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## Brazilian waste management: Belo Horizonte's case study of sustainable management

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### Abstract

This study is part of a PhD research and aims to present one Brazilian case study of waste management, the process of waste management plan elaboration in Belo Horizonte city Brazil, and the sustainable actions that this city has, which is considered reference about waste management in Brazil. The process of waste management plan in this city started in 2014, and in 2016 is in the last stage. Three groups are important to this process. The first one is the technical group, constituted by urban oversight of Belo Horizonte, Brazil. The second is the steering committee, formed by representatives of the executive power organs. The last one is the consulting board, that includes political bodies for social participation, representatives of the public sector municipal and from the state, and the organized civil society as well, contemplating the popular segments, technical / academic, and from the companies too. Papers of Scopus and Science Direct were consulted as well to compare this Brazilian case with European cases.

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## **1. Introduction**

Development countries face problems or difficulties to treat and to manage their waste. For food waste management, something important is to consider one review of the existing system, one review of the existing regulations, to identify related stakeholders, set up standards and regulations, establish goals, conduct food waste management activities / programs, repeat estimating and compare options, and evaluate the food waste management system. Education and public participation must be part of this (THI et al., 2015).

In a case of cooperation between public and private areas to manage the waste, sometimes one good option is to join public and private companies. In a study that compared two models for dealing with urban solid waste in Brazil, namely, management by contract and management by public–private partnership, indicates that the management by a public–private partnership was more advantageous for dealing with urban solid waste than management by contract. This former provided a strong selective collection program, reduced the amount of solid waste sent to sanitary embankments, led to the recovery an area of land previously degraded by the incorrect disposal of urban solid waste and stimulated the installation of an energy recovery unit (MARCONSIN & ROSA, 2013).

When we are talking about waste management, the collaboration of society is something essential. According to Mavropoulos et al., (2015, p. 381) until recently, waste management was faced as a matter of appropriate storage, collection, transfer, treatment and disposal, and the main effort was to minimise environmental and health impacts. Thus, engineering and logistic tools were sufficient to plan and implement waste management systems. But today resource management and social behaviour are becoming an integral part of any waste management system.

In Brazil, one good example of cooperation between municipalities is the Intermunicipal Public Consortium Alto Sapucaí, signed for the construction of landfill in Itajubá, Brazil. This was the first consortium in Brazil, serving a population of 90,000 people, involving six municipalities (Delfim Moreira, Itajubá, Piranguinho, Piranguçu, São José do Alegre and Wenceslau Braz), getting 51 tons of waste per day. Another successful example of consortium is implemented in the Zona da Mata region, involving the municipalities of Carangola, Divine, Faria Lemos, Fervedouro, Pedra Bonita, Pedra Dourada, Santa Margarida, Tombos (Minas Gerais), Natividade, and Porciúncula (Rio de Janeiro). The consortium of the Zona da Mata was a pioneer when it comes to having among its consortium members, cities of different states (BEEA MINAS GERAIS, 2014).

The aim of this work is to present the system constituted by the public company (government), private company (MYR consulting), and the society to make and to approval one waste management in Belo Horizonte, Brazil.

## **2. Brazilian case study of Belo Horizonte**

Belo Horizonte is one of the most capitals in Brazil, with a population of 2,513.451 people, 64 universities, and 331,401 km<sup>2</sup> of area (BIGS, 2016). This study is based in the participation of the author in events about Belo Horizonte's waste management plan. In a total, seven events happened in the city. Three groups are important to approach. The first one is the technical group, constituted by urban oversight of Belo Horizonte. The second is the steering committee, formed by representatives of the executive power organs. The last one is the consulting board, that includes political bodies for social participation, representatives of the public sector municipal and from the state, and the organized civil society as well, contemplating the popular segments, technical / academic, and from the companies too.

