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Article

Participatory prioritization of sustainable development projects in informal territories: A case study of Gran Yomasa, Usme, Bogotá, Colombia

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Abstract: The article presents an innovative methodology to prioritize sustainable development projects in informal territories, applying the GERC-ES Method in Gran Yomasa, Usme, and Bogotá. Adopting a mixed quantitative-qualitative approach, the research selected 64 indicators that articulate key variables related to urban habitat and sustainability. The participatory process, which involved 53 community residents, 14 students, and 6 researchers, allowed defining and prioritizing 14 sustainable projects aligned with local needs. The projects were classified according to their impact on environmental, social, and economic dimensions, as well as their alignment with sustainable development goals, which ensured relevant and applicable interventions in similar contexts. The proposed methodology highlights the importance of integrating the community in planning and prioritization, promoting sustainable and equitable solutions that respond to the problems of the territory.

Keywords: habitability; sustainability; community participation; territories; urban environment

1. Introduction

The development and evolution of cities in the 21st century present major challenges, as they have become key drivers of economic growth and centers of opportunity, with 55% of the world's population living in urban areas and projected to reach 68% by 2050. This growth brings with it socioeconomic and environmental challenges, such as resource exploitation, biodiversity loss and climate change. (Ahvenniemi et al., 2017; ICLEI—Local Governments for Sustainability, 2019; Michalina et al., 2021; Newman et al., 2015; Verma and Raghubanshi, 2018).

Cities with high pollution and low quality of urban life reflect the deregulation in the land market, highlighting the need to assess habitability (Coca-Stefaniak et al., 2009; Insch and Florek, 2008; Páramo et al., 2018). New urbanism seeks human-centered spaces to make cities more sustainable (Alzaidy and Al-Musawi, 2023; Garfias Molgado and Guzmán Ramírez, 2018).

Precarious housing conditions perpetuate poverty and inequality, conditions that severely affect communities and limit access to opportunities. According to Yaschine (2015), one in two people live in poverty and one in ten in extreme poverty. The survey (DANE—Departamento Administrativo Nacional De Estadística, 2021) reported that 21% of the population in Bogota lives near garbage dumps, 13% have garbage dumps nearby and 5.5% are in multidimensional poverty.

Social interaction and urban quality of life are associated with public space and perceptions of well-being, influenced by adaptability and influenced by adaptability to the environment and access to services (Alvarado Azpeitia et al., 2017; Garfias-Molgado and Araujo-Giles, 2015; Páramo and Burbano, 2022). Public space is essential for urbanism and social development (Borja and Muxi, 2003; Páramo et al., 2018).

Habitability is key to the sustainable development of communities, integrating social and ecological aspects that enable individual and collective development, and interacting with environmental processes (Garfias Molgado and Guzmán Ramírez, 2018). Initially focused on housing, this notion has been expanded to include the external environment, such as the neighborhood and urban infrastructure, according to the model of Bronfenbrener (1987). This perspective addresses both internal and external habitability, establishing their relationship with human needs (Landázuri Ortiz and Mercado Doménech, 2004; Marquina and Pasquali, 2006; Max-Neef et al., 1986; Páramo et al., 2018).

Public space, considered a fundamental right, is essential for collective and urban life (Borja and Muxi, 2003; Páramo et al., 2018). However, it is rarely incorporated as an indicator of urban quality of life, despite its importance as a key factor for well-being (Páramo et al., 2018). The economic and social activity of cities can contribute to environmental degradation, exacerbating socioeconomic problems such as security and segregation (Ghalib et al., 2017).

To promote sustainable urban development, it is essential to address environmental, social, and economic aspects in line with Goal 11 of the 2030 Agenda (Michalina et al., 2021; Moreno, 2022). This approach requires integrating equity, efficiency, and environmental preservation as fundamental pillars (Castiblanco-Prieto et al., 2019; CEPAL—Comisión Económica para América Latina y el Caribe, 2019; Nacif, 2016).

To promote sustainable urban development and resilient cities, it is crucial to foster citizen participation and policies that address climate change in community and international cooperation scenarios. Developing countries face challenges in urbanization, and the proliferation of informal settlements contradicts these principles (Flores-Lucero, 2013).

In informal territories, it is vital to work on sustainability through densification, diversification of land use, and creation of pollution-free environments to improve the quality of life (Flores-Lucero, 2013). Moreover, the scientific community has developed tools to assess urban sustainability, using indicators that allow managing and planning sustainable cities, promoting health and quality of life (Ahvenniemi et al., 2017; Chrysoulakis et al., 2014; Huang et al., 2015; Michalina et al., 2021; Pintér et al., 2012; Wu and Wu, 2012).

These indicators assess sustainability status and performance and are useful for managing resources (Ghalib et al., 2017; Xu and Coors, 2012). But the review of sustainable indicators has identified limitations in those that do not respond to urban informality in Latin America (Huovila et al., 2019; Verma and Raghubanshi, 2018). Thus, UN-Habitat indicators and other studies were not considered representative for cities like Bogota, marked by a lack of planning (Zheng et al., 2016).

Studies by Nunes et al. (2016) and García and Seguel (2019) analyzed sustainability at the neighborhood level, considering density, transportation, and connectivity. In Bogotá, it evaluated 8 informal neighborhoods (Yunda, 2019), prioritizing pedestrian streets and mixed land uses.

