Solid Waste Management in Urban Areas: The Case of Inter-Municipal Public Consortia in Brazil

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***Abstract*—This article aims at reflecting on the operational, administrative, and financial difficulties faced by Brazilian municipalities to implement the guidelines of the National Solid Waste Policy-NSWP, established as of edition of Federal Law 12.305/10. Most of the Brazilian municipalities do not bear a structure capable of enabling effective management of its urban solid waste, including its environmental, social, and economic aspects. Thus, municipal administrations have to seek viable alternatives from an administrative point of view for effective implementation of these guidelines. The alternatives must take into account possible partnerships with neighbouring municipalities and private sector.**

***Index Term*—urban solid waste, urban engineering, public administration, inter-municipal public consortia**

I. Introduction

It can be said that solid urban waste is synonym of resource and, therefore, we are talking about raw material, energy and minerals. The solid waste market is constantly evolving and growing.

The Braziliansolid waste management policy is very up-to-date and contemporary from the environmental point of view. However, municipalities that must comply with it are in an emerging country, with several regional differences and undergoing three years of severe financial crisis. How can Brazil meet the requirements of its national solid waste policy taking into account the reality of its municipalities?The constitution of public consortia among municipalities seems to be a viable alternative.

II. What Is the Perspective of Urban Solid waste management in Brazil?

One way to measure the lack of development of a country is by looking at its waste [1].Direct and precise statement of the journalists of the Folha de São Paulo newspaper, at the start news story on the situation of dumpsnationwide. Numbersrelated to the generation of solid waste are alarming in Brazil and in other developing countries.

Observing data available from several sources, it can be mentioned that, in 2011, the global population was 7 billion inhabitants andsolid waste production was 1.3 billion tons per year. Projections indicate that in 2050 we will have 10 billion inhabitants on the planet and will produce 4 billion tons per year of solid waste. A famous equation, among the world's experts on the subject, says: population plus development equals more waste. According to numberspresented by scholars in the subject, worldwide, solid waste management has become a matter of survival. Therefore, there is an increasing intense debate about the growing and significant generation of solid waste, especially those from urban areas.

At an event on solid waste held in 2015 in Belgium [1] on the production and management of urban solid waste, an objective conclusion was reached: the current economic model is giving clear signs that it needs to be changed. After all, our planet has limits. With respect to this reality, the very World Wildlife Foundation – WWF disclosed the following statement in its site: "household waste is nature's cancer."

According to ABRELPE [2], between 2005 and 2014, there was, in Brazil, an increase of 24% in urban solid waste. 71 million tons of urban solid waste are collected on an annual basis, of which 58% have adequate environmental destination - that is, are sent to sanitary landfills-SL or waste treatment and disposal centers-WTDC and 42% of the solid waste produced still have inadequate disposal- i.e., they are sent to exposed dumps[3], causing serious and severe environmental and health problems. Anyway, this serious problem is to be solved, in part, by urban engineering as a contemporary science[2].

One cannot fail to mention that Brazil has the largest dump of Latin America, called *Estrutural*. Unbelievably,

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[1] World Congress on Solid Waste of the International Association of Solid Waste, held from September 8 to 11, 2015.
[2] Brazilian Association of Public Cleaning and Special Waste Companies. Third sector entity.
[3] Dump: an inadequate manner for final disposal of solid waste, characterized by the simple discharge of waste on thesoil, without measures to protect the environment or public health. Adopted by the Institute of Technological Research of the State of São Paulo.

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this dump is located in Brasília, which, in addition to being the capital of the country, is the Brazilian city with the highest *per capita* income. This situation is considered a true national disgrace. Some time ago, the Brazilian press intensely exploited the images of *Estrutural*, located 15 km from the National Congress. This example shows the dimension of the complexity of the matter for Brazil and the huge challenge that must be faced by public managers in the country.

The Ministry of Environment estimates that there are today, in Brazil, approximately 3 thousand garbage dumps, despite issuance of a federal law that stipulated, in 2010, the National Solid Waste Policy - NSWP. The presence of referred open-air garbage dumps, unbelievably, still takes place in the 9th economy in the world.

The population directly affected by dumpsis that of low income, which seeks its income therein. Referred population comprises men and women, of all ages, children and adolescents.

Due to the daily contact with these dumps, the population of waste pickers constantly faces several infectious and parasitic diseases, such as, for example, tuberculosis, tetanus, cholera etc. Of course, these waste pickersseek adequate treatment in the public health system. Therefore, there is an unnecessary overloading of the health system, that would not exist if environmental and social care were being strictly adopted by municipal governments in Brazil. It must be pointed out that the Brazilian Constitution imposes that the management of solid waste is under the responsibility of the municipalities. It is therefore up to them to make available the resources (financial, human and material) to carry out this task, which is complex and demands a high level of operating organization. After all, "many of the municipal problems transcend the boundaries of their territory, requiring joint action [3]".

