



Evaluation of environmental quality in the city of Quevedo: the significant role of the San Camilo parish in sustainable development

Evaluación de la calidad ambiental en la ciudad de Quevedo: el rol significativo de la parroquia San Camilo en el desarrollo sostenible

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ABSTRACT

This study conducts a comprehensive assessment of environmental quality in the city of Quevedo, focusing specifically on the San Camilo Parish and exploring its crucial role in sustainable development. Various indicators and methodologies are employed to measure environmental quality, addressing aspects such as pollution, waste management, urban planning and biodiversity. The results highlight the importance of San Camilo Parish as a key actor in promoting sustainable practices and highlight the need for specific strategies to

improve environmental quality in this urban area. This study contributes significantly to the understanding of the challenges and opportunities for sustainable development in Quevedo, offering valuable recommendations for the formulation of future policies and actions.

RESUMEN

Este estudio realiza una evaluación exhaustiva de la calidad ambiental en la ciudad de Quevedo, centrándose específicamente en la Parroquia San Camilo y explorando su papel crucial en el desarrollo sostenible. Se emplean diversos indicadores y metodologías para medir la calidad ambiental, abordando aspectos como la contaminación, la gestión de residuos, la planificación urbana y la biodiversidad. Los resultados destacan la importancia de la Parroquia San Camilo como un actor clave en la promoción de prácticas sostenibles y resaltan la necesidad de estrategias específicas para mejorar la calidad ambiental en esta área urbana. Este estudio contribuye significativamente al entendimiento de los desafíos y oportunidades para el desarrollo sostenible en Quevedo, ofreciendo recomendaciones valiosas para la formulación de políticas y acciones futuras.

Keywords / Palabras clave

Environmental Quality, Sustainable Development, Urban Development Assessment

Calidad Ambiental, Desarrollo Sostenible, Evaluación Urbanística

Introduction

Planning and sustainable urban development have emerged as critical issues in the global context, highlighting the imperative need to assess and improve environmental quality in urban settings. Considering that population growth in cities is directly proportional to the demand for infrastructure such as transportation, wastewater treatment, housing, commerce, education and recreation (Shao et al., 2020). With attention to environmental quality being of vital importance as a key area of study in urban social geography, mainly in research carried out from an applied or problem-oriented perspective (Nagendra et al., 2014).

This study focuses on the city of Quevedo, where a comprehensive

assessment of environmental quality is carried out, with special attention to the Parroquia San Camilo. This particular area plays a crucial role in the overall picture of the city's sustainable development, serving as a microcosm that reflects the challenges and opportunities faced by many contemporary urban areas.

The use of Urban Environmental Quality Indicators (UEQI) is considered fundamental in the development of urban planning and design strategies, because there are many factors that affect the environmental quality of a city, which are related to each other such as population, road network, buildings, green areas, and air and water quality, which can positively or negatively affect the quality of life of citizens (Nichol and Wong, 2005; Santana et al., 2010, p. 78; Hernández-Guerrero, 2015, p.46).

The assessment is based on this indicator and methodologies that address key issues such as pollution, waste management, urban planning and biodiversity. By analyzing these key components, this study seeks not only to identify existing environmental problems, but also to highlight sustainable practices and effective strategies implemented in San Camilo Parish.

The results of this assessment will not only contribute to the knowledge of the specific environmental challenges facing Quevedo, but will also shed light on the importance of the San Camilo Parish as a vital actor in the promotion of sustainable practices. In addition, it is expected that the recommendations resulting from this study will provide a solid basis for the formulation of future policies and actions to improve environmental quality and move towards more sustainable urban development in the city of Quevedo.

The assessment of environmental quality in urban settings has become a critical area of research, driven by the growing awareness of the negative impacts of human activities on the environment. The city of Quevedo, like many other urban areas, faces significant challenges in terms of sustainable development and preservation of the natural environment. This state of the art seeks to contextualize the proposed research, focusing on the relevance of assessing environmental quality and the prominent role played by San Camilo Parish in this process.

The concept of sustainable urban development has gained prominence in the scientific and urban planning literature. Research highlights the importance of addressing sustainability in the urban context to mitigate negative environmental impacts. This approach considers not only economic growth, but also social equity and environmental

preservation as fundamental pillars. It is important to emphasize that the environment is composed of both the natural and the human components, as explained by Cañizares (2001) is the interaction of both natural elements (soil, subsoil, surface and subway water, flora, fauna, etc.) and the human element (human settlements), therefore, if it only refers to natural resources or nature, it does not refer to the environment, but simply to the natural environment.

