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Urban acupuncture as a social strategy for the revitalization of the riverfront of the Malecón del Río Tumbes

Acupuntura urbana como estrategia social para la reactivación del borde fluvial del Malecón del Río Tumbes

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Abstract

This research analyzes the application of urban acupuncture as a social strategy to revitalize the riverfront of the Malecón del Río Tumbes in Peru. A mixed-methods approach with a non-experimental, explanatory design was adopted, including a non-probabilistic sample of 58 participants (local residents and business owners) and 11 key informants. Data were collected through surveys, interviews, and spatial analysis, allowing for the evaluation of perceptions regarding specific urban interventions. The results highlight moderate positive correlations between urban regeneration and social conditions ($rs = 0.596$, $p < 0.01$), tactical urbanism and physical conditions ($rs = 0.599$, $p < 0.01$), and ecological architecture and environmental conditions ($rs = 0.628$, $p < 0.01$). Furthermore, the proposals showed high acceptance, with 72.41% approval for urban regeneration and 93.1% support for the creation of green spaces. It is concluded that urban acupuncture, due to its social focus, represents a viable and effective strategy for revitalizing riverfronts, provided it comprehensively integrates social, physical, and environmental aspects, along with the active participation of the local community. This approach fosters social cohesion and environmental sustainability in peripheral urban contexts.

Keywords: urban acupuncture, riverfront, urban regeneration, tactical urbanism.

Resumen

Esta investigación analiza la aplicación de la acupuntura urbana como estrategia social para reactivar el borde fluvial del Malecón del Río Tumbes en Perú. Para tal fin, se adoptó una metodología mixta con diseño no experimental de nivel explicativo, que incluyó una muestra no probabilística de 58 participantes (residentes y comerciantes locales) y 11 informantes clave. Los datos se recolectaron mediante encuestas, entrevistas y análisis espaciales, permitiendo evaluar las percepciones sobre intervenciones urbanas puntuales. Los resultados destacan correlaciones positivas moderadas entre la regeneración urbana y las condiciones sociales ($rs = 0.596$, $p < 0.01$), el urbanismo táctico y las condiciones físicas ($rs = 0.599$, $p < 0.01$), así como la arquitectura ecológica y las condiciones ambientales ($rs = 0.628$, $p < 0.01$). Además, se registró una alta aceptación de las propuestas, con un 72.41% de aprobación para la regeneración urbana y un 93.1% de respaldo a la creación de espacios verdes. Se concluye que la acupuntura urbana, por su enfoque social, representa una estrategia viable y efectiva para revitalizar el borde fluvial, siempre que integre de manera integral los aspectos sociales, físicos y ambientales, junto con la participación activa de la comunidad local. Esta aproximación fomenta la cohesión social y la sostenibilidad ambiental en contextos urbanos periféricos.

Palabras clave: acupuntura urbana, borde fluvial, regeneración urbana, urbanismo táctico.

Introduction

Throughout history, rivers have played a defining role in the emergence and evolution of cities, functioning as essential corridors for transportation, commerce, and human settlement (Kimari & Parish, 2020; Procopiuck et al., 2020). Industrialization, however, fundamentally altered this relationship. In many cities, rivers were progressively channelized, neglected, or even transformed into drainage systems, diminishing both their ecological integrity and their social significance (Pattacini, 2021). Consequently, what had once served as vibrant places of

interaction gradually became spaces associated with transit, abandonment, and disconnection, reflecting not only physical deterioration but also the erosion of their symbolic value (Augé, 2008; Sapena et al., 2021).

A growing body of research demonstrates that urban rivers exert a substantial influence on residents' quality of life (Benavente & La Rosa-Boggio, 2025; La Rosa-Boggio et al., 2025). Studies by Matsuoka and Kaplan (2008), Naghibi et al. (2024), and Sun et al. (2024) have shown that well-designed urban landscapes, particularly those providing meaningful contact with nature, visually appealing environments, and opportunities for recreation, promote psychological well-being, encourage civic participation, and reinforce a shared sense of community identity (Reece et al., 2024).

Within this context, the riverfront should be understood as a complex transitional landscape where governance, everyday social practices, and collective identity intersect and continually evolve (Arias-Caicedo et al., 2019; Barthel & Scott, 2024; Dragicevic, 2024).

Contemporary scholarship consistently emphasizes the importance of revitalizing urban riverfronts because of the broad range of benefits they generate (De la Fuente Muñoz, 2021; Gonçalves & Pinho, 2024). First, green infrastructure enhances urban resilience by mitigating flood risks and strengthening cities' capacity to adapt to increasingly severe climatic events. Second, regenerated waterfronts reinforce urban identity and contribute to city branding through integrated design, recognizable landmarks, and cultural assets. Third, ecological restoration improves biodiversity while increasing climate resilience, objectives that align with international policy initiatives such as the European Union Nature Restoration Law, which promotes the principle of achieving no net loss of urban green space (Mishra & Saxena, 2024; Nesterenko et al., 2021; Pradilla & Hack, 2024).

Urban river restoration commonly relies on integrated interventions that include stormwater management, riverbank stabilization, riparian reforestation, and sustainable urban drainage systems. Such measures have become increasingly important as the ecosystem services provided by urban rivers gain recognition for both their intrinsic ecological value and their contributions to urban functionality (Molder et al., 2024; Padilla-Etienne, 2022).

