TERRITORIAL TRANSFORMATION AND SUSTAINABILITY IN SAN JUANITO (META): THE ARTICULATING ROLE OF BEAN CROPS

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Introduction

Nestled in the foothills of Colombia's Eastern Cordillera, in the department of Meta, lies the municipality of San Juanito. Despite its small size, this territory offers a unique opportunity to observe the interplay between peasant economy, environmental sustainability, and territorial transformation, all mediated by a crop that has become both symbol and sustenance: the bean. This grain, cultivated by generations of Andean families, has transcended its role as food to become the cornerstone of the local economy, the primary source of income for hundreds of rural households, and, simultaneously, the trigger for ecological tensions stemming from intensive agricultural practices carried out within areas of high environmental sensitivity, such as Chingaza National Natural Park and its buffer zone.(Hernández-Rodríguez et al., 2022).

The historical context of San Juanito reveals a close link between production processes and the sociopolitical phenomena that marked the country during the last decades of the 20th century. Amid the internal armed conflict, bean and corn cultivation became established as subsistence strategies, even during times of confrontation between insurgent groups and state forces, with beans being one of the few products capable of offering some economic stability to rural families (Capetillo-Burela et al., 2024). However, the subsequent pacification of the area brought with it accelerated agricultural expansion, spurred by the withdrawal of armed actors and the opening of markets that, under the framework of free trade agreements, generated new opportunities, increasing the vulnerability of farmers to price fluctuations and international competition.(Silva-Illescas et al., 2024).

Weak institutional presence in San Juanito has led to an ambivalent evolution: on the one hand, international and national policies following the 1992 Rio Summit and Agenda 21 promoted the incorporation of environmental and social criteria into rural production models; but on the other hand, the local reality showed a process of practical regression, in which poverty, geographic isolation, and weak institutional presence prevented peasant communities from internalizing these principles. During the 1990s and 2000s, sustainability was understood more as a technical-administrative discourse than as a daily practice, while the territory was transformed through bean monoculture and pressure on the high Andean Forest, whose logging intensified to obtain agricultural stakes, generating progressive soil degradation and loss of vegetation cover.(Montealegre Torres, et al., 2021).

From a legal standpoint, the issue takes on a complex dimension due to the coexistence of environmental conservation regulations—such as Law 99 of 1993, which created the National Environmental System (SINA)—with the economic needs of a population that has historically depended on agriculture. San Juanito, with more than 50% of its territory within the boundaries of Chingaza National Natural Park, is subject to restrictive legislation that limits land use, agricultural expansion, and the exploitation of natural resources. (Gisell& Pulido, 2024).However, these regulations are not always accompanied by viable economic alternatives, leading to a constant tension between environmental legality and the survival of rural communities. Thus, the sanctions, confiscations, or prohibitions imposed by environmental authorities have been interpreted by farmers as mechanisms of exclusion, while state entities argue for the need to conserve the strategic ecosystems of the paramo and cloud forest.

Over time, this tension has shaped a dichotomy between conservation and development that remains unresolved. The land restitution process and the comprehensive reparations programs implemented by the Land Restitution Unit (URT) in recent years represent a turning point, as they introduce a post-conflict sustainable development approach. In this approach, returning to the countryside does not simply mean resuming production, but rather rebuilding ties with the land from a perspective of economic and environmental sustainability. The case of the Torres Acosta family, who in 2024 managed to recover their farm and establish a 2.5-hectare bean crop with state technical support, symbolizes this new stage of rural development: one in which sustainability ceases to be a regulatory imposition and becomes a possibility for dignity and rootedness (URT, 2024).

From a territorial perspective, San Juanito is configured as an ecological and productive mosaic where paramo

ecosystems, high Andean Forest, and agricultural areas in transformation converge. More than fifty percent of its territory belongs to the Chingaza National Natural Park, which restricts land use and forces farmers to adapt to conservation regulations that often clash with their economic needs. Even so, the population has developed resilient strategies ranging from productive associations, as in the case of Asofriteta, to the search for sustainable alternatives that integrate(González-Becerra et al., 2025)agroecological practices, crop rotation, and the strengthening of community-based rural tourism as a means of economic diversification(Romo et al., 2025).

