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# CHAKIÑAN: RECOVERY OF ANCESTRAL INFRASTRUCTURE AND MANAGEMENT OF THE LIVING TERRITORY IN THE COMMUNITY OF LAS LAGUNAS, SARAGURO, ECUADOR

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## CHAKIÑAN: RECUPERACIÓN DE INFRAESTRUCTURA ANCESTRAL Y GESTIÓN DEL TERRITORIO VIVO EN LA COMUNIDAD DE LAS LAGUNAS, SARAGURO, ECUADOR

## CHAKIÑAN: RECUPERAÇÃO DE INFRAESTRUTURA ANCESTRAL E GESTÃO DO TERRITÓRIO VIVO NA COMUNIDADE DE LAS LAGUNAS, SARAGURO, EQUADOR

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## ABSTRACT

Indigenous communities in Ecuador, such as Las Lagunas in Saraguro, possess an autonomous organization based on the Ayllu and the Andean worldview. Their system of ancient trails, called chakiñanes, has historically facilitated mobility and connectivity with sacred sites. However, the lack of upkeep and the pressure of motorized urban development threaten their survival. This research analyzes chakiñanes as ancestral infrastructure for sustainable habitat management. Through a multiscalar, mixed approach —integrating participatory mapping, photogrammetry, and the diagnosis of water and spiritual infrastructure—44 ancient trails were identified. The findings reveal that 95% of the community considers these routes vital to their identity, despite their physical fragmentation. It is concluded that revitalizing the chakiñanes through a micro-basin approach and the use of local materials will not only restore pedestrian mobility but also strengthen territorial governance for sustainable habitat and cultural landscape conservation.

Keywords
cultural landscape, pedestrian mobility, ancestral infrastructure, community planning

## RESUMEN

Las comunidades indígenas de Ecuador, como Las Lagunas en Saraguro, poseen una organización autónoma basada en el Ayllu y en la cosmovisión andina. Su sistema de caminos antiguos, llamados chakiñanes, ha facilitado históricamente la movilidad y la conexión con sitios sagrados. No obstante, la falta de mantenimiento y la presión del desarrollo urbano motorizado amenazan con su desaparición. Esta investigación analiza los chakiñanes como infraestructura ancestral para la gestión del hábitat sustentable. Mediante un enfoque mixto multiescalar —que integró mapeo participativo, fotogrametría y el diagnóstico de la infraestructura hídrica y espiritual— se identificaron 44 caminos antiguos. Los hallazgos revelan que el 95% de la comunidad considera estos ejes vitales para su identidad, a pesar de su fragmentación física. Se concluye que revitalizar los chakiñanes bajo una lógica de microcuenca y de materiales locales no solo recuperará la movilidad peatonal, sino que también fortalecerá la gobernanza territorial de un hábitat sostenible y la conservación del paisaje cultural.

Palabras clave
paisaje cultural, movilidad peatonal, infraestructura ancestral, planificación comunitaria

## RESUMO

As comunidades indígenas do Equador, como a de Las Lagunas, em Saraguro, possuem uma organização autônoma baseada no Ayllu e na cosmovisão andina. Seu sistema de caminhos antigos, chamados chakiñanes, tem facilitado, historicamente, a mobilidade e a conexão com locais sagrados. No entanto, a falta de manutenção e a pressão do desenvolvimento urbano motorizado ameaçam fazê-los desaparecer. Esta investigação analisa os chakiñanes como infraestrutura ancestral para a gestão sustentável do habitat. Por meio de uma abordagem mista e multiescalar — que integrou mapeamento participativo, fotogrametria e o diagnóstico da infraestrutura hídrica e espiritual —, foram identificados 44 caminhos antigos. Os resultados revelam que 95% da comunidade considera esses eixos vitais para sua identidade, apesar de sua fragmentação física. Conclui-se que a revitalização dos chakiñanes, sob uma lógica de microbacia e com o uso de materiais locais, não apenas recuperará a mobilidade dos pedestres, mas também fortalecerá a governança territorial de um habitat sustentável e a conservação da paisagem cultural.

Palavras-chave
paisagem cultural, mobilidade de pedestres, infraestrutura ancestral, planejamento comunitário

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# INTRODUCTION

The community landscape of indigenous peoples is constantly transforming and faces the challenge of integrating ancestral knowledge into habitat planning to ensure territorial sustainability. In this scenario, intervention in ancestral areas requires a deep understanding of the logics of historical occupation and the Andean cosmovision, where architecture is conceived as an intrinsic dialogue with the *Pachamama* (Lozano Guamán, 2021). Including this approach allows contrasting the limitations of contemporary construction models, in which the combination of nature and culture constitutes the emerging paradigm for planning and revitalizing territories based on their heritage resources (Pérez Bustamante & Parra Ponce, 2004). Under this approach, it becomes key to recover systems such as *bahareque,* which represent local identity and technique (Lozano Guamán, 2022). One of the fundamental elements of this territorial configuration is the *Chakiñanes*, mobility systems used since pre-Columbian times that take into account not only the complex Andean topography, but also a symbolic structure connecting the social and productive life of the communities.

The study of these ancient roads in America has the *Qhapaq Ñan* (Inca Trail) as its backbone, a physical and spiritual road network that linked the lands of the *Tawantinsuyo*. This monumental infrastructure not only attests to the constructive dominance of the Inca civilization, but also represents the result of a strategic expansion that took advantage of and perfected the pre-existing traces of earlier cultures (Marca Chérrez, 2011). As Guerrero Baca (2017) argues, understanding these ancestral territorial and constructive systems is imperative for the conservation of heritage in Latin America, as they blend the natural landscape with social identity. This system also facilitated efficient territorial control across different altitudinal levels through a dynamic organization of economic, political, and social relations (Ordóñez Suárez, 2019).

In the Ecuadorian context, the *Qhapaq Ñan* profoundly influences the identity of peoples such as the Kichwa Saraguro, in the province of Loja. In this southern area, the route connects archaeological landmarks such as Cerro Carboncillo and Tambo de Villamarca, which descends towards the Paquishapa River, to join settlements such as Ingapirca and Tambo Blanco (Marca Chérrez, 2011). This territorial occupation logic is also reflected in the architecture, morphological configuration, and spatial organization of settlements, where the transition from the vernacular to the modern requires a rigorous typological analysis, under the premise that the inhabited space is the product of an accumulated knowledge that links materiality with identity (Lozano Guamán, 2014).

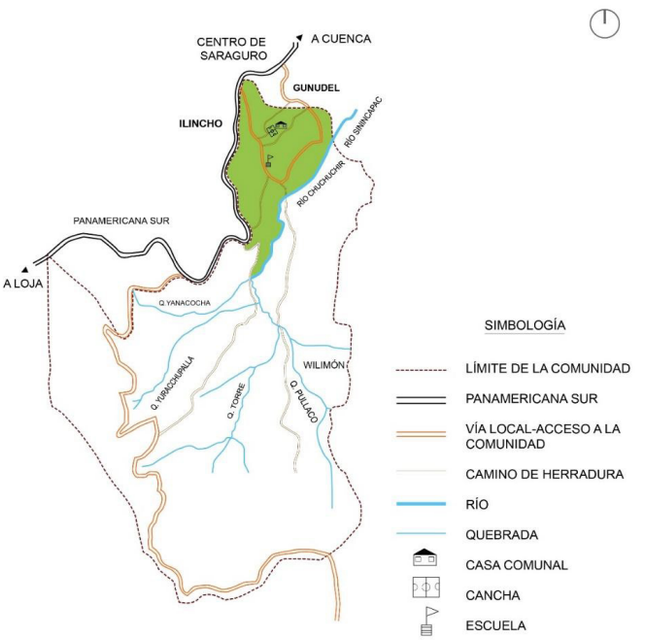



Figure 1. Schematic map of the Las Lagunas community territory. Source: Prepared by the Authors, based on Quizhpe Guamán (2013).

Despite its incalculable historical value and its loss in Andean ritual, a large part of this network in the Saraguro canton lacks preventive conservation plans, even though it is considered a valued element in provincial planning (Dávila Egüez, 2015). This technical shortcoming jeopardizes the survival of the ancestral *Chakiñanes*, which today serve as the last vestige of pre-Columbian connectivity and living memory in the region. To provide a geographical dimension to this phenomenon, a multiscale location and general location map was developed (Figure 1), which allows a cartographic approach from the macro-regional context to the specific section being intervened in. The protection of this fabric becomes ever more urgent when considering that the pressure of motorized urban development on Andean pedestrian infrastructure not only alters local mobility, but also jeopardizes the continuity of cultural landscapes rooted in earthen-built architecture. As noted by Colosi et al. (2025), contemporary transformation dynamics and the lack of connection in territorial planning accelerate the material loss of vernacular heritage environments, forcing the proposal of strategies to rescue local constructional knowledge in the face of urban anthropogenic risk.

## THE TERM CHAQUIÑÁN

The term *Chakiñan*, derived from the Kichwa words *chaki* (foot) and *ñan* (way), technically refers to the narrow pedestrian paths that form the basis of local mobility in the Andean world. According to the Ordóñez Suárez road system classification (2019), these roads

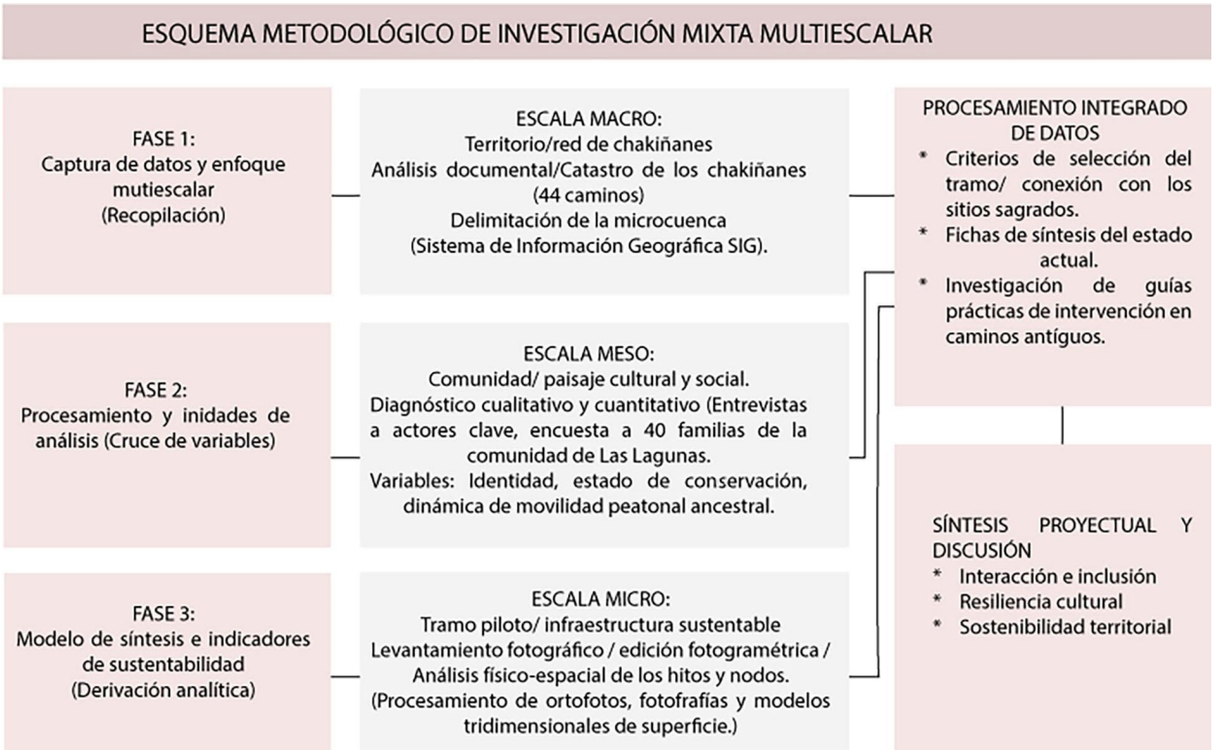



Figure 2. Design methodology. Source: Prepared by the Authors.

are organized by order of importance. The *Qhapaq Ñan* acted as the first-order route that connected the central lines of the four styles of the *Tawantinsuyo*; the *Runa Ñan* functioned as the second-level route destined to connect regions; and finally, the *Chakiñan* was established as the third-level route, whose main role was to link internal areas, the communities, and the *Ayllu*. This capillary network of *Chakiñanes*, albeit narrow, was fundamental for the Inca state vision by serving as the dynamizing axis of social and economic relations at a local scale (Marca Chérrez, 2011), which allows the flow of *mitimaes* (family groups) and the exchange of mass consumer products in geographically complex sectors such as Saraguro (Canziani Amico, 2012).

Based on this, the research raises the following question: How does the recovery of this network of ancient roads, *Chakiñanes*, contribute to the resilience of sustainable habitats and the preservation of symbolic and functional structures in contemporary indigenous communities? The objective is to propose an intervention model that links vernacular techniques with autonomous territorial planning.

# METHODOLOGY

This research is conducted using a mixed approach, based on exploratory and descriptive methodologies (Hernández Sampieri & Mendoza Torres, 2018). The methodology follows a multiscale vision that allows understanding the territory as a living system (Figure 2).

## MACRO SCALE: TERRITORIAL DELIMITATION AND LIST OF CONNECTIVITY NETWORKS

The macro-scale approach was structured around the geographical boundary and morphometric analysis of the micro-basin, which is home to the community territory of the *Lagunas Chukidel Ayllullacta* in the Saraguro Canton, Loja province, Ecuador, defining it as the fundamental biophysical unit for sustainable habitat planning. In this phase, the implementation and layout logic of the *Chakiñanes* were evaluated in relation to topographic variables and the surface water network. For this, a geospatial database was designed using Geographic Information Systems (GIS), and digital terrain models (MDE, in Spanish) were used as cartographic inputs. This technical procedure aimed to correlate terrain slopes with the sinuosity coefficients of ancestral paths, enabling the examination of energy efficiency and topographic adaptability patterns associated with pedestrian mobility within the community territory.