Taken together, these perspectives suggest that the contemporary city cannot be understood solely as an assemblage of physical structures, the *urbs*, or as a network of logistical flows. Rather, it represents a living system of human relationships and shared meanings, the *civitas*, materialized through public space (La Rosa-Boggio et al., 2025). Along urban riverfronts, however, the relationship between natural ecosystems and the built environment has increasingly given way to socio-communicative fragmentation, creating an urgent need for interventions capable of restoring both environmental quality and social connectivity.

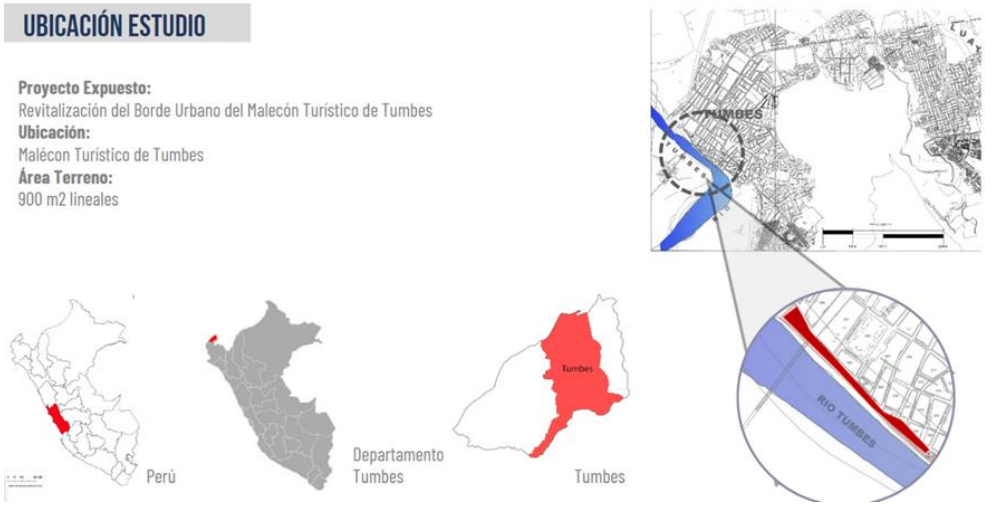
Located in Peru's northwestern border region adjacent to Ecuador, Tumbes occupies a strategic position that facilitates cross-border trade, tourism, and cultural exchange. The region is widely recognized for its rich biodiversity, including extensive mangrove ecosystems and coastal landscapes, while the Tumbes River constitutes one of its most valuable natural assets, sustaining agricultural production and supporting local ecological processes (Flores et al., 2013). This geographical setting has long positioned Tumbes as an important gateway between the two countries.

Despite these advantages, the Tumbes riverfront remains considerably underutilized. Large vacant areas continue to limit opportunities for economic activity, cultural expression, and public recreation that could otherwise benefit local communities. Consequently, the city's river promenade, the Malecón de Tumbes, represents an urban space whose strategic value has yet to be fully realized.

Against this backdrop, the present study addresses the socio-spatial fragmentation separating the river from the surrounding urban fabric by proposing urban acupuncture not merely as a design methodology, but as a socially oriented strategy capable of restoring meaningful relationships between people and place.

From the perspective of social communication, public space provides the primary arena in which democratic life unfolds and social hierarchies become visible (Botana, 2022). As Vidal and Pol (2005) argue, spatial appropriation enables individuals to connect their identities with particular places, transforming physical settings into landscapes of shared meaning. Years of deterioration have weakened this relationship along the Tumbes Riverfront Promenade, fostering perceptions of insecurity while diminishing the vitality of the area. Revitalization therefore requires more than architectural renewal; it calls for interventions that restore everyday social interaction and reconnect people with the public realm.

Figure 1
Location of the study area



Note. Taken from the maps included in the Tumbes Urban Development Plan (2020)

Within this context, the study addressed the following overarching research question: How can urban acupuncture contribute to the revitalization of the Tumbes Riverfront Promenade? Three specific research questions were derived from this central inquiry: How can urban regeneration improve the social conditions of the Tumbes Riverfront Promenade? How can tactical urbanism enhance the physical conditions of the Tumbes Riverfront Promenade? How can ecological architecture improve the environmental quality of the Tumbes Riverfront Promenade?

Recent studies by Guimarães et al. (2021), Lu et al. (2019), Raimondi et al. (2020), Veról et al. (2020), and Veról et al. (2019) suggest that successful urban river restoration depends on integrated interventions, including stormwater management, riverbank stabilization, channel reconfiguration, riparian reforestation, sustainable urban drainage systems, and the strategic combination of hard and soft river edges. Collectively, these measures strengthen flood resilience, improve ecological integrity, and expand the public benefits associated with urban waterways.

Guided by this evidence, the primary objective of the present study was to determine whether urban acupuncture can effectively revitalize the Tumbes Riverfront Promenade. Achieving this objective required identifying priority areas for intervention and developing integrated strategies capable of supporting the riverfront's long-term recovery.

Figure 2
Study area



The rationale for this research stems from the pressing need to transform urban riverfronts, particularly the Tumbes Riverfront Promenade. As transitional landscapes connecting urban and rural environments, these areas play a pivotal role in shaping the social, economic, and environmental dynamics of cities. Yet, their persistent underutilization represents a missed opportunity for sustainable urban development (Lucchi et al., 2024).

