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Relevant Aspects in Solid Waste Management and Public Policies Investigated on Four Continents

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ABSTRACT

When debating solid waste and its management through effective public policies, it is not possible without dissociating oneself from socioeconomic growth, intra and intergenerational equity, as well as environmental issues such as sustainability and responsibility. In view of the above, the purpose of this study is based on a narrative bibliographic study of some existing and applied public policies in Latin America and the Caribbean for the management of urban solid waste, its proven efficiency in increasing the recycling rate through these policies. The exploratory research was carried out in the database of the Elsevier bookstore, Scopus, using the Boolean operators "solid waste and management and sustainability and public policies" with year of publication filters from 2018 to 2023. Effective policies and use of appropriate techniques, although with low population adherence, they were reported in the European Union, although with low representativeness, recycling rate still below the goals committed in the COPs, in the USA, internal programs based on support legislation in each state of the federation and federal incentives make the sector promising energy reuse of bio-inputs, In Latin America and the Caribbean, renewable and clean energy programs have yielded good results with the support of international investment partners in the quest to mitigate greenhouse gases, waste management has found growth in Chile, Brazil, Colombia, Mexico, still persisting the use of landfills and low rates of selective collection, The African continent has suffered from the lack of basic sanitation, solid waste management, Asia has a good technological structure for waste treatment mainly plastics, although some techniques used bring relevant public health problems.

Keywords: Management; Responsibility; Sustainability; Growth

INTRODUCTION

When debating solid waste and its management through effective public policies, it is not possible to dissociate it from socio-economic growth, since the interdisciplinarity of the subject is relevant, nor is it possible to exclude the methodology proposed by the Kuznets environmental curve, which suggests that as a region's per capita income increases, consumption of natural resources tends to decrease, without environmental authorities having to impose their moderating power [1].

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However, point out in a recent study that income inequality substantially influences the calculation of the inverted U-shaped curve, where there is a stability and subsequent decline in environmental impact towards an N-shape, thus increasing the complexity of the decoupling between economic growth and carbon emissions in their various sources.

The necessary vision of the environmental liability that solid waste has become, its proper management through public policies based on criteria that cover availability, accessibility, due process, intra and intergenerational equity, as well as environmental issues such as sustainability and responsibility, are the subject of constant discussion and study in the search for a consensual solution [2].

However, draw attention to the paradox that exists between integrated waste management, which involves the technical components of management, including awareness campaigns, environmental education and the adoption of policies, and waste management, which involves, as cite in their study, models of techniques that are present as aids in the solid waste management process, with a view to increasing the recycling rate based on the adaptive cycle that facilitates governance through the preparation, implementation and subsequent evaluation of the results obtained. Examples of these facilitators include anaerobic digestion, the hydrothermal method, composting, biodigesters and pyrolysis reactors in all their stages.

In Ecuador, Villalba Ferreira, et al. presented a study on the alternative of inter-municipal cooperation in shared waste management as a way of increasing the recycling rate, reducing operating costs, seeking sustainability, better performance and strengthening the circular economy for municipal solid waste [3].

The fact is that, whether through integrated waste management, using a technological contribution, seeking to integrate systems, municipalities as a smaller unit of state has a challenging point on their shoulders, which is the increasing numbers in the generation of municipal solid waste.

Nimita Jebaranjitham, et al. report a percentage of 2.01 billion tons/year with the prospect of 2.2 billion tons by 2025, thus reinforcing the need for global equity in the recycling rate, breaking the levels currently established of 16% for developing countries and 50% for developed countries.

Pragmatic visions present themselves, because in certain global regions mentioned above, there is a perception of the serious problem of landfill, including a consensus on its extinction in order to increase the recycling rate, even though this decision could lead to inappropriate disposal in uncontrolled landfills, while in Uganda, the search is on to open up new spaces in order to mitigate social bottlenecks and reduce environmental pollution, clearly proving that both the population density and the socio-economic situation of each region directly affect the recycling rate [4].

