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Soil pollution of urban origin: environmental management of solid waste in the municipalities of Pernambuco Center Agreste

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ABSTRACT

The Brazil has serious problems in the management of solid waste. The Pernambuco states occupy an area of approximately 98,146 square kilometers and are divided into 12 Regions Development, based on environmental, socioeconomic, cultural and geographic. The Northern Region Agreste has 19 municipalities with a population of approximately 430,222 habitants; the region faces problems of degradation and soil erosion, lack of sanitation, in addition to poor housing. Poor management and inadequate disposal have generated social and environmental impacts increasingly significant because the production system not only uses of natural resources, but also generates increasing amounts of materials in the form of waste on the environment. When using the landfill for final disposal of waste, this area suffers a high degree of negative environmental impacts such as contamination of the subsoil and groundwater in disposal sites. This research aims to present environmental problems on the management of municipal solid waste, its environmental damage of some municipalities of the Agreste and present some suggestions for programs and actions to improve environmental quality.
Keywords: solid waste, soil pollution, dumping ground

Poluição do solo de origem urbana: gestão ambiental de resíduos sólidos nos municípios de Pernambuco Centre Agreste

RESUMO

O Brasil tem sérios problemas na gestão de resíduos sólidos. O estado de Pernambuco ocupa uma área de aproximadamente 98.146 quilômetros quadrados e é dividido em 12 Desenvolvimento de Regiões, baseado em meio ambiente, socioeconômico, cultural e geográfico. A Região Norte Agreste tem 19 municípios com uma população de aproximadamente 430.222 habitantes; A região enfrenta problemas de degradação e erosão do solo, falta de saneamento, além de habitação pobre. A má gestão e a eliminação inadequada geraram impactos sociais e ambientais cada vez mais significativos porque o sistema de produção não é apenas o uso de recursos naturais, mas também gera quantidades crescentes de materiais sob a forma de resíduos no meio ambiente. Ao utilizar o aterro sanitário para disposição final de resíduos, esta área sofre um alto grau de impactos ambientais negativos, como a contaminação do subsolo e das águas subterrâneas nos locais de disposição. Esta pesquisa tem como objetivo apresentar problemas ambientais na gestão de resíduos sólidos municipais, o dano ambiental de alguns municípios do Agreste e apresentar algumas sugestões para programas e ações para melhorar a qualidade ambiental.
Palavras-chave : Resíduos sólidos, poluição do solo, despejo

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Introduction

A major challenge for Brazilian municipalities is reduction and proper disposal of solid waste. The development of cities and the population density potentiated the impacts and the generation of solid waste, but with the advancement of science, there was the understanding of need for structuring the solid waste management in the pursuit of improved environmental quality and health safety (PEDROSA & NISHIWAKI, 2014).

The approval of Law No. 12,305 / 10, establishing the National Policy on Solid Waste - PNRS and regulated by Decree 7404 of 2010, which set out principles, objectives, guidelines, goals and key actions, such as the National Solid Waste Plan , aims to guide and require actions to protect public health and environmental quality (BRAZIL, 2010).

After approval of the aforementioned law, all municipalities must submit a waste management plan. According to Law No. 12,305 / 10 art. 18, the preparation of the municipal plan of integrated solid waste management is a prerequisite for the Federal District and the municipalities have access to the resources of the Union or controlled by it, for the projects and services related to urban cleaning and solid waste management, or to be benefited by incentives or financing of federal credit organizations or sponsoring for this purpose (BRAZIL, 2010).

In the face of current public policies and applicable laws could be gradually reverse the current situation where most municipalities aimed their waste in an environmentally improperly. Through goals and environmental programs, it was possible to encourage the society in general and to the goals for waste reduction, recycling and reuse of solid waste generated from various activities.

Some municipalities are still allocating their waste irregularly in landfills, thus generating various environmental and health problems. Often found in the garbage dumps some waste pickers with their irregular facilities for housing and thus acquire the most diverse diseases, such as viral infection, bacterial dysentery, pneumonia and bronchial asthma (ROCHA, 2007; HOLANDA, 2014; MACIEL; CASTRO, 2015).