The Tumbes Riverfront Promenade exemplifies this contradiction. Although it possesses considerable potential as a tourism and recreational destination, it also reflects pronounced social vulnerability. From this perspective, urban acupuncture is conceived as a catalytic strategy in which carefully targeted, small-scale interventions stimulate broader urban transformation by restoring social interaction, activating public life, and ultimately improving residents' quality of life (Bromage et al., 2025)

The study also aligns closely with the United Nations Sustainable Development Goals (SDGs), particularly those promoting sustainable cities and communities and the conservation of terrestrial ecosystems (González, 2025; Opoku, 2019). Reimagining the Tumbes Riverfront Promenade through the principles of urban acupuncture offers insights that extend beyond the local context, providing a potentially transferable framework for other intermediate-sized Latin American cities facing comparable environmental and urban challenges (Ramkissoon et al., 2024). Community participation constitutes a central pillar of this approach. Ensuring that local residents actively contribute to the planning and implementation of interventions increases the likelihood that proposed solutions will reflect local priorities and expectations. Such participation not only strengthens social cohesion and reinforces collective identity but also enhances the long-term sustainability and resilience of urban regeneration initiatives (Maghsoodi Tilaki & Farhad, 2024; Ye et al., 2024).

Figure 3
Current conditions of the Tumbes Riverfront Promenade



Methodology

The study was conducted along the Tumbes Riverfront Promenade, specifically within the riverfront corridor bordering the Tumbes River in the Department of Tumbes, Peru. The study area encompassed a 1.2-km section of the waterfront, locally known as Malecón Benavides. This tropical environment experiences a mean annual temperature of approximately 25°C and pronounced seasonal rainfall between December and March.

A mixed-methods approach was adopted using a non-experimental explanatory research design. The analytical framework comprised two principal variables. Urban acupuncture served as the independent variable and was examined through three dimensions: urban regeneration, tactical urbanism, and ecological architecture. The dependent variable, riverfront revitalization, was evaluated across three complementary dimensions: social, physical, and environmental conditions.

Participants were selected through non-probability purposive sampling based on predefined inclusion criteria. The study included 26 households located directly opposite the promenade and 32 local merchants, artisans, and nearby residents. To enrich the qualitative component, 11 key informants were also recruited, comprising five architects specializing in urban design, three government officials, two business representatives, and one representative of the local artisans' association. Eligible participants included adults residing or working within the study area, frequent visitors, commercial property owners, and occupants of residential, commercial, and tourism-related buildings. Individuals living outside the immediate riverfront area, minors, and occupants of healthcare or educational facilities were excluded from the study.

Data collection relied on expert-validated research instruments. Quantitative information was gathered using a 23-item structured questionnaire, including 13 items assessing urban acupuncture and 10 items measuring riverfront revitalization. The qualitative component employed an 18-item semi-structured interview guide, complemented by technical observation forms used to document the physical condition of buildings, the waterfront infrastructure, ecological and landscape characteristics, and the performance of the surrounding road network. Quantitative data were analyzed using IBM SPSS Statistics Version 28, whereas qualitative coding and thematic analysis were performed with ATLAS.ti Version 9.

The investigation adhered to internationally recognized principles of research ethics and scientific integrity. Informed consent was obtained from every participant before data collection. Confidentiality and the protection of personal information were guaranteed throughout the research process, and participation remained entirely voluntary, allowing individuals to withdraw at any stage without consequence. The study further upheld principles of equity and non-discrimination, ensuring transparent data management and reporting while maintaining a strong

commitment to social responsibility and compliance with local ethical regulations governing research involving human participants.

Results and discussion

The empirical research focused on the Tumbes Riverfront Promenade, specifically along Oscar R. Benavides Avenue, extending from Tumbes Norte Avenue to Manco Cápac Street. To facilitate systematic assessment, the study area was divided into four strategic sectors, enabling a more detailed examination of spatial conditions and intervention priorities.

Field observations revealed that extensive underutilization of vacant spaces along the riverfront has constrained opportunities for community development. At the same time, deteriorating infrastructure and inadequate public lighting have contributed to widespread perceptions of insecurity, reinforcing patterns of territorial segregation that disproportionately affect socially vulnerable populations. Rather than functioning as an active public space, the promenade has gradually become an environment characterized by pronounced social vulnerability. These conditions are summarized in Table 1.

Table 1

Social vulnerability matrix for the Tumbes Riverfront Promenade and surrounding areas

Vulnerability category	Findings reported in the Tumbes Urban Development plan	Implications for public space
Demographic dynamics	Young population with high demand for employment and public services	Urgent need for productive and inclusive public spaces
Healthcare infrastructure	Unequal spatial distribution and limited service capacity	Elevated public health risks in areas affected by deficient sewerage systems
Basic services	Intermittent drinking water supply	Declining living conditions and public health along the riverfront
Public safety	Strong perception of insecurity, aggravated by inadequate street lighting	Reduced social use of the promenade during evening hours
Green infrastructure	Critical shortage of green space per capita	Negative consequences for social cohesion and healthy urban development

Note. Author's own elaboration based on the Tumbes Urban Development Plan (2020)

These findings underscore the need for a fundamental shift in territorial planning. Conventional planning approaches have largely failed because they overlook the aspirations and lived experiences of local communities. By contrast, the revitalization of the Tumbes Riverfront Promenade requires an emerging model of urbanism that recognizes residents as active producers of urban space, encouraging collective improvement through participatory action and civic engagement (Arango & López, 2021; Hernández Araque, 2016).

Landscape assessments further indicated that, across the first three sectors of the promenade, vegetated areas located between the waterfront and the main roadway consisted primarily of shrubs, 67% of which were found to be in poor condition. The remaining 33%, concentrated in Sectors 3 and 4 on the widened platform, contained ornamental vegetation and palm trees, approximately 75% of which were well maintained. Nevertheless, lawn cover remained limited, and even the greenest areas exhibited extensive growth of unmanaged weeds.

