# ANALYSIS OF SUSTAINABILITY IN SOLID WASTE MANAGEMENT IN THE CITY: THE CASE OF PARIPIRANGA, BRAZIL

**ABSTRACT**

Before the Industrial Revolution production systems comprised a cycle in which the waste was produced and absorbed by the environment. With the uncontrolled growth of cities and the increase of the population was a major consequence of the increased production of waste. There was, thus, waste management that aims to manage, in an organized and consistent, both the handling and disposal of such wastes in the environment. This study aimed to develop a method of analysis of urban solid waste management in cities, and the consolidation of the method was taken as case study the issue in the municipality of Paripiranga, State of Bahia. The proposed analysis refers to the dimensions of sustainability, but also from a model SWOT analysis showing strengths, weaknesses, threats and opportunities in waste management in the municipality of Paripiranga. The methodology used was based on research relevant literature, and through field interviews with municipal and popular. The main results show that the waste management Paripiranga is far from being considered an ideal model to the point that people are uninformed and uninterested in the subject. The government only uses the landfill as a model of waste management. Public policies under Participative Master Plan should be put into practice, and several gaps related to popular participation must be completed.

**KEYWORDS**: Waste Management; Environment; SWOT Analysis; Participatory Director Planning.

# ANÁLISE DE SUSTENTABILIDADE NA GESTÃO DE RESÍDUOS SÓLIDOS NA CIDADE: O CASO DE PARIPIRANGA, BAHIA, BRASIL

**RESUMO**

Antes da Revolução Industrial os sistemas produtivos compunham um ciclo no qual os resíduos eram produzidos e absorvidos pelo meio ambiente. Com o crescimento desenfreado das cidades e o aumento considerável da população uma das principais conseqüências foi o aumento da produção de resíduos. Surgiu, assim, a gestão de resíduos que tem por objetivo administrar, de maneira organizada e coerente, tanto o manuseio como o depósito desses resíduos no meio ambiente. Este estudo teve como objetivo desenvolver um método de análise da gestão de resíduos sólidos urbanos nas cidades, e para consolidação do método tomou-se como estudo de caso a temática no município de Paripiranga, Estado da Bahia. A análise proposta remete-se às dimensões da sustentabilidade, como também a partir de um modelo de análise SWOT mostrando pontos fortes, fracos, ameaças e oportunidades na gestão de resíduos do município de Paripiranga. A metodologia utilizada foi baseada em pesquisa em bibliografia especializada, e de campo através de entrevistas com gestores municipais e com populares. Os principais resultados mostram que a gestão de resíduos de Paripiranga está longe de ser considerada um modelo ideal, ao ponto que, a população está desinformada e desinteressada no assunto. O poder público adota apenas o lixão como modelo de gestão de resíduos. As políticas públicas previstas no Plano Diretor Participativo devem ser colocadas em prática, e várias lacunas relacionadas à participação popular devem ser preenchidas.

**PALAVRAS-CHAVE**: Gestão de Resíduos; Meio ambiente; Análise SWOT; Plano Diretor Participativo.

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## INTRODUCTION

The sustainable development generated a series of arguments from 1970, and had his concept strengthened with the launching of the Brundtland Report. According to Moreira (2000, p.41), sustainable development can be defined as the way to supply the present generation´s needs without affecting or compromising the future generations. Since then, several encounters and treats were promoted, aiming to discuss and solve problems related to the environment, trying to minimize the impact of the human being´s actions, considered the great environmental transforming agent, and whose actions are directly responsible for the main climate and geographical changes in the planet.

According to Lourenço (2006, p.3), the sustainable development is a concrete objective which to be achieved depends on public and private actions that enable its expansion; within this context, sustainable dimensions and their indicators appear. To Bellen (2006, p.23), "the concept of sustainable development comes from one relatively long historical process of revaluation between the civil society and her natural environment." Being a continuous and complex process, a variety of approaches which seek for understanding how sustainability works is needed.

A diversity of concepts about sustainable development and sustainability is perceived. In summary, sustainable development is understood as actions and attitudes practiced by the human being who views the progress and development for needs satisfaction, but with a concerning sight for future generations. However, sustainability is understood as the harmonic relation between mankind and nature and the balance formed and conserved along the years by the equal evolution of its dimensions. In this context, it appears the necessity of tools creation by the public powers and the support of the private initiative for the society problems solution.

During much time the present economic development model degraded and polluted the environment, based on the abusive use of natural resources and less environmental control of pollution; the consequences are the several and present problems viewed all over the world. One of the main vectors one of the development was the rural exodus that made entire populations leave the field and go to the cities, and, therefore, causing one of the most serious problems in the present time, the residues production.

Ferreira (1999) in his work ´Novo Aurélio Século XXI` presents some concepts for ´residue`, named: remaining, what remains from any substance; leftover. Many times residues are misunderstood as they were waste: "what is swept up from houses, yards, streets are thrown away, slag, every no-useful thing thrown away". Thus, it is perceived one difference, once residues offer any use and can be reused, while waste cannot be.

Urgency to solve this matter birthed the Residues Management realized as the activity that seeks for defining manners of management and reuse for the great quantity of produced residues. According to Aguiar and Philippi Jr. (1999, p. 1918), one program on solid residues management is not closed itself, relating to several society´s segments, public organs, financial institutions,

residents association and enterprises. Its use became a current and indispensable tool to control de residues management in any municipality.