In this sense, considering the situation at national level, the following questions are set out: what is the financial impact on the health system due to these diseases caused by dumps? Which national public entity holds this statistic?

As far as known, there is no health agency, sanitary surveillance agency or environmental inspection entity that calculates, statistically, such information, which are essential for a country that intends to achieve full social-economic-environmental development. Of course, other countries in Latin America, Africa and Asia present similar characteristics related to this environmental disregard.

Based on these issues we wish to address some aspects related to the effective implementation of the NSWP in Brazil. Federal law 12.305/2010 is, admittedly, an important regulatory milestone for the country, but it deserves to be examined taking into account the political and financial realities of the Brazilian municipalities.This law encourages the search for consortium solutions, prioritizing consortia of municipalities to access federal government resources [4].

According to the Brazilian Constitution, municipalities are entirely responsible for the management of their solid waste, from the collection of household residues and urban cleaning up to their environmentally adequate final destination. Brazil is divided into 5 major regions that present different social, environmental, cultural, and economic characteristics among themselves. These characteristics are reflected in the 5,670 municipalities that make up the Brazilian territory.

III. Generation and Management of Urban Solid Waste Versus Sustainableurban Infrastructure

With a large of attributions assigned to the Brazilian municipalities, as of the promulgation of the Federal Constitution of 1988, there are insufficient resources in their budgets to truly effectively comply with all attributions. As a result of this duality, the Municipal Administrations plead, compulsorily, over the years, financial support from the federal and state governments. In Public Administration, if there are no budgetary and financial resources available for a certain activity[4] there is no way to implement it. There is no magic in this regard. Therefore, there must be the political determination and resources to deploy an adequate management of solid urban waste, which would allow - of course in a broader public policy – the inclusion of jobs for collectors of recyclable material in dumps, who carryout the primary role of separation of recyclable materials in garbage dumps and in controlled landfills. It is estimated that there are in Brazil, today, about 800,000 collectors of recyclable materials.

"Since well treated and managed, much of the solid waste can be reused, generating employment, increasing income, reducing energy demand and raw materials [5]." It's important to highlight, in a contemporary world, the economic and environmental importance of urban solid waste and the role played by waste pickers in garbage dumps. Urban solid waste has, in essence, several ways of exploitation. In fact, the economic and environmental potential of urban solid waste is enormous. There are several ways of treating solid waste (composting, biogas, etc.), widely used in Europe, North America and Israel, for example.

Definitely, the way Brazilian municipalities see solid waste has to be changed in order to expand and improve the management model, especially regarding urban solid waste, which occur in a much higher proportion, when compared to rural waste.

Several experts in urban solid waste management are unanimous in stating that the goals of the Brazilian Solid Waste Policy were very ambitious, reflecting the euphoria of the years of economic growth (2003-2010). The majority of municipalities fell far short of the established goals and, consequently, failed to eradicate the dumps until August 2014, which was the deadline set by the current legislation in Brazil.

[4]Activity, in the official technical language, is called budget heading.

Considering the known history on the subject, there is no way not to question: if small municipalities have not been able to finish, for various reasons, with the dumps, will they succeed in the coming years? One cannot glimpse new goals without considering the national context. After all, Brazil is facing a serious financial crisis, which according to renowned scholars on the subject, will be of medium-term. These experts say that, maybe, as of 2019 Brazil's financial situation will start to show improvements. Until then how many moredumps will emerge in Brazil?

Considering the country's financial crisis – and obviously all the 5,570 Brazilian municipalities – and the announcement made by the Ministry of Planning, Budget and Management of an unprecedented public deficit[5] of more than R$170 billion (approximately US$ 50 million) in the accounts of the Federal Government for 2016, the situation tends to worsen.

Finally, this Brazilian financial crisis will provide less resources to face the critical issue of the dumps, in addition to pushing more people to the degrading work in the dumps.

Folha de São Paulo newspaper published, on the same article regarding dumps at national level, the statement of a IPEA's[6] researcher, Albino Rodrigues Alvarez, who mentions that maybe not even in 50 years we will be able to get rid of these dumps. The plan was very ambitious. Garbage is a civilizational challenge and is directly linked to education[1].

Moreover, according to a research carried out by ABRELPE between 2010 and 2014, theproduction of garbage in Brazil grew by 29%, while the population grew by 6%.

Another interesting fact that characterizes solid urban waste management is CEMPRE's[7] information that, in Brazil, in 2014, there were only 927 municipalities with selective garbage collection[6]. An insignificant number of municipalities, considering the universe of more than 5,500 municipalities in Brazil. In Japan and Europe, recycling represents a widely developed economic activity [7].

