Environmental Impact Analysis as a Consequence of Cement Production in Villa María del Triunfo, Lima 2023

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Abstract

The objective of the research was to explain the environmental impact in a district of Lima as a consequence of the cement production carried out by the factory in a traditional way. The study was conducted under the interpretative paradigm, with a qualitative approach, descriptive level, basic type and phenomenological design. The informants were a diverse group to obtain responses: eight people, including municipal employees and specialists, managers and residents. A semi-structured interview guide was used as an instrument and the in-depth interview technique was applied. The criteria of scientific rigor were met transferability, credibility, dependability and auditability. The textual responses were processed with Atlas.ti, coding and interpretation were carried out using the inductive method. The results report that the factory produces cement in a traditional rustic way and emits highly harmful clinker, gases and cement dust that is spread in the air, water and soil of the district. It has been concluded that the toxic substances have a significant negative impact on the environment, polluting the air, soil and water. As a consequence of pollution, people's health has been affected, developing diseases such as skin and lung disorders.

Keywords: cement production, environmental impact, air, water and soil pollution.

1. Introduction

Cement production is a key industry for urban development and infrastructure, but it is also a major source of environmental pollution. This study focuses on evaluating the environmental impact of cement production in Villa María del Triunfo, Lima, an area that has experienced serious environmental and public health problems due to this industrial activity. We can say that worldwide cement production constitutes a risk of environmental pollution if the optimal

management of its waste is not carried out in the light of environmental preservation and care. Optimal management to avoid negative environmental impact requires sustained work on the part of the factory that produces this material used for construction and other works. According to Dulaimi and Al-Hindawy (2023) in the production of cement in the world, industrial by-products such as fly ash, slag and waste glass should be used to reduce emissions and develop a circular economy in order to eliminate, as much as possible, the negative environmental impact in the cement production area. Indeed, it is impossible to overstate the importance of having access to affordable building materials in order to provide appropriate housing for the world's growing population, particularly in developing countries. The need to find local resources as alternatives for the construction of useful but affordable housing in both rural and urban regions is growing as costs increase significantly (Osunade, 2002).

In the case of Peru, which is a developing country, the possibility of changing cement for another material for the construction of houses, roads, bridges, among others, is remote, due to the lack of associated technology and the lack of trained workers. Research in the country is scarce. In the case of the Lima district of Villa María del Triunfo, the existence of a cement factory is a threat to the environment. Despite the need to preserve the environment throughout the country, cement continues to be produced in the district in question, with the risk of increasing environmental contamination rates. The research is justified from a theoretical perspective in that the results will fill theoretical gaps regarding the environmental impact of cement production in a district of Metropolitan Lima and the role that the relevant authorities are playing to reduce air, soil and water pollution indices (Alania, 2023). Based on these results, further research can be carried out to contribute to scientific knowledge on environmental issues. From the perspective of the practical implications of research that promotes the implementation of sustainable actions in cement production, several key points should be considered. First, it is conclusive to assess the environmental effect of the material throughout its life cycle (Quaddus and Siddique, 2001). This includes the use of alternative materials and recycled waste, which can be included in new production systems without any environmental impact (Naqi and Jang, 2019). The proposed methodology involves a decomposition analysis that quantifies the effects of various factors and justifies the results with the wind protection effect (Diniz et al., 2021).

2. Methodology:

The study was conducted using an interpretive paradigm with a qualitative approach and phenomenological design. In-depth semi-structured interviews were conducted with eight key informants, including employees of the cement factory, municipal specialists and local residents. Data coding and analysis was performed using Atlas.ti software, following an inductive method. The final step was to use a phenomenon-based research design, which, according to Borda et al. (2017), begins with a problem statement and allows researchers to learn about the knowledge, skills, and emotions of older adults to better understand and explain the experiences of their informants.

Table 1. Aprioristic categorization

Categories	Subcategories
Cement production process	Clinker
	Gas emissions
	Cement dust
Environmental impact	Air pollution.
	Soil Contamination
	Water pollution

Table 2. Persons who participated in the research

2	Environmental specialists of the Municipality of VMT
2	Atocongo-VMT cement plant workers
2	Residents of the area surrounding the cement factory
1	MINSA Environmental Specialist
1	Environmental media specialist at UGEL 01

During the fieldwork, information was collected using a semi-structured interview guide through the in-depth interview technique. Using appropriate methods and tools is essential to obtain accurate and reliable information, which is essential for the research. The method that guided the work was inductive: this method speeds up data collection and transcription, as it helps the researchers to understand what the people who participated in the study think about the main topic.

