

Brief Review of the Environmental Conditions of the Industrial Zone of El Salto, Jalisco: A Scientific Dissemination Approach

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Abstract—Industrial pollution in the El Salto Industrial Zone, Jalisco, represents an environmental and public health problem that requires a comprehensive approach. This document justifies the need to implement environmental management strategies based on scientific evidence, considering the impact of pollution on the health of the population and the local ecosystem. The main objective is to analyze the environmental risks generated by industrial activity in the area, identify their effects on the health of the population and propose mitigation strategies through public policies and environmental regulations. The aim is to strengthen supervision of compliance with current legislation, improve environmental monitoring mechanisms and encourage citizen participation in the surveillance of industries. The scope of the document includes the evaluation of the pollution of the Santiago River, the quality of the air and soil, as well as the relationship between exposure to pollutants and the incidence of diseases. Proposals for intervention are put forward that involve the Secretariat of Environment and Territorial Development (SEMADET), the industrial sector and civil society. This multidisciplinary analysis integrates knowledge from medicine, biostatistics and public policy, enabling a data-driven approach to decision-making and promoting sustainable industrial development.

Keywords—Environmental conditions, industry, pollutants.

Geographical Explanation of the Industry

The El Salto Industrial Zone is located in the municipality of El Salto, Jalisco, within the Guadalajara Metropolitan Area. It extends along the industrial corridor that includes the municipalities of El Salto, Juanacatlán and part of Tlajomulco de Zúñiga. This area is strategic due to its proximity to the city of Guadalajara, the Miguel Hidalgo y Costilla International Airport and the main communication routes that connect with the rest of the country (Government of Jalisco, 2021).

Main industries present

El Salto is home to a diverse set of industries, with a predominance of the chemical, metallurgical, textile, automotive and food sectors. Some of the companies established in the region include solvent and paint production factories, metalworking, bottling and auto parts assembly plants, many of which generate hazardous waste and polluting emissions (SEMARNAT, 2020).

Within this industrial corridor there are highly polluting companies, which has led to numerous socio-environmental conflicts due to the discharge of toxic

substances into the Santiago River, one of the most polluted in Mexico (Greenpeace, 2019).

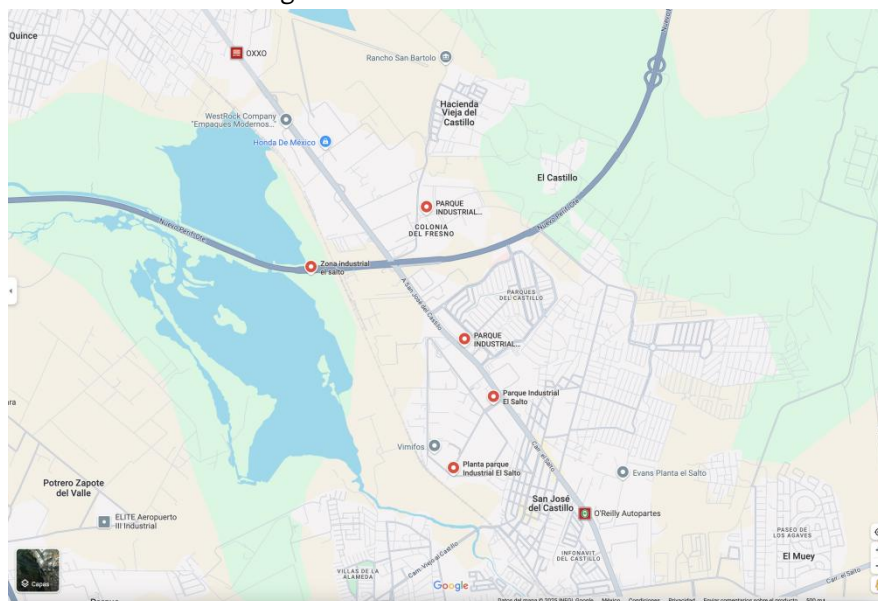


Illustration 1Geographic distribution of the Industrial Zone of El Salto, Jalisco (Google Maps , 2025)

History of environmental impacts and socio-environmental conflicts

The El Salto industrial zone has been a focus of environmental concern for several decades. One of the most serious problems is the pollution of the Santiago River, which has received industrial discharges without adequate treatment, affecting water quality and the health of the surrounding communities (Lezama et al., 2019). Studies have reported high levels of heavy metals, volatile organic compounds and other toxic substances in the water, which has been linked to health problems such as respiratory diseases and cancer in the local population (Pérez-Pacheco et al., 2021).