Solid waste management at its current level is a challenge to be mitigated, with a view to energy security based on sustainability and the socio-economic and cultural aspects involved in the process. Seeking and implementing the idea of a circular economy requires a change in philosophy from "take-make-discard" to a "reduce recycle-repair-reuse-share" approach. The waste hierarchy index tool presented by, which has been used in a relevant way to improve the circular economy, although it does not demonstrate its effectiveness through indicators, with the recycling rate being the most widely used indicator according to Wuttke.

In light of the above, the purpose of this study is based on a narrative bibliographical study of some existing public policies applied in Latin America and the Caribbean for urban solid waste management, their proven efficiency in increasing the recycling rate through these policies, their scope of management and their effective replicability, also raising a comparison with other regions on the planet. Global databases were accessed with the premise of providing a theoretical basis for current studies on solid waste management based on relevant and effective public policies [5].

LITERATURE REVIEW

Exploratory research carried out in the Elsevier bookstore database, Scopus, using the Boolean operators "solid waste and management and sustainability and public policies" with the publication year filters from 2018 to 2023, environmental science, where with the Ryan application articles were discarded that only contained the words, but not the context sought [6].

The influence of geopolitics on waste management, sustainability and the formulation of public policies in Latin America and the Caribbean

Today, geopolitics is a very important factor in the internal conduct of countries and in the formulation of policies that meet the common needs of citizens, albeit with a close eye on external trade partners.

Ugarteche, et al. quote, in their study mention the influential role of China in Latin America and the Caribbean, with a strong investor in reformulating the current energy matrix of the aforementioned countries towards a clean, sustainable and economically viable energy matrix. As the authors also point out, Latin America's importance in terms of natural resources compared to other countries, such as forests, water resources, minerals and untapped fuel reserves, cannot be overlooked. Although draw attention to the worsening social inequality eminent in the energy matrix transition [7].

But what is the real importance of the region, the concentration of 15% of the planet's population, the largest number of eco-regions on the planet, the largest concentration of fresh water in the world, added to the possibility of exploiting rare and precious metals, pharmaceutical inputs, inputs for the cosmetics line, oil deposits are points that make Latin America and the

Caribbean a geopolitical space to be colonized again mainly due to its political fragility observed in some parts.

In Buenos Aires, their study showed that the city disposed of 54% of its waste in landfills, transferring the rest to regions on the outskirts of the city, point out that Colombia has invested a lot in discussion, information and environmental education and in shared waste management processes; in Brazil, a partner association has each year demonstrated the growth of solid waste liabilities, partners in waste recycling, and although with law 12. 305 of 2010, which deals with waste recovery, there are still many challenges to be overcome. The size of the country, coupled with constant political changes, is detrimental to the implementation of management programs that encompass solid waste, water resources and the maintenance of biodiversity [8].

In a recent publication, they show that in 313 Chilean cities, through the Malmquist-Luenberger indicator, in the period between 2015-2019, eco-productivity and eco-efficiency achieved significant improvements in solid waste management, promotion of circular economy and reduction of landfill deposits; while, show us Paraguay's deficiency in the face of population expansion in waste management and the use of uncontrolled landfills as a maintenance strategy [9].

In a randomized study Ferro, et al., present in Uruguay a relevant aspect for the control and sustainable management of waste, which is food waste caused by behavioral, personal, educational and socioeconomic factors, raising the discussion about behavior in relation to consumption and waste disposal, its environmental impacts and operating costs for sustainable management and bottlenecks in the implementation of the circular economy.

In view of the above, it is of the utmost importance that managers and governance in Latin America and the Caribbean implement profound socio-economic and cultural changes with a view to understanding their potential and assuming their role in the sustainable construction of the region [10].

North America's challenges in shaping the low-carbon economy

In this review of extended producer responsibility and corporate social responsibility, which give life to governance without government, Hickle provides a relevant insight. These are structural points that show us a structural possibility in the sorting, segregation, collection and recycling of solid waste, as these approaches distribute along the life chain of products from "cradle to grave" the responsibility for recovery by producers, specific companies for collection supervised by departments with responsibility for this.

