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Artículos Científicos

Basura Cero. Gestión de residuos sólidos urbanos en México

Zero Waste. Urban solid waste management in Mexico

Desperdício Zero. Gestão de resíduos sólidos urbanos no México

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Resumen

La presente es una investigación documental de corte cualitativo que aborda el tema de la educación ambiental como respuesta a la problemática actual de insuficiencia en la gestión de los residuos sólidos urbanos. Se menciona el programa Basura Cero como una propuesta para reducir la generación de desechos, así como la implementación de estrategias para educar y concientizar a la población en términos ambientales acerca de este programa, el cual se puede adoptar para mejorar los hábitos de consumo. Para ello, se analiza un caso mexicano que se encuentra en búsqueda de una economía circular a través de la implementación de un programa de gestión de residuos Base Cero en la Ciudad de México, con el fin de identificar las acciones que se están llevando a cabo y los avances que se han tenido para lograr una mejor gestión de los residuos.

Palabras clave: consumo responsable, educación ambiental, residuos sólidos urbanos.



Abstract

The present work is a qualitative documental research that studies the topic of environmental education as a response to the current issue of improper solid waste management. A Zero Waste program is proposed to reduce to a minimum waste generation as well as the implementation of educational strategies to teach environmental awareness and sensibility and thus, have a positive effect on consumption habits. A Mexican case is analyzed that seeks to achieve a circular economy through the implementation of a Base Zero waste management program in Mexico City, in order to identify the actions that are being taken and the progress that has been made to have a better waste management.

Keywords: Responsible consumption, environmental education, urban solid waste.

Resumo

Trata-se de uma pesquisa documental qualitativa que aborda a questão da educação ambiental como resposta ao problema atual da gestão inadequada dos resíduos sólidos urbanos. O programa Resíduos Zero é citado como uma proposta para reduzir a geração de resíduos, bem como a implementação de estratégias de educação e conscientização da população em termos ambientais sobre esse programa, que podem ser adotadas para melhorar hábitos de consumo. Para isso, analisa-se um caso mexicano que busca uma economia circular através da implantação de um programa de gestão de resíduos Base Zero na Cidade do México, a fim de identificar as ações que estão sendo realizadas, e o progresso que foi feito para alcançar uma melhor gestão de resíduos.

Palavras-chave: consumo responsável, educação ambiental, resíduos sólidos urbanos.

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Introduction

Currently, the generation of waste and the pollution that it produces is a priority issue on the Public Agenda in Mexico and in the world due to the social and environmental repercussions it represents. There are various factors that aggravate this problem, such as the high and continuous growth in the levels of waste production, the high consumption rates and the lack of an adequate management and control system, among others (Bernache, June 1, 2009). For this reason, it is necessary to implement strategies to reduce the negative impacts that these factors produce on the environment to lessen the effects of climate change.

In response, proposals have been generated to develop new forms of consumption and production that are more efficient and friendly to the environment; One of them is the Zero Waste program, which proposes to generate strategies so that the rate of waste production is considerably reduced. It is considered that to achieve these ends it is necessary to promote a culture of responsible consumption to improve the habits of the population, through environmental education programs that impact all sectors of the population.

According to Vilches and Gil Pérez (2010), planetary emergency issues must be evaluated in a fair measure to determine the actions to be taken, having as a priority to use integral solutions that involve the different factors that intervene in it. These actions, these authors call key action themes, and are related to education for sustainability, responsible consumption, sustainable urbanization, among others.

In this sense, education plays a fundamental role in achieving informed, involved and aware citizens of the need to initiate responsible consumption citizen actions that lead to a sustainable future. While individual actions are important, collective actions are even more so. With this, Vilches and Gil Pérez (2010) refer to actions that transcend and achieve a greater social impact, such as “reduce, reuse, recycle, use technologies that respect the environment and people, contribute to education and citizen action, participate in socio-political actions for sustainability, as well as evaluate and compensate” (p. 8).

This scheme is prominent when the current times of climate change are discussed and the real understanding of the factors that generate environmental imbalances on the planet is urgent. Thus, it is essential to estimate the polluting consequences that the irrational use of natural resources used to satisfy superfluous needs that have nothing to do with the basic needs of the human being will bring with it, supported by a worrying anthropocentric position of current society (Nubia-Arias , 2016).



