INDICATORS FOR INTEGRATED WASTE MANAGEMENT SYSTEM IN BRAZIL: WHAT SHOULD COME NEXT?

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ABSTRACT

This paper is part of an ongoing research work carried out by Siades - Environmental Information System for Sustainable Development Research Programme at University of Sao Paulo – School of Public Health. It presents a critical overview of the Brazilian information system with regard to available indicators for waste sector.

At present, waste management issue is coming to the debate by different social actors. During 60’s the provision of clean water for the general public was the main target of the federal and regional governments in the environmental sanitation area. Afterwards, in the 70’s there was a concern among the authorities and technicians about the wastewater problem and its effects on the environmental and public health. Water and wastewater management became important issues in the political agenda of the country. In the early 90’s, solid waste issue was pointed out as one of the main problems to be tackled in the national sanitation sector. There have been some efforts towards more sustainable practices in this area. However, little information has been produced in order to draw the current and future scenario of waste. Consequently, there is a growing need for streamlined instruments of information in environmental, economic, social and institutional areas in order to build an integrated urban solid waste management system.

Indicators are instruments of information that should be used extensively. In this context, the purpose of this research work is to analyse and assess indicators available in Brazilian waste area; recommend improvements in data quality; and reflect on a broad range of indicators for integrated urban waste system, in order to come up with a set of streamlined indicators to attend current and future demands.

The first step of research’s methodology comprised basically of great variety of literature review of indicators of sustainable development. Second step focused on a critical analysis
of Brazilian waste management system and its available indicators. Finally, third and current step involves the compilation of all data and information in a comprehensive discussion of the main topics, in order to propose, in a near future, a set of indicators to be used at national, regional and local levels.

Preliminary outcomes conclude there has been an increase of the number of features assessed in waste management sector in Brazil. Nevertheless, information is not produced in a systemic basis. Comprehensives information for waste issue should also tackle many features such as: production and consumption patterns and how it is aligned with the principles of sustainability; the management of resources - including the assessment of natural capital stocks and the movements towards a more dematerialized economy; as well as, complete information about waste management services should be available. It is important to highlight that selecting a number of streamlined indicators is one of learning process, thus it involves criteria and challenges in all stages of work. These issues are mentioned in details along this research paper.

In conclusion, it follows there are still a number of streamlined indicators to come up with in order to assist the formulation process of an integrated waste system, as well as, to assess its efficiency towards sustainability.

KEYWORDS

Indicators; information system; integrated management; urban solid waste; sustainable development

INTRODUCTION

Over the years, waste issue and its related topics have drawing attention of a great part of the citizens around the world. The enforcement of the concept of sustainable development adopted in the UN Conference on Environmental and Development meeting in Rio de Janeiro in 1992, called on governments to prepare national strategies towards sustainability with regard to waste problem. Since then, great number of studies has been carried out in order to define principles, methodologies and other tools for implementation of agreements recommended in the document Agenda 21[4]. Some initiatives highlighted in chapter 40 of Agenda 21 address the importance of accurate and timely information as a powerful resource in support of sustainable development.

Indicators are instruments of information system. They compile a great variety and complex data in order to inform the public, assisting decision-makers in planning strategies and the evolution of policy initiatives. It also signalises improvements, or not, in operational processes. From this point, solid waste management demands construction and use of indicators in order to provide relevant information about the current state and future developments.
FACTS AND FIGURES ON THE BRAZILIAN WASTE ENVIRONMENT

During 60’s and 70’s, the provision of drinking water for the general public was the main target of the federal and regional governments in the environmental sanitation area. In 1968, only 30% of residents were connected to water system. There was a concern among the authorities and technicians about wastewater problem and its effects on the environmental and public health. Thus, water and wastewater management became important issues in the political agenda of the country. In 1971, it was finalized the National Sanitation Plan – Planasa, in order to expand the number of households provided with water and wastewater services in urban areas [18]. Planasa was in force until 1985, and its main target was: have achieved, by 1981, 90% of Brazilian households with access to water pipe system; and 65% of Brazilian households with access to wastewater pipe system [16].

In early 90’s, the growing number of solid waste produced by different sectors of the Brazilian society, their negative impacts on the environmental and public health, as well as, the intense debate at international level – specially after The Earth Summit and the creation of Agenda 21 - were some of the features that have brought solid waste issue to discussion by different social actors.