Recently, drew attention to the difficulty encountered by North Americans in dealing with the new and relevant environmental liability of plastic waste in the form of microplastics. The costs of implementing and recycling this material in the US are much higher than in the EU. The authors show substantial growth from 530 Mt in 2015 to 715 Mt in 2023. They also report important bottlenecks such as problems in sorting plastics, difficulties in re-extruding products and a lack of public action and commitment in the process, thus reducing the American recycling rate, putting it well below the target [11].

Furthering the discussion, Badgett, et al present a summary of US techniques and policies involving federal, state and municipal control bodies for non-metallic organic solid waste, where landfills that receive more than 50 t/year of these materials are subject to state regulation; in parallel, a food hierarchy program was implemented in 2014, aimed at mitigating waste, acting to reduce waste at source, feeding people in need and feeding animals. The authors also present the strengthening and encouragement of composting in American states, where the www.biocycle.net program, among other things, provides quality and traceability seals on bio-inputs from composting, and the government exempts these producers from taxes [12].

These are effective and targeted actions aimed at reducing greenhouse gases in landfills, making better use of this device, and professionalizing the sector due to the growing supply of vegetable biomass made up of food waste.

The European Union and tackling solid waste management

The European union has been present in the global discussions on sustainability, in the study of electronic waste, in the formulation and implementation of a circular economy with a legal framework compatible with the size of the discussion through directives 2018/851 on the implementation of the circular economy and waste control, 2008/98 on the protection of human health through waste control and management, where extended producer responsibility, together with corporate social responsibility, shape bold planning aimed at improving the environmental performance indicator.

In the meantime, Ríos and Picazo-Tadeo present their study, in which bottlenecks and real problems with the management of Municipal Solid Waste (MSW) exist and require the European Union to adopt more effective attitudes, since MSW brings with it a reduction in biodiversity, an increase in Greenhouse Gases (GHGs), and increased pressure on terrestrial and aquatic ecosystems. To this end, in their study, the authors discuss that in 2017, the European Union had a per capita generation of 486 kg/year, reaching the figure of 0.21 billion tons of waste. The authors also show that with the exception of Germany, Belgium, Finland and Denmark, which are at the opposite end of the spectrum, the performance of most countries is well below expectations, still using undesirable techniques such as landfill and incineration with very low recovery and reuse rates [13].

África, Asia and Oceania and sustainable waste management

From the perspective of Shi et al, the countries of the African continent have suffered a significant decline in the achievement of sustainable solid waste management. There are several nuances that interfere in the process: Open-air

disposal of waste, a high rate of use of uncontrolled landfills, low or no legislation for the waste collection sector, coupled with a low level of education and mostly countries with a per capita income of less than U$ 5.000. 000, as well as contamination of groundwater, poor basic sanitation and poor drinking water, all of which present the continent with a real problem in terms of the liabilities generated by solid waste.

The problem generated by solid waste is intrinsically related to the environment, but not only because of its impact, but also because of its direct relationship with the energy waste that arises from not reusing the waste produced, and also because of the consumption of a greater quantity of natural resources, generating a dependence on non-renewable energy sources, creating a paradox, because while some nations on the planet are moving to resolve the environmental impacts caused by the high consumption of non-degradable materials, others insist on increasing production to supply consumption, without observing human coexistence with the environment [14].

In a study published by Cobbinah, et al. they present a picture of the West African country of Ghana, where poor resource management, coupled with constant political changes, significantly interfere with the drafting of legislation in line with sustainability; there is a search and demand by the population on its leaders in all spheres to find solutions to the worsening problem of urban solid waste, partnerships for management according to the authors are even carried out but do not have the desired scope [15].