Based on materials available on the virtual page of Belo Horizonte, the process performed to make the waste management plan of Belo Horizonte divided into four main steps: 1. Communication and mobilization. 2. Diagnosis of the waste situation (inventory of collectors, dividing them into independent and cooperative). 3. Associated management and last topic is the 4. Development of future scenarios. There were two other hearings on 15th, and 16th December. On 15th were East's regional, Northeast and Northwest. On 16th Pampulha's regional, North and Venda Nova.

March 16th, 17th and 18th, 2016 there were other public hearings in order to present the possibilities of the management tasks inserted in the Plans Health Services Waste Management (PHSWM) and also Plan of Waste Management of Construction and Bulky (PVMCB). These documents were available for public consultation by the

own city page. Civil and representatives of different sectors of society were present in the district Flávio Marques Lisboa, district Bernardo, and district Padre Eustáquio, participating in the activities presented in the days mentioned.

On March 31st, happened a Seminar about the Metropolitan Management Plan focusing on health service waste and waste of civil construction. Were present (besides the civil society), General Director of Belo Horizonte's metropolitan region development, Secretary of State for Transport and Public Works, State Secretary of Minas Gerais Public Health, the State Department of Environment and Development sustainable, State Environment Foundation, Department of Infrastructure and the Ministry of Cities Project, and Water and Sanitation Division of the Inter-American Development Bank.

In order to meet and reflect on new strategies for social participation aimed at expanding the results of public policies implemented at the municipal level, the Metropolitan Development Agency of Belo Horizonte (MDABH) promoted on April 27th, 2016 a dialogue with the mayors and civil society on: sustainable cities and the implementation of social observatories. Present were representatives of Agency, the Brazilian Social Network for Fair and Sustainable Cities, the NGO Nossa Betim, of the Comptroller General, as well as a higher education institution Contagem city. The event was reported in the virtual page of BH's town hall.

On June 1st, 2016, gathered representatives of the Directorate General of MRBH, the Technical Assistance and Rural Enterprise (EMATER MG), the Secretary of State of Agrarian Development (SEDA), Secretary of State of Planning and Management (SSPM MG), the Centre for Development and Regional Planning (CDRP Federal University of Minas Gerais), the SEA! Studies in Urban Agriculture, the Federation of Agricultural Workers of the State of Minas Gerais (FETAEMG), Nossa Roça – Agritourism, Superintendence of Agriculture and Supply of the Municipal Economic Development and Tourism and by the end of the Municipal Planning Bureau. The goal was to build a diagnosis of agriculture in the metropolitan region of Belo Horizonte, in its many forms and arrangements, especially for urban agriculture, family and agroecology. The following table provides the main events that happened between 2015 and 2016.

At the meeting on October 25<sup>th</sup>, 2016, the representatives of the steering committee, technical group and advisory council could discuss the proposals for the future solid waste management scenarios in Belo Horizonte. The meeting was open to a maximum of 20 participants. At this moment of the discussions the plan was in its last stage of elaboration, being this the fourth stage.

The workshop promoted on November 9<sup>th</sup>, 2016 aimed to present what had already been done in the participatory process, to form groups for the discussion of mechanisms of social control and to present the results with openness for manifestation of the population. On November 26<sup>th</sup>, 2016 the public hearing on the plan had the formation of working groups that discussed:

1. Management of urban solid waste;
2. Management of special waste;
3. Environmental education, social mobilization and social control.

In the first theme (solid urban waste) 21 people were present to discuss urban waste; In the second theme (special waste) 14 people were present and in the third theme (environmental education, social mobilization and social control), 29 people were present.

Table 1. Events in Belo Horizonte city about the waste management plan.

Date	Name
December 14th, 15th, and 16th, 2015.	Regional hearings to present the waste management plan.
February 15th and 16th, 2016.	Course about integrated management.
February 24th and 25th, 2016.	Course about construction waste management.
March 16th, 17th, and 18th, 2016.	Regional hearings about the health waste management and construction waste.
March 31st, 2016.	Seminar to present the Plan of Metropolitan's region to manage the health and construction waste.
April 27th, 2016.	Dialogue – sustainable cities and the implementation of social observatories.
June 1st, 2016.	Dialogue – Agriculture in Belo Horizonte's Metropolitan Region (overview and outlook).
October 25th, 2016.	Discussion about the municipal plan for integrated waste management, main topic: special waste.
November 9 <sup>th</sup> , 2016.	Workshop – control mechanisms. Purpose analysis.
November 26 <sup>th</sup> , 2016.	Public hearing on the discussion of proposals for municipal solid waste policy in Belo Horizonte.