Before the Industrial Revolution the productive systems compounded a cycle in which the residues were produced and absorbed by the environment, but with the cities growing and modernization, the residues production has been increasing in such way that the environment could not absorb, thus, it appeared the residues management which gained space due to the environmental awareness and the environmental management dissemination concerning of transforming mankind-nature in a harmonic and integrated relation. This is birthed as one organization, enterprise, where there are demands and tasks which when well applied increase the enterprise asset, therefore, the importance of the residues management for the administration while science.

In this way, the present work aimed to develop one method of sustainability analysis for urban solid residues management, and the residues management in the municipality of Paripiranga, State of Bahia, Brazil, was the experiment taken.

## THEORICAL REVISION

### Sustainability and Sustainable Development

The major part of the thoughts about sustainability, or another subject, is begun from good questions formulation about the essence of human problems. The Science itself evolved and brought development, formulating and answering questions. Which questions could stimulate this dialogue initiative? What does sustainability mean? What are Sustainable Societies and how they are built? How can I contribute for my own place turning into a Sustainable Society?

Those doubts began to come up during the Stockholm Conference (1972) and arguments in the Roman Club, where the need to birth public politics conception which could bring solutions for the environmental problems birthed from the relation society-environment was noticed, when the first debates about sustainable development were appearing. It was perceived the impossible finite growth from one finite resources base, being notorious the advices on environmental deterioration (AZEVEDO, 2002, p. 10).

The subject gained strength and popularity since the United Nations Conference for the Environment and Development (RIO 92) taken in Brazil. It was highlighted the *Wold Commission on Environment and Development* (Brundtland Report) thought which the concept of sustainable development was spread, as also the ethical concern about the current generations related to the future ones was revealed. To Jacobi (2007, p.41) this report introduced a roll of actions to be developed by the States and also targets to be achieved at the international level, where the agents are the several multilateral institutions. The main actions refer to agreeing for emission limits, biodiversity protection where the developed countries are more specified.

There are several perceptions about the sustainability concept. Around the world, several politics based on these concepts have been planned, managed and measured with the aim to turn sustainability into a reality.

The word sustainability births different concepts for different types of people, politicians, students, agricultures, community members, where each person has one way to see as sustainability influences her life; this results from the different needs that each individual presents, considering that the ways to perceive the nature and constructed relations are varied (AZEVEDO, 2002).

To Armani (2003, apud CARVALHO et al., 2007, p.76):

> Sustainability must be comprehended under two complementary focuses, the systemic and the managing one; the systemic aims the political insertion, credibility and the organizations social base strength. While the managing one focus on the management challenges and the conditions of organizations efficiency.

Besides the concept of sustainability, another opposing to it named unsustainability was also created, what to Ferreira (2005) means the bio-geo-ecological processes acceleration due to the growing consumer human speed, that is, the great consumption destroys one ecosystem balance being necessary to avoid the natural resources shortage and depletion.

From different perceptions about the concept of sustainability different kinds of sustainability dimensions were appearing. Azevedo (2002) affirms that the main dimensions are: economic, social, environmental, ethical, cultural, temporal and spatial. To Consalter (2008, p.58), the main dimensions are: sociocultural, technical agronomical, ecological and economic. While Caporal and Costabeber (2003) affirm that within the agro ecological view the principal dimensions perceived are: ecological, social, economic, cultural, political and ethical. While, Deponti and Almeida (2002, p. 64) presents the economic, social, cultural and environmental as sustainability dimensions.

In summary, social, economic, cultural, spatial, political and ecological dimensions are perceived as the main ones (Figure 02).
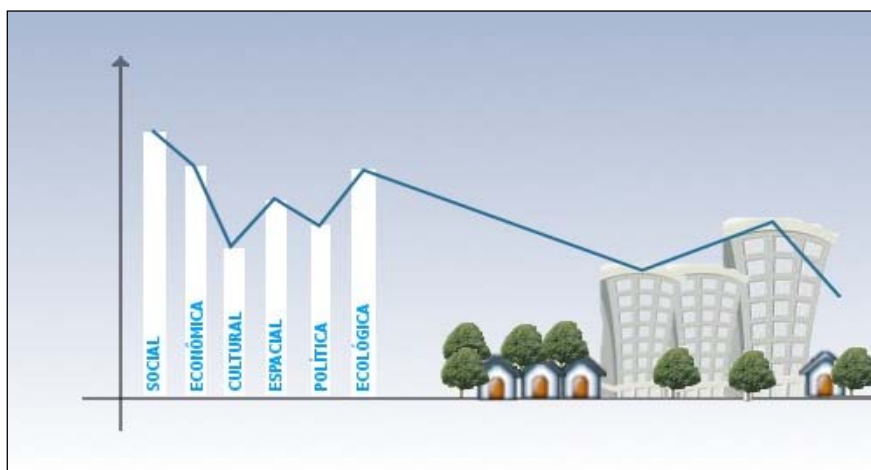


**Figure 02:** Importance of the Sustainability indicators. **Source:** SOUTO, 2009.

The social dimension seeks to reduce the levels of social exclusion and the communities´ quality life loss. Caporal and Costabeber (2004, apud CONSALTER, 2008, p. 59) affirm:

> The social dimension represents precisely one of the basic pillars of sustainability, once the environmental preservation and natural resources conservation only become meaningful when the generated product is equally suitable and usufruted by the several segments of society.

