

Harmonious and sustainable evolution of production

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ABSTRACT

This document addresses scientific and technological developments in contrast to contemporary environmental challenges, focusing in particular on the inadequate management of plastic waste. The problem of landfills is discussed, highlighting their role in the dispersal of microplastics and environmental contamination. The aim is to raise awareness of the need to rethink the use of plastic, especially in disposable products and cosmetics, whose waste contributes significantly to marine pollution. The methodology includes a literature review of international regulations and events on sustainable development, as well as a national case study illustrating the local impacts of solid waste.

Keywords: Plastic waste, Landfills, Microplastics, Sustainable development.

INTRODUCTION

Human beings are evolutionary and yearn for it. To make himself and his environment better and better, as he satisfies. Science is changeable and, just like human beings and through them, is constantly being reinvented. It is plausible to bring that several discoveries of evolution itself have often enabled comfort and promising scientific advances originally and today are no longer seen with the same eyes. Being it due to new data and facts, which brought significant information for this perception to be changed, or simply due to obsolescence.

The world today is faced with the results of constant evolution. And one of these results is the colossal waste that has been stored globally on a worrying scale. It is already known to everyone that there is a need to intervene on this waste and reduce the generation of new ones, not to say paralysis. This is an agenda that has been debated for the last 50 years and there has still been no consensus, despite enormous pressure from environmental groups positioned worldwide. And meetings such as Stockholm, in 1972, Eco-92 or Rio-92 (Earth Summit), Rio+10, in 2002, and Rio+20, in 2012 and G20 in 2024, which bring the importance of respecting the natural water cycle to achieve water security, among other important awarenesses to be assimilated. There is much to bring and expose so that before it is irremediable, it can effectively, in addition to drawing up plans, make them come true.

Brazil is a power in plastic generation. One of the biggest current problems in terms of waste. And having as one of the largest destinations the landfills that according to WWF (World Wide Fund for Nature). Plastic in various shapes, dividing and subdividing before and after entering the landfill. This fact,

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together with the high absorption capacity of toxic components, should concern everyone. Since they can impact the environment and human health on several fronts. This waste comes from industry, homes and commerce at various levels.

Through the degradation of plastic, microplastic is obtained. Due to this breakage, it increases its permanence in the environment, making it more difficult to be collected and extracted from various surfaces due to its size, having a great ease of dispersion. Landfills were a concept created that today should be rethought, since in addition to not working as idealized, it does not match the reality where they should preserve the environment. In the context of microplastics, landfills are one of the biggest propagators, after water.

OBJECTIVE

The objective of this document is to bring arguments that help to rethink some advances, as well as plastic in several products where they are not recyclable and are simply discarded or inserted into products in reduced size, which many do not even know are composed of microplastics and then go down the drain and later into the sea, as is the case with use in cosmetics. Returning to the environment in an improper way and with consequences with a high degree of harmfulness for humanity.

METHODOLOGY

For the preparation of this document, a bibliographic review was carried out, which brings standards and laws in which disposal in landfills and has guidelines on the management of solid waste. Regulations that bring landfill categories, well monitoring and information on the estimated permanence of plastics and landfill by-products. It also highlights the various attempts to elaborate the bases of sustainable development, which resulted in several international meetings and documents prepared with an emphasis on the environment, such as: United Nations Conference on the Human Environment (Stockholm, 1972); Intergovernmental Conference on Environmental Education in Tbilisi (Russia, 1977); Thessaloniki International Conference on the Environment and Society, Education and Public Awareness for Sustainability (Greece, 1997); Second United Nations Conference on the Human Environment (Rio de Janeiro, 1992), Rio+10 (Johannesburg, South Africa in 2002), Rio+20 (Rio de Janeiro, 2012).

In addition to the bibliographic review, this document brings a national report that involves two cities directly and others indirectly involved or affected, since they are supplied by a basin that receives the waters involved in this report. They expose part of the environmental problem and the high probability of complications, where there is a place bearing the weight and consequences of a landfill, agglomerating garbage from another city. Because the one in the city in question, which was the largest open-air garbage dump in Latin America that has officially existed since 1978, had to close it in 2012 after 34 years of



unhealthiness. Redirecting garbage to a place outside its domains and that environmentally does not make sense. In view of the closure of the old reservoir, this document brings to light the environmental and humanitarian issues - before it becomes a health emergency as it once was - that a large part of the amount of waste can and should have sustainable intervention. Despite being the host of an important meeting for environmental issues for the third time, there is no strong position on the issue addressed. It's no use just hosting, you have to solve it and give it a better destination, or at least minimize the impacts of your own garbage.

