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Collaborative governance in practice: power, networks and inclusion in a biocultural landscape

Oscar Alberto Maldonado Ibarra[1], Alfonso Langle-Flores[1], Rosa María Chávez-Dagostino[1], Myrna Leticia Bravo-Olivas[1] and Adriana Aguilar Rodríguez[2]

[1]Centro Universitario de la Costa, Universidad de Guadalajara, Puerto Vallarta, Mexico and [2]Centro de Investigación en Ciencias de Información Geoespacial, Aguascalientes, Mexico

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Corresponding author:
Alfonso Langle-Flores;
Email: alfonsolangle@gmail.com

Summary

Collaborative governance among multiple stakeholders is typically essential for conserving complex social-ecological systems. Mexico's 'biocultural landscapes' – a territorial governance initiative – may be seen as pioneering models to promote this. However, actual outcomes depend on the initial conditions, institutional design, leadership and details of the collaborative process. We used a mixed-methods approach combining social network analysis and semi-structured interviews to analyse the structure of the collaboration network within Mexico's Sierra Occidental Biocultural Landscape (SOBL). Our findings revealed a sparse, low-reciprocity network dominated by a few public managers, indicating potential power imbalances and challenges to building trust. Stakeholder interviews showed misalignments with theoretical collaborative governance including power imbalances, limited inclusiveness and a lack of trust among participants. While the SOBL has achieved collaborative results, such as the community forest fire brigades and the development of land management plans, achieving its full potential as a model for biocultural conservation requires addressing power dynamics and building a more equitable governance structure.

Introduction

Through the active engagement of diverse stakeholders, collaborative governance has emerged as a key strategy for co-producing effective conservation policies and strategies. This governance model is especially critical for managing complex landscapes, where top-down approaches often prove insufficient (Bodin 2017), if they are to achieve the global conservation targets set by the Kunming–Montreal Global Biodiversity Framework (CBD 2022). Collaborative arrangements involving different stakeholders are a commonly used governance mechanism, and networks are a tool to analyse them in landscape conservation (Guerrero et al. 2015, Scarlett & McKinney 2016, Allen et al. 2022). Adopting a network perspective is crucial for understanding complex institutional arrangements (Ansell & Gash 2008) and stakeholders' interactions (Bodin 2017, Berardo et al. 2020, Bodin et al. 2020). Social network analysis (SNA) has the potential to map these interactions (Bodin et al. 2006, Bodin & Crona 2009), clarify roles, identify key brokers and reveal structural constraints, offering valuable insights for conservation planning (Bodin & Crona 2009, Guerrero & Wilson 2017, Sayles & Baggio 2017) and actions (Guerrero & McAllister 2013, Langle-Flores et al. 2020). Despite harbouring 10% of the world's species (PNUD 2024), Mexico stands at a crossroads between economic development and the conservation of its biocultural heritage; deforestation and land-use change are significant issues. In this context, the Sierra Occidental Biocultural Landscape (SOBL) was established in 2011 as a multi-stakeholder collaborative initiative to promote forest conservation (Bezaury et al. 2015). The SOBL possesses a biocultural heritage shaped by centuries of interaction between human communities and the environment (Paisaje Biocultural 2023), with the first evidence of small human settlements and agriculture dated to 800 BCE (Mountjoy 2012). In 1608, the Indigenous population decreased considerably, and economic activities of interest to the Spanish Crown were developed, such as silver mining (Moreno-Martínez 2014).

The SOBL encompasses a mosaic of cloud forests, pine–oak woodlands and riparian corridors, contributing significantly to Mexico's biodiversity (IIEG 2019). Conservation efforts in the region have evolved considerably. In 2002, a proposal to create a mega-biosphere reserve faced social opposition, but in 2009 a watershed protection decree was revived. In this context, the SOBL initiative was launched in 2011 as a civil society organization with the support of the French Embassy. A 2023 state decree institutionalized the initiative and issued a Biocultural Landscape certificate, transferring governance to the Intermunicipal Board for