In summary, the urban infrastructure situation regarding solid waste is dramatic in terms of public, financial, social and environmental management, although Brazil is the 9th world economy, the main economy of Latin America and a member of the G-20.

IV. Case Study of the Municipalities in the State of RIO DE JANEIRO

The State of Rio de Janeiro is composed of 92 municipalities, of which 60% have more than 50,000 inhabitants and of these 30% have up to 20,000 inhabitants. It must be assumed that a large majority of municipalities do not have administrative, operational and financial conditions to enable proper management of urban solid waste, in accordance with the current legislation in the country.

By 2007 only four municipalities in the State of Rio de Janeiro allocated their solid waste to environmentally appropriate locations, which represented 9% (1,236 tons) of the daily share of solid waste generated in the State. This situation was modified until 2014, when it waspossible to change the scenario of the presence of dumps in the State, which is the second most important in the country.

Due to limited resources available in the annual budgets of municipal administrations, the effective management of urban solid waste is not a priority. Before it, other functions of municipal administrations emerge, such as personnel, health and education.

Unfortunately, despite the importance of the proper final disposal of urban solid waste, this has not deserved due attention of public administrators, not because they do not understand the importance of the subject, but by absolute lack of availability of resources, especially financial resources.

Faced with the current economic crisis, the situation of municipal management of solid waste, which was already critical, becomes even more complex to be equated by municipal public servants.

According to data of the Secretary of State for the Environment of Rio de Janeiro - SEA, 92 municipalities in the State of Rio de Janeiro produce approximately 17,000 tons/day of solid waste, which are distributed to controlled landfills but also to 42 garbage dumps.

According to SEA, 19 of these 42 dumpsrely on the presence of waste pickers, children, animals and vectors. In addition, 40% of the 17.000 tons/day refer to recyclable waste. Without much effort, the almost total inefficiency of public management is observed regarding the possibility of reuse and recycling of materials.

Thus, the importance of integrated and consortia solutions is perceived, so as to optimize, for all participating municipalities, the costs of implementing SL or TWDC.

In addition, the small size of the territory of the State (44,000 km^2) is another ally for the viability of the implementation of consortia, since municipalities are close together, without the need to transport solid waste for several kilometres.

V. Set up of Public Inter-Municipal Consortia for the Management of Urban Solid Waste through Sustainable Infrastructure

It must be sought to assist municipalities in the adoption of efficient and environmentally and economically viable technological solutions for the management of solid waste.

Both spheres of government – federal and state – have to provide technical assistance to municipal administrations, which do not have installed capacity, well-prepared technical staff and, much less, financial resources to implement, operate and maintain in full operation a SL or WTDC.

[5] Public deficit occurs when a government's expenses are higher than its revenues.

[6] Institute of Applied Economics Policy, attached to the Secretariat for Strategic Affairs of the Presidency of the Republic

[7] Corporate Commitment to Recycling. Third sector entity.

The implementation of an enterprise the size of a SL or WTDC is costly (US$ 3,6 million), requires very well qualified professionals and requires a complex operating system to manage (legislation, engineering techniques, skilled labour, etc.).

Although at a high cost, SL or WTDC would continue to be the best and most efficient technical alternative for proper disposal of urban solid waste, both from the environmental and public health standpoint. It is about sustainable infrastructure that needs to be adopted in municipal urban planning in Brazil and in developing countries.

The possibility of financing for the installation and operation of a SL or WTDC should not be ruled out. However, Brazilian municipalities, in their majority, do not, for various reasons, have conditions to individually raise funds. The situation would be the opposite if they could participate in some inter-municipal public consortium, which would have a more solid and efficient structure.

At national level, the Ministry of Cities should financially support municipalities or public consortia of municipalities regarding the viability of a SL or WTDC. It would demand small financial counterpart from the municipalities or consortia. In addition to providing fundamental support for the technical issues surrounding the theme.

Still at national level, specific financing lines should be structured via the BNDES[8], with special conditions.

At external level, there are funding lines from international development agencies such as the World Bank, BID[9] and CAF[10].However, the federal and state governments would have to technically and administratively support the municipalities in funding applications, which require multiple and complex steps to be taken.

On the other hand,the conditions of such international financing are very favourable for the borrowers. Financing conditions, such as interest rates, grace period, amortization period etc. are attractive.

In relation to the modernization of public management, in order to enable the creation of public consortia among municipalities, there is a viable possibility, through Federal Law 11.107/05, dated April 6, 2005, which established the general rules for the formation of such consortia[8]. This modality is extremely interesting, since public consortium has the power of a public entity and the agility of private initiative.