At the same time, the reconstruction of the historical road fabric was complemented by on-site social mapping and field route validation. This method integrated local collective memory with global positioning (GPS) techniques to georeference a list of

historical road networks and systematically register vernacular toponymy associated with biophysical and family governance landmarks (*Ayllu*). Based on Montaño Huerta's (2017) suggestions regarding the visibility of underlying spatial logics in the planning of intercultural landscapes, the methodological framework treated the original nomenclature as a record of environmental memory. The inclusion of qualitative community perception data alongside the geometric layers of the territory (Quizhpe Guamán, 2013) helped consolidate a unified cartographic matrix. This technical instrument served as the spatial basis for delimiting and justifying the selection of the section under investigation at a higher resolution in subsequent scales, dispensing with conventional urban planning approaches that omit the non-motorized mobility infrastructure of historical origin.

## MESO-SCALE: SOCIO-SPATIAL CHARACTERIZATION AND COMMUNITY DYNAMICS OF THE HABITAT

The meso-scale approach was proposed using a mixed-methods research design to correlate the population's socio-spatial perception with the dynamics of use, appropriation, and conservation of the historical pedestrian network. For the qualitative component, the methodological procedure involved designing and administering semi-structured, intergenerational interviews. This instrument aimed to collect information to reconstruct the collective environmental memory and analyze the historical evolution of the habitat in the face of contemporary urban and road transformation processes. The data collection was directed at three women leaders of the community council, selected through intentional non-probability sampling. The inclusion criteria adopted for this group of key informants required: a) generational representativeness and historical permanence in the area; b) knowledge of vernacular toponymy and community social mapping; and c) exercise of roles linked to local governance and territorial decision-making.

On the other hand, the quantitative component was administered via a questionnaire to a sample of 40 heads of household from Las Lagunas. To standardize the survey of the inhabited space, non-probabilistic sampling by quotas was applied, which projects a distribution of response units across the six consolidated sectors that make up the community's morphology: Wabo loma, Lirios, Waile, Takchana, Rarik, and Yarimala. The survey's methodological design operationalized habitability and sustainability variables, focused on measuring the frequencies of use of the *Chakiñanes*, the reasons for pedestrian displacement (access to agricultural plots, grazing, water supply, or mystical connectivity), the typology of material damage to the trails, and the community valuation regarding the protection of the cultural landscape. The qualitative data collected were processed using categorical content analysis, while the quantitative data were tabulated in statistical matrices for subsequent cross-tabulation of spatial variables.

## MICRO SCALE: PHYSICAL-SPATIAL ANALYSIS AND PHOTOGRAMMETRIC RECORDING OF THE PILOT SECTION

The microscale approach focused on the morphological recognition of the accesses and intersections connecting the central motorized highway to the *Chakiñanes* network. The methodological procedure combined fieldwork with near-remote sensing techniques and systematic high-resolution photographic recording. For the geometric characterization of the built environment, a terrestrial photogrammetric reconstruction method by sections was applied. This process consisted of sequentially capturing images with longitudinal overlap exceeding 70% to generate two-dimensional orthomosaics and digital surface models. These tools allowed evaluating, with metric precision, the sections of the paths, the materiality of the enclosures, and the configuration of the accesses.

Through this micro-detail documentation, the physical continuity of the pedestrian paths was parameterized to analyze their permeability and accessibility conditions to local water nodes and symbolic infrastructure (springs and sacred landmarks). The monitoring of the graphic pieces included digital rectification and scaling of the samples, which establish a geometric baseline for identifying morphological anomalies, variations in the original road width, and physical obstructions.

## PARAMETERIZATION AND TECHNICAL CRITERIA OF THE CONSTRUCTIVE CHARACTERIZATION

For the material characterization and evaluation of the conservation status of the *Chakiñanes*, the methodological procedure was adapted from the standardized technical guidelines for intervention in the Andean Road system. The analytical variables were coded based on two heritage reference instruments: the protocol of the Qhapaq Ñan Project (INPC, 2004), from which the method of physical-environmental diagnosis of pre-Hispanic roads was extracted, and the Guide for training in preventive conservation of archaeological structures in stone and earth (Qhapaq Ñan-Ecuador, 2019), from which the deterioration indicators in lithic masonry were adopted.

The application of both frameworks structured a technical comparison matrix used in microscale field surveys. This instrument standardized the observation along three lines: a) basic road morphology (cuttings, backfill, platforms




Figure 3. Glossary of the Constructive Characteristics of the Royal Inca Trail. Source: Prepared by the Authors, using INPC (2004).

or steps typologies); b) materiality and containment systems (supporting walls or cobblestones); and c) physical vulnerability (erosion by runoff or loss of sections). By operationalizing these manuals as field diagnostic tools, a parametric database of pre-existing elements was consolidated (Figures 18 and 19). This geometric characterization constitutes the essential technical scaffolding for discussing the material findings and for grounding the subsequent consolidation guidelines in the study area (Figures 3 and 4).

# RESULTS AND DISCUSSION

## CHARACTERIZATION, INVENTORY, AND TOPONYMY OF THE ANCESTRAL NETWORK OF CHAKIÑANES (MACRO SCALE)

The processing of geospatial data, combined with the validation of the community social mapping, resulted in the identification and cataloging of a historical road network comprising 44 active and latent *Chakiñanes* within the territory of Las Lagunas (Figure 5). Far from constituting only isolated linear vestiges, these axes of mobility are structured as a highly integrated green, low-emission infrastructure that responds to the morphological, hydric, and socio-cultural logics specific to the Andean cultural landscape. When systematically classifying these paths (Table 2), a direct correspondence between the vernacular nomenclature and the governance of the living space is observed. The registration of family milestones in 29.5% of the road toponymy corroborates the idea that the historical pedestrian network is inseparable from the residential and kinship structure of the Ayllu, where public space serves as a physical support for collective memory and social cohesion. This functional and symbolic link validates the suggestions of Montaño Huerta (2017) regarding the original toponymy as a living environmental archive, and allows to contrast the contemporary models of conventional urban planning critically; while the latter impose numerical

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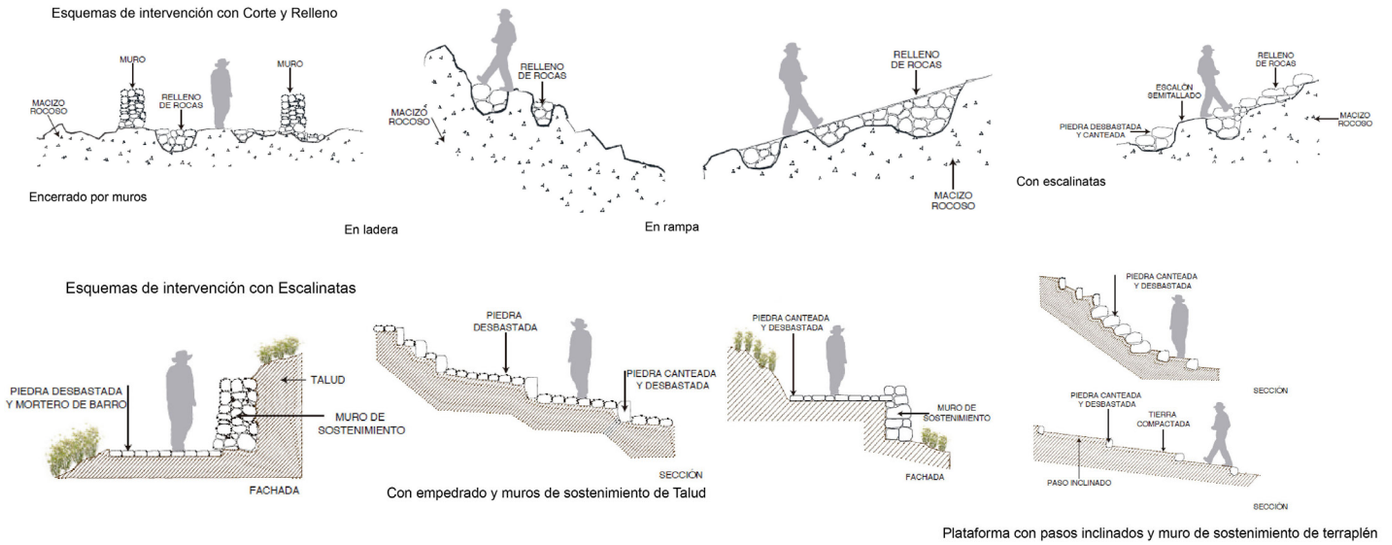



Figure 4. Intervention methods with Cuttings, Backfill, and Steps. Source: Prepared by the Authors based on Qhapaq Ñan-Ecuador (2019).

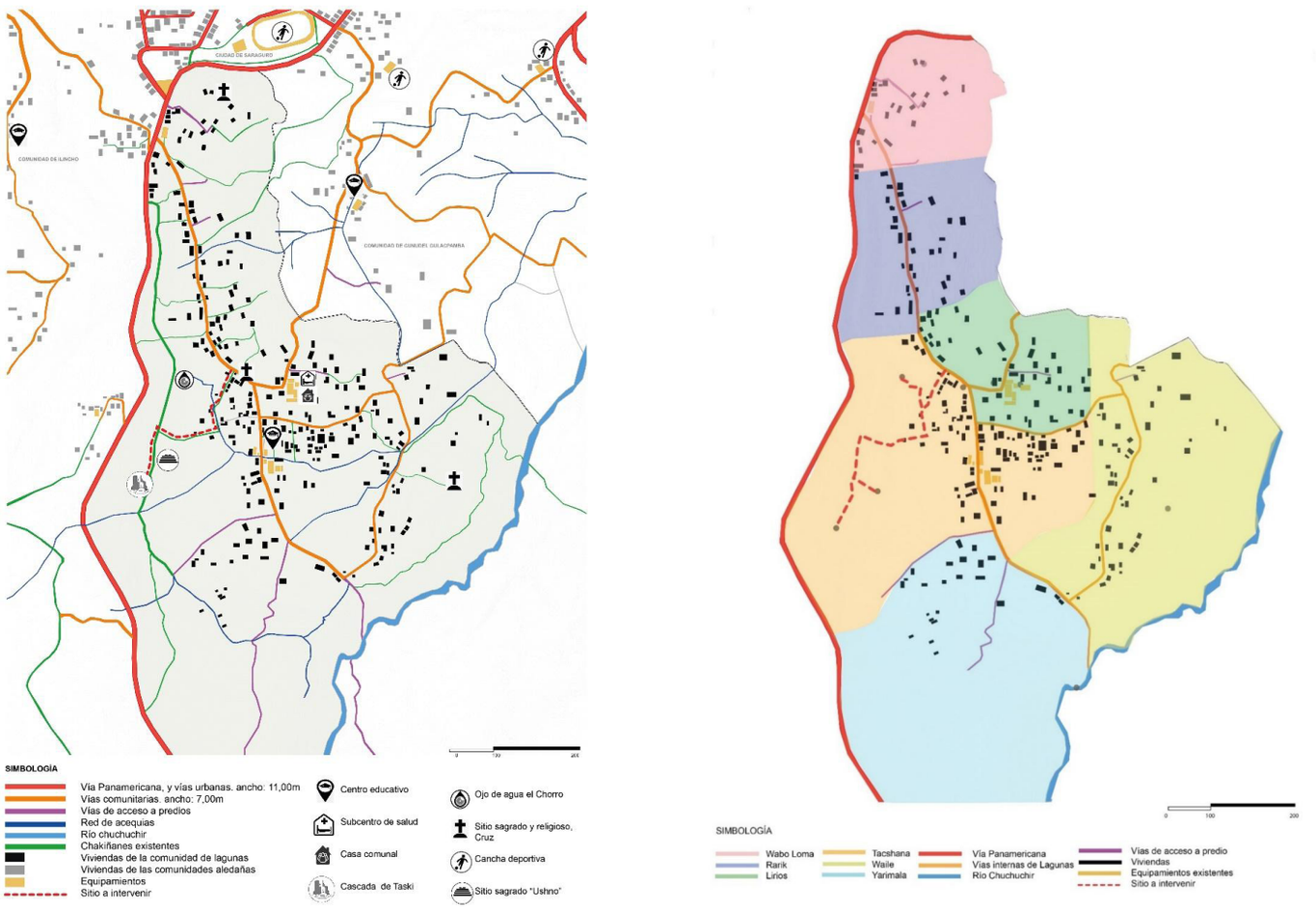



Figure 5. Fragment scale map and sectors of the Las Lagunas community. Source: Lozano Guamán, 2022.