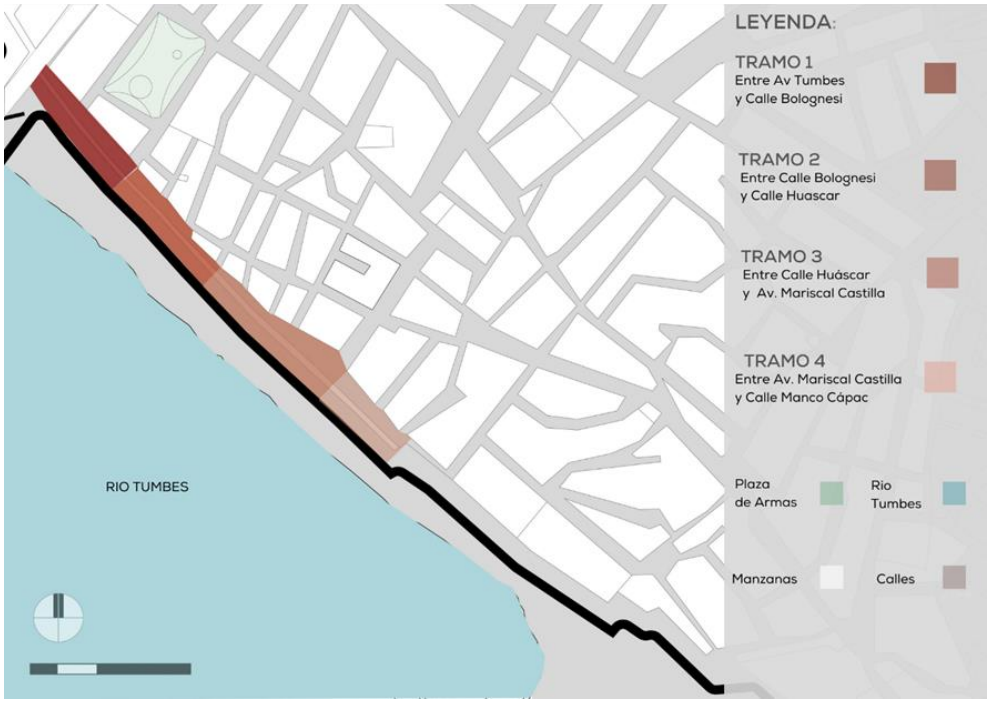
To address the first research objective —examining the relationship between urban regeneration and social conditions— the responses of the 58 study participants were initially tested for normality using the Kolmogorov–Smirnov test. Both principal variables exhibited non-normal distributions, with significance levels of 0.005 for urban acupuncture and 0.003 for riverfront revitalization ($p < 0.05$). Consequently, Spearman's rank-order correlation was selected for subsequent statistical analyses. The results demonstrated statistically significant associations across all evaluated dimensions, indicating that participants perceived urban design interventions as closely linked to improvements in everyday living conditions.

Table 2
Correlations between urban and social variables

Independent variable (urban acupuncture)	Dependent variable (riverfront revitalization)	Coefficient	Social interpretation
Urban regeneration	Social conditions	**0.596**	Moderate positive relationship, indicating that holistic urban design contributes to stronger social cohesion.
Tactical urbanism	Physical conditions	**0.599**	Moderate positive relationship, suggesting that rapid, localized interventions improve the quality and dignity of the built environment.
Ecological architecture	Environmental conditions	**0.628**	Moderate positive relationship, indicating that sustainable design strategies enhance environmental quality and residents' well-being.

The statistical evidence suggests that local residents regard improvements to the physical environment not as aesthetic enhancements but as essential social investments. Nearly 72.41% of respondents considered the relationship between urban regeneration and social conditions to be adequate, reflecting widespread expectations that urban interventions will reduce crime while strengthening community cohesion. At the same time, the finding that 53.45% of participants rated existing physical conditions as only moderate points to persistent deficiencies in public infrastructure that have yet to be systematically addressed by public authorities.

Figure 4
Sectorization of the Tumbes Riverfront Promenade



The participant profile consisted of 26 resident households (44.8%) and 32 local merchants and artisans (55.2%). To complement these perspectives, the qualitative component incorporated 11 key informants, including five architects with expertise in urban planning, three government officials, two representatives from the commercial sector, and one representative from the local artisans' association. This combination of stakeholders provided a comprehensive understanding of the challenges and opportunities associated with the revitalization of the riverfront.