Due to this possibility, a research study is being carried out in order to analyse the first three municipal public consortia already constituted in the State of Rio de Janeiro.

These three consortia include fourteen municipalities, in three distinct regions of the state: metropolitan, mountain and the coffee valley.

In this case, the management of a SL or WTDC would be of the set of municipalities which would define the leader of the consortium and for which period.

The research aims to investigate whether the formation of public consortia would be the most appropriate alternative for municipalities to fulfill their mission in relation to solid urban waste management.

As for the research method, data collection through bibliographic and documentary surveys, the application of questionnaires, interviews with consortium representatives and participant observation are used to analyse and understand the structure of consortia operations.

In summary, there are viable ways to install SL or WTDC, whereas the *status quo* of the Brazilian municipalities, especially those of small and medium size[11], which are the absolute majority in the country.

"Given the difficulties inherent in the size and complexity of waste production in the consumer society, it is essential to improve waste management instruments [9]." There is specific legislation, although most municipalities do not have the conditions to actually solve their management of urban solid waste.

The final disposal of urban solid waste is a serious and fundamental issue for a country that intends to become developed and has the majority of its population (84%) living in urban areas. Otherwise, SL or WTDC bring as key benefits: conservation of natural resources, economic development and social inclusion. "However, in Brazil today, municipalities – with rare exceptions – are not prepared personally, economically and technically to face this challenge! [10]

How do public managers intend to deal with sustainable urban development and the course of contemporary urban spaces without, however, following viable ways to effectively addressthe issue of solid waste management? The option for inter-municipal public consortium should be considered.

VI. Conclusion

Brazilian municipalities need strategic solutions to act in planning, managing and fund-raising for the huge and serious problem of urban solid waste.

Municipalities do need technical, operational and financial support to house technological and social innovations linked to SL or WTDC. In addition to existing legislation, support from the federal and state governments would be decisive for the success of inter-municipal consortia. Thus, municipalities could become more efficient and socially inclusive.

The three consortia in the state of Rio de Janeiro under study confirm this situation. Without support from other spheres of government, the fourteen municipalities will not be able to manage their urban solid waste.

Therefore, the constitution of inter-municipal consortia is a potentially viable alternative for the implantation of sustainable infrastructure, given the

[8] National Bank for Economic and Social Development (BNDES)
[9] Inter-American Development Bank
[10] Latin-America Development Bank

[11] Small-sized municipality: up to 50.000 inhabitants. Medium size: up to 250.000 inhabitants.

socio-economic-environmental conditions of a developing country, such as Brazil.

REFERENCES

[1] L. Ferraz, and A. Prado,"Lixões sem fim," *Jornal Folha de São Paulo*, Cotidano B3, September 9, 2015.

[2] Panorama dos resíduos sólidos no Brasil, 12th ed., ABRELPE, São Paulo, 2015. [Online]. Available: http://www.abrelpe.org.br/. Accessed on September 27, 2015.

[3] P. N. Neto, *Resíduos Sólidos Urbanos –Perspectivas de Gestão Intermunicipal em Regiões Metropolitanas*; São Paulo: Atlas, 2013, ch. 3, p. 22.

[4] R. M Barros, *Tratado Sobre Resíduos Sólidos –Gestão,Uso e Sustentabilidade*; Rio de Janeiro: Interciência, 2013, ch. 2, p. 9.

[5] W. de J. Souza, *Resíduos - Conceitos e Definições para Manejo, Tratamento e Destinação*; Piracicaba, SP: FEALQ, 2012, ch. 9, p. 230.

[6] Compromisso Empresarial para a Reciclagem-CEMPRE. Informativos. [Online]. Available: http://www.cempre.org.br/. Accessed on September 24,2015.

[7] S. Calderoni, *Os Bilhões Perdidos no Lixo*, 4th ed. São Paulo: Humanitas/USP, 2001, ch. 1, p. 37.

[8] Government of Brazil, "Federal Law 11.107," *Official Journal of Brazil*, Brasília, DF, #13, pp. 1-4, April 7, 2005.

[9] D. A. Moreira, *Responsabilidade Ambiental Pós-Consumo – Prevenção e Reparação de Danos à Luz do Princípio do Poluidor-Pagador*, 1st ed. Rio de Janeiro: PUC-Rio, 2015, ch. 1, p. 38.

[10] A. Leite, "A realidade dos municípios brasileiros frente à nova política nacional de resíduos sólidos," in *Gestão Sustentável de Resíduos Sólidos Urbanos – transferência de experiência entre a Alemanha e o Brasil*, K. Fricke, C. Pereira, A. Leite and M. Bagnati, Ed. Braunschweig, Germany: ANS e. V., 2015, ch. 2, pp. 407-409.

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