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ORIGINAL

Environmental Management of the Coastal Boundary: Sustainable Solutions for the Green Area Deficit in Manta

Gestión ambiental del Límite Costero: Soluciones Sostenibles para el Déficit de Áreas Verdes en Manta

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ABSTRACT

This study analyzes the current state of green areas along the coastal boundary of the city of Manta, Ecuador—a zone undergoing rapid urbanization with negative consequences for environmental sustainability. Using a mixed methodological approach of a non-experimental and cross-sectional nature, which combined spatial analysis, direct observation, interviews, and regulatory review, the study identified a fragmented and limited distribution of green spaces, particularly in areas such as Playa Murciélago, Barbasquillo, and the Malecón. The results reveal high levels of environmental degradation, loss of ecosystem services, pollution, and poor ecological connectivity—factors that impact both biodiversity and citizen well-being. Furthermore, the study identified uncontrolled urbanization, persistent environmental pollution, and the effects of climate change as structural causes of the deficit. The research proposes technical and legal guidelines focused on ecological restoration and sustainable urban planning, including the implementation of green infrastructure and participatory environmental governance mechanisms. It concludes that the coordination of public policies, land-use planning, and citizen participation is essential to revalue the coastal landscape as a common good of high ecological, cultural, and social value, thereby ensuring a fairer and more resilient urban development for the city of Manta.

Keywords: Green Areas; Climate Change; Urban Coast; Green Infrastructure; Territorial Planning.

RESUMEN

El presente estudio analiza el estado actual de las áreas verdes en el límite costero de la ciudad de Manta, Ecuador, una zona que enfrenta un acelerado proceso de urbanización con consecuencias negativas para la sostenibilidad ambiental. A partir de un enfoque metodológico mixto de tipo no experimental y transeccional, que combinó análisis espacial, observación directa, entrevistas y revisión normativa, se identificó una distribución fragmentada y limitada de espacios verdes, especialmente en sectores como Playa Murciélago, Barbasquillo y el Malecón. Los resultados evidencian altos niveles de deterioro ambiental, pérdida de servicios ecosistémicos, contaminación, y escasa conectividad ecológica, factores que afectan tanto la biodiversidad como el bienestar ciudadano. Asimismo, se establecieron como causas estructurales del déficit la urbanización descontrolada, la persistente contaminación ambiental y los efectos del cambio climático. El estudio propone lineamientos técnicos y legales enfocados en la restauración ecológica y la planificación urbana sostenible, incluyendo la implementación de infraestructura verde y mecanismos de gobernanza ambiental participativa. Se concluye que la articulación entre políticas públicas, planificación territorial y participación ciudadana es fundamental para revalorizar el paisaje costero como un bien común de alto valor ecológico, cultural y social, garantizando así un desarrollo urbano más justo y resiliente para la ciudad de Manta.

Palabras clave: Áreas Verdes; Cambio Climático; Costa Urbana; Infraestructura Verde; Planificación Territorial.

INTRODUCTION

The city of Manta, located in the province of Manabí, Ecuador, is consolidating its position as an urban, port, and tourist center of growing importance in the country. However, it faces a structural deficit of green areas, a common problem in Latin American cities, but especially acute in coastal areas subject to urban and tourist pressures. Aguilar et al.[1] argue that this deficiency has been a constant feature of different local administrations and that its resolution requires profound changes in public policies, accompanied by comprehensive strategies that promote sustainable models.

This deficiency represents one of the great challenges for the city, given that green spaces play a vital role in environmental balance and citizen well-being. Muñoz[2] highlights that these areas not only improve air quality and regulate urban temperature, but also have positive effects on mental health, social cohesion, and economic development. In particular, they function as natural infrastructure that mitigates the impact of climate change, regulates the water cycle, and reduces air pollution.[3]

The situation on the coastal edge of Manta reflects a complex problem: uncontrolled urban expansion, land speculation, and the absence of effective environmental policies have limited the presence of vegetation, directly affecting local biodiversity, ecosystem services, and social dynamics in the area. Warns that the lack of urban green space in coastal areas contributes to erosion, harms native fauna and flora, and compromises productive activities such as artisanal fishing and community tourism. It also reduces recreational opportunities for the population, deteriorating the social fabric and affecting general well-being.