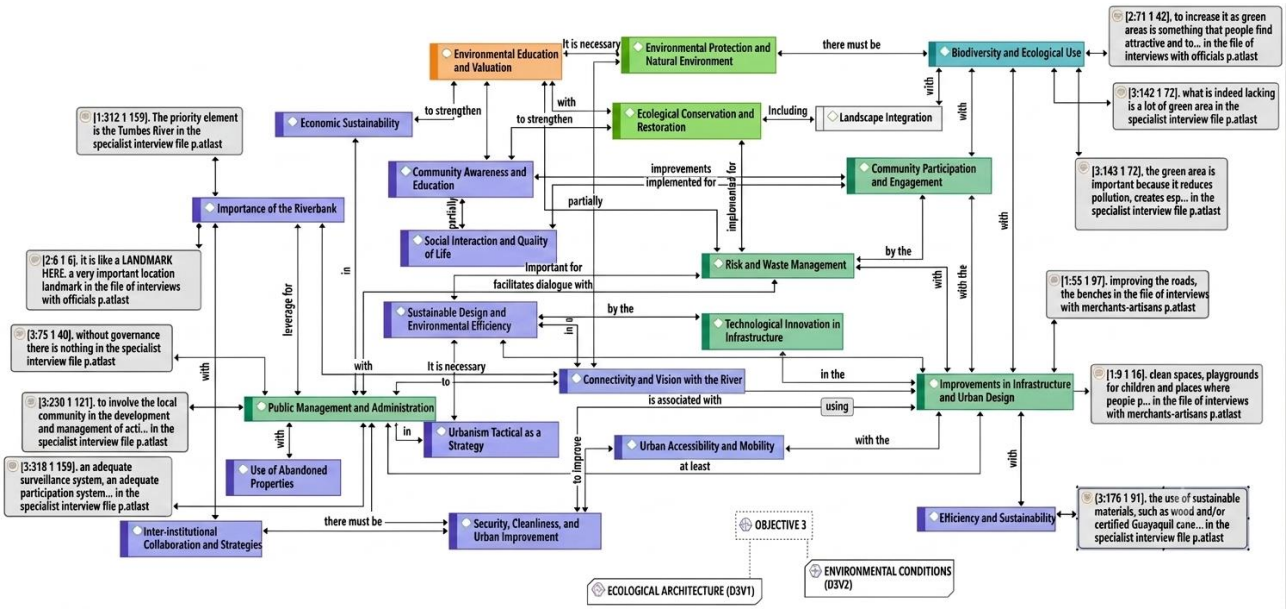
Qualitative findings revealed broad consensus among architects and urban planning specialists regarding the pivotal role of urban regeneration in restoring the vitality of the promenade. Experts 01 and 04 emphasized that successful regeneration must integrate social and economic dimensions rather than focus exclusively on physical renewal. Expert 02 highlighted the importance of recovering the site's historical identity while re-establishing a functional relationship between the city and the river. Likewise, Expert 05 identified several anticipated benefits, including employment generation, stronger social cohesion, and increased property values. At the same time, Expert 04 cautioned that poorly managed external investment could weaken the relationship between local residents and the regenerated public space, ultimately undermining long-term social sustainability.

Government officials and local business representatives offered complementary perspectives. Representatives 01 and 05 described the proposed intervention as an opportunity to transform the promenade from an insecure and underused area into a vibrant and welcoming public space. Representatives 02, 03, and 04 emphasized its considerable tourism potential and stressed the importance of integrating economic activity with social and cultural initiatives. Representative 04 further underscored the need for sustained interinstitutional collaboration, while Representatives 01 and 06 highlighted the contribution of cultural events to the recovery of public life along the riverfront.

The quantitative analysis reinforced these qualitative observations. Overall, 72.41% of respondents rated both urban regeneration and social conditions as adequate. Spearman's correlation analysis identified a moderate positive relationship between the two variables ($r_s = 0.596$, $p < 0.01$), demonstrating that urban regeneration initiatives were significantly associated with improvements in the social environment of the Tumbes Riverfront Promenade. These findings suggest that strategically planned regeneration can strengthen community interaction and enhance the social quality of public space.

Figure 5

Coding of interviews for specific objective 1 (qualitative component)



Note. Author's own elaboration

The second research objective examined the influence of tactical urbanism on the physical conditions of the Tumbes Riverfront Promenade. The results revealed statistically significant associations between both

dimensions. Among the 58 participants, 27.59% rated both tactical urbanism planning and the physical quality of the public space as adequate. Nevertheless, the fact that 53.45% evaluated existing physical conditions as only moderate indicates substantial opportunities for improving urban infrastructure.

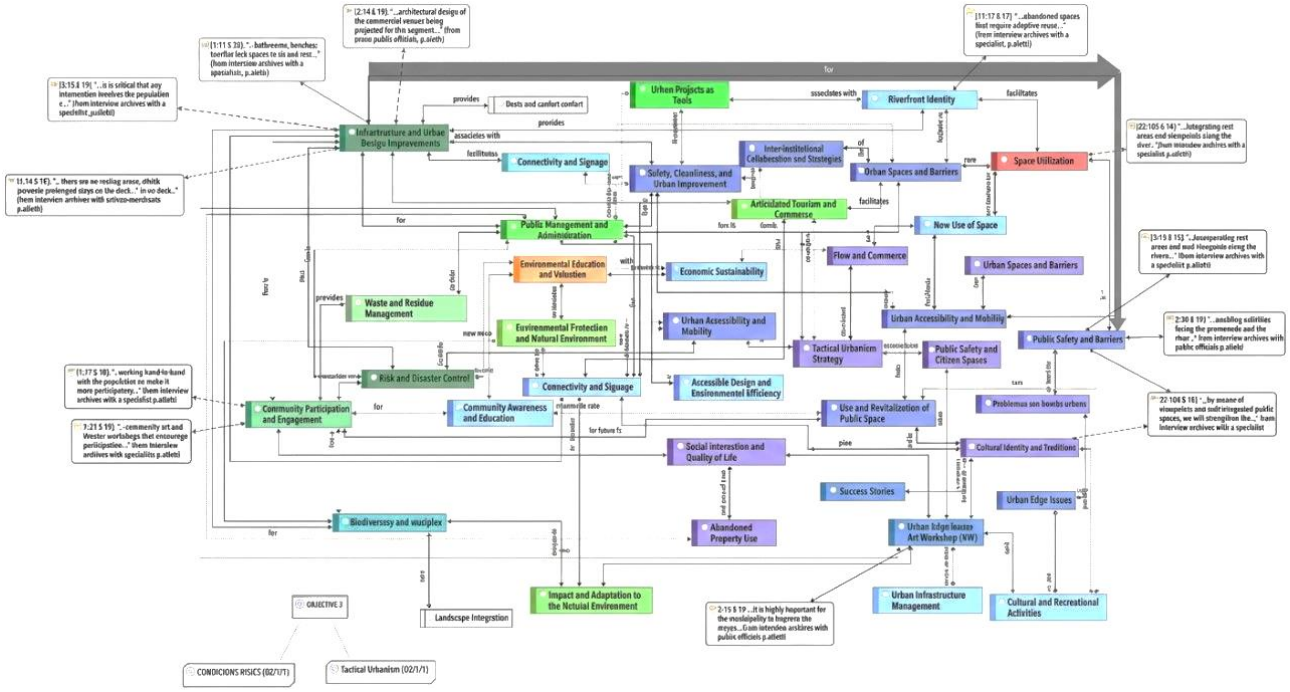
The qualitative evidence strongly supported these findings. Experts 01, 02, and 04 consistently identified community participation as a prerequisite for successful implementation throughout every stage of the project. Expert 01 argued that active community ownership promotes long-term stewardship of public spaces, whereas Expert 02 emphasized the need for clear governance structures and strategic institutional support. These observations closely mirror the moderate assessment of current physical conditions obtained through the quantitative survey. Statistical analysis confirmed a moderate positive correlation between tactical urbanism and physical conditions ($r_s = 0.599$, $p < 0.01$).

