Environmental externalities associated with the expansion of industrial facilities in the Bajío region of Guanajuato, driven by nearshoring.[1]

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Abstract

This study aims to examine the negative environmental externalities generated by industrial parks and warehouses in the Bajío region of Guanajuato, Mexico, resulting from their expansion driven by nearshoring. The methodology employed includes a review of theoretical approaches regarding globalization, nearshoring, and environmental externalities; data collection on industrial parks and facilities; and the application of a direct valuation method for environmental externalities. This method utilizes data on land-use changes, soil degradation, overexploitation of water resources, water pollution, and hazardous waste generation. The analysis indicates that the industrial dynamism driven by nearshoring has altered the natural environment of the region's population, affecting their well-being and resulting in a loss of positive environmental externalities. It is observed that the current economic growth model—characterized by a prevailing economic rationality and a focus on industrial development and process relocation—fails to prevent environmental degradation or avoid generating negative environmental externalities for local populations, even with technological advancements; in other words, it does not contribute to sustainable development.

Introduction

There is no doubt that industrial development forms the foundation of economies worldwide; its production logic is driven by the pursuit of economic returns, a dynamic that has fostered the excessive use of natural resources and the degradation of ecosystems. Indeed, industrial activities have caused adverse environmental impacts—such as air pollution, deforestation, soil degradation, surface and groundwater contamination, natural habitat alteration, and

[1] This work is part of the PAPIIT Project IN304725, "Expansion of financialized industrial and logistics properties in urban peripheries: analysis of their territorial impact and environmental externalities," conducted with the support of the General Directorate for Academic Personnel Affairs (DGAPA) of UNAM. This work is currently in the process of publication

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climate change. These negative environmental impacts resulting from industrial activities manifest as negative environmental externalities—that is, adverse effects on individuals who do not directly participate in these economic activities and receive no compensation for the consequences, as noted by Pigou (1920).

Thus, the location of industries is significant, as the inhabitants of the areas where these industries are established—or those living nearby—are the ones directly affected by environmental damage or degradation resulting from industrial operations. This highlights the current prominence of a strategy employed by large transnational corporations: the relocation of productive capital to nearby locations—known as "nearshoring"—through which they seek to reduce transportation costs and ensure the smooth functioning of production chains.

The drive to attract foreign direct investment to the country has led to an accelerated and growing pace in the installation of industrial parks and facilities, which offer their infrastructure and services to a wide range of companies—from large corporations to the small and medium-sized enterprises that make up value chains. This trend of nearshoring, accompanied by the proliferation of industrial parks and facilities, has not occurred evenly across Mexico; rather, it has been concentrated in specific regions—such as the Bajío area of Guanajuato—thereby transforming the region into a pivotal hub within the dynamics of capital accumulation.

This work examines whether the new trend of nearshoring has led to negative environmental externalities driven by the expansion of industrial parks and facilities in the Bajío region of Guanajuato, Mexico, during the 2018–2025 period. The chapter is organized into three sections. The first addresses the relationship between the new nearshoring trend and environmental externalities. The second section examines nearshoring and the expansion of industrial parks and facilities in the country, particularly in the Bajío region of Guanajuato. Finally, the third section analyzes the environmental externalities resulting from the installation of industrial parks and facilities in the Bajío region of Guanajuato—spurred by nearshoring—and their repercussions for local communities and the region's sustainable development.

Methodology

A review of the scientific literature on globalization, nearshoring, and environmental externalities was conducted. Based on this review, theoretical-conceptual propositions were formulated to address the relationship between industrial relocation—along with the expansion of industrial parks and facilities—and the generation of environmental externalities.

Units of analysis were defined based on the concentration of industrial parks and facilities; specifically, the municipalities of Apaseo el Alto, Celaya, Irapuato, Salamanca, Silao, and León in the state of Guanajuato, which together form an economic region. A geographic area of influence for these facilities (a 10 km radius around them) was also established, given that proximity to such infrastructure and its operations is a determining factor in the extent to which nearby communities are affected—that is, the degree to which they are exposed to environmental externalities.

It is important to note that while various methods exist for evaluating externalities, this study takes as its starting point the perspective proposed by David Harvey regarding an individual's degree of accessibility and proximity to natural resources—factors observable through the enjoyment or loss of positive environmental externalities (Harvey, 1988). Based on this approach, the study employed the direct valuation method for externalities (as outlined by Mejía, 2016) and the impact pathway method (Delacámara, 2008). These procedures consider variables such as changes in land use, changes in productivity, and the loss of welfare or benefits (specifically regarding accessibility and proximity to natural resources—that is, the loss of positive environmental externalities) resulting from changes in environmental quality.

For this study, the following variables were established: land-use change, land rental prices, soil degradation, overexploitation of water resources, surface and groundwater pollution, and hazardous waste generation. It is important to note that the scope of this work was limited to considering welfare losses, without addressing their monetary valuation or associated economic costs. Furthermore, variables such as health issues, economic losses from agricultural and livestock activities, and the risk of loss of assets or property were excluded due to a lack of baseline data, particularly at the municipal level.

Documentary information regarding the established variables was gathered, and databases were created. A Geographic Information System (GIS) was used to capture data and correlate variables—specifically, the relationships between parks, industrial facilities, and environmental externalities—in order to present geospatial data. Subsequently, the information was analyzed based on the theoretical-conceptual framework, results were developed, and finally, conclusions were formulated.

Nearshoring and Environmental Externalities

The process of globalization has evolved over time, giving rise to new strategies that allow large corporations to continue accumulating capital. In recent years, nearshoring has emerged as a major trend in the reconfiguration of global value chains. This shift is driven by two main factors: first, the COVID-19 pandemic caused supply chain disruptions that stalled production and commercialization, prompting companies to prioritize mitigating risks related to the availability of inputs and products—or, in other words, safeguarding the operation of global production chains. Second, relocating operations closer to parent companies aims to cut transport costs and streamline the movement of goods; these factors have led multinational corporations to adopt nearshoring as a key strategic approach.

