better performance in the anaerobic digestion of fruit and vegetable residues.[8,9] However, it has already been found that it is a less stable process, given the various adverse effects to the digestion process, such as, for example, the reduction of the activity of methanogenic microorganisms and the disadvantage of hydrogen consumption by these same microorganisms, since the Temperature affects the flow of hydrogen transferred between the acetogenic and methanogenic phases.[10]

According to Fisgativa et al.[11] the fermentable organic fraction of solid urban waste can produce, on average, 460L of methane for each kilogram of waste (normal temperature and pressure conditions), which represents almost twice the methanogenic potential of bovine manure (270 LCH4.(kgVS)$^{-1}$) and sewage sludge (255 LCH_4.(kgVS)$^{-1}$), for example.[12] Additionally, waste of different types and with high concentrations of organic material can be treated together (anaerobic codigestion), at low operating costs and minimizing the emission of gases responsible for the greenhouse effect.

In this sense, when it comes to scientific research and development of new technologies as recommended by NSWP, Leite et al.[13] built and monitored a system consisting of an anaerobic bioreactor operated in batch and a unit for crushing fermentable organic waste. The substrate consisted of a mixture of fermentable organic residues with anaerobic sewage sludge (80:20,w/w), which contributed significantly to the increase in the density of microorganisms, thus providing greater efficiency in the transformation of the mass of carbonaceous material into methane (47.2 Nm_3CH_4).

Bouallagui et al.[14] who used the co-digestion process to treat a substrate consisting of residues from fruits and vegetables, in addition to wastewater (51.5% increase in biogas yield), and by Gómez et al.[15] who investigated the co-digestion of solid vegetable residues associated with primary sewage sludge. In this case, the authors obtained a partially bio-stabilized residue, which can eventually be used in soil correction after secondary treatment. Therefore, within a sustainable context and from a social, economic and environmental point of view, it is necessary to provide a continuous and synchronized reduction in the rate of per capita generation of urban solid waste and, consequently, the full use of the quantity of the various fractions generated in the production chains.[16] On the other hand, it is necessary to deal with what is still produced in a technically and economically viable way. However, these points will only be reached when the legal framework of the national solid waste policy and the active participation of the whole society are in full harmony.

Conclusion

Of the quantity generated from MSW in Brazil, something around 55% (w/w) is putrescible organic matter (34.5million tons per year) and could be fully used to produce, for example, an alternative source of energy (methane gas). In addition, something around 45% (w/w) is made of recyclable material and could return to the production chains, contributing substantially to the preservation of natural resources, in addition to contributing purposefully to the social inclusion chain. However, Brazil still needs to implement effective and consistent programs for recycling and reusing the fraction of potentially recyclable and/or reusable urban solid waste, valuing workers in public cleaning services and devising public policies for generating employment and income.

Acknowledgments

None.

Funding

None.

Conflicts of interest

Author declares that there is no conflict of interest.

References

1. DIEESE. *Movement in the Labor Market, Turnover, Intermediation and Employment Protection?Inter-union Department off Statistics and Social and Economic Studies.* São Paulo–DIEESE. 2017.
2. Andrade RM, Ferreira JA. A gestão de resíduossólidosurbanos no Brasilfrenteàsquestões da globalização. *REDE– RevistaEletrônica do Prodema.* 2011;6(1):7–22.
3. Leite VD, Silva SA, Lopes WS, et al. Resíduossólidosurbanos no estado da Paraíba: aspectosconjunturais. *I SimpósioNordestino de Saneamento Ambiental.* Brazil: Paraíba; 2010.
4. Leite VD, Lopes WS, Sousa JT, et al. Resíduossólidosurbanos no Estado da Paraíba e o contexto da sustentabilidadeambiental. *Research Society and Development*. 2021;10(1):e33110111781.
5. Zago VCP, Barros RTV. Management of urban solid organic waste in Brazil: from the legal system to reality. *Sanitary and Environmental Engineering*. 2019;24(2):219–228.
6. LIN J, Zuo J, Gan L, et al. Effects of mixture ratio on anaerobic co-digestion with fruit and vegetable waste and food waste of China. *Journal of Environmental Sciences*. 2011;23(8):1403–1408.
7. FAO. *United Nations Food and Agriculture Organization.* Desperdício de Alimentos. Convenção ABRAS, São Paulo. 2017.
8. Bouallagui H, Rachdi H, Gannoun H, et al. Mesophilic and thermophilic anaerobic co-digestion of abattoir wastewater and fruit and vegetable waste in anaerobic sequencing batch reactors. *Biodegradation*. 2008;20(3):401–409.
9. Ryue J, Lin L, Kakar FL, et al. A critical review of conventional and emerging methods for improving process stability in thermophilic anaerobic digestion. Energy Sustain Dev. 2020;54:72–84.
10. Amani T, Nostrati M, Mousavi SM, et al. Study of microbiological and operational parameters in thermophilic syntrophic degradation of volatile fatty acids in an up flow anaerobic sludge blanket reactor. *J Environ Chem Eng*. 2015;3(1):507–514.
11. Fisgativa H, Tremier A, Dabert P. Characterizing the variability of food waste quality: A need for efficient valorisation through anaerobic digestion. *Waste Management.* 2016;50:264–274.
12. Peu P, Picard S, Diara A, et al. Prediction of hydrogen sulphide production during anaerobic digestion of organic substrates. *Bioresource Technology*. 2012;121:419–424.
13. Leite VD, Barros AJM, Meneses JMC, et al. Codigestãoanaeróbia de resíduosorgânicos. *RevistaDAE.* 2017;65(208):35–46.
14. Bouallagui H, Touhami Y, Ben Cheikh R, et al. Bioreactor performance in anaerobic digestion of fruit and vegetable wastes. *Process Biochem*. 2005;40(3-4):989–995.
15. Gómez X, Cuetos MJ, Cara J, et al. Anaerobic co-digestion of primary sludge and the fruit and vegetable fraction of the municipal solid wastes: Conditions for mixing and evaluation of the organic loading rate. *Renew Energy.* 2006;31(12):2017–2024.
16. Silva AG, Leite VD, Silva MMP, et al. Combined aerobic composting of septic tank sludge and solid vegetable waste. *Revista de EngenhariaSanitária e Ambiental.* 2008;13(4):71–379.