The irregular disposal of waste can cause direct and indirect damages to the environment causing contamination associated with the transport of pollutants by infiltrating percolated liquid, responsible for the contamination of the subsoil and groundwater at disposal sites (NOBILE *et al.*, 2011). According to Ferreira *et al.* (2016), it reflects the problematic situation in the use of natural resources as if they were infinite, without the slightest concern for the environment and the impacts generated.

According to the Panorama of Solid Waste in Brazil in 2014, the figures related to the disposal of the collected waste, the survey revealed that 58.4% were allocated to landfills and the remaining 41.6% is sent to landfills or controlled landfill, which slightly differ from landfills, since both do not have the set of required systems and measures for environmental protection against wear and tear (ABRELPE, 2014).

The state of Pernambuco occupies an area of approximately 98,146 square kilometers and is divided into 12 Regions Development (RD), based on environmental, socioeconomic, cultural and geographic. RD Central Agreste consists of 26 municipalities, covers an area of 10.103,53 km², has a total population of 1.048.968 inhabitants (IBGE, 2010), featuring a population density of 103,82 hab./km². They are members of this RD the Swamp municipalities of Brejo da madre de Deus, Riacho das Almas and São Caetano.

This research aims to present environmental problems on the management of municipal solid waste and its environmental damage caused by the lack of measures to minimize / mitigate soil contamination due to its poor environmental disposal of waste generated in the Swamp municipalities Brejo da Madre de Deus, Riacho das Almas and São Caetano.

In the case of soil study, this pollution in the surface layer of the earth's crust is related to direct and indirect damages caused by uncontrolled exploitation and occupation, depositing the soil harmful chemicals to forms of microbial life and regular ecological interactions (SILVA, *et al.*, 2015).

When using an area to open a landfill for final disposal of waste, this area suffers a high degree of negative impacts to the environment as well as offering a number of risks to human health. The management of such waste has been the focus of concern of researchers from various fields of study, in addition to becoming one of the major challenges to the cities over the next few decades (SANTIAGO &, DIAS, 2012).

The areas of landfill cause serious environmental problems due to the impact on soil (compaction), groundwater (contamination), by air waste burning (caused by scavengers) and smelly; social impacts by the absence of public policies, opportunities to communities that survive the dump, and lack of public awareness about environmental education and selective collection of habit. (MIRANDA & STEUER, 2014).

Pollution is linked to the concentration or amount of residues present in air, water or soil (FRAGA;

DINIS, 2005). In order to exercise control of pollution in accordance with environmental legislation, are defined standards and air quality indicators (NOx concentrations, CO, SOx, etc.), water (O2 concentrations, pH, temperature, etc.), soil (erosion rate, etc.) that wishes to respect a particular environment (BRAGA *et al.*, 2010).

The contamination of soil and water may occur through the infiltration of liquids generated by passing water through the solid waste in the decomposition process and even by simple degradation or decomposition of waste (Santos et al. 2014). In addition to the above problems is evident the possibility of commitment and soil contamination by heavy metals, due to the improper disposal (ALCANTARA, 2010).

Metals are chemical elements or compounds with high molecular density that occur naturally in nature and because its main characteristics, such as brightness and high density, hardness, malleability, ductility, elasticity and strength, and the ability to conduct heat and electrical current efficiently , meant that these elements were used widely in various areas and human activities (p. eg. metallurgy, mining, etc.) (BARROCAS, 2013).

Also according to the author, this resulted in the alteration of natural biogeochemical cycles of these elements making them one of the leading and most dangerous groups of contaminants these days that pollute the environment and can cause damage to soil biota, such as Ag, Cd, Hg, Ni, Pb, Sb, As, Co, Cr, Cu, Se and Zn.