The planet is experiencing one of the most severe environmental crises in history, dying amid the effects generated by the atrocious looting of its resources, an issue that has the purpose of satisfying environmentally inadmissible social needs, as well as maintaining production and consumption levels. unusual, typical of the capitalist system in which economically important countries are immersed. These negative effects not only impact the environment, but also health.

In 1998, just over two decades ago, Professor Pedro Medellín already indicated with concern about the main environmental problems that afflicted the world, which continue to appear on the list of urgent attention issues. Medellín indicated from that time that the evident decontextualization of the concepts of industrialization and globalization, coupled with the technological boom of the mid-twentieth century, bring an uncontrollable amount of toxins to the environment and generate an imbalance in natural processes beyond their capacity to resilience (Medellín, 1998).

In 2013, Cruz and Ojeda acknowledge that during the last decades the increase in waste generation has been very accelerated due, in part, to technological advances that are based on the exploitation of renewable and non-renewable resources, which are found at the limit of its regenerative capacity to absorb the waste generated by human activities and consumption (Cruz and Ojeda, 2013). In 2015, the notions that painfully continue in accordance with the thesis presented by Medellín almost two decades ago were exposed. It is mentioned that the development model is increasingly dependent on consumption and, therefore, on the extraction of natural resources that are reaching a scandalous scenario of vulnerability, which endangers human life itself (Ramírez, 2015) and which is also known as risk society (Beck, 1998).

Some of the main environmental problems that afflict the world are the production of chemical substances, the generation of energy based on fossil fuels, agriculture, the direct destruction of habitat, as well as the complicated urban problems (Medellín, 1998) related to the increase demographic (Tellería, 2013), since a greater amount of resources is demanded to satisfy the needs of the growing population. In general, humanity with its actions makes the earth suffer irreparable consequences, such as the contamination of bodies of water, desertification, loss of biodiversity, the increase in the generation of waste, climate change, among others, a situation that falls directly in the deterioration of the environment.

For this reason, this document presents an analysis specifically related to the environmental deterioration generated by urban solid waste in Mexico. The Zero Waste



program is addressed as one of the possible strategies to considerably reduce waste generation, accompanied by an environmental education proposal, specifically examining the progress of the Action Plan for a circular economy in Mexico City. The General Law for the Prevention and Comprehensive Management of Waste in Mexico classifies waste as hazardous, special management and urban solid (Chamber of Deputies of the H. Congress of the Union, 2018), the latter being the object of analysis of this written.

Methodology

The methodological route was based on a deep bibliographic review to analyze the environmental problems generated by urban solid waste in Mexico. Specifically, a search was carried out for current data on the amount of waste generated in the country, as well as on existing programs in Mexico with the vision of Zero Waste.

The case of Mexico City was selected because there are government initiatives being developed to try to improve waste management processes. For this analysis, a general review of the existing literature was carried out to specify the conditions on which the programs that plan to address this phenomenon are based. Likewise, it is explained that although these tasks must be implemented and regulated by the government, it is also important to have the contribution of society and the participation of private initiative.

Results

Solid urban waste as a priority environmental issue in Mexico

In Mexico, the issue of waste has been studied for several decades due to the excessive growth that has existed in its generation. In 1993, Careaga mentioned that for that year the situation was difficult, although not crisis-ridden, but he also considered that it was an opportune moment to analyze this important topic without passion. In fact, at present there are specialists like Bernache who highlight the imminent concern about the seriousness of the current crisis caused not only by the increase in waste production, but also by the absence of corrective measures for its comprehensive management (Bernache, 2011).

The problem of waste is intrinsically related to the current form of consumption defined by “voracious patterns of acquisition of objects, goods and merchandise” (Bernache, 2011, p. 24) that quickly become a waste (Bernache, 2011; Careaga, 1993). Therefore, it is necessary to work on educational plans that promote in the consumer an awareness of the responsible acquisition of goods and services (Bernache, 2011).



Waste is one of the most serious and complicated environmental problems that governments have to face due to their accelerated growth and their heterogeneous behavior. For this reason, it is necessary that management plans consider the recovery of waste, its transformation and reuse, since in this way it can positively impact the saving of raw materials (Cruz y Ojeda, 2013).