The statistical significance of this relationship was reflected in a series of practical design proposals advanced by the participants. Recommendations included the use of locally sourced sustainable materials (Expert 01), movable urban furniture (Expert 05), flexible multi-purpose structures (Expert 04), universally accessible ramps (Experts 01, 04, and 05), improved public lighting to enhance safety (Representative 04), additional green spaces (Experts 04 and 05), and better connectivity and wayfinding systems (Representatives 03 and 04). Only 8.62% of respondents considered tactical urbanism inadequate, whereas 50% rated it as adequate. Likewise, 29.31% evaluated the physical condition of the promenade as adequate, while 17.24% considered it inadequate.

Taken together, these findings demonstrate that well-planned tactical interventions can substantially improve the physical quality of the riverfront. Participants particularly emphasized the value of low-cost, temporary interventions, including recreational spaces (Representative 01; Expert 05), educational activities (Expert 02), and portable green infrastructure (Expert 05). Such initiatives position tactical urbanism as an effective mechanism for activating underutilized public spaces while laying the groundwork for broader urban transformation.

Figure 6

Coding of interviews for specific objective 2 (qualitative component)



Note. Author's own elaboration

The third research objective focused on designing ecological architecture strategies capable of improving the environmental quality of the Tumbes Riverfront Promenade. The integrated analysis of quantitative and qualitative evidence revealed consistent support for environmentally sustainable interventions. Statistical analysis

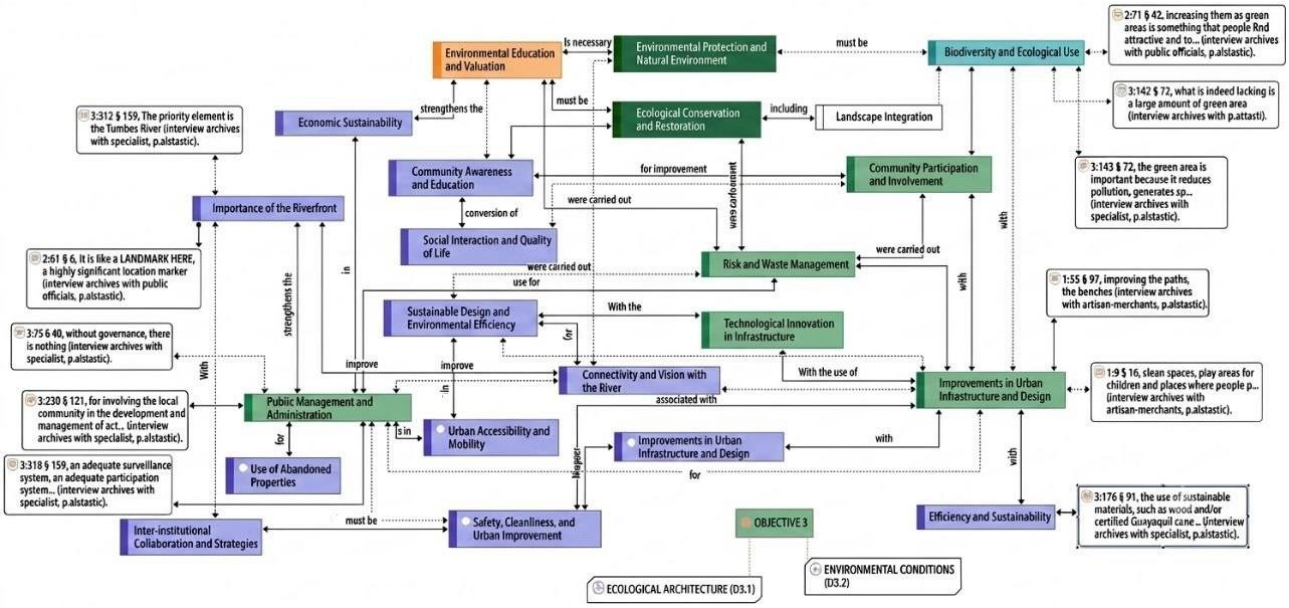
identified a moderate positive correlation between ecological architecture and environmental conditions ($r_s = 0.628$, $p < 0.01$). Furthermore, 43.10% of respondents simultaneously rated both variables as adequate, reflecting widespread public confidence in sustainability-oriented initiatives.

