

Improvement of Public Space and Mobility in Sauces, Tarqui

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Abstract— This study presents a territorial diagnosis of the Sauces 3, 4, 5, 6, 7, and 9 sectors located in the Tarqui parish of Guayaquil, Ecuador, with the purpose of identifying the principal urban, environmental, and mobility-related challenges affecting the quality of life and territorial sustainability of the area. The research responds to the growing pressures generated by traffic congestion, inadequate stormwater drainage, occupation of public spaces, reduction of green areas, and expansion of informal commercial activities within a highly consolidated urban environment. The study employed a mixed-methods approach integrating field observation, territorial mapping, documentary review, demographic analysis, and interpretation of municipal planning instruments including the PDOT and PUGS. The territorial analysis was structured through five interconnected subsystems: biophysical-environmental, socioeconomic, human settlements, mobility-connectivity, and political-institutional. The findings reveal that the Sauces sector possesses important territorial strengths, including consolidated infrastructure, strategic urban connectivity, and active neighborhood economic activity. However, significant vulnerabilities persist due to flooding risks, vehicular saturation, insufficient public spaces, weak enforcement of land-use regulations, and conflicts associated with informal occupation of urban space. The study concludes that sustainable territorial planning in Sauces requires integrated urban management strategies focused on mobility improvement, environmental resilience, recovery of public spaces, and stronger institutional coordination. The diagnosis provides technical criteria that may support future urban interventions and sustainable territorial planning processes within the northern sector of Guayaquil.

Keywords: Territorial planning, urban mobility, public space, socio-environmental vulnerability, sustainable development.

INTRODUCTION

Importance and Context

The study area made up of the Sauces 3, 4, 5, 6, 7, and 9 sectors, located in the Tarqui parish in Guayaquil, is considered one of the most representative urban territories in the north of the city due to its level of consolidation, population density, and socioeconomic activity. With an approximate area of 2.27 [km] ², this area has residential, commercial, recreational and service uses that articulate the daily life of more than 70,000 inhabitants. The importance of diagnosing this territory lies in the identification of problems that affect its functioning, such as traffic congestion, insufficient storm drainage, informal commerce, the deterioration of public spaces and pressure on existing infrastructure, aspects evidenced in the preliminary analysis of the sector.

In the provincial and urban context of the Guayaquil canton, the north of the city has been recognized in planning instruments as a key space that requires interventions aimed at improving mobility, strengthening land management and optimizing urban facilities, which reinforces the relevance of this diagnosis.

LITERATURE REVIEW

Urban territorial planning has become an essential component of sustainable development strategies in rapidly urbanizing cities. Contemporary planning approaches emphasize the importance of balancing economic growth, environmental sustainability, mobility, and social equity through integrated territorial management (UN-Habitat, 2022). In Latin American metropolitan areas, accelerated urban expansion has intensified challenges associated with informal settlements, infrastructure pressure, traffic congestion, environmental degradation, and unequal access to public spaces and urban services.

According to Gómez Orea (2007), territorial planning involves the systematic interpretation of territorial dynamics to identify risks, limitations, opportunities, and development potentialities. This process supports evidence-based decision-making and facilitates the design of sustainable interventions adapted to local territorial conditions. From this perspective, territorial diagnosis represents a key methodological instrument for understanding the interaction between environmental, social, economic, and institutional systems within urban territories.

Socio-environmental vulnerability has become increasingly relevant in urban studies due to the effects of uncontrolled urbanization and climate-related risks. Hardoy, Mitlin, and Satterthwaite (2001) explain that inadequate drainage systems, excessive soil sealing, reduction of green areas, and informal occupation of land significantly increase urban exposure to flooding and environmental deterioration. These conditions are particularly visible in densely populated sectors where infrastructure capacity is insufficient to respond to growing urban demands.

Urban mobility and public space management are also central elements of sustainable territorial planning. Cervero (2013) argues that territories characterized by mixed land use and commercial concentration frequently experience traffic saturation, pedestrian insecurity, and deterioration of urban functionality when mobility planning is limited or fragmented. Similarly, the recovery and protection of public spaces contribute directly to social cohesion, environmental quality, and urban livability.

