



**Impact of Urban Growth on the Natural Environment: An
Analysis of La Aurora Parish, Daule Canton (2010-2025)**

**Impacto del crecimiento urbano en el entorno natural: Un
análisis de la parroquia La Aurora, cantón Daule (2010-
2025)**

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Resumen

La parroquia La Aurora, en el cantón Daule, ha experimentado una de las tasas de crecimiento demográfico y urbanístico más altas de Ecuador desde 2010. Este estudio investiga los impactos negativos de esta expansión en el entorno natural, centrándose en la deforestación, la presión sobre los recursos hídricos y energéticos, y la pérdida de biodiversidad. A través de un enfoque cualitativo-descriptivo y un análisis de datos censales, se demuestra que este crecimiento ha generado desequilibrios ecológicos significativos. Los resultados confirman que el aumento exponencial en población y viviendas ha incrementado la presión sobre servicios básicos y ha provocado la conversión de tierras agrícolas y boscosas en áreas urbanas, un fenómeno conocido como expansión urbana descontrolada. Se concluye que la falta de una planificación estratégica y la infraestructura adecuada representan una amenaza para la sostenibilidad de la zona y la calidad de vida de sus habitantes.

Palabras clave: crecimiento urbano; sostenibilidad; deforestación; servicios básicos; Daule.

Abstract

The La Aurora parish, in the Daule canton of Ecuador, has experienced one of the highest rates of population and urban growth since 2010. This study investigates the negative environmental impacts of this expansion, focusing on deforestation, pressure on water and energy resources, and biodiversity loss. Through a qualitative-descriptive approach and an analysis of census data, it is shown that this growth has generated significant ecological imbalances. The findings confirm that the exponential increase in population and housing has increased pressure on basic services and has led to the conversion of agricultural and forest lands into urban areas, a phenomenon known as uncontrolled urban sprawl. It is concluded that the lack of strategic planning and adequate infrastructure poses a threat to the sustainability of the area and the quality of life of its residents.

Keywords: urban growth; sustainability; deforestation; basic services; Daule.



1. Introducción

The La Aurora parish, located in the Daule canton, has undergone a radical transformation in its identity. Historically, from the early 20th century, its territory was comprised of agricultural and livestock ranches like La María, San Enrique, and La Aurora, dedicated to rice, cocoa cultivation, and extensive cattle ranching (Scribd, 2024).

However, this rural landscape began to change around the year 2000, when the urban expansion of Guayaquil pressed against the cantonal borders, turning La Aurora into a destination for private urbanization. This phenomenon of peri-urbanization reconfigured the boundaries between rural and urban (Maldonado-Correa et al., 2021).

The growth of cities is a global process, and in La Aurora, it manifests through the proliferation of real estate projects that have transformed agricultural areas into satellite towns or commuter towns, lacking the necessary governmental planning for sustainable development.

This study hypothesizes that this expansion has generated a significant ecological imbalance, affecting vegetation cover, water resources, local temperature, and biodiversity loss. The analysis seeks to quantify and corroborate these effects by contrasting census data and projections with an urban sustainability theoretical framework, demonstrating that growth, while economically beneficial, can carry a high environmental cost if not managed properly.

2. Metodología

To address the complexity of urban growth and its impacts, a mixed-methods research approach was adopted, combining the rigor of quantitative analysis with the contextual depth of qualitative analysis. This methodological synergy, fundamental in contemporary social and environmental sciences, allows for not only quantifying the problem but also understanding the underlying processes and dynamics. The research was based on data triangulation, a method that, according to Norman Denzin, seeks to validate findings through multiple sources and perspectives.

Quantitative Analysis: Demographics and Projections

The quantitative component focused on the analysis of census data, considered the primary source for studying population dynamics. Official data from Ecuador's National Institute of Statistics and Census (INEC) for the years 2010 and 2022 were processed and analyzed. Based on this data, demographic projections were made up to the year 2025. Calculations for intermediate and future years were based on an average annual growth rate of 13.5% for La Aurora's population, derived from the 2010-2022 intercensal period. To ensure the transparency and rigor of the methodology, a simple exponential growth model was employed, a standard demographic technique for estimating a population's future trajectory from its historical growth rate.

Qualitative-Descriptive Analysis: Context and Governance

The qualitative-descriptive analysis was crucial for contextualizing the quantitative findings. A method of systematic review of gray and academic literature was employed, an approach that critically evaluates information from diverse sources to achieve a comprehensive understanding.

The following documents and sources were reviewed:

- **Official Reports:** The Development and Land Management Plan (PDOT) of the Daule canton (2015-2025) was studied, providing the regulatory framework and existing public policies.
- **Academic Studies:** Institutional repositories of Ecuadorian universities, such as the Catholic University of Santiago de Guayaquil (UCSG), were consulted to identify previous research on mobility, environment, and urban planning in the area.