The social dimension, thus, refers to the capacity of the system of bear the society itself, considers the educational aspects and the demographic layout of the society as indicators, among others. To (Bellen, 2006, p.37) the social perspective "emphasizes the human presence in the ecosphere and has as major concern the human´s well-being, his condition and the means used to enhance his life quality".

The economic dimension refers to the sustainable management of goods and materials aiming to create one balance between the financial inputs and outputs. According to Consalter (2008, p.67), this dimension treats about the sustainable management of the natural resources that must produce one profitability which makes attractive its continuation; resulting in the sense that the system in use produces one stable and reasonable profitability over time. According to Azevedo (2002), in the ecological economy, the economic value considers the value in use and the value in no-in use. The first refers to goods and services which are consumed currently and to resources exploitation, while the no-in use are the ones which reflect moral and ethical matters.

The cultural dimension follows the premise that the production systems must respect the cultural identity of the evolved social groups. Azevedo (2002, p. 25) highlights that in this way the rules or other systems application must really consider the local population´s cultural aspects, concerning about relative indicators linked to education, aspects linked to people´s purchasing power and living conditions. The cultural analysis is related to modernization journey without breaking the cultural identity of determined previously existing cultural concepts (BELLEN, 2006, p. 37).

The spatial dimension refers to the sustainability perception within each context, coming from local to global. The determinant points for sustainability change as also the proper meaning of the term itself. In this way, sustainability must be treated differently when distinct defined scales of observation are considered (AZEVEDO, 2002). Bellen (2006) comments that "for reaching the spatial dimension is needed to make a better distribution of the human settlements and the economic activities, one balanced rural-urban configuration to protect the biological diversity must be created".

According to Caporal and Costabeber (2003), the political dimension is concerned to participative strategies and methods capable of assuring the self-esteem rescue and the full exercise of citizenship. Also exalts the necessity of the participative and democratic processes which develop and contribute to development. This dimension, thus, represents people voice power and the relation with government, financial institutions among others society´s opinion formers.

The ecological dimension is characterized for the seeking for the minimum environmental degradation, biomes conservation and balanced ecosystems. According to Caporal and Costabeber (2003), the maintenance and recovering of the natural resources base are main aspect for reaching

the sustainability heights, considering the awareness of the need of one holistic approach and systemic focus, within the aspect of the residues management; this dimension is applicable to limit the environmental impacts caused by the residues production.

Under the ecological perspective, it is reflected the idea of amplifying the capacity of the planet on the use of the potentials found in the ecosystems while tries to keep a derisory rate of deterioration; thus, to diminish the emission of polluter substances and others which harm the environment (BELLEN, 2006, p.37).

**Solid Residues**

The population growth, the industrial development and the accelerated urbanization, all attached to the society individualist position, contribute to the misuse of the natural resources and solid waste production. Most part of these residues is given back to the environment inadequately causing soil, waters contamination and environmental, economic and social losses (MAZZER; CAVALCANTI, 2004, p.68).

One of the first definitions about types of residues uses the terms waste classified in two kinds, ´dry` waste and damp ´waste`. The dry waste is compounded of potentially recyclable materials (paper, glass, can, plastic etc.), while the damp waste is formed by the organic part of the residues for example food leftovers, fruits peels and pruning. This classification is very used in the selective collection programs due to be easily comprehended by population (BRASIL, 2005, p.115).

The *CONAMA* in its resolution 05/93 follows the concept given by the *NBR nº 10.004*, of the *Associação Brasileira de Normas Técnicas (ABNT)*, where solid residue is defined as following:

> Solid and semi-solid residues that result from communities activities: industrial, household, hospital, commercial, agricultural, services and sweeping. This definition includes sludge produced by water treatment systems, those generated inside equipment and installations of pollution control, as also determined liquids whose features make its throwing in the sewage public system or waters bodies unviable, or demand to make it technical and economic viable solutions, due to the best available technology. (*CONAMA*, 2008, p.592).

The *Conselho Nacional do Meio Ambiente* (*CONAMA*, 2008, p. 593) classifies the solid residues in four distinct groups. Group A: residues that present potential risk to public health and environment due to biological agents; Group B: residues that present potential risk to public health and environment due to their chemical characteristics; Group C: radioactive waste - radioactive materials or materials contaminated by radionuclide, from clinical analysis laboratories, nuclear medicine services and radiotherapy fit in this group; Group D: common residues are all those that do not fit in the groups described above.

Monteiro (2001, p. 25) presents some of the ways to classify the residues, where among them the potential risk to contamination, nature and provenance.

Considering the potential risks to contamination they are classified in: Class 1 or harmful: those which, due to their flammability, corrosivity, reactivity, toxicity or pathogenity, offer risks to public health through death increasing, or even provoke adverse effects to environment when inadequately handled or disposed; Class 2 or non-inert: the residues that can present characteristics of combustibility, biodegration and solubility, being able to bring risks to health or environment, not fitting in the other classes; Class3 or inert: those which due to their own characteristics, do not offer risks to health and environment, and that, when representatively sampled, according to the rule NB 10.007, and summited to one static or dynamic contact with distilled or deionized water, under ambient temperature, according to the solubilisation test according to the *NBR 10.006* rule, do not show their components dissolved under concentrations superior to the water standards of potability, according to the list nº 8 (attachment H of the *NBR 10.004*), excepting the standards of aspect, color, turgidity and taste.