Within Ecuador, territorial governance is regulated through legal and planning instruments such as the Constitution of Ecuador (2008), the Código Orgánico de Organización Territorial, Autonomía y Descentralización (COOTAD), and the Ley Orgánica de Ordenamiento Territorial, Uso y Gestión de Suelo (LOOTUGS). These frameworks establish principles related to sustainability, citizen participation, equitable land use, and territorial resilience. At the municipal level, the PDOT and PUGS of Guayaquil define planning guidelines associated with mobility, land use, infrastructure development, environmental management, and public space organization.

The present study contributes to the territorial planning literature by analyzing the urban dynamics of the Sauces sector in Tarqui, Guayaquil, through an integrated territorial diagnosis approach. The research examines how mobility conflicts, environmental vulnerability, public space occupation, and institutional limitations interact within a consolidated urban environment, generating challenges and opportunities for sustainable territorial intervention.

Research Objectives

The general objective of the study is to characterize the current state of the territory made up of the Sauces 3, 4, 5, 6, 7 and 9 sectors, in order to understand its functioning and the conditions that influence its urban development. To achieve this purpose, five specific objectives are proposed, each one associated with the territorial subsystems used in the analysis. The physical subsystem that seeks to identify the natural conditions

and risks present, especially those related to low altitude and the possibility of flooding. From the socioeconomic subsystem, it is intended to recognize the population characteristics and the economic activity that is concentrated in neighborhood businesses, entrepreneurship and legal markets.

The settlement subsystem looks at urban structure, existing facilities and land use, while the mobility subsystem looks at routes, streets, public transport and the difficulties generated by rush hour traffic. Finally, the institutional subsystem evaluates the regulatory framework and the participation of local organizations such as the Municipal GAD of Guayaquil and the Parish Council of Tarqui.

Scope

It comprises an area of approximately 227 hectares, covering the six stages of the Sauces sector, whose cartographic and administrative delimitation is detailed in the base document. The analysis corresponds to the year 2025, considering recent information collected in the field, review of municipal cartography and current urban regulations. The methodological scope is structured based on the detailed study of the five territorial subsystems mentioned, integrating data collection, qualitative and quantitative analysis, geographical interpretation, direct observation and review of instruments such as the PDOT, PUGS and ordinances related to land use, buildings and public space. This approach allows us to understand both the internal dynamics of the sector and its relationship with the urban structure of northern Guayaquil.

MATERIALS AND METHODS

Research Approach

This study employed a mixed-methods approach integrating qualitative and quantitative techniques to analyze the territorial dynamics of the Sauces 3, 4, 5, 6, 7, and 9 sectors located in the Tarquí parish of Guayaquil, Ecuador. The methodological approach was selected to provide a comprehensive understanding of the environmental, social, economic, mobility, and institutional conditions affecting the study area. The qualitative component included direct field observation, photographic documentation, spatial reconnaissance, and interpretation of urban dynamics associated with public space occupation, informal commerce, traffic congestion, and environmental vulnerability. The quantitative component incorporated demographic information, territorial indicators, municipal cartography, and regulatory analysis obtained from official planning instruments and institutional databases. Demographic and territorial indicators were complemented using information obtained from the National Institute of Statistics and Census (INEC, 2022).

Study Area

The study area comprises approximately 2.27 km² within the northern sector of Guayaquil and includes the Sauces 3, 4, 5, 6, 7, and 9 sectors. The territory is characterized by a predominantly flat topography, high urban consolidation, mixed residential and commercial land use, and direct connectivity to major transportation corridors such as Avenida Isidro Ayora and Avenida Benjamín Carrión.

The area presents important urban functionality due to its commercial activity, population density, and strategic location within the metropolitan structure of Guayaquil. However, it also exhibits environmental and infrastructural challenges associated with flooding risk, vehicular saturation, limited public spaces, and increasing pressure on urban services.

DATA COLLECTION

Primary data collection included:

- Direct field observation of territorial conditions
- Photographic documentation of public spaces, mobility conflicts, and environmental conditions
- Spatial reconnaissance and identification of urban dynamics
- Informal observation of commercial and pedestrian activity
- Verification of infrastructure and drainage conditions

Secondary information sources included:

- PDOT and PUGS planning instruments of Guayaquil
- Constitution of Ecuador (2008)
- COOTAD and LOOTUGS regulations
- Municipal ordinances related to land use and urban management
- Territorial cartography and demographic information
- Institutional and urban planning documents

Territorial Subsystems

The territorial diagnosis was structured through five interconnected subsystems:

Biophysical Subsystem

Analysis of climate conditions, relief, vegetation coverage, drainage systems, and environmental risks associated with flooding.

