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Municipal Solid Waste Management: Public Consortia as an Alternative Scale-Efficient? Lessons from the Brazilian Experience

Wanessa de Matos Firmino Silva[1], Denise Imbrosi[2], Jorge Madeira Nogueira[2]

[1]Department of Economics, University of Brasilia and the World Bank, Brasilia, Brazil
[2]Centre of Studies on Agriculture and Environmental Economics (CEEMA), Department of Economics, University of Brasilia, Brasilia, Brazil
Email: imbroisi@unb.br, jmn0702@unb.br, jmn0702@terra.com.br

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Abstract

One of the biggest challenges facing modern society is solving excessive generation and the environmentally safe disposal of solid waste. In this context, effective management of municipal waste is required, but local authorities in many countries are constrained by limited finances and inadequate services. The decisions in the area of municipal solid waste management are not only capital intensive, but also tough from the environmental and social points of view. There is a need to develop and implement a simple, but reliable tool that will help mayors in this process. In this paper, we analyze Public Consortia of Municipalities, a basic instrument of the National Policy for Solid Waste of Brazil, a country with more than 5000 municipalities. Public Consortia is expected to reduce costs due to economies of scale and smaller demand for land. This study identifies the characteristics of Public Consortia, its advantages and disadvantages for urban solid waste management based upon the analysis of 29 Public Consortia in the Northeast, Southeast and South regions of Brazil. Through gathering of information and empirical data our analysis reveals challenges that are not being addressed and that impact in both, the formation of Public Consortia, as well as the urban solid waste management alternatives.

Keywords

Solid Waste Management, Municipal Solid Waste Management, Criteria Evaluation, Public Consortia

1. Introduction

Excessive generation of and scarce environmentally safe disposal sites for solid

waste are among the biggest challenges facing modern society. The international concern in relation to solid wastes, household solid wastes, has increased due to increase in production and to inadequate management and disposal areas. Since the Rio Conference 92, there has been the incorporation of new priorities for sustainable solid waste management, which has directed the action of Governments, industry and society.

These priorities include the reduction of waste generation, reducing final disposal on the ground, maximizing reuse, the selective collection and recycling, composting and energy recovery. In particular, one of the biggest problems in densely urbanized areas, especially in metropolitan areas, is the lack of appropriate places to have the waste properly disposed. Furthermore, in most landfills, there is no proper treatment for the slurry (toxic liquid generated by organic garbage decomposition). This condition results that toxic waste can contaminate the soil and underground water sources, while the gases produced in the decomposition process are released (Jacobi & Besen, 2011).

In most countries, local authorities are charged with the responsibility of collecting and disposing of solid and liquid municipal wastes within their areas of jurisdiction (municipalities or counties). According to estimates from the World Resources Institute and USAID, mentioned by Henry, Zhao, & Dong (2006), many local authorities in developing countries spend over 30% of their budgets on refuse collection and disposal but can only collect at most 50% - 70% of municipal solid waste (MSW). Most do not meet environmentally safe MSW disposal levels because of a lack of sanitary landfills.

This reality of municipal solid waste management (MSWM) is also present in a large and economic diversified country like Brazil, where municipalities are responsible, by law, for the provision for public service of urban cleaning and solid waste management. There are 5570 municipalities in the country; approximately 90% of them have population lower to 50,000 inhabitants (IBGE, 2014a). The National Survey of Basic Sanitation 2008 (IBGE, 2014a) shows that just over 30% of these municipalities have an adequate destination for the collected waste. In recent years, several norms and the National Policy on Solid Waste[1]-PNRS (on its Portuguese acronym) have provided a legal framework for the solid waste management sector.

The PNRS imposes deadlines for the closure of dumpsites and the implementation of proper waste disposal, providing treatment, recycling, composting, gas recovery from landfills, planning and cost recovery initiatives, putting pressure on governments at all levels, especially the municipal, to comply with the new law. However, municipalities, the smaller ones, face difficulties for SWM: 1) inadequate service coverage and operational inefficiencies of services, 2) limited utilization of recycling activities, 3) inadequate landfill disposal, 4) inadequate management of hazardous and healthcare waste, and 5) lack of resources, planning and technical expertise for the municipal solid waste management.

[1]Law No. 12,305 of August 2010 and Decree No. 7404 of December 2010.

In this context, one of the instruments encouraged by the PNRS[2] is the regionalized delivery of MSWM services through formation of Public Consortia, which is justified in the norm for scale gains, which would, in theory, to the efficiency of the provision of services for urban solid waste (USW). The Consortia aims at trying to reduce the private costs of MSWM distributing costs over more than one municipality to improve services, dispose correctly the USW, improve service delivery, reduce investment costs, increase technical cooperation, include the collectors of recyclable materials in the selective collection process and mitigate environmental damage (Nascimento Neto & Moreira, 2012; IPEA, 2012).

The first question that drove this study was to establish whether the prioritization and the incentive to the access to government resources provided by the PNRS to municipalities, for formation of Public Consortia for regionalized management of USW services, led to an efficient MSWM. Other supplementary questions also arose in relation to economic, social and territorial factors that influence the efficiency of a shared management of solid waste and that would be decisive in encouraging and prioritizing access to resources by Law. To understand a policy instrument is necessary to understand their characteristics and what it entails in terms of effectiveness, efficiency and equity. However, when the research started, it was found that there was no information available on the main characteristics and problems faced by Public Consortia for MSWM in the country.