According to the national sanitation survey – PNSB 2000 [10] – Brazilian’s population has increased 16,4% from 1991 to 2000, whereas, the total of household waste collected from 1989 to 2000 has increased 49% [2]. Figures 1 and 2 show the per capita waste generation in Brazil during this period, and in the city of Sao Paulo throughout the last decades.

Figure 1. Waste generation from daily households and small commercial activities in Brazil (source: Araujo 2005)

Figure 2. Per capita waste generation from daily households and small commercial activities in Sao Paulo (source: Schneider 2003; Cetesb 2004)
Regarding to the political and legal aspects, there has been a trend in most countries of the world towards decentralization from national governments of responsibility for delivering services. In Brazil, the federal constitution of 1988 stated the role of local authorities in providing solid waste management services. Since then, waste services are operated by contracts with the private sector, especially in medium and big cities. In order to pay the contracts, many municipalities have implemented a specific tax to pay its costs.

According to the national sanitation survey PNSB 2000, cities with population up to 50,000 inhabitants spend around 5% of the municipal budget in waste management services\[10\]. Despite many problems that have coming out due to the decentralization of responsibility to local authorities – especially the increased disparities in fiscal resources, it could be pointed out a slight improvement in waste sector.

Figure 3 shows that inadequate waste disposal in Brazil has decreased from 1989 to 2000, whereas the total of waste recycled, composted, incinerated and disposal at landfill sites have increased.

![Figure 3. Waste final destination according to the national sanitation surveys - 1989 and 2000 (source: IBGE 1989; IBGE 2000)](image)

In 1990’s the National Council for the Environment - CONAMA has set a number of regulations for industrial waste, hazardous waste, health services waste, port & airport waste, disposal of tires and batteries\[6\]. The lack of federal policy and legislation system for this sector has made the National Congress to nominate, in 2001, a special commission responsible for the creation of a national waste management policy\[13\]. Debates with different social actors were carried out for over two year. However, the outcome of proposal was not on vote by the national congress – which has changed most of its constitutive body in the year 2002.

In 2004, the Ministry of Urban Affairs in conjunction with the Ministry of the Environment started a new study for national waste plan, which is in draft stage\[13\]. Meanwhile, Brazil does not have a specific federal legislation for solid waste sector.
There has been an increase of information production in different levels of Brazilian society. Public and private institutions produce relevant data on waste topics. The Brazilian Institute of Geography and Statistics - IBGE – was the first institution to publish national information about waste. In 1977, IBGE in conjunction with the Ministry of Health launched the first statistical production about municipal public cleaning and waste collection[8]. The research work was carried out with questionnaires sent to the local authorities. Despite, this specific work on waste issue, systematically information about household waste collection has been published in the National Statistical Yearbook – PNAD, from 1981 onwards[10].

Besides that, comprehensive information of basic sanitation is published by IBGE every decade. The first national survey of basic sanitation – PNSB - was published in 1983. It was included waste issue and its related indicators, such as: public cleaning and household waste collection[9]. This same work was improved over the years, and finally, in 1989 it became national reference of information about solid waste management services.

The aims of PNSB 1989 were to assess the provision and quality of sanitation delivery services, as well as, to analyse the environmental conditions and its effects on public health. For this reason, the questionnaires were divided in three parts[9].

- Part one: identification of the institutions responsible for the services (public or private sector)
- Part two: identification of infrastructure and services provided - public cleaning, household waste collection, disposal of waste, sorting collection, fleet and collection crews
- Part three: identification of the relationship between the operator of the services and the community.

In 1999, IBGE celebrated the agreement with the Federal Department for Urban Development – SEDU/PR; National Health Foundation - FUNASA; the state bank – Caixa Econômica Federal; and the contribution of the Pan American Health Organization - PAHO in order to carry out, in the year 2000, the second national survey of basic sanitation[10].

Great part of the analysis published in the PNSB 2000 concerning to solid waste are based on three main parameters: urban population and the number of municipalities including their geographical regions provided with public cleaning services; and weight of waste collected or received at the final destination. Data collected were compiled in three indicators:

- per capita waste generation;
- number of households provided with waste collection services;
- final disposal of waste.

Regional agencies and municipal departments throughout the country also produce important and useful information about environmental sanitation. Since 1997, the Environmental Protection Agency from the State of Sao Paulo – CETESB has gathered data from 645 municipalities in order to analyse and assess the environmental and sanitation conditions of the disposal sites and waste final destinations in the State. The evolution and monitoring of this work are expressed by three different types of quality rate, or indicators, for the following features: landfill sites – IQR; trench landfill – IQR Valas; and
composting plants - IQC. The outcomes are published every year as the “Inventory of Household Solid Waste of the State of Sao Paulo”. It is worth mentioning, this work shows a steep increase in the number of adequate final destination of household waste\textsuperscript{[5]}.

