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TEMPORAL ANALYSIS OF THE ENVIRONMENTAL IMPACTS GENERATED BY THE ACCUMULATION OF OPEN-AIR : GARBAGEA STUDY OF THE SURROUNDINGS OF IFTM - CAMPUS ITUIUTABA[1]

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1. Text based on the the research entitled "Analysis of Temporal Environmental Impact Generated by the Accumulation of Garbage in the Open: A Study of the Surroundings of the IFTM - Ituiutaba ".*Campus*

Abstract: The expansion of urban areas has contributed to the appearance of various negative environmental impacts. Solid waste from various anthropogenic activities is a major cause of environmental impacts. This work is a temporal analysis of the irregular disposal of waste in the area surrounding traffic circle access to the Ituiutaba campus of the IFTM (Institute andFederal of Education, Science and Technology of the the Triângulo Mineiro) and seeks to assess the environmental impacts of open with dump, the the solid waste around the campus of the Federal Institute of Education, Science and Technology of the Triângulo Mineiro (IFTM). The specific objectives were to carry out a temporal analysis of the use of the study area as open-air garbage, to characterize the environmental impacts resulting from the accumulation of aim of investigating the temporal evolution of irregular disposal open-air garbage and to identify sustainable ways treating and correctly disposing of this waste. The study was carried out through field research, with direct observations in the areastudy Based on the information collected and on-site visual analysis, it is clear that there is an urgent need to implement strategies for environmental education, recycling and the proper disposal of solid waste in the area in question. These actions should be carried out in conjunction with the population, local institutions, recycling cooperatives and the bodies responsible for managementsolid. waste Only with everyone's active participation will it be possible to tackle the challenge of waste, accumulationpreserve the environment and improve the local community's quality of life.
Keywords: Solid ; wasteDump; Final disposal.

INTRODUCTION

The accumulation of waste in the open generates serious environmental impacts, defined by CONAMA Resolution 001 of 1986 as changes in the physical, chemical or biological properties of the environment, which affect public health, safety, the well-being of the population and the quality of natural resources. This problem has intensified with the emergence of disposable products and increased consumption of industrialized products, resulting in a growing volume of solid waste.

Proper disposal of this waste is essential to prevent damage the environment and public health. Inadequate solid waste management, especially in developing countries like Brazil, is one of the main environmental challenges. Accelerated urbanization, coupled with a lack of infrastructure and resources, exacerbates the situation. In 2017, Brazil generated 78.4 million tons of solid waste, 40.9% of which was disposed of improperly, compromising environmental quality.

The pollution caused by waste open-air includes soil, water contaminationand air, as well as encouraging the proliferation of disease vectors. To mitigate these impacts, many municipalities Brazilian have adopted selective collection and recycling, programsseeking to reuse materials such as paper, plastic, glass and metal. However, most waste is still disposed of in dumps, which puts the ecological balance and public health at risk.

The research points out that responsibility for the final disposal of solid waste municipal authorities, lies with local except in the case of special. wasteIn, raising awareness public and developing appropriate waste management systems are crucial to reducing environmental. impactThe site chosen for the study was justified by its proximity to an educational institution, where the visibility of exposed waste raises aesthetic and environmental concerns, with the risk of contamination of the soil and

bodies of water. The study was carried out in the municipality of Ituiutaba, Paulolocated in the interior of the state of São.

Minas Gerais, in the southeast of the country, as shown in figure 1. Its population in 2021, according to the estimate of the Brazilian Institute of Geography and Statistics (IBGE), was 105,818 inhabitants, at an altitude of 605 m (BRASIL, 2010). The research was carried out at the open dump, approximately 5.2 km from the town's headquarters.

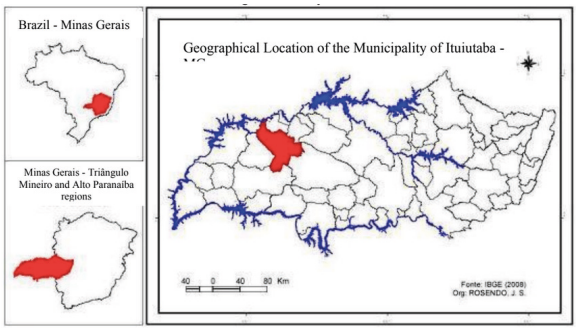

Figure 1: Study site

Source: Nascimento and De Melo, 2010

The population has a habit of throwing garbage in the open at the study site, because for a long time the area was used as adump, so the practice of throwing garbage in the open is also due to cultural habits or lack of access to adequate waste. collection and disposal servicesHowever, it is important to point out that the accumulation ofgarbage in the open has a number of negative impacts on the environment and people's health, as mentioned above.