SOCIOECONOMIC SUBSYSTEM

Examination of demographic characteristics, neighborhood economic activity, informal commerce, and social dynamics.

Human Settlements Subsystem

Evaluation of housing conditions, land occupation patterns, urban density, public services, and urban infrastructure.

Mobility and Connectivity Subsystem

Analysis of road networks, traffic congestion, pedestrian circulation, public transportation accessibility, and territorial connectivity.

Political-Institutional Subsystem

Review of territorial regulations, municipal planning instruments, institutional coordination, and citizen participation processes.

Analysis Tools

The study incorporated geographic and analytical tools to support territorial interpretation and problem identification. Google Earth and ArcGIS were used for spatial analysis, territorial delimitation, and interpretation of urban cartography. Microsoft Excel was utilized to organize territorial indicators and demographic information, while documentary analysis supported the interpretation of planning regulations and institutional frameworks.

An integrated territorial matrix was developed to identify relationships between urban conflicts, territorial effects, root causes, and affected subsystems. This analytical process facilitated a comprehensive understanding of the interactions between environmental vulnerability, mobility limitations, informal occupation of public spaces, and institutional management challenges within the study area.

RESULTS

Biophysical Subsystems

The study area presents predominantly flat topography with minimal elevation variation, conditions that facilitate urban occupation but simultaneously increase environmental vulnerability associated with surface water accumulation. The climate is classified as humid tropical, with average annual temperatures ranging between 25°C and 27°C and rainfall levels concentrated primarily during the rainy season between January and April.

The analysis identified limited vegetation coverage and a low proportion of consolidated green areas within the territory. Existing vegetation is dispersed and insufficient to provide significant environmental regulation or thermal mitigation. In addition, the presence of secondary drainage channels and deficient stormwater infrastructure contributes to recurrent flooding problems during periods of intense precipitation.

IDENTIFIED PROBLEMS

Reduction of Vegetation Coverage and Green Areas

A considerable portion of the territory lacks adequate vegetation and public green spaces. Several areas originally intended for recreational or ecological purposes have been progressively occupied by parking activities or informal urban uses.

Impact:

The reduction of vegetation contributes to increased environmental temperatures, deterioration of urban landscape quality, and limited recreational opportunities for residents.

Flooding Vulnerability

Multiple sectors experience recurrent water accumulation due to deficient stormwater drainage systems, flat terrain conditions, and inadequate urban runoff management.

Impact:

Flooding generates deterioration of road infrastructure, temporary mobility restrictions, and potential damage to residential properties during the rainy season.

Potentialities

- Availability of areas suitable for ecological restoration and urban greening initiatives.
- Strategic opportunities for the development of community green corridors and public recreational spaces.
- Presence of productive-age population capable of supporting environmental and community improvement programs.

SOCIOECONOMIC SUBSYSTEM

General Characterization

The Sauces sector demonstrates high population density and active neighborhood economic dynamics primarily associated with small-scale commerce, family-operated businesses, and local service activities. Informal economic activity represents an important component of territorial functionality and household income generation.

The study identified a strong concentration of neighborhood commerce distributed along principal corridors and residential streets, reflecting both entrepreneurial capacity and economic dependence on informal labor structures.

IDENTIFIED PROBLEMS

Limited Economic Diversification

The local economy depends heavily on neighborhood commerce and informal service activities, generating economic vulnerability during periods of instability or reduced commercial activity.

Impact:

Limited diversification restricts employment opportunities and reduces long-term economic resilience.

Informal Employment Conditions

A significant proportion of economic activity operates outside formal regulatory and labor protection frameworks.

Impact:

Job insecurity, lack of social protection, and economic instability affect household sustainability and increase social vulnerability.

Potentialities

- Strategic territorial location connected to major transportation corridors.
- Strong local entrepreneurial culture capable of supporting formal economic development processes.
- High pedestrian and commercial activity favorable for organized business growth.

HUMAN SETTLEMENTS SUBSYSTEM

General Characterization

The territory is characterized by a consolidated urban fabric composed predominantly of reinforced concrete and masonry housing structures. Urban density is high due to mixed residential and commercial land use, progressive building occupation, and increasing pressure on available urban space.

Basic public services are generally present throughout the sector; however, infrastructure limitations and maintenance deficiencies affect service quality in several areas.