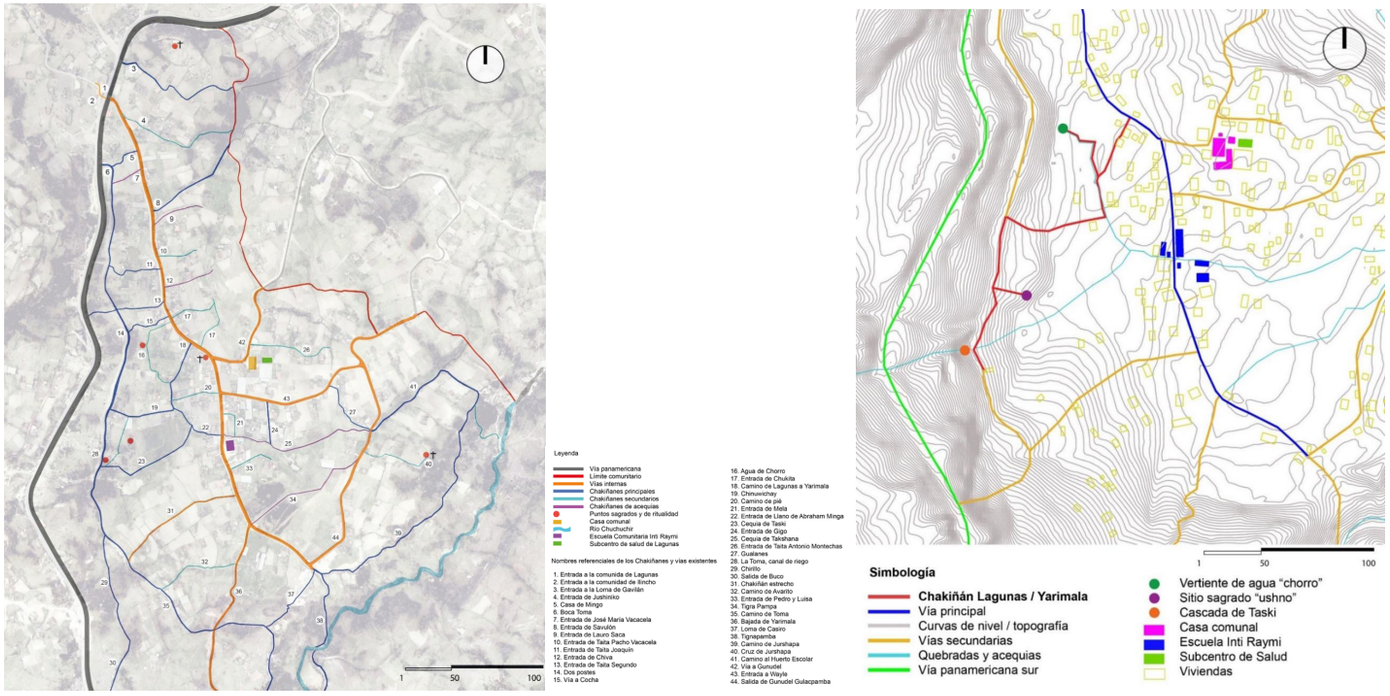



Figure 6. Mapping of the Chakiñanes and irrigation canals of the community of Las Lagunas. Topographic survey. Source: Prepared by the Authors using Google Maps.

| Category | Registered Names (according to Mapping and Collective Memory) |
|---|---|
| Entrances and Sectors (Connectivity) | (1) Entrance to the Lagunas community, (2) Entrance to the Ilincho community, (3) Entrance to the Gavilán Hill, (4) Entrance to Jushiniko, (15) Road to Cocha, (17) Entrance to Chukita, (18) Route from Lagunas to Yarimala, (21) Entrance to Mela, (30) Exit from Buco, (36) Descent from Yarimala, (42) Road to Gunudel, (43) Entrance to Wayle, (44) Exit from Gunudel Gulacpamba. |
| Family and Personal Milestones (Toponymy) | (5) Mingo's House, (7) Entrance of José María Vacacela, (8) Entrance of Savulón, (9) Entrance of Lauro Saca, (10) Entrance of Taita Pacho Vacacela, (11) Entrance of Taita Joaquín, (12) Entrance of Chiva, (13) Entrand of Taita Segundo, (22) Entrance to Plains of Abraham Minga, (24) Entrance of Gigo, (26) Entrance of Taita Antonio Montechas, (32) Avarito's Road, (33) Entrance of Pedro and Luisa. |
| Hydrography and Irrigation (Infrastructure) | (6) Inlet, (16) Stream, (23) Taski irrigation canal, (25) Takshana irrigation canal, (28) La Toma irrigation canal, (35) Toma Road. |
| Physical and Landscape Milestones | (14) Two posts, (19) Chinuwichay, (27) Gualanes, (29) Chirillo, (34) Tigra Pampa, (37) Casiro Hill, (38) Tignapamba, (39) Jurshapa Road, (40) Jurshapa Cross, (41) Road to Huerto Escolar. |
| Specific Typologies | (20) Footpath, (31) narrow Chakiñán. |

Table 1. Identification of the names of the Chakiñanes of the community of Las Lagunas. Source: Prepared by the Authors.

or extraneous nomenclatures that disarticulate the sense of belonging, the *Chakiñanes* network preserves a transgenerational social cartography that guides the autonomous territorial management of the community (Figures 5 and 6).

## SOCIO-SPATIAL DYNAMICS AND TRANSFORMATIONS OF THE COMMUNITY HABITAT (MESO SCALE)

The coding of the interviews and the statistical analysis reveal a structural contradiction between the symbolic persistence of the *chakiñánes* and their progressive material degradation in Las Lagunas. Historically, this footpath network operated as an infrastructure of physical connectivity and identity cohesion (Rodríguez Valbuena, 2011). However, the intergenerational testimonies (Table 1) mark a rupture in the 1960s: the opening of motorized roads altered the territorial metabolism, displacing the central pedestrian line and fragmenting the social fabric. This phenomenon aligns with Lozano Guamán, Jaramillo-Benavides, & Lozano-Guamán (2025) in that conventional planning tends to erode community autonomy and toponymy by dismantling self-managed collective spaces (Cerasi & Quaroni, 1990).

| Name | Age | Sector | Key Contribution |
|---|---|---|---|
| Rosa Angelita Guamán | 84 | Lirios | Historical importance of the Chakiñán as the only connection and warning about forgetting their original names. |
| Rosa Delia Quizhpe | 64 | Rarik | Vindication of ancestral identity (Chukidel Ayllullacta) and the link between education, values, and language. |
| Rosa Vicenta Guamán | 57 | Rarik | Management perspective from the town hall, emphasizing community autonomy and the risk of losing public space. |

Table 2. Synthesis of interview responses. Source: Prepared by the Authors.

| Question | Variable/Option | Percentage (%) | Numerical results for the 40 respondents (100%) |
|---|---|---|---|
| 1. Sector where the respondent community member lives | Rarik | 32.50% | The majority sector of origin (13 out of 40 community members). |
| | Wabo Loma | 17.50% | Representative zone linked with Waile (7 out of 40 community members). |
| | Waile | 17.50% | Representative zone linked with Wabo Loma (7 out of 40 community members). |
| | Yarimala | 15.00% | Regular intermediate participation (6 out of 40 community members). |
| | Takshana | 12.50% | Low participation in the diagnosis (5 out of 40 community members). |
| | Lirios | 5.00% | Fewer census records (2 out of 40 community members). |
| | Total of the Question | 100.00% | Exact closure on the sample of 40 community members surveyed. |
| | | | |
| 2. The use that they give to Chakiñanes at present | Transfer of animals | 43.80% | 43.8% of all uses mentioned (28 mentions). |
| | Access to crops | 23.40% | 23.4% of all uses mentioned (15 mentions). |
| | On the way to another community | 17.20% | 17.2% of all uses mentioned (11 mentions). |
| | Access to housing | 15.60% | 15.6% of all uses mentioned (10 mentions). |
| | Total of the Questions | 100.00% | Based on the 64 accumulated mentions. |
| | | | |
| 3. The frequency with which a chaquiñán is used | Rarely | 45.00% | Predominantly sporadic in frequency (18 responses). |
| | 3 to 4 times a week | 27.50% | Regular intermediate use for work (11 replies). |
| | Once, or several times a day | 17.50% | Intensive daily road users (7 replies). |
| | Once a week | 10.00% | One-time, recurring, low-frequency use (4 replies). |
| | Total of the Questions | 100.00% | Sample of 40 community members surveyed. |
| | | | |
| 4. Aspects that affect the Chakiñanes at present | Lack of upkeep | 41.30% | 41.3% of the total mentions (26 mentions). |
| | Authorities have a lack of interest in the upkeep | 34.90% | 34.9% of the total mentions (22 mentions). |
| | Lack of control over misuse by the population | 14.30% | 14.3% of the total mentions (9 mentions). |
| | Insecurity when walking | 9.50% | 9.5% of the total mentions (6 mentions). |
| | Total of the Questions | 100.00% | Based on the 63 responses. |
| | | | |

| Question | Variable/Option | Percentage (%) | Numerical results for the 40 respondents (100%) |
|---|---|---|---|
| 5. Level of collaboration in the case of reconstruction of a chaquiñán | Partial | 47.50% | Predisposition conditioned to time or resources (19 replies). |
| | Total | 42.50% | Direct and absolute civic commitment to the work (17 replies). |
| | Little | 7.50% | Severe limitations or low interest in support (3 replies). |
| | None | 2.50% | Refusal or absolute impossibility to join mingas (1 reply). |
| | Total | 100.00% | Sample of 40 community members surveyed. |
| | | | |
| 6. Use that could be given to the Chakiñanes at present (Projection) | Better connection between the community and the... | 33.30% | 33.3% of the ideas for improvement (24 mentions). |
| | Create a tourist route throughout the... | 29.20% | 29.2% of the ideas for improvement (21 mentions). |
| | Rest spaces | 22.20% | 22.2% of the ideas for improvement (16 mentions). |
| | Cycle path | 13.90% | 13.9% of the ideas for improvement (10 mentions). |
| | Just keep them passable | 1.40% | 1.4% of the ideas for improvement (1 mention). |
| | Total of the Questions | 100.00% | Based on the 72 projection-based responses. |

Table 3. Matrix of survey questions and answers. Source: Prepared by the Authors.

The quantitative data (Table 3) empirically support this morphological transition. Although there is a consensus on their cultural value, 45.00% of respondents use them "rarely", linking their current use almost exclusively to the shepherding of animals (43.80%) and access to crops (23.40%). Thus, the *Chakiñán* is relegated to a secondary peri-urban role, which alters what Van der Voordt & De Jong (2002) define as the functional balance of the habitat. This physical breakdown has led to conflicts over altered land boundaries, which require the activation of indigenous justice to restore territorial organization (Rodríguez Valbuena, 2011). Although 41.30% attribute the deterioration to a lack of institutional upkeep, the *Ayllu*'s social capital remains latent: 42.50% express a strong willingness to participate in reconstruction *mingas* (community work). In light of these metrics, road rehabilitation aligns with Borja & Muxí (2003) by optimizing autonomous collective space and supporting a sustainable habitat model grounded in low-emission mobility and community landscape management.

## MICRO SCALE

The analysis, through photographic registration and photogrammetric editing, of the accesses from the main road network to the internal footpath network shows the physical discontinuities in the ancestral mobility system. The section-level restitutions show that the disturbances are concentrated in the transition zones of the motorized road network. Land privatization and irregularities in perimeter enclosures have reduced the historical useful widths of the paths, transforming traditional meeting nodes into residual corridors. This fragmentation jeopardizes community access to water and productive and spiritually significant infrastructure.

By superimposing physical (accessibility, conservation, and connectivity) and symbolic (cultural landscape landmarks) variables, a strategic pilot section was selected (Figures 7, 8, and 9). The selection criteria considered its multidimensional representativeness: the path connects the Lirios and Yarimala sectors and integrates three nodes of the Andean hydraulic-ceremonial infrastructure: El Chorro (spring), Ushno (ceremonial center), and the Taski Waterfall (ecological-ritual system).

The diagnosis of these components reveals a degree of environmental vulnerability. While El Chorro exhibits stable water quality, though threatened by surface runoff, the Taski Waterfall is severely affected by anthropogenic contamination and reduced flow rate. The functional analysis of the maps, following Van der Voordt & De Jong (2002), showed that this section serves as a transversal connector between topographic ridges and scattered water plains. Thus, the selected *Chakiñán* encapsulates the microbasin's geomorphological complexity and actively connects the territory.

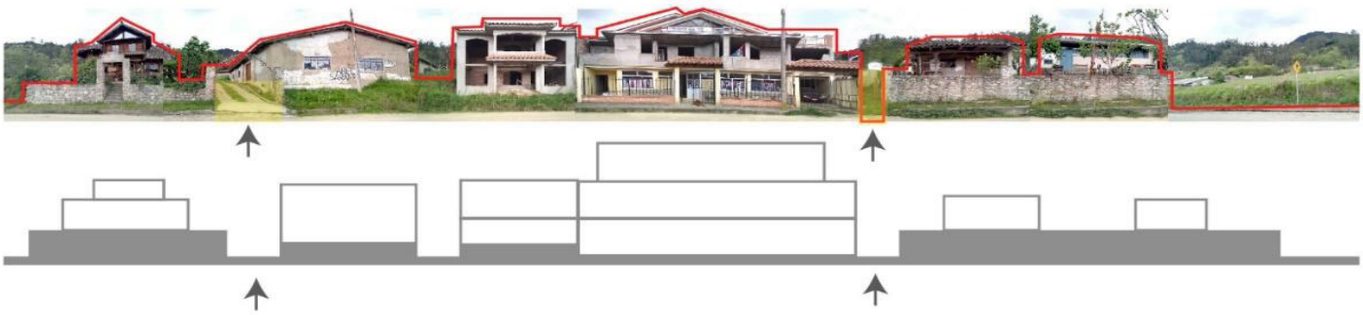


Figure 7. Section 1/9. Photogrammetric analysis from the main road of Las Lagunas. Source: Prepared by the Authors.

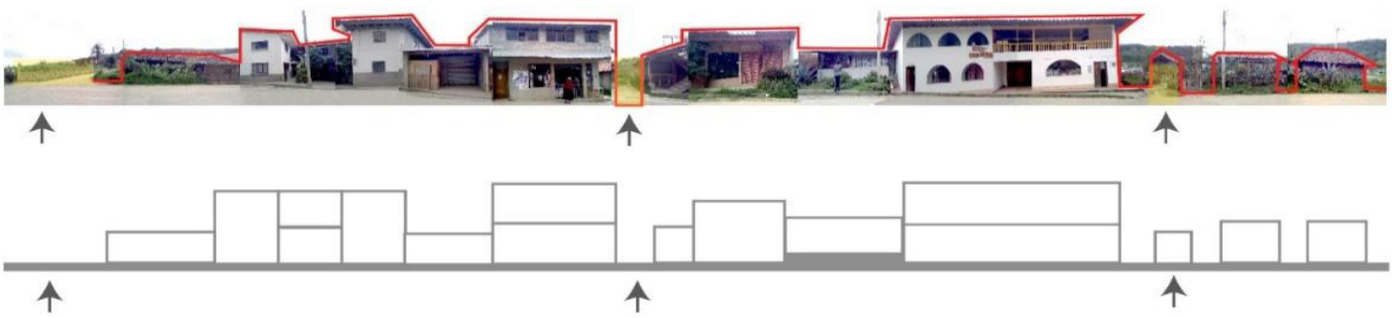


Figure 8. Section 2/9. Photogrammetric analysis from the main road of Las Lagunas. Source: Prepared by the Authors.