In this process of rural reconfiguration, beans have played a dual role, simultaneously serving as a source of environmental pressure and a symbol of economic resilience. Producers, organized in groups like Asofriteta or participating in land restitution projects supported by the URT (Land Restitution Unit), have demonstrated that the crop can become a tool for social and economic reconstruction, especially when combined with sustainable practices, direct commercial partnerships, and state technical support (URT, 2024). This integration of sustainability, cooperation, and productivity gives rise to an emerging model of territorial transformation that seeks to balance the ecological, social, and economic dimensions of rural development.

The interest of this research lies precisely in analyzing how bean cultivation, from its local history to its contemporary dynamics, reflects the transition from a territory marked by conflict and marginalization to one that aspires to sustainability and peasant autonomy. In this sense, a comprehensive approach is proposed that articulates the ecological dimension—linked to the conservation of the strategic ecosystems of Chingaza—with the socioeconomic dimension—focused on strengthening the productive and associative capacities of farmers—recognizing that sustainability is not limited to technical agricultural management practices, but rather implies a cultural and political transformation of how the territory is inhabited.

Results

The research was conducted using a mixed-methods approach, combining quantitative and qualitative techniques to interpret the territorial and socio-environmental dynamics of bean cultivation in the municipality of San Juanito (Meta). The quantitative component was structured around the financial analysis of local production systems and the modeling of income, expenses, and net margins during the period 2021–2025. This involved constructing projected time series based on field records and operating balances that reflect the actual evolution of agricultural profitability. The qualitative component, on the other hand, relied on semi-structured interviews with producers, participant observation, and social mapping exercises. These methods allowed for the identification of land-use patterns, regulatory tensions arising from the presence of Chingaza National Natural Park, and the local sustainability strategies that emerge in response to these constraints. Both approaches were articulated through a triangulation matrix where the economic results were interpreted in light of the cultural, environmental and normative meanings that the peasants attribute to their productive practice.

During fieldwork, data collection revealed that bean cultivation is not only an economic activity but also a symbol of rural identity and permanence. Interviews and site visits showed a small-scale production structure, with an average of 2.5 hectares per family unit, dependent on domestic labor and with little mechanization. This condition defines both the economic vulnerability and the social resilience of the territory, given that production takes place on hillside soils with severe environmental restrictions and high legal compliance costs due to their location in buffer zones. In this context, agricultural practices still rely heavily on wooden trellises and agrochemicals, which impacts vegetation cover and soil quality; however, in the last five years, a gradual transition towards more sustainable practices has been observed, driven by regulatory pressure and collaboration between local associations and environmental entities seeking to reconcile production with conservation.

Year	Revenue (COP)	Expenditures (COP)	Operating Margin (COP)	Annual change (%)
2021	11,200,008	11,979,813	-779,805	—
2022	11,760,008	12,503,813	–743.805	+5.0
2023	12,348,008	13,096,014	–748.005	+5.0
2024	12,965,409	13,717,825	-752,416	+4.9
2025	13,613,679	14,370,726	–757.046	+5.0

Source: Prepared by the author based on the financial model (projection adjusted to current prices, 2021-2025)

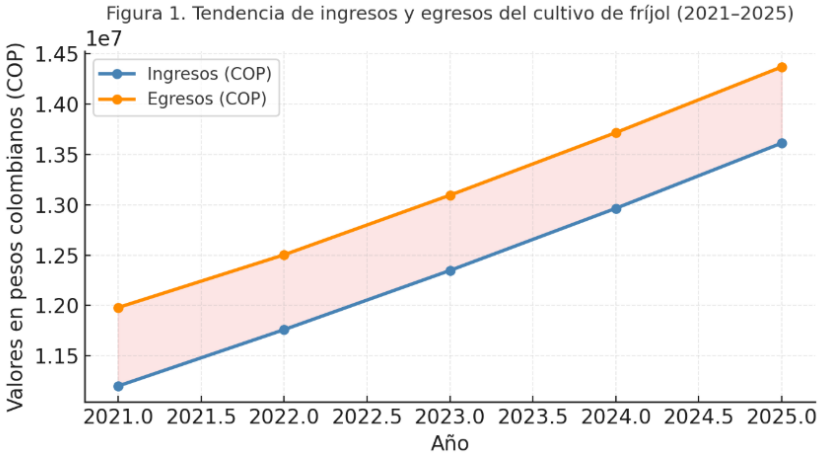


Figure 1. Trend of income and expenses for bean cultivation (2021–2025).

