

Territorial Planning Strategies and Land Use and Management Plan (PUGS) of Guano Canton

Gary Fernández Morocho¹, Axel Medina Montoya², César Morocho Copa³, Bryan Colorado Pástor⁴ José Vera Pilay⁵

¹ Universidad Estatal de Milagro, Milagro, Guayas, Ecuador [ORCID 0009-0005-0575-1238](https://orcid.org/0009-0005-0575-1238); gfernandezm4@unemi.edu.ec

² Universidad Estatal de Milagro, Milagro, Guayas, Ecuador [ORCID 0009-0008-1708-493X](https://orcid.org/0009-0008-1708-493X); amedinam3@unemi.edu.ec

³ Universidad Politécnica Salesiana, Guayaquil, Guayas, Ecuador [ORCID 0009-0009-4668-9695](https://orcid.org/0009-0009-4668-9695); cmorochoc12@est.ups.edu.ec

⁴ Universidad Estatal de Milagro, Milagro, Guayas, Ecuador [ORCID 0000-0002-8054-0626](https://orcid.org/0000-0002-8054-0626); bcoloradop@unemi.edu.ec

⁵ Universitat Politècnica de València, Valencia, Madrid, España [ORCID 0009-0004-5237-8061](https://orcid.org/0009-0004-5237-8061); jverapilay@upv.edu.es

Abstract— This study evaluates the alignment of the Development and Territorial Planning Plan (PDOT) and the Land Use and Management Plan (PUGS) of Guano canton, Ecuador, with international frameworks—such as the 2030 Agenda (SDG 11) and the New Urban Agenda—and national regulations like COOTAD and LOOTUGS. Employing a mixed methodological approach, the research combines a qualitative documentary analysis of planning policies with a quantitative comparative evaluation matrix to assess territorial sustainability, land management, and urban resilience. The results reveal progress in integrating sustainability criteria but highlight critical challenges. In the biophysical and human settlement sectors, Guano faces unplanned, low-density urban sprawl characterized by two-floor buildings, which hinders infrastructure delivery. Specifically, 45.20% of properties in the San Gabriel sector lack functional sewerage connections, and 32.30% in the Langos sectors lack drinking water. Economically, private property subdivisions are rapidly reducing productive agricultural land. Conversely, the canton's social component shows significant strength through its cultural heritage and connection to the UNESCO-recognized Tungurahua Volcano Geopark. Institutionally, local ordinances exhibit weaknesses in controlling irregular land occupation and protecting green zones. The study concludes that Guano must transition from its current dispersed growth dynamic toward a compact city model to optimize public resources and preserve its rural landscape. Finally, while the canton faces clear limitations in fully achieving SDG 6 (Clean water and sanitation), SDG 8, and SDG 9, its current planning instruments show dedicated efforts toward fulfilling SDGs 11, 12, and 13.

Keywords: Territorial planning, urban planning, land use, territorial sustainability.

INTRODUCTION

The development and territorial planning plan is a strategic instrument to guide the balanced development of the territories, promote environmental sustainability, strengthen social cohesion and optimize the use of available resources. In a global context characterised by accelerated urbanisation processes, expansion of productive activities and growing vulnerability to climate change, territorial planning has acquired a fundamental role as a mechanism to guarantee more inclusive, resilient and sustainable cities and human

settlements. In this regard, various international instruments have established guidelines for national and local governments to incorporate sustainability criteria in land management.

At the macro level, the 2030 Agenda for Sustainable Development proposes a global framework for action based on 17 Sustainable Development Goals (SDGs), among which SDG 11 seeks to "make cities and human settlements inclusive, safe, resilient and sustainable" (United Nations [UN], 2015). In addition, the New Urban Agenda, adopted during the Habitat III Conference, promotes integrated planning models that favor the orderly growth of cities, efficient land management and the reduction of territorial inequalities (UN-Habitat, 2016).

At the meso level, Ecuador has incorporated these international guidelines into its national and territorial planning instruments. The National Decentralized System of Participatory Planning establishes mechanisms to articulate public policies with different levels of government, while the National Development Plan directs actions towards sustainability, territorial equity and the strengthening of local capacities. Similarly, the Development and Territorial Plan of the province of Chimborazo constitutes a key instrument for coordinating provincial development strategies and promoting adequate management of the territory according to its potentialities and limitations.