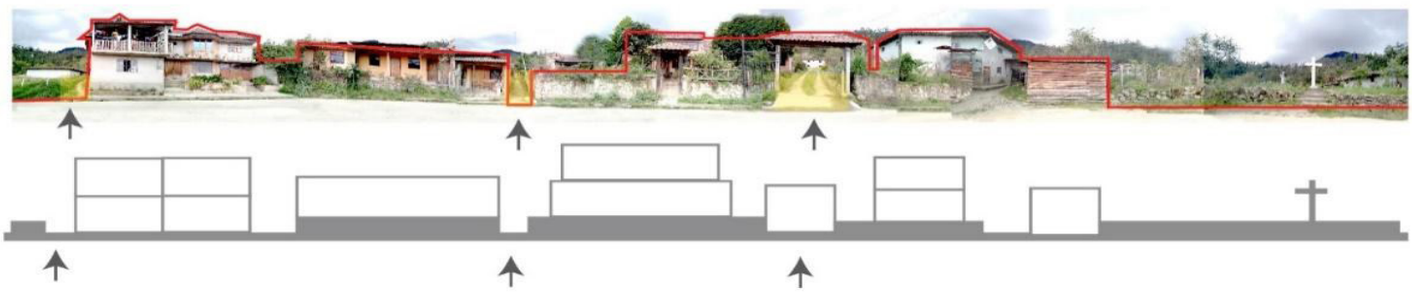


Figure 9. Section 3/9. Photogrammetric analysis of 3 sections. Source: Prepared by the Authors.

## INTERVENTION PROPOSAL: SUSTAINABLE HABITAT REVITALIZATION STRATEGIES

### Guidelines for Sustainable Design and Multiscale Articulation

The conversion of the empirical and analytical findings to the proposal's approach is instrumentalized through a low-emission infrastructure territorial revitalization model. The pilot project is conceived as a connective system adapted to the dynamics of the living territory of the Las Lagunas community. Based on the problems identified, such as the loss of useful width, ecological degradation, and pedestrian fragmentation, the intervention is guided by four operational dimensions focused on sustainable habitat:

- Morphological Recovery and Spatial Justice: Restoration of original road sections (1.50 m to 3.00 m) to mitigate the physical obstacles detected by photogrammetry and restore the continuity of the communal autonomous pedestrian flow (Lozano Guamán et al., 2025).
- Preventive Conservation of Water Ecosystems: Implementation of non-invasive passive construction techniques in springs and pre-Hispanic structures to prevent material degradation and surface water pollution (Qhapaq Ñan-Ecuador, 2019).

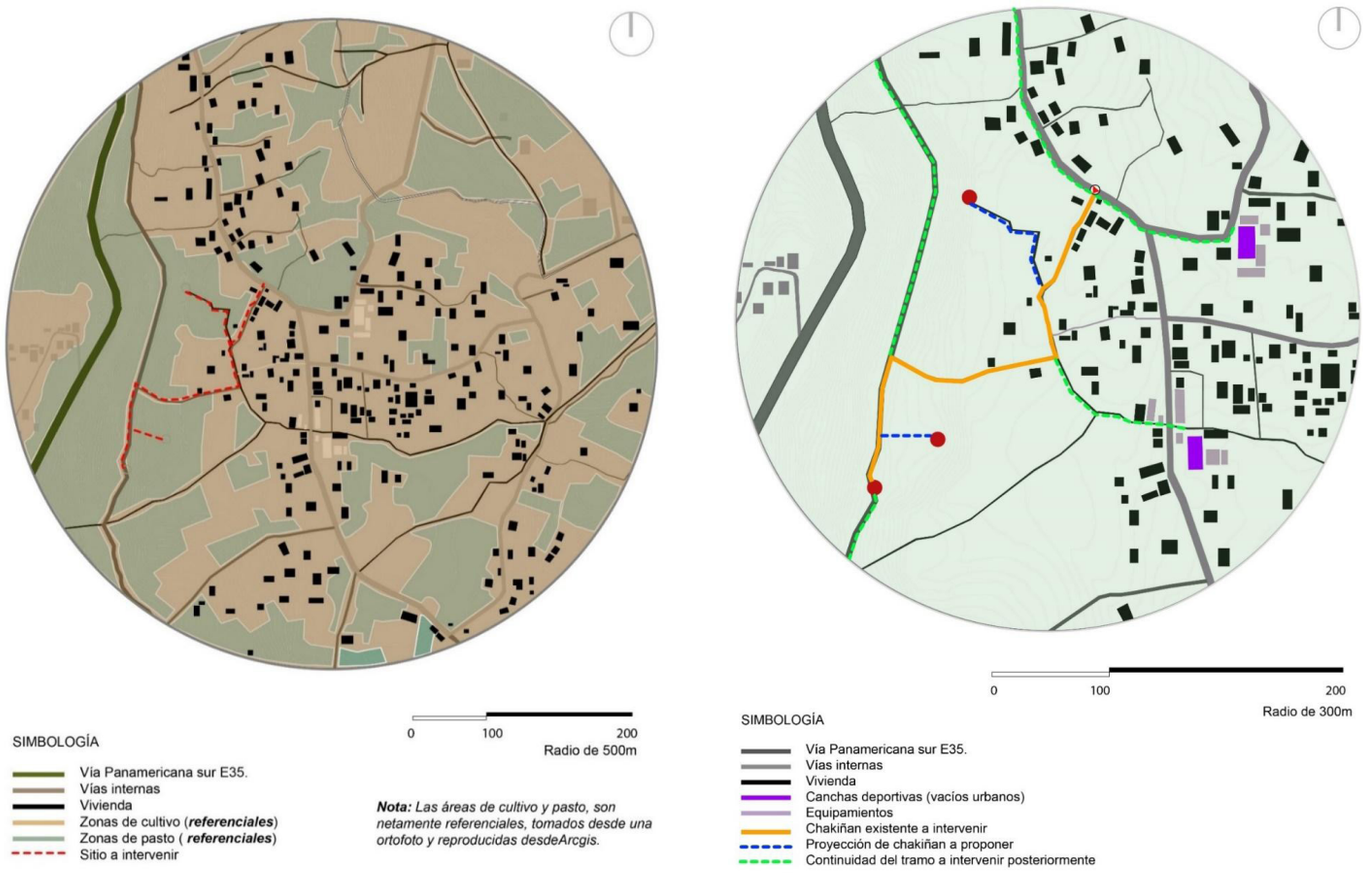



Figure 10. Land Use Maps - connection of community facilities and sacred sites of the chosen section in 500 m and 300 m radii. Source: Prepared by the Authors using Google Maps.

- Inclusion and Topographic Mitigation: Slope stabilization and design of steps, pedestrian ramps, and permeable paths adapted to the Andean relief, which optimizes the safety of mobility on a human scale without altering the natural runoff.
- Landscape Revitalization and Identity Signage: Incorporation of native vegetation to consolidate biological corridors and installation of visual communication devices based on vernacular toponymy (Montaño Huerta, 2017).

**Zoning by sections of morpho-landscape intervention**

According to the micro diagnosis, the route was subdivided into homogeneous sections to handle boundary and accessibility conflicts.

Road transition section and accesses: They consolidate the entrance from motorized roads through stone-wall edge stabilization and include open irrigation canals to mitigate erosion from rain runoff and watershed runoff (Figure 12).

Immediate connecting sections: Located in areas of high agricultural pressure. They redefine the limits of the *Chakiñan* through living fences featuring endemic flora, ensuring pedestrian flow and the passage of small livestock, which account for 43.80% of the identified productive uses (Figure 10 and Figure 11).

Based on the diagnostic results, a pilot section was selected for its symbolic value and spiritual connectivity. The selection criterion prioritized the path that links the Lirios sector with Yarimala, integrating three nodes of connectivity of the water-spiritual infrastructure and their value within the heritage landscape, such as: *The Chorro* (spring), *The Ushno* (ceremonial center), and the *Taski Waterfall* (Figure 13, Figure 14, Figure 15, Figure16, and Figure 17).

## CULTURAL LANDSCAPE ARCHITECTURE: INTERVENTIONS IN SACRED SITES AND SUPPORTING INFRASTRUCTURE (TAMBOS)

The architectural intervention formalizes the articulation between local knowledge, heritage preservation, and sustainable planning through the singularized treatment of three sacred sites (Figure 18), as described in Table 4.

- Revitalization of the Chorro (spring). Technical confinement of the spring through a local stone-

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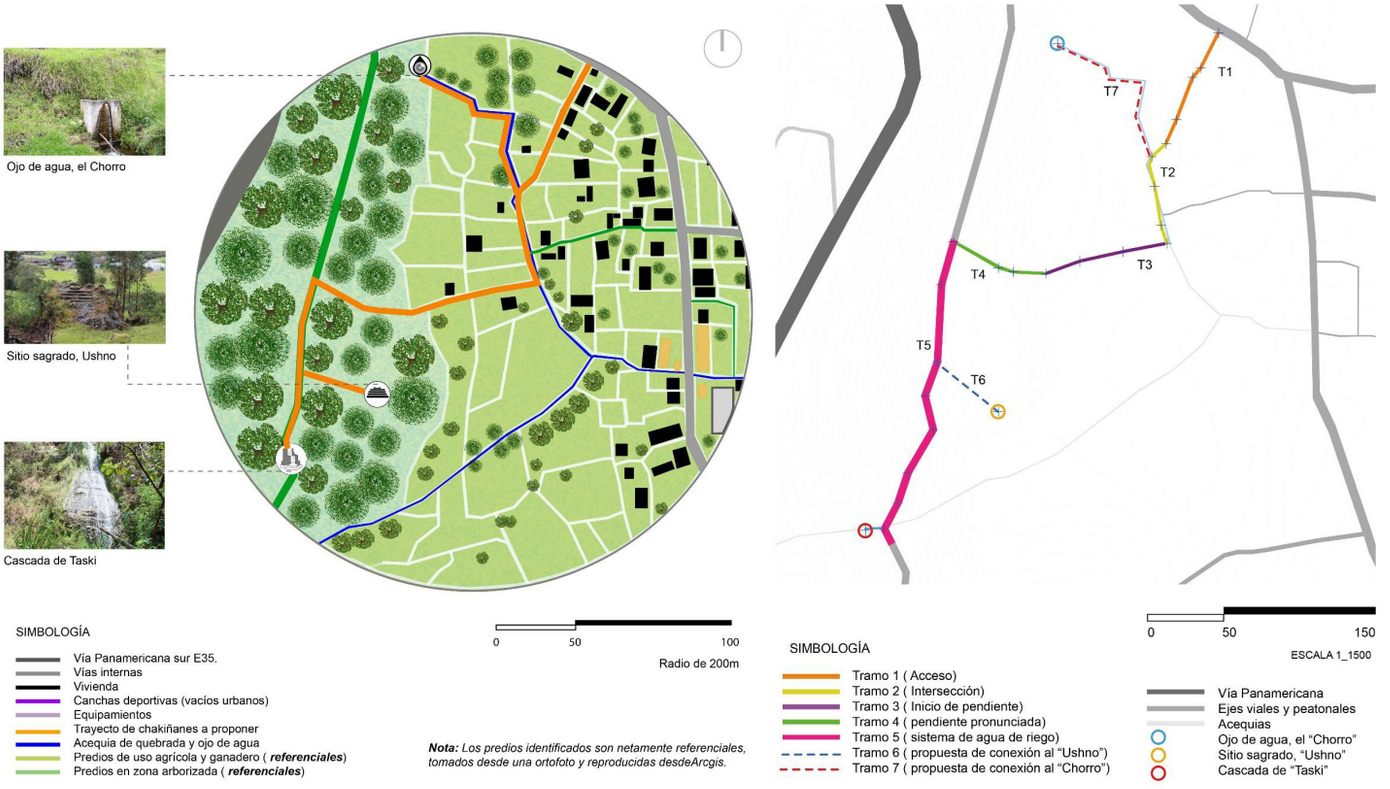



Figure 11. Map within a 200 m radius of the sacred sites to be intervened. Division by sections. Source: Ortofoto, ArcGIS.



Figure 12. Route of the Chakiñán to be intervened. Source: Prepared by the Authors.

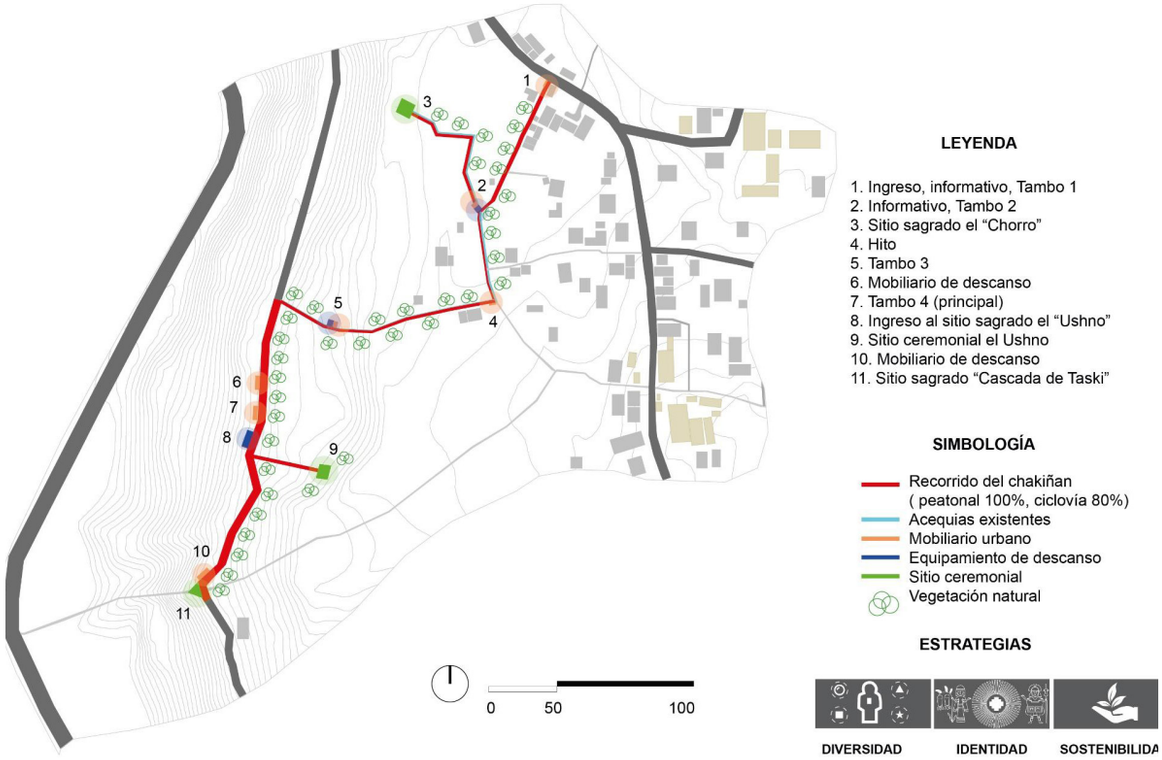



Figure 13. Map of intervention proposal by sections according to their physical characteristics and strategies. Source: Prepared by the Authors.