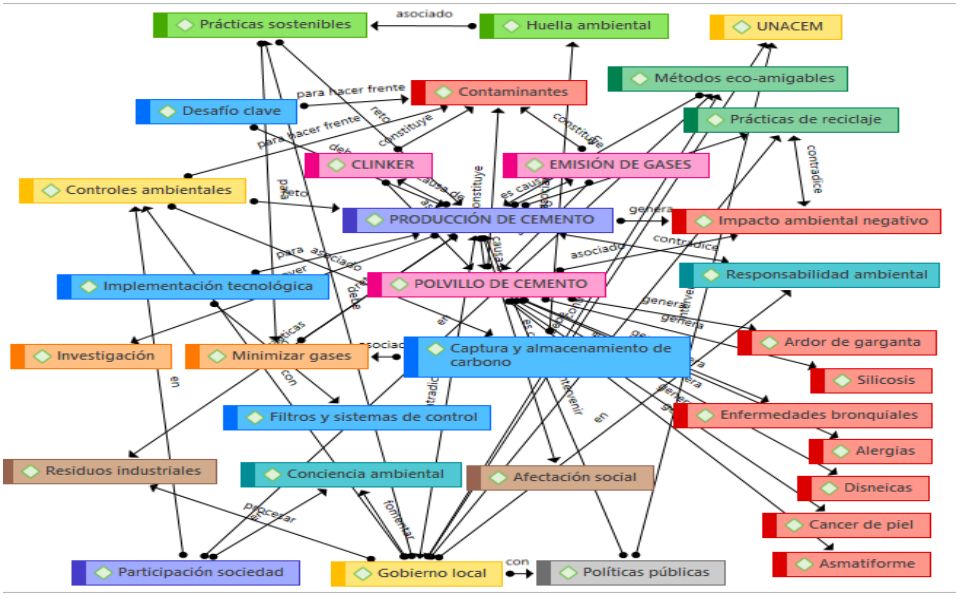
The data collection process consisted of the following steps: data collection and textualization of responses; coding (identification of codes); categorization; data loading into a qualitative analysis program such as Atlas. Ti; interpretation of results; presentation of results; discussion of results; and conclusions and recommendations were reached. By following these steps, the research can gain a deeper understanding of the research topic and generate valuable insights that can inform decision making.

Analyzing scientific research data is crucial for drawing meaningful conclusions and making informed decisions. To analyze the data, we used the qualitative software, Atlas.ti, a qualitative data analysis program that allowed us to enter codes and then interpret their meaning based on the construction of semantic networks.

3. Results and Discussion

The results of the study indicate a significant increase in respiratory and skin diseases among the local population. According to those interviewed, this is due to cement production in Villa María del Triunfo, a process that emits several pollutants, including clinker, gases, and cement dust, which also have negative effects on the area's air, water, and soil.

Cement production process



The study reveals that cement production in Villa María del Triunfo, Lima, is highly polluting, as it is seriously affecting the environment and the health of local inhabitants. Despite technological advances, the factory continues to operate in the traditional way, causing irreversible damage. Workers and nearby residents suffer from respiratory diseases, allergies, and serious problems such as skin cancer and silicosis. The cement production process generates a number of significant environmental impacts, mainly through the emission of pollutants and gases. These pollutants, together with cement dust, contribute negatively to air quality, affecting both the environment and people's health.

To mitigate these adverse effects, the adoption of sustainable practices and eco-friendly methods is crucial. The implementation of strict environmental controls and corporate environmental responsibility play a vital role in reducing these impacts. In addition, environmental awareness among stakeholders and the general public is essential to encourage more sustainable practices. Health and safety are critical issues in the context of cement production (Alania, 2023). Exposure to the pollutants generated can cause serious diseases such as silicosis, bronchial diseases, allergies, dyspneic, skin cancer and asthma. In addition, acute symptoms such as burning throat are common among workers and people close to the production plants.