Páramo and Burbano (2022) presented an instrument with 47 indicators to assess the habitability of public space in Colombian and Latin American cities. These indicators are grouped into five dimensions: environment, social manifestations, mobility and accessibility, infrastructure, and cultural and economic expressions. For its part, the Inter-American Development Bank (IDB) proposed a methodological guide for emerging cities that includes indicators in three dimensions: environment, urban and fiscal development, and governance. In addition, it describes a methodology for planning and monitoring sustainable strategies (BID—Banco Interamericano de Desarrollo, 2016). In this context, it was concluded that the IDB indicators were the most appropriate for prioritizing sustainable projects due to their comprehensiveness and objectivity.

This study, with a focus on the informal city, was developed in Gran Yomasa, Usme, and Bogotá, an area that faces various problems: high-risk areas, air and soil pollution, lack of green areas, presence of open-air dumps, and deficiencies in infrastructure and basic services (de Bogotá, 2020). The research was carried out in collaboration with TECHO Colombia, an organization that seeks to overcome poverty through community infrastructure projects and education and entrepreneurship programs (TECHO Colombia, 2024).

In this sense, the following research question was raised: How to prioritize sustainable development projects in informal territories led by TECHO Colombia to improve the quality of life and promote more equitable urban development?

2. Materials and methods

The research was developed with a mixed approach. The quantitative approach, deductive in nature, starts from general data and is based on logical and mathematical reasoning (Hernández et al., 2014; Ñaupas et al., 2014), while the qualitative approach approaches the research in a dynamic and circular way, adjusting the methodology according to the study (Hernández et al., 2014). Mixed approaches combine quantitative and qualitative methods, preserving their structures and procedures for a more complete understanding (Hernández et al., 2014).

In this study, a dominant model concurrent nested design (DIAC) was employed, where quantitative and qualitative data were collected simultaneously, with one of the methods as the primary. Quantitative data measure the impact of the project, while qualitative evidence examines participants' experiences (Hernández et al., 2014).

The core method focused on qualitative action research, which aims to solve everyday problems and foster social change by promoting community awareness and active participation. This methodology involves observing the problem, analyzing data and acting by proposing specific solutions, a process that was followed to achieve the objectives of the study (Hernández et al., 2014).

The DIAC design included a cross-sectional approach, characterized by data collection at a single point in time to describe variables and their impact. This allowed characterizing the population in terms of habitat and territorial problems, using a causal correlation matrix. This design analyzed the relationship between categories and variables, identifying significant interactions between urban habitat, territory and sustainable development, linked to IDB indicators (Hernández et al., 2014).

The analysis of the results was carried out in a participatory manner, reporting data on aspects that affect the quality of life of the community and promoting solutions through dialogue. This qualitative approach involved the community, identifying their needs and analyzing their strengths, weaknesses and conflicts through collaboration with leaders, networks and groups, facilitating joint work in the identification of variables, indicators and proposals for sustainable solutions (Hernández et al., 2014).

The study involved 53 inhabitants of the Bolonia neighborhood in Gran Yomasa, Usme, including 3 community leaders and 50 residents, organized into working groups. The selection of participants was based on their previous involvement with the activities of the TECHO Colombia organization, which collaborates with the Catholic University of Colombia in initiatives aimed at overcoming poverty in informal settings.

In addition, 14 ninth-semester civil engineering students participated in data collection and community activities. This participation was part of a classroom project that, since 2017, has supported TECHO Colombia in the design and construction of community infrastructure. Six researchers from different institutions also collaborated, allowing the integration of 73 people in total to validate and prioritize actions aimed at improving the quality of life in informal settlements.

The sampling was non-probabilistic, designed according to the dynamics of the study and the decisions of the research team. This approach ensured the trust and collaboration of the participants (Hernández et al., 2014).

The approach with the community allowed the identification of key variables of urban habitat, territory and sustainable development, fundamental for the work matrix and for the analysis and evaluation of the context, ensuring the development and conclusion of the research. Thus, the methodology was defined in 3 phases:

Phase 1: Correlation levels.

1) For the application of the method according to the established scope, it was necessary to review concepts in specialized documents, which subsequently allowed the identification of transversal variables related to sustainability indicators in cities, to recognize and characterize relevant issues associated with urban habitat, territory and sustainable development. These findings were presented and discussed with the participants to refine the most relevant variables related to sustainability in an informal territory based on a bibliographic review related to sustainability indicators.

2) Subsequently, to define the variables of the methodological design, the theories of sustainable development were taken as a reference, including sustainable urban development, territory and urban habitat. These perspectives articulate various issues related to the resources available in an urban context, based on principles of sustainability and adaptation (Bernal, 2017).

In the social field, an approach was considered that promotes an inclusive and egalitarian interpretation of the individual and his environment (Castells, 1999). For their part, political and economic aspects were incorporated as support for territorial competitiveness, facilitating both the feasibility and implementation of sustainable projects. In addition, the importance of the infrastructure necessary to meet people's needs was emphasized (Max-Neef et al., 1986).

3) Then, the relevant variables in the topics of urban habitat, territory and sustainable development were identified, which were presented and discussed with the community through a social mapping exercise in which 15 urban habitat and territory variables and 7 sustainable development variables were validated and recognized.

4) With the variables already identified and validated, a methodology for the categorization and correlation of variables and indicators of urban habitat and territory with determining factors of sustainable development was determined. In this way, a causal correlation matrix was designed to comply with the scope of the work. The ad hoc tool was constructed based on the review of literature on urban habitability and sustainability proposed (Torres et al., 2023; Torres Parra, 2020; Torres Parra et al., 2024), which made it possible to relate the fundamental dimensions of the triangle of conflicts in the structure of the territory, such as environmental, social and economic (the three established dimensions). These dimensions facilitated the categorization of the identified variables, since their association later allowed the identification of the relevant issues of each variable to identify the most relevant indicators in terms of territorial sustainability.