In 2008, the case of Miguel Ángel López Rocha, a child who died after coming into contact with arsenic-contaminated water from the Santiago River, brought to light the environmental crisis in the region and led the Jalisco State Commission on Human Rights to demand urgent sanitation measures (CEDHJ, 2009). However, despite some government efforts, the contamination persists and continues to generate conflicts between the community, industries and environmental authorities.

In addition to the impact on water bodies, air quality in the area has also been a cause for concern due to the emission of volatile organic compounds and suspended particles from industrial activity, which contributes to poor air quality in the region (INECC, 2022).

In response to these problems, the Secretariat of Environment and Territorial Development (SEMADET) of Jalisco has implemented environmental monitoring programs and stricter regulatory measures for industries in the area, although challenges still persist in the effective application of environmental regulations (SEMADET, 2021).

Chemical contaminants from industry

Identification of environmental risks

The El Salto Industrial Zone, Jalisco, presents multiple environmental risks derived from industrial activity, the lack of adequate waste control and the contamination of natural resources. The main environmental risks in the region are identified below.

Pollution	Description
Water	One of the most critical environmental problems in El Salto is the pollution of the Santiago River, which receives discharges of industrial and urban wastewater without adequate treatment. According to studies by SEMARNAT (2020), the river contains high concentrations of heavy metals

	<p>such as arsenic, lead, cadmium and mercury, as well as persistent organic compounds from chemical and metallurgical industries.</p> <p>Water pollution represents a significant risk to public health, as exposure to heavy metals has been linked to kidney disease, neurological disease, and cancer (Pérez-Pacheco et al., 2021). In addition, leachates from poorly managed industrial waste contribute to the degradation of groundwater, affecting access to drinking water in the region (Lezama et al., 2019).</p>
Air	<p>Industries in El Salto generate atmospheric emissions of volatile organic compounds (VOCs), suspended particulate matter, and greenhouse gases such as carbon dioxide (CO₂), nitrogen oxides (NO_x), and sulfur dioxide (SO₂) (INECC, 2022). These emissions come from combustion processes in metallurgical, chemical, and manufacturing factories, contributing to the deterioration of air quality and the increase in respiratory diseases in the surrounding population (SEMADET, 2021).</p> <p>A study by the National Institute of Ecology and Climate Change (INECC, 2022) indicates that the levels of PM_{2.5} and PM₁₀ particles in the industrial zone of El Salto exceed the limits established by the Mexican Official Standard NOM-025-SSA1-2014, which represents a risk factor for chronic lung diseases, such as asthma and chronic obstructive pulmonary disease (COPD).</p>
Floor	<p>Improper management of industrial waste has led to the accumulation of hazardous substances in the soil, affecting its quality and fertility. Soils contaminated with hydrocarbons, solvents and heavy metals have been identified in the vicinity of industrial plants, which represents a risk for agriculture and local biodiversity (Greenpeace, 2019).</p> <p>The Mexican Official Standard NOM-138-SEMARNAT/SSA1-2012 establishes the permissible limits of contaminants in soils for industrial activities, however, monitoring and remediation of contaminated sites in El Salto have been insufficient (SEMARNAT, 2020). This contamination can also affect nearby bodies of water due to the drag of contaminants by stormwater runoff.</p>

Table 1 Description of the type of contaminant by natural agent (Own elaboration, 2025)

Risks to the community

Risk of industrial explosions and fires

The storage and handling of flammable and toxic substances in various industries in El Salto increases the risk of explosions and fires. Chemical and petrochemical industries in the area operate with hazardous materials such as solvents, hydrocarbons and volatile reagents that, if handled improperly, can generate large-scale incidents (SEMADET, 2021). Historically, explosions have occurred in factories in the region due to leaks of flammable substances, resulting in structural damage and health problems for workers and nearby residents (Lezama et al., 2019). According to **NOM-028-STPS-2012**, industries that handle hazardous materials must implement safety and emergency response plans to mitigate these risks; however, the lack of regulatory compliance in some companies continues to be a recurring problem (SEMARNAT, 2020).