Identified Problems

Deficiencies in Basic Services

Certain sectors present limitations associated with sewerage systems, irregular water supply, and deficiencies in waste collection services.

Impact:

Infrastructure deficiencies contribute to public health risks and deterioration of urban quality of life.

Housing Located in Risk Areas

Some residential structures are located near drainage channels or sectors exposed to flooding risk.

Impact:

Environmental vulnerability increases the probability of structural damage and mobility limitations during the rainy season.

Lack of Public and Recreational Spaces

The sector presents an insufficient quantity of parks, green areas, and recreational infrastructure.

Impact:

Limited public spaces reduce opportunities for social interaction, recreation, and environmental improvement.

Potentialities

- Availability of vacant or underutilized land suitable for planned urban interventions.
- Good territorial connectivity facilitated by major road infrastructure and public transportation access.
- Consolidated urban infrastructure favorable for future territorial improvement projects.

MOBILITY AND CONNECTIVITY SUBSYSTEM

General Characterization

The territory maintains strong connectivity with principal urban corridors such as Avenida Isidro Ayora and Avenida Benjamín Carrión, facilitating access to commercial, institutional, and residential areas within northern Guayaquil. Public transportation coverage is generally adequate; however, mobility efficiency is significantly affected during peak traffic periods.

Identified Problems

Traffic Congestion

High vehicular concentration and road saturation generate recurrent traffic congestion, particularly during peak mobility hours.

Impact:

Increased travel times, deterioration of pedestrian mobility, environmental pollution, and reduction of urban functionality.

Occupation of Public Space

Informal commercial activities and irregular parking practices reduce available circulation space for pedestrians and vehicles.

Impact:

Public space deterioration and conflicts associated with mobility and accessibility.

Potentialities

- Existing road infrastructure capable of supporting mobility improvement strategies.
- Opportunities for pedestrian-oriented urban interventions and traffic management initiatives.
- Strategic location within the metropolitan transportation network.

POLITICAL-INSTITUTIONAL SUBSYSTEM

General Characterization

The Sauces sector is governed by municipal territorial regulations established through the PDOT, PUGS, and associated urban ordinances. The territory contains educational institutions, community police units, municipal services, and health facilities that contribute to neighborhood functionality.

Identified Problems

Regulatory Non-Compliance

Several buildings and commercial activities do not fully comply with territorial regulations related to land use, building parameters, and urban occupation.

Impact:

Urban disorder, land-use conflicts, and deterioration of territorial organization.

Limited Institutional Oversight

Municipal institutions face operational limitations associated with inspection capacity and urban control processes.

Impact:

Reactive rather than preventive territorial management and delayed response to urban conflicts.

Weak Citizen Participation

Community organization processes are irregular and lack long-term continuity.

Impact:

Reduced coordination between residents and institutions in territorial problem-solving processes.

Potentialities

- Existing legal and institutional planning framework.
- Presence of emerging community leadership initiatives.
- Municipal recognition of the sector as a priority intervention area for infrastructure and mobility improvements.

DISCUSSION

The territorial diagnosis conducted in the Sauces sectors of the Tarqui parish demonstrates the complex interaction between urban consolidation, mobility limitations, environmental vulnerability, and institutional management within a densely populated metropolitan territory. The findings indicate that the principal territorial conflicts are directly associated with accelerated urban occupation, insufficient environmental adaptation, and fragmented territorial governance processes. Similar dynamics have been identified in several Latin American cities where rapid urban growth has exceeded the operational capacity of existing infrastructure and planning systems. Similar urban pressures have been documented by the World Bank (2021), which highlights the growing infrastructure and mobility challenges affecting metropolitan areas in developing countries.

One of the most significant findings of this study relates to the relationship between flooding vulnerability and urban land occupation patterns. The reduction of vegetation coverage, progressive soil sealing, and deficiencies in stormwater drainage systems have intensified the territory's exposure to seasonal flooding. These findings are consistent with the observations of Hardoy, Mitlin, and Satterthwaite (2001), who explain that inadequate environmental management within consolidated urban territories substantially increases socio-environmental risk and reduces urban resilience capacity.