Large corporations certainly consider several factors when relocating productive capital to nearby locations; among the most important are: a degree of integration between the local manufacturing industry and value chains (typically involving the provision of supplies); the availability of infrastructure and investment in research and development; high-quality infrastructure to facilitate logistics and industry- and commerce-related public services; a skilled workforce; and access to efficient energy. (BANOBRAS, 2025)

Industrial relocation—along with associated processes such as the development of infrastructure, industrial parks, and transport services—is undoubtedly causing negative environmental externalities in the locations where companies establish themselves; consequently, these negative environmental externalities are generated across different locations and in an unequal manner. According to Harvey, the effects of externalities are localized—a category that encompasses not only positive externalities (such as economic opportunities, housing, transport networks, and infrastructure) but also negative ones—and

he highlights that these externalities are linked to hidden mechanisms of income redistribution that also manifest spatially (1988, p. 86).

Consequently, the relocation of productive activities entails the generation of—generally negative—environmental externalities in the areas where this transfer of productive capital occurs. This is because the industry utilizes the natural capital available at its location—such as land, water, forest resources, minerals, and hydrocarbons—which are required for its industrial processes; yet, it is widely acknowledged that this natural capital is not factored into production costs, nor is sufficient attention paid to its conservation. These industries tend to locate precisely where the necessary operational resources are available, a trend that has recently driven the development and operation of industrial facilities and parks in such areas.

Indeed, when companies relocate their investments and productive capacities to nearby locations, they prioritize the availability of infrastructure to support production, logistics, administration, and distribution; this has led to increased investment in industrial parks and facilities.

Certainly the implementation of nearshoring has been accompanied by the development and expansion of industrial facilities within industrial parks, as companies' production and distribution processes for goods and services require facilities adaptable to various uses. Industrial facilities are recognized as playing a pivotal role in attracting foreign investment; consequently, numerous companies in the industrial real estate sector offer investment opportunities in these spaces across various regions, such as Mexico.

Clearly, the expansion of industrial facilities is linked to the generation of environmental externalities, as the construction and operation of these installations drive land-use changes, consume local natural capital, alter the natural landscape, utilize or overexploit natural resources (such as water and timber), reduce vegetation cover, degrade the soil, discharge toxic and non-toxic solid and liquid wastes, emit dust and chemicals into the atmosphere, diminish ecosystem services, and generate environmental pollution (affecting air, water, soil, and noise levels). Consequently, it is essential to identify the environmental externalities caused by these industrial facilities in their respective locations in order to understand their impact on the social well-being of local populations.

In this regard, we believe that Harvey's definition of real income—viewed not merely as the amount of money an individual can count, but as the degree of accessibility to and proximity of natural and artificial resources available to that individual, as evidenced by the enjoyment or loss of positive environmental externalities—enables us to gauge the loss of well-being experienced by individuals or social groups due to negative environmental externalities (Harvey, 1988).

It is observed that negative environmental externalities translate into problems regarding the use of natural resources, because those carrying out economic activity do not pay the cost associated with the loss of access to and enjoyment of natural resources previously available to local populations; for Harvey, this constitutes a malfunction of the market price mechanism, since those generating the externalities do not pay for the loss of well-being suffered by others—there is no compensation.

It is widely held that the loss of well-being experienced by populations due to environmental externalities generated by industrial activities is not taken into account by business owners or real estate investors; furthermore, the affected residents have no say in whether or not they wish to endure such impacts. Delacámara (2008) even notes that, even if the population were financially compensated for the harm suffered, the externality itself would not be eliminated; that would only occur if measures were actually taken to prevent the externality from being generated in the first place.

Nearshoring: expansion of industrial parks and facilities in Mexico and the Bajío region of Guanajuato.

In the early 21st century, the nearshoring strategy adopted by transnational companies gained significant momentum due to the emergence of new factors driving competitiveness—such as logistics costs, access to energy, and supply security within global value chains (Curzio, 2024). For Mexico, this meant that many transnational companies—particularly those from North America—invested in the country, driven by its geographic proximity to the United States and the United States-Mexico-Canada Agreement (USMCA), which provides a framework ensuring legal certainty for investors. Indeed, the USMCA is seen as offering the

potential not only for commercial integration but also for productive integration as a regional bloc.

It is worth noting that, despite the shift in U.S. economic policy and the announced imposition of tariffs on exports from various countries—particularly China, European Union member states, and key trading partners Canada and Mexico—Mexico continues to offer competitive advantages for North American and Asian companies due to the existing production and trade integration within North America; consequently, nearshoring is expected to take place in the country. Nevertheless, Mexico must negotiate the USMCA to secure its participation in global value chains and ensure continued exports to the United States.

Indeed, the impact of nearshoring in Mexico is reflected in foreign direct investment (FDI) figures: in 2019, the country attracted $32.821 billion and ranked 14th among the top FDI recipients; by 2021, it had risen to 10th place—despite a slight drop in the total amount to $31.621 billion—and in 2022, FDI reached $35 billion (Curzio, 2024, citing data from the Ministry of Economy). The manufacturing sector receives the largest share of investment at 46.9%, followed by the financial sector at 14.5%, other sectors at 12.1%, and the commerce sector at 7.5%.

Due to its proximity to the United States, Mexico has become a relocation site for North American companies; however, various analysts suggest that proximity alone is insufficient. To attract investments and production capabilities, the country must also offer comparative advantages to these firms. Key among these advantages is the availability of infrastructure vital to business operations and supply chain flows—infrastructure that encompasses not only transportation networks but also industrial parks and facilities with excellent connectivity to those networks.

Consequently, nearshoring has driven the construction of industrial parks and facilities; according to the Mexican Association of Private Industrial Parks (AMPIP), Mexico had 460 industrial parks in 2025. The space occupied by this type of infrastructure increased between 2019 and 2023—rising from 2.0 million square meters in 2019 to 5.0 million square meters in 2023—though growth slowed in 2024, recording 3.1 million square meters (AMPIP, 2025).

The sectors occupying these industrial spaces are distributed as follows: 51% by diverse manufacturing industries, 23% by logistics, 17% by the automotive sector, 4% by e-commerce, 3% by other sectors, and 2% by food and beverages (AMPIP, 2025). A significant aspect of these industrial parks is the source of investment: 74% comes from foreign investment, while 26% comes from domestic investment.