Considering nature and origin Monteiro (2001, p. 26) classifies the residues in: household; commercial; public; special household; special sources residues. The household residues are produced in daily tasks in houses, apartments and other residential buildings. The commercial are those originated in commercial establishments, which characteristics depend on the activity developed; are subdivided in small and big commercial residues producers. The small producer generates until 120 liters of waste daily, while the big producer generates one volume of residues higher than that one (MONTEIRO, 2001, p. 26).

The public residues are those present in the public places, generally resulted from the nature. The public garbage is directly associated to the urban esthetical aspect, so deserves, thus, attention through the cleaning activities planning, mainly in touristic towns (MONTEIRO, 2001, p. 28).

The group of special household residues comprehends works debris, batteries, fluorescent bulbs and tires. The works debris also fit in this category, because of their big produced quantity and the importance that their recovering and recycling is assuming in the national scenery (MONTEIRO, 2001, p. 28).

The special sources residues are those that in function with their specific characteristics begin to deserve special caring in their handling, packaging, storage, transport and final disposal. Among them are highlighted: the industrial waste that is residue produced by the great industrial activities; present several diverse characteristics and can be classified in harmful, non-inert and inert, according to the *NBR 10.004*. Radioactive waste: residues that present radiation level above the permitted by the environmental standards. Waste from ports, airports and bus terminals: residues from passengers´ consumption in vehicles and airplanes; their dangerousness lies in the risk of transmission of illnesses already eradicated in Brazil; this transmission can occur through contaminated cargos, like animals, meat and plants. Agricultural waste: basically formed by packaging remnants impregnated with pesticides and chemical fertilizers used in agriculture;

residues from health services: produced in the institutions destined to preserve population health (MONTEIRO, 2001, p. 31).

## Residues Management

In Brazil, according to the article 182 of the Federal Constitution, the municipality is the responsible for the basic services like basic sanitation and residues collection.

> The urban development policy, executed by the Municipal Public Power, according to the general rules, is laid down by law, aims to ordinate the plentiful development of the urban social functions and to guarantee the inhabitants well-being (BRASIL, 1988).

According to the *Manual de Educação para o Consumo Sustentável* (BRASIL 2005, p.114), it is not more acceptable by society to see their residences being flooded due to the residues production and nothing be done. It is necessary to curb the residues generation besides to promote non-useful materials reuse and recycling to avoid that, with this, the residues integrated management appears de forma indispensable trying to improve in one general way people´s life quality.

Residues management is understood as one unit of strategies of technical, political and administrative levels, aiming mainly the public health preservation, protection and enhance of the urban life quality; in almost all Brazilian territory this kind of management is sought (MACHADO; PRATA FILHO, 1999, p. 2059).

The concept of social integrated management, seen as one possible solution for the residues management issue, is added to that previous one. According to Nunesmaia (2002, p. 124), the social integrated management is defined from the importance added to social, to the sanitarian, environmental and economic aspects, to communities´ participation and concerning each local reality. So, it is indispensable to Brazil to apply this model considering the great variety of diversity found in all territory. Zaneti and Sá (2002, p. 8) affirm that the participative dimension incorporated by the public policies for the urban solid residues sector must be understood not only as a simple seeking for population agrees about the pre-defined models, but as a consequent seeking for one true responsibility of all involved actors in the management process. This means that everybody´s participation is indispensable to make residues management process viable.

## Technics of Urban Solid Residues Management

According to Tenório (2004, p.72), the urban solid residues management is understood as one unit of normative, operational, financial and planning actions that any municipal administration must contain, respecting and following sanitarian, environmental and economic criteria to treat and dispose their residues, therefore, the urban solid residues management involve one series of

technics and stages (Table 01). Generally, the main technics are the physical, thermal and biological ones and the main stages are collection, transshipment station and disposing in landfills.

**Table 01:** Table containing technics of urban solid residues management.

| PROCESS OF TRANSFORMATION | METHODS OF TRANSFORMATION | MAIN CONVERSION INTO PRODUCTS |
|---|---|---|
| | Physical | |
| Components separation | Manual or mechanical | Individual components found in household residues |
| Volumes reduction | Methods of composting and basing | Volume of original material reduction |
| Size reduction | Methods of communition | Original components reduction |
| | Thermal | |
| Combustion | Thermal oxidation | COx, SOx, NOx, other oxidation products ashes and slags |
| Sterilisation | Microwaves | Elimination of pathogenic microorganisms |
| Pyrolysis | Destructive destilation | PHAs, oil, tar, combustible gases |
| | Biological | |
| Aerobic composting | Biological aerobic conversion | Humus composting |
| Aerobic digestion | Biological aerobic conversion | CH4, COx, humus |

The physical technic comprehends the components separation, the volume reduction and the size reduction. The separation of components occurs through manual or mechanical manners and has as main results the individual components found in the household residues; volume reduction uses methods of compaction and basing and aims to reduce the original material volume; size reduction takes methods of comminution that aim to reduce the original components size (TENÓRIO, 2004, p.173).