5) Subsequently, a set of representative indicators was integrated for each topic (64 indicators in total), since these facilitated a highly detailed analysis of a more controlled group of topics to which priority should be given when proposing a project framed in the sustainability of the territory. Therefore, the indicators proposed by the IDB in its initiative on "Indicators of the Emerging and Sustainable Cities Initiative" were taken as reference information, where the criteria for classifying the indicators are established, based on the recognition of the problems present in the territories, so that they can be grouped by themes that allow for the solution of specific problems. To this end, they were based on three characteristics (BID Banco Interamericano de Desarrollo, 2013):

Comprehensiveness: Indicators that make it possible to evaluate the most critical points of a territory, associating them with the transparency of the processes.

Objectivity: The researcher must carry out an impartial diagnosis to guarantee the correct applicability of the indicators when analyzing a problem, since they must be precise, unambiguous and easy to understand.

Comparability: Indicators that make it possible to show the performance of a territory and thus define whether they have shown improvement or regression over time.

6) Considering the above, the "*Y*" axis of the causal correlation matrix was dimensioned, determining the relationships and correspondences between the urban habitat and territory themes in relation to the dimensions (3 in total), the variables (15 in total), the themes (29 in total), and the indicators (64 in total). This synergic relationship was able to establish a causal and consequent relationship that facilitated the selection of the most relevant IDB indicators that can be involved as a form of evaluation and justification in projects that promote urban sustainability in a territory such as Gran Yomasa.

7) Next, the "*X*" axis of the causal correlation matrix was determined, which is based on the theoretical basis of sustainable development and is aimed at correlating

variables (7 in total) and themes (14 in total) concerning the promotion of territorial sustainability. For this purpose, the sustainable development dimension and its corresponding variables and themes were considered.

8) Taking into account the above, to fulfill the objective of participatively prioritizing sustainable development projects in the territory to be led with the TECHO Colombia Organization based on the proposed methodology, a basic quantitative scale of 1 and 0 was defined, for which, when a causal correlation was identified between the "*X*" and "*Y*" axes, a numerical value of one (1) was assigned, and when this correlation between axes was inexistent, a numerical valuation of zero (0) was given. The values of the correlations were defined as follows: high (14–10 points), medium (9–6 points), and low (5–1 points). Thus, generating a new column that would integrate the "Number of correlations", which allowed in an organized manner for all participants to prioritize their problems based on sustainability indicators and variables of territory, habitat, and sustainable development.

Phase 2: Effect Value (Ve).

9) Once the indicators were prioritized by means of the correlation methodology between Axis "*Y*" and Axis "*X*", we proceeded to group each of the correlation levels (high, medium, and low) and the corresponding equal score, defined in the indicators.

10) Once the indicators were grouped according to their score and level of correlation (high, medium, low), the indicators were categorized by theme and by score of equal or similar correlation level. However, the prevailing condition for the grouping of indicators was the subject matter they covered. In this sense, we proceeded to define projects that responded to the priority needs of the affected communities. This process was carried out through a collaborative dialogue with the 73 stakeholders involved, ensuring that each project was aligned with the objectives of improvement and sustainable development. In addition, working groups were established where participants were organized according to their profile, background and topics of interest, allowing for an effective crossover of knowledge and motivations.

Thus, for the different levels of correlation (high, medium and low), a total of 64 indicators were considered, from which 14 projects emerged. Within these 14 projects, 4 are proposed for the high correlation level, 6 are proposed for the medium correlation level and 4 projects are proposed for the low correlation level.

11) Once the projects were defined and in agreement with the same working group, we proceeded to determine for each project which Sustainable Development Goals (SDGs) were impacted by each of them.

12) To prioritize the execution of these projects, the GERC-ES Method (Management and Evaluation of Characteristic—Strategic References) was applied, which is a quantitative method used in strategic project plans, where it is necessary to establish the actions to be carried out, the order in which they should be carried out and the way in which the execution process should be managed and controlled (Saldeño, 2009).

The GERC-ES Method is practical, simple and easy to apply; to develop it, the cooperation of a work team is necessary, where from a participative and collaborative dynamic they can establish the strategic and action lines, as well as weight each of the elements that compose them (Saldeño, 2009).

In this way it was defined that for this process the strategic lines would be defined according to the high, medium and low correlation levels defined in PHASE 1 of the methodology, and the action lines would be defined by the projects corresponding to each of these correlation levels.

13) To prioritize those projects that, in the opinion of the working group, were more immediate to be carried out, we proceeded to weight the Value Effect (Ve) corresponding to each Line of Action (projects), which defines the effect, i.e., the priority, urgency or immediacy of each action. This "effect" is evaluated as follows: Essential, Very Important, Important and Not Important. For each of them, there are values ranging from 1 to 5 (Essential = 5, Very Important = 3.5, Important = 2, Not Important = 1), classified from the least important to execute, to the very important, which need to be carried out immediately.

Phase 3: Line Value (VL), Cost Value (Vc) and Optimal Plan Value (VOpl).

14) Once the Effect Value of each Line of Action has been obtained, all the values corresponding to each range (Essential, Very Important, Important, Important, Not Important) of all the Lines of Action belonging to each Strategic Line are added together. Each of these final summation values,

$$\Sigma 1 = \Sigma \text{Line of Action} \tag{1}$$

will be multiplied by the evaluation value corresponding to each valuation range (Essential = 5, Very Important = 3.5, Important = 2, Little Important = 1), giving as a result, final values, from the multiplication operation of the terms "ΣLines of Action" and "Evaluation", obtaining as a result, a new value, defined as Σ2,

$$\Sigma 2 = [(\Sigma \text{Lines of Action}) \times (\text{Evaluation})] \tag{2}$$

in each of the ranges.