According to the information available on the virtual page of Belo Horizonte's Municipality, the Superintendence of Urban Cleaning (SUC) carries out its activities with the company's support Myr Sustainable Projects. The plan is being developed following the following steps: i) diagnosis of solid waste; ii) identification of the possibilities of joint management; iii) planning PMGIRS actions and finally iv) presentation and disclosure of the final version of the document (PREFEITURA DE BELO HORIZONTE, 2014). Three committees were created to approve the waste management plan (Figure 1).

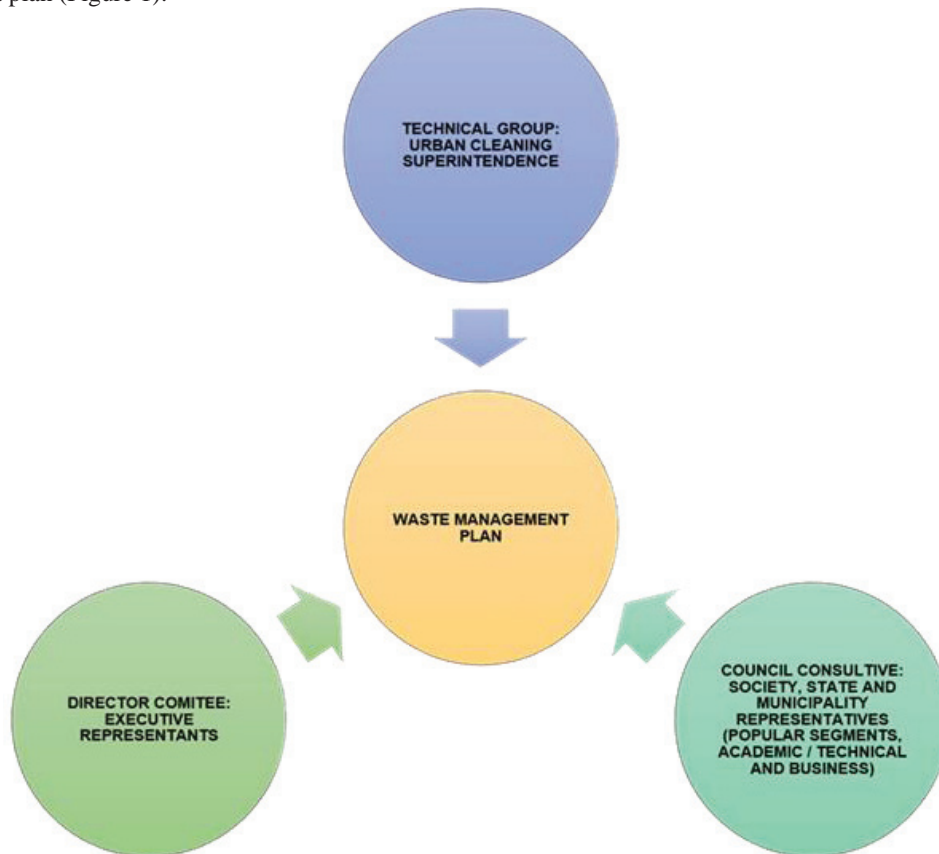


Fig. 1. Belo Horizonte's waste management representatives. Source: Adapted from PBH (2016).

An important action related to the batteries, was something proposed in 2016 in Belo Horizonte, through the Municipal Environment Secretary (MES), and began installing collectors of batteries in public buildings management municipal.