The informational gap identified led us to expand the purpose of the work, corroborating the vision of Ethridge (1995) to expose that the data and the data collection process can affect how one perceives the problem and how one takes conscience of it. It was carried out then a data survey on the sources of funding for MSWM, since the lack of municipal resources is the first justification for encouraging Consortia. We sought to identify the Public Consortia for existing MSWM in Brazil and conduct a case study with 29 Public Consortia, rising, through the answers obtained, the main characteristics and the problems faced by this instrument of the PNRS.

With the gathering of information and the collection of empirical data, it was possible to reveal problems that would otherwise go unnoticed, as the identification of primary issues in the management of solid waste that interfere in encouraging consortiums solutions. Instead of pointing out which factors most influence the efficiency of Consortia, the paper exposes which of them are considered on its formation and the consequences for their efficiency. In addition, it shows the relevance of the evaluation and makes a proposal on how and what to evaluate in USW management through Public Consortia from the obtained results.

2. The Public Consortia Alternative

The weak regulation of legislation in SWM is a barrier to be faced in the early stages of planning public policies for the MSWM, especially in developing coun-

[2]The Basic Sanitation Law (LSB) also encourages the formation of Public Consortia (Brazil, 11,445, 2007b).

tries (Ezeah & Roberts, 2012). In places without waste management policy, the first step is the implementation of a direct regulation. Thus, despite some limitations, the approval of PNRS in 2010 marked a new stage in public policy of SWM in Brazil because it standardizes the processes and duties to be fulfilled by individuals, companies and governments nationwide.

The Law of PNRS, in general terms, brings the concepts of shared responsibility, inclusion of waste pickers and hierarchy-not generation, reduction, reuse, recycling, solid waste treatment and environmentally adequate disposal of waste. It also presents some requirements, such as closing landfills, creating plans, implementation of proper disposal of waste (treatment, recycling, composting, gas recovery from landfills, planning and cost recovery initiatives). The Integrated Solid Waste Management Plans[3] is a key issue of the law, and should include diagnostic studies on solid waste generation, identify favorable areas for disposal, regional solutions and opportunities for consortia solutions, operating rules, technical training activities, actions with the participation of interest groups, the costing system, collection forms of service delivery, identifying environmental liabilities and remedial measures, among others (Brazil, 2010a)[4].

Public Consortia is an instrument of the Brazilian PNRS. According to the Law, municipalities that choose consortia solutions for MSWM have priority access to the Government's resources (Brazil, article 45, 2010a; art. 78 and 79, 2010b) and the preparation of the Plans is conditional for proposals and the receipt of funds (Brazil, art. 16 and 18, 2010a). However, the PNRS has some limitations, such as the inability of municipalities to apply its requirements because of municipal administrative capacity-lack of financial and technical resources, infrastructure or the complexity of the Law. Details of Public Consortia are summarized in **Table 1**.

3. Public Consortia for MSWM in Brazil: An Evaluation

For this research, it was sought to identify, at first, the prevailing cases of Public Consortia for MSWM in Brazil. Since there is no Federal Agency that centralizes this information, we conducted a survey in all 26 Brazilian states and the Federal District. The focus of the survey was to seek the Public Consortia that had the sole purpose of SWM or at least with one of its components being SWM. The survey of existing Public Consortia for SWM was conducted from January to May 2014 based upon responses received by email, phone contacts, internet searches, review of academic papers on specific Consortia, municipal laws, reports and State Integrated Plans.

Through these procedures we identified 77 Consortia: 38 in the Northeast, 25 in the Southeast, 11 in the South, 2 in the Center-West and only one in the North region of the country. Given the nonexistence of data on characteristics,

[3]The PNRS established the formulation of Integrated Solid Waste Management Plans on federal, state, municipal and inter-municipal levels.

[4]However, data from IBGE (2014a) shows that 66.5% of the municipalities do not have an Integrated Solid Waste Management Plan according to the Law.

Table 1. Public Consortia-Brazil's framework.

Concept	Public Consortia are based on **voluntary cooperation** between Federation entities (federal, state and municipal levels) for **joint action** on **common interest** matters, as regulated by the Law of Public Consortia (LCP on its Portuguese acronym). They are present in different sectors such as health, transport, regional development, tourism, sanitation, solid waste, among others.
Types	Horizontal: Same sphere of government (municipality-municipality or state-state) Vertical: different federal entities (municipality-state or municipality-state-Union).
Steps defined by law LCP[5]	1) Protocol of Intentions (initial document, published on the official paper, defines purpose and area performance) 2) Ratification of the Protocol of Intentions (made by Law in the Legislative Houses of each federative entity-federal state or municipal) 3) Notice of General Meeting (Sets Regulations, all decisions are taken).
Objectives for the SWM	For SWM can act to develop Integrated Plans, in the provision of regular collection services, implement composting and recyclable units, build and operate sanitary landfills for final disposal, share tools and equipment, carry out exchange of experience and information, among others. In addition, the Public Consortia can have multiple ends, like meet different objectives or sectors in the same contract. In this case, the Consortium can provide any type of service that is of interest to the municipalities in other areas of public policy such as education, health, security, etc., as a Consortium for SWM that also has the objective of health issues and tourism or a Consortium of Water Resources, which also includes in its objectives the SWM.
Types of provision of SWM services	May receive ownership of the services provided (directly) or as a contracting entity (delegate), both under contract: ▪ Outsourced ▪ Concession or Public-Private Partnership (PPP) ▪ Sanitation Company of the State ▪ Consortium itself-Program Contract (each municipality conducts a program contract with the Public Consortia)
Ways of obtaining revenue	**1) In carrying out the provision of services:** ▪ Program Contract-performed by each consortium member when the Consortia itself provides the services to members; ▪ Operation Contract for provision of services-carried out with entities of not Consortium members; and ▪ Charging and collection fees- for the provision of services; **2) Regardless of the provision of services:** ▪ Apportionment Contract-compulsory form of budget funds transfer of each member of the Consortia for the maintenance of its infrastructure. The funds cannot be used for general expenses; and ▪ Agreements or transfer contract or transfer fund to fund-transfers of funds carried out by members of the Federation that are not consortium members (examples of this Government Funds and Programs will be explain in the next section).