This location was chosen because it is the access to an important institution technical and higher in the Pontal do Triângulo Mineiro region. The environmental and pollution education visual around the IFTM Ituiutaba *campus* has drawn the attention of the local population, as well as the media in the municipality and the state of Minas Gerais. The open dump has an area of approximately 139,902 m^2, almost 14 ha, as shown in figure 2.

Figure 2: Delimitation of the study.area

Source: Image taken from Google Earth, 08/2022.

The aim of this study is to investigate the temporal evolution of irregular waste disposal solid around the *campus of* the Federal Institute of Education, Science and Technology of the Triângulo Mineiro (IFTM).

The specific objectives are:

1. Carry out a temporal analysis of the use of the study area as open-air.waste

2. Characterize the environmental impacts resulting from the accumulation of garbage in the open.

3. Point out sustainable ways of treating and disposing of this waste correctly.

METHODOLOGICAL PROCEDURES

The study methodology was developed in three main stages: literature review, field research and temporal data analysis, with the a comprehensive assessment of the environmental impacts caused by the open dump.aim of providing

The literature review was based on a detailed search of scientific material published in the last 20 years, selected for their relevance to the subject of solid waste and environmental impact. Databases such as Google Scholar, CAPES Journals and were consultedScielo, using keywords such as: "Solid waste", "Dump", "Final disposal" and "Environmental impact".

In, an analysis of current legislation related to solid waste to provide a theoretical and legal basis for the study.management carried out

The field research was carried out in order to diagnose the current situation of the open dump in the study area. To this end, **direct on-site observations** were carried out, documented by means of a photographic survey, which made it possible to capture the possible visible environmental impacts, such as soil and water contamination, landscape degradation and the presence of disease vectors.

In, the flow of vehicles unloading waste at the site was monitored determine the quantity and frequency of improper disposal. The survey included identifying the types of waste disposed of and their environmental, implicationssuch as the presence of hazardous waste and waste that is difficult to decompose.

A temporal analysis of the conditions of the dump was carried out using Google images, Earth covering the period from 2006 to 2022. This analysis made it possible to observe the evolution of the accumulation of waste and the progressive. environmental impacts-Changes in vegetation cover, soil erosion and expansion of the affected area were.analyzed

The assessment of environmental impacts will be structured based on five fundamental criteria: frequency, extent, duration, direction and degree of impact. This will make it possible to measure and classify the main impacts caused by the dump, such as the contamination waterof surface and underground, carbon), the the emission of greenhouse gases (mainly methane and dioxidedegradation of local, fauna and and florarisks to public health the deterioration of soil quality in a continuation of the current research.

The research was structured to identify and diagnose the main problems facing the affected area. The factors that interfere in the processes of waste generation, accumulation and final disposal were investigated, identifying the agents responsible.

THEORETICAL BACKGROUND

The term "waste" is often used generically to describe discarded materials that are no longer immediately useful. However, in academic, literaturewaste can be seen as a category of waste that is not reused or recycled. According to Leite (2003), waste is that which no longer has any economic value and is destined for landfills or incineration.

Solid waste is a more technical and comprehensive term that refers to discarded materials that can be recycled or reused. According to Dias (2009), solid waste includes a variety of materials that, if well managed, can be reintegrated into the production cycle, promoting sustainability.

Pollution is the introduction of substances or physical agents into the environment that cause harmful effects on human health, fauna, flora and ecosystems. Odum (1988) defines pollution as an unwanted change in the environment, usually caused by human activities, which can damage the quality of life.

Contamination refers to the presence of harmful substances in a specific, but not necessarily at levels that cause significant adverse effects. According to Steffen environment*et al.* (2011), contamination is an initial state that can lead to pollution if the levels of contaminating substances increase.