Figures of urban solid waste in Mexico

According to article 5, section XXIX, of the General Law for the Prevention and Integral Management of Waste, a waste is that material or product that is discarded and is in a solid, semi-solid, liquid or gaseous state, which is contained in a container or deposit, and is subject to being valued, treated or taken for final disposal. Likewise, in section XXXIII of the same article, urban solid waste is defined as those with domiciliary characteristics generated in homes, establishments and those resulting from the cleaning of roads and public places (the latter provided they are not considered as another type of residue in the law) (Chamber of Deputies of the H. Congress of the Union, 2018). These are the result of the elimination of materials such as containers, packaging or packaging.

In the twentieth century, Mexico went from a rural to an urban society, a situation that brought about a change in consumption patterns; In other words, it went from a society that predominantly generates organic waste to one that produces inorganic waste, a characteristic of urban industrial societies (Secretariat for Social Development [Sedesol], 2011). This increase in waste generation is due to changes in consumption habits, demographic growth, social activities and economic-productive activities (De Valle, 2005). One aspect that must be considered lies in the socioeconomic level, since - according to Kharvel (2012) - high-income countries generate more waste per person compared to low-income countries.

Mexico is a predominantly urban country that has important cities, which during the last thirty years have concentrated the largest number of the population, being these the center of the country's economic development (Sedesol, 2011). The 2010 population census indicates that 72% of the country's population lives in 383 cities with more than 15,000 inhabitants. In fact, current projections estimate that the country's population will reach 121 million people in the next 18 years, with the main growth being in intermediate cities. Therefore, in Mexico there will be 20 cities with more than one million inhabitants in 2030, which implies complex challenges for urban, economic and social planning policy.



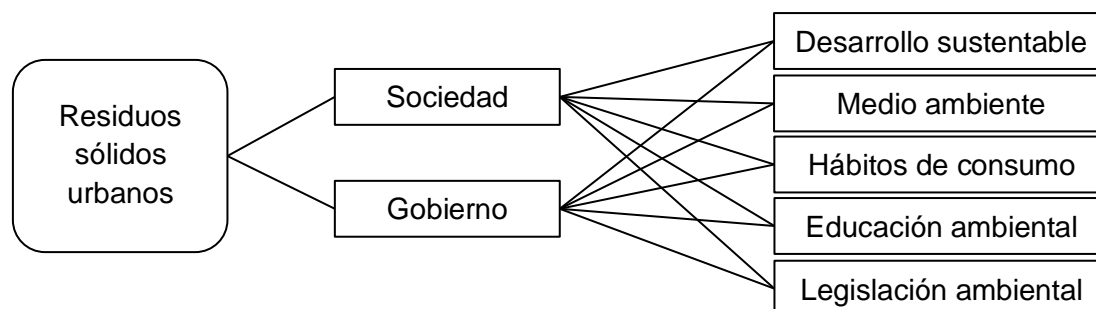
This process of growth and concentration of the population will demand goods and services to support it, such as water, energy, materials and an adequate disposal of waste dumped into water, air and soil. In this sense, it should be considered that "the inappropriate dumping of solid waste alters the quality of these three resources, as well as its impact on human health and ecosystems" (Calva-Alejo and Rojas-Caldelas, 2014, p. 60).

In sum, the management of urban solid waste is a huge challenge for Mexico. In 2010, the country generated 109,750 tons of solid waste daily, of which 64% was deposited in sanitary landfills, 9% in controlled landfills and the remaining 27% was disposed of in uncontrolled sites. The average daily per capita generation is 0.9 kg, considering rural areas with 0.4 kg and in metropolitan areas with 1.5 kg (Sedesol, 2011).

Now, despite the fact that less than a third of this waste ends up in uncontrolled sites, it also generates serious environmental problems that harm the health and safety of the inhabitants in nearby areas (Sedesol, 2011) due to its high volume. and, on occasions, due to non-compliance with the standards and norms on environmental protection (Carrasco and Rodríguez, 2015).

For all the above, it is essential that the relationship between the actors involved in said problem is also analyzed, that is, who regulates it, who generates it, who discards it, who reuses it and who studies it, as shown in the Figure 1.