Source: Elaborated by the authors based upon: Amaral, 2014; Brazil, 2007a; Carneiro, 2014; Nascimento Neto & Moreira, 2012; Ribeiro, 2007; Schneider et al., 2013.

[5]It is noteworthy that the LCP does not provide planning stages, such as economic feasibility studies, diagnostic of the sector, consultations with stakeholders and other sectors involved prior to the effective training of Public Consortia. In the case of Public Consortia for MSWM, the Integrated SWM Plans can fulfill part of the planning stages.

purposes and specificities of Public Consortia for SWM in the country, we developed a second stage in for data gathering. Therefore, a questionnaire was elaborated with questions about characteristics, purposes and specificities of those 77 identified Consortia in the first survey. The questionnaire was made available on a website for 30 days from May to June 2014. We got reply with completed questionnaire from 29 Consortia (8 from the Northeast, 14 from the Southeast, and 7 from the South).

3.1. Analysis of Results

The total number of municipalities' members of the 29 Consortia is 285 (100 in Northeast, 137 in Southeast and 48 in South). The data from Chart 1 demonstrates that, for the 29 Consortia, the formation of Public Consortia tends to focus in municipalities with up to 50,000 inhabitants[6], being the majority concentrated in the ranges between 10,001 to 50,000 inhabitants. Noticing that from the 5570 municipalities in the country, approximately 90% have population lower to 50,000 inhabitants (IBGE, 2014a). This means that the study sample tends to represent the dominant characteristics of Brazilian municipalities. In addition, it focuses in small municipalities, which present greater difficulties in the provision of MSWM services-lack of resources, infrastructure and technical capacity. In this context, these municipalities through regional shared initiatives have sought solutions to meet the requirements of the PNRS, reducing costs and providing shared public services.

Why municipalities and states create Consortia for a shared SWM? This is a relevant question from a public policy making point of view. Chart 2 shows that in the three regions, of Brazil the main objectives are: 86% total relating to final

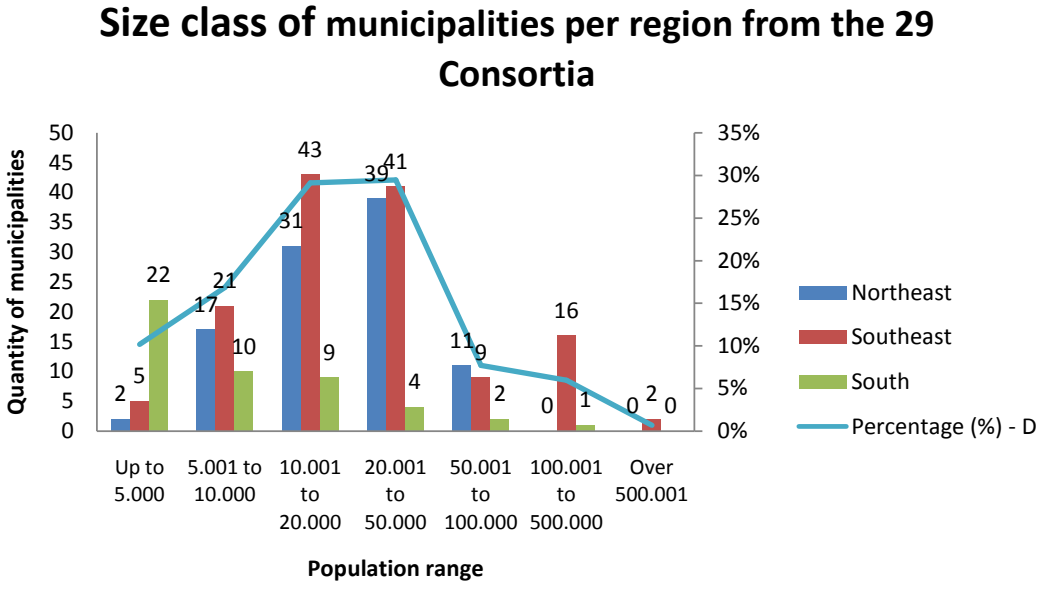

Chart 1. Size class of municipalities per Brazilian region from the 29 Consortia. Source: Elaborated by authors, based upon data from IBGE, 2010 Census and research results.

[6]The population data are from the 2010 Census (IBGE, 2014a).