According to the World Health Organization[4], a minimum of 9 m^2 of green space per inhabitant is recommended, a figure that is not met in many areas of Manta. This deficiency contravenes the guidelines established in Manta's Land Use and Development Plan (PDOT) which highlights the need to integrate environmental sustainability criteria into urban design. Morales López et al.[5] emphasize that it is essential to accurately diagnose the current state of urban green areas, especially in vulnerable areas such as the coastal boundary, in order to guide decision-making and prevent further territorial imbalances.

Furthermore, research such as that agrees that inequality in the distribution of green areas reinforces processes of urban segregation and affects the quality of life of the most vulnerable sectors. This inequality is not only a response to socioeconomic and legal dynamics, but also to a lack of inclusive planning that recognizes ecosystem services as fundamental collective rights.

In this context, the present study aims to diagnose the current state of green areas located on the coastal boundary of Manta, identify the main causes of their deficit, and propose strategic guidelines for their planning and sustainable conservation. The research adopts a mixed approach that combines qualitative and quantitative tools, integrating spatial analysis, direct observation, interviews with key actors, and regulatory review.[6] This approach seeks not only to contribute to academic knowledge on urban environmental management, but also to offer a concrete proposal for the ecological and functional recovery of this coastal strip, promoting citizen participation, environmental justice, and territorial equity.

METHOD

The purpose of this study was to analyze the current state of green areas on the coastal boundary of Manta, identify the main causes of their deficit, and propose strategic guidelines to guide their planning and conservation from a sustainable and territorially contextualized approach.

The methodological design of the research was non-experimental, cross-sectional, and mixed, which allowed for the observation and analysis of the current characteristics of the environment without modifying the variables studied, integrating qualitative and quantitative approaches for a broader understanding of the phenomenon.[7] This methodology allowed for the triangulation of various sources of information, combining spatial analysis with social interpretation and proposing solutions based on empirical evidence.

Phase 1: Spatial and physical diagnosis of the territory

To meet the proposed objectives, a detailed assessment of the state of green areas along the city's coastal strip was carried out. Geospatial analysis tools such as cadastral maps and satellite images were used, which allowed for the accurate identification of the distribution, accessibility, and quality of green spaces in relation to urban density and existing infrastructure.

The study area was georeferenced based on a 5-kilometer-long strip between the Playita Mía beach resort and the Barbasquillo sector, with an analysis width of 500 meters. This delimitation was mapped using the database developed by the GEIM Group, allowing the observations to be supported by visual and spatial evidence (figure 1).

As a reference parameter, the international standard proposed by the World Health Organization[4] was considered, which recommends a minimum availability of 9 m^2 of green areas per inhabitant to ensure the physical, mental, and environmental well-being of the urban population.