Figura 1. Residuos sólidos urbanos y su relación con los actores



Fuente: Elaboración propia

Education for a change in environmental attitude

Palmer (2003) explains that environmental education is a field characterized by a paradox, since although no one denies the importance of learning to live in a sustainable way, ultimately it is not given a priority place in the study programs of the basic and middle levels, and it is not considered urgent in the social action agenda at the state or federal level.

Environmental education is then closely associated with sustainable development, and the nature of this relationship arises as a function of the paradigmatic conception of the environment on which it is based. These different conceptions influence the pedagogical approach and the strategy that will be carried out in the classroom or in the government campaign, as shown in table 1.

Tabla 1. Una tipología de concepciones del medio ambiente en educación ambiental

Medio ambiente...	Tipo de relación	Características principales	Ejemplos de estrategias de enseñanza-aprendizaje
como naturaleza	ser apreciada, respetada, preservada	lo original, medio ambiente “puro”, la naturaleza como catedral, como un útero	<input type="checkbox"/> exhibiciones de la naturaleza <input type="checkbox"/> inmersión en la naturaleza
como recurso	ser manejado	nuestra herencia biofísica colectiva, sustento de calidad de vida	<input type="checkbox"/> campañas de 3Rs <input type="checkbox"/> auditoría de consumo de energía
como problema	ser resuelto	el medio ambiente biofísico, soporte de la vida, amenazado por la contaminación, deterioro	<input type="checkbox"/> estrategias de solución de problemas <input type="checkbox"/> caso de estudio
como lugar para vivir	conocer y aprender de él, planear, cuidar de él	nuestro ambiente cotidiano con sus componentes socioculturales, tecnológicos e históricos	<input type="checkbox"/> historia ambiental de nuestro lugar <input type="checkbox"/> proyecto de eco-jardín
como la biosfera	en la que todos vivimos, hacia el futuro	la nave espacial Tierra, objeto de conciencia planetaria, un mundo de interdependencias entre seres y cosas	<input type="checkbox"/> caso de estudio en problemas globales <input type="checkbox"/> cuentos que ilustran diferentes cosmologías
como proyecto en comunidad	en el cual participar	un entorno de vida compartido; el foco de análisis crítico social; un tema político para la comunidad	<input type="checkbox"/> investigación-acción integral (proceso participativo enfocado en la transformación) <input type="checkbox"/> foros de problemas

			del medio ambiente
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Fuente: (Sauvé, 1996, p. 13)

A sensitive environmental education process ideally includes all the complementary visions described in Table 1 integrated into a single pedagogical approach. The approach to environmental education must be chosen with careful analysis to lead to sustainable development.

For their part, Pooley and O'Connor (2000) propose not to focus environmental education programs on the acquisition of environmental knowledge as an agent of change in behavior towards the environment, since it has proven to be an inefficient strategy. The authors indicate that it is through what people feel and believe about this problem that will cause a change in their attitudes.

The implementation of the Zero Waste program brings with it an important element of environmental education to sensitize the population regarding the importance of acquiring better habits for the benefit of the environment. During the design of outreach programs, it is essential to focus — as Pooley says — on moving feelings and establishing the appropriate beliefs so that the change in citizens' attitudes is palpable.

Therefore, it is necessary to address the theory of planned behavior, which maintains that people act according to their intentions and perceptions of control over behavior, while intentions are influenced by attitudes towards behavior, subjective norms and perceptions of behavior control (Ajzen, 2001; Ajzen and Madden, 1986). These principles have been applied to various issues, including the environment, so it can be indicated that the elements that intervene in people's behaviors tend to be in disagreement between attitudes and behaviors.

According to Durán, Alzate, López and Sabucedo (2007), what is essential does not lie in whether “the positive or negative feeling towards the performance of a behavior increases the probability of performing it, but rather to analyze to what extent the emotion generated by a given situation affects the perceived need to act in a concrete way” (p. 289). There is a strong relationship between environmental attitudes and behavioral intention with a broad domain of pro-environmental actions (Chan, 1996), which is why it is considered that environmental deterioration generates negative reactions in people's emotions, which brings with it sensitization and reactions positive regarding the issue and, therefore, the undertaking of actions to benefit the environment.