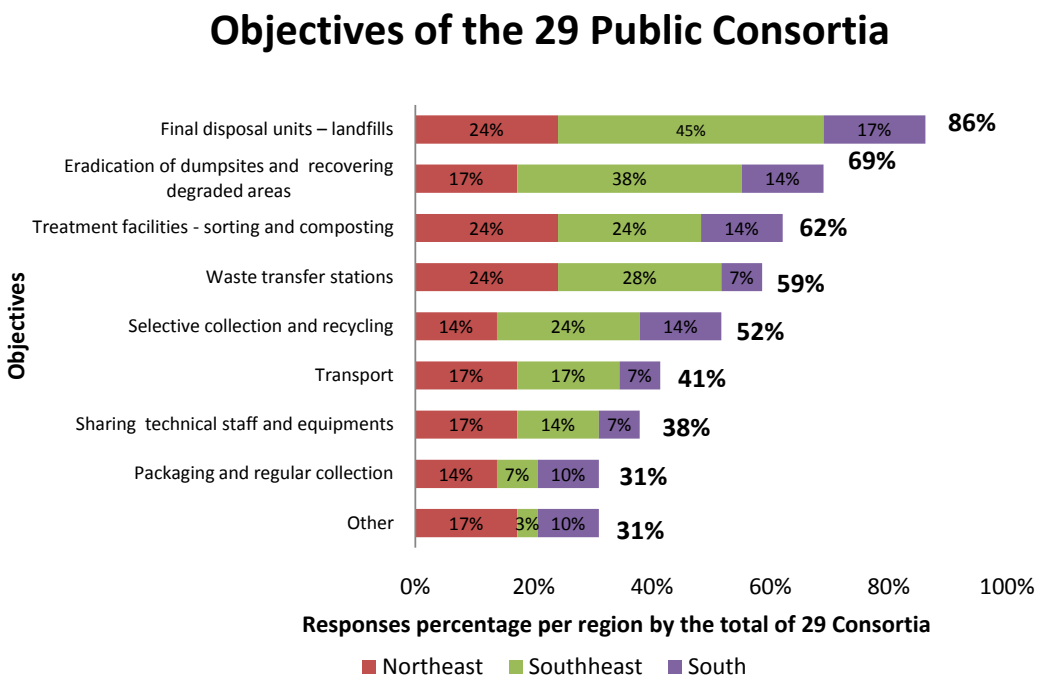

Chart 2. Objectives of the 29 Public Consortia. Source: Elaborated by authors based upon data from this research.

disposal units and 69% to eradicate dumpsites and recovering degraded areas.

There is some evidence that Brazilian municipalities prioritize expenditure on collection and transport due to public health issues. Data from ABRELPE (2012) indicates an index of 90.2% of USW collection in Brazil versus 39.8% of municipalities that properly send USW collected to landfills. The other 60.2% goes to controlled landfills and dumpsites. When analyzing the incentives for creating the Consortia, it was evident that the need to obey the PNRS, the lack of municipal financial resources and the presence of dumpsites are connected to the key Consortia's objective of having an adequate disposal of solid waste.

We initially hypothesized that the main motivation for municipalities to participate in Public Consortia was to gain priority access to Federal Government's resources or incentives established by the PNRS. However, only eight Consortia out of the 29 signaled the priority of access to resources as an incentive for the formation of Consortia. Most them are in the Northeast region, the poorest in Brazil. From these eight consortia, six were created after PNRS[7] and only two were created before 2010, the year of PNRS creation. One of these two, established in 2004, informed changes in the Consortia's contract to have access to federal funds.

Financial, economic and technical issues are the main reasons for municipalities to seek a joint solution for their SWM. The lack of municipal financial resources was identified as an incentive for the creation of the Consortia for more than 80% of responses. On the other hand, half of the 29 Consortia manifested

[7]The PNRS Law was enacted in August 2010, so the Consortia formed until 2009 were considered before PNRS and Consortia formed from 2010 and after PNRS.

the need for tax collection as a challenge to cover expenditure on maintaining services. The lack of municipal technical capacity was evident throughout the research, confirmed by the answers of the Consortia. This undoubted represents an additional cost for the Consortia in training municipalities' managers.

In addition, the absence of Integrated Plans (municipal or inter-municipal) requires more efforts and resources towards the formation of a Consortia. Many Brazilian municipalities, approximately 65% (IBGE, 2014a), do not yet have their Integrated Plan required by the PNRS. This was confirmed by the responses of the 29 Consortia analyzed. Twelve of them reported not having any plan; only seven have a Municipal Integrated Plan and four the Inter-municipal. Six of them did not answer the question.

As far as the formation of a Consortia is concerned, lack of Integrated Solid Waste Management Plans will require more efforts in training of human resources, since several initial steps that should be part of the creation of Consortia requires, for example, under taking economic and financial feasibility studies, environmental, social and territorial diagnostics about the waste generation[8].

Any policy maker becomes apprehensive in analyzing these results. If one takes into consideration Roura's (1997) public policies steps, the enactment of the PNRS in Brazil is far from ideal. Roura argues that a first phase of a public policy sets recognition, analysis, design, and consultation steps, as set out in the first column of **Table 2**. In the second column, we have the "desirable components" and in the third "observed results" of our investigation, related to each one of these steps. Although these steps are essential for the implementation of an instrument such as the Public Consortia, answers obtained in our research suggest that the components of each step of this first phase are very below the level desirable for each step.

There other shortcomings in the Consortia related to Roura's first phase of public policy life-cycle. Considering that the major goal of the 29 Consortia is the final disposal of solid waste and, consequently, the construction of landfills, it is motive of concern the low proportion of studies on territorial characteristics, land use occupation and distance between the municipalities in the answers of the 29 Consortia. This would not be a problem if the municipalities had already completed an Integrated Solid Waste Management Plan that presumably contains these previous studies. However, considering the low percentage of those who reported having one of the Plans, it is assumed that this is not the case. Data from the IBGE (2014a) confirms that the absence of such analyzes is a dominant reality in Brazilian municipalities, given that only 1742 (31.27%) of the municipalities have specific legislation on zoning or land use occupation. This may make it impossible to plan the construction of regional and shared landfills.

The delay or absence of the completion of the first phase steps can affect the

[8]This short come was also pointed out in the conclusions of the TCU's Auditing (2011) reporting that financing and agreements needs to be established for the formulation of Integrated Solid Waste Management Plans (state, municipal and inter-municipal levels), as they are a pivotal part of MSWM and will influence the effectiveness and efficiency of applied activities and instruments.