A parallel evolution is observed in both variables, with a constant negative gap that keeps the operating margin in deficit values, reflecting the economic vulnerability of the peasant production system.

In the economic component, the information obtained allowed for the construction of a five-year financial model (2021-2025) records the producers' income, expenses, and margins under average local market conditions. The data reveals that annual income increased from 11.2 million pesos in 2021 to 13.6 million in 2025, with a cumulative growth of 21%, while expenses increased from 11.9 million to 14.37 million in the same period, representing a 20.6% increase. Although the overall trend is positive, the difference between these two indicators shows that the operating margin remained negative throughout the period, fluctuating between -0.74 and -0.78 million pesos. This behavior, graphically represented in the income and expense figures, demonstrates a subsistence production model where increases in productivity are absorbed by rising input, transportation, and marketing costs, preventing the activity from achieving economic sustainability in the medium term.

Participant observation allowed for a comparison of these results with the perceptions of the producers, who identified three main factors affecting profitability: the cost of imported inputs, the instability of producer prices, and the lack of direct marketing channels. In response, associative processes emerged seeking to negotiate collective prices and access institutional business strengthening programs. The qualitative analysis of the farmers' narratives revealed that, although the term sustainability is associated with environmental conservation, for farmers it has a broader meaning, linked to economic stability and the recognition of their work as a legitimate part of territorial development. In this sense, sustainability is not conceived solely as a reduction of environmental impact, also, as the possibility of continuing to produce without risk of sanctions or displacement, which makes environmental legality a critical component of rural well-being.

In the ecological dimension, data triangulation revealed a strong correlation between crop expansion and reduced forest cover on hillsides. Social mapping exercises conducted with local residents showed that areas deforested for bean trellising coincide with water recharge zones and steep slopes, exacerbating soil erosion and compaction. Laboratory analyses of samples from these areas revealed significant losses of organic matter and pH variations, particularly in plots with over ten years of continuous use. These observations were complemented by interviews with agricultural technicians and local officials, who indicated that compliance with environmental regulations has been inconsistent, as land-use restrictions are not always accompanied by economic alternatives, creating a constant tension between conservation and rural survival.

The combination of semantic tools and analytical matrices allowed for a broader understanding of these tensions. By processing interviews and technical documents with a lexical frequency analysis system, a high co-occurrence was detected among the words *"bean*, " *"sustainability, " "profitability*, " and *"environmental legality*," with correlation coefficients greater than 0.9, indicating that economic and ecological concerns are inseparable in local discourse. Meanwhile, the association between *associativity* and *rural tourism* showed correlation values of 1.0, reflecting the emergence of a hybrid production model in which diversification into tourism activities is perceived as a viable sustainability strategy. These relationships, represented in the semantic correlation matrix, confirm that territorial sustainability depends on the interaction between the economy, legality, and community organization rather than solely on productive variables.