The thermal technic comprehends combustion, sterilization and pyrolysis. Combustion takes as method of transformation the thermal oxidation and produces carbonaceous oxides, sulphur oxides and nitrogen oxides, as well as other products from carbonaceous oxides ashes and slags. Sterilization takes microwaves and aims to eliminate pathogenic microorganisms. It is mainly used in RSS; pyrolysis takes destructive distillation and produces PHAs, oil, tar, combustible gases (TENÓRIO, 2004, p. 173).

The biological technic is formed by aerobic composting and digestion. The aerobic composting takes as method of transformation the aerobic biological conversion and produces humus composting, while the aerobic digestion uses the same method and produces methane, carbonaceous oxides and humus (TENÓRIO, 2004, p. 163).

Collection is considering by Tenório (2004) the first physical step for residues management, being made door-to-door, throughout all the main districts, following one program, previously established and communicated to local population.

In big cities, where the distance between head quarter and residues final destination is relatively long, it is necessary to use transshipment stations to storage the residues temporal so

that they will be transported to landfills or dumps. During this stage, the physical treatments of size and volume reduction can be applied (TENÓRIO, 2004, p. 175).

Landfill is a technic of disposing residues on soil which aims to minimize environmental impacts, used through engineering principles, to confine the solid residues in the smallest areas as possible and to reduce them to the smallest permitted volumes always covering them with a land layer after each conclusion (BRASIL, 2006, p. 267). The sanitarian landfill process is the most applied all over the world, and has as advantages the low cost comparing to other treatment types, the use of low cost and simple operation equipment and the implementation in low value lands. The main disadvantages are: the loss of raw materials and energy contained in residues, the devaluation of the surroundings of the landfill, the risks of contaminating the water table, the production of slurry and percolated liquid and the need of vigilance after the landfill closure. Slurry is a liquid from the solid residues (waste), particularly when disposable on soil, for example, on sanitarian landfills. It results mainly from rain waters that infiltrate and biological decomposition of the organic part of the solid residues (GUERRA et al., 2009, p. 85). Otherwise, the percolated liquid is the unit of waters infiltrating in the interior physical body of the landfill resulted of several eventual sources of infiltration.

The treatment of urban solid residues is defined by Monteiro (2001) as a series of procedures destined to reduce the quantity or the potential polluter of the solid residues, avoiding waste discharge in inadequate place or ambience as also transforming it in inert material or biologically stable. There are several manners to make this treatment, whether using sanitarian landfills as previously defined, whether controlled landfills, incineration, composting and recycling plants.

The controlled landfill is one technic of disposing the urban solid residues, without damaging or bringing risks to public health and its safeness minimizing, thus, the environmental impacts. This method takes principles of engineering to keep on confining the solid residues covering them with one layer of inert material during each working time. The controlled landfill is distinct from the sanitarian one, once collection and slurry treatment, as also draining and biogas burning are made (BAHIA, 2006, p. 46).

Incineration is a technic of eliminating residues which has been known for approximately 100 years. In the beginning, it aimed basically only to reduce residues volume to increase the industrial landfills volume, but its objective is also to eliminate toxic and danger residues, causing their combustion. Its use and installation are generally expensive in function of the need of filters and sophisticated technological implements which diminish or eliminate the air pollution (TENÓRIO, 2004, p. 188). According to the *Manual de Saneamento da FUNASA* (BRASIL, 2006, p. 266).

> Incineration is a process of oxidation under high temperature, with the burning of gases at between 1000º C and 1450ºC, within a time of until four seconds, must occur in well projected and correctly operated installations and aims to reduce its volume to 5% and its weight to the initial value of 10%.

Composting is a technic to elaborate a fermented mixture with living beings remains, very rich in humus and microorganisms that serves to enhance soil fertility, once is applied to it (GUERRA, 2009, p. 96). But, according to Monteiro (2001), is the natural process of biological decomposition of animal and vegetal organic materials, through the action of microorganisms without adding another composting, being aerobic or anaerobic. The aerobic process that is the most adequate to household residues treatment; the decomposition is made by microorganisms that only live under oxygen presence. The odors exhaled are not aggressive and the decomposition is more rapid. The anaerobic process is made by microorganisms that live without oxygen. It occurs under low temperatures, exhaling strong odors, and takes more time till the organic material is stabled.

The recycling plants present 03 stages of operation: reception, feeding and sorting. Reception is the stage where the measure of weight or volume is taken using scales or estimative calculation and the storage is made using silos or adequate deposits. Feeding is the process through which the loading in the production line is made by machinery. Sorting is the flow dosage in sorting lines and the processes of separation of each kind of recycling material.

Tenório (2004, p.201) quotes that "under citizen´s view, recycling has been the only alternative for residues problem", but, the recycling programs must be well planned so that an eventual failure does not bring one sense of frustration in population what would waste one great form of eliminating residues; it must be implanted the selective collection as residues collection instrument, so that the process will be put in practice.

The selective collection is the process taken to easy the recycling, once it refers to the capacity of separating products according to its origin and type, for them to be reused or appropriately eliminated. For this, thus, it is necessary a whole campaign for environmental education to clear population about the selective collection practicing importance. Basically, there are three technics or strategies of separation and selective collection: separation made by the source waste generator (pavement collection programs), Volunteer Delivery Points (VDPs), followed by processing in recycling plants, and plants to separate and recycle the mixture solid residue (Tenório, 2004, p. 202).