Table 2. Public Policy steps-first phase-desirable components e observed results on the 29 Consortia.

	Steps	Desirable application	Observed results
First Phase	Recognition	Data rising on SWM generation of each municipality, amount and composition-diagnosis of generation, collection situation, transportation, treatment and final disposal of each Consortia's city.	Just over half of the 29 Consortia completed a diagnosis of SWM generation of each municipality. On other side, analyzing the responses per region, the South stands out with over 80% of accomplishment.
	Analysis	Studies of economic and financial viability of the Consortia and the environmental and social studies of the damage caused by missing or incorrect forms of SWM. In addition to territorial studies, land use occupation, and distance between the cities.	Of the 29 consortia, less than 40% had both studies. However, the Northeast region stands out with 63% in studies of economic viability, but in studies of environmental and social impacts their participation is below 40%. Of the 29 consortia, only half held territorial studies, land use occupation and distance between the municipalities.
	Design	It can be considered as the Integrated Solid Waste Management Plans (Municipal and Inter-municipal)	12 Consortia reported not having any of the plans, only 7 have noted the Municipal Plan and 4 the Inter-municipal. The others did not answer.
	Consultation	Consultation and involvement of stakeholders: municipal cleaning agencies; SWM NGOs; neighboring communities to landfills; population of the municipality seat; sector companies; recycling cooperatives. Also, involving interest groups: State and/or Municipal Secretariats of Cities, Environment, Urban Planning, Health, Sanitation, Municipal Councils.	Of the 29 Consortia, only 30% held consultations and involved stakeholders in the Consortia formation process and half consulted the Secretariats that somehow have activities related to SWM.

Source: Elaborated by authors based upon data from ROURA (1997) and results of this research.

time of completion of the second phase steps in the Roura's analytical framework (see Table 3). Taking as an example from our sample the Consortia that are not yet in operation, and considering by the answers that most began elaborate the Protocol of Intentions between the years 2009 and 2010. If these Consortia come into operation in 2014, they took four to five years from the first phase of discussion and to the second phase of execution. The Consortia indicated some reasons for the non-operation: conclusion phase of Integrated Solid Waste Management Plan, statute approval phase or delay in the preparation of executive projects.

3.2. Criteria for Evaluating Public Consortia for MSWM and Research Results

A complementary analysis is to evaluate the Public Consortia as a component of

Table 3. Public policy steps-second phase-desirable application e results observed on the 29 Consortia.

	Steps	Desirable application	Observed results
Second Phase	Discussion	1) The Consortia Protocol of Intentions can be considered the first step in the discussion stage. 2) Ratification of the Protocol of Intentions in the Legislative Chambers; 3) Call and adoption of the Statute by the General Assembly and published in the official press.	The preparation of the Protocol of Intentions of the 29 Consortia was carried out between the years 1998 to 2013 and most of the Consortia concluded it. It is noteworthy, however, that the LCP is from the year 2005, which could justify the not signaling of its conclusion by the Consortia formed prior to this date. The 29 Consortia showed a high percentage of carrying out steps for ratification and adoption of the Statute. Among the creation of the Protocol and ratification, the Consortia pointed their fulfilment either in the same year or within two years of the date of preparation.
	Execution	1) Beginning of activities; 2) Consortia operation-actual implementation of the Consortia's activities.	Of the 29 consortia, 93% have indicated they have a Protocol of Intentions against 31% that are in operation. The Consortia that are not operating began with the elaboration of the Protocol of Intentions of between the years 2007 to 2013, mostly between the years 2009 and 2010. Based on the majority, if these consortia start operating in 2014, they took four to five years between the first stage of discussion and the last execution.

Source: Elaborated by authors based upon data from ROURA (1997) and results of this research.

a public policy for solid waste management. For doing so, we applied traditional evaluation criteria of public policy available in the specialized literature (see Baumol and Oates, 1979: equity, efficiency, effectiveness, incentive to maximum effort, administrative cost, and permanence. Based upon the results of our sample of 29 Public Consortia in Brazil it is possible to evaluate this instrument, as a PNRS instrument. In **Table 4** we summarize a proposal of what should be considered in each criterion for evaluating SWM through Public Consortia based upon the Brazilian experience. We point out its expected results and the main obstacles faced to achieve them. We also suggest how to evaluate whether each criterion was accomplished and, finally, we make a connection with the lessons learned from results analysis for each criterion.

4. Concluding Remark

The Brazilian National Policy on Solid Waste (PNRS) is considered a milestone in the regulation of the solid waste activities in the country. However, Law enforcement without analyzing the municipalities' capacity to fulfill it, can lead to its ineffectiveness and inefficiency in the use of resources. Our investigation of 29 Public Consortia provides an empirical view of the current scenario of the Public Consortia for MSWM in Brazil.

Our results showed that small municipalities have sought a shared management

Table 4. Criteria for evaluating public policy: results observed on the 29 Consortia.