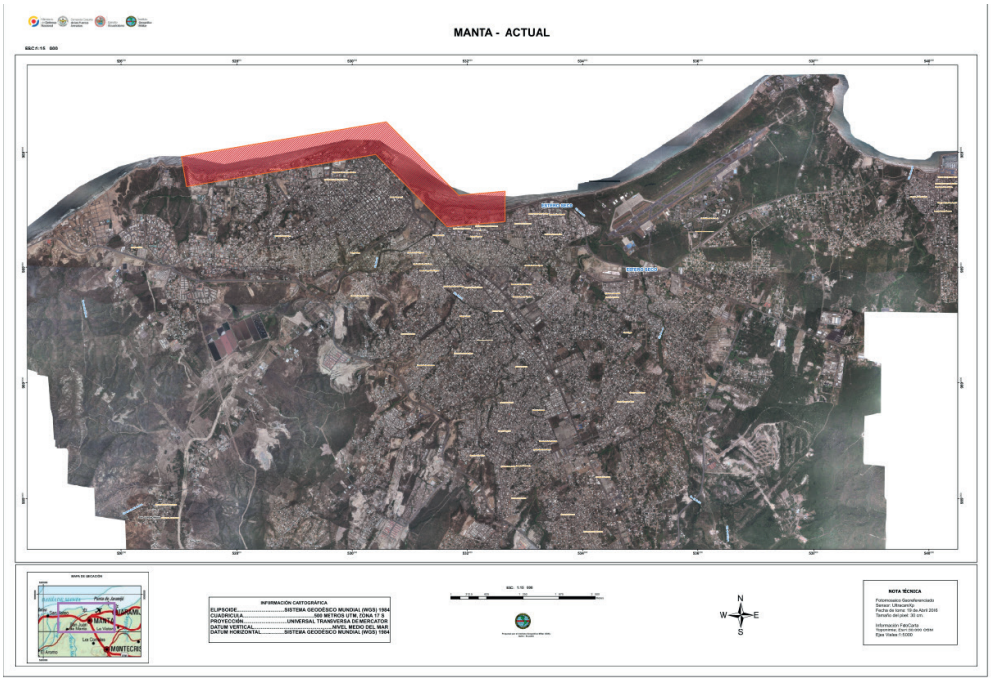

Figure 1. Study area of the coastal boundary of the city of Manta

Phase 2: Qualitative assessment of causes and perceptions

Subsequently, a qualitative analysis process was developed to identify the structural, regulatory, and social factors that have contributed to the deficit of green areas on the coastal boundary. To this end, an analysis matrix was developed to evaluate variables such as uncontrolled urban expansion, informal land occupation, lack of environmental policies, and loss of key ecosystem services, following Chiesura[7] proposal on the importance of the intangible value of green spaces.

Data collection was carried out using a customized format (annex 1), which included direct observation, photographic records, and on-site assessment of vegetation cover and physical conditions of the environment. This tool was complemented by documentary analysis and participatory mapping, which ensured the validity of the instrument and its alignment with local conditions.[8]

In addition, elements of the green infrastructure approach proposed by Tzoulas et al.[3] were considered, understanding green areas as functional ecological networks that promote both ecosystem health and human well-being, especially in areas with increasing urban pressure such as the Manta coast.

Phase 3: Proposal of technical and legal guidelines

Based on the findings obtained in the previous phases, strategic technical and regulatory guidelines were developed, aimed at the comprehensive and participatory management of green areas on the coast. Current environmental legislation in Ecuador was reviewed, as well as local planning instruments such as the PDOT and the Land Use and Management Plan (PUGS), identifying opportunities for improvement in the regulation and conservation of the urban coastal landscape.

In addition, successful experiences documented in local studies[9] on urban environmental restoration and the recovery of community recreational spaces were analyzed. These cases served as references for structuring viable proposals that could be adapted to the context of Manabí.

The integration of sociodemographic variables, spatial data, and qualitative analysis allowed for the identification of territorial patterns of environmental inequality, reinforcing the need to adopt an approach based on spatial justice and equity in access to ecosystem services.

RESULTS AND DISCUSSION

Rapid urban growth in the coastal ecosystems of Manta has created a critical situation in terms of the presence, quality, and distribution of urban green areas. The territorial diagnosis revealed a fragmented and limited distribution of vegetated areas, especially in key sectors such as Playa Tarqui, Playa Murciélago, Playa Los Esteros, the Malecón, and Playa Barbasquillo. These areas showed little ecological continuity, which affected their ecosystem functionality and reduced their capacity to provide sustainable environmental and social benefits.[3]

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Environmental degradation and loss of ecosystem services

From a qualitative perspective, records made between April 14 and 18, 2025 revealed visible signs of environmental deterioration. High levels of pollution, progressive loss of native vegetation, accumulation of solid waste, soil erosion, and a decline in local wildlife were documented. In the Barbasquillo sector, for example, a pattern of disorganized urbanization and absence of natural buffer zones was observed, which affected both the ecological environment and community well-being (figure 2).

Figure 2. Visualization of the deficit of green areas in the Barbasquillo sector

The analysis of ecosystem services revealed significant impacts on the four fundamental components:

- Provision: reduced access to fresh water, loss of useful vegetation cover, and reduced availability of local raw materials.
- Regulation: reduced capacity to mitigate urban temperatures, increased risk of seasonal flooding, and deterioration of air quality.
- Supporting: fragmentation of natural habitats essential for biodiversity.
- Cultural: loss of spaces for recreation, contemplation, and nature tourism.

These impacts affect the health and well-being of the population, generating urban stress, social isolation, loss of territorial identity, and a general deterioration of environmental quality, in contravention of the standards recommended by the World Health Organization.[4]

Structural factors contributing to the green space deficit

The study identified three main structural factors as causes of the green space deficit in Manta:

1. Uncontrolled urbanization: the main trigger for deterioration, due to an expansion model based on tourist and commercial infrastructure without sustainability criteria. In Flavio Reyes, intense land occupation with little vegetation and a clear disconnect between the urban fabric and the coastal ecosystem were identified (figure 3).