The source waste generator type involves the separation of the recyclable materials in individual components. It is done by the producer as also by the pavement collectors. It is important to make clear for the society that they sort material while recyclable or non-recyclable, mainly considering the organic waste sorting made by the producer.

The Volunteer Delivery Points (VDPs) are strategic places in towns, where the material separated by the generator must be delivered, being their managers responsible for defining waste types and how they will be collected and disposed; this offers as main advantage the low operational cost comparing to the source waste generator strategy (TENÓRIO, 2004, p. 204).

The plants for separating and recycling the mixture solid residue do not offer separation between the recyclable or not recyclable residues. The mixture residue is transported to one

processing center where they are sorted and can be recycled through automatized methods (TENÓRIO, 2004, p. 204).

## METHODOLOGY

The study object comprehends the diagnosis with the elaboration of one model of sustainability analysis which will be the base for other academic works as also other analysis of residues management. The study is divided into two moments, the primary and the secondary one. The primary object begins with the sample choice that represents the municipality of Paripiranga in Bahia State; after this, the collection and data analysis are made, being divided into bibliographical and field research. The second object evokes the analysis construction that will compound the model. In this way, one SWOT analysis and one sustainability dimensions analysis which evaluated the residues management in the municipality of Paripiranga were taken.

### Characterization of Intentional Non-Probabilistic Sample

The municipality of Paripiranga is located in the semi-arid Northeast II of Bahia, limiting to the East and South with the State of Sergipe, to the West by Adustina and to the North by Coronel João Sá. The municipal area is 436.6 km2, access from Salvador, is carried out by highways BR-324, BR-116, BR-BR-410, 110 and BR-220 on a total distance of 364 km. It has a population of 28,347 people IBGE (2007). The city has a bank branch, a lottery, a postal Agency, interurban transport companies, bus station, a TV repeater station, radio station. Is inserted in the polygon of drought, showing a mega thermal type climate semi-arid and dry sub humid, with average annual temperature of 23.2° C, average rainfall in the year 930 mm and the rainy season from May to July (VIEIRA, 2005).

Relief, carved in metamorphic rocks of the Group trick-barrels and churches of crystalline, corresponds to trays, River Plains, valleys, isolated hills and cut by saws, which drains the water catchment areas of the rivers Vaza-barris and Real. Soil type eutrophic, Saccharum, Cambisols and *luvissolo planossolo solódico* eutrophic support native vegetation characterized by contact *caatinga*. (VARGAS, 2005).

### Data Collection and Analysis

The data collection, that is the research stage where the instruments application and the selected technics is initiated was taken, to effectuate the work objective (MARCONI; LAKATOS 2005).

The bibliographical research was made based on various scientific articles published in several magazines, as also handbooks for residues management of the State of Bahia, FUNASA

and federal government, as well as several books that discuss residues management, sustainability analysis, its indicators and dimensions.

The field research was taken through procedures based on observation and non-directive interviews and questionnaires. Through that bibliographical and field information was possible to identify the study ambience basic or much apparent characteristics, drawing their sustainability dimensions, and constructing one analysis model. The SWOT analysis is characterized as being the global evaluation of strengths, weaknesses, opportunities and threats and involves the monitoring of one organization internal and external ambiences.

## RESULTS AND ARGUMENTS

### Analysis Method of the Management of Urban Solid Waste

The method built up in this work adopted precepts used in other works and sought the creation of one tangible model also reachable for the current municipality as also the municipalities which present similar realities. This method was constituted of five distinct stages, named: direct observation; interview applied to the related public; SWOT analysis conduction; one sustainability dimensions analysis conduction; and application.

In the observation stage, it was considered the authors´ point of view, what is perceived about the residues management in the municipality of Paripiranga, as also the adjacent municipalities. Observation means to apply accurately to the physical senses and any object to obtain a clear and precise knowledge (CERVO; BERVIAN; SILVA, 2007, p. 31).

In the second moment, the related publics were interviewed, and considering this study, the municipal public power and population as a whole, where the subside was prepared so that the information generated by the direct observation gained support and reinforce, easing the construction of one applicable model of solid residues management.

The SWOT analysis is the point where the results obtained from the field research are associated within this kind of analysis, so that the strengths, weaknesses, opportunities and threats are conceived. The moment the results are already birthed and conceived after the most experimental moment and the information are collected, one more accurately analysis comprehension is prepared.

The analysis of the sustainability dimensions was taken viewing to understand how the several situations related to this kind of management are comprehended, so, they are associated with several perceptions about the concept of sustainability until the society´s view is put in practice.

The application is the propositional moment, with the suggestions about the weaknesses improvement, besides the strengths maintenance, based on the sustainability dimensions analysis. In this stage, it will be possible to verify how real and applicable the obtained data is.

**Testing the Model: The Experiment**

Taking the application of the analysis method above described for the urban solid waste management in the municipality of Paripiranga, State of Bahia, it was possible to establish the SWOT analysis (Table 02) and the Sustainability Analysis of the sample.