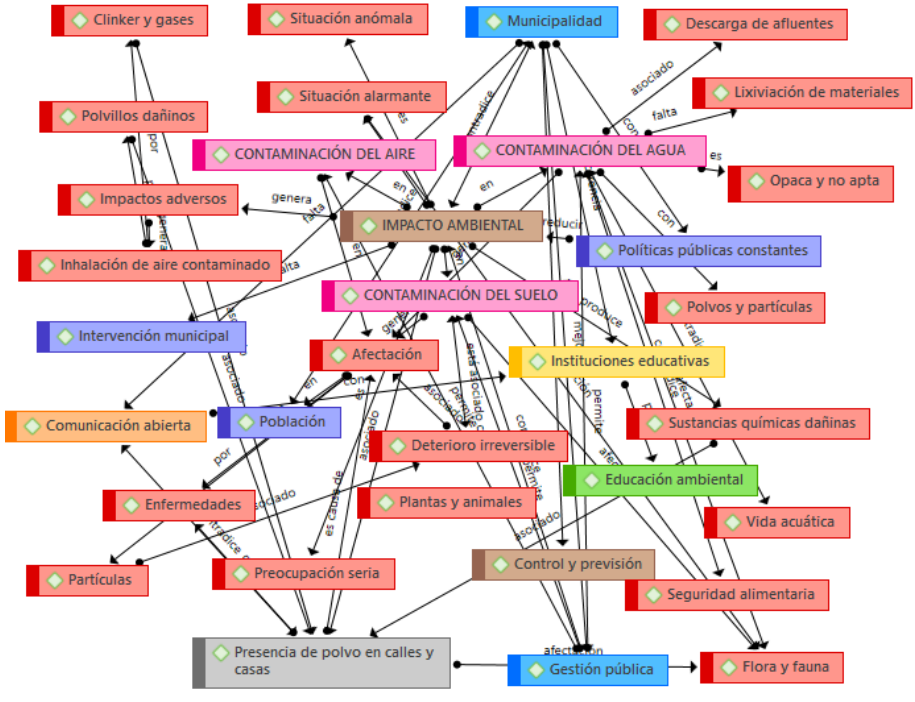
The importance of direct and sustained government involvement is consistent with the finding of Palomino et al. (2022) that government, along with other organizations and groups, must intervene to address the environmental consequences of the current regulatory vacuum in some countries around the world. Predation, lack of conservation and lack of care are taking a heavy toll around the globe. New diseases often appear, and environmental pollution has more devastating effects on people, animals and plants. Along these lines, research by Dulaimi & Al-

Hindawy (2023) reported that the organization should take interest in adopting differentiated core capabilities to improve the environment. Reducing the environmental pollution of cement producers by reducing the levels of slag dust and ash will contribute to reduce the environmental impact as soon as the waste is reused to obtain maximum environmental benefits. According to the results, liquid crystal glass replaced coarse aggregates, slag replaced part of cement, fly ash replaced part of sand to contribute to the development of environmental sustainability.

Technological advancement and innovation are key to addressing these challenges. The implementation of new technologies and the use of filters and control systems to capture and store carbon can help to significantly reduce gas emissions and pollutants. The role of public policy and local government is indispensable in establishing effective regulations to control emissions and promote environmental responsibility. Likewise, the active participation of society is crucial to demand sustainable and responsible practices from companies.

The results are in line with other studies that underline the need for sincere policy actions and environmental management approaches. The research highlights the importance of environmental awareness and active participation of all stakeholders to improve the sustainability of cement production. From a theoretical perspective, the findings reflect the importance of environmental attitudes and rational action, suggesting that both individuals and companies should adopt pro-environmental behaviors to preserve the environment.

Environmental impact in the district of Villa María del Triunfo



The following are the results for the category: environmental impact in the district of Villa María del Triunfo, Lima. The investigation found that the cement factory emits substances such as clinker, gases and cement dust, which pollute the air and harm the health of the population. These pollutants cause respiratory diseases, asthma, allergies, cardiovascular diseases and lung carcinoma. Moreover, these adverse impacts not only affect the district's residents, but also contribute to global pollution, affecting air, soil, and water quality.

The local municipality has not intervened effectively to protect the health of its citizens. According to an education sector specialist, the municipality's involvement in promoting environmental care around the mill has been minimal. Collaboration between authorities, residents, and companies is essential to address and mitigate these problems. There is a need to promote environmental monitoring, education, and the adoption of sustainable practices in cement production and other industries. Environmental education incorporated into environmental management can facilitate the participation of the population because it contributes to the acquisition of knowledge and the development of action strategies and attitudes in favor of the environment and local culture for the contribution of enriching ideas and alternatives (Delgado, 2022).