Indeed, industrial spaces in our country have increased, largely due to the creation and expansion of industrial trusts—specifically Real Estate Investment Trusts (REITs) (FIBRAS its Spanish acronym). These are capital investments aimed at financing the acquisition and/or construction of real estate assets that generate rental income and appreciate in value over time, thereby offering capital gains. While the owners of industrial REITs are generally a broad range of investors, they primarily consist of large real estate groups or developers; through publicly traded trust certificates (CBFIs), they enable the general public to invest and hold shares in small portions of these assets.

REITs have been expanding their real estate portfolios—specifically regarding industrial properties and distribution centers—driven by the nearshoring trend. Notable examples of these trusts include Fibra Macquarie, Prologis, Fibra Uno, Fibra Monterrey, and Fibra Next; the latter has become the largest industrial FIBRA in Mexico, with a portfolio valued at $8.5 billion ("Fibra Next advances toward industrial leadership in Mexico 2025," November 22, *El Economista*). These industrial real estate investment trusts have found the ownership, operation, and development of this asset class to be a key source of profit.

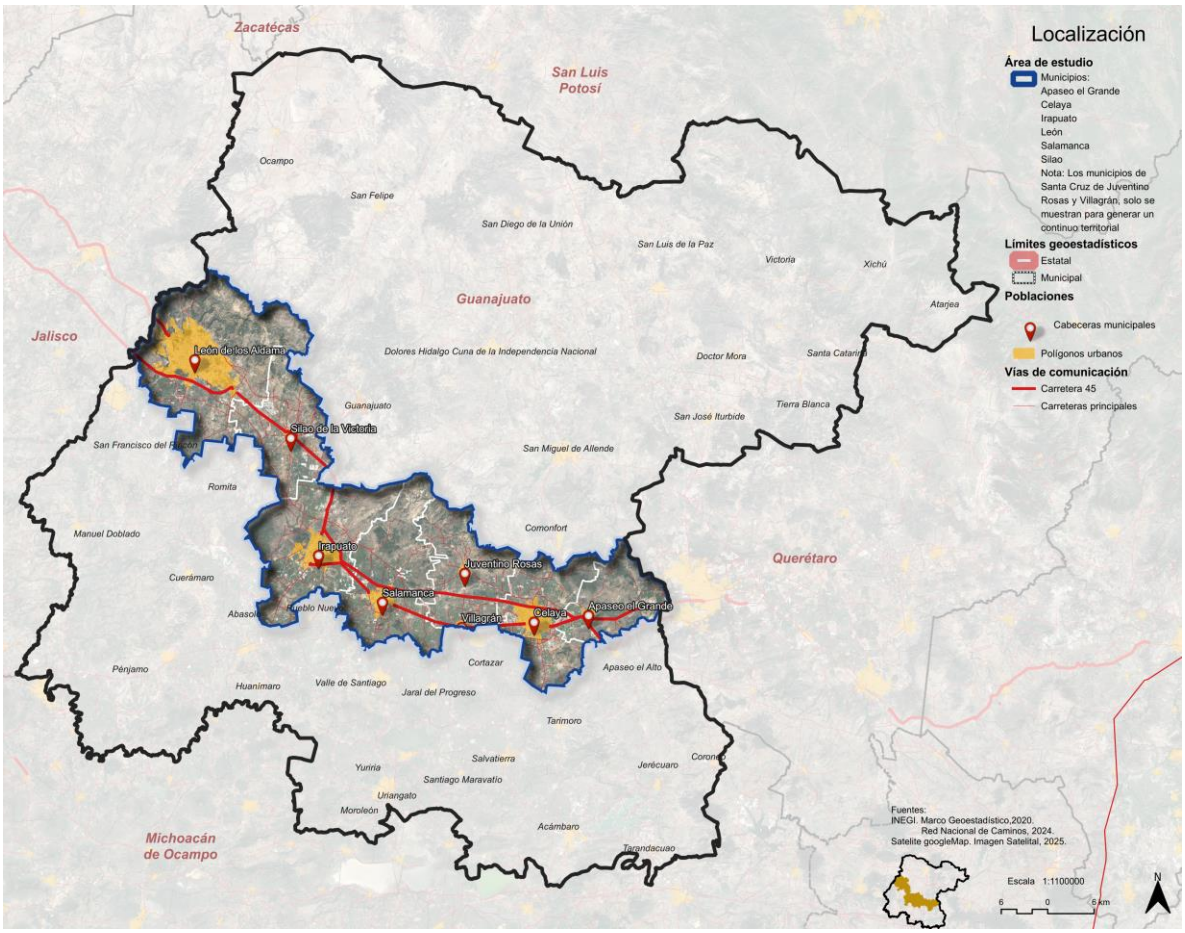
However, it is important to note that industrial spaces in Mexico have become concentrated in specific regions: the Northern region accounts for 58.7% of the industrial real estate market, the Bajío-West region for 24.5%, and Mexico City and its metropolitan area for 16.8% (AMPIP, 2025). This growth in industrial space is driven by the fact that such facilities constitute key infrastructure for production supply chains; consequently, companies factor the availability of these spaces into their investment location decisions, alongside the existing agglomeration economies found in those regions.

Furthermore, the concentration of industrial spaces in certain regions stems from the fact that they have become crucial locations for carrying out production and commercial processes, as they are considered ideal environments for capital accumulation. O’Neil (2022)

notes that certain decisive factors have made regional trade paramount, such as trade agreements, industrial agglomerations (linked to the availability of office facilities, industrial parks and warehouses, and service provision), shared time zones, and similar cultural patterns.

The Bajío region of Guanajuato undoubtedly possesses these elements; this area comprises the municipalities of Celaya, Salamanca, Irapuato, Silao, and León. It is defined by an industrial corridor spanning these municipalities, which have attracted investment across the industrial, commercial, and service sectors. A wide range of industries has established operations there—including automotive, auto parts, footwear, tanning, agro-industry, chemicals, petrochemicals, metalworking, textiles, and related fields—driving population concentration and the consolidation of a city network. In recent years, the municipality of Apaseo el Grande has gained prominence as foreign-owned companies from the region's key sectors have set up operations within its territory, fostering its integration into this regional area; consequently, we have included it in this study.

Bajío region of Guanajuato



Source: Prepared by the author using data from INEGI, 2020 Geostatistical Framework, Road Network, 2024. Google Maps satellite. Satellite image, 2025.