	PROPOSED RESEARCH THEORY			STUDY RESULTS
Criteria Evaluation	**Expected results/objectives of the Public Consortia for SWM**	**Obstacles faced to achieve the objectives**	**Recommendation on how to evaluate the criteria**	**Study Results-29 Public Consortia for SWM**
Equity	-Ensure that the shared management of services provided by consortia benefit or compensate those living in more vulnerable situations, such as those living near to dumpsites and landfills, in poor or risk locations that do not have waste collection and live with, susceptible to diseases, adverse scenic impact and reduced welfare. -Ensure that the provision of solid waste services is of similar quality to all members of the Consortia municipalities. -Include the general population affected in the process, as the surrounding community of waste transfer sites and landfills and the recycling cooperatives.	-Political interests, economic and institutional imbalance of municipalities can interfere in the negotiations between the Consortia members. -The legal representative of the Consortia is the Chief Executive; in the case of Inter-Municipal Consortia, the Mayor of the municipalities, which may have opposite political interests regarding the Party of each member. -Difficulty in defining the location of the landfill seat because the impacts to its municipality are higher.	-Determine if with the formation of the Consortia, the provision of SWM service in the municipalities was expanded in poor or risk locations and if the impacts to the surrounding communities of waste transfer stations and landfills were measured and compensated. -Assess whether the environment policy is favorable to the creation of the Consortia and if Consortia goals will overcome political interests. -Determine environmental, economic and social studies, as well as the land use occupation, documents of proof of land ownership and environmental licenses for the installation of the landfill.	-The final disposal is the main objective and, therefore, building landfills. However, with the answers obtained it was not possible to assess the difference in the provision of services between the municipalities receiving the landfill and the other Consortia's members. In addition, there were a low proportion of territorial studies; land use occupation and distance between the municipalities. This may make it impossible to plan the construction of regional and shared landfills. -The lack of Plans makes more difficult the comparing parameters to determine whether the provision of SWM services was expanded and if the impacts were measured in municipalities with Consortia, it is necessary to evaluate the provision of service with and without the Consortia. -The inclusion of affected parts was considered low attesting in the first phase, consultation to affected parts was below 30%. Per the questions asked, it was not possible to evaluate the relationship and inclusion of waste pickers in the Consortia.
Efficiency	-It is expected the improvement of service provided, minimizing costs and the shared management of environmental and social issues involved. -Prove that the individual municipal costs of SWM service provided services decreased with integration into a Public Consortia.	-Consortia are indicated in the PNRS and have prioritized access to resources, justified by the standard of scale, which would lead to efficiency-in theory. In this context, Consortia for SWM appears, a priori, as a second-best solution. However, their application	-Determine the implementation of the first phase steps, which may indicate that other local and institutional characteristics determine the efficiency or not of the Consortia, such as: landfill location and distance from waste transfer stations; management capacity and planning of the	-The lack of financial resources was identified as one of the predominant incentive for creating Consortia. This lack of resources supports the hypothesis that the priority access to the Federal's resources or incentives instituted by the Federal Government guaranteed by

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Efficiency	If observes costs increase, consider whether it reflects the presence of the services where before they were non-existent or inadequate. -Verify if the creation of Consortia enables an implementation of new technologies that would reduce costs and environmental impacts.	can be as difficult as the first best solution, the different variables involved and emergence of possible new restrictions. As, for example, the lack of technical capacity, leading to the bad quality of technical projects and environmental studies -Lack of charging instruments for services maintenance.	Consortium; managers and operators' technical capacity; resources and revenue for services maintenance; implementation of recycling collection. -Consortia should prove ways for service maintenance, as for example, charging instruments.	PNRS is an incentive for the formation of consortia. -However, most Consortia do not have Integrated Plans, because of that they would not have access to resources of the Union as having one of the Plans is a requirement of the Law (Brazil, Art. 18, 2010a).
Effectiveness	-Determine if the environmental damage is reducing after Consortia application, measured by, for example, not generating waste or by changing the behavior of individuals and businesses. -Some Consortia for SWM objectives are: improve service delivery, reduce operating costs, minimize risks and environmental impacts, and optimize the use of areas for final disposal.	-Complexity and bureaucracy to ratify the Protocol of Intentions may lead to delays in the process. -Lack of technical capacity impacts in planning and management the entire process. -Previous technical study of the roads that link the municipalities and economic and financial viability should be conducted.	-Is there technical staff able to manage the whole SWM process (logistic, legislation, environmental issues)? -Engage the stakeholders, particularly those that are affected throughout the process.-Check if dumpsites were closed and their areas recovered.-Evaluate if MSWM are better and if damage on health and to environment are being reduced.	-Just over half of the 29 Consortia did a SWM diagnosis. -Lack of Plans has direct impact on increase of efforts and resources, particularly on first stages. Only 11 Consortia confirmed have one of the Integrated Plans. -The percentage of ratification and Statute approval was high. However, of the 29 consortia, 93% indicated having the Protocol of Intentions against 31% that are in operation.
Incentive to maximum effort	-Prove that the joining of municipalities to MSWM allows the application of innovative solutions that reduce environmental damage and economic costs.	-Through the Consortia municipalities have prioritize incentives in access to resources. Also, PNRS determines as an instrument the cooperation and improvement of clean technologies to minimize environmental impacts. However, it is not clear what incentives Consortia would have on applying innovative solutions.	-Check if there are incentives for Consortia to seek innovative behavior for SWM.	-There were not questions directed to this topic because of that the responses of the 29 Consortia did not made possible to identify the application of innovative solutions that reduce environmental damage and economic costs or means to encourage them. Only one of the South's Consortia indicated that obtains extra resources from the sale with the collected recycled material, demonstrating the use of market opportunities.