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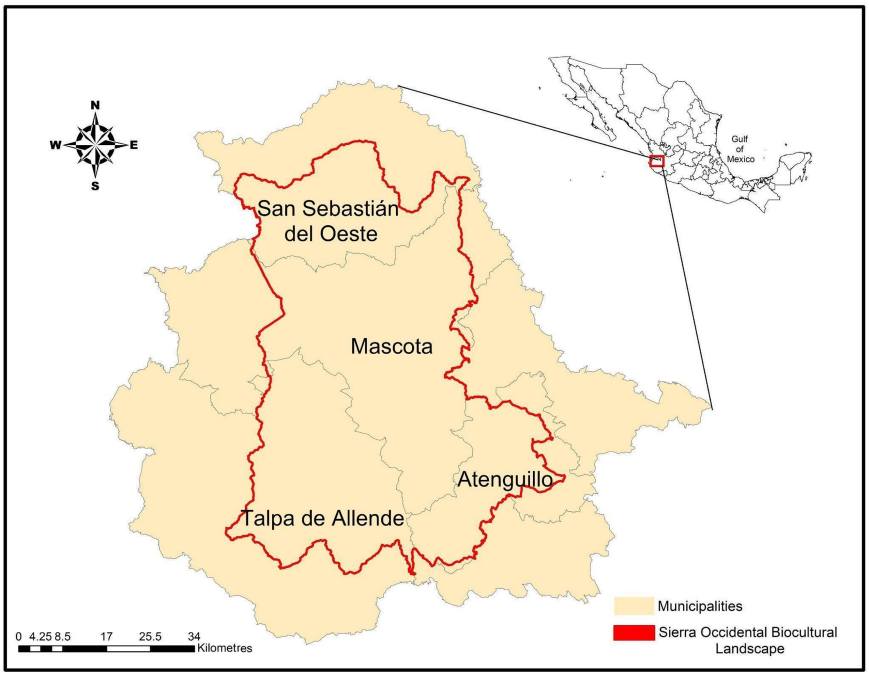


Figure 1. Location of the Sierra Occidental Biocultural Landscape in Mexico (inset) in Jalisco, specifically showing the municipalities of San Sebastián del Oeste, Mascota, Talpa de Allende and Atenguillo.

the Sustainability of the Western Sierra and Coast (JISOC), an environmental agency within the state government. The SOBL is a voluntary land management initiative governed by the Territorial Charter (2019–2034). The SOBL's mandate is to conserve the landscape through a biocultural approach that protects the region's cultural heritage, including biodiversity, landscape and local knowledge, while achieving sustainable rural development. To reach these goals, the SOBL developed a multi-stakeholder institutional design that connects different levels of government with sectors of society. The initiative's main governance structure is the JISOC's Board of Directors, which includes the mayors of Mascota, Talpa de Allende, San Sebastián del Oeste and Atenguillo, thereby aligning municipal efforts with those of state and federal authorities. The SOBL initiative provides forums for public participation, such as the Citizen Participation Council and six thematic working groups: livestock and dairy products; coffee growing; tourism; timber forest use; non-timber forest products; and crafts and sweets. The SOBL's rules, based on the Territorial Charter, promote co-responsibility, voluntary participation, consensus-based decision-making, thematic committees, accountability mechanisms and procedures for certifying productive projects through the SOBL seal. Despite its ecological and cultural richness, the SOBL faces a number of challenges that threaten its existence. Key environmental issues include inadequate forest management, land-use changes and water pollution (Paisaje Biocultural 2022). Mining and agave and avocado plantations have exacerbated these problems, creating a complex social landscape that requires multi-stakeholder collaboration to balance competing interests. The novelty of the present research is its empirical assessment of the governance challenges that constrain a biocultural landscape-scale conservation initiative. This focus differs from previous research on environmental governance in the region, which has analysed governance reconfiguration following a regulatory shock in a tourism-orientated protected area (Langle-Flores et al. 2025) or governance evaluations using social-ecological network analysis in a forest conservation collaborative arrangement based on economic incentives (Langle-Flores et al. 2020). We examine the SOBL's collaborative process using Ansell and Gash's (2008) governance framework, which focuses on consensus-orientated decision-making between public agencies and non-state stakeholders. It emphasizes success factors in collaborative governance, including starting conditions (e.g., power imbalances), institutional design (e.g., inclusiveness), inclusive leadership (e.g., trust-building) and the collaborative processes (e.g., effective communication). Assessing these factors and the network structure is key to improving environmental governance. By combining SNA with qualitative interviews, we aimed to reveal underlying power structures and collaboration dynamics (Guerrero et al. 2020, Langle-Flores et al. 2020) while gaining insights into trust-building and inclusiveness, which are key predictors of collaborative governance (Ansell & Gash 2008, Emerson et al. 2012, Langle-Flores et al. 2025). Analysis of such collaborative networks in landscape-scale conservation remains limited in Latin America (Burgos & Mertens 2024). We therefore assessed the SOBL network's properties and its alignment with starting conditions, institutional design, leadership and collaborative processes, which influence the success of collaborative efforts. We gathered stakeholder perspectives on factors influencing collaborative governance in the SOBL, identifying areas for improvement, and we contribute to a deeper understanding of biocultural conservation in practice.