Interviews with specialists and institutional representatives identified multiple strategies for strengthening biodiversity and expanding urban green infrastructure. Proposed measures included the incorporation of native vegetation to preserve local biodiversity and improve the microclimate, together with community gardens, green roofs, and hydroponic systems. Beyond reducing environmental pollution, these interventions would create additional recreational opportunities while addressing the shortage of green space through the adaptive reuse of adjacent abandoned properties and the installation of rooftop gardens on second-story commercial buildings. Collectively, these strategies were viewed as effective means of reinforcing the relationship between residents and the surrounding environment.

Participants also prioritized the use of locally available sustainable construction materials, including certified timber and recycled Guayaquil cane, complemented by rainwater harvesting systems, LED lighting, wind-powered streetlights, and preventive maintenance programs. Community support for these proposals proved remarkably strong: 93.1% endorsed the creation of additional green spaces (50% agreed; 43.1% strongly agreed), while 91.3% supported incorporating renewable energy technologies (53.4% agreed; 37.9% strongly agreed). These results indicate that environmentally responsible interventions are both technically feasible and socially acceptable within the context of the Tumbes Riverfront Promenade, offering a solid foundation for improving long-term environmental quality.

Figure 7

Coding of interviews for specific objective 3 (qualitative component)



Note. Author's own elaboration

The findings associated with the first research objective revealed that 72.41% of participants considered both urban regeneration and social conditions to be satisfactory, while the statistical analysis identified a moderate positive correlation ($r_s = 0.596$, $p < 0.01$). These results indicate that urban regeneration initiatives contribute meaningfully to improving the social environment of the Tumbes Riverfront Promenade, reinforcing community cohesion and enhancing the quality of public life. This pattern is consistent with the work of Matsuoka and Kaplan (2008) and Reece et al. (2024), who demonstrated that thoughtfully designed urban landscapes exert positive effects on psychological well-being and social behavior in public spaces. The high level of public approval may be attributed to the participatory approach adopted throughout the research process, which encouraged residents to identify with the proposed interventions. Nevertheless, future investigations should determine which specific

components of urban regeneration—such as expanded communal areas, improved accessibility, or enhanced public amenities—generate the greatest gains in social cohesion, place attachment, and community identity.

With respect to the second objective, 27.59% of respondents evaluated the physical improvements associated with tactical urbanism as satisfactory, while Spearman's analysis revealed a moderate positive correlation ($r_s = 0.599$, $p < 0.01$). These findings are consistent with previous studies by Bell et al. (2020) and Hemingway and De Castro Mazarro (2022), which support the effectiveness of targeted, small-scale interventions in transforming degraded urban environments. However, the predominance of moderate ratings (53.45%) suggests that opportunities remain to optimize implementation strategies. Future interventions could benefit from incorporating more durable construction materials and climate-responsive design solutions better suited to local environmental conditions. Comparative research examining different tactical urbanism approaches—for example, modular street furniture versus permeable paving systems—would further clarify their long-term performance and public acceptance in riverfront environments with similar characteristics.

The third objective likewise produced encouraging results. A moderate positive association emerged between ecological architecture and environmental conditions ($r_s = 0.628$, $p < 0.01$), with 43.10% of respondents expressing favorable evaluations of both dimensions. These findings corroborate the work of Guimarães et al. (2021) and Veról et al. (2020), who emphasize that sustainable design strategies play a fundamental role in restoring urban rivers while strengthening climate resilience and ecological integrity. Particularly noteworthy was the exceptionally strong public support for sustainability-oriented interventions. The creation of additional green spaces received 93.1% approval, while 91.3% of respondents supported the incorporation of renewable energy systems. Although these results demonstrate broad social acceptance, additional research should evaluate the technical, economic, and maintenance feasibility of these interventions under resource-constrained conditions. Life-cycle assessments of green roofs, hydroponic systems, and comparable ecological infrastructure would provide valuable evidence to guide future implementation (Veról et al., 2019).

A principal strength of this investigation lies in its mixed-methods design, which enabled rigorous triangulation between quantitative findings and qualitative insights contributed by diverse local stakeholders. Integrating these complementary forms of evidence strengthened the robustness of the conclusions and provided a more comprehensive understanding of the riverfront revitalization process. Several limitations should nevertheless be acknowledged. The relatively small, non-probability sample ($n = 58$) restricts the extent to which the findings can be generalized beyond the study area. Furthermore, because the investigation employed a cross-sectional design, it captured community perceptions at a single point in time and therefore could not assess changes in either public attitudes or physical conditions following implementation. Longitudinal monitoring would be particularly valuable for evaluating the durability and long-term impacts of future interventions.

To maximize both the communicative and social effectiveness of riverfront revitalization, urban acupuncture should be implemented according to a set of principles that foster collective ownership and ensure the long-term sustainability of interventions:

- **Community participation:** Residents should actively engage in the planning, implementation, and ongoing stewardship of projects, cultivating a shared sense of ownership.
- **Collaborative governance.** Neighborhood organizations, public institutions, and local authorities should jointly coordinate project management while sharing responsibilities and resources.
- **Social activation.** Public spaces should be designed to encourage everyday interaction, strengthen social ties, and reinforce community networks.
- **Transforming space into place.** Physical improvements should preserve and celebrate the city's cultural identity by incorporating locally meaningful references into landscape and urban design.