Differences in the methodological processes of data collection and the continental dimensions of Brazil are some of the features that enable some differences in data published by different institutions. Information processed at national level, does not necessarily match with those gathered at regional and local levels. As an example, the study\textsuperscript{[1]} carried out by Abrelpe – Brazilian Association of Solid Waste Management Companies compares numbers regarding to per capita waste generation published by IBGE and CETESB. The finding indicators are concern to two different levels: data collected by IBGE express numbers of southeast region of Brazil, where Sao Paulo is located; and data collected from CESTEB only concern to the State of Sao Paulo.

Figure 4 shows the comparison between data produced by IBGE and CETESB. It demonstrates the per capita waste generation according to the size of the cities and the average of waste collected.

![Figure 4. Per capita waste generation in the Brazilian Southeast Region by IBGE and in the State of Sao Paulo by CETESB (source: Abrelpe, 2004)](image)

Indicators proposed by CETESB for the State of Sao Paulo, except for cities with population up to 10,000 inhabitants, are below the average proposed by IBGE for the southeast region. It is important to highlight that the State of Sao Paulo is the richest state of the country. For this reason, its per capita waste generation is expected to be higher than the average given by IBGE for the whole region. In other words, some of the two indicators does not correspond the status quo.

In its publication, Abrelpe states that indicators gathered at regional level tend to be more reliable than those getting from a greater scale. Thus, data collected by CETESB for the State of Sao Paulo signalise to be regarded prior to the numbers proposed by IBGE\textsuperscript{[1]}. 
In 2002, IBGE published 50 indicators for sustainable development divided in four dimensions: economic, environmental, social and institutional. It aimed to provide a new information system to monitoring progresses towards sustainability. Their construction was based on a set of sustainable indicators proposed by the UNCSD – United Nations Commission for Sustainable development, which in 1996 proposed a set of 57 indicators of sustainable development get from 134 indicators selected previously [4]. The second edition of indicators of sustainable development came out in 2004. There were included nine more indicators. Both editions bring information for waste sector, which are stated in two dimensions: economic and environmental.

Indicators highlighted in the environmental dimension are regard to sanitation issues, such as: number of urban and rural households provided with waste collection, and final destination of waste. These indicators are also published in the Statistical Year Book – PNAD, as well as, in the National Survey of Basic Sanitation – PNSB. On the other hand, new indicators are introduced in the economic dimension: [11]

- recycling of material per industrial sector: it establishes a ration between the number of raw and recyclable material used in four types of industries: paper, glass, PET and aluminium.
- sorting collection: number of municipalities has implemented recycling programmes, number of households provided with this service, and total of recyclable material collected.
- radioactive waste: generation and disposal of materials

Besides IBGE, SNIS - National Information System for Sanitation is also an important institution that produces data for sanitation sector. It was created and has been developed by the Modernization Programme of Sanitation Sector PMSS; the National Department of Environmental Sanitation – SNSA of the Ministry of Urban Affairs – MCIDADES. The work comprises of producing and maintaining database of water and wastewater services, in order to be used by different social actors in different levels. Since 1995, information have been produced and updated annually. In 2002, SNIS published the first work on indicators for waste sector. It is a diagnosis of municipal waste services, which aimed to draw a national scenario for solid waste management. Questionnaires were sent to the municipalities and data were gathered in a voluntary basis – 108 out of 121 municipalities have answered the questionnaires. It implies: 2,2% of the Brazilian municipalities, and 31,7% of the national population. In 2003, this last number increased to 39,0% [16].

There is no universal scheme for gathering and processing information about waste issue. Methodological process of data collection is still under construction. SNIS is creating new software applicative for waste sector, once many tolls used for water and wastewater are not efficient in waste area.

It is worth mentioning, in 2000, a Brazilian NGO – Forum Nacional Lixo e Cidadania; and UNICEF – United Nations Children’s Fund have set a diagnosis of municipal solid waste management with regard to social aspects. It aimed to get specific information about the work of scavengers - including children, adults and the elderly, in the collection of recyclable materials in the streets and at disposal sites. This work was carried out using questionnaires sent to all 5.500 municipalities. It was answered 1360 questionnaires, which represents 30% of Brazilian municipalities. Information gathered has showed there were over 500 children involved in scavenging procedures at disposal sites in the year 2000[17]. Nevertheless, it is important to highlight, there have been great efforts from different social actors in order to improve this social indicator.
WHAT SHOULD COME NEXT?