Material and Methods

The survey was conducted through bibliographic research in reference sources such as Brazilian Institute of Geography and Statistics, Ministry of Environment, the Brazilian Association of Technical Standards and in scientific journals with environmental issues.

Through technical data provided by the Institute of Social and Technological Development-IDEST in your project in Brejo municipalities of the Brejo da Madre de Deus, Riacho das Almas and São Caetano in Agreste Central of Pernambuco, via Agreement with CONIAPE - Public Intermunicipal Consortium of Agreste Pernambucano and Borders, it was possible to achieve a more updated and detailed study of the mentioned municipalities.

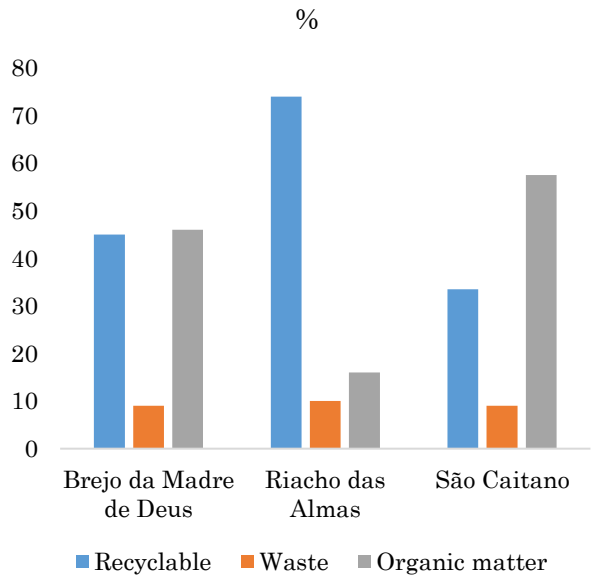
The IDEST in your project held gravimetric composition of each municipality of this study. The process for gravimetric determination of composition was performed by the method of quartering (ABNT / NBR 10 007 / 2004). This method used by the project was described by Tabalipa and Fiori (2006), in which the samples were collected in five (05) MSW pile of points dumped into the Municipal Garbage Dump, being mixed, separated and finally weighed.

Results and Discussion

By gravimetric composition, performed by the technical team of IDEST, the study of the physical characteristics of the solid waste, it was possible to analyze the characteristics of the waste (Figure 1).

The municipalities this study also aimed their municipal solid waste and electronics in landfills, it is known that these open-air storage areas is an environmentally inadequate form of deposition according to Law Nº. 12.305/10, where no compression procedure or waste cover, which has to lead to the pollution of soil, air, and water, as well as the proliferation of vectors of diseases.

Figure 1 - Composition Gravimetric. Source: Idest 2015.



The predominance of these forms of disposal can be explained by several factors, such as lack of technical and administrative capacity, low budget allocation, little public awareness of environmental problems or lack of organizational structure of public institutions involved in the issue in municipalities (ZANTA & FERREIRA, 2003).

An important fact is that in the municipality of Brejo da Madre de Deus there are about four (04) dumps, one of them, the land belongs to the City Hall and the other three are leased (IDEST, 2015). However, it was possible to analyze even before the quantitative dumps in Heath, the amount of organic waste is produced 46% and 45% is recycled.

Quantitative this is a national trend, where commonly the percentage of organic is greater, whereas this parameter varies according to the characteristics, habits and customs of each region (ABRELPE, 2011).

Table 1 - List of geographical coordinates of dumps found in the municipalities (IDEST, 2015).