The district's soil is also being affected by cement production. Dust and particulate emissions are deposited on the soil, contaminating it and affecting its quality. These contaminants can alter the chemical composition of the soil, reduce its fertility, and affect the health of the surrounding ecosystem. In addition, the release of chemicals and industrial wastes can persist in the soil for a long time, creating risks to human health and local biodiversity.

Water pollution is another significant impact of cement production in the district. Wastewater generated during the production process contains chemicals and suspended materials that contaminate nearby water bodies. In addition, solid waste such as fly ash and slag can leach heavy metals into the water, affecting water quality and endangering human health and aquatic ecosystems. Water pollution is also aggravated by dust and particulate matter deposited in nearby bodies of water.

From a health perspective, water pollution represents a significant concern. Waste and emissions from cement production can leach into local water sources, contaminating them with harmful chemicals. Consumption of contaminated water can lead to health problems such as gastrointestinal and dermatological diseases, as well as affecting aquatic life and food safety. Addressing these sources of contamination is crucial to protect community health and ensure access to clean and safe water.

The research also highlights the need for stricter regulations and environmental controls to mitigate the impact of cement production. It is essential to implement cleaner technologies and sustainable practices in cement factories. In addition, it is recommended that solid waste management systems be strengthened, soil remediation be encouraged, and constant monitoring be carried out to prevent the accumulation of contaminants in sensitive areas. Reforestation and the use of renewable energies are also important measures to reduce the environmental footprint.

The results are consistent with previous studies that highlight the importance of effective environmental management and the adoption of sustainable practices. Research such as

Vázquez-Rowe et al. (2019) and Saldarriaga et al. (2022) highlight the need for environmental justice to ensure equal protection against environmental risks. In addition, recent studies suggest that technologies based on industrial solid waste can be a green and promising option to support cement production and mitigate environmental pollution.Teóricamente, The results reflect the importance of adopting ecological and political economy approaches to address environmental issues.

Political Ecology theory suggests that political power and unequal power dynamics play a central role in defining and managing environmental problems. Adopting a broader perspective that links the distribution of power with productive activities and ecological analysis can help develop more effective and sustainable solutions for cement production and environmental protection.

4. Conclusions

Cement production in Villa María del Triunfo generates high air pollution due to emissions of clinker, gases, and cement dust. These pollutants seriously affect the health of the population, causing respiratory diseases, asthma, allergies and cardiovascular diseases. Vázquez-Rowe et al. (2019) found that industrial emissions in Peru are among the main pollutants in the country, which coincides with the findings of this study on the need for more rigorous environmental management to protect public health.

The research reveals that the municipality of Villa María del Triunfo has not intervened effectively to protect its citizens. The active participation of local authorities is crucial to address air pollution problems, as suggested by Saldarriaga et al. (2022), who emphasize the importance of friendly and effective environmental management to guarantee the right to a healthy environment. Cement production also contaminates the soil, affecting its quality and capacity to support vegetation. Industrial waste and dust emissions are deposited on the soil, generating risks to human health and biodiversity. Aldana (2022) stresses the need to reduce the environmental impact of business activities and ensure their natural resource-friendly management.

The emission of harmful substances during cement production contaminates water, affecting the quality of rivers, lakes and subway aquifers. This contamination puts human health and aquatic ecosystems at risk (Alania, 2023). Choque-Quispe et al. (2021) report that water in urban areas of Peru is significantly contaminated due to the action of factories, highlighting the need for stricter regulations. From a medical perspective, air, soil and water contamination from cement production represents a significant risk to public health. Pollutants can cause serious health problems and affect the quality of life of residents. It is essential to implement measures to reduce these sources of pollution, as suggested by Dulaimi & Al-Hindawy (2023).

The implementation of cleaner technologies and sustainable practices in cement production is crucial to mitigate its environmental impact (Alania, 2023). The use of renewable energies, waste management systems and reforestation are some of the recommended measures. The research by Acuña-Simbaqueva et al. (2021) stresses the importance of environmental education and the adoption of a circular economic system to achieve sustainable development. It is essential to ensure that all people have access to the same level of protection against environmental risks.

Environmental justice, as mentioned in the studies of Saldarriaga et al. (2022), should be a pillar in the management of polluting industries, ensuring that there is no discrimination in the protection of health and the environment.

Political Ecology theory emphasizes the central role of political power in environmental management. Corporations must adopt greater social and environmental responsibility, as suggested by Bryant (1998). It is crucial to link the distribution of power with productive activities and ecological analysis to develop more sustainable and effective solutions.

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