At the micro level, the Development and Territorial Planning Plan (PDOT) and the Land Use and Management Plan (PUGS) of the Guano canton, published in the Official Gazette on June 19, 2025, represent the main local planning instruments to guide urban and rural growth, regulate land use, and ensure sustainable territorial development. Therefore, it is pertinent to analyze and evaluate the degree of alignment of these instruments with current international and national regulations, identifying strengths, opportunities for improvement and possible application mechanisms.

From a diagnostic perspective, this analysis allows us to understand the importance of territorial planning as a tool for public management, as well as to generate a synthesis of recommendations that contribute to strengthening the articulation between local planning instruments and international principles of territorial sustainability, favoring a more efficient, inclusive and resilient development model for the Guano canton.

MATERIALS AND METHODS

a. Theoretical foundation

The development and land use plan is a comprehensive process aimed at organizing the occupation, use and management of the territory in a balanced manner, taking into account the environmental, economic, social and institutional dimensions. Its purpose is to promote sustainable development that meets present needs without compromising the opportunities of future generations (World Commission on Environment and Development, 1987). From this perspective, territorial planning has established itself as a strategic tool to reduce spatial inequalities, optimize the provision of services and strengthen the resilience of human settlements in the face of contemporary challenges.

At the international level, one of the main normative references is the 2030 Agenda for Sustainable Development, adopted by the United Nations (UN) in 2015. This instrument establishes 17 Sustainable Development Goals (SDGs), among which SDG 11 seeks to achieve inclusive, safe, resilient and sustainable cities and human settlements. To this end, it promotes equitable access to housing, transport, public spaces and basic services, as well as participatory and integrated urban planning (UN, 2015). The 2030 Agenda recognizes that territorial sustainability depends on the ability of governments to articulate public policies that favor orderly growth and efficient land management.

In addition, the New Urban Agenda, adopted during the Habitat III Conference held in Quito in 2016, constitutes the main global framework for sustainable urban planning. This instrument promotes compact, connected and inclusive development models, aimed at reducing urban sprawl, improving sustainable mobility and strengthening integration between urban and rural areas (UN-Habitat, 2016). It also promotes participatory territorial governance as a fundamental element to guarantee adequate management of the territory.

In relation to these international guidelines, various theoretical currents have contributed to the development of new approaches to sustainable urban planning. Among them, the theory of the 15-minute city, proposed by Carlos Moreno, stands out, which states that citizens should have access to essential services such as education, health, commerce, recreation, and employment within a maximum distance of fifteen minutes on foot or by non-motorized transport (Moreno et al., 2021). This model seeks to reduce unnecessary travel, reduce carbon emissions and strengthen social cohesion by creating multifunctional and accessible neighbourhoods.

Similarly, the Transit-Oriented Development (TOD) approach proposes to concentrate urban growth around efficient mobility corridors, promoting balanced densification and the reduction of dependence on the automobile (Calthorpe, 1993). This theory has been widely adopted as a strategy to improve territorial accessibility and reduce the environmental impacts derived from dispersed urban sprawl.

Another relevant reference is the theory of urban resilience, which raises the need to strengthen the capacity of cities to anticipate, adapt and recover from natural, economic and social phenomena (Resilience Alliance, 2010). In the current context of climate change, this approach is especially important for territorial planning, as it allows risk management and climate adaptation criteria to be incorporated into land use planning instruments.

At the national level, Ecuador has incorporated these principles through a regulatory framework aimed at promoting sustainable territorial development. The Constitution of the Republic of Ecuador (2008) establishes that planning is an obligation of the State and an instrument to guarantee Good Living, territorial equity and the conservation of natural heritage. It also recognizes the social and environmental function of property and the need to regulate land use for the benefit of the collective interest.

In addition, the Organic Code of Territorial Organization, Autonomy and Decentralization (COOTAD) assign to the Decentralized Autonomous Governments specific competences in matters of territorial planning and ordering. For its part, the Organic Law on Territorial Planning, Land Use and Management (LOOTUGS) establishes the principles and instruments to regulate the sustainable use of land, promoting compact, efficient and environmentally responsible urban development (National Assembly of Ecuador, 2016).

The application of these guidelines materialized through instruments such as the Development and Territorial Planning Plans (PDOT) and the Land Use and Management Plans (PUGS), which are fundamental tools to guide the growth of the territories, define sustainable occupation models and guarantee the articulation between national policies and local needs.