Nearshoring continues to unfold in the Bajío region of Guanajuato; new companies are establishing themselves there, while existing firms are expanding their production capacities—primarily in the automotive, electronics, aerospace, pharmaceutical, agri-food, food processing, and logistics sectors. These include Asian companies as well as multinationals from various other countries.

A wide variety of multinational companies have indeed settled in the Bajío region of Guanajuato, particularly in its major cities and surrounding areas. These companies have driven the construction and operation of industrial parks and facilities; specifically, while the state of Guanajuato had 40 industrial parks in 2023, that figure rose to 47 by 2025—according to the State Government—spread across 17 municipalities. However, the highest concentration is found along Guanajuato's "industrial corridor," specifically in Apaseo el

Grande (six), Celaya (three), Salamanca (one), Irapuato (one), Silao (fourteen), and León (six), totaling 31 industrial parks. (AMPIP, 2023; Government of the State of Guanajuato, Bulletins, May 14, 2025)

It is worth noting that Guanajuato Puerto Interior, located in Silao, stands out among these industrial parks; it constitutes a major industrial and logistics complex for the region, housing four industrial parks and the Sky Plus aerospace logistics park. It is home to 123 companies from 18 countries and hosts government agency offices, research centers, and commercial installation—including hotels, restaurants, hospitals, and banks. (Partenaire/Mx, April 3, 2024).

Undoubtedly, there has been a boom in the industrial real estate market, driven largely by demand from companies requiring such spaces as a result of nearshoring. In fact, in 2024, Chinese companies accounted for 42% of industrial space absorption in the region—followed by Italian, Japanese, and Mexican firms—a trend reinforced by local government efforts to attract Asian investment. (Martínez, E. 2024 November 8)

The industrial expansion rate in 2024 was 2.25%, with the delivery of 1.25 million square feet of new projects and approximately 634,000 square feet of space available for construction, in addition to 206,000 square feet for "build-to-suit" projects. (Martínez, E. 2024, November 8) This industrial expansion has driven up land prices—even reaching record highs for the state—with the price per square foot ranging from $0.45 to $0.55 USD. (Martínez E. 2024, November 8) This indicates significant land availability for the construction of these industrial spaces; in fact, the state of Guanajuato reportedly has 3,350 hectares of land available for new companies across its 47 existing industrial parks.

It is worth noting that industrial spaces are primarily in demand by economic sectors that have been developing in the region for some time—namely, the automotive industry and its supply chain, the metalworking industry, and the chemical and pharmaceutical industries. This demand for industrial space has led to land-use changes that have reduced the amount of land previously used for agriculture, as well as urbanization processes; these shifts have transformed not only the landscape but also the region's socio-spatial organization. It is

important to point out that these territorial and social transformations have also resulted from the economic policies of state and local governments—policies focused on attracting foreign investment and encouraging companies to relocate to their territories, with local governments standing ready to provide the water, electricity, and other services necessary for industrial parks and facilities to operate.

Undoubtedly, investment in industrial infrastructure is significant for the region; local governments aim to use it to attract more foreign capital and foster nearshoring—particularly by highlighting connectivity and proximity to the United States. This reflects the region's interest in continuing its integration into global production and trade networks—a process that has been underway for several decades.

Environmental externalities associated with the expansion of industrial facilities in the Bajío region of Guanajuato

However, the expansion of industrial parks and facilities in the Bajío region of Guanajuato has brought about negative environmental externalities—resulting in a loss of well-being for local populations—that are neither compensated for by the developers and occupants of these industrial spaces nor, in many cases, mitigated. Below, we examine some of the environmental externalities stemming from the expansion of industrial parks and facilities driven by nearshoring in the Bajío region of Guanajuato.

1.- Land-use change

On one hand, the expansion and proliferation of industrial parks and facilities entail changes in land use that, in turn, generate negative impacts on biodiversity and the provision of ecosystem services; this is due to the resulting transformation of natural vegetation, deforestation, desertification, and the consumption of natural resources within industrial and commercial production processes. Similarly, the expansion of transport infrastructure—as well as urban growth—causes negative environmental impacts; in short, changes in land use and the exploitation of territory by transnational capital have resulted in the generation of environmental externalities.

While it is acknowledged that alterations to the natural vegetation cover have been caused primarily by the development of agricultural and livestock activities, there is no doubt that the expansion of the industrial corridor in the state of Guanajuato—along with the associated growth of human settlements—has also contributed to this. According to Pérez, A., H. Regil, and J. Mas (2020), the loss of permanent irrigated farmland has been a consequence of the expansion of the industrial corridor and the growth of the cities of Irapuato, Silao, Salamanca, and Celaya.

Undoubtedly, a shift in land use has been taking place; land previously used for agricultural and livestock activities is now being utilized for business facilities, industrial parks, and warehouses, or for human settlements. This entails a loss of control over land resources by farmers—effectively a negative environmental externality that is insufficiently compensated—and even the loss of land ownership by local inhabitants, as shown in the following table.

Table 1. Land-use change dynamics in the Bajío region.
2016–2021

Municipality/Area of influence of industrial parks	Land-use change dynamics			Grand total Area in hectares
	Disturbance	Loss	Recovery	
Apaseo el Grande			92.09	92.09
10 km radius of influence			23.81	
Celaya		322.84		322.84
10 km radius of influence		322.84		0.00
Irapuato		264.98		264.98
10 km radius of influence				0.00
León	22.59	4 638.29	754.53	5 415.41
10 km radius of influence		4 505.80	570.01	5 075.81
Salamanca		332.16		332.16