Law No. 12.305 of 2010 defines integrated solid waste management as a set of actions that seek solutions for waste disposal, considering political, economicdimensions, environmental, cultural and social, with social control and sustainable. Studies developmentsuch as those by Araújo and Ribeiro (2016) highlight the environmental impacts of open, dumpsincluding water, contaminationemission of polluting, gasesimpacts on fauna, human health, erosion and odor.

Environmental education is crucial to tackling the problem of solid waste. Amorim et al. (2010) and Maroun (2006) emphasize the

need for awareness and inclusion community in waste, managementhighlighting selective collection and recycling as viable solutions. De Moura and Dos Santos Rosendo (2012) analyzed the efficiency of selective collection in Ituiutaba-MG, pointing to low community participation as a challenge.

Dumps cause air, water and soil pollution, affecting public health and the environment. Studies such as those by Costa et al. (2016) and De Souza Silva (2015) show the seriousness of these impacts and the need for solutions such as sanitary landfills, recycling and composting. Proper waste management and soil conservation are essential for the health and well-being of the community.

To improve waste management, it is necessary to invest in infrastructure, environmental education and effective public policies. Partnerships between recycling cooperatives, universities and local governments can promote awareness and the active participation of the population. The implementation of continuous and comprehensive environmental education programs is key to ensuring sustainability and efficiency in waste management.

RESULTS AND DISCUSSION

The study analyzed the evolution of the open-air dump at the traffic circle and around the IFTM Ituiutaba campus, using images from different years showing the clear evolution of increase in the at open-air dump the traffic circle and around the IFTM Ituiutaba campus, as can be seen in Figures 3 to 12. In 2006 (Figure 3), as access to the study site was via a dirt road, the area was visually reclaimed and used for agricultural purposes.

Figure 3 - Delimitation of the study area.

Source: Image taken from Google Earth, 11/2006.

In 2013 (Figure 4), signs of the site being used for garbage disposal began to appear, as there was a significant improvement in access to the IFTM - Campus Ituiutaba, with the asphalting of the access roads and, consequently, it was easier to arrive with garbage debris and to dispose of household waste waste andfrom the construction industry

Figure 4 - Delimitation the ofStudy Area

Source: Image taken from Google Earth, 08/2013.

In the period from 2016 to 2018 (Figures 5 to 7) there was an increase in waste. This period coincides with access to the IFTM - Campus Ituiutaba via Avenida Minas Gerais with the construction of the Camilo Chaves Neto Lake Complex, reducing the distance to be traveled by about three kilometers, thus impacting the increase in improper disposal in the study area.

Figure 5 - Delimitation of the Study Area
Source: Image taken from Google Earth, 04/2016

In 2017 (Figure 6), in addition to the increase in garbage, the area was also burned, a method used to reduce the volume and eliminate excess waste on, for thesitelater reuse as a garbage dump by the town's population.

Figure 6 - Delimitation of the AreaStudy
Source: Image taken from Google Earth, 09/2017

Figure 7 - Delimitation of the Study Area
Source: Image taken from Google Earth, 07/2018

On the other hand, in 2019 and 2020 (Figures 8 and 9), there was a decrease in garbage at the site, when an Ecoponto was set up in the area (2019) for the voluntary delivery of small volumes of rubble, large objects (furniture, sofas, etc.), tree pruning waste and and recyclable due to social isolation (2020), making difficult for itpeople to be on the streets and thus making it difficult to use the study area as a garbage dump.

Figure 8 - Delimitation of the Study Area
Source: Image taken from Google Earth, 06/2019

Figure 9 - Delimitation of the Study Area
Source: Image taken from Google Earth, 05/2020

In 2021 (Figure 10), the area will again oncebe used as a dump all year round.

Figure 10 - Delimitation of the Study Area
Source: Image taken from Google Earth, 07/2021

Figure 11 - Delimitation of the Study Area
Source: Image taken from Google Earth, 07/2022

In the year 2022 (Figures 11 and 12), the area occupies a strip 50 meters wide with a length of up to 700 meters, gradually expanding from the start of the traffic circle to the junction of the side road and the ring road, which has been used since 2013, when the access to the IFTM Ituiutaba Campus was paved.