Risk Impact Guide according to SEMARNAT

Generalities

The El Salto Industrial Zone, Jalisco, represents a focus of environmental pollution due to the activity of various chemical, metallurgical, automotive and manufacturing industries. To assess the environmental impact generated by these industries, it is necessary to analyze their effects on ecosystems, human health and natural resources in the region. The environmental impact assessment (EIA) allows to identify, predict and mitigate the negative effects of industrial activities, in compliance with the **General Law on Ecological Balance and Environmental Protection (LGEEPA)** and the **Mexican Official Standard NOM-162-SEMARNAT-2012** on criteria for the preparation of environmental impact statements (SEMARNAT, 2020).

Impact on water bodies

The Santiago River has been classified as one of the most polluted bodies of water in Mexico due to the presence of heavy metals, organic matter, and hazardous chemicals discharged by industries established in El Salto. A study by Pérez-Pacheco et al. (2021) found that 70% of water samples from the Santiago River exceed the

permissible limits for arsenic, mercury, and lead according to NOM-001-SEMARNAT-2021, which represents a risk to aquatic biodiversity and human health.

Water pollution has severely impacted aquatic fauna and flora. High levels of toxicity have been recorded in fish and other aquatic organisms, affecting the food chain and ecological balance of the river (Greenpeace, 2019). In addition, the consumption of contaminated water by nearby communities has been linked to gastrointestinal, renal and neurological diseases (Lezama et al., 2019).

Impact on air quality

Industrial emissions in El Salto contribute to air pollution with PM₁₀ and PM_{2.5} particles, volatile organic compounds (VOCs), and toxic gases such as sulfur dioxide (SO₂) and nitrogen oxides (NO_x) (INECC, 2022). Monitoring carried out by the Secretariat of Environment and Territorial Development (SEMADET, 2021) revealed that PM_{2.5} levels in the industrial zone exceed the limits established in NOM-025-SSA1-2014 by 80%, which increases the risk of respiratory and cardiovascular diseases in the population.

The impact of air pollution is reflected in the increase in cases of asthma, bronchitis and chronic obstructive pulmonary disease (COPD) in nearby communities (Pérez-Pacheco et al., 2021). In addition, the dispersion of atmospheric pollutants affects vegetation and contributes to soil acidification, which compromises agricultural production in the region (Lezama et al., 2019).

Impact on soil and terrestrial ecosystems

The soil in the El Salto industrial zone has been affected by the improper disposal of hazardous waste and spills of toxic substances. Studies have detected high concentrations of hydrocarbons, solvents and heavy metals in the soil, which alters its fertility and generates adverse effects on local biodiversity (Greenpeace, 2019).

Soil degradation directly affects the flora and fauna of the region, causing a decrease in native species and alterations in the ecosystem. According to NOM-138-SEMARNAT/SSA1-2012, contaminated sites must undergo environmental remediation processes, however, restoration measures in the area have been insufficient (SEMARNAT, 2020).

Impact on public health

The inhabitants of El Salto have been affected by industrial pollution, with a significant increase in diseases

associated with exposure to pollutants. Epidemiological research has reported a high rate of kidney failure, cancer and respiratory diseases in the population due to water, air and soil pollution (Lezama et al., 2019).

The National Institute of Public Health (INSP, 2022) identified that prolonged exposure to heavy metals in drinking water has increased the incidence of kidney failure by 40% compared to other regions of the state of Jalisco. In addition, a high prevalence of skin and gastrointestinal diseases has been documented in communities near the Santiago River (Pérez-Pacheco et al., 2021).

Compliance with environmental regulations

Despite the existence of environmental regulations such as NOM-001-SEMARNAT-2021, NOM-025-SSA1-2014 and LGEEPA, compliance with these regulations in the El Salto industrial zone has been poor. The lack of inspection and enforcement of sanctions by the authorities has allowed several industries to continue operating without adequate waste treatment systems (SEMARNAT, 2020).

The Management Program to Improve Air Quality in Jalisco 2021-2027 points out the need to strengthen environmental supervision and apply stricter sanctions to companies that fail to comply with regulations (SEMADET, 2021). The implementation of cleaner technologies and continuous monitoring of pollution are urgent actions to reduce the environmental impact in the region.