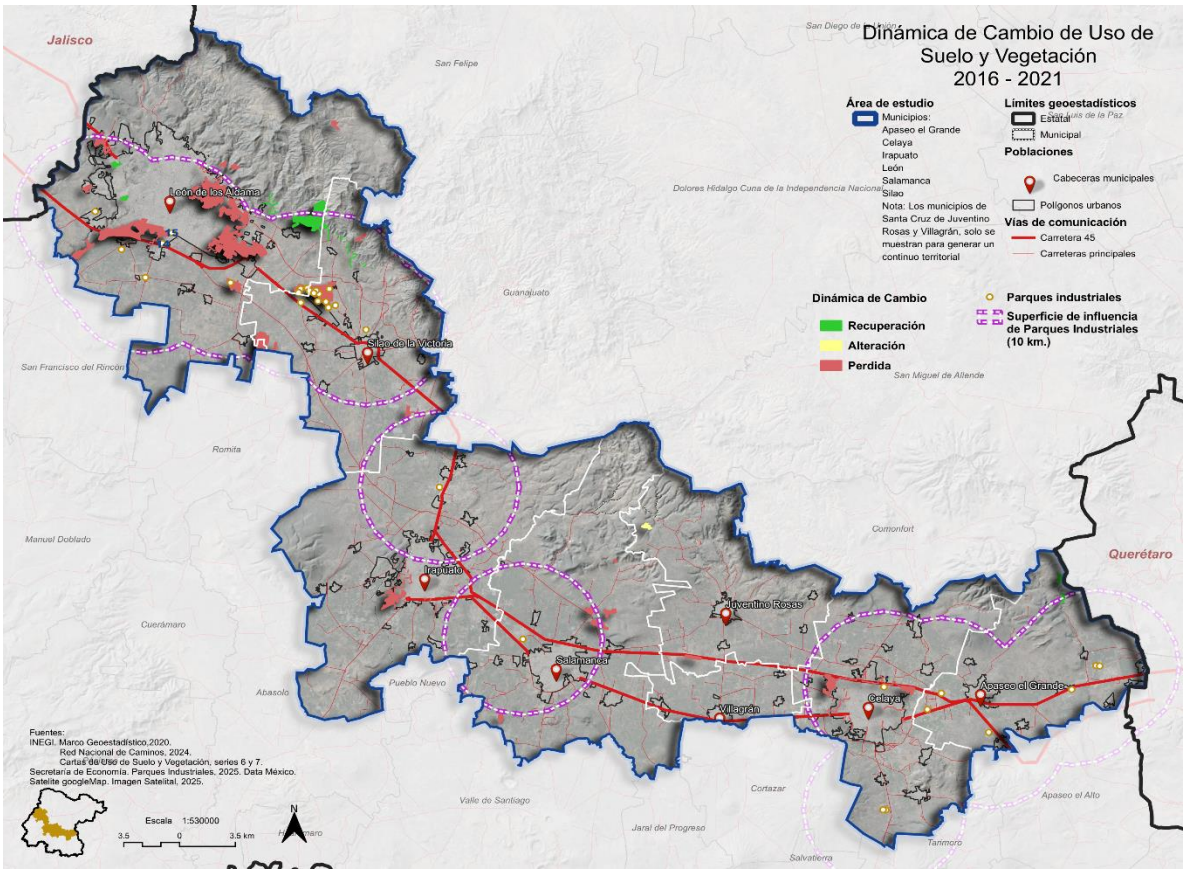
10 km radius of influence		138.93		138.93
Silao de la Victoria		934.72	44.33	979.05
10 km radius of influence		875.72	34.18	909.90
Grand total	22.59	6 492.99	890.95	7 406.53
10 km radius of influence		5 843.29	628.00	6 124,64

Source: Prepared by the authors using data from SEMARNAT's Forest Inventory and Geomatics Directorate, 2011.

Furthermore, the change in land use has led to physical soil degradation—specifically compaction, crusting, and sealing—and, undoubtedly in the case of agricultural areas, the loss of productive capacity. For farmers, this land-use change represents a negative environmental externality, as they lose control over the land resource and the fruits of their productive activity; in other words, they bear the costs of this process—namely, a loss of real income.

A negative impact on soil quality is acknowledged, resulting from the improper management of solid waste that contaminates the soil. This issue stems from the expansion of urban areas—specifically León, Irapuato, Celaya, and Salamanca—within the Bajío industrial corridor. This region is expected to continue concentrating industrial and commercial production activities, population, and infrastructure, thereby carrying a higher likelihood of continued negative impacts on soil quality. (IPLANEG, 2018)

Bajío Region, Guanajuato: Land Use and Vegetation Change
2016–2021



Source: Prepared by the authors using data from Land Use and Vegetation Maps (Series 6 and 7); Secretariat of Economy (Industrial Parks, 2025); Data México; and Google Maps satellite imagery (2025)

2. Increase in land prices

Furthermore, the demand for industrial space drives up land prices or fuels speculation in the land market, making it difficult for local residents to access land. Indeed, land prices in certain areas of Guanajuato have risen due to demand for industrial real estate development—though prices vary based on location, permitted land use, terrain characteristics, the conditions of existing industrial parks, and, above all, corporate demand—resulting in a price range of $400.00 to $9,000.00 pesos per square meter.

Examples of this price fluctuation and the reasons behind the variations include the following: at the La Amistad Industrial Park in Apaseo el Grande, available land costs $2,000.00 pesos per square meter, with financing plans offered; at the Marabis Industrial Park in Irapuato, which has 60,000 square meters of land available, the price is set in dollars by

the real estate developer and is yet to be determined—furthermore, the developer specializes in the acquisition, leasing, and valuation of land and industrial facilities in the Bajío region, offering comprehensive solutions that include 3PL logistics and energy efficiency. Their promotional material also highlights the land's location and its connectivity to the Bajío Airport and the cities of Mexico City, Querétaro, and San Luis Potosí. Another example is an industrial site offered along the Irapuato-Silao highway: a 1,863-square-meter plot priced at $5,588.52 pesos per square meter. Another case is a plot within the Guanajuato Inland Port (Puerto Interior de Guanajuato) priced at $3,000.00 per square meter, with an area of 4,530 square meters. A further example is the PILBA Industrial Park in León, which is selling a 51,060-square-meter plot at $55 USD per square meter—equivalent to $1,047.75 pesos (based on the exchange rate on June 18, 2025)—noting its proximity to the Michelin and Topsun companies.

Industrial real estate developers generally emphasize that the land they offer for industrial use is already located within industrial parks. These parks feature underground electrical infrastructure, access control, private security, utility connections at the lot line, wide avenues, and ample space for maneuvering and parking; developers also typically list the companies already established in these parks.

It is evident that land acquisition has been extensive and will continue to be so, as shown by the interest of Fibra Next—a real estate investment trust (REIT) created by Fibra Uno (FUNO) to manage and acquire industrial properties in Mexico. Gonzalo Robina, Deputy CEO of FUNO—cited by Luis Miguel González in the newspaper *El Economista*—noted that Fibra Next launched "...with 6 million square meters of industrial facilities and is expected to reach over 20 million square meters of gross leasable area within five years." Furthermore, the executive remarked that the total area of industrial facilities in the country "...is approximately 70 million square meters, of which Fibra Next currently holds 6 million, representing 10% of the market." (González, L. 2025 July 23))

Fibra Next has an expansion plan; according to Raúl Gallegos, the trust's CEO, land reserves will be added to serve as the foundation for this expansion over the next six years.