With these two new ranges, for Equation (1) and Equation (2), a Total sum (Σ Total) is made, which will result in two values for each Strategic Line (Σ1 and Σ2). Once these values are obtained, a division is made between "Σ1" and "Σ2", resulting in the Line Value (LV) of the Strategic Line,

$$\text{Line Value (VL)} = (\Sigma 2 \div \Sigma 1) \tag{3}$$

with which the company is working.

15) Subsequently, the Cost Value (Vc) is measured, which is the result of the weighting carried out by the participants in the process. The assignment of these values will depend on a set formed by the ease, execution, cost and management of each of the projects analyzed. This is evaluated as High Cost, Moderate Cost, Low Cost and No Cost. For each of them, there are values ranging from 0 to 5 (High Costs = 5, Moderate Costs = 3, Reduced Costs = 1, No Cost = 0), maintaining the same classification as above. It should be noted that the range, due to the magnitude of the projects, for this case would vary between High Costs = 5 and Moderate Costs = 3.

16) Once the table of requirements has been completed about the Line Value, Effect Value and Cost Value, the Individual Value of the Action (VIac) is calculated, which is generated from the sum of the Effect Value (Ve) and the Cost Value (Vc).

$$\text{VIac} = \text{Ve} + \text{Vc} \tag{4}$$

17) The Total Value of the Action (VTac) is then calculated, which is the product of the multiplication of the Individual Value of the Action (VIac) by the Line Value (VL),

$$VTac = VIac \times VL \quad (5)$$

Considering that the Line Value (VL) has been previously defined.

18) Subsequently, the sum of all the Total Performance Values (VTac) is added up, thus obtaining the Optimal Value of the Plan (VOpl),

$$VOpl = \Sigma\ VTac \quad (6)$$

19) The participants define under consensus an estimated time for the realization of the project according to the experience. In the case of this process, a period of 5 years was estimated.

20) Subsequently, an execution percentage (%act) is estimated for each action, considering the time estimated by consensus of all the participants and how they are going to face these actions/projects for their community.

21) In this way, the Total Value of Action (VTac) is obtained according to each % act. of each Line of Action.

22) The sum of all the percentages with respect to the Total Performance Values (VTac) forms part of the total percentage of the Optimal Plan Value (VOpl). This calculation is carried out for each period estimated by the participants.

23) Once the Accumulated Planning table has been defined, the aim is that once the projects actually start, the control of the fulfillment is carried out over the 5 years provided, thus generating a table of Accumulated Realization; this is how a control can be made, in relation to the Accumulated Planning and its respective performance percentages (%act.).

24) Using the data resulting from the study and the subsequent creation of the Accumulated Planning and Accumulated Realization tables, a graph is made of the estimated time (time defined by the work team for the execution of the process) versus the sum of the Total Performance Values (ΣVTac) of the two tables, which will show the comparison of both trends, that of theoretical planning (Accumulated Planning) and that of practical realization (Accumulated Realization). Once all the results have been obtained, conclusions are drawn about the work, its applicability, execution, benefits, possible failures, etc.

3. Results

The results of the research carried out highlight the importance of community participation in the planning of sustainable projects in vulnerable urban areas. The study sought to identify and prioritize projects that favor sustainable development in informal territories, through a participatory approach that involves local actors and researchers from the academy.

In this way, the following was determined:

1) Relevant variables were identified in the topics of urban habitat, territory and sustainable development, which were presented and discussed with the community through a social mapping exercise in which 15 urban habitat and territory variables and 7 sustainable development variables were validated and recognized (see **Table 1**).

Table 1. Urban habitat and territory variables, and sustainable development.

Variables	
Urban habitat and territory	**Sustainable development**
1. Energy efficiency	1. Well-being of the population
2. Natural resources	2. Preservation of the environment
3. Land use/territorial planning	3. Urban dimension
4. Sanitation	4. Economic efficiency
5. Vulnerability	5. Political will
6. Air	6. Communities
7. Noise	7. Social cohesion
8. Safety	
9. Well-being	
10. Income	
11. Employment	
12. Equity	
13. Investment	
14. Connectivity	
15. Mobility / transport	

Source: The authors.

2) A causal correlation matrix was designed, which allowed the relationship between the fundamental dimensions of the triangle of conflicts in the structure of the territory, such as the environmental, social and economic dimensions. These dimensions facilitated the categorization of the identified variables, since their association subsequently allowed the identification of the relevant issues of each variable to identify the most relevant indicators in terms of the sustainability of the territory (see **Table 2**).

Table 2. Topics corresponding to the *Y* axis, urban habitat and territory; and to the *X* axis, sustainable development.

Topics	
Urban Habitat and Territory	**Sustainable Development**
***Y* Axis**	***X* Axis**
1. Efficient Production	1. Equity
2. Clean Production	2. Participation
3. Water	3. Ecological footprint
4. Density	4. Balance of the biosphere
5. Land Use Planning	5. Land occupation
6. Environmental Impacts: Soil, Water, Visual and Atmospheric Pollution	6. Access to urban infrastructure
7. Solid Waste Management	7. Competitiveness
8. Physical Safety of the Environment	8. Social progress
9. Air Quality Control	9. Policies
10. Concentration of Pollutants in the Air	10. Planning
11. Noise Control	11. Confidence

Table 2. (*Continued*).