Methods

The SOBL is located within the Trans-Mexican Volcanic Belt and the Sierra Madre del Sur in western Mexico (Maldonado Ibarra 2022). Its 245 000 ha encompass four municipalities in the state of Jalisco (Mascota, Talpa de Allende, San Sebastián del Oeste and Atenguillo; Paisaje Biocultural 2023), and it reaches an altitude of 2760 m (Fig. 1). This region has a human population of 38 710 (Gobierno del Estado de Jalisco 2020) and a high regional average Human Development Index (UNDP 2024) of 0.71 (Appendix S1 & Table S1; IIEG 2023). We employed a sequential exploratory mixed-methods design to analyse collaboration within the SOBL, tracking its transition from a civil society organization to an

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initiative. We collected and analysed both quantitative and qualitative data to gain deeper insights and greater validation (Creswell & Clark 2017), ensuring a comprehensive understanding of the network properties and stakeholder narratives in three phases: (1) SNA to map collaboration ties among stakeholders; (2) semi-structured interviews with five key stakeholders within the network; and (3) semi-structured interviews with eight local stakeholders outside the network to broaden our perspective.

Phase 1

For the SNA, we employed purposive snowball sampling (Marsden 1990) to explore stakeholder ties. Initial participants were selected based on recommendations from two experts, both of whom were identified as founders of the SOBL initiative. These stakeholders referred us to other participants, our aim being to include stakeholders from different sectors within the SOBL. We conducted 22 face-to-face interviews between August and September 2019, with four of them being conducted after this period due to COVID-19-related delays. Using a name generator method (Marsden 1990) to collect data on collaboration ties, we asked each participant: 'With whom do you collaborate when participating in conservation activities within the SOBL initiative?' The 22 participants were classified into six groups based on their primary economic activity as follows: tourism operators (TUR), environmentalists (ENV), public managers (GOE), municipal representatives (GOM), business owners (COM) and ranchers (RAN). To maintain anonymity, each SNA node was given a unique identifier combining its sector and organization. The label consisted of the first three letters of the sector to which they belong, a letter representing the organization and a number identifying a specific stakeholder (e.g., GOEA1; Langle-Flores et al. 2020). We constructed a 22 × 22 adjacency matrix to represent the directed collaboration network, which was then analysed and visualized using *UCINET* (Everett & Borgatti 1999) and *Gephi* (Bastian et al. 2009). We calculated global network metrics (density, centralization, reciprocity, transitivity and connectance) to assess the overall structure of collaboration. Additionally, we used a node-level metric (betweenness centrality) to identify the role of individual stakeholders in the network (Wasserman & Faust 1994).

Global network metrics

For directed networks, density (D) was the ratio of the number of ties present in the network (E) to the total number of possible ties ($N(N-1)$), as shown in Equation 1:

$$D = \frac{E}{(N(N\ -\ 1))} \tag{1}$$

where N is the number of nodes. Density ranges from 0 to 1, with higher values indicating greater interconnectedness. This is associated with higher levels of trust and social support (Wasserman & Faust 1994).

Krackhardt's connectance (C) is the proportion of node pairs that can reach each other through a path of any length. It was calculated using Equation 2 as follows:

$$C = \frac{\sum_{i\neq j} r_{ij}}{N(N\ -\ 1)} \tag{2}$$

where N is the total number of nodes in the network and r_{ij} is an element from the network's reachability matrix that has a value of 1 if node j is reachable from node i and 0 otherwise. The summation $\Sigma_{i\neq j} r_{ij}$ counts every ordered pair of distinct nodes (i,j) where a path exists from i to j. The denominator $N(N-1)$ represents the maximum possible number of connections between distinct nodes in a direct network; it reflects the overall cohesion of the network (Krackhardt 1994).