According to Belo Horizonte's town hall, this action has no cost for public administration and work is an initiative of Environmental Education Management of MES, which sought creative ways to put the project into operation. They are being used mineral water containers of 20 liters, which were donated to the collection of batteries. When the containers are full, they are collect by EKO Group, which will waste disposal. The work of Belo Horizonte city, through the MES, is to promote and encourage proper disposal and the population as a partner by means of education actions and respect for the environment (PBH, 2016). In Belo Horizonte, the main responsible for the waste management are Minas Gerais' state Environment Department and the Urban Cleaning Oversight.

The main reasons that make waste management a challenging are: the increase in waste generation; the costs associated with municipal budget; the lack of understanding of the diversity of factors that affect the different stages of management and also what are the factors that promote the functioning of the system that are beyond the generation, segregation (when there household separation) collection, recycling; and final waste disposal (GUERRERO et al., 2013).

Those responsible for developing sustainable solid waste management programmes must consider the impacts of programme elements on everyone involved. López-Toro says that poorly operated municipal solid waste management systems, especially in developing countries with cultural and natural attractions, tend to dissuade tourism, thus negatively impacting local economies. However, if waste is dealt with properly, it can have a positive impact on society by optimizing the use of raw materials and energy, protecting natural resources and the climate, respecting the health and safety of employees and their rights as workers, and contributing to economic growth and the creation of wealth (LÓPEZ-TORO et al., 2016). Solid waste management is a huge challenge in developing countries mainly due to factors such as population increase, poverty and the lack of proper investment by the respective governments (JARA-SAMANIEGO et al., 2017). Any country, developed or developing, generates a variety of waste, and has to manage it somehow. As a result of population growth and the increasing demand for material prosperity, the quantity of global waste has been on the rise (TAKIGUCHI, 2016).

In a study of 28 European countries were evaluated factors related to the government, consumer and the responsibility of the entrepreneur in the management of solid waste. Age, gender, education and occupation were studied at work, as well as variables such as country of origin and the area of residence (whether rural or urban).

23,976 people were interviewed. Something stated in other studies was that women, people with higher education, who have a better working and living in the countryside or in small towns, are in general more sensitive to the issues related to solid waste. Men and people living in a big city are more willing to delegate this responsibility to the companies. The government-based solution is only chosen by the less educated. Finally, individuals with greater environmental awareness and effort rather pay for services, while those who are less environmentally conscious prefer government action (TRIGUERO et al., 2016).

Optimization of the integrated management strategy for a region requires knowledge of alternatives and available to waste management technologies, economic and environmental costs associated with these alternatives and their applicability to a specific region, it is important that the administrator has based a regional planning optimized management to achieve pre-established goals (BRAGA & RAMOS, 2006). Researchers point out that the integration of landfill (18.1%), fuel production through waste (3.1%), composting (2%), anaerobic digestion (40.4%) and recycling (36.4%) is useful in the management of municipal solid waste (MIR et al., 2016).

### 3. Conclusions

According to Brazilian's law number 12,305, all of the state had to have their own waste management plan since 2012. Belo Horizonte tried to do this, but just after join with the Federal University of Minas Gerais and contract one private company, was possible to do this. This partnership is something important for the city, to comply with the legislation, and necessary to improve the Belo Horizonte's waste management. Although having a major regulatory framework on the management of solid waste, and that the Law 12.305 of August 2010, Brazil is lagging behind when it comes to the application of what is regulated. In 2015 it was decided to extend the deadline for municipalities to close their dumpsters and then use landfills, which was not fulfilled.

When we want to build a sustainable management solution considering the waste management problems in Belo Horizonte, or in general, we must focus on technology, public participation of the population, and academic investigation about the best alternative for the city. Belo Horizonte is considered one of the best cities in south America when the point is waste management, but even with a good system about environmental questions, the city faced huge problems to finish the plan, and after this, the plan was finished in 2016, which now is opened for the population participation on the internet.