Topics	
Urban Habitat and Territory	**Sustainable Development**
***Y* Axis**	***X* Axis**
12. Violence	12. Management
13. Public Services	13. Agreement
14. Habitat Quality	14. Cooperation
15. Education	
16. Health	
17. Social Security	
18. Income and Income Distribution	
19. Unemployment	
20. Informal Employment	
21. Poverty / Socio-Spatial Segregation	
22. Infrastructure	
23. Internet	
24. Telephony	
25. Balanced Transport Infrastructure	
26. Clean Transport	
27. Planned and Managed Transport	
28. Economic Transport	
29. Balanced Demand	

Source: The authors.

3) A set of representative indicators was defined for each theme (64 indicators in total), based on three characteristics: comprehensiveness, objectivity, and the possibility of comparison. With this information, the "Y" axis of the causal correlation matrix is dimensioned, determining the relationships and correspondences between the themes of urban habitat and territory, compared to the dimensions (3 in total), the variables (15 in total), the themes (29 in total), and the indicators (64 in total) (see **Table 3**).

Table 3. Indicators corresponding to the *Y* axis, urban habitat and territory, of the causal correlation matrix.

	Dimension	Variables	Topics	Indicator
Urban Habitat and Territory	Environmental	Energy Efficiency	Efficient Production	Annual residential electricity consumption per household
				% of industries with internalization of environmental costs
			Clean Production	% of industries with implementation of clean technologies
				% of industries with use of alternative energies
		Natural Resources	Water	Volume of water extracted by sector of the economy
				Water quality
				Annual water consumption per capita

Table 3. (*Continued*).

	Dimension	Variables	Topics	Indicator
Urban Habitat and Territory	Environmental	Land Use/Land Management	Density	Annual growth rate of the urban footprint
				Urban population density
			Land-use planning	Existence and active implementation of a land use plan
				Updated and legally binding master plan
				Number of recycling and recovery industries
				% of land area with agricultural potential
				Expansion area/Urban area
		Sanitation	Environmental impacts: Soil, water, visual and atmospheric pollution	Contaminated water bodies/Total water bodies
				% of the population affected by respiratory system diseases
				Noise levels
				Population affected by disasters
				Relocated population at risk area
			Solid waste management	Remaining life of the property on which the landfill is installed
				% of municipal solid waste from the city dumped in landfills open-air, controlled landfills, bodies of water or burned
				% of municipal solid waste in the city that is separated and classified for recycling
		Vulnerability	Physical safety of the environment	% of the municipal budget for the improvement of degraded areas
				% of households at risk due to inadequate construction or location in areas with non-mitigable risk
				Disaster risk management in urban development planning
		Air	Air quality control	Existence, monitoring and compliance with air quality standards
			Concentration of pollutants in the air	Air quality index
				PM concentration
		Noise	Noise control	Existence, monitoring and compliance with noise pollution standards
	Social	Security	Violence	Homicides per 100,000 inhabitants
				Domestic violence rate (in the last 12 months)
				Thefts per 100,000 inhabitants

Table 3. (*Continued*).

	Dimension	Variables	Topics	Indicator
Urban Habitat and Territory	Social	Well-being	Public services	Public service coverage: percentage of urban population with access to drinking water, sewage, sanitation, electricity and public telephone services
			Habitat quality	% of housing that does not meet the habitability standards defined by the country
				Quantitative housing deficit
				% overcrowding
			Education	Illiteracy
				Student dropout
			Health	Morbidity
				Mortality
				Infant mortality
			Social security	Social and family security system coverage/total population
				Population covered by the subsidized health system/Total population
	Economic	Income	Income and income distribution	Economic dependence of a certain number of family members
		Employment	Unemployment	Unemployment rate (annual average)
			Informal employment	Informal employment as a percentage of total employment
		Equity	Poverty/Socio-spatial segregation	SISBEN level
				Unsatisfied basic needs
				% of the population below the poverty line
				% of housing located in informal settlements
		Investment	Infrastructure	% of municipal budget for road and transport infrastructure works
				% allocated to water monitoring, treatment and sanitation
				% of public and private investment in pollution control
				Municipal budget for the local emergency fund
				Square meters under construction of basic and complementary infrastructure for the comprehensive management of solid waste
		Connectivity	Internet	Fixed broadband Internet subscriptions (per 100 inhabitants)
				Mobile broadband Internet subscriptions (per 100 inhabitants)
			Telephony	Mobile phone subscriptions (per 100 inhabitants)

Table 3. (*Continued*).

	Dimension	Variables	Topics	Indicator
Urban Habitat and Territory	Economic	Mobility/Transport	Balanced transport infrastructure	Kilometers of roads dedicated exclusively to public transport per 100,000 inhabitants
				Kilometers of pavement and pedestrian walkways per 100,000 inhabitants
			Clean transport	Average age of the public transport fleet
			Planned and managed transport	Transport planning and administration system
			Economic transport	Affordability index
			Balanced demand	Employment/housing ratio

Source: The authors.

4) Then the "*X*" axis (sustainable development) of the causal correlation matrix was defined, which articulates variables (7 in total) and themes (14 in total) concerning promoting the sustainability of the territory (see **Table 4**).

Table 4. Variables corresponding to the *X* axis, sustainable development, of the causal correlation matrix.

Dimension														
Sustainable Development														
Variables														
Well-being of the population		Preservation of the environment		Urban dimension		Economic efficiency		Political will		Communities		Social cohesion		Number of correlations
Topics														
Equity	Participation	Ecological footprint	Balance of the biosphere	Land occupation	Access to urban infrastructure	Competitiveness	Social progress	Policies	Planning	Trust	Management	Concertation	Cooperation	

Source: The authors.

5) Once the indicators were prioritized using the correlation methodology between the "*Y*" axis and the "*X*" axis, the corresponding equal score defined in the indicators was grouped into each of the correlation levels (high, medium and low).