The study also identified important tensions between commercial activity, mobility functionality, and public space occupation. Informal commerce and irregular parking practices have progressively occupied areas originally intended for circulation and recreation, generating vehicular congestion, pedestrian limitations, and deterioration of public space quality. Terraza, Rubio Blanco, and Vera (2016) emphasize that sustainable mobility planning in Latin American cities requires integrated interventions capable of

balancing transportation efficiency, public space recovery, and environmental sustainability. According to Cervero (2013), territories characterized by mixed land use and insufficient mobility planning frequently experience transportation inefficiencies and declining urban functionality. The Sauces sector reflects these broader territorial challenges commonly observed within rapidly urbanizing metropolitan environments.

From an institutional perspective, the diagnosis revealed limitations associated with regulatory enforcement, urban oversight, and continuity of citizen participation processes. Although planning instruments such as the PDOT, PUGS, COOTAD, and LOOTUGS establish clear territorial guidelines, implementation difficulties continue to affect the effective management of land use and public space organization. The existence of fragmented interventions focused primarily on short-term conflict resolution has limited the development of integrated territorial sustainability strategies capable of addressing environmental, mobility, and social challenges simultaneously.

Despite these territorial conflicts, the study identified significant development opportunities associated with the strategic location of the Sauces sector, consolidated urban infrastructure, commercial activity, and emerging community leadership. The territory possesses important conditions for the implementation of sustainable urban interventions focused on green infrastructure recovery, mobility improvement, environmental resilience, and strengthening of public spaces. Future territorial planning initiatives should prioritize integrated management approaches capable of balancing economic activity, environmental protection, and social well-being within the metropolitan context of Guayaquil.

One limitation of this research involves the restricted availability of updated geospatial indicators and quantitative environmental data at the neighborhood level. Future studies should incorporate advanced GIS analysis, hydrological modeling, mobility simulation, and longitudinal territorial monitoring in order to strengthen predictive analysis and improve urban planning proposals. Nevertheless, the present study provides important technical and analytical criteria for understanding the territorial dynamics affecting the Sauces sectors and contributes to the development of sustainable territorial planning strategies within consolidated urban environments.

Table 1 Integrated Problem Matrix

Problems	Root cause	Territorial effect	Subsystems
Recurrent flooding	Deficiency in storm drainage and low slope in the terrain	Damage to homes and road deterioration	Biophysical + settlements + mobility
Traffic congestion	Road saturation at rush hour due to narrow streets and high vehicle traffic	Increased travel times and pollution in public spaces	Mobility + Connectivity
Disorderly informal trade	Lack of constant institutional control and high economic need of the population	Occupation of public space and conflicts over land use	Economic + Sociocultural + Institutional
Non-compliance with urban regulations	Weak oversight and limitations of institutions	Urban disorder and conflict generation	Political + Institutional
Weak Citizen participation	Lack of good sustained neighborhood organization	Little communication to solve territorial problems	Sociocultural + Institutional

CONCLUSIONS

The territorial diagnosis conducted in the Sauces 3, 4, 5, 6, 7, and 9 sectors of the Tarqui parish made it possible to identify the principal environmental, mobility, socioeconomic, and institutional conflicts affecting the functionality and sustainability of the territory. The analysis demonstrated that accelerated urban occupation, deficiencies in stormwater drainage systems, deterioration of public spaces, traffic congestion, and weak territorial control have generated increasing pressure on urban infrastructure and reduced environmental resilience within the study area.

The research also revealed the strong interrelationship between environmental vulnerability, mobility limitations, informal commercial occupation, and institutional management challenges. These territorial dynamics affect the quality of life of residents and contribute to urban disorder, deterioration of public spaces, and reduced territorial efficiency. At the same time, the territory possesses important development opportunities associated with its strategic location, consolidated infrastructure, commercial activity, and community potential for participatory urban improvement initiatives.

From a territorial planning perspective, the study highlights the importance of implementing integrated urban management strategies focused on sustainable mobility, recovery of public spaces, environmental restoration, strengthening of institutional coordination, and improvement of citizen participation processes. Sustainable interventions should prioritize long-term territorial resilience while balancing economic activity, environmental protection, and social well-being. According to Yigitcanlar, Kamruzzaman, and Teriman

(2015), neighborhood sustainability depends on the integration of environmental, institutional, social, and infrastructural dimensions within urban planning processes.

Despite limitations associated with the availability of updated geospatial and environmental information, the study provides important technical and analytical criteria that may support future territorial planning processes and urban intervention strategies within the northern sector of Guayaquil. The findings contribute to the broader discussion on sustainable urban development and territorial governance within consolidated metropolitan environments in Latin America.

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