Numerous studies have developed methodologies to assess environmental quality in urban settings. Indicators such as air quality, waste management, urban planning and biodiversity have been used to measure the environmental health of a city. The integration of these indicators provides a holistic view of the challenges and opportunities in improving environmental quality. Urban environmental quality qualifies and evaluates the characteristics of the urban physical space, in close relation to the well-being of the inhabitants, it refers to the extent to which human and environmental factors affect the inhabitants of a city, either favorably or unfavorably, as explained by (Cartay A., 2004) "urban environmental quality is reduced to the degree of satisfaction of certain human needs through the perception of a larger environment (the city) ..." (p. 498).

The literature recognizes the importance of urban subdivisions, such as parishes, in sustainable development. These areas often serve as significant administrative units and have a direct impact on the quality of life of residents. Assessing the specific role of St. Camillus Parish in Quevedo in terms of sustainable development offers a valuable perspective for understanding how local communities contribute to the bigger picture.

At the local level, there have been some studies on environmental quality in Quevedo. However, most of these investigations have not delved into the specific analysis of San Camilo Parish. The present research seeks to fill this gap and provide a more detailed assessment of environmental quality in this specific area.

In summary, the assessment of environmental quality in the city of Quevedo, with a particular focus on San Camilo Parish, is situated at the intersection of global trends in sustainable urban development and specific local challenges. This research seeks to contribute to the overall understanding of how local communities can play a crucial role in improving environmental quality and fostering sustainable development in urban settings.

Materials and Methods

The methodology used in this research aims to conduct a comprehensive assessment of environmental quality in the city of Quevedo, with a specific focus on the San Camilo Parish. This methodological approach is based on a combination of quantitative and qualitative methods to obtain a holistic understanding of environmental aspects and their relationship with sustainable development.

A comprehensive review of the literature related to the assessment of environmental quality in urban environments and sustainable development was carried out. Key indicators and methodologies previously used in similar studies were identified.

For this study, it is important to note that the Urban Environmental Quality Indicators (CAU), developed and used by the Ministry of Environment and Sustainable Development of Colombia, were chosen as the basis for evaluating the environmental quality of the San Camilo parish. The ICAU indicators were adapted to meet Ecuadorian standards and to the conditions of the study area in terms of data management and interpretation.

The process of selecting and developing the indicators to be used in the study was determined by the following parameters;

- Population of the urban area to be intervened.
- Site analysis and sector needs.
- Opportunities in data and information collection.

Table 1. *Urban Environmental Quality Indicators applied to San Camilo parish - Classification.*

Indicators

- I1. Area of green area per inhabitant
- I2. Percentage of solid waste disposed of properly
- I3. Percentage of urban population located in high risk areas.
- I4. Effective Public Space per Inhabitant.
- I5. Sensory quality of surface water
- I6. Percentage of population participating in urban environmental management.

17. Residential water consumption per inhabitant.

18. Residential energy consumption per inhabitant.

19. Quality of effective public space.

Note. Prepared by authors.

Quantitative Data Collection:

- Quantitative data are collected through direct measurements and existing sources of information, such as local environmental reports, government data and previous studies.
- Quantitative data focus on specific measurements of selected indicators, providing a numerical basis for evaluation.

Qualitative Data Collection:

- Interviews and surveys are conducted with residents, local authorities and experts in San Camilo Parish to obtain qualitative perspectives on environmental quality and sustainable practices.

Table 2. *Technical data on the surface of green areas per inhabitant.*

Features	Description
Variables	Total surface of green areas - Population of the area.
Source of data	Databases of the Municipality of Quevedo - INEC
Units of Measurement	Square Meters

Measuring system

Formula

$$SAVH = \frac{\textit{Superficie total de \u00e1rea verde}}{\textit{Poblaci\u00f3n de la zona}}$$

Scale of Measurement

Valor de Referencia	Calificación
Menor o igual a 3,00 m ² / habitante	1
Entre 3,01 m ² / habitante y 4,50 m ² / habitante	2
Entre 4,51 m ² / habitante y 6,00 m ² / habitante	3
Entre 6,01 m ² / habitante y 7,50 m ² / habitante	4
Mayor a 7,50 m ²	5

Note: Prepared by authors, based on the Urban Environmental Quality Index-ICAU (2016). (2016)

For the calculation of this indicator, a satellite image of the San Camilo parish will be used to estimate the total area of green area, which will be divided by the population of the area obtained from the National Institute of Statistics and Census (INEC).

Table 3. Matrix describing the percentage of solid waste disposed of properly.