The environmental problems caused by urban solid waste undoubtedly demand active and positive behaviors in search of the implementation of a shared solution (Durán, Alzate & Sabucedo, 2009), with attitude towards behavior being a determining factor of intention. However, "the success of carrying out a behavior depends not only on a favorable intention but also on a sufficient level of behavioral control, with which this variable can also be directly related, like the intention, to the behavior" (Durán, Alzate y Sabucedo, 2009, p. 29).

Zero Waste Program in reducing waste

The issue of waste has become a vulnerable aspect of politics, as central governments want to achieve sustainable waste management; however, they pass this responsibility on to local governments, which use two forms mainly for their final disposal: incinerators and landfills. There is a way to see waste as an opportunity and consider solutions as part of an important climate change agenda through waste management for urban regeneration (Murray, 2002).

The Zero Waste program seeks to transform the forms of disposal, as it is based mainly on modifying the sources that originate them. In other words, it does not focus on the garbage sector, but on the original source. It approaches the problem from the paradigm of the knowledge economy and proposes a different model of environmental policy. While recycling and composting remain at the core of the strategy, Zero Waste goes further by proposing an industry redesign.

The primary objectives of the Zero Waste program respond to three environmental needs that are pressing today: a) Zero Discharge proposes a policy to reduce the toxicity of waste to zero and thus take care of the purity of water; b) Zero Atmospheric Damage seeks to reduce methane emissions from landfills to zero, and c) Zero Material Waste aims to eliminate all solid waste.

According to the Ecological and Sanitary Environmental Corporation of Colombia (Corpoecoambiental, 2012), the Zero Waste program is divided into five fundamental axes:

1. Environmental awareness: It is the most important stage, since it requires the active participation of the population. That is to say, it is necessary to influence the change of mentality regarding urban solid waste to stop thinking that due to the payment of taxes, the problem must be addressed by government entities. It is



- at this point that we precisely establish the importance of understanding waste as "waste", and not as "garbage" (that is, it is recoverable and valuable).
2. Employment promotion: Generation of labor quota produced from the creation of ecological-environmental companies in charge of collecting recyclable waste separated by citizens. With this, the citizen is involved in these tasks that facilitate the work of recycling, recovery and reuse of recoverable waste, promoting an environmental culture.
 3. Diagnosis, design, assembly and operation of integral plants: Projects destined for the treatment, recovery, recycling and use of household waste for beneficial environmental, economic and social purposes.
 4. Recovery of soils and bodies of water: Improve the quality and productivity of soils through the use of organic fertilizer produced with organic household waste, which is recovered and used for these purposes.
 5. Gradual elimination of open-air garbage dumps or landfills: This is the main foundation of the Zero Waste program. It consists of combating the environmental problems generated by the inadequate disposal of solid waste, since when it is deposited in sanitary landfills, its recovery and use is prevented.

For most people the term garbage is considered negative, as it is associated with contempt, annoyance, useless, worthless, something that must be undone. This is the beginning of the problem, since with disdain there is a lack of interest in the waste produced, without much concern about their fate. In addition to this, waste is generated with a speed that exceeds the process required for it to decompose (Corpoecoambiental, 2012).

According to the Global Alliance for Alternatives to Incineration (GAIA), the application of the Zero Waste program has the main purpose of reducing what is disposed of in landfills and incinerators. The plan includes the reduction, composting, recycling, reuse of waste, changes in consumption habits and industrial redesign (GAIA, s. F.). In this way, an attempt is made to reduce contamination levels and minimize the budget that governments allocate to the management and final disposal of waste. Bernache (June 1, 2009) puts it this way:



Its management demands considerable amounts from the budget of the city councils (...). There is no treatment of waste and effective separation programs are scarce, so that most of the garbage ends up buried in deplorable conditions and causing high levels of contamination at the site and in the region. (párr. 1).

In Mexico, in the 1990s, the following principle was proposed: "He who pollutes pays", in order to hold citizens responsible for the waste and environmental damage generated by their activities. The results of this initiative were diverse, since in some cases the logic of the principle was understood and the generation of waste was reduced, but in others it seemed to favor the increase of waste because this principle was exposed with sanction for economic purposes (Guzmán and Macías, 2011).