DEVELOPMENT

ECO-92 and Rio-92, brought, among the documents, Agenda 21, with the objective of building sustainable societies, which integrates methods of environmental protection, social justice and economic efficiency. The 2021 report by UNEP, the UN Environment Programme, brings the document called: From Pollution to Solution (UNEA), a global analysis of marine litter and plastic pollution shows that there is a growing threat in all ecosystems from production to the sea.

According to UNEP (2021) Plastic waste, microplastics, are associated with serious health impacts, especially for women. They may include changes in human genetics, traces of microplastic have been found in breast milk (Ragusa & all, 2022). It can impair brain development and breathing rates. In contact with blood cells, it can generate a greater feeling of fatigue, since it binds to hemoglobins, reducing its oxygen-carrying capacity. In addition, experts highlight the risks associated with the development of cancer, heart disease and dementia, as well as fertility problems, among other possible health problems. The impacts of chemicals and microplastics are dangerous according to UNEP (2021).

These agents can contaminate its environment, flora and fauna, so the entire chain can be contaminated, for example, when feeding on a plant grown in this environment or watered by contaminated water, the cascade effect will start, passing from the plant to the herbivore, and from the herbivore to the carnivore or shortening, from the plant to the human being. Microplastic is an example of waste that is not

They decompose easily and preserve for a long period. Its evidence has already been found in the human body and in marine animals known as Krills, a study published in Royal Society Open Science (2023), which reported the presence of microplastics. Small pieces of plastics measuring less than 5mm, which can be of primary origin, coming from industrial, residential and transport waste, or secondary, through degradation, where larger pieces of plastic are transformed into smaller ones. Therefore, the impact caused by microplastics on the environment is very significant, as it is very easy to disperse due to their size, and they can be found in different environments (Brasil, 2019). The correct disposal of waste, and especially clinical waste, has a direct and different impact on the population, since such waste has different



categories, including some of high harm. Bringing pathological agents if disposed of inappropriately. (ANVISA, 2004).

According to the National Solid Waste Policy (SNIS, 2020), the final destination is consenting to be in landfills, as long as they obey specific procedures, in order to avoid risks of contamination, and minimize adverse environmental impacts. One of the great challenges to urban environmental management in Brazilian municipalities for a long time has been the issue of basic sanitation, great complexity emerges from this theme. Although a landfill is a structure designed to receive solid waste. The problem of landfills in the generation of microplastics occurs in storage and mostly the non-separation of them correctly. It immensely increases its subdivision, as landfills are largely responsible for the formation of secondary microplastics and the incorrect disposal of this type of waste, in an environment without proper treatment, can cause several damages, especially in an environment that has contact with liquids.

The PNRS establishes the instruments for advances in the management and management of solid waste in the national territory. The proper management of solid waste was established in article 9 of the Law, which expresses the order of priority of actions to be observed with the help of the 3Rs (Reduce, Reuse and Recycle).

Since microplastic, which is not difficult to find in a landfill, is waste. And despite having its rules, waste management has been underestimated, its high degree of environmental harmfulness is underestimated. Aqueous waste is also generated and/or collected, even more so on rainy days, which even with the sectorized containments, which should have, and over time the increase in volume, the stoning of equipment, external factors such as the geographical positioning and approximation of the sea that has the sea air (humid mist formed by droplets of seawater), which has different actions in the equipment, than the normal rain since there is the green coast nearby. And what about the liquids that are already mixed inside the landfill? Such that it comes to form the well-known leachate liquid, leachate. Today, methane gas and carbon dioxide are already marketed in landfills, which also are called biogás.

In cases, which even exist in Brazil, of sanitary landfills built on top of rainwater reservoirs, it is a danger that they should not run from pollution of the water table or an aquifer. As is the case of the landfill of Seropédica-RJ, which has under it nothing less than the piranema aquifer that is part of Itaguaí and Seropédica. This landfill, located in Seropédica, which had divergences in acceptance, with strong repudiation, from the local population and environmental agencies, who analyzed the possibilities of an inherent environmental tragedy, with the accumulation and combination of several other factors that could occur in the management of a sanitary landfill in Brazil.