In the last 20 years, social and behavioral changes have been intense, and cities have experienced a substantial demographic explosion due to economic stability and the search for a better quality of life and security, especially in low-income countries. The convenience offered to consumers has significantly transformed the shape of the market for everyday products. The generation of waste is enormous, whether in primary or secondary packaging, all of which has a single destination: the municipal solid waste collection and disposal system.

Provide their study found that the Asian continent generated around 121 Mt of plastic waste, of which in 2016 74% was left on the continent for treatment and subsequent disposal, from this point two points arise, the first shows us that there is availability of technology, logistics and sufficient facilities to treat this waste, whether by catalytic pyrolysis, incineration, extrusion and reuse; the second point highlighted refers to the amount of greenhouse gases generated in some recovery processes, such as: Volatile Organic Compounds (VOCs) dioxins, furans, among others and their direct impact on the regional population [16].

In St. Petersburg, we see similar problems, 1.1 kg per capita per day per person generated of solid waste, amounting to 71 Mt/year, where only 10% of the waste generated is disposed of in controlled landfills and the remaining 90% in the open. Lack of public policies that meet the needs of the sustainable management sector, outdated treatment plants, but the project of the local authorities is to match its recycling rate to that of Taiwan.

In their review, Meena, et al, point out almost identical problems in India, 70 Mt/year of solid waste generated, 90% dumped in inappropriate landfills, lack of ecological awareness, high population rate, open-air waste disposal, although in 2016 the equivalent of the Indian environmental ministry adopted measures to improve sustainability conditions, through the implementation of composting, incineration, pyrolysis, recycling, biorefining and biogas techniques, mitigating its current condition of low recycling and material reuse rates, although the implementation of a circular economy is still a distant goal [17].

Du, et al. discusses existing policies in Australia aimed at increasing recycling rates. These policies include a ban on the use of plastic bags, the tracking of fog waste, household collection of chemical products, a ban on landfills, with the aim of achieving a better level of energy reuse, although the recycling rate is linked to local economic development [18].

DISCUSSION

Effective policies and the use of appropriate techniques, albeit with low population adherence, have been reported in the European Union, although with low representation, the recycling rate is still below the targets committed to in the COPs, in the USA, internal programs based on supportive legislation in each state of the federation and federal incentives make the sector of energy reuse of bio-inputs promising, although even with a policy of extended producer responsibility such as that adopted by the European Union, problems persist with the recycling of plastics and microplastics, as well as municipal solid waste [19].

In Latin America and the Caribbean, renewable and clean energy programs have yielded good results with the support of international investor partners in the quest to mitigate greenhouse gases, and basic sanitation has been a challenging quest for some countries, which still have low figures according to the World Bank, waste management has seen growth in Chile, Brazil, Colombia and Mexico, with landfills still being used and low levels of selective collection and in some countries open dumping and the lack of efficient public policies still put the implementation of a recycling-reuse-sharing program on hold.

Countries on the African continent have suffered from a lack of basic sanitation policies and sustainable management of solid urban waste, leading to various public health problems caused by vectors and contamination of rivers and water tables for the same reason. Asia has a good technological structure for treating waste, especially plastics, although some of the techniques used cause significant public health problems. In Russia, energy recovery is substantial, although some cities with higher populations suffer greatly from the high incidence of solid urban waste [20,21].

CONCLUSION

Establishing a support network for municipalities through stricter legislation aimed at reducing the use of landfills, monitoring them and applying techniques appropriate to each region in the integrated management of solid waste is a real and current need to solve a problem that is constantly getting worse.

When a public authority seeks to make decisions based on transparent, adequate and up-to-date research sources, the immediate effects are greater. Of course, at no time can we overlook the extremely important role of the end consumer, who, through reducing food waste, proper disposal and the search for products made from sustainable materials, greatly strengthens the implementation of the circular economy. It is also necessary to emphasize the importance of the figure of the waste picker, the need for greater support for this class, so that the activity becomes more professional and less alternative.

Enforcing the legal rite of extended or shared responsibility, thinking of solid waste not as waste but as a commodity is another crucial point in the quest for truly sustainable waste management.

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