Reciprocity (r), the proportion of node pairs (dyads) in a network that are mutual ($i \rightarrow j$, $j \rightarrow i$), was calculated using Equation 3 as follows:

$$r = \frac{\sum_{i\neq j} x_{ij} x_{ji}}{\sum_{i\neq j} x_{ij}} \tag{3}$$

where the numerator $\Sigma_{i\neq j} x_{ij} x_{ji}$ counts every tie that is part of a mutual pair, which is then divided by the denominator $\Sigma_{i\neq j} x_{ij}$, representing the total number of ties in the network. Reciprocity is an indicator of trust and cooperation (Wasserman & Faust 1994).

Transitivity (Tr) reflects the degree of network closure, representing the probability that two stakeholders connected to a shared third party are also directly connected to one another. Based on the principle that if a path exits from i to j and from j to k, a transitive triad is closed by a path from i to k, and this was calculated using Equation 4 as follows:

$$Tr = \frac{\sum_{i,j,k} x_{ij} x_{jk} x_{ik}}{\sum_{i,j,k} x_{ij} x_{jk}} \tag{4}$$

where the numerator $\Sigma_{i,j,k} x_{ij} x_{jk} x_{ik}$ counts these closed triads, while the denominator $\Sigma_{i,j,k} x_{ij} x_{jk}$ counts all of the potential triads. Transitivity indicates the degree of closure within the network (Handcock et al. 2008).

The degree of centralization (NC_x) measures the extent to which a network is dominated by a few nodes. It compares the observed network centralization to its theoretical maximum (Everett & Borgatti 1999). It was calculated using Equation 5 as follows:

$$NC_x = \frac{\sum_1^n = 1(C_{xmax}\ -\ C_{Xi})}{max \sum_{i=1}^n (C_{xmax}\ -\ C_{xi})} \tag{5}$$

where the numerator $\Sigma(C_{xmax} - C_{Xi})$ represents the observed centralization by summing (Σ) the differences between the degree of centrality of the most connected node (C_{xmax}) and that of all other individual nodes (C_{Xi}). This sum is then divided by the denominator $max\Sigma(C_{xmax} - C_{xi})$, which represents the maximum possible value for the numerator, a scenario found only in a perfectly centralized 'star' network.

Among the nodal network metrics, betweenness centrality ($Betw(k)$) evaluates the extent to which a node acts as an intermediary or bridge. It is defined as the proportion of all shortest paths (geodesics) between any two nodes that pass through the focal node (k; Freeman 1977). It was calculated using Equation 6 as follows:

$$Betw(k) = \sum_{i<j, i\neq k, j\neq k} \frac{\sigma_{i,j}(k)}{\sigma_{i,j}} \tag{6}$$

where i and j are all pairs of nodes other than k, $\sigma_{i,j}$ is the total number of shortest paths between node i and node j and $\sigma_{i,j}(k)$ is the number of those shortest paths that pass through node k.

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Table 1. Global network metrics, overall connectivity and collaboration dynamics among the 22 stakeholders in the Sierra Occidental Biocultural Landscape collaboration network.

Network metric	Score
Number of nodes	22
Number of ties	33
Density	0.071
Degree of centralization	0.129
Reciprocity	0.303
Transitivity	0.263
Connectivity	0.338

Phase 2

Semi-structured interviews were conducted with five key network stakeholders, identified through the SNA based on their high betweenness centrality scores. These stakeholders represented two state governments, two municipal governments and one environmental organization. The interviews were conducted online between October and November 2024 using a questionnaire (Appendix S1) designed to explore interviewee perceptions of the factors necessary for successful collaborative governance, based on Ansell and Gash (2008). All interviews were recorded, transcribed and analysed using narrative analysis, with categories derived from Ansell and Gash (2008). The qualitative findings are presented as a unified text, illustrated with representative excerpts (Riessman 2008).