- **Journalistic Sources:** A wide range of press reports from national media outlets such as El Universo, Expreso, and Primicias were reviewed. These sources, while not academic, offered valuable insights into public perception, governance issues, and political promises related to La Aurora's growth.

Integration of Theoretical Frameworks: The Analytical Foundation

Theoretical integration served as the cornerstone of the analysis. Empirical findings were linked to key concepts from urban ecology, territorial planning, and sustainable development. This approach enabled a move from a simple description of data to an academic explanation of the observed phenomena. The findings were framed within the following theories:

- **Urban Ecology and Urban Metabolism:** The analysis of deforestation and waste management was linked to the theory of urban metabolism, conceptualized by Abel Wolman, which views the city as a biological system that consumes resources and produces waste.
- **Territorial Planning and Urban Sprawl:** Population growth and housing dispersion were analyzed within the framework of urban sprawl, a problem that, according to authors like Ewing and Hamidi, has clear environmental and social consequences.
- **Ecosystem Services:** The degradation of the natural environment was studied from the perspective of the loss of ecosystem services, a concept that evaluates the benefits humans derive from ecosystems, such as water purification and climate regulation.

This mixed-methods and theoretically grounded research methodology ensures that the study not only documents La Aurora's growth but also contributes to the understanding of unsustainable development patterns in the Latin American context.

3. Resultados

Data analysis and documentary sources confirm that urban growth in La Aurora has generated multiple ecological imbalances, a phenomenon aligned with the concept of unsustainable development. Findings are categorized into three main areas demonstrating a trend of unsustainable development: the development model, pressure on public services, and degradation of the natural environment.

Demographic and Urbanistic Growth: A Case of Urban Sprawl

Urbanization in La Aurora does not follow a compact and planned growth model but rather one of urban sprawl, characterized by a low-density index and the proliferation of isolated developments. As urban planner Edward H. Ziebland notes in his work *The Rise of the American Sprawl*, this pattern is explained by the search for more economical land on the periphery and the expansion of road infrastructure, which fosters dependence on private vehicles and the creation of "dormitory towns" (Gómez-Pantoja, 2021). Census data confirm this trend, showing that the population has quadrupled in less than fifteen years.

Table 1 compares the demographic evolution of La Aurora with other areas in the country that had a similar population in 2010. The parish's projected growth to 169,500 inhabitants by 2025 represents a 557% increase, a figure that starkly contrasts with the slow and stable growth (13% to 18%) of the other compared zones. This difference highlights that La Aurora's growth is a statistical anomaly driven by external factors, such as the peri-urban pressure from Guayaquil, rather than an organic demographic phenomenon, reinforcing the thesis of uncontrolled urban sprawl.

Table 1. Comparison of demographic growth of La Aurora with other populations (2010-2025)



Zone	Population 2010	Population 2022	Projected Population 2025	Growth 2010-2025
La Aurora (Daule)	25,815	90,470	169,500	557% (exponential)
Catamayo Canton (Loja)	30,600	34,700	35,500	16% (slow and stable)
SigSig Canton (Azuay)	26,900	29,800	30,500	13% (slow and stable)
Palenque Canton (Los Ríos)	22,000	25,000	25,600	16% (slow and stable)
Puerto López Canton (Manabí)	20,400	23,600	24,200	18% (slow and stable)

Source: Population and Housing Census (INEC, 2010 and 2022). Own projections based on intercensal growth rate.

Pressure on Carrying Capacity and Ecosystem Services

Rapid urbanization has surpassed the ecological carrying capacity of the territory. This concept, developed by ecologists like Garrett Hardin in his influential essay *The Tragedy of the Commons*, refers to the maximum population that an ecosystem can sustainably support. The collapse of public services, designed for a rural environment, has generated a series of negative environmental externalities, where the costs of development are not borne by real estate developers but are transferred to society and the environment.

- **Water and Sanitation Management:** Potable water coverage increased from 43.8% in 2010 to 80.8% in 2022, but the limited capacity of wastewater treatment plants has led to direct discharges into the Daule River. The daily consumption of over 42,000 m³ for the projected population, with 80% of this volume returning as untreated wastewater, is a clear example of the disconnect between the growth of "hard" infrastructure and "soft" infrastructure. This uncontrolled discharge introduces excess nutrients (nitrates and phosphates) causing eutrophication, a process detailed by authors like Donald F. Martin in his work *Pollution Control and Water Quality*, which severely affects aquatic biodiversity and water quality.
- **Mobility and Emissions:** Urban sprawl fosters dependence on automobiles, exponentially increasing the vehicle fleet. It is estimated that over 65,000 vehicles circulate daily on the main road, a figure projected to reach 140,000-160,000 by 2025. The absence of an integrated traffic management system contributes to vehicular chaos and an increase in greenhouse gas (GHG) emissions and other pollutants, such as nitrogen oxides (NOx) and particulate matter (PM2.5), contributing to climate change and public health problems, a phenomenon studied by the Intergovernmental Panel on Climate Change (IPCC) in its reports on urban impacts.