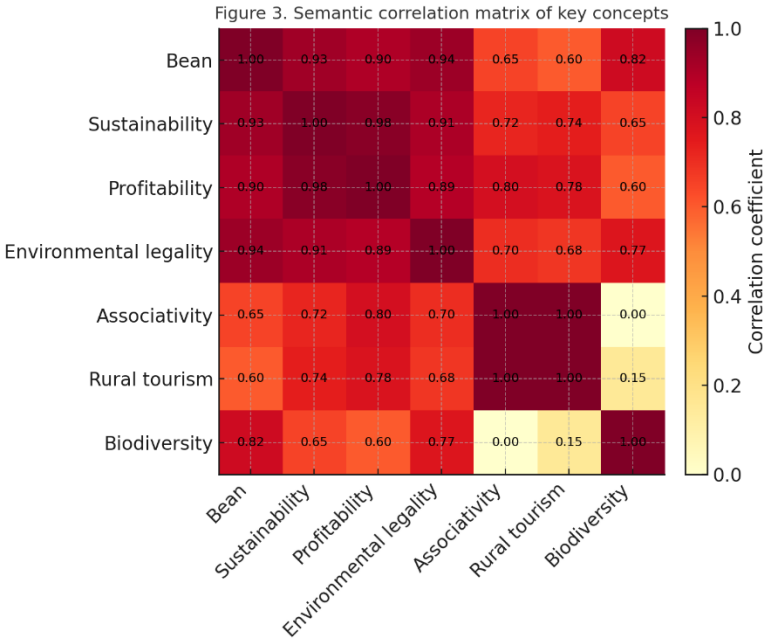
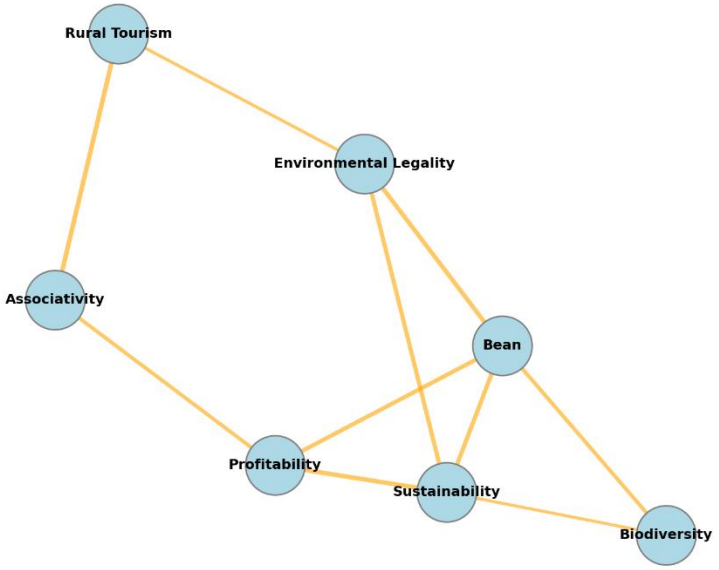


Figure 3. Semantic correlation matrix of key concepts. The matrix shows the relationships between the main concepts associated with the bean production system. Correlation coefficients greater than 0.9 demonstrate the strong link between sustainability, profitability, and environmental compliance, while the perfect correlation between association and rural tourism reflects the emergence of a hybrid production model based on cooperation and economic diversification.

Figure 4. Conceptual network of relationships between sustainability, economy, and community organization



The conceptual network represents the interdependencies identified among the main axes of the bean production system, where the strongest links (thicker lines) are observed between the economic, ecological, and regulatory dimensions, reflected in the association between *beans*, *sustainability*, *profitability*, and *environmental legality*. This concentration of relationships indicates that producers perceive sustainability as a simultaneously productive and legal condition, in which economic viability depends on environmental compliance (Kulczyk et al., 2023).

At the bottom of the network appears an independent cluster comprised of *associative initiatives* and *rural tourism*, whose seamless connection (1.0) demonstrates the consolidation of a community-based economic diversification model, where tourism is integrated as an extension of the agricultural system and as a complementary income strategy. This bifurcation suggests that the territory is transitioning from an agro-extractive model towards a hybrid and collaborative scheme, capable of balancing profitability and conservation.

Additionally, financial analysis and projections showed that the cost structure is concentrated in three categories: cost of sales, marketing expenses, and administrative expenses, which account between 70% and 75% of total annual expenditures. This pattern explains why margins remain negative even with productivity increases, as the local market structure favors intermediaries and penalizes direct producers. Scenario simulations presented in the financial analysis indicate that a 10% reduction in sales costs or a 5% increase in the producer price would reverse the negative margin and reach the break-even point, demonstrating that small variations in marketing parameters could have significant effects on the economic stability of rural households.

Discussion

The analysis of the results reveals that sustainability in San Juanito cannot be understood solely as an environmental goal or as a process of agricultural modernization, but rather as a comprehensive phenomenon that articulates ecological, economic, institutional, and cultural dimensions in a relationship of constant interdependence. This finding is linked to the perspectives of sustainable territorial development, which, according to(Montealegre Torres, 2024),they transcend the traditional productivist paradigm by placing local actors and their forms of organization at the heart of structural change. In this sense, empirical evidence suggests that bean crops have become a platform for community cohesion and an instrument for rebuilding the link between peasant economy and environmental management, a phenomenon that coincides with the postulates of(Montealegre Torres et al., 2024)on agroecology as a basis for resilient systems in the face of market pressures and transformations of the rural landscape.