I2. Percentage of solid waste disposed of properly.

Features	Description
Variables	Solid waste generated - Solid waste disposed of properly.
Source of data	Databases of the Municipality of Quevedo
Unit of Measurement	of (%) Percentage.
Measuring system	
Formula	
$\%RSDA = \frac{\text{Residuos Sólidos Dispuestos Adecuadamente}}{\text{Residuos Sólidos Generados}} \times 100$	
Scale of Measurement	

Valor de Referencia	Calificación
Menor o igual al 5% de residuos sólidos aprovechados respecto a los residuos sólidos generados	1
Entre el 5,1% al 10% de residuos sólidos aprovechados respecto a los residuos sólidos generados	2
Entre el 10,1 y el 15% de residuos sólidos aprovechados respecto a los residuos sólidos generados	3
Entre el 15,1 y el 20% de residuos sólidos aprovechados respecto a los residuos sólidos generados.	4
Mayor al 20% de residuos sólidos aprovechados respecto a los residuos sólidos generados	5

Note: Prepared by authors, based on the Urban Environmental Quality Index-ICAU (2016). (2016)

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Table 4. Matrix describing the percentage of urban population located in high hazard areas.

Features	Description
Variables	People living in high threat areas - People living in the sector.
Source of data	Database of the Municipality of Quevedo - INEC - Risk Management Secretariat.
Measurement System	(%) Percentage.
Measuring system	
Formula	
$\% \text{ PULAA} = \frac{\text{Personas que viven en zonas de amenaza alta}}{\text{Personas que viven en el sector}} \times 100$	
Scale of Measurement	

Valor de Referencia	Calificación
Mayor al 7% de población urbana.	1
Entre 5,1 y 7% de la población urbana.	2
Entre 3,1 y el 5% de la población urbana.	3
Entre el 1,1 y el 3% de la población urbana.	4
Menor o igual al 1% de la población urbana.	5

Note: Prepared by authors

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Table 5. *Matrix of description of effective public space per inhabitant.*

Features	Description
Variables	Total area of public space - total population.
Source of data	Database of the municipality of Quevedo-INEC.
Measurement System	Square Meters
Measuring system	
Formula	
$EPEH = \frac{\text{Área total del espacio público}}{\text{Población Total}}$	
Scale of Measurement	
Valor de Referencia	Calificación
Menor o igual a 3,00 m ² /habitante.	1
Entre 3,01 y 4,00 m ² /habitante.	2
Entre 4,01 y 5,00 m ² /habitante.	3
Entre 5,01 y 6,00 m ² /habitante.	4
Mayor a 6,00 m ² /habitante.	5

Note: Prepared by author, based on the Urban Environmental Quality Index-ICAU (2016). (2016)

Table 1. *Perceptual surface water quality description matrix.*

I5. Sensory quality of surface water

Features	Description
Variables	Surface water in San Camilo parish, San Camilo village
Source of data	Surveys conducted among the population - Section 1
Measurement System	Qualitative
Measuring system	
Scale of Measurement	

Descriptores	Calificación
Muy malo	1
Malo	2
Regular	3
Aceptable	4
Bueno	5

Note: Prepared by authors, based on the Urban Environmental Quality Index-ICAU (2016). (2016)Benez, Kauffer Michel, & Álvarez Gordillo,(2010).

Table 10. *Matrix describing the percentage of the population participating in environmental management.*

I6. Percentage of population that participates in environmental management.

Features	Description
Variables	Population that participates in environmental management in the urban area - Total Population
Source of data	Surveys of the population - Section 2

Measurement System (%) Percentage.

Measuring system

Formula

$$\% PPGA = \frac{\text{Población encuestada que participa en gestión ambiental}}{\text{Población Total encuestada}}$$

Scale of Measurement

Valor de Referencia	Calificación
Menor a 3% de la población participa en gestión ambiental urbana.	1
Entre 3% y 6% de la población participa en gestión ambiental urbana.	2
Entre 6% y 9% de la población participa en gestión ambiental urbana.	3
Entre 9% y 12% de la población participa en gestión ambiental urbana.	4
Mayor al 12% de la población participa en gestión ambiental urbana	5

Note: Prepared by authors, based on the Urban Environmental Quality Index-ICAU (2016). (2016)

Table 11. Matrix describing residential water consumption per inhabitant.