Municipalities	Dumping ground	
	Geographic coordinates	
Brejo da Madre de Deus	S 08° 09' 55.8"	W 036° 11' 11.5"
	S 08° 08' 02.5"	W 036° 22' 35.5"
	S 08° 05' 01.4"	W 036° 13' 41.3"
	S 07° 59' 05.5"	W 036° 13' 25.3"
São Caitano	S 08° 18' 38.5"	W 036° 07' 14.6"
Riacho das Almas	S 08° 06' 36.6"	W 035° 52' 54.2"

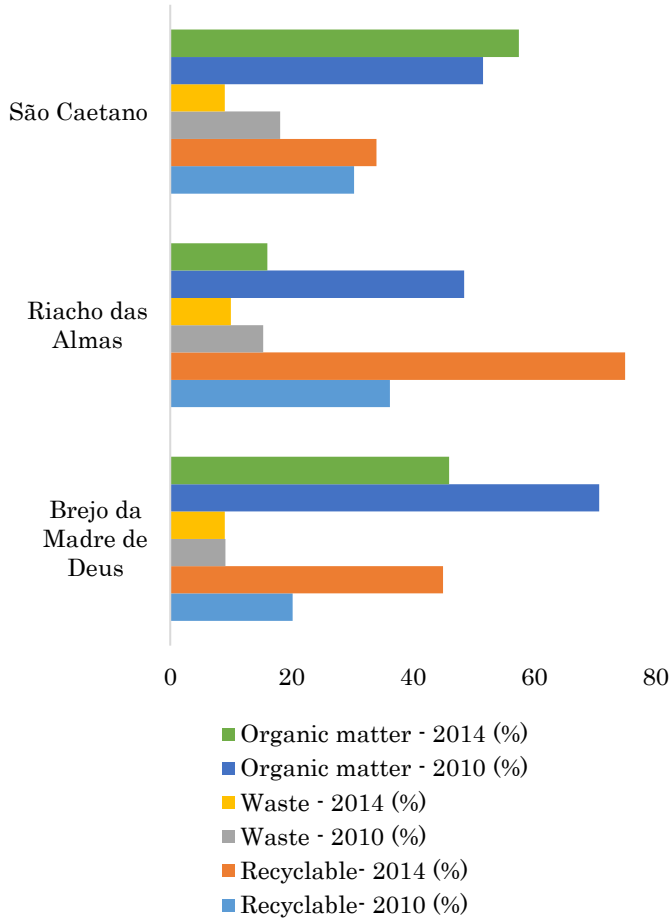
According to IDEST (2015), the São Caitanto showed a higher amount of resídue generation per day, with 64.09 ton./dia and a rate of 1.75 kg / hab. /day, followed by Heath with 58.25 ton./dia respectively with a rate of 1.2 kg /hab. /day and Riacho das Almas with 24.07 ton./dia with 1.2 kg / in hab. / day, noting that this information is based on the estimated population the year 2014.

The organic fraction in the municipalities was also quite representative, where the city of São Caetano presented 57.5% and in Brejo da Madre de Deus with 46%, but Riacho of Almar showed only 16%.

However in a survey conducted by the Pernambuco Institute of Technology (2012) pointed out that only Souls of Riacho presented in solid waste, less than half of organic matter (48.46%), reducing significant 32.46% while the Brejo da Madre de Deus reduced 24.71% in this study.

By contrast the city of São Caetano increased the production of solid waste from the organic matter in almost 6% (5.9%). Another factor worth mentioning is the reduction of waste compared to studies of Itep (2012), even in small percentages previously reached 0.09%, 5.31% and 9.1% in Brejo municipalities of Madre de God, souls Creek and Sao Caitano respectively, as shown in Figure 2 below.

Figure 2 - Composition profile of solid waste related to 2010 and 2014. Source: Itep (2012) and Idest (2015).



The three municipalities in the study do not perform any action or selective collection and composting. On the data presented in gravimetric composition, where most of the waste is recyclable and organic, it can be considered as an indication and thus seek alternatives to minimize the amount of illegally deposited waste through the selective collection in partnership with recyclable material collectors and reusable found in dumps municipalities.

According to Silva *et al.* (2015), the waste ratio and its not recycling directly affect the environmental impacts of all its policies, both affecting the soil, the contamination of ground water, the air, denigrating the ozone layer and water, all these excesses caused by the human being can be justified for not having the perception of who are able through a simple act of recycling.