Phase 3

In February 2025, additional semi-structured interviews were conducted with eight additional non-network stakeholders who were not part of the initial SOBL network sample. These individuals were identified during the sampling process but had limited or no interaction with other network stakeholders. The objective was to include a broader range of perspectives on collaborative governance in the SOBL. Participants included representatives from the mining, tourism and coffee industries, as well as small business owners and *raicilla* (agave distillate) producers from San Sebastián del Oeste and Mascota. Interviews were conducted in writing and by telephone.

Results

Collaborative network

The SOBL collaboration network included 22 stakeholders from seven sectors: four public managers from the SOBL, two from the Sierra Occidental Inter-municipal Board, four municipal representatives, six tourism professionals, one environmentalist, four business owners and one rancher. The network consisted of 22 nodes with 33 ties between them, resulting in a low density of 0.071 (Table 1). This network's degree of centralization was 0.129, and its reciprocity was 0.303, indicating that only c. 30% of the ties were mutual. The analysis also revealed a low transitivity coefficient of 0.263, suggesting weak 'triangulation' within the collaboration network. The network also exhibited a Krackhardt's connectance of 0.338. The betweenness centrality reveals that public managers were the most significant connectors within the network. Nodes from the public sector (GOEA1, GOEA3, GOMA2 and GOEB1) exhibited the highest normalized betweenness centrality values, with scores of 17.857, 15.952, 14.524 and 14.286, respectively (Fig. 2 & Table 2). While key stakeholders were also present in other sectors, such as business (COMD1) and ranching (RANA1), their centrality scores were notably lower (Table 2).

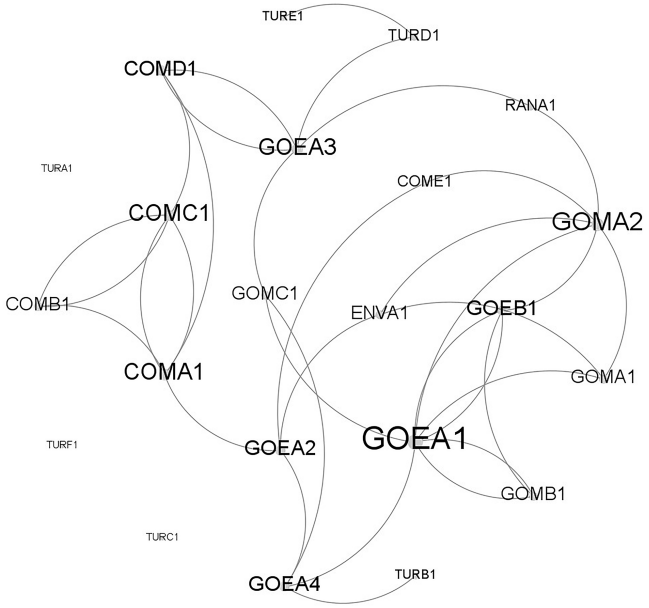


Figure 2. Visualization of the Sierra Occidental Biocultural Landscape collaboration network. Nodes represent the stakeholders involved, and the lines represent their collaborative ties. The size of the node represents the stakeholder's betweenness centrality. The first three letters of the label indicate the sector to which the stakeholder belongs: tourism (TUR), environmentalists (ENV), public managers (GOE), municipal representatives (GOM), business owners (COM) and ranchers (RAN).

Collaborative governance factors

The semi-structured interviews revealed a mixed alignment of the SOBL with the principles of successful collaborative governance, with notable misalignments in key areas, including power imbalances, inclusiveness and trust-building (Tables 3 & S2). In contrast, factors such as incentives to participate, a mixed history of cooperation and partially aligned elements, such as facilitative leadership, face-to-face dialogue and shared understanding, showed greater consistency with collaborative governance principles.

Starting conditions

Participant perceptions revealed power imbalances within the collaborative process in the SOBL, with decision-making often concentrated among public managers. These imbalances were linked to the different levels of government. For example, one stakeholder pointed out that 'power is not balanced, it depends on the scale: federal, state or municipal government, and *ejido* or community' (TURH1). In contrast, four public managers described the collaboration as balanced, although they acknowledged that some stakeholders wanted to impose their will on others. Four participants also stated that agreements were always reached, which helped to diminish imbalances. Despite these perspectives, a broader sentiment emerged that collaboration allowed