This holistic perspective extends beyond climate adaptation through measures such as resilient vegetation and nature-based drainage systems. It also advances social inclusion by prioritizing universal accessibility and equitable access to public space. Improving environmental and physical quality in this way fosters a lasting culture of stewardship and collective responsibility toward public spaces, an essential condition for building resilient communities in socially vulnerable urban environments.

The practical implications of these findings position urban acupuncture as an effective framework for riverfront revitalization when social, physical, and environmental dimensions are addressed in a balanced and integrated manner while respecting local patterns of participation and governance. This perspective is particularly relevant for intermediate-sized Latin American cities, where limited financial resources often constrain large-scale

redevelopment, yet relatively small, strategically targeted interventions can generate substantial social and environmental benefits (Sousa et al., 2024).

Overall, the evidence suggests that urban acupuncture represents a powerful mechanism for revitalizing the Tumbes Riverfront Promenade, provided that implementation follows a comprehensive strategy integrating social inclusion, physical renewal, and environmental sustainability through sustained community participation. Under these conditions, riverfront regeneration can support the creation of public spaces that are more inclusive, resilient, and socially vibrant.

Table 3

SWOT matrix of the core problem with proposed strategies

SWOT Analysis	
Strengths S1: The Tumbes Riverfront Promenade's strategic location within a key tourist hub, providing easy access for both the local community and visitors. S2: A rich cultural identity that can be leveraged in the revitalization effort, offering significant potential for recreational and commercial activities.	**Weaknesses** W1: Deteriorated infrastructure, which undermines accessibility, safety, and the overall quality of the public space. W2: Deficient maintenance and a lack of long-term sustainability planning for urban interventions.
Opportunities O1: Availability of financial resources through public projects and public-private partnerships for urban revitalization. O2: A growing trend toward ecotourism and an increased valuation of sustainable urban environments adjacent to water bodies.	**Threats** T1: Risks associated with deficient long-term management and maintenance of the interventions once implemented. T2: Resistance to change from certain community sectors, who may oppose the transformation of the space.
External Analysis (EFE Matrix)	
Offensive Strategy S1O1: Implement urban acupuncture interventions to enhance the Riverfront Promenade's functionality and aesthetics, thereby promoting sustainable tourism and increasing the area's overall appeal.	**Reorientation Strategy** W1O2: Capitalize on the rising interest in ecotourism and sustainability to secure both public and private funding, thereby overcoming budgetary constraints and ensuring a comprehensive revitalization of the Riverfront Promenade.
Defensive Strategy S2T1: Develop a long-term maintenance plan to ensure the continuity of infrastructure improvements and prevent subsequent deterioration.	**Survival Strategy** W2T2: Establish an awareness program and foster interinstitutional coordination to engage the community and minimize resistance to change, thus ensuring the sustainability of the revitalization process.

Note. Author's own elaboration

Conclusions

The findings demonstrate a moderate positive relationship between urban regeneration and the social conditions of the Tumbes Riverfront Promenade, as evidenced by a Spearman correlation coefficient of 0.596 ($p < 0.01$). The high level of public approval (72.41%) further indicates that urban regeneration initiatives contribute positively to the social environment by strengthening community cohesion, reinforcing residents' sense of belonging, and encouraging everyday social interaction among local inhabitants and business owners.

Regarding the physical dimension, tactical urbanism was also found to be moderately and positively associated with riverfront revitalization ($r_s = 0.599$, $p < 0.01$). Nevertheless, the predominance of moderate evaluations (53.45%) suggests that future interventions should place greater emphasis on implementation strategies that incorporate climate-responsive design, durable construction materials, and adaptable urban solutions capable of ensuring the long-term functionality and resilience of public infrastructure.

The environmental dimension produced similarly encouraging results. Ecological architecture exhibited a moderate positive correlation with environmental conditions ($r_s = 0.628$, $p < 0.01$), while 43.10% of respondents evaluated both variables favorably. Particularly noteworthy was the strong community endorsement of environmentally sustainable initiatives, with 93.1% supporting the expansion of green spaces and 91.3% expressing approval of renewable energy technologies. These findings reflect a clear public preference for solutions that not only mitigate environmental degradation and urban heat but also enrich recreational experiences and strengthen local biodiversity along the riverfront.

Overall, the evidence supports the conclusion that urban acupuncture represents a viable and effective framework for revitalizing the Tumbes Riverfront Promenade, provided that implementation follows a holistic approach integrating social, physical, and environmental dimensions within a genuinely participatory planning process. Although the relatively small, non-probability sample warrants caution when extending these findings to other settings, the mixed-methods design substantially strengthened the study by combining robust quantitative evidence with rich qualitative insights provided by specialists, institutional representatives, and local residents.

Despite its analytical strengths, the cross-sectional nature of the research prevented the assessment of how interventions and their impacts evolve over time. Long-term monitoring therefore remains essential for determining whether the observed benefits can be sustained after implementation. Ultimately, successful riverfront revitalization depends on the continued engagement of the local community together with the balanced integration of social, environmental, and physical interventions. Such an approach encourages collective ownership of public space, strengthens climate resilience, and fosters a shared culture of stewardship that supports the long-term sustainability of urban regeneration initiatives.

Future research should prioritize longitudinal studies capable of measuring the sustained effects of urban acupuncture on key social and environmental indicators. Comparative analyses involving additional urban riverfronts across Latin America would help identify transferable planning principles and best practices, while comprehensive cost-benefit assessments incorporating economic modeling and advanced climate simulations would provide stronger evidence regarding the scalability and long-term feasibility of urban acupuncture in resource-constrained contexts.

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