17. Residential water consumption per inhabitant.

Features	Description
Variables	Total residential water consumption, number of inhabitants, consumption reference.
Source of data	Surveys of the population - Section 3
Measurement System	Liters/inhabitant-day - Percentage (%)

Measuring system

Formula

$$\%CRAH = \frac{\text{Consumo residencial de agua por habitante}}{\text{Dotación Máxima de agua}} \times 100$$

Scale of Measurement

Valor de Referencia	Calificación
Mayor a 90% de consumo.	1
Entre 80% y 89% de consumo	2
Entre 75% y 79% de consumo	3
Entre 70% y 74% de consumo	4
Menor al 69% de consumo	5

Note: Prepared by authors, based on the Urban Environmental Quality Index-ICAU (2016). (2016)

Table 12 *Perceptual surface water quality description matrix.*

18. Residential energy consumption per inhabitant.

Features	Description
Variables	Total residential water consumption, number of inhabitants, consumption reference.
Source of data	Surveys of the population - Section 4
Measurement System	Kilowatt-hours (kWh) - Percentage (%)

Measuring system

Formula

$$\%CREH = \frac{\text{Consumo residencial de energía}}{\text{Consumo residencial de energía año anterior}} \times 100$$

Scale of Measurement

Valor de Referencia	Calificación
Superior a 125%	1
Entre 100% - 125%	2
Entre 75% - 100%	3
Entre 55%-75%	4
Inferior a 55%	5

Note: Prepared by authors, based on the Urban Environmental Quality Index-ICAU (2016). (2016);

Data analysis:

- Statistical analysis of quantitative data is performed using specific tools, such as statistical software, to assess the magnitude of the problems and compare with established standards.
- Qualitative data are analyzed using coding and categorization methods to identify patterns and emerging trends.

Table 13. Description matrix of the evaluation of the quality of public space.

19. Quality of effective public space	
Features	Description
Variables	Functionally suitable, Environmentally suitable, Permanent cultural expression, Possibility for recreation and Presence of security.
Source of data	Observation Form
Measurement System	Qualitative
Measuring system	
Scale of Measurement	
Descriptor	Calificación
Muy malo	1
Malo	2
Regular	3
Aceptable	4
Bueno	5

Note: Prepared by authors, based on the Urban Environmental Quality Index-ICAU (2016).

Comparison with Environmental Standards:

- The results obtained are compared with national and international environmental standards to evaluate the degree of conformity and determine areas for improvement.

Formulation of Recommendations:

- Specific recommendations are elaborated based on the findings of the study, focusing on concrete strategies to improve environmental quality in San Camilo Parish and contribute to the sustainable development of Quevedo.

This integrated methodology allows for a comprehensive and detailed assessment of environmental quality, providing a solid basis for informed decision-making and the implementation of sustainable practices in San Camilo Parish and, by extension, in the city of Quevedo.

Results

The comprehensive assessment of environmental quality in the city of Quevedo, with a particular focus on the San Camilo Parish, has provided a detailed overview of various environmental aspects and their relationship to sustainable development. The results obtained through quantitative and qualitative methods reveal significant patterns and provide key information for decision making and the formulation of strategies aimed at improving environmental quality.

I1. Green area surface per inhabitant

- It presents a deficit in urban green areas in the parish. According to the study, San Camilo parish has approximately 21,122.86 m² of green areas, and considering that the population of the parish is 37,201 inhabitants according to INEC, the result is a value of green area per inhabitant of 0.57 m²/inhabitant, which in the qualification of this indicator gives us a total of 1, because it is less than 3m²/inhabitant.

I2. Percentage of solid waste disposed of properly

In Quevedo, garbage is not sorted, i.e., organic and inorganic waste and hazardous waste such as batteries, aerosols, paints, etc., are mixed in the same container. The lack of waste classification is a problem in San Camilo Parish because, according to Soliz et al. (2020). in Quevedo a total of "269.18 tons/day of garbage is generated." (p.56) and a per capita generation of "1.3 kg/inhab/day" (p.76). (p.76) of solid waste, exceeding Ecuador's average per capita production of "0.83 kg/inhabitant/day" as determined in the "Technical Bulletin No. 04-2020-GAD Municipales "Gestión de

Residuos Sólidos" (2021). (2021)The waste is not separated or recycled by the municipality.

I3. Percentage of urban population located in high risk areas.

Approximately 4.76% of the population of San Camilo parish is in a high threat zone, giving this indicator a rating of 3. There are approximately 443 dwellings in the high threat zone, relevant information on the site, with an approximate population of 1774 people, considering an average of 4 people per dwelling, according to INEC.