**Table 02:** SWOT Analysis.

| STRENGTHS | OPPORTUNITIES |
|---|---|
| - Waste Collection Schedule;<br>- Participatory Director Plan containing laws turned to residues management;<br>- Debris and construction materials collection. | - Creation of Controlled Sanitarian Landfill;<br>- Creation of collectors and processors of residues cooperatives. |
| **WEAKNESSES** | **THREATS** |
| - Lack of social integrated management;<br>- Lack of recycling process;<br>- No-use of incineration process;<br>- No-use of composting process. | - Inappropriate management in the processes of collection and residues dispose;<br>- Local culture and lack of information from the major part of the population. |

*Strengths*

**Waste Collection Schedule:** it can be observed that the town is among the 297 Bahia municipalities which practice the continuing waste collection. The process is made three times a week (Monday, Wednesday and Saturday) and covers the whole municipality. The waste is collected by a dump truck and counts on with five persons´ participation (01 driver, 02 collectors that stay in the streets and 02 assemblers who store them over the dump truck).

**Participatory Director Plan:** through its director plan, previews actions turned to enhance the residues management. Creating one director plan is an obligation for municipalities with more than 20 thousand inhabitants and it is fundamental so that society learn more about her governor´s obligations, besides being a legal instrument which counts on the effective participation of great number or people. But, the participatory director plan of Paripiranga presented a rare characteristic: thus all the dissemination made by the organizers, the popular participation was small. This was proven by the research made by the population where 86% of the interviewed people affirmed that they did not took part of the audiences and the laws writing approved in that instrument.

**Regular collection of debris and construction materials:** the local prefecture uses this artifice to keep the streets always cleaned, so for this, it has a cadaster of all works. Therefore, the building permit is liberated and enables the deposit of construction materials adequately stored, according to laws defined by the municipal organic law, thus, the works that do not obey the standards have their material recollected and stored in one municipal deposit. In questionnaire

taken by population, it was asked "are people satisfied with the rule established by prefecture where all the streets are kept free of rubbish?" The major part answered that they were satisfied.

### *Weaknesses*

**Lack of integrated social management:** It evokes the municipality effective people´s participation. Their contributions within the processes refer to educational matters, as also participation in selective collection and recycling campaigns. There are no programs developed by the public power which involves population. When asked about the selective collection use, most answered that that does not exist or they did not know about that.

**Recycling:** there is not any kind of material recycling plants, what is considered a weakness due to the global reality of sustainable practices which aims the responsible maximum use, besides there is not any stage of recycling process, nor separation by source generator, nor the existence of VDPs, nor recycling and separating plants. The Mayor affirms that knows that technic and believes in its efficiency for the quantity of produced residues, but a study to evaluate the viability for creating this project in Paripiranga has never been taken.

**Incineration:** the process is more advisable for some determined residues like the health services resultant ones. Its application would avoid the health services ones to have the same destiny the others have, besides there would not have plagues and bacteria perpetuation. There is not any incinerator which would enable the process for the most dangerous residues. It could be verified that they are treated the same way other residues are, without any specific care, what offers danger due to the lack of bacteria control.

**Composting:** this process emphasizes the reuse of the organic residues potentials, that, when reverted, are used as organic fertilizers, viewing the municipality agricultural potential. The no-use of this practice is clearly one weakness that makes even more impossible the profits for local farmers that prefer the use of defensives and industrial fertilizers to the natural ones. In this point, composting could be one solution to fight the increasing cost with the agricultural productions, because the composting would be used as fertilizers concerning that great part of the interviewed people also were farmers and would like to know more about this manner of treatment.

### *Opportunities*

**Creation of controlled sanitarian landfill:** the creation of landfills which do the control and treatment of percolate waters as also of slurry is fundamental in any sanitarian landfill. In Paripiranga, the existing landfill has not this characteristic yet, but the Participatory Director Plan

already previews the recovering of this landfill working and its implantation as one controlled model. The interviewed people believe that the creation of this landfill would much improve the quality of life of Paripiranga population as a whole.

**Creation of collectors cooperatives:** considering the regional population economic needs, extremely related to agriculture, and also the great number of persons which spends most of their time without income, chasing work nozzles. In this way, more professionalized and United, they could yet increase their income contributing, thus, for their city well-being and cleanness.

*Threats*

**Inappropriate management of the processes of residues collection and disposal:** It is notorious that the processes of residues collection and disposal do not attend the standards and rules, the functionaries do not use safe materials and *EPI*, besides the landfill organization does not follow the adequate standards for the good residues management. It can be observed that the city is among the 297 municipalities of the State of Bahia which practices the continuous waste collection; the sweeping is made daily, the residues are collected three times a week, does not practices the selective collection neither uses recycling methods, it owns one sanitarian landfill which does not has controls for percolate and slurry.

**The local culture and the lack of information from the major part of the population:** Through the questionnaires applied to part of the local population, it was verified that the major part does really not understand the problematic and the importance of the residues management practice and the consequences of the bad use of the technics for society. Certainly, this is one of the biggest barriers for the recycling technics use whatever be the types of residues, once great part of the interviewed persons affirmed that do not manage to distinguish which residues are recyclable and in which group they fit in.

**Sustainability Analysis**

Following all the thematic discussed and based on questionnaires applied to population and authorities of the municipality, it can be comprehended how the local residues management is working and its relation with sustainability dimensions.