Prevention, Mitigation Measures and Environmental Management Strategies

Pollution in the El Salto Industrial Zone, Jalisco, has generated severe environmental impacts on water, air, soil and public health. Faced with this problem, it is essential to implement prevention and mitigation measures, as well as environmental management strategies, aimed at reducing the negative effects of industrial activities and ensuring regulatory compliance. These actions must be based on sustainability principles and on the SEMARNAT Environmental Risk Management Framework (SEMARNAT, 2020).

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Reducing water pollution

To mitigate the pollution of the Santiago River, it is essential to implement adequate treatment of industrial wastewater. It is recommended that companies adopt advanced filtration and bioremediation systems, in line with the standards of NOM-001-SEMARNAT-2021. In addition, the installation of wastewater treatment plants at the regional level would contribute to reducing the discharge of heavy metals and toxic substances (Pérez-Pacheco et al., 2021).

Authorities must strengthen inspection and surveillance of industrial discharges, applying stricter sanctions to companies that fail to comply with permissible limits on pollutants. The participation of civil society and environmental organizations in community reporting and monitoring is key to strengthening transparency and regulatory compliance (Greenpeace, 2019).

Control of air polluting emissions

Air quality in El Salto has been affected by the emission of PM_{2.5} particles and toxic compounds. To mitigate this impact, industries need to adopt cleaner technologies, such as particle filters, catalysts and efficient combustion processes, in accordance with NOM-085-SEMARNAT-2011 on emissions from fixed sources (INECC, 2022).

Furthermore, reforestation and the creation of vegetation barriers around industrial areas can help reduce the dispersion of atmospheric pollutants and improve air quality. These actions must be complemented by continuous monitoring programs, led by the Secretariat of Environment and Territorial Development (SEMADET), to assess the evolution of pollution and design appropriate mitigation strategies (SEMADET, 2021).

Soil remediation and protection

To address soil contamination, it is necessary to implement bioremediation and chemical stabilization processes, based on the guidelines of NOM-138-SEMARNAT/SSA1-2012 on contaminated soils. In addition, safe management protocols for hazardous waste must be established and the infrastructure for the

containment of industrial waste must be improved (SEMARNAT, 2020).

Companies should develop environmental restoration plans, incorporating the use of innovative technologies such as phytoremediation (using plants to absorb pollutants) and the application of microorganisms for the degradation of toxic substances. These strategies will contribute to the recovery of damaged ecosystems and the prevention of new negative impacts (Lezama et al., 2019).

Corporate environmental management strategies

Industries in El Salto must adopt environmental management systems based on the ISO 14001 standard, in order to establish audit protocols, waste reduction and efficiency in the use of resources. In addition, it is advisable to adopt the Cleaner Production Principle (PML) promoted by the UN, which seeks to minimize the environmental impact from the product design phase and production processes (Pérez-Pacheco et al., 2021).

A key factor in environmental management is corporate social responsibility (CSR). Industries must commit to developing reforestation, water sanitation and environmental education programs for the community. The creation of environmental funds for ecological restoration is an effective strategy to offset the damage generated by industrial activity (INECC, 2022).

Community participation and regulatory strengthening

Environmental management in El Salto must involve the community in decision-making. The creation of citizen environmental councils, in collaboration with authorities and companies, will allow for greater oversight and transparency in the application of environmental policies.

From the government level, it is necessary to strengthen the application of the General Law on Ecological Balance and Environmental Protection (LGEEPA) through strict supervision of polluting industries and the imposition of more severe sanctions in case of non-compliance (SEMARNAT, 2020).

The development of ecological land use plans will allow for the delimitation of buffer zones and restrict the installation of highly polluting industries in areas of high environmental risk. Likewise, investment in real-time environmental monitoring technologies will contribute to a rapid response to extreme pollution events (SEMADET, 2021).

Conclusions

The environmental problems in the El Salto Industrial Zone, Jalisco, demonstrate the urgent need to implement comprehensive environmental mitigation and management strategies that involve both society and the government and industrial sectors. The pollution of the Santiago River, soil degradation and poor air quality are a reflection of an industrial development model that has prioritized economic growth over environmental sustainability and public health. Given this scenario, it is essential to strengthen local public policies and ensure their compliance through effective monitoring mechanisms.