Figure 3. Visualization of the green space deficit in the Flavio Reyes sector

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2. Environmental pollution: the second critical factor, with levels of impact ranging from 40 % to 60 % depending on the sector analyzed. An accumulation of solid waste was observed in beach areas, irregular sewage discharges, and the presence of microplastics in recreational areas, which aggravated environmental degradation. On the Malecón, the loss of plant and animal species was significant, accompanied by a noticeable decrease in ecological connectivity. These processes were exacerbated by sea level rise, heavy rainfall, and changes in weather patterns, which accentuated the vulnerability of the coastal ecosystem (figure 4).

Figure 4. Visualization of the deficit of green areas in the Malecón sector

3. Climate change: the cumulative effects of global warming—such as coastal erosion and soil salinization—have increased the ecological and social vulnerability of the coastal zone.

In sectors such as Playa Murciélago, records showed vegetated areas that did not exceed the minimum required per inhabitant, with conditions that hindered both physical accessibility and ecological connectivity. This compromised the mobility of wildlife and citizens, directly affecting the biodiversity and recreational functionality of the space (figure 5).

Figure 5. Visualization of the green space deficit in the Playa Murciélago sector

Similarly, although projects such as the Agustín Intriago Megapark have begun to be implemented, areas such as Espigón still have significant gaps in green infrastructure, landscape fragmentation, and lack of functional integration between green areas (figure 6). This shows that, while there are some initial efforts, systemic planning is still needed to achieve impactful results.

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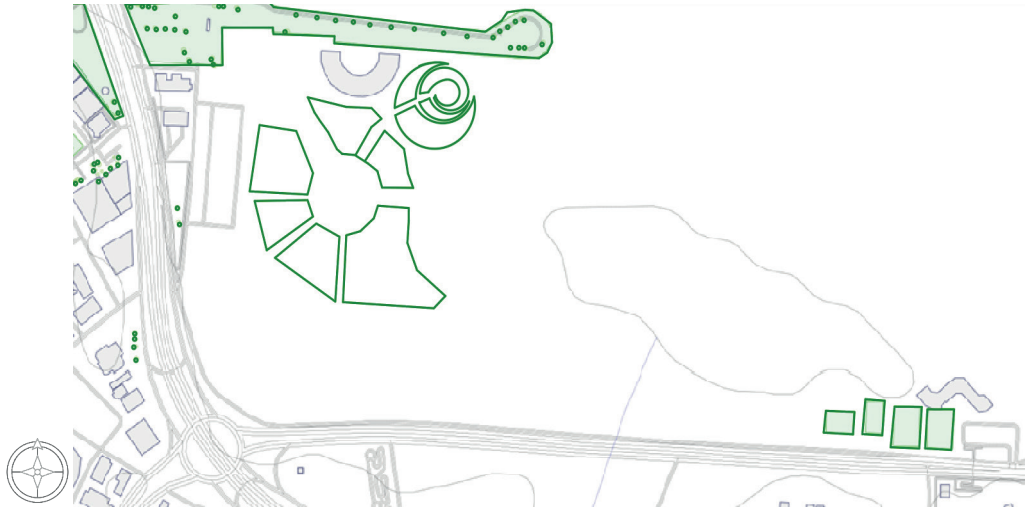

Figure 6. Visualization of the green space deficit in the Espigón sector

Economic and social implications

The effects of this deterioration were also evident from an economic perspective. The loss of landscape value, pollution of tourist areas, and degradation of public spaces affected Manta's tourist appeal, leading to a reduction in local income from tourism and informal trade. Likewise, traditional productive activities such as artisanal fishing and subsistence agriculture were affected by the deterioration of natural resources, exacerbating the fragility of the local economy and widening inequality gaps.

At the social level, the lack of green spaces directly affected the physical and mental health of residents, limited opportunities for recreation and contact with nature, and reduced community gathering spaces, especially in low-income areas that lack private alternatives for leisure. This green infrastructure deficit also disproportionately affected children, older people, and women caregivers, who rely more on public spaces for their daily routines.

Proposal for participatory ecological restoration

Given this situation, the need to establish comprehensive urban environmental management guidelines that integrate land-use planning with ecological restoration was reaffirmed. One of the proposed strategies was the implementation of green infrastructure, understood as a set of nature-based solutions that restore the ecological functionality of the coastline and ensure its long-term sustainability. The creation of biological corridors, coastal linear parks, and vegetated buffer zones was proposed to act as ecological filters and functional connectors between fragments of existing ecosystems.