The relationship between beans, sustainability, profitability, and environmental legality, observed in semantic correlations and economic structure, reveals that sustainable development in ecologically sensitive territories depends on the institutional capacity to harmonize conservation policies with the social reality of the communities. Land-use restrictions imposed by the regulations of Chingaza National Natural Park have become a double constraint: on the one hand, they guarantee the protection of strategic ecosystems; on the other, they limit access to sustainable livelihoods if they are not accompanied by productive alternatives compatible with conservation. This dilemma reflects the point made regarding (Kulczyk et al., 2023)common goods, which argues that sustainability requires polycentric governance mechanisms where rules are co-designed and co-managed by the users of the resource. In the case of San Juanito, community agreements and associative experiences are incipient expressions of this type of governance.

The emergence of the associativity-rural tourism axis, detected in the conceptual network, indicates that communities have begun to reconfigure their economies through a hybrid model that combines agroecological production and ecosystem services, in a logic similar of the transition economies documented by(Moronta Trejo et al., 2025).This shift in economic orientation not only responds to regulatory pressures, also to a process of symbolic revaluation of the territory, where the agricultural landscape, biodiversity, and peasant culture are integrated into a shared narrative of sustainability. This process, observed in the practices of Asofriteta and in the diversification towards tourism activities, coincides with the arguments of (Montealegre Torres, 2024), who maintain that rural sustainability does not only emerge from the imposition of external technical models, also from the dialogue between local knowledge and support institutions.

From an economic perspective, the projected financial results for 2021–2025 confirm the structural fragility of the subsistence farming model, in which income grows proportionally to expenses and maintains persistent negative margins. However, this same evidence opens the possibility of developing reconversion strategies aimed at reducing sales costs and adding value through cooperative practices and differentiation by origin. Several studies (Enthoven, 2025; Zhang et al., 2025)agree that strengthening short supply chains and promoting territorial labels can increase farmers' profit margins without compromising environmental sustainability. Combining these strategies with rural tourism offers a viable alternative for stabilizing income, generating local employment, and reducing pressure on hillside ecosystems.

Furthermore, ecological evidence shows a clear relationship between the expansion of agriculture and the loss of forest cover, with impacts on soil quality and water regulation, reinforcing the urgency of transitioning to agroecological systems and implementing active restoration practices in degraded areas. The results of the soil analysis, with significant reductions in organic matter and pH, are consistent with the approaches of(Enthoven, 2025),regarding the need to reintroduce crop rotations, polycultures, and plant cover as part of integrated landscape management. Territorial sustainability is not limited to the continued agricultural production, also it extends to the construction of a dynamic ecological balance that allows communities to adapt without eroding their natural resources.(Montealegre Torres et al., 2021).

Conclusions

The territorial transformation observed in San Juanito reveals that sustainability is not built simply through the application of regulations or the adoption of agricultural technologies, but rather through the social capacity to reinvent the territory across processes of organization, collective learning, and a redefinition of the relationship between community and the natural environment. Bean cultivation, far from being merely an economic activity, has become a structuring element of the landscape and a point of convergence between cultural identity, subsistence, and ecological reconversion, demonstrating that small-scale farming economies possess a potential for social innovation that is often underestimated in rural development policies.

The analysis revealed that the true challenge of sustainability lies in the governance of common resources and equitable access to productive opportunities, rather than in isolated crop productivity. Financial data showed a vulnerable economic structure, but also a solid foundation for developing cooperative strategies that improve profitability through added value, certification of origin, and short supply chains. These kinds of transformations depend not only on state intervention, also on the consolidation of horizontal territorial alliances where farming communities, public entities, and universities share knowledge, responsibility, and benefits.

Environmental evidence, reaffirms that the ecological balance of the territory is not achieved by restricting production, if not by redefining land uses according to their carrying capacity and promoting regenerative practices

that restore resilience to hillside ecosystems. Participatory restoration, the recovery of vegetation cover, and integrated water management are essential components to ensure the ecological continuity of the territory, while guaranteeing decent livelihoods for its inhabitants.

Finally, the research process suggests that sustainability in San Juanito should be understood as a transitional path rather than an achieved state. This transition involves strengthening the ethical dimension of territorial management, restoring trust in local institutions, and fostering a culture of shared environmental responsibility that transcends the temporality of projects. As long as beans remain the central element of the economy and the collective memory of the peasantry, the territory can move toward a model in which production, conservation, and coexistence cease to be conflicting objectives and become complementary principles within a shared vision of development.

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