### References

- [1] BEEA – Brazilian Environmental Engineering Association. Municípios mineiros se unem para acabar com os lixões. Available in: <<http://www.abes-mg.org.br/visualizacao-de-clippings/pt-br/ler/1705/municipios-mineiros-se-unem-para-acabar-com-os-lixoes>>. Access in: September 30th, 2016.
- [2] BIGS – Brazilian Institute of Geography and Statistics. Minas Gerais. Belo Horizonte. Available in: <http://cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=310620>. Access in: October 6th, 2016.
- [3] Braga, M. C. B & Ramos, S. I. P. Development of a database model for the systematization of integrated solid waste management programs in public cleaning services. Engenharia Sanitária e Ambiental, Rio de Janeiro, vol. 11, n. 2, p. 162-168, Apr./Jun. 2006.

- [4] Guerrero, L. A., Maas, G., Hogland, W. Solidwaste management challenges forcities in developing countries. Waste Management - Elsevier, USA, vol. 33, p. 220-232, Jan. 2013.
- [5] Jara-samaniego, J., Pérez-murciab, M.D., Bustamanteb, M. A., Pérez-Espinosa, A., Paredes, C., López, M., López-Lluchd, D.B., Gavilanes-Teráne, I., Moral, R. Composting as sustainable strategy for municipal solid waste management in the Chimborazo Region, Ecuador: Suitability of the obtained composts for seedling production. Journal of Cleaner Production, USA, vol. 141, p. 1349–1358, Jan. 2017.
- [6] López-Toro, A. A., Rubio-Romero, J. C., Suárez-Cebador, M., Arjona-Jiménez, R. Consideration of stakeholder interests in the planning of sustainable waste management programmes. Waste Management & Research, USA, vol. 34, p. 1036-1046, 2016.
- [7] Marconsin, A. F & Rosa, D. S. A comparison of two models for dealing with urban solid waste: Management by contract and management by public–private partnership. Resources, Conservation and Recycling, USA, vol. 74, p. 115, May. 2013.
- [8] Mayropoulos, A., Tsakona, M., Anthouli, A. Urban waste management and the mobile challenge. Waste management & research, USA, vol. 33, p. 381-7, Apr. 2015.
- [9] Mir, M. A., Ghazvinei, P. T., Sulaiman, N. M. N., Basri, N. E. A., Saheri, S., Mahmood, N. Z., Jahan, A., Begum, R. A., Aghamohammadi, N. Application of TOPSIS and VIKOR improved versions in a multi criteria decision analysis to develop an optimized municipal solid waste management model. Journal of Environmental Management, USA, vol. 166, p. 109-15, Jan. 2016.
- [10] Prefeitura de Belo Horizonte. Sala de notícias. 2014. Available in: <<http://portalpbh.pbh.gov.br/pbh/ecp/noticia.do?evento=portlet&pAc=not&idConteudo=178503&pIdPlc=&app=salanoticias>>. Access in October 1st, 2016.
- [11] Prefeitura de Belo Horizonte. Plano Municipal de Resíduos Sólidos. O que é o plano. 2015. Available in: <[http://portalpbh.pbh.gov.br/pbh/ecp/comunidade.do?evento=portlet&pIdPlc=ecpTaxonecpTaxonomiaMe&app=planoresiduosbh&tax=44728&lang=pt\\_BR&pg=10667&taxp=0&](http://portalpbh.pbh.gov.br/pbh/ecp/comunidade.do?evento=portlet&pIdPlc=ecpTaxonecpTaxonomiaMe&app=planoresiduosbh&tax=44728&lang=pt_BR&pg=10667&taxp=0&)>. Access in October 1st, 2016.
- [12] Takiguchi, H. Global Environment Facility’s support for sustainable waste management. Journal of Material Cycles and Waste Management, USA, vol. 18, p. 248-257, 2016.
- [13] Thi, N. B. D., Kumar, G., Lin, C-Y. An overview of food waste management in developing countries: current status and future perspective. Journal of Environmental Management, USA, vol. 157, p. 220, Jul. 2015.
- [14] Triguero, A., Álvarez-Aledo, C., Cuerva, M. C. Factors influencing willingness to accept different waste management policies: empirical evidence from the European Union. Journal of Cleaner Production – Elsevier, USA, p. 1-9, Jun. 2016.