According to Costa *et al.* (2015) treatment of the organic fraction of municipal solid waste, composting may be in economic gains for public administration as reduce transportation costs and disposal to

landfill and environmental gains to increase the useful life of landfills.

Conclusion

The current challenge for municipalities is looking for alternatives to reverse the situation of final disposal of solid waste and the reduction of these. The definition of strategies to structure a system of integrated management of solid waste is a very delicate step towards the low budget allocation, lack of organizational structure, public awareness and environmental problems.

Municipalities cited in this paper have some characteristics in common, such as the location of irregular disposal of waste, the presence of scavengers in garbage dumps, lack of organizational structure and the lack of the suitable place to build a landfill. Given this current situation the municipalities show is unsustainable because it does not implement a selective collection system, there is no waste sorting center and do not make good environmental practices.

Based on the gravimetric composition of the municipalities, it is possible to establish ways to reduce waste generation through incentive programs continue in commercial and home stores, in order to reduce and reuse their waste, on the other hand would be entitled to tax reduction and access to some benefits. In addition, it would be essential to implementation of a government program like the Environmental Agenda in Public Administration - A3P in municipalities, implement selective collection system incorporating schools and collectors of recyclable and reusable material, and to establish an integrated management plan with the prospect of implementation of a landfill Syndicated.

References

ALCANTARA, A. J. O. *Composição gravimétrica dos resíduos sólidos urbanos e caracterização química do solo da área de disposição final do município de Cáceres-MT*. 2010. 88 f. . Dissertação (Mestrado em Ciências Ambientais) – Universidade Estadual de Mato Grosso. 2010. Disponível em: <http://www.unemat.br/prppg/ppgca/teses/2010/02.pdf> Acesso em: 10 abr. 2016.

ABRELPE. Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. *Panorama dos Resíduos Sólidos no Brasil 2014*. Disponível em: <http://www.abrelpe.org.br/Panorama/panorama2014.pdf>. Acesso em: 04 abr. 2016.

ABRELPE. Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. *Panorama dos Resíduos Sólidos no Brasil 2011*. 2011. Disponível em: <http://a3p.jbrj.gov.br/pdf/ABRELPE%20Panorama%202001%20RSU-1.pdf>. Acesso em 04 abr. 2016.

ABNT - Associação Brasileira de Normas Técnicas. NBR n. 10.007, Amostragem de Resíduos: Procedimento. Rio de Janeiro: ABNT, set. 1987. Disponível em: <http://wp.ufpel.edu.br/residuos/files/2014/04/nbr-10007-amostragem-de-resc3adduos-sc3b3lidos.pdf>. Acesso em 20 abr. 2016.

BARROCAS, P. R. G. Metais. IN: SISINNO, C. L. S.; FILHO, E. C.O. *Princípios de Toxicologia Ambiental.* 1. ed. Rio de janeiro: Interciência, cap. 4. p. 39 – 73, 2013.

BRAGA, M.C.B.; RAMOS, S.I.P; DIAS, N. C. *Gestão de Resíduos Sólidos para sustentabilidade*. IN: Introdução ao gerenciamento ambiental. Rio de Janeiro: Interciência, cap. 8. p. 269 – 336, 2010.

BRASIL. Presidência da República. Lei no 12.305, de 02 de agosto de 2010. Institui a Política Nacional de Resíduos Sólidos. *Diário Oficial da União*, Poder Executivo, Brasília, DF, 03 ago. 2010.

COSTA, A. R. S.; XIMENES, T. C.F.; XIMENES, A.F.; BELTRAME, L. T. C. O processo da compostagem e seu potencial na reciclagem de resíduos orgânicos. *Revista GEAMA*, Recife, v.2, n.1, p. 116-130, 2015.

FERREIRA, M. G.O.; BILAR, A. B. C.; MOURA, F. S.; FERREIRA, L. R.; RIBEIRO, E. P. Solid waste management and environmental education fromthe perspective of workers of a cooperative recycling. *Revista Geama*, v.5, n.1, p. 94-102, 2016.