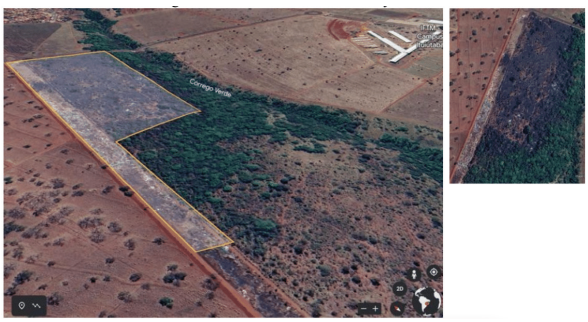

Figure 12 - Delimitation of the Study Area
Source: Image taken from Google Earth, 08/2022

During the fieldwork, it was observed that most of the solid waste disposed of in the area consists of paper, cardboard, wood, plastic, tires, metals, animal carrion and organic waste, as can be seen in Figures 13 and 14. These observations are corroborated by the work of De Souza Silva (2015), Gonçalves (2017) and Costa et al. (2016) where such waste is wrongly disposed of directly on the ground, causing pollution and soil degradation.

Figure 13 - Solid Waste Disposal
Source: Gerson C. S. Jr. (2022)

Figure 14 - Solid Waste Disposal
Source: Gerson C. S. Jr (2022)

This waste causes pollution and soil degradation, as well as visual pollution, altering seriously the local landscape. The burning of waste, a common practice to reduce the volume of garbage, generates air pollution and nuisance to the population. The environmental impacts observed include the reduction of soil biota, the carrying capacity of fauna, native biodiversity, increased erosion and soil pollution. These findings corroborate previous studies, which highlight the importance of proper solid waste management for environmental sustainability.

FINAL CONSIDERATIONS

Considering the above, there is a need to develop a project to raise public awareness in order to prevent the problem, which at first will be a training course for waste pickers, where the importance of waste and be taught, its proper disposal willas well as the importance of waste pickers in society and their role,

in addition to a public awareness campaign. The lack of adequate infrastructure to deal with the increase in waste production, combined with a lack of public awareness, can lead to serious environmental and public health consequences. The solution to this problem requires a joint effort by the government and society.

The accumulation of garbage in the open at the traffic circle and around the IFTM ring road, Ituiutaba campus, is a visible environmental problem and the population suffers as a result as does the,environment.

The hypothesis that the appearance of open-air dumps in the municipality of Ituiutaba - MG is the result of the increase in waste production in recent decades was refuted, since there are no such open-air dumps in developed countries

However, the hypothesis, that the problem of open dumps is due to a lack of awareness on the part of the population to dispose of waste correctly and that this increases the, aggravating problemthe problem in question, was confirmed because even with selective collection, landfill,, household waste collectionthis problem appears in several places on the outskirts of cities.

To continue the research at a more advanced stage, we suggest carrying out analyses of physico-chemical and microbiological the soil and water in the Córrego Verde, to see if there contaminationis soil, the the presence of erosion, processespresence of heavy metals in the water. Draw up a questionnaire and conduct interviews with the surrounding population.

Based on this analysis, solution proposals were drawn up, which included:

- Integrated waste, management planswith a focus on selective collection and recycling;

- Environmental education programs aimed at raising public awareness of the damage caused by improper disposal;

- Environmental recovery of the degraded area, including revegetation and controlled closure of the dump;

- Proposals for public policies that encourage the proper treatment of solid waste and promote more sustainable development.

These proposals were formulated on the basis of best practices observed in the literature and successful experiences in other municipalities.

SUGGESTED: IMPROVEMENTS

- Technological: Measuring Instruments- The inclusion of drones for aerial, sensors, mappingair and water quality as well as analysis of chemical compounds present in the soil, can improve the accuracy of observations and provide more robust quantitative data.

- Quantitative Methods: It is suggested that specific environmental indicators be used, such as the Water Quality Index (IQA) and the Environmental Sustainability Index, to objectively measure the level of environmental degradation.

With these improvements, the methodological procedures gain greater scientific rigor and comprehensiveness, guaranteeing a more precise and in-depth analysis of environmental impacts.

The study concludes that it is essential to address the accumulation of open-air waste in order to guarantee a balanced environment, as provided for in the Federal Constitution. Raising awareness and implementing sustainable, solutionssuch as recycling and composting, are essential to minimize the negative impacts of this practice and promote a more sustainable future for generations to come.

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