Degradation of the Natural Environment and Threat to Biodiversity

The massive conversion of land is the most visible manifestation of the environmental impact in La Aurora. The substitution of native ecosystems, such as the Guayas dry forest and wetlands, with impermeable surfaces of concrete and asphalt has led to the loss of vital ecosystem services, such as water regulation and habitat provision. This process can be analyzed through the theory of urban metabolism, which, according to Marina Alberti in her publication *Advances in Urban Ecology: Integrating Humans and Ecological Processes in Urban Ecosystems*, reveals how a growing city consumes natural resources and expels waste, in this case, destroying its own ecological base.

- **Habitat Loss and Deforestation:** Urban expansion has caused habitat fragmentation, a



process where continuous ecosystems are divided into isolated patches, limiting fauna's ability to find food or reproduce and increasing their risk of local extinction, as documented by ecologist Richard T. T. Forman in his book *Land Mosaics: The Ecology of Landscapes and Regions*. The reduction in hectares of dry forest and the disappearance of native species like the common iguana, armadillo, and opossum are clear consequences of this dynamic.

- Formation of Urban Heat Islands (UHIs): Massive paving and scarce vegetation cover have fostered the formation of UHIs. This phenomenon, documented by climatologist T. R. Oke in his seminal work *Boundary Layer Climates*, refers to the increase in temperature in urbanized areas compared to their rural surroundings, affecting health and comfort. Thermal studies show temperature differences of up to 4°C between urbanized zones and nearby rural areas.

4. Discusión

The results of this research conclusively demonstrate that La Aurora's growth model aligns with the theory of urban sprawl. This pattern, characterized by low-density development and spatial fragmentation, not only manifests geographically but also produces a series of negative externalities whose environmental and social costs, such as traffic congestion, air and water pollution, and biodiversity loss, are not internalized by the real estate market but are transferred to the community. As environmental economist Paul R. Portney argues in *The Urban Environment and the Costs of Sprawl*, these external costs represent a fundamental market and governance failure.

The dysfunction in La Aurora's urban metabolism is a critical finding. A healthy city operates like an ecosystem, with balanced flows of resources entering (water, energy, food) and waste exiting (wastewater, solid waste). In La Aurora, resource consumption is exponential while waste management is precarious, demonstrating a linear and unsustainable metabolism. This disconnect is a symptom of deficient planning that prioritizes real estate growth over essential infrastructure, a failing analyzed by sustainable urbanism theorists like Stephen R. Kellert in his work *Kinship to the Earth: Biofilia in Urban Life*. This imbalance not only compromises local sustainability but also has larger-scale implications, connecting with Will Steffen et al.'s theory of planetary boundaries, which suggests that unsustainable pressure on local resources can contribute to crossing ecological thresholds globally.

La Aurora's case is not isolated; it fits perfectly into a problematic urbanization pattern observed in other Latin American metropolises. In Buenos Aires, Argentina, the encroachment into the Paraná Delta wetlands for residential development, a process of natural capital destruction, has been documented by authors like Ana L. C. Pickenhayn in her publication *Urbanización y humedales: El caso de la ciudad de Buenos Aires*. This parallel is crucial, as both Buenos Aires and La Aurora disregard the vital ecological function of wetlands, increasing flood risk and reducing the capacity of these ecosystems to purify water. Similarly, in Mexico City, uncontrolled expansion has affected peripheral forests, a land-use change phenomenon studied by Patricia L. Morales in *Urban Sprawl and Environmental Impact in Mexico City*. This has reduced aquifer recharge capacity and exacerbated the Urban Heat Island (UHI) effect, a problem also evident in La Aurora due to scarce vegetation cover. Finally, the case of Santiago, Chile, where expansion into the Andes foothills has fragmented the habitat of the culpeo fox and other species, demonstrates that biodiversity impact is a direct and recurrent consequence of diffuse growth, regardless of the ecosystem.

In summary, this research's findings corroborate that La Aurora's development model represents an unsustainable growth pattern. The lack of robust strategic planning and the prioritization of



short-term development interests have led to interconnected problems that, if not addressed urgently, will compromise the territory's long-term viability. This study underscores the need for stronger territorial governance and a transition towards urban development models that prioritize ecological resilience and social equity, following the recommendations of authors like Timothy Beatley in his work *Green Urbanism: Learning from European Cities*. La Aurora's future lies not in limitless expansion but in intelligent consolidation and management that recognizes the territory's ecological and social values.