In this context, sustainable territorial planning requires integrating the principles established by the 2030 Agenda, the New Urban Agenda and Ecuadorian regulations with contemporary approaches such as the 15-minute city, sustainable transport-oriented development and urban resilience. The convergence of these instruments and theories makes it possible to build more inclusive, efficient territories adapted to the environmental and social challenges of the 21st century, strengthening the capacity of local governments to promote balanced and sustainable development processes.

In the territorial context of the year 2026, the Guano canton faces important challenges and opportunities linked to the consolidation of a sustainable and balanced development model. Located in the province of Chimborazo, Guano is characterized by a predominantly rural territorial structure, significant heritage, cultural and landscape wealth, and an economy based on agricultural, handicraft, commercial and tourist activities. Its strategic location within the provincial urban system gives it a relevant role in the functional articulation with the Riobamba canton and with the regional mobility corridors. However, the territory presents problems associated with dispersed urban expansion, pressure on agricultural areas, limitations in the coverage of infrastructure and basic services in the rural sectors, as well as exposure to natural hazards derived from their complex geographical and environmental configuration.

b. Methodology

This research will be developed through a mixed methodological approach, integrating qualitative and

quantitative methods to analyze the articulation between international and national regulations and territorial planning instruments applied in the Guano canton. This approach will make it possible to combine the interpretation of regulatory documents with the objective assessment of criteria related to territorial sustainability.

From the qualitative approach, a documentary analysis of the main regulations and instruments of territorial planning in force at the international, national and local levels will be carried out. Among the documents that will be reviewed are the 2030 Agenda for Sustainable Development, the New Urban Agenda, the Constitution of the Republic of Ecuador, the Organic Code of Territorial Organization, Autonomy and Decentralization (COOTAD), the Organic Law of Territorial Planning, Use and Management of Land (LOOTUGS), the National Development Plan, the Development and Territorial Planning Plan (PDOT) of the province of Chimborazo and the PDOT and Use and Management Plan of the Guano canton. The analysis will be aimed at identifying principles, objectives, guidelines and strategies related to sustainable development, land management, mobility, territorial resilience and participatory governance.

From the quantitative approach, a comparative evaluation matrix will be developed to determine the level of correspondence between local planning instruments and the criteria established by international and national regulations. To this end, analysis variables related to environmental sustainability, social inclusion, sustainable mobility, risk management, efficient land use and territorial governance will be defined. Each criterion will be assessed using a compliance scale, allowing the identification of strengths and opportunities for improvement in the planning instruments studied.

The methodological procedure will be developed in the following stages:

1. Document review

Bibliographic, regulatory and technical information related to sustainable land use planning will be collected and analyzed, considering international, national and local references, as well as contemporary approaches to urban planning.

2. Systematization of information

The information obtained will be organized through documentary analysis sheets and a comparative matrix based on criteria of territorial sustainability, land management and urban resilience.

3. Analysis of planning instruments

The correspondence between the Development and Territorial Planning Plan (PDOT) and the Land Use and Management Plan (PUGS) of the Guano canton will be evaluated with respect to the principles and guidelines of sustainable planning.

4. Interpretation of results

Strengths, limitations and opportunities for improvement of the instruments analyzed will be identified, formulating recommendations aimed at strengthening the management and sustainable territorial planning of the canton.

The application of this methodology will allow obtaining a comprehensive vision of the degree of alignment of the territorial planning instruments of the Guano canton with contemporary approaches to sustainable development, constituting a technical basis for the formulation of proposals and recommendations that contribute to the strengthening of territorial management and urban and rural sustainability.

RESULTS

The analysis of the Development and Territorial Planning Plan (PDOT) and the Land Use and Management Plan (PUGS) of the Guano canton made it possible to identify important advances in the incorporation of territorial sustainability criteria; however, it also evidenced various problems that limit the consolidation of a balanced and sustainable development model.

In relation to the biophysical component, deficiencies were identified in the coverage and functionality of basic services, particularly in consolidated urban sectors. A representative case corresponds to the San Gabriel sector of the Airport, where approximately 45.20% of the properties have sewerage networks that are not connected to a functional collector system, reducing the effectiveness of the service. Similarly, in the Langos San Miguel and Langos La Inmaculada sectors, it was evident that around 32.30% of the properties lack access to drinking water. It was also observed that the construction of new roads in areas with fragile geological characteristics has increased susceptibility to landslides and landslides. These conditions, added to processes of unplanned urban expansion, have generated pressures on natural ecosystems, causing environmental degradation and the affectation of wildlife habitats.