According to Guzmán et al.[10], citizen participation is key to ensuring the sustainability of environmental interventions. In this regard, it was proposed to promote community monitoring networks, neighborhood green management committees, and participatory budgeting mechanisms that actively involve citizens in the design, implementation, and maintenance of green areas. This participation not only strengthens territorial appropriation but also contributes to the creation of a shared environmental culture.[11,12]

In short, it was considered essential to generate a comprehensive technical proposal based on a critical reading of the territory, taking into account factors such as:

- Local climatic and ecological conditions.
- Urban dynamics and land use.
- The degree of vulnerability to phenomena such as coastal erosion, soil salinization, and sea level rise.
- And effective mechanisms for participatory environmental governance.

The articulation of these elements would make it possible to reduce the gaps in current planning and lay the foundations for a resilient, inclusive, and environmentally conscious urban model that revalues the coastal landscape not only as a physical space but also as a common good of high ecological, cultural, and social value for the city of Manta.[13,14]

CONCLUSIONS

This study revealed a progressive deterioration of ecosystem functions in the coastal area of the city of Manta, as a result of disorderly urban expansion, poor environmental planning, and weak implementation of sustainable policies. The green areas evaluated did not meet recommended international standards, were

fragmented, and showed a worrying lack of ecological connectivity, which limited both their environmental functionality and social accessibility.

The loss of vegetation cover, habitat fragmentation, and the absence of ecological corridors have compromised the resilience of the coastal ecosystem, affecting its capacity for natural regeneration. This scenario has been exacerbated by pollution from fishing activities, inadequate solid waste management, the lack of efficient wastewater treatment systems, and the effects of climate change, whose impact on erosion and salinization has become increasingly evident.

From a social perspective, the scarcity of green spaces had a direct impact on the physical and psychological well-being of the population, reducing opportunities for leisure, recreation, and contact with nature. The most vulnerable communities, with less access to private leisure spaces, were particularly affected, widening environmental inequality gaps.

In view of this situation, it is recommended that coastal ecological restoration projects be implemented, including sustainable drainage systems, the creation of biological corridors, wildlife observatories, and vegetated buffer zones. These actions, in addition to mitigating ecological impacts, could become new sustainable tourist attractions for the city.

Despite recent initiatives such as the Agustín Intriago Megapark, the shortage of urban green spaces in Manta remains significant. This study is therefore an urgent call to action for local governments, academic institutions, and civil society to promote an environmentally responsible urban development model. Revaluing the coastal landscape as a common good of high ecological, cultural, and social value is essential to ensuring the sustainability of the city and the quality of life of its inhabitants.

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FINANCING

None.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Joel Ricardo Alvia Fiallos, Gina San Andrés-Zevallos.
Drafting - original draft: Joel Ricardo Alvia Fiallos, Gina San Andrés-Zevallos.
Writing - proofreading and editing: Joel Ricardo Alvia Fiallos, Gina San Andrés-Zevallos.

ANNEXES

USGP UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO	**UNIVERSIDAD SAN GREGORIO DE PORTOVIEJO**					
	Estudiante:	*Alvia Fiallos Joel Ricardo*				
	Ficha de Levantamiento de Información por Falta de Servicios Ecosistémicos					
UBICACIÓN						
FECHA						
DESCRIPCIÓN DEL PROBLEMA						
CAUSAS DE LA DEFICIENCIA	Urbanización		Contaminacion		Cambio Climatico	
SERVICIOS ECOSISTEMICOS AFECTADOS	**Provición:** Agua dulce, alimentos, materia prima			**Regulación:** Calidad de aire, control de inundaciones		
	Nivel de Afectación			Nivel de Afectación		
	Alto	Moderado	Bajo	Alto	Moderado	Bajo
	Soporte: Conservación de flora y fauna			**Cultural:** Turismo, actividades recreativas		
	Nivel de Afectación			Nivel de Afectación		
	Alto	Moderado	Bajo	Alto	Moderado	Bajo
IMPACTOS ECOLOGICOS	Biodiversidad			Ecosistema		
IMPACTOS ECONOMICOS	Agricultura			Turismo		
IMPACTOS SOCIALES						
MEDIDAS DE MITIGACIÓN						
PROYECTOS SUGERIDOS						
ESTADO ACTUAL						

Appendix 1. Data collection form designed by the author

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