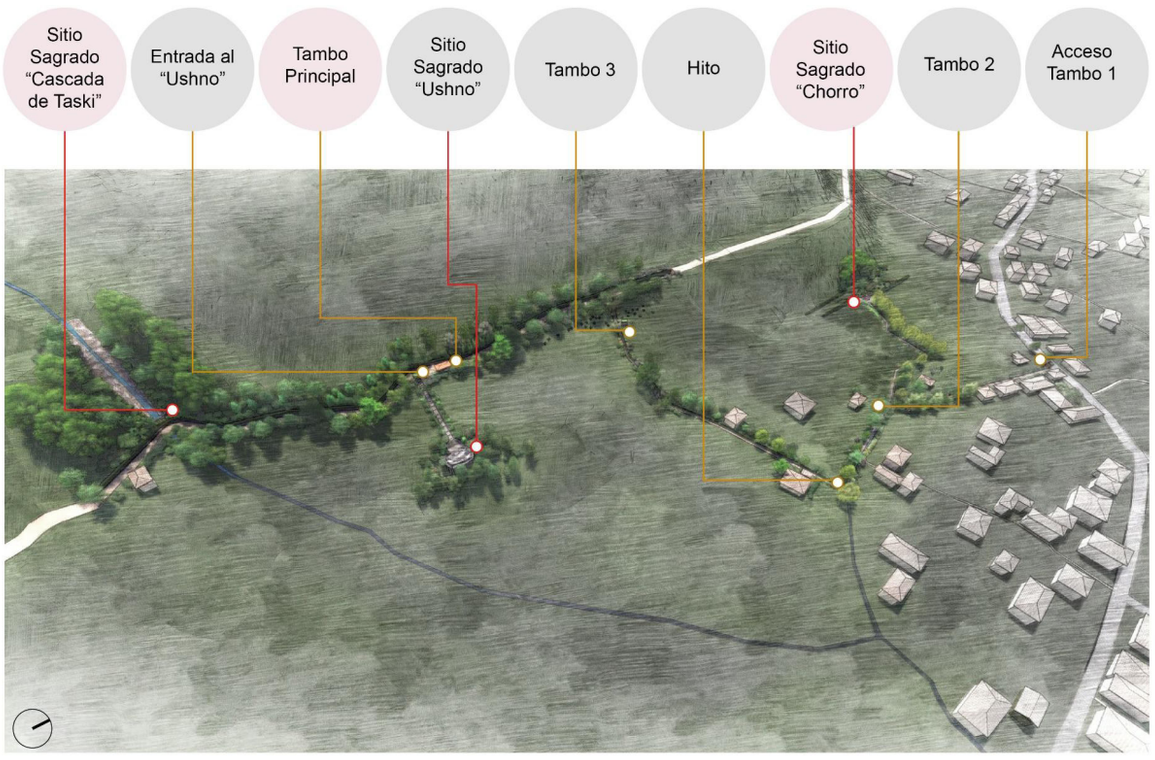



Figure 14. Aerial visualization of the intervention by sections. Source: Prepared by the Authors.

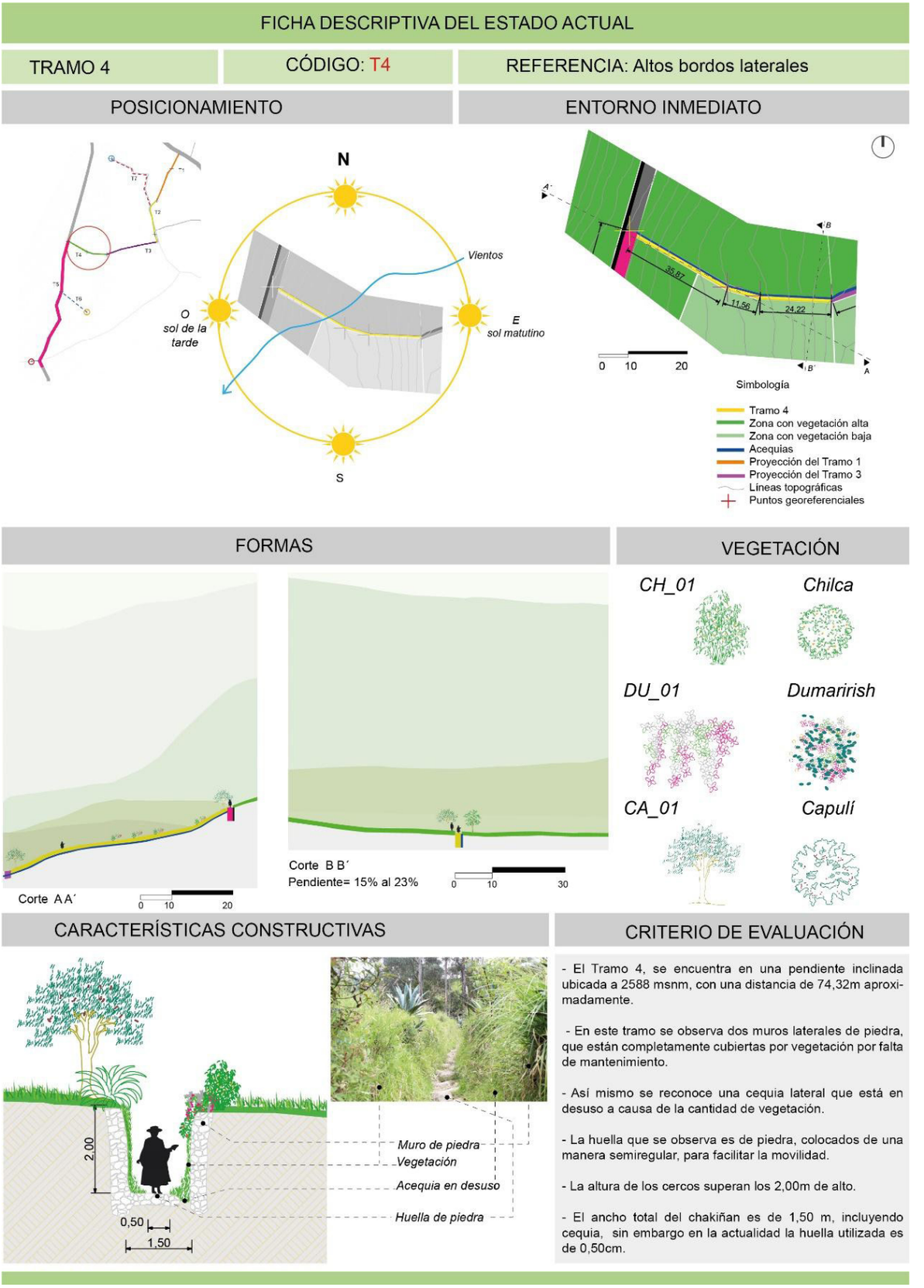



Figure 15. Analysis sheets of the Current State of Section 4. Source: Prepared by the Authors.

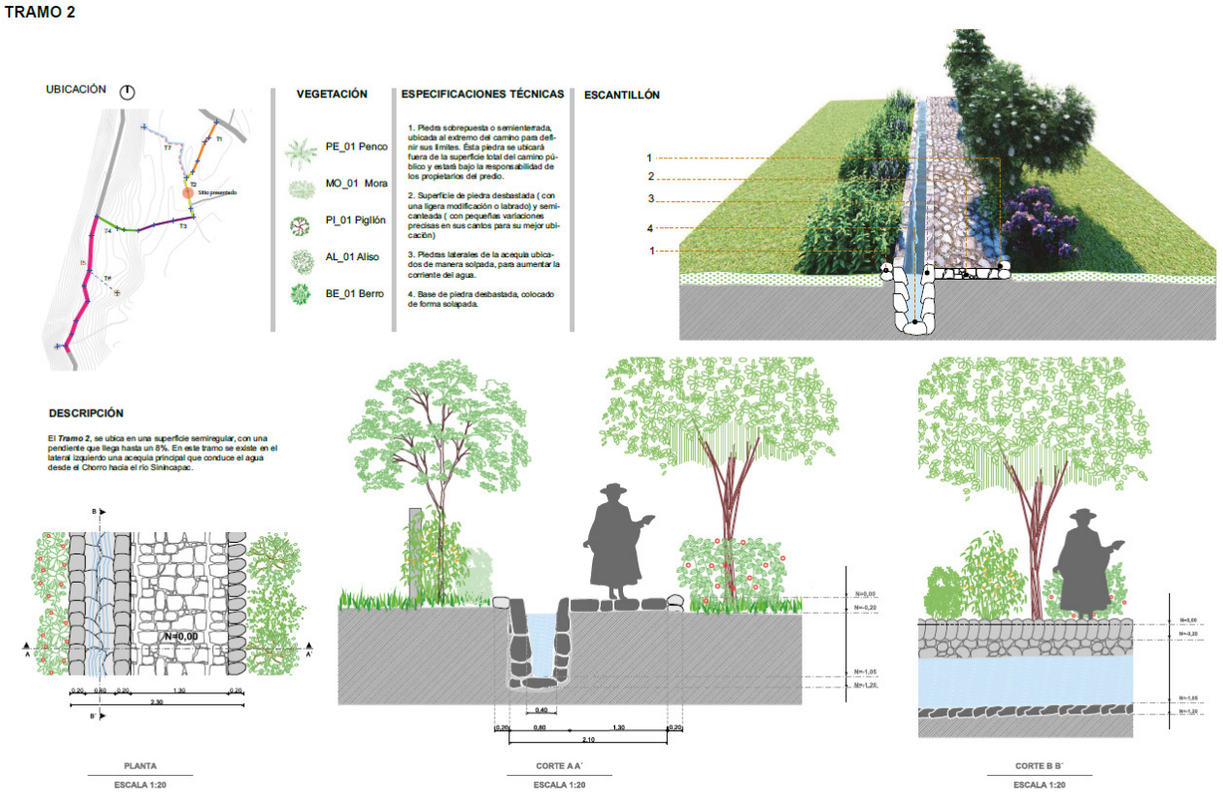



Figure 16. Proposal for an intervention in the Chakiñán Section 2. Source: Prepared by the Authors.

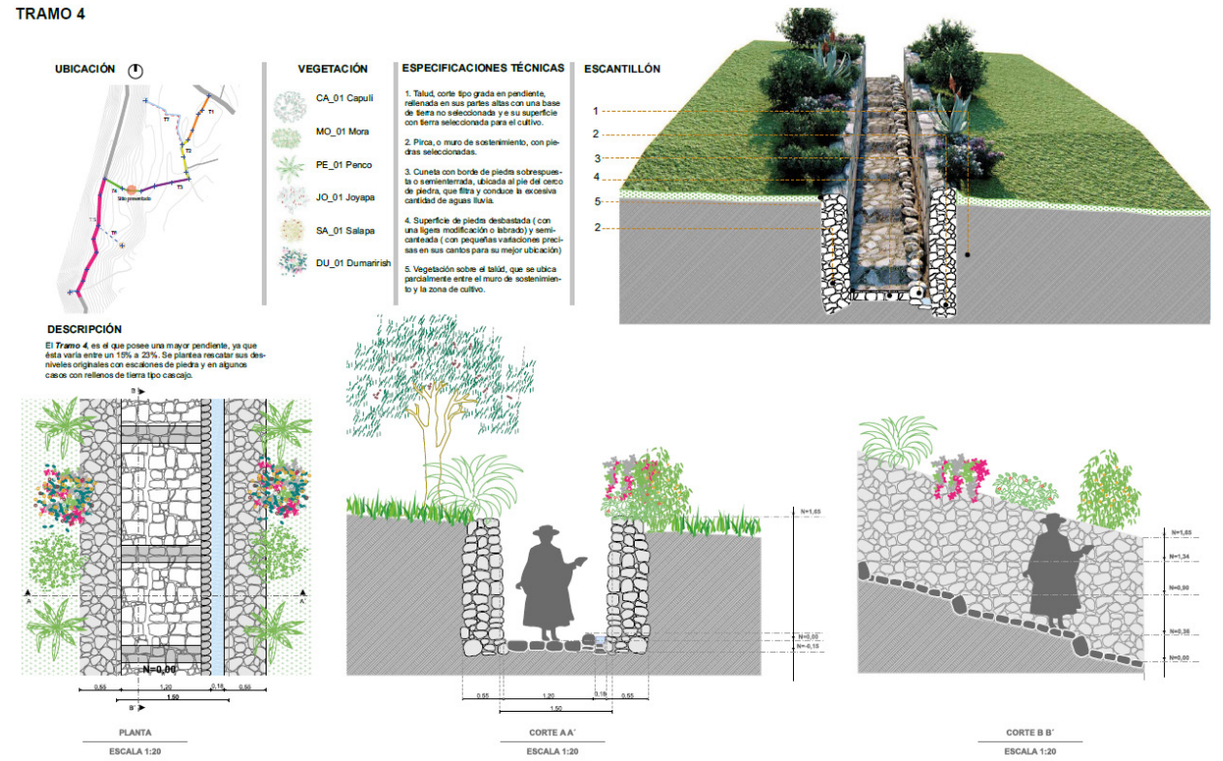



Figure 17. Proposal for intervention in the Chakiñán Section 4. Source: Prepared by the Authors.