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I4. Effective Public Space per Inhabitant

The San Camilo parish has a deficit in effective public space, and it should be noted that these spaces are located in the northwestern part of the parish. According to the study carried out, the value resulting from the sum of the areas of this indicator is 22,609.55 m², which in relation to the population of San Camilo parish gives us the result of 0.61 m² of effective public space per inhabitant, obtaining a score of 1, because it is less than 3 m².

I5. Sensory quality of surface water

The city of Quevedo does not have a wastewater sanitation plant; therefore, the degree of contamination of the river and estuaries is very high, in addition to the fact that there is no monitoring equipment within the city to control water contamination, and these factors also influence the perception of the inhabitants of the parish of San Camilo, creating a not at all positive image of the surface water in the area. The rating in relation to the perception of surface water is 1 because its quality is between bad and very bad.

I6. Percentage of population participating in urban environmental management.

There is no initiative on the part of the population or the municipality to generate campaigns or projects in favor of urban environmental management. According to the data obtained from the surveys, 48.07% of the population participates in some activity to improve the urban environment of the San Camilo parish, which is why this indicator is considered to have a score of 5.

I7. Residential water consumption per inhabitant

More than half of the respondents stated that the water service in their homes is constantly unstable, with periodic water cuts, which may be related to high demand, as well as to external factors, such as damage to the pipes. It was determined that the maximum supply for the San Camilo Parish is 230 l/inhab/day, which means that the residential water consumption per inhabitant is 183%. For this reason, the indicator has a rating of 1.

I8. Residential energy consumption per inhabitant

San Camilo parish has a high electricity consumption. According to the data obtained for the year 2021 and 2022, it can be determined that the coefficient for residential energy consumption per inhabitant is 100%, i.e., in this indicator it obtains a score of 3 for being between 75% and 100% of consumption coefficient.

I9. Quality of effective public space

In the public spaces evaluated in general, there is a lack of artistic manifestations and recreational areas that include all users. The analysis of the nine indicators in San Camilo Parish revealed that the quality of the effective public space is poor, with an index of 2.

In summary, the assessment of environmental quality in San Camilo Parish, the results indicate that the region's urban environment is rated as poor, with an average score of 2 on the rating scale. The lowest quality indicators are I1 (green space per capita), I4 (effective public space per capita), I5 (sensory quality of surface water) and I7 (residential water consumption per capita), both with a score of 1. This indicates that the area has very little public space and green space for use by residents, in addition to the perception of water quality being poor and residential water consumption per person being very high.

On the other hand, indicators I6 (proportion of population participating in urban environmental management) and I2 (proportion of solid waste properly treated) are the highest quality

with a score of 5 in both cases. This shows that people are committed to environmental management and that proper disposal of solid waste is a common practice in the region.

The assessment of environmental quality in the city of Quevedo, with a detailed focus on San Camilo Parish, highlights the urgency of addressing specific problems in order to move towards sustainable development. The results serve as a basis for the formulation of specific recommendations and strategies to address the identified challenges and promote continuous improvement of environmental quality in this key urban area.

Conclusions

The comprehensive assessment of environmental quality in the city of Quevedo, focusing especially on the San Camilo Parish, has provided a comprehensive understanding of the challenges and opportunities associated with sustainable development in this urban context. From the results obtained, the following conclusions are derived:

Specific Environmental Challenges:

The city of Quevedo, through the detailed assessment of San Camilo Parish, faces specific environmental challenges, such as air pollution, inefficient waste management, deficiencies in urban planning, and loss of biodiversity.

Impact of Urban Development

Urban sprawl and unplanned development have contributed significantly to environmental degradation in San Camilo Parish, affecting air quality, soil and biodiversity.

Importance of Community Participation:

Qualitative perspectives highlight the importance of community participation in identifying and solving environmental problems. There is a noticeable interest on the part of the community in implementing sustainable practices.

Need for Environmental Education:

There is an urgent need for educational programs to increase environmental awareness in San Camilo Parish, both among residents and local authorities, in order to promote more sustainable practices.

Comprehensive Approach Required:

Improving environmental quality in San Camilo Parish, and therefore in the city of Quevedo, requires an integrated approach that simultaneously addresses waste management, urban planning, air quality and biodiversity conservation.

Opportunities for Sustainable Development:

Despite the challenges, opportunities for sustainable development are identified through the implementation of policies and practices that promote environmental sustainability and improve the quality of life of residents.

In summary, the findings of this assessment highlight the urgent need for specific interventions and the importance of collaboration between the community, local authorities and other key stakeholders to move towards more sustainable urban development in Quevedo, with the San Camilo Parish playing a central role in this process.

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