Finally, the important role of the government as a promoter of change in society must be considered, through projects, programs and policies that allow knowing the perceptions of the population. The government must maintain the commitment to give solidity and permanence to the proposals, regardless of administrative movements and periodically report the achievements, benefits and difficulties with which progress is being made (Robles, Gasca, Quintanilla, Guillén. And Escofet, 2010). Therefore, the general public must be involved to establish corrective measures in environmental terms through the implementation of the Zero Waste program.

Empirical case. Zero waste for a circular economy

In Mexico, more than 100,000 tons of urban solid waste are generated daily. This represents an amount close to 37 million tons per year, which are disposed of in landfills, landfills and incinerators. This situation has helped to hide the real problem, generating environmental, landscape and health damage. The waste - once discharged at final disposal sites - decomposes and emits thousands of dangerous chemical compounds that pollute the air, soil and water (Greenpeace, 2017).

For this reason, there are various environmental programs in the country's entities and municipalities whose priority is to make the population aware of the problem that urban solid waste represents, as well as the large amount of economic resources that are used for its management. They mainly propose to reduce the amount generated per citizen, reuse as much waste as possible, repair the products that can still be used and separate the waste that they wish to dispose of permanently.



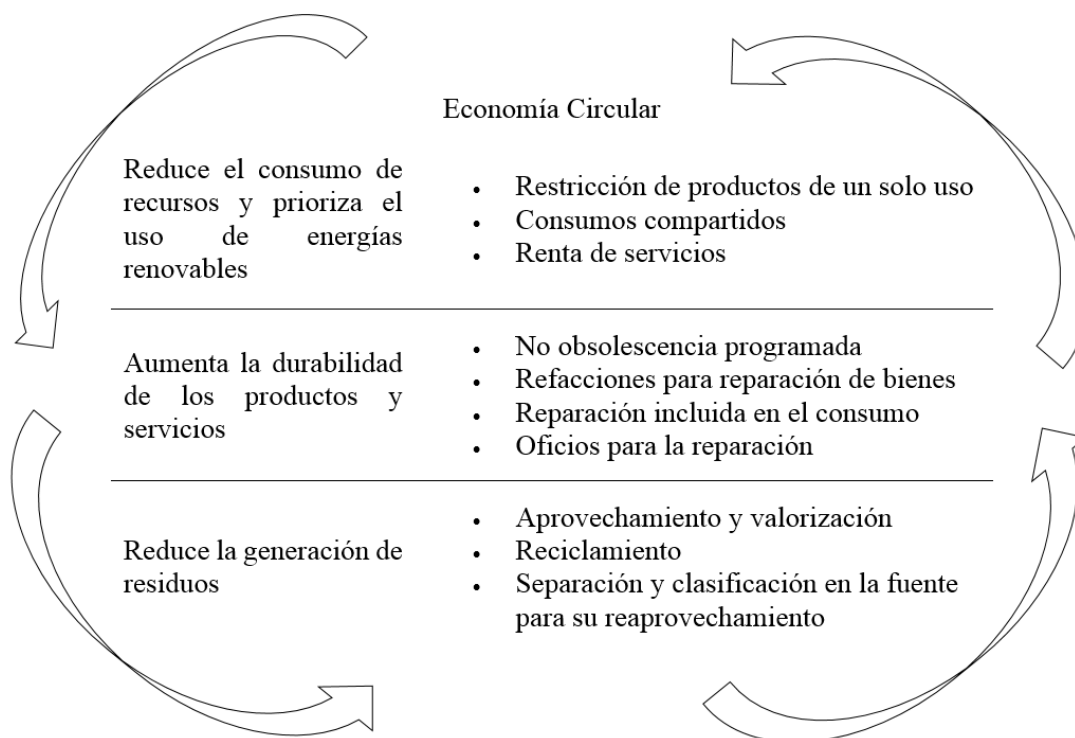
Among one of the most current and publicized programs is the announced Zero Waste. Action plan for a circular economy of Mexico City by the Ministry of the Environment [Sedema], which was announced since May 2019, and with which it is intended to achieve an innovative city of rights (Sedema , 2019a). This plan is part of the "comprehensive strategy to improve the environment in Mexico City", made up of seven central points, of which the plan belongs to point 3 of the strategy (Sheinbaum, [video] 14 de febrero de 2020).