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Administrative Cost	-One of the joining of municipalities objectives through the Consortia is to reduce investment and costs, and cooperate with physical and technical resources. For example, it is expected that with a shared landfill, represents a reduction in operating costs for the municipalities. -Consortia need an initial planning to ensure necessary financing resources. Also, it is necessary to prove from where the resources to cover the MSWM costs services will come from-by collection of taxes, directly from municipal budgets or subsidies.	-Prioritize access to resources can help the initial funding, but will it sustain the activities in the long term? -There is lack of planning the true costs of the whole process of landfill structure maintenance. The absence of specific municipal budget for the SWM sector and the difficulty of creation, implementation, and charging for SWM services are a common problem and fall on Consortia. Not charging for SWM services does not incentive the population to reduce waste generation, which leads to higher SWM services demand and new infrastructure.	-The responsibilities of municipalities and the Consortia should be well defined, and the form of services execution-by the Consortia itself, Concession or Public Private Partnership (PPP). -Communication and education programs costs should be included to involve stakeholders and the public, so they can understand the importance of services and the need to pay taxes. -SWM needs continuous and uninterrupted maintenance and the resources and revenue for its self-sufficiency should be proved.	-Municipality's budget is the largest source of funds for cleaning, regular and recycling collection, and transport. Consortia contracts appear as the greatest source of funds for the construction, operation and maintenance of landfills. However, it drew attention that only one Consortia pointed out charging for service delivery. -Despite guarantee by law charging for SWM services is insufficient. Even though the Funds tends to request self-sufficiency for maintenance of activities, only half of the 29 Consortia marked the collection of taxes as a challenge to cover the costs of SWM services. Integrated Plans and Protocol of Intentions should provide economical instruments. -Lack of technical capacity was evident throughout the Funds and Consortia surveys that will represent additional costs. -Without Integrated Plans it will require more efforts and resources on the first phase of Consortia creation. -There were no direct questions concerning the construction or landfill operation; however, as the major goal of the Consortia was the final disposal, it may conclude that landfill location is critical for its impact on costs.

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Permanence	-Will Consortia capable of providing continuity of service besides PNRS requirements or by changes of Mayors in each election, or having self-sufficiency resources for services maintenance?	-As a voluntary form of regional arrangement, municipalities can enter or exit the Consortia where they want, which may impact on Consortia's management and planning. -Small municipalities that get Federal's resources to build landfills often fail to keep them and the area returned to a dumpsite. Is Consortia able to change this issue? -Joining of municipalities also means the connection of political parties, Party ideas and different political interests, it can impact Consortia implementation and permanence.	-What is the state role in SWM process? How states can contribute to the services maintenance, such as institutional, legal and financial support? -Resources and revenue for its self-sufficiency should be proved, particularly if there are landfills.	-The political discontinuity of Municipal Administrations at every change of government and Party political interests were pointed out as one of the challenges on half of the 29 Consortia. The role of the federal and state governments and the consequences for the permanence and efficiency of PNRS if the municipalities do not have their support may be questioned. Data from the 29 Consortia, 19 Inter-municipal and 10 between state and municipalities, cannot say each one has more probability to continue. However, the data found that when the state is a member of the Consortia, they benefited from state's technical, financial, institutional and regulatory support. Because of that and the lack of capability indicates when the municipalities are by themselves, the Consortia between states and municipalities deserves further studies to evaluate their efficiency and permanence.

Source: Elaborated by authors based upon data from: Mendes, 2013; Lipsey, 2007; UNEP, 2009; Pequeno, 2013; IPEA, 2012; Nascimento Neto & Moreira, 2012; and research results.

of RSU by forming Public Consortia, having as the main objective the final disposal process through the construction and operation of regional landfills, closing of dumpsites and recovering degraded areas. Depending on common interests and needs of municipalities, Consortia can meet different objectives or sectors in a single contract, which can reduce administrative costs and increase regional cooperation.

The need for compliance with the PNRS and a lack of municipal funds are dominant incentives to the creation of Consortia to SWM. In addition, it was attested that the priority access to the Federal's resources or incentives instituted by the Federal Government guaranteed by PNRS was an important incentive for Consortia created after PNRS. However, this incentive does not ensure the efficiency of Consortia because other variables are involved and there are new

possible restrictions on the access to financial resources.

Nevertheless, the absence of Integrated Solid Waste Management Plan at municipal and inter-municipal level is an example of one of those restrictions and was attested throughout the survey, confirming data from IBGE (2014b) showing that 66.5% of the municipalities do not have a Municipal Integrated Solid Waste Management Plan per the terms of the law. This shows the lack of planning in the creation of Consortia, preventing them from having access to government resources and information of the reality of the sector, its features and the real demand for this type of service. Thus, it is recommended that studies and evaluations are conducted to check if and how these Plans have been drawn up, the qualifications of its developers, the representation of the local reality, and if it could potentially generate effectiveness, efficiency and equity.

Therefore, prioritizing public resources by forming Consortia established in the PNRS is not necessarily associated with effective management; it can potentially induce ineffectiveness and inefficiency of the SWM policy, among other relevant issues. It is identified a policy failure in the case of not considering that if there is a lack of Plans and technical capacity, the objectives of the Law in predicting this priority in access to resources would be not achieved. Another potential policy failure is not to perceive that the issue of SWM is not only present on solid waste and sanitation's public policy agendas. In this context, transversely policies among ministries and government agencies are essential.

In applying criteria for public policy evaluation upon SWM for Public Consortia in Brazil we had some useful insights into Consortia implementation issues. They pointed out some advantages and disadvantages of municipalities deciding to create Consortia for SWM. The results indicate that the following items must be considered in implementing SWM through Public Consortia: 1) Encouraging transversal sectorial actions for MSWM; 2) Greater federal and/or state involvement in the development of Consortia to SWM; 3) Strengthening technical and institutional capacity in the three spheres of government, especially at municipal level, on USW area, with allocation of resources and programs for this purpose; 4) Implementation of charging instruments for SWM services; 5) Directing resources to the development of Integrated Solid Waste Management Plan; 6) Encouraging the implementation of the first phase stages-diagnosis; studies of economic and financial viability, environmental, social, territorial factors and distance between the municipalities for the selection of the landfill site; planning; and stakeholder consultations; and 7) Including monitoring and evaluation mechanisms in the whole process.