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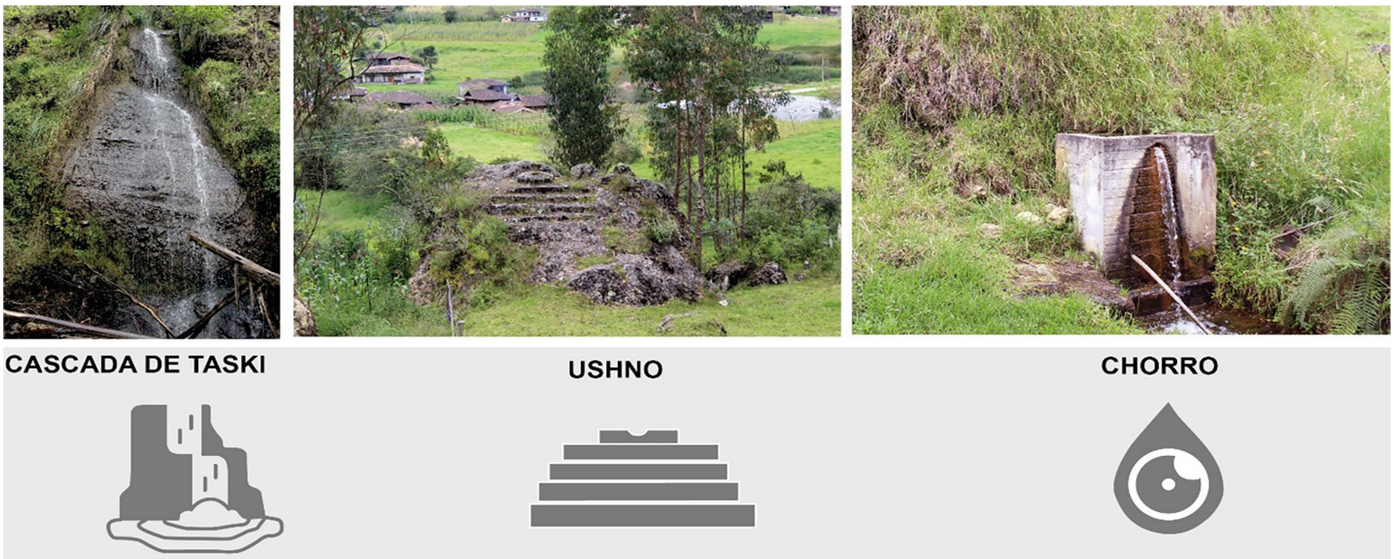



Figure 18. Photograph of the sacred sites to be intervened. Source: Prepared by the Authors.

| TASKI WATERFALL | USHNO | CHORRO |
|---|---|---|
| Description: Sacred Andean symbol for healing and rituals; it represents the origin of life and the blood of the earth. | Description: Pyramidal structure for ceremonies and astronomical milestones, with water or *chicha* as the protagonists. | Description: An underground spring that historically served as a sacred place for bathing princesses or *ñustas*. |
| Status: Presents critical contamination and a progressive decrease in its natural flow. | Status: Strategically located near the Inca road network due to the abundance of water sources in the environment. | Status: Good-quality water via natural filtration; requires channeling to prevent overflows and exposure to external agents |

Table 4. Characteristics of the sacred sites: El Ushno, El Chorro, and Taski waterfall. Source: Prepared by the Authors.

collection vessel to avoid external pollutants, adding a ceremonial space and, in turn, restoring its role as a community laundry and social-cohesion node under water-efficiency criteria (Figure 19 and Figure 20).

- Consolidation of the Ushno: Removal of invasive vegetation and perimeter delimitation of the archaeoastronomical structure with permeable stone pavements, which highlight the geometry of the platform for its preventive conservation and ceremonial use (Figure 21 and Figure 22).
- Healing of the Taski Waterfall: Implementation of artificial subsurface flow wetlands (phytoremediation) prior to discharge to mitigate critical pollution, complemented with low-impact viewpoints integrated into the topography (Figures 23 and 24).

To support the route and in view of the projected community and tourist use expressed by 29.20% of the respondents, the ancestral typology of the Tambo (resting place) is incorporated. These structures function as shelters, territorial control points, and landscape interpretation pavilions. Its materiality is based on low-emission architecture and circular metabolism, through:

- Load-bearing structure: Local wooden frames and *bahareque* systems (mud, straw, and cane) (Calderón, 1985), which reduce the incorporated carbon footprint and revalue the vernacular technologies of Saraguro (Cevallos Salas, 2003) (Figure 25).
- Passive strategies: Green roofs with native vegetation to optimize thermal insulation and integrate the volume into the landscape environment (Figure 26).
- Ecological sanitation: Composting dry toilet modules in the main pavilion. This solution addresses the lack of sewerage in the micro-basin, prevents aquifer contamination, and closes the nutrient cycle by generating organic fertilizer for local crops (Figures 27 and 28).

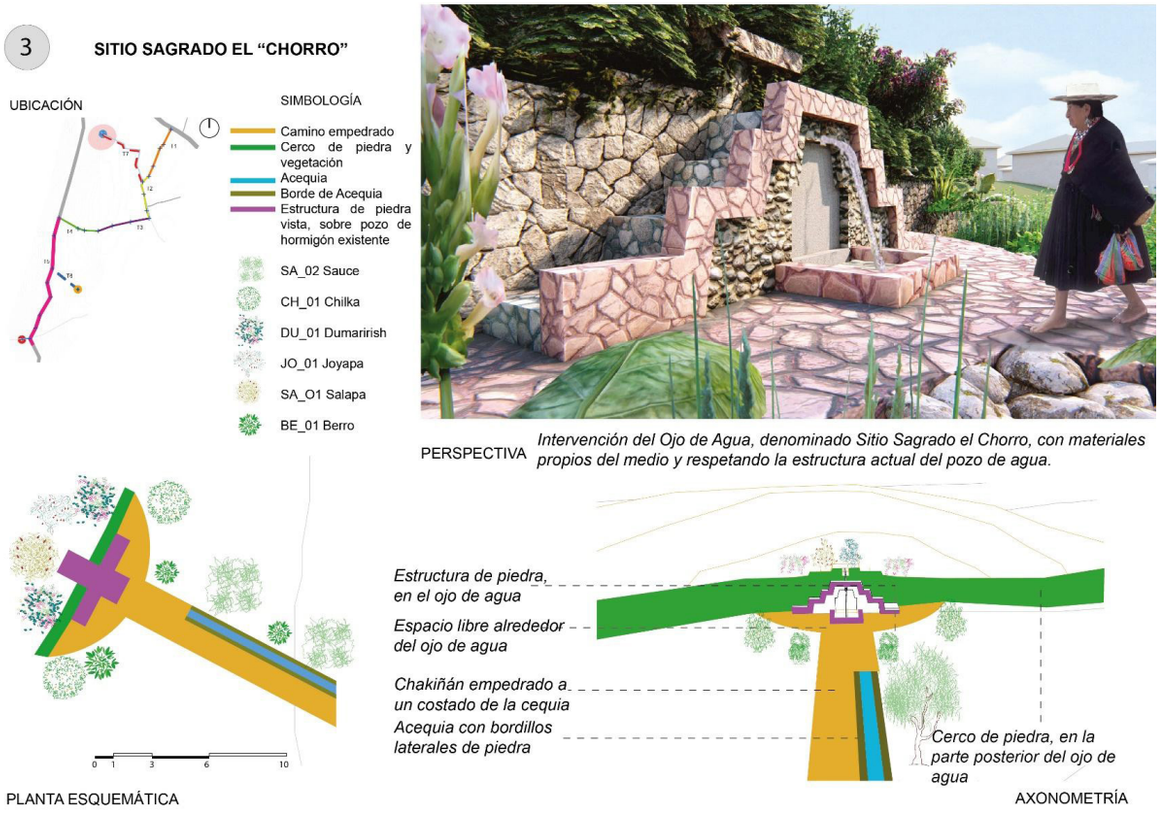



Figure 19. Proposal for the intervention of Section 3. Source: Prepared by the Authors.

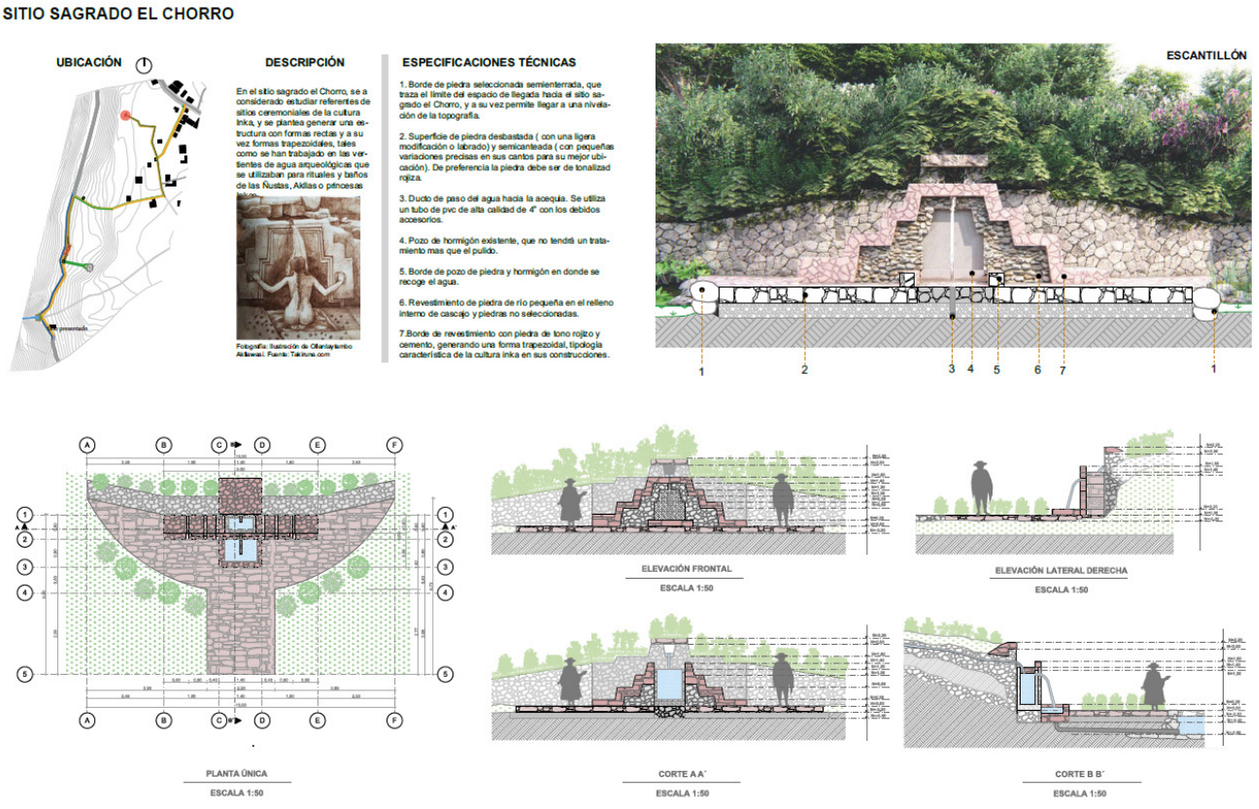



Figure 20. Proposal of intervention in the El Chorro sacred site. Source: Prepared by the Authors.

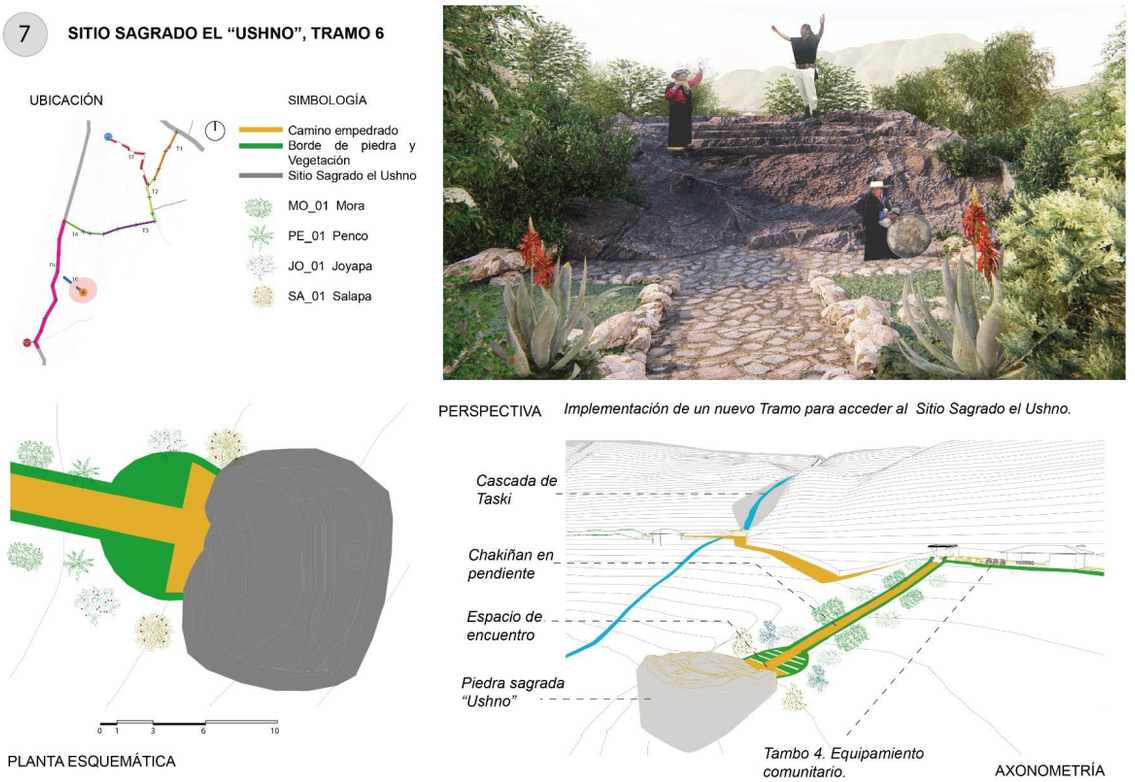



Figure 21. Proposal for Section 7's intervention. Source: Prepared by the Authors.