In this program, the Ministry of the Environment "invites residents of the capital to reduce the consumption of waste, prioritize the use of renewable energies and increase their durability through the Circular Economy" (Sedema, 2019a, para. 1), such As shown in figure 2. Currently, 12,700 tons of urban solid waste are collected daily in Mexico City, of which only 4,100 tons are used and it is projected to increase this amount to 10,700 tons, through recycling activities. and composting, mainly.

Some proposed strategies are to prohibit the use of plastic bags in 2020, and in 2021 the use of cutlery, straws, glasses, lids, balloons and other highly polluting items made with plastic; This is aimed at reducing consumption and reducing the volume of waste generated.



Figura 2. Economía circular



Fuente: (Sedema, 2019b)

The objective of the government of Mexico City is to move from a linear economy to a circular economy, that is to say, that waste is no longer generated, but rather that it is fully used as raw material. In this way, we try to achieve the principle of zero waste, that is, to generate a scheme where solid waste is no longer sent to landfills. This is the primary challenge: that everything is usable in different ways so that waste returns to the economy (Sheinbaum, [video] February 14, 2020). So, it can be pointed out that circular economy and zero waste are part of the same project.

The capital government indicated that in 2005 a maximum of 200 million pesos was destined for the final disposal of solid waste in Mexico City; However, at present 2.8 billion pesos are allocated, money that is spent mainly in the transfer of waste from Mexico City to the neighboring states of Morelos and the State of Mexico. Among the advances mentioned so far are the compost plant and the use of waste by cement companies. However, these actions are still insufficient, as there is currently a large production and disposal of waste in sanitary landfills. It should be mentioned that the plan is still in place; However, during 2020 its development has been obstructed for reasons that also concern the government, and progress has not been made known until now.

In 2019, Mexico has been surrounded by new government proposals that promote progress with the implementation of the Zero Waste principles, in order to achieve an adequate management of urban solid waste. The urgency of the issue is recognized not

only in economic terms, but also in environmental terms, derived from the large amounts of tons that are reported daily throughout the country.

Final discussion: limitations, strengths and weaknesses of the study

The analysis presented in this document was of a qualitative nature and its main objective was to address the current problem of insufficiency in the management of urban solid waste. Although this is a priority issue at the global level, the central point of this work lies in analyzing the specific situation in Mexico.

Among the main strengths of the study, it is worth mentioning the importance of Zero Waste programs, especially those proposed in Mexico for the purpose of reducing the amount of waste generated daily, as well as the proposed implementation of strategies for educate the population and promote a higher level of awareness regarding the severe environmental consequences that the actions of each individual generate. The latter in order to improve consumption habits to have a positive impact on the protection of the environment.

However, despite efforts to document and publicize the environmental implications that current consumption levels generate, it must be recognized that this work requires the active participation of the country's government agencies, since without forceful actions any effort To inform will have no impact on society.

Therefore, it is considered as one of the main limitations for this study to generate positive synergy between the research work and decision-making to take real actions that allow us to feel a solid and lasting progress towards sustainability.

Conclusions

Currently, in Mexico one of the main environmental problems identified is non-compliance with current regulations in terms of urban solid waste management, this despite the efforts that exist to achieve it and the significant investment that municipal governments make to such ends. However, it is considered that the root of the problem lies in current consumption habits, which is why there is a need to promote a profound change in education and awareness of society in general.

In this issue, an important point is that the population hardly wants to be involved in solving the problem, without considering in depth what the origin is. Definitely, the



solution can only be found when the population changes its actions. In addition, you should stop thinking that the problem should only be addressed by governments, since the solution is in everyone, and it can be started with small actions.

For this reason, the initiatives that governments are undertaking with the application of the Zero Waste program are essential to reduce the generation of urban solid waste, as well as its revaluation through a second use. The implementation of the Zero Waste program in response to the problem of waste focuses on promoting a comprehensive process in its management, with the aim of reducing waste that reaches final disposal sites in sanitary landfills and incinerators and preventing waste from worsening. problem and the implications this brings to the environment.

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