**Social Dimension:** it was verified that the Participatory Director Plan views the use of selective collection and recycling practices, but without any depth. Only the Article 32 specifies the infrastructure implementation policies directives related to the residues collection, transport and final destination. The incise 01 of the same article cites that the municipality must develop and

implement the selective collection program and the incise 03 that partnerships with the private initiative to make potential the implementation of the selective collection programs must be created. Another point observed during that research it was that the major part of the population is not aware of the need of the selective collection practices and recycling use, as also does not know exactly how to practice the separation by types.

**Economic Dimension:** it was verified that the municipality does not follow a plan which aims to reduce the costs implied in the solid waste management. The use and the no-use values which evoke the sequence of gods and services consumed and the ethical and moral matters are not being respected correctly. Few inhabitants affirm that they practice the residues collection for selling and reuse. The main collected materials are aluminum derived, cardboard boxes and PET bottles. The inhabitants who collect those materials sell them to middlemen who, periodically, appear in the town and collect them. Any study about economic viability for recycling plants construction has not been taken. The collectors, even being a small number, do not contribute financially within the process; associations and cooperatives could be created in partnership with the public power, aiming to diminish the costs of the residues treatments and even to contribute to people´s income. Another aspect is that the resources used in the processes of collection and storage of residues are entirely came from the municipality without any other private or public funds support.

**Cultural Dimension:** according the interviews, it is perceived that Paripiranga inhabitants, generally, have not developed the consciousness about the need of environmental preservation practice yet; home conditions also influence on the way people treat and keep their residues. The city periphery inhabitants and who lives in simpler and economically poorer houses are used to keep the garbage at open air without any type of treatment. The local Education sector could take part more effectively, preparing children to develop the capacity of practicing and establishing forms of minimizing the impacts caused by residues production.

**Spatial Dimension:** under the spatial dimension view, it was verified that the municipality inhabitants do not have the real understanding about the importance and the concept of sustainable development, as also, the sustainability one. It is perceived that citizens keep the idea that since they live in one interior city, yet in development, the residues management matter is not part of their reality, that is, they do not judge it important in comparison to other aspects connected to the economics and the social life way Practically the majority of persons interviewed believe that it is irrelevant that issue, so much so that when asked if they knew what the concept of sustainability was, only 30% affirmed they knew it, but as it was observed by the local authorities, there is one good awareness for that issue, because, they notice the significant city growth and the need to give a correct destination for the residues receiving the best treatment.

On example cited was that with the people number increase, mainly on weekends, when the town hosts a great number of graduation students from other municipalities, the waste collection frequency was increased from 02 to 03 days, due to the residues productions growth. Many people have perception troubles and yet are used to deposit their garbage on pavements in disorganized way, without being aware of the collection dates. "The challenge is great", alerts the Mayor; many times, people seem not to want to cooperate.

**Political Dimension:** The municipal secretary for finances reported that the public power tries to involve the local society in general subjects discussions linked to environment; lectures and free tribunes in the town council, but the population´s participation is much reduced. Few people are interested in take part of and defend their interests. It is believed that associations and cooperatives formation would help the prefecture as also the local progress and development. Concerning the existing public policies, they cited the participatory director plan which rises many of that points and tries to high the level of the population-government level.

**Ecological Dimension:** It is verified that the municipality does not take any study about the environmental impacts caused by the sanitarian landfills use, considers that the most important aspect in the choice, the houses distance and the distance of the municipality main place, as also there is not any treatment for the slurry and the percolate waters, but the incise 1º of the article 32 of the municipal director plan aims to adequate the operational conditions of the municipal sanitarian landfill, mainly considering the waste covering, the odors control and the treatment of the percolate liquids.

## FINAL CONSIDERATIONS

It can be seen that the practice on management residues in Paripiranga also needs so much to be evolved. There is a lack of planning and attention on rules, mainly when is referred to the conditions for residues collection and storage; the conditions found in the landfill are not ideal and do not correspond to the standards normatized by *CONAMA*.

Through this study, the low situational level of the relation with the sustainability dimensions, highlighting the environmental and economic dimensions. It was observed that the inhabitants did not develop yet the environmental preservation census and are not used to practice selective collection, neither make any effort to demand from the authorities significant changings for those questions. Another point is that the economic potential of residues management has not yet been discovered. Nowadays, there are several collectors´ cooperatives and associations in all country which manage an expressive profit only with residues collection and reuse.

Considering, yet, one analysis from the sustainability, it was verified that under the spatial point of view, the *paripiranguense*, in general, does not have the appropriate care with the matter of the impacts caused by the incorrect deposit of residues. They believe that for being one city of 28 thousand inhabitants, the impacts caused to it are insignificant considering the great metropolis.

Through this study, it was possible to construct one analysis model SWOT that identified the strengths, weaknesses, opportunities and threats within the residues management used in the municipality of Paripiranga. The highlighted factors refer to the apparent public power concerning with that subject, since, there is the creation of the participatory director plan with laws turned to the enhance and implantation of models between the cited forces, which help for the correct residues management

Therefore, it is necessary that the public policies exposed in the participative master plan are implemented. When these policies are told there is the reference to controlled landfill with proper treatment for odors; for percolated liquid and slurry; implantation of a model of selective collection; amplification of sweeping services and peripheral zones cleaning. Besides, it becomes essential the investment on education and the whole population awareness, because through research was perceived that persons has a deep superficial knowledge about reality and consequences that residues pollution bring to their ecosystem and local reality.

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