In this way, in the high correlation, 1 indicator with a score of 14 was obtained, 2 indicators with a score of 13, 1 indicator with a score of 12, 3 indicators with a score of 11 and 7 indicators with a score of 10 (see **Table 5**).

Table 5. Indicators corresponding to the high correlation level.

Correlation Level	Indicator	Number Of Correlations
High	Annual residential electricity consumption per household	14
	Water quality	13
	Number of recycling and recovery industries	13
	Urban population density	12
	Population affected by disasters	11
	Population in risk areas, relocated	11
	% of housing that does not meet the habitability standards defined by the country	11

Table 5. (*Continued*).

Correlation Level	Indicator	Number Of Correlations
High	% of industries with internalization of environmental costs	10
	Volume of water extracted by sector of the economy	10
	Legally binding and updated master plan	10
	Noise levels	10
	Remaining life of the property on which the landfill is installed	10
	% of municipal solid waste from the city dumped in open-air landfills, controlled landfills, bodies of water or burned	10
	Disaster risk management in urban development planning	10

Source: The authors.

In the average correlation, 10 indicators were obtained with a score of 9, 13 indicators with a score of 8, 8 indicators with a score of 7 and 9 indicators with a score of 6 (see **Table 6**).

Table 6. Indicators corresponding to the average correlation level.

Correlation Level	Indicator	Number Of Correlations
Half	Existence and active implementation of a land use plan	9
	Contaminated water bodies/Total water bodies	9
	% of homes at risk due to inadequate construction or location in areas with unmitigable risk	9
	Coverage of public services: percentage of urban population with access to drinking water, sewage, sanitation, electricity and public telephone services	9
	Quantitative housing deficit	9
	% allocated for water monitoring, treatment and sanitation	9
	Kilometers of roads dedicated exclusively to public transport per 100,000 inhabitants	9
	Average age of public transport fleet	9
	Transportation planning and management system	9
	Number of housing/employment routes	9
	% of industries with implementation of clean technologies	8
	% of industries using alternative energy	8
	Annual water consumption per capita	8
	Existence, monitoring and compliance with noise pollution regulations	8
	% of land area with agricultural potential	8
	Expansion area / Urban area	8
	Infant mortality	8
	% of the population affected by respiratory system diseases	8
	% of municipal solid waste in the city that is separated and classified for recycling	8
	% of municipal budget for the improvement of degraded areas	8
	% of housing located in informal settlements	8
	Square meters under construction of basic and complementary infrastructure for the comprehensive management of solid waste	8
	Kilometers of pavement and pedestrian paths per 100,000 inhabitants	8

Table 6. (*Continued*).

Correlation Level	Indicator	Number Of Correlations
Half	% of public and private investment in pollution controls	7
	Municipal budget for the local emergency fund	7
	Student desertion	7
	Existence, monitoring and compliance with air quality standards	7
	Air quality index	7
	Informal employment as a percentage of total employment	7
	% of municipal budget for road and transport infrastructure works	7
	Fixed broadband Internet subscriptions (per 100 inhabitants)	7
	% of overcrowding	6
	Illiteracy	6
	Morbidity	6
	Social and family security system coverage/total population	6
	Unmet basic needs	6
	% of the population below the poverty line	6
	Mobile broadband Internet subscriptions (per 100 inhabitants)	6
	Mobile phone subscriptions (per 100 inhabitants)	6
	Affordability Index	6

Source: The authors.

In the low correlation, 6 indicators were obtained with a score of 5, 3 indicators with a score of 4 and 1 indicator with a score of 3 (see **Table 7**).

Table 7. Indicators corresponding to the low correlation level.

Correlation Level	Indicator	Number Of Correlations
Low	Homicides per 100,000 inhabitants	5
	Domestic violence rate (last 12 months)	5
	Thefts per 100,000 inhabitants	5
	Mortality	5
	Population covered by the subsidized health system/Total population	5
	Unemployment rate (annual average)	5
	Annual growth rate of urban footprint	4
	PM concentration	4
	Economic dependence on a certain number of family members	4
	SISBEN level	3

Source: The authors.

6) Once the indicators were grouped according to their theme and relevance, the working team proceeded to define projects that responded to the priority needs of the affected communities. In this way, and taking into account the grouping of indicators and the project proposal, the result obtained can be seen in **Table 8**.

Table 8. Projects categorized by correlation level and themes.

Correlation Level	Number Of Indicators Considered	Total Projects
High	14	Project 1: "Energy and Water Resources Optimization in Vulnerable Communities" Project 2: "Resilient Urban Planning and Disaster Adaptation" Project 3: "Industrial Management and Reduction of Environmental Impacts" Project 4: "Waste Reduction and Improvement of the Life Cycle of Landfills"
Medium	40	Project 1: "Comprehensive Plan for Natural Resources and Environmental Management" Project 2: "Sustainable Urban Development and Access to Safe Housing" Project 3: "Community Health and Wellbeing Improvement Program" Project 4: "Optimization of Infrastructure and Public Services" Project 5: "Promotion of Connectivity and Technological Development" Project 6: "Strengthening Formal Employment and Economic Development"
Low	10	Project 1: "Comprehensive Program for Security and Violence Reduction" Project 2: "Strengthening the Health System and Social Coverage" Project 3: "Employment Strategy and Reduction of Economic Dependency" Project 4: "Monitoring and Management of Sustainable Urban Growth"

Source: The authors.

Thus, for the different levels of correlation (high, medium and low) a total of 64 indicators were taken into account, from which 14 projects emerged. Within these 14 projects, 4 are proposed for the high correlation level, 6 are proposed for the medium correlation level and 4 projects are proposed for the low correlation level.