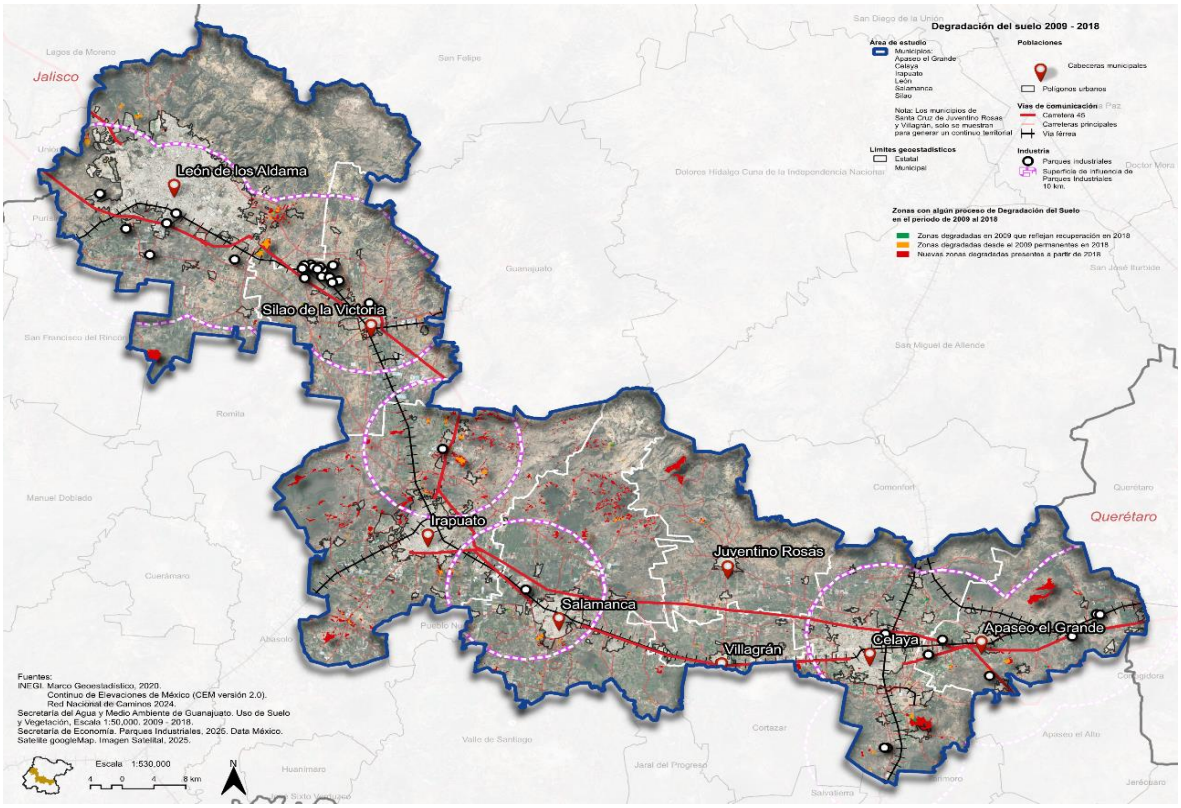
Furthermore, these trusts have issued shares on the stock market with the aim of becoming key players in the industrial real estate sector at both national and regional levels (Escobar, S., 2025 July 24). Clearly, the expansion of land acquisition for industrial use will entail changes in land use and alterations to the landscape, resulting in certain negative environmental externalities for the local population.

3. Soil degradation

Soil degradation consists of a decline in biological productivity or biodiversity—and, consequently, in the current and future capacity to sustain human life—as noted by Oldeman (Oldeman 1998, cited in Semarnat, 2008). While agricultural and livestock activities are recognized as the primary causes of soil degradation, it is also acknowledged that urban and industrial development contribute to its deterioration.

It is widely acknowledged that industrial development in the Bajío industrial corridor has contributed to soil degradation due to contamination. This is particularly attributable to hydrocarbon spills or leaks associated with economic activities such as transport equipment manufacturing and the retail trade of motor vehicles, spare parts, fuel, and lubricants—activities that are major contributors to environmental contamination (environmental liabilities) in the municipalities of León and Silao.

Bajío Region, Guanajuato. Soil degradation
2009–2018



Source: INEGI, 2020 Geostatistical Framework, Mexico Elevation Continuum (CEM, version 2.0), 2024 National Road Network; Secretariat of Economy, 2025 Industrial Parks, Data México, Google Maps satellite imagery (2025).

Likewise, we find that another negative environmental externality has been the overexploitation of water resources, which we address below.

4. Overexploitation of water resources.

In the state of Guanajuato, groundwater availability is vital for supplying water for human consumption and supporting productive activities. Government authorities acknowledge that the state is experiencing the overexploitation of water resources; of the state's 20 aquifers, 19 are in deficit. According to the National Water Commission (CONAGUA) in Guanajuato, all aquifers show declining water levels, with the exception of the Xichú-Atarjea aquifer (CONAGUA, 2023). While aquifers in the northern part of the state exhibit the highest degree of overexploitation, those along the industrial corridor—such as the Valle de Celaya, Irapuato-Valle, and Valle de León aquifers—also show significant overexploitation. This is

particularly true in areas where numerous industrial parks and facilities are located. Although the agricultural sector is recognized as the primary consumer of groundwater, the aquifers are generally exploited by four main sectors: agriculture and livestock, hydroelectric power generation, industry, and public services. The following section outlines the status of the aquifers along the Bajío industrial corridor.

Status of Aquifers in the Bajío Region of Guanajuato
2023

Aquifer	Groundwater extraction volume	Deficit
Valle de León	186.14 hm^3/year	-61.64 hm^3/year
Silao-Romita	174.95 hm^3/year	0 hm^3/year
Irapuato-Valle	539.65 hm^3/year	-60.15 hm^3/year
Valle de Celaya	470.25 hm^3/year	-156.45 hm^3/year

Source: Prepared by the author using data from CONAGUA, 2023.