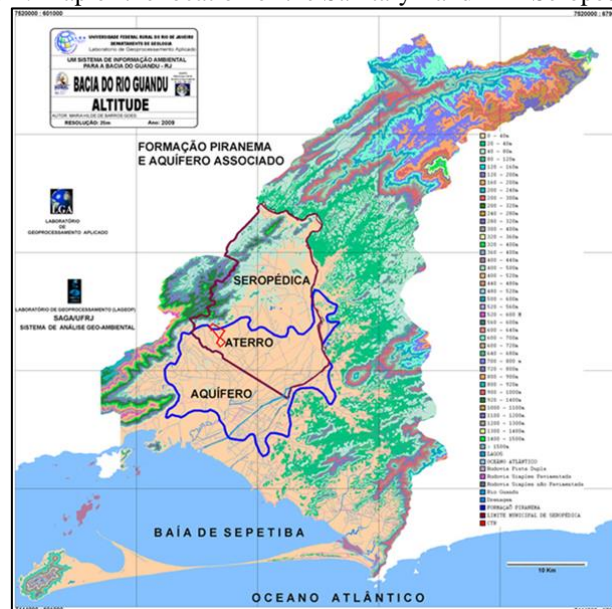
Several agencies were against the installation of a sanitary landfill on top of a drinking aquifer. In the area of the landfill in question there are two rivers and three springs. It is a region where the rivers should come down from the mountains clean, without pollutants. The aquifer is an important freshwater

reserve. In this sense, areas that can guarantee or help the survival of people - since the subject is a water resource - who depended on the supply of their wells. And now they depend exclusively on private water supplies, because the other option is to risk whether they are following the rules and whether those rules are sufficient to prevent catastrophes. And if an accident occurs, it will be not only monetary damage, but damage to health. Is it worth this risk? These issues deserve to be highlighted, such as the increase in the volume in the landfill and the managerial threats, such as in 2016 that the concessionaire was notified of a possible leak, which was later debated. These are some reflections of the advances in economic growth. The possibility of contamination of a resource that by law should be safeguarded.

Article 225. Everyone has the right to an ecologically balanced environment, a good for the common use of the people and essential to a healthy quality of life, imposing on the Government and the community the duty to defend and preserve it for present and future generations. Paragraph 1 - To ensure the effectiveness of this right, it is incumbent upon the Public Authority: (...) Paragraph 2 - Whoever exploits mineral resources is obliged to recover the degraded environment, in accordance with the technical solution required by the competent public body, in accordance with the law. Paragraph 3 - Conducts and activities considered harmful to the environment shall subject the offenders, whether individuals or legal entities, to criminal and administrative sanctions, regardless of the obligation to repair the damage caused. (Brazil, 1988)

The site of the landfill is over the Piranema aquifer, the third largest in the state of Rio de Janeiro, thus considered by the Hydrographic Basin Committee as a water reserve and emphasizing that the rivers are contributors to the Sepetiba Bay.

Figure 1: Map of the location of the Sanitary Landfill – Seropédica (RJ)



Source: LGA/UFRRJ

Several positions of environmental representatives at the time, and to this day, were sent and presented, as is the case of the Department of Geosciences of UFRRJ, who questioned the location of the



project with a view to environmental issues. And according to Lilian Quaino (2012) - before the installation of the landfill - who interviewed Rosângela Stralio, head of Administration and researcher at Embrapa, at the time, she said that the aquifer was also used, at the time, to supply artesian wells that irrigated local crops, including those of Embrapa itself. Also according to the report to Globo through Lilian Quaino, Rosângela talks about the risk of water contamination by garbage leachate. And he brought up the aquifer protection vulnerabilities:

Unlike other aquifers that are naturally protected, such as those in São Paulo, which are deep and have the protection of rocks, ours has a water table close to the surface, and has sandy soil, with sandy rocks and several geological faults that allow communication between the water and the surface. It is an aquifer of high susceptibility. (QUAINO, L. 2012)

It is worth highlighting the attempts before, during and after the implementation of the landfill in the region. The production of daily garbage has been increasing more and more. If the garbage man does not pass, just observe how the garbage exposed on the street is produced. Gramacho had saturation studies and it still took years for its closure and it was an emergency form that they bid and chose the new place. Despite the studies and estimates of these residuals. Now redirected to Seropédica. This waste is not even from your region. And when it is saturated, what will they do in an emergency?