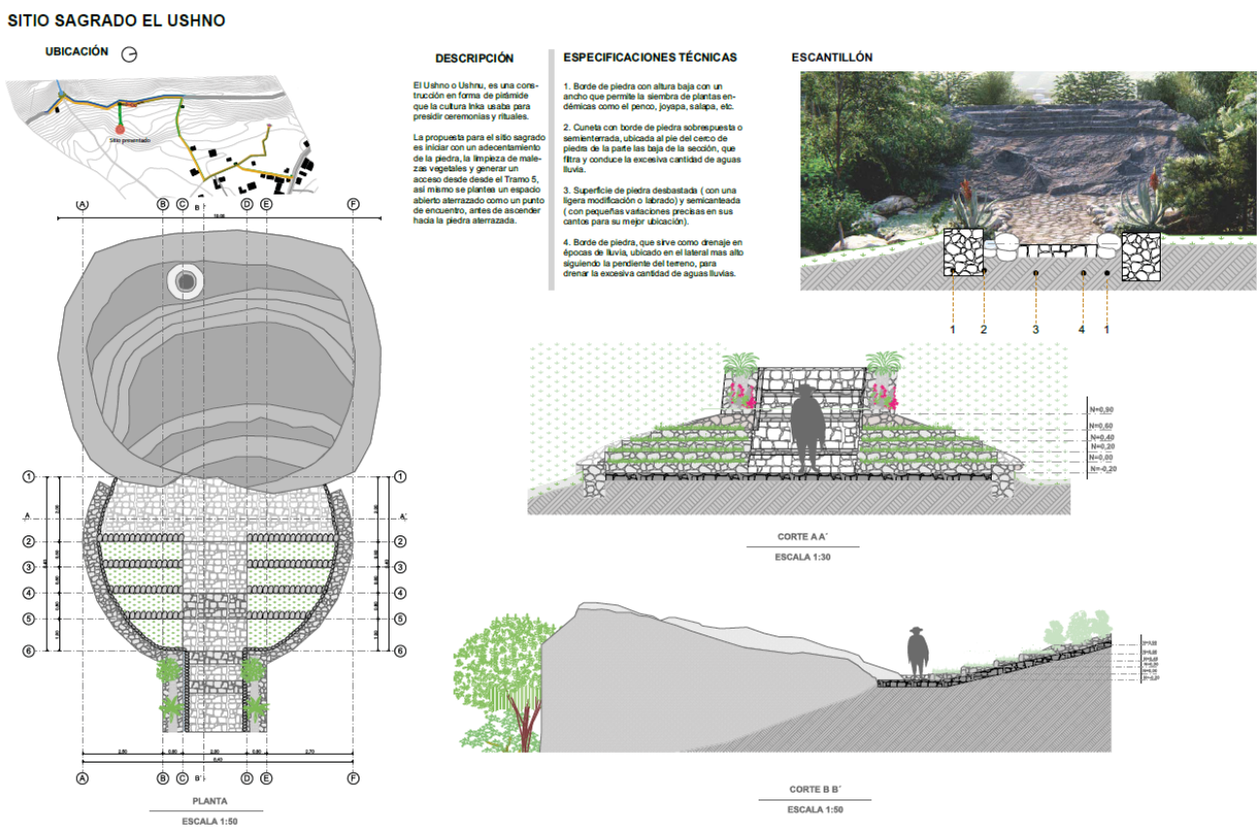



Figure 22. Proposal of intervention in the El Ushno sacred site. Source: Prepared by the Authors.

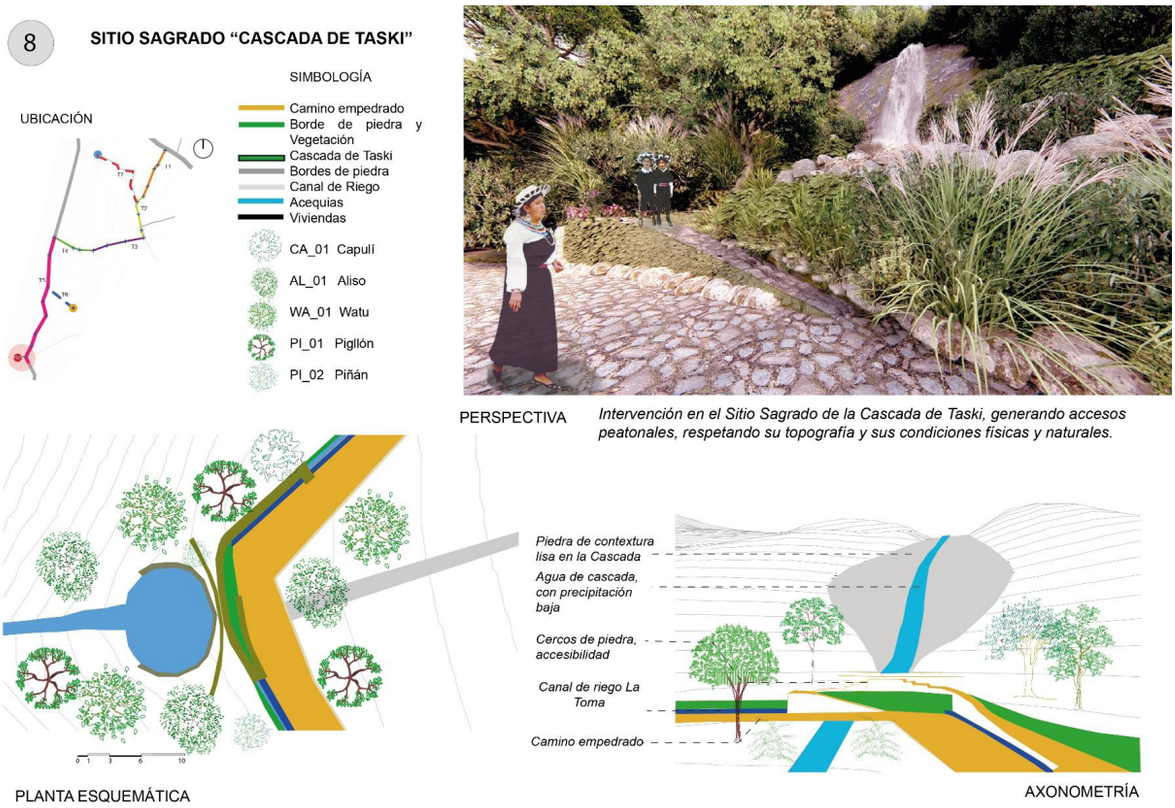



Figure 23. Proposal for Section 8's intervention. Source: Prepared by the Authors.

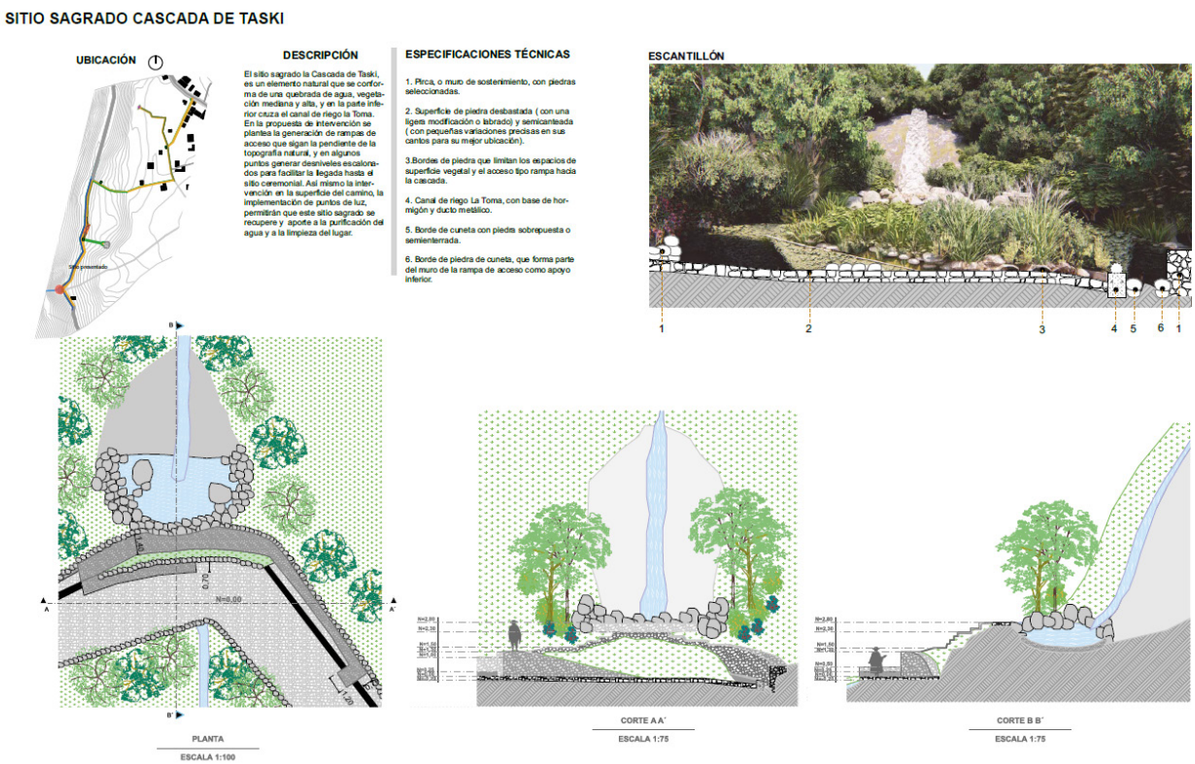



Figure 24. Proposal of intervention in the Taski Waterfall sacred site. Source: Prepared by the Authors.

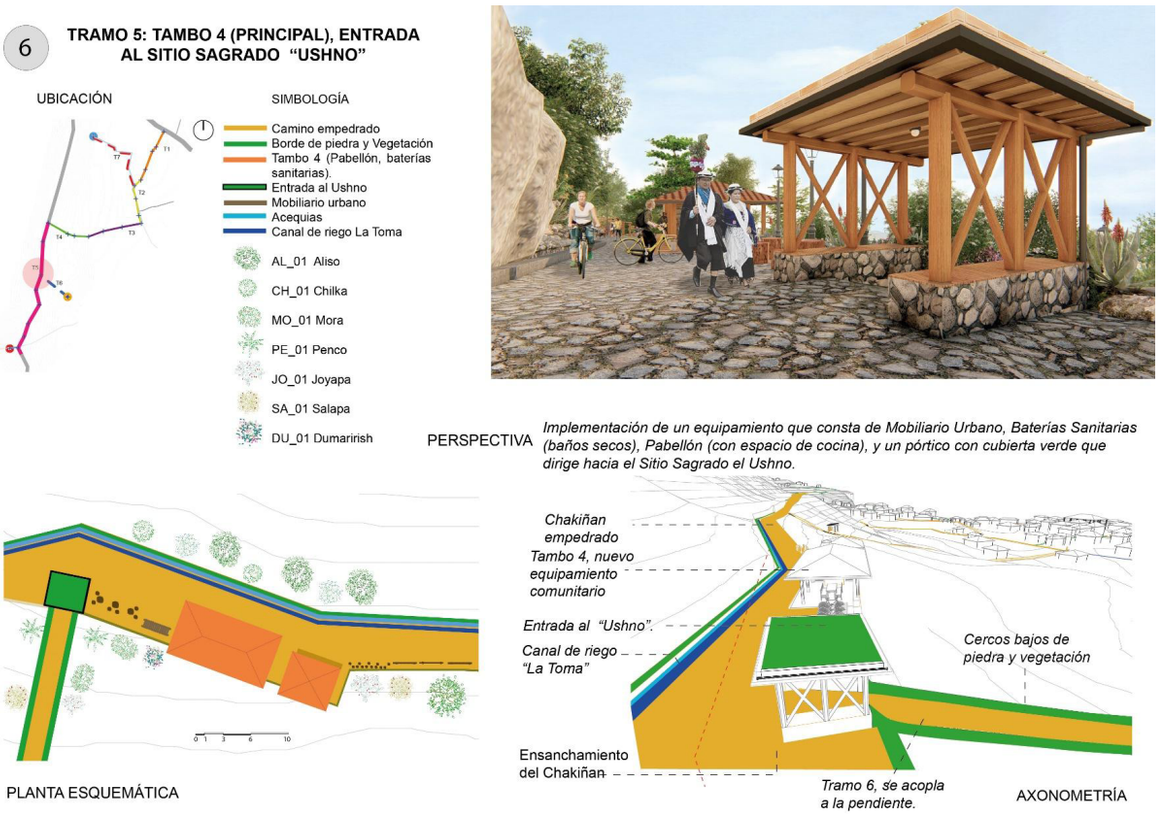



Figure 25. Proposal for the intervention of Section 6. Source: Prepared by the Authors.

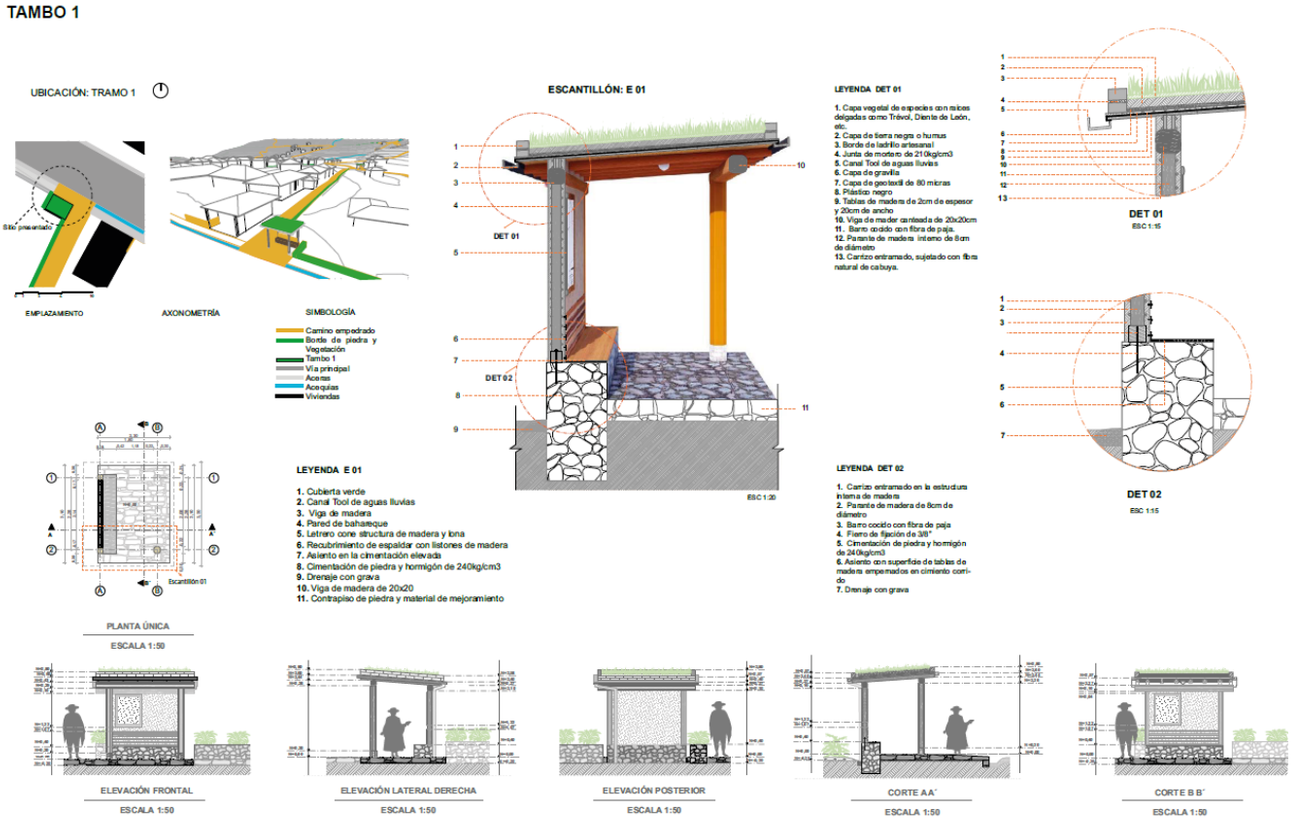



Figure 26. Proposal for Tambo 1: bahareque and green cover. Source: Prepared by the Authors.