7) Considering the types of projects, the SDGs that they impact were analyzed and thus grouped according to their number and frequency in the projects as follows:

- SDG 1: End of poverty—Appears in 6 projects.
- SDG 3: Good health and well-being—Appears in 6 projects.
- SDG 4: Quality education—Appears in 3 projects.
- SDG 5: Gender equality—Appears in 1 project.
- SDG 6: Clean water and sanitation—Appears in 5 projects.
- SDG 7: Affordable and clean energy—Appears in 3 projects.
- SDG 8: Decent work and economic growth—Appears in 5 projects.
- SDG 9: Industry, innovation and infrastructure—Appears in 7 projects.
- SDG 10: Reduced inequalities—Appears in 7 projects.
- SDG 11: Sustainable cities and communities—Appears in 9 projects.
- SDG 12: Responsible consumption and production—Appears in 4 projects.
- SDG 13: Climate action—Appears in 5 projects.
- SDG 15: Life on land—Appears in 3 projects.
- SDG 16: Peace, justice and strong institutions—Appears in 1 project.

8) In order to prioritize the implementation of these projects, the GERC-ES Method was applied. In this way, it was defined that for this process the strategic lines were given by the high, medium and low correlation levels, defined in PHASE 1 of the methodology, and the lines of action would be defined by the projects corresponding to each of these correlation levels (see **Table 9**).

Table 9. Definition of the variables corresponding to the strategic lines and the lines of action.

Strategic Line	Lines Of Action
High	Project 1: "Energy and Water Resources Optimization in Vulnerable Communities"
	Project 2: "Resilient Urban Planning and Disaster Adaptation"
	Project 3: "Industrial Management and Reduction of Environmental Impacts"
	Project 4: "Waste Reduction and Improvement of the Life Cycle of Landfills"
Medium	Project 1: "Comprehensive Plan for Natural Resources and Environmental Management"
	Project 2: "Sustainable Urban Development and Access to Safe Housing"
	Project 3: "Community Health and Wellbeing Improvement Program"
	Project 4: "Optimization of Infrastructure and Public Services"
	Project 5: "Promotion of Connectivity and Technological Development"
	Project 6: "Strengthening Formal Employment and Economic Development"
Low	Project 1: "Comprehensive Program for Security and Violence Reduction"
	Project 2: "Strengthening the Health System and Social Coverage"
	Project 3: "Employment Strategy and Reduction of Economic Dependency"
	Project 4: "Monitoring and Management of Sustainable Urban Growth"

Source: The authors.

9) In order to prioritize those projects that, in the opinion of the working group, were more immediate to carry out, the Effect Value (Ve) corresponding to each Line of Action (projects) was weighted, which defines the effect, that is, the priority, urgency or immediacy of each action (see **Table 10**).

Table 10. Participatory definition to prioritize projects according to the effect value (Ve).

No	Strategic Line	Lines Of Action	Totalization				
			Effect Value (Ve)				
			Essential	Very Important	Important	Little Importance	
1	(1) High	Project 1: "Energy and Water Resources Optimization in Vulnerable Communities"	45	21	6	1	73
		Project 2: "Resilient Urban Planning and Disaster Adaptation"	40	25	7	1	73
		Project 3: "Industrial Management and Reduction of Environmental Impacts"	31	34	6	2	73
		Project 4: "Waste Reduction and Improvement of the Life Cycle of Landfills"	44	22	5	2	73
2	(2) Medium	Project 1: "Comprehensive Plan for Natural Resources and Environmental Management"	23	31	13	6	73
		Project 2: "Sustainable Urban Development and Access to Safe Housing"	13	29	25	6	73
		Project 3: "Community Health and Wellbeing Improvement Program"	12	31	27	3	73
		Project 4: "Optimization of Infrastructure and Public Services"	12	28	26	7	73
		Project 5: "Promotion of Connectivity and Technological Development"	11	32	23	7	73

Table 10. (*Continued*).

No	Strategic Line	Lines Of Action	Totalization				
			Effect Value (Ve)				
			Essential	Very Important	Importa nt	Little Importance	
2	(2) Medium	Project 6: "Strengthening Formal Employment and Economic Development"	11	23	26	13	73
3	(3) Low	Project 1: "Comprehensive Program for Security and Violence Reduction"	24	40	5	4	73
		Project 2: "Strengthening the Health System and Social Coverage"	11	21	36	5	73
		Project 3: "Employment Strategy and Reduction of Economic Dependency"	18	19	33	3	73
		Project 4: "Monitoring and Management of Sustainable Urban Growth"	17	25	3	28	73

Source: The authors.

10) Once the Effect Value of each Line of Action has been obtained, the Line Value (VL) of each of the three Strategic Lines is obtained (see **Table 11**).

Table 11. Definition of the line value (VL) of each of the 3 strategic lines with their corresponding lines of action.

Strategic Line	Line Value (VL)	Lines of Action	Essential	Very Important	Important	Little Importance	∑ Total (∑1; ∑2)	Line Value (VL) = (∑2/∑1)
Evaluation			**5**	**3.5**	**2**	**1**		
(1) High	4.15	Project 1: "Energy and Water Resources Optimization in Vulnerable Communities"	45	21	6	1		
		Project 2: "Resilient Urban Planning and Disaster Adaptation"	40	25	7	1		
		Project 3: "Industrial Management and Reduction of Environmental Impacts"	31	34	6	2		
		Project 4: "Waste Reduction and Improvement of the Life Cycle of Landfills"	44	22	5	2		
∑1 = ∑Lines of Action			160	102	24	6	292	
∑2 = (∑Lines of Action) × (Evaluation)			800	357	48	6	1211	4.15
(2) Medium	3.06	Project 1: "Comprehensive Plan for Natural Resources and Environmental Management"	23	31	13	6		
		Project 2: "Sustainable Urban Development and Access to Safe Housing"	13	29	25	6		
		Project 3: "Community Health and Wellbeing Improvement Program"	12	31	27	3		
		Project 4: "Optimization of Infrastructure and Public Services"	12	28	26	7		
		Project 5: "Promotion of Connectivity and Technological Development"	11	32	23	7		

Table 11. (*Continued*).