FRAGA, H; DINIS, M. A. Poluição de solos: riscos e consequências. *Revista da Faculdade de Ciência e Tecnologia*, n. 2, p. 98, 2005.

HOLANDA, G.V. *Realidade social dos catadores do lixão de Inhamã – Abreu e Lima e as principais patologias que os acomete*. Resíduos sólidos: perspectivas e desafios para a gestão integrada. 1. ed. Recife: EDUFRPE, p. 393, 2014.

IDEST - Instituto de Desenvolvimento Social e Tecnológico. *Plano de Gerenciamento Integrado de*

Resíduos Sólidos dos municípios consorciados ao CONIAPE. 1. ed. Caruaru: IDEST, 2015.

ITEP – Instituto de Tecnologia de Pernambuco. *Plano Estadual de Resíduos Sólidos de Pernambuco.* p. 306, 2012. Disponível em: < http://www.cprh.pe.gov.br/downloads/PlanoResiduoSolido_FINAL_002.pdf >. Acesso em: 24 de mai. 2016.

MACIEL, A. B. C.; CASTRO, N. E. S. Resíduos sólidos domésticos no bairro Pitimbu, Natal/RN: algumas reflexões. *Revista OKARA*, v. 9, n. 3, p. 462-481, 2015.

MIRANDA, M. J. L; STEUER, I. R. W. Diagnóstico e análise socioambiental do gerenciamento dos resíduos sólidos urbanos do município de carpina – PE. Resíduos sólidos: perspectivas e desafios para a gestão integrada. 1. ed. Recife: EDUFRPE, p. 393, 2014.

NOBILE, F. O; GALBIATTI, J. A.; MURAISHI, R. I.; ARAUJO, J. R. Variáveis biométricas da cana-de-açúcar fertilizada com resíduos orgânico e industrial e irrigada com água servida e potável. *Engenharia Agrícola*, p. 193 - 200, 2011.

PEDROSA, D. S. F.; NISHIWAKI, A. M. *Resíduos sólidos: uma visão prospectiva a partir da análise histórica da gestão.* Resíduos sólidos: perspectivas e desafios para a gestão integrada. 1. ed. Recife: EDUFRPE, p.393, 2014.

ROCHA, V. G. Resíduos Sólidos Urbanos: Análise sobre a Situação do Município da Barra dos Coqueiros/SE. *Revista da Fapese*, v. 3, n. 2, p. 25-38, 2007.

SANTIAGO, L. S.; DIAS, S.M.F. Matriz de indicadores de sustentabilidade para a gestão de resíduos sólidos urbanos. *Eng. Sanit Ambient*, Campo Limpo, v.17 n. 2, p. 203-212, 2012.

SANTOS, A. T. L.; HENRIQUE, N. S.; SHHLINDWEIN, J. A.; FERREIRA E.; STACHIW, R. Aproveitamento da fração orgânica dos resíduos sólidos urbanos para produção de composto orgânico. *Revista Brasileira de Ciências da Amazônia*, v. 3, n. 1, p. 15-28, 2014.

SILVA, A. R. S.; MELO, D. G.; MORALES, F. J. S.; ANTÔNIO, T.; COELHO, T. P. M.; SILVA, G. S. Impactos ambientais referentes à não coleta de lixo e reciclagem. *Ciências exatas e tecnológicas*. v. 2, n.3, p. 63 -76, 2015.

TABALIPA, N. L., FIORI, A. P. Caracterização e Classificação dos Resíduos Sólidos Urbanos do Município de Pato Branco-PR. *Revista Brasileira de Ciências Ambientais,* n 4, p. 26 – 28, 2006.

ZANTA, V. M.; FERREIRA, C. *Gerenciamento Integrado dos Resíduos Sólidos Urbanos*. IN: Resíduos sólidos urbanos: aterro sustentável para municípios de pequeno porte. Rio de Janeiro: ABES, RiMa, ca