One of the key elements in solving this crisis is the active participation of civil society. Citizen pressure has proven to be a determining factor in the application of stricter environmental regulations and in the demand for sanctions for those companies that fail to comply with the legislation. The creation of environmental citizen councils and the promotion of environmental education are fundamental tools for the community to become a key player in monitoring and reporting polluting activities.

At the government level, a more rigorous approach is needed in the application of the General Law on Ecological Balance and Environmental Protection (LGEEPA), in addition to strengthening the Secretariat of Environment and Territorial Development (SEMADET) as a supervisory body. The allocation of resources for real-time environmental monitoring and the promotion of incentives for companies that adopt clean technologies are essential steps to reduce the environmental impact of industry in the region.

The challenge lies not only in the implementation of rules and regulations, but in building a development model that balances industrial growth with respect for the environment and the health of the population. The link between society, industry and government is the only way to achieve a structural change that guarantees a more sustainable future for El Salto and other regions with similar problems in Mexico.

CONCLUSIONS

Since our formation as a multidisciplinary team, our suggested contribution lies in the evaluation of the impact of industrial pollution on the health of the population of El Salto, Jalisco. Respiratory,

dermatological and gastrointestinal diseases associated with exposure to contaminants in water, air and soil require rigorous epidemiological analysis. My knowledge of pathophysiology and environmental health allows me to identify the main conditions derived from pollution and propose prevention and medical care strategies focused on vulnerable populations, such as children and the elderly. In addition, the promotion of health education campaigns would help raise awareness in the community about the associated risks and encourage habits that reduce exposure to contaminants.

From our training in public health, complementary medicines and medicine, we can contribute to the quantitative analysis of the environmental impact on public health through epidemiological studies and statistical models. The application of methodologies such as time series, logistic regression and multivariate analysis would allow us to evaluate the relationship between pollution and the increase in the incidence of diseases in the region. This evidence is essential for the formulation of data-based public policies, ensuring that government decisions are based on scientific information and not only on economic or political interests.

Furthermore, from a public policy perspective, I can contribute to the design and implementation of environmental management and public health programs, proposing stricter regulations for the industry and promoting incentives for companies that adopt clean technologies. Collaboration with institutions such as the Ministry of Environment and Territorial Development (SEMADET) and the Ministry of Health would allow for the design of comprehensive strategies for environmental prevention, monitoring and remediation.

REFERENCES

- [1] Jalisco State Commission on Human Rights (CEDHJ). (2009). *Recommendation 1/2009: Case of contamination of the Santiago River*. <https://www.cedhj.org.mx>
- [2] Government of Jalisco. (2021). *Environmental diagnosis of the metropolitan area of Guadalajara*. <https://www.jalisco.gob.mx>
- [3] Greenpeace. (2019). *Toxic rivers: The pollution of the Santiago River in Jalisco*. <https://www.greenpeace.org/mexico>

- [4] National Institute of Ecology and Climate Change (INECC). (2022). *Air quality assessment in industrial areas of Mexico*. <https://www.gob.mx/inecc>
- [5] Lezama, J., Arellano, M., & Pérez, L. (2019). *Environmental impact and social conflicts in El Salto, Jalisco*. *Journal of Environmental Studies*, 12(3), 45-62.
- [6] Pérez-Pacheco, I., Gómez, A., & Vargas, C. (2021). *Water pollution and public health in communities near El Salto, Jalisco*. *Health and Environment*, 18(1), 78-92.
- [7] Ministry of Environment and Natural Resources (SEMARNAT). (2020). *Report on environmental quality in industrial zones in Mexico*. <https://www.semarnat.gob.mx>
- [8] Secretariat of Environment and Territorial Development (SEMADET). (2021). *Environmental management program for the El Salto Industrial Zone*. <https://semadet.jalisco.gob.mx>
- [9] Greenpeace. (2019). *Toxic rivers: The pollution of the Santiago River in Jalisco*. <https://www.greenpeace.org/mexico>
- [10] National Institute of Ecology and Climate Change (INECC). (2022). *Air quality assessment in industrial areas of Mexico*. <https://www.gob.mx/inecc>
- [11] National Institute of Public Health (INSP). (2022). *Impact of environmental pollution on the health of communities in El Salto, Jalisco*. <https://www.insp.mx>