Over the last decade, there has been an increasing number of information for waste sector in Brazil. However, little comprehensive information has been developed in order to tackle the issue in a systemic approach. Information are produced per and for sectors and, normally, do not include the holistic perspective. That is the case of the set of indicators for sustainable development produced by IBGE. Despite the welcome initiative of coming up with a new set of indicators, information regard to waste is incomplete whether analysed from sustainable point of view. For this reason, it is imperative to streamline indicators in order to handle economic, environmental, social and institutional dimensions simultaneously. This new concept of indicators would bring all dimensions to the area of actions, which are listed below:

- production: indicators to analyse production patterns – from the planning and designing stages until manufacturing/industrial processes.
- consumption: indicators to analyse consumption patterns. Social aspects related to education, information and public confidence on waste management sector at large are great issues to be measured.
- resource management: indicators to analyse the impacts of extracting, manufacturing, transporting, trading and use of products. These set of indicators are life-cycle-material oriented. It is worth mentioning, the need for indicators to assess the capacity of the natural capital stocks and the movements towards to a more dematerialised economy.
- waste management services: indicators to analyse and assess all delivery services provided – collection, transportation, treatment, disposal, and so on.

Implementing the four dimension of sustainable development in a set of indicators is a topic of concern in many areas and stage of work, such as: assisting decision-making process, creating waste policy including waste hierarchy, waste planning and regulatory framework, the process of enforcement of the law; and finally in promoting awareness and public participation. In this context, the following topic which is, indeed, part of the future step proposed, highlights some features to be tackled during the analysis and the construction processes of streamlined indicators.

CRITERIA AND CHALLENGES OF COMING UP WITH STREAMLINED INDICATORS

First of all, it is important to mention this research paper has named the proposed indicators as “streamlined indicators”, in order to distinguish between indicators of sustainable development proposed by IBGE.

Streamlined indicators could be understand as indicators of fourth generation, once it goes beyond the traditional indicators of first generation – economic indicators; second generation – economic and social indicators; and third generation – economic, social and environmental indicators. Indicators of fourth generation also take into account the institutional dimension, which is regarded, especially in the area of political science, as one of the greatest subjects of modernity - thus an important object of study [7]. Streamlined indicators should be: policy relevant, useful for users, analytical soundness, measurable, and economically viable [14].
Coming up with streamlined indicators is a global challenge, once they should be aligned with the principles of sustainability. Meadows [12] says the word, “sustainability” is a value word, like all value words – justice, beauty, freedom, democracy, and so on – “they are subjective, nearly impossible to define, nevertheless possible to sense (or to sense their absence)” [12]. Hence, there are many barriers to overcome and many issues of concern prior to set a number of indicators that involve not only quantitative, but qualitative information. The main challengers are:

- **gather reliable data**: data collection should be based on reliable procedures
- **clear in value and content**: be certain which direction is good or bad, be simple, and understandable
- **feasible and timely**: reasonable cost/benefit ratio, compilable without delays and able to show trends over time
- **appropriate in scale**: not over or under information aggregated
- **democratic, participatory and tentative**: all stakeholders should participate during the whole process.
- **research/human resources**: should have an effective and competent workforce, reputable professional should go between stakeholders, as well as, research and technology should be viable and exchangeable.
- **develop communication strategies**: information must reach the target audience, and must be easy to interpret.
- **create new paradigms**: it is necessary to transcend worldview and some cultural behaviours.

In conclusion, creating streamlines indicators is one of learning process. Both, criteria and challenges, mentioned here is regard to “ideal” indicators. It is difficult to come up with indicators that really meet all the features listed above; however they are, indeed, references that should be perceived.

**CONCLUSION**

Waste has for a long time been regarded as an issue of secondary importance in the sanitation and political agenda of the country. There have been efforts in the production of more information for this area; however data, information and indicators produced are still incipient in order to measure and monitoring progress towards an integrated urban solid waste management. It is time to establish an information system, where the selected indicators would be able to attend current demands and signalises trends over the future. Streamlined indicators are tools to support human societies in their living journey throughout the 21st Century.

**REFERENCES**