It is because of these and other types of possibilities that policies that aim to solve with more than palliative measures are important. And at the same time, implement corrective actions to minimize impacts and increase the volume of waste produced.

Habits of society that are in the context of basic sanitation can contribute to the reduction and management of waste. The National Solid Waste Policy (SNIS, 2020) and Law No. 12,305/2010 and Decree No. 10,936/2022, guide the management of solid waste. Some of these residues in contact with aqueous substance are diluted more easily, increasing the contaminated area. According to Montagner et al. (2021), when reaching water bodies, some waste contributes to the formation of microplastics. The PNRS (2010) The proper management of solid waste was established in article 9 of the Law. According to ABNT NBR13896-1997, the criteria of the standard seek, among other factors, to establish adequate protection and brings: "Standard establishes the minimum conditions required for the design, implementation and operation of landfills of non-hazardous waste, in order to adequately protect the surface and underground water collections nearby, as well as the operators of these facilities and neighboring populations". (ABNT, 1997, p.1)

There are the norms. It is necessary to inspect or expand inspection, in places where it exists, since such behaviors are not yet inherent to the population. There is the disposal of hospital material, in addition to everyday items and biological items. Not only hospitals and clinics that serve humans, but also veterinary clinics and hospitals, in addition to home care.



Due to the possibility of public health risks skin and bacterial infections, Hepatitis B and C, tetanus and HIV (Uehara et al., 2019). According to RDC No. 222, of March 28, 2018 - All health service waste must be classified and separated according to its risk to health, plants and animals, risk classification 1: low individual and community risk, risk classification 2 - moderate individual risk and limited risk to the community, Risk Classification 3 – High individual risk and moderate risk to the community, Risk Classification 4 – High individual risk and high risk to the community, that is, each material must be identified according to its risk classification and placed in appropriate material as needed.

A classes of landfills: Class II (non-hazardous) and Class I (hazardous). Class I Industrial Waste Landfill; Class II Industrial Waste Landfill; Class II Household Waste Landfill; Industrial Liquid Effluent Treatment Unit; Autoclaving Health Services Waste Treatment Unit; Soil Treatment Unit Contaminated by Thermal Desorption; Class I Industrial Waste Treatment Unit by Shielding for subsequent burning in cement kilns and Class I Industrial Waste Treatment Unit by Solidification. (RIMA, 2020)

FINAL CONSIDERATIONS

The problem of landfills is soil contamination, and consequently of nearby tributaries, there are also explosions and micro explosions due to the high gaseous concentration. And the possibility of getting out of all these problems to the external environment. Which can cause damage to flora and fauna and to human beings. Something that has a high degree of harmfulness to humanity. To tackle the problem of microplastics in landfills, a comprehensive strategy needs to be adopted, starting with an analysis of plastic waste and microplastics. Before the period arrives it becomes a type of plague, it is a way that humanity may not be able to evolve to the point of remedy.

It is necessary to combat the consumption of items that are not reusable or recyclable. There is a need to reduce it little by little. This problem focuses on increasing the use of plastics in everyday life and their disposal to landfills and not recycling, in cases where there is no such possibility. In cases where the components of the polymer do not allow interference for reuse or do not have these possibilities for the most varied reasons, as is the case with microplastic. There is the alternative of prohibiting the commercialization, as is indicated for microplastic and nanoplastic, and encouraging the exchange of this material. Carry out campaigns and actions aimed at raising awareness and encouraging good practices of the 3Rs (Reduce, Reuse and Recycle). Part of this awareness should come from public agencies together with the help of private ones. It is everyone's problem. Through science, technology and innovation in an accessible and sustainable way.

With regard to society's behaviors and habits that are in the context of basic sanitation, they can contribute to the reduction and management of this waste, especially those with the potential for the formation of new microplastics. According to law No. 3325 of 1999. Which talks about environmental



education in the State of Rio de Janeiro, complementing the federal law No. 9,795/99 on environmental education. Through partnerships with public and private initiatives. Proposing projects and accompanying them. How to be sustainable keeping in mind the SDGs and doing our best to follow and improve this process little by little in schools and universities using the environmental education law.



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