References

ABRELPE (Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais) (2012). *Panorama dos resíduos sólidos no Brasil 2012*. Edição Especial de 10 anos.

Amaral, J. R. (2014). *Superintendente do NISB/COMSUL (Consórcio Público dos Municípios da Mata Sul Pernambucana)*. Informação verbal. Contato por *e-mail* em 27 mai.14.

Barreto, R. (2014). *Coordenação de Saneamento em Saúde, FUNASA*. Comunicação

Pessoal. Entrevistas concedidas em 03 e 11 abr. de 2014.

Baumol, W. J., & Oates, W. E. (1979). *Economics, Environmental Policy, and the Quality of Life* (Chapters 14 and 15, pp. 209-229). Upper Saddle River, NJ: Prentice-Hall.

Brazil (2007a). *Decreto nº 6.017, de 17 de janeiro de 2007*. Regulamenta a Lei n 11.107, de 06 de abril de 2005, que dispõe sobre normas gerais de contratação de consórcios públicos. Diário Oficial [da] República Federativa do Brasil. Brasília, DF, 17 Jan. 2007. http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/decreto/d6017.htm

Brazil (2007b). *Lei nº 11445, de 05 de janeiro de 2007*. Estabelece diretrizes nacionais para o saneamento básico. Diário Oficial [da] República Federativa do Brasil. Brasília, DF, 5 jan. 2007. http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/lei/l11445.htm

Brazil (2010a). *Lei nº 12.305, de 02 de agosto de 2010*. Institui a Política Nacional de Resíduos Sólidos. Diário Oficial [da] República Federativa do Brasil. Brasília, DF, 02 ago. http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm

Brazil (2010b). *Decreto nº 7.404, de 23 de dezembro de 2010*. Regulamenta a Lei nº 12.305. Diário Oficial [da] República Federativa do Brasil. http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/Decreto/D7404.htm

Brazil, Instituto Brasileiro de Geografia e Estatística (IBGE) (2014a). *Pesquisa de Informações Básicas Municipais: Perfil dos municípios brasileiros 2013*. Rio de Janeiro, RJ.

Brazil, Instituto Brasileiro de Geografia e Estatística (IBGE) (2014b). Censo Demográfico 2010. IBGE Cidades. http://cidades.ibge.gov.br/xtras/home.php

Carneiro, C. E. G. (2014). *Gerência Executiva da Caixa Econômica Federal, Governo de São Paulo*. Comunicação pessoal. Contato telefônico em 30 mai.

Ethridge, D. (1995). The Research Problem and Objectives. In *Research Methodology in Applied Economics—Organizing, Planning, and Conducting Economic Research* (Chap. 6, pp. 101-114). Washington DC: National Academy Press.

Ezeah, C., & Roberts, C. L. (2012). Analysis of Barriers and Success Factors Affecting the Adoption of Sustainable Management of Municipal Solid Waste in Nigeria. *Journal of Environmental Management, 103,* 9-14.

Henry, R. K., Zhao, Y., & Done, J. (2006). Municipal Solid Waste Management Challenges in Developing Countries—Kenyan Case Study. *Waste Management, 26,* 92-100.

IPEA, Instituto de Pesquisa Econômica Aplicada (2012). *Diagnóstico dos Instrumentos Econômicos e Sistemas de Informação para Gestão de Resíduos Sólidos*. Relatório de pesquisa. Brasília.

Jacobi, P. R., & Besen, G. R. (2011). Gestão de resíduos sólidos em São Paulo: Desafios da sustentabilidade. *Estudos Avançados, 25,* 135-159. https://doi.org/10.1590/S0103-40142011000100010

Lipsey, R. G. (2007). Reflections on the General Theory of Second Best at Its Golden Jubilee. *International Tax and Public Finance, 14,* 349-364. https://doi.org/10.1007/s10797-007-9036-x

Mendes, C. C. (2013). Arranjos Federativos e Desigualdades Regionais no Brasil. In *IPEA, Brasil em Desenvolvimento 2013: Estado, Planejamento e Políticas Públicas* (Vol. 1, Chap. 7, pp. 199-220). Brasília: IPEA.

Nascimento Neto, P., & Moreira, T. A. (2012). Consórcio intermunicipal como instrumento de gestão de resíduos sólidos urbanos em regiões metropolitanas: reflexões teórico-conceituais. *Revista Brasileira de Gestão e Desenvolvimento Regional (G&DR), Taubaté, SP, Brasil, 8,* 239-282.

Pequeno, P. A. M. A. (2013). *Inclusão das ações de regulação na gestão regionalizada dos resíduos sólidos nos estados do Rio de Janeiro*. Artigo apresentado em ABAR, VIII Congresso Brasileiro de Regulação.

Ribeiro, W. A. (2007). *Cooperação Federativa e a Lei de Consórcios Públicos*. Brasília, DF: CNM.

Roura, J. R. C. (Org.) (1997). La Elaboración de la Política Económica. In *Introducción a la Política Económica* (Chap 4, pp. 99-132). Universidad de Alcalá, McGraw-Hill.

Schneider, M. D. et al. (2013). *Orientações básicas para a gestão consorciada de resíduos sólidos. Inovação na Gestão Pública*. Cooperação Brasil-Alemanha. Editora IABS, Brasília.

UNEP (United Nations Environment Programme) (2009). *The Use of Economic Instruments for Environmental and Natural Resource Management.* Training Resource Materials. 1ª edição.