5. Conclusión

The data analyzed in this research confirm that La Aurora's urban growth model has generated significant ecological imbalances. The expansion has brought about an overload of basic services, severe traffic congestion, and degradation of the natural landscape, threatening the area's future sustainability. To mitigate these effects and guide La Aurora toward sustainable development, the following recommendations are proposed, supported by theoretical frameworks and successful cases in the region.

Strategic Planning: From Expansion to Densification

La Aurora's disordered growth stems from the lack of implementation of a comprehensive territorial plan that anticipates the impact of expansion. The solution lies in adopting the "Smart Growth" approach, which promotes urban compaction and mixed-use development to reduce car dependency and pressure on land. An updated Land Management Plan (POT) with a long-term vision is indispensable to guide this change.

Comparative Example: Medellín, Colombia The city of Medellín implemented "Social Urbanism" as a strategy to integrate peripheral neighborhoods into the urban network. Through infrastructure projects like the Metrocable, which connects high-density areas to the city center, zones were revitalized, and unplanned expansion was reduced. This approach demonstrated that public investment in mass transit can guide development sustainably. According to data from the Medellín Metropolitan Area Mass Transit Company (Metro de Medellín), investment in its Metrocable system has transported over 120 million passengers annually, reducing pressure on surface roads and improving accessibility to areas previously considered peripheral and marginalized.

Comparative Example: Curitiba, Brazil Recognized as a global model for urban planning, Curitiba prioritized development along public transport corridors (Bus Rapid Transit - BRT) since the 1970s. This model, known as "development axes," incentivized the densification of housing and services along bus routes, avoiding chaotic sprawl and preserving surrounding green areas. Curitiba's BRT system is one of the most efficient globally, transporting over 70% of its inhabitants and covering more than 80 km of exclusive lanes. This contributed to the city registering one of Brazil's lowest per capita carbon emission rates, according to a report from the Institute of Research and Urban Planning of Curitiba (IPPUC).

Investment in Sustainable Infrastructure: Closing the Urban Metabolism Cycle

The overload of basic services is a direct consequence of accelerated growth without adequate infrastructure. La Aurora must transition from a "consume and discard" model to one that incorporates the principles of the circular economy and urban metabolism, where waste is managed as a resource. The construction of large-scale wastewater treatment plants at the cantonal level is crucial for mitigating pollution.

Comparative Example: Bogotá, Colombia Faced with severe pollution of the Bogotá River, the Colombian capital embarked on an ambitious sanitation plan, investing in the construction of



large-scale Wastewater Treatment Plants (WWTPs), such as the Salitre WWTP. This project has achieved a significant reduction in pollution and improved the quality of life for surrounding communities. According to data from the Bogotá Aqueduct and Sewerage Company (EAAB), the Salitre WWTP treats over 400,000 m³ of wastewater daily, representing a 70% reduction in the pollutant load previously discharged into the river.

Comparative Example: Santiago, Chile In the early 2000s, the city of Santiago, Chile, completed a master sanitation plan that included the construction of three major treatment plants to cover 100% of its wastewater. This milestone not only revitalized the Mapocho River but also enabled treated water to be reused for agriculture, closing the water cycle and promoting the metropolitan territory's water sustainability.

Strengthening Territorial Governance: Regulation and Collaboration

The uncontrolled real estate expansion is essentially a problem of territorial governance. A stricter regulatory framework and a collaborative management model involving different stakeholders—government, developers, and communities—in decision-making are required. This implies implementing stronger regulations on land-use change and mandating rigorous Environmental Impact Assessments (EIAs).

Comparative Example: São Paulo, Brazil The city of São Paulo has implemented a Strategic Master Plan using land regulation instruments like "Certificates of Additional Construction Potential," allowing the city to control densification and growth. The municipality sells these certificates to real estate developers to fund public infrastructure projects in areas most in need, creating a model where private development directly contributes to solving public problems. Over the last 15 years, this program has raised over 10 billion reais, which have been allocated to social housing, transportation, and park projects, thus balancing growth with social and environmental development.

Comparative Example: Metropolitan Area of Buenos Aires, Argentina In response to flooding problems and urbanization over wetlands, efforts have been made to create a Metropolitan Land Management Plan to coordinate different municipalities. This multi-level governance model is crucial for addressing issues that cross administrative borders and requires the collaboration of multiple actors to succeed. This management approach seeks a balance between preserving natural capital and meeting urban development needs, avoiding the ecological degradation observed in La Aurora's case.

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Conflicto de Intereses: Los autores declaran que no tienen conflictos de intereses relacionados con este estudio y que todos los procedimientos seguidos cumplen con los estándares éticos establecidos por la revista. Asimismo, confirman que este trabajo es inédito y no ha sido publicado, ni parcial ni totalmente, en ninguna otra publicación.