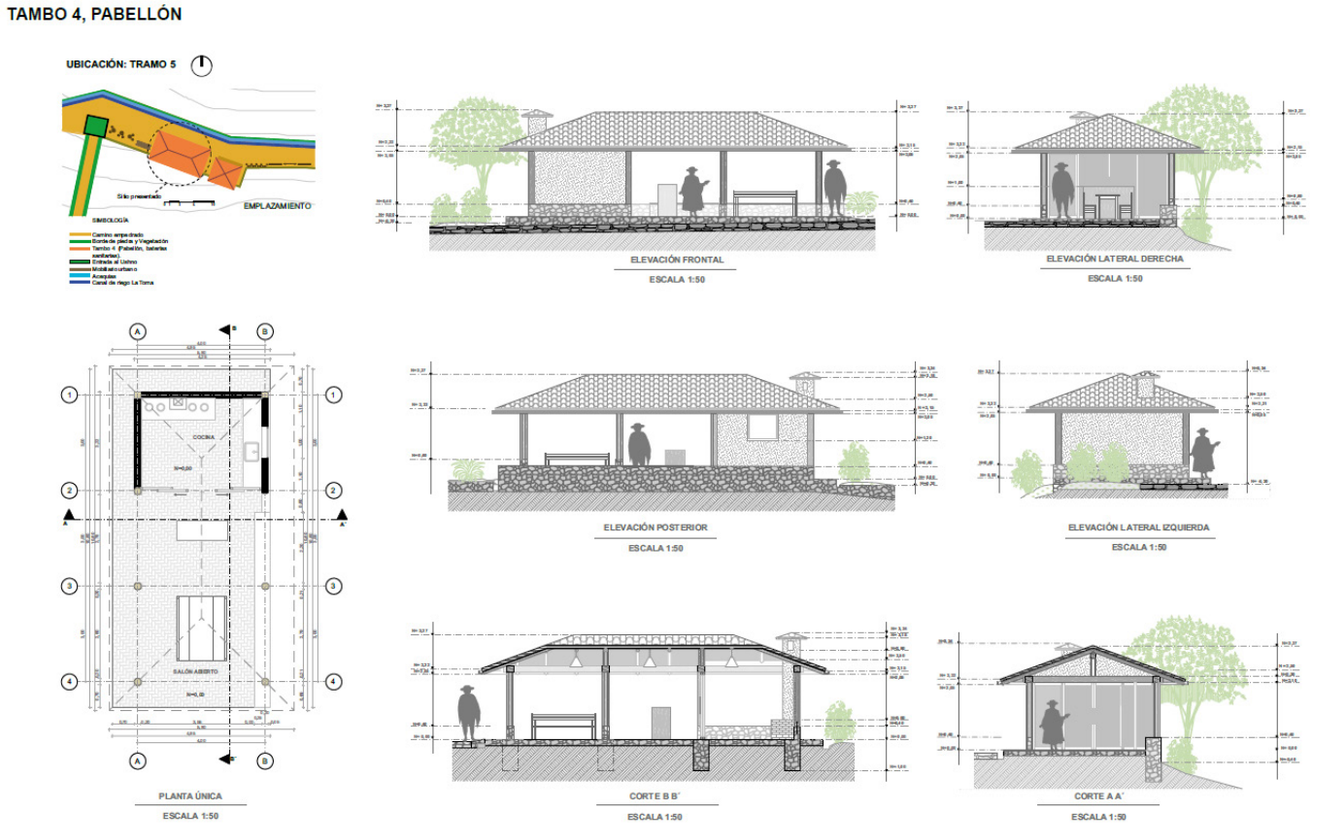



Figure 27. Tambo 4 proposal, main pavilion with the bahareque construction system. Source: Prepared by the Authors.

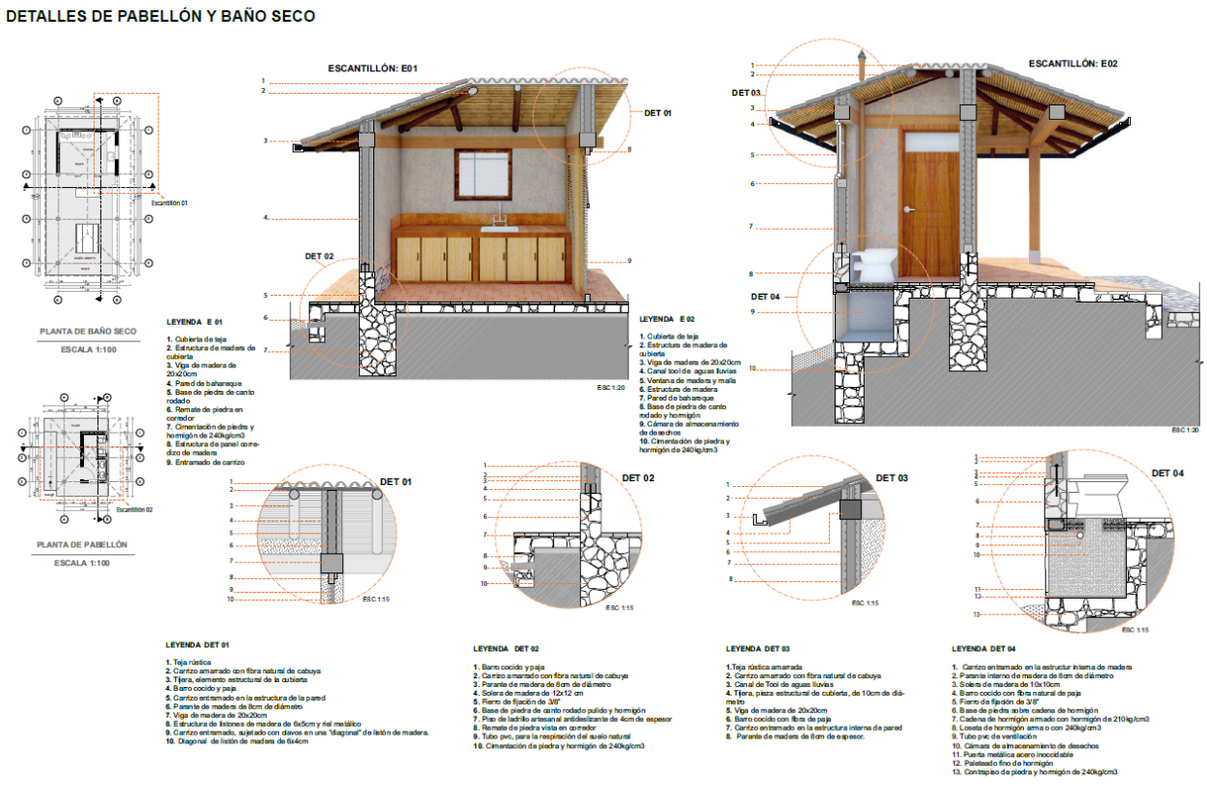



Figure 28. Constructive details of the pavilion and dry toilet. Source: Prepared by the Authors.




A. Tramo 1 del Chakiñán intervenido, con la recuperación del cerco verde lateral.

B. Tramo 7, intervención de espacio peatonal juto a la acequia existente.

C. Intersección del Tramo 1,2 y 7.

D. Intervención del Sitio Sagrado El Chorro.

Figure 29. 3D visualizations. Source: Prepared by the Authors.




E.Tramo 4, intervención en la superficie y la recuperación de los cercos de piedra laterales, acequia y vegetación.

F. Tramo 5. Implementación del Tambo principal, baterías sanitarias, y mobiliario urbano.

G. Implementación de un acceso desde el Tramo 5 hacia el Sitio Sagrado el Ushno.

H. Intersección entre el Tramo 2, Tramo 3 y la continuidad de la acequia que conduce el agua del sitio sagrado el Chorro.

Figure 30. 3D visualizations. Source: Prepared by the Authors.




Figure 31. 3D visualizations. Source: Prepared by the Authors.

# DISCUSSION

The contribution of this research to the field of sustainable habitat lies in validating ancestral mobility as a form of green, low-emission infrastructure for climate change mitigation and rural territorial planning. The multiscale and integrated analysis of the *Chakiñanes* network shows that these structures do not operate as isolated linear vestiges, but as dynamic components of an interconnected Andean cultural landscape. This conceptual approach agrees with the multidimensional approaches presented by Novoa Ríos & Hernández García (2026), who argue that the comprehensive rehabilitation of the habitat requires intertwining the technical functionality of the infrastructure with the perceptual and spatial dimensions that communities configure in their daily lives. Faced with contemporary models of peripheral and motorized urban planning that fragment micro-basins, the preservation of permeable pedestrian paths, the collective management of runoff water through ditches, and the use of low environmental impact construction systems — such as the *bahareque* — guarantee ecological coherence and the conservation of territorial heritage in mountain contexts (Guerrero Baca, 2017; Cristancho Barrios, 2024; Gonzalo Sánchez, 2012).

The operational response of the Las Lagunas community to the systematization and cataloging of its road network corroborates the theories of participatory planning aimed at sustainability. The development of self-managed internal regulations demonstrates that community infrastructure has internal governance mechanisms capable of dispensing with centralized state regulatory frameworks for its preventive conservation, provided that the physical space corresponds to the social mapping of the landscape. This dynamic makes visible the concept of emerging heritages proposed by Alegría & Valencia (2024), understood as manifestations and subaltern memories that derive their validity from the daily practices of communities and challenge the monumental and institutional notions of conservation (Figure 29, Figure 30, and Figure 31).

This phenomenon can be seen in the immediate physical appropriation by the local population, as reflected in the initiation of autonomous maintenance tasks and the formulation of collective regulations to protect their trails. As in the community management experiences analyzed by Arango-Marín et al. (2025), these assembly practices configure territorial care networks that mitigate the deficiencies of conventional urbanism, which prioritize the reproduction of community life and the autonomous preservation of sustainable habitat. In this way, the structured territorial design from the operational dimensions of the Andean cosmovision works as a catalyst for heritage awareness (Corrales Blanco, Pineda Iriarte & Salazar Rodríguez, 2021). Likewise, the observed effect of irradiation on neighboring communities suggests that the recovery of the *Chakiñán* activates the Saraguro people's socio-spatial memory. The viability of the proposed model lies in its ability to reactivate the *minga*, consolidating it not only as a collaborative work system, but also as a tool for cultural resistance, the management of the living territory, and the safeguarding of the sustainable landscape (Pacheco Arévalo, 2007; Quizhpe Guamán, 2013).

# CONCLUSIONS

The research shows that the *Chakiñanes* system constitutes an active mobility model with low emissions and high social efficiency. The results confirm that the territorial fragmentation caused by motorized urban expansion can be effectively mitigated by applying ancestral construction techniques that combine water resource management with pedestrian traffic. The community work of the *minga* is validated as a technical, operational, and sustainable governance mechanism, capable of ensuring the permanence of the cultural landscape in the face of the pressures of conventional development.

The cartographic and statistical analysis indicates that, despite the morphological transformations initiated in the 1960s by the opening of vehicular roads, 95.00% of the population of Las Lagunas identifies these trails as essential components of their identity and territorial structure. This persistence takes on scientific significance when evaluated at the basin scale. The geometric lines are not isolated, but rather are ecological ribs that connect the microbasin, strategically linking the water recharge points, the ceremonial centers, and the residential areas. This geomorphological logic responds to respecting the topography and to the union of water cycles as an integrating system of space and collective life.

From the perspective of territorial heritage, the *Chakiñan* transcends its original function of physical connectivity to consolidate itself as an ecological corridor and repository of Andean biodiversity, hosting endemic species (joyapa, penco, aliso) and medicinal plants, linking landmarks of high hydric-spiritual significance such as El Chorro, El Ushno, and the Taski Waterfall. Therefore, the proposed technical intervention is not defined as a conventional modernization of the infrastructure, but as a strategy for the reactivation of the social-spatial memory, demonstrating that architectural technique and landscape design can serve as material support for the continuity of the local community and its symbolic logics.

Finally, this study establishes a binding dialogue between vernacular knowledge and academia, translating local knowledge into a universal technical language that bases the validity of traditional systems within the framework of sustainable habitat. For future planning processes in territories of high cultural relevance, three operational guidelines are recommended:

For territorial research: To make planning studies subject to the processes of community life and local praxis, thereby avoiding the museification of identity and promoting its validity as an engine of sustainable development.

For academic training: To reorient the teaching of architecture and urbanism towards interventions grounded in active listening and socio-ecological sensitivity, using graphic representation as a tool for the technical rescue of vernacular systems.

For local management: To use architectural cataloging and social cartography as internal mediation tools to resolve boundary conflicts and consolidate collective legal security, thereby guaranteeing the historical and spatial continuity of the community habitat.

# CONTRIBUTION OF AUTHORS CRediT

Conceptualization: F.M.L.G., A.K.K.L.G.; Data Curation: F.M.L.G., A.K.K.L.G.; Formal analysis: F.M.L.G., A.K.K.L.G.; Acquisition of financing: F.M.L.G., A.K.K.L.G.; Research: F.M.L.G., A.K.K.L.G.; Methodology: F.M.L.G., A.K.K.L.G.; Project management: F.M.L.G.; Resources: F.M.L.G.; Software: F.M.L.G.; Supervision: A.K.K.L.G., A.K.K.L.G.; Validation: A.K.K.L.G.; Visualization: F.M.L.G.; Writing - original draft: F.M.L.G.; Writing - revision and editing: A.K.K.L.G.

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