Strategic Line	**Line Value (VL)**	**Lines of Action**	**Essential**	**Very Important**	**Important**	**Little Importance**	**∑ Total (∑1; ∑2)**	**Line Value (VL) = (∑2/∑1)**
Evaluation			**5**	**3.5**	**2**	**1**		
(2) Medium	3.06	Project 6: "Strengthening Formal Employment and Economic Development"	11	23	26	13		
∑1 = ∑Lines of Action			82	174	140	42	438	
∑2 = (∑Lines of Action) × (Evaluation)			410	609	280	42	1341	3.06
(3) Low	3.12	Project 1: "Comprehensive Program for Security and Violence Reduction"	24	40	5	4		
		Project 2: "Strengthening the Health System and Social Coverage"	11	21	36	5		
		Project 3: "Employment Strategy and Reduction of Economic Dependency"	18	19	33	3		
		Project 4: "Monitoring and Management of Sustainable Urban Growth"	17	25	3	28		
∑1 = ∑Lines of Action			70	105	77	40	292	
∑2 = (∑Lines of Action) × (Evaluation)			350	367.5	154	40	911.5	3.12

Source: The authors.

In this way, once the Cost Value (Vc) of each defined project was measured, a 5-year work period was established with the group; thus, a percentage of execution (%act) was estimated for each action, which allowed the requirements table to be completed with respect to the Individual Value of the Action (VIac), the Total Value of the Action (VTac) and therefore the Optimal Value of the Plan (VOpl), as Equation (6).

4. Discussion

The study highlights the importance of a participatory and collaborative approach in project planning for vulnerable urban communities, involving local actors and academia to identify variables and apply causal correlation methodologies that ensure sustainable development. The validation of 15 urban habitat variables and 7 sustainable development variables through social mapping allowed for a comprehensive analysis and a precise diagnosis, strengthening the sense of belonging and community commitment.

It is worth highlighting that the causal correlation matrix allowed for the design of the tool that subsequently facilitated the prioritization of projects that seek sustainability in the territory of Gran Yomasa, addressing in a holistic and systemic way the problems present in its environment through methods that facilitate leaders to make decisions and subsequently propose initiatives that allow solutions to be provided in aspects of territory and urban habitat that require sustainability processes. Therefore, the tool used in the study facilitated the categorization of variables into environmental, social, and economic dimensions, prioritizing key indicators such as energy efficiency and waste management, which are essential for highly relevant projects such as "Energy and Water Resources Optimization."

The projects defined in the research are not only based on empirical data but are also aligned with the Sustainable Development Goals (SDGs), strengthening their global relevance. The relationship with SDGs such as Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), and Sustainable Cities and Communities (SDG 11) reinforces the intention of these projects to promote lasting structural changes.

The GERC-ES method was essential for the prioritization of projects, integrating multiple dimensions in a matrix that assesses impact and urgency. This method, by weighing the causal correlation and the effect of actions, allowed the identification of priority interventions that positively impact sustainability and quality of life. Five-year planning based on line and cost values ensures efficient allocation of resources and flexibility in implementation.

This work in partnership with various actors in society allowed TECHO—Colombia to adopt a methodological approach to prioritize its community infrastructure processes strategically in the territories where it works. Through the integration of different visions, experiences, and knowledge, it is possible to build processes that positively impact the quality of life of the community through the correlation between variables of sustainability, territory, and habitability. This contribution to knowledge is based on a participatory exercise, where all those involved have equal relevance in the process.

5. Conclusion

The research process highlights the importance of establishing collaborations between the community and academia in the planning of sustainable development projects, especially when dealing with vulnerable territories, where the opinion and participation of their inhabitants is part of the transformation of their own territory. This participatory approach not only allowed for the accurate identification of the challenges and priorities of the communities but also for the design of plans focused on their needs and aspirations.

Through social mapping, it was possible to identify and validate variables related to urban habitat and sustainable development, providing a comprehensive analysis that supported the creation of well-structured projects. These variables reflect the reality of the territory and constitute an essential basis for the prioritization of actions.

The use of the GERC-ES Method allowed to structure strategic lines aligned with the needs of the community and with a focus on sustainability. This method facilitated the identification of projects with high impact, such as energy optimization and water resource management, ensuring interventions that improve the quality of life and promote the resilience of the territory.

The alignment of the projects with the Sustainable Development Goals (SDGs) reinforced their long-term relevance. Projects aimed at improving access to essential resources such as clean water and affordable energy (SDGs 6 and 7) and promoting sustainable cities (SDGs 11) ensured a direct and positive impact on communities, contributing to the fulfillment of global commitments.

Finally, the implementation of five-year planning with adaptive flexibility allows for an efficient response to the changing needs of communities, ensuring that interventions are sustainable, inclusive and equitable.

In summary, the results of the research demonstrate that the integrated use of tools such as variable identification, the GERC-ES Method and community collaboration allows for progress towards more efficient planning aimed at achieving sustainable development. This highlights the capacity of communities to lead significant changes when strengthened by collaborative strategies and robust scientific approaches.

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