Regarding the economic component, the results show a growing transformation of the traditional productive uses of rural land. The proliferation of property subdivisions promoted by private initiatives has contributed to the progressive reduction of the areas destined for agricultural production. This dynamic has generated a loss of agricultural land and the displacement of commercial activities linked to the primary sector to peripheral areas or even outside the canton, affecting the local economic structure and compromising the sustainability of traditional productive activities.

In the social component, an important strength related to the cultural, historical and tourist heritage of the canton was identified. The PDOT recognizes this potential and proposes strategies to take advantage of it as an engine of local development. In this context, the link of the territory with the Tungurahua Volcano Geopark, internationally recognized by UNESCO, stands out, which represents an opportunity to strengthen sustainable tourism, environmental education and the valorization of natural and cultural resources. However, the use of these resources requires adequate planning to guarantee their conservation and long-term sustainability.

As for the human settlement's component, insufficient regulation of urban growth was evidenced. The expansion of residential areas between the urban parishes of La Matriz and El Rosario reflects a process of dispersed occupation that has exceeded the capacity to provide infrastructure and services. As a consequence, deficits are identified in mobility, public transport, equipment and coverage of basic services, generating conditions that limit the quality of life of the population and make it difficult to comply with the principles of compact and sustainable cities promoted by international planning instruments.

Finally, in the political-institutional component, the analysis shows limitations in the application of the current regulatory mechanisms. The "Substitute Ordinance to the First Reform to the Substitute Ordinance that Regulates the Use and Occupation of the Land of the Guano Canton" presents weaknesses to guarantee the effective protection of green areas and conservation areas, control processes of unplanned urban expansion and adequately sanction irregularities related to the use and occupation of the land. This situation highlights the need to strengthen regulatory instruments and territorial control mechanisms to ensure more efficient land management aligned with the sustainability principles established in the PDOT and the PUGS.

CONCLUSIONS

The Ecuadorian regulatory framework, mainly made up of the Constitution of the Republic of Ecuador, COOTAD and LOOTUGS, provides the necessary guidelines for territorial planning and risk management; however, its effective application depends on the technical, administrative and financial capacity of the Decentralized Autonomous Governments.

Territorial planning instruments, such as PDOT and PUGS, are key elements to guide the appropriate use of land and promote a more balanced and sustainable territorial development.

The analysis of the case of the Latacunga canton shows that the incorporation of risk management in territorial planning is essential to strengthen the sustainability of the territory, optimize response mechanisms to adverse events and contribute to the well-being of the population.

The reduction of vulnerabilities in the face of natural hazards requires the participation of citizens, efficient institutional management and the application of preventive strategies that contribute to the construction of safer and more resilient territories.

Plan (PUGS) of the Guano canton made it possible to identify progress in the incorporation of territorial sustainability criteria; however, challenges persist that limit the consolidation of an efficient and sustainable urban development model. The main problems are related to the insufficient coverage of basic services, unplanned urban expansion, the reduction of productive land and weaknesses in the mechanisms of control and regulation of land use.

One of the most relevant findings is that the canton maintains an extensive and dispersed growth dynamic, characterized by low-density buildings, with an average height of two floors. This model increases land consumption, hinders the efficient provision of infrastructure and services, and generates higher costs for public administration. In this context, it is necessary to orient territorial development towards a compact city model that optimizes land use, strengthens urban connectivity and reduces pressure on rural and environmental areas.

Similarly, it is evident that urban growth has been mainly influenced by real estate dynamics associated with property subdivision processes, which has favored the expansion of urban sprawl over agricultural areas. Considering the landscape, cultural and environmental value of the territory, future planning should prioritise a vision of the city based on the urban and territorial landscape, making sustainable use of its heritage and natural resources as factors of economic and social development.

Finally, with respect to the Sustainable Development Goals (SDGs), it is concluded that the canton still has limitations to fully comply with SDG 6 (Clean water and sanitation), as well as SDGs 8 and 9 related to sustainable economic growth, innovation and infrastructure. However, the planning instruments show efforts aimed at meeting SDGs 11, 12 and 13, through actions focused on urban sustainability, responsible management of resources and adaptation to climate change.

Conflict of Interest Statement

The authors declare no conflicts of interest regarding the research, authorship, and/or publication of this article.

Ethical Approval / Informed Consent Statement

This study used documentary and regulatory information, public statistical data, and field observation in open spaces, without involving human subjects or identifiable personal data. Therefore, individual informed consent was not required. All information was handled in accordance with research ethics principles and good practices, avoiding disclosure of sensitive data and respecting regulations on access to public information.

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