As can be seen, the aquifer with the largest water deficit is the Celaya Valley aquifer; notably, this is one of the areas experiencing significant expansion of industrial parks and facilities.

It is important to note that the automotive industry—a key sector in Guanajuato comprising 380 companies located in industrial parks—relies exclusively on groundwater. It draws this water from aquifers facing significant deficits, including: 1) Upper Laja River Basin, 2) Irapuato-Valle, 3) Pénjamo-Abasolo, 4) Turbio River, 5) Salvatierra-Acámbaro, 6) Silao-Romita, 7) Celaya Valley, and 8) León Valley. Estimates regarding the volume of water required to manufacture a single automobile range from 148,000 to 454,000 liters; while these figures vary, there is no doubt that car manufacturing entails high water consumption (Sandoval, S., M. Sánchez, and A. López, 2024). In addition to groundwater overexploitation, industrial activity also causes water pollution, a topic we address below.

5.- Surface water and groundwater contamination.

It has been established that industrial processes (manufacturing, production, processing, consumption, cleaning, and maintenance operations) generate contaminated wastewater; if left untreated, this wastewater becomes a source of pollution—in other words, it creates negative environmental externalities for the inhabitants of the areas where these industries are located or for those who live nearby.

It is known that the discharge of untreated industrial wastewater causes pollution in receiving water bodies, thereby degrading the quality of surface water and groundwater; this jeopardizes public health and the optimal functioning of ecosystems (SEMARNAT, 2013).

Generally, this wastewater is discharged into rivers, lakes, and seas, or onto open ground or into the subsoil, causing these environments to lose their natural state and their capacity to maintain ecological balance and preservation; in other words, this results in environmental impacts that affect human health. The pollutants involved vary and differ depending on the industry generating the wastewater.

Regarding the industrial parks and facilities in the Bajío region of Guanajuato, numerous and diverse industries have established themselves there—most notably the automotive sector—making it important to identify the types of pollutants this industry discharges in its wastewater. It should be noted that various processes and sub-processes within the automotive production chain generate contaminated wastewater.

Automotive industry: Polluting processes and forms of waste

Process	Typical contaminants	Primary form of waste
Metal finishing (plating, coating)	Dissolved metals (Cu, Zn, Ni, Cr, Pb), acids/alkalis	Wastewater, metal hydroxide sludges
Iron and Steel Production	Ammonia, Cyanide, Phenols, Cresols, BTEX, Naphthalene, Anthracene, Hydraulic oil, Suspended solids	Sewage

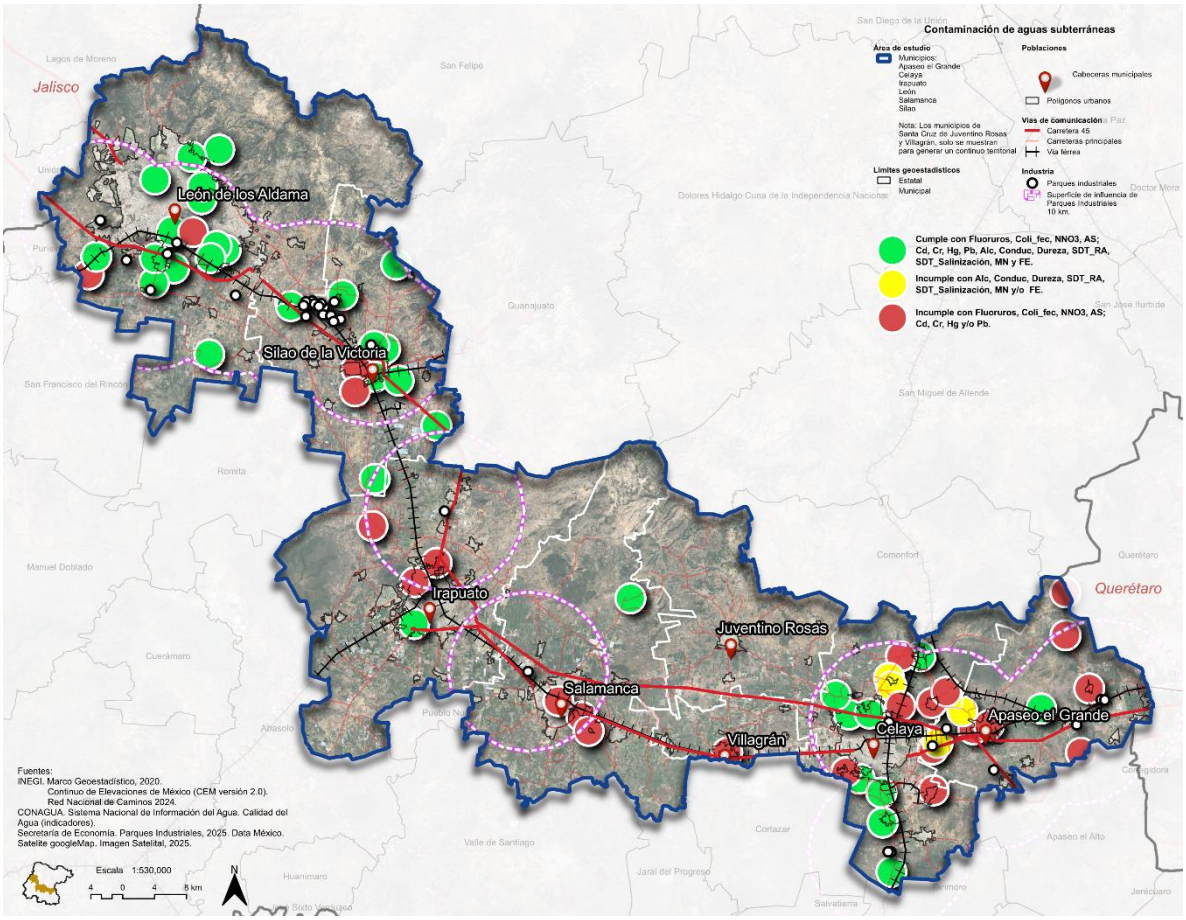
Metal forming (sheet metal, wire)	Hydraulic oil (soluble), Tallow, Solid particles	Sewage
Steel Galvanization	Acids (HCl, H2SO4), acidic rinse waters	Sewage
Painting and coating	Pigments, Resins, Solvents	Sewage
Cleanup operations	Detergents and surfactants	Sewage

Source: Super Auto, 2025

According to the regionalization carried out by IPLANEG, the Irapuato-Salamanca sub-region exhibits the highest levels of wastewater discharge due to the presence of the thermoelectric power plant; it is followed in terms of volume by the Laja-Bajío region and, finally, the León sub-region (IPLANEG, 2018).

Groundwater contamination issues exist in all the region's municipalities; consequently, various communities located near industrial parks and facilities are affected by this contamination, as shown in the following map.

Bajío Region, Guanajuato. Groundwater contamination
2025



Source: Prepared by the author using data from CONAGUA. National Water Information System. Water Quality. Indicators.

6.- Generation of hazardous waste.

According to SEMARNAT, “hazardous waste consists of materials possessing any of the CRETIB characteristics that render them hazardous (C—corrosivity; R—reactivity; E—explosivity; T—toxicity; I—flammability; or B—biological-infectious), as well as the containers, receptacles, packaging, and soils contaminated by them, as established by the General Law for the Prevention and Integrated Management of Waste (LGPGIR; DOF 2003)” (SEMARNAT, 2014)

The generation of this type of waste has contributed significantly to the contamination of certain sites, with the waste generally originating from the oil and petroleum subsectors. Key types of waste generated by these subsectors include: oily sludge; solid waste (such as waste, rags, plastics, cardboard, wood, paintbrushes, paper, and paint-soaked brushes);

batteries and cells; ballasts; and gasoline, diesel, and naphtha. In 2023, it was found that these subsectors were the sources of hazardous waste in the municipalities studied. Specifically, waste in Celaya consisted primarily of oily sludge and solid waste; in Irapuato, it included batteries, cells, ballasts, oily sludge, and solid waste; in León, it comprised water contaminated with hydrocarbons, fuels, oil, and grease, as well as batteries, cells, ballasts, spent or contaminated gasoline, diesel, and naphtha, oily sludge, and solid waste; in Salamanca, the waste consisted of oily sludge and solid waste; and in Silao, it was primarily solid waste. (ASEA, 2025)

However, it is fair to note that various transnational companies located in Guanajuato's Bajío region—as well as the industrial parks and facilities themselves—have been adopting measures to mitigate their environmental impact. Some of these measures focus on upgrading production technologies, while others involve using materials that can be reused or recycled, or even new materials with a lower environmental footprint; furthermore, some companies are exploring ways to minimize the environmental harm caused by their final products. All these measures reflect the growing momentum of the circular economy—an approach grounded in science and green chemistry and oriented toward sustainability—driven by evolving market demands that prioritize environmental stewardship without sacrificing profitability. Increasingly, companies and industrial parks are seeking sustainability certifications, such as Leadership in Energy and Environmental Design (LEED) and Excellence in Designs for Greater Efficiencies (EDGE), which are considered essential for attracting investment.

Among the companies adopting measures to mitigate their environmental impact in the Bajío-Guanajuato region are the Michelin plant (tire manufacturer), which operates using renewable energy and has reduced its emissions; the Heineken plant (beer producer), which provides local growers with technologies to reduce fertilizer and water use, as well as new cultivation models utilizing agro-biotechnology; and Grupo Flecha Amarilla (passenger transport), which has implemented measures to cut emissions—including the purchase of hybrid buses—and to ensure proper waste management

Overall, it is evident that nearshoring in the Bajío region has led to the creation of a production and logistics hub—featuring numerous industrial parks and facilities—driven not only by the current dynamics of transnational capital but also by the interest and response of local actors (primarily government and businesses) seeking to integrate into the global economy. This area is characterized by a concentration of companies—mostly transnational—within industrial parks that utilize local natural resources, available labor, basic services, and road and transport infrastructure; at the same time, these operations generate negative environmental externalities for local communities, thereby diminishing individual and collective well-being—in other words, resulting in environmental injustice.

Conclusions

The study confirms that the relocation of productive capital by transnational corporations—specifically through "nearshoring," a strategy aimed at reducing transport costs and securing the operation of production chains—has been significant in the Bajío region of Guanajuato. Numerous corporations and their suppliers, primarily from the automotive, electronics, aerospace, and logistics sectors, have established operations there, thereby driving the creation and expansion of numerous industrial parks and facilities.

The number of industrial parks and facilities in the region has grown for two reasons: first, this type of operational infrastructure enables companies to reduce costs, benefit from agglomeration economies, and secure their logistics processes and connectivity; second, real estate developers—utilizing investment vehicles known as FIBRAs—find a valuable source of profitability in this activity, which encompasses everything from land acquisition and infrastructure construction to the sale or lease of spaces, as well as their maintenance and management.

An analysis of nearshoring and the resulting expansion of infrastructure—which houses industrial operational and logistical activities—reveals that this industrial dynamism has led to environmental impacts and, consequently, negative environmental externalities for the region's population. This has resulted in a diminished capacity to manage the resources needed to cope with the effects of alterations to their natural environment—in other words, a

loss of well-being. Furthermore, it is evident that local communities have been excluded from decision-making processes regarding the installation and operation of these companies within their territories.

Among the primary effects experienced by the inhabitants of this region—particularly for those who live near industrial parks and facilities—we observe changes in land use, reduced access to land, often forced shifts in productive activities, soil degradation, and the overexploitation and contamination of groundwater and surface water; in short, they suffer externalities that harm their individual and collective well-being.

Although industries—including industrial parks and facilities—have recently shown interest in implementing measures to reduce the environmental impact of their production and logistics processes, much remains to be done, not only to mitigate environmental damage or degradation but to eliminate it entirely. Indeed, it is evident that industries and their operational infrastructure prioritize commercial interests over the logic of environmental preservation and improvement—which entails the responsible stewardship of natural resources—thereby diminishing the region's inhabitants' opportunity to enjoy an optimal environment.

Thus, it can be noted that the current model of economic growth—focused particularly on industrial development—fails, even with its technological advances, to prevent environmental degradation or avoid generating negative environmental externalities for local populations; in other words, it does not contribute to sustainable development. All of this points to the need to seek new pathways to achieve economic growth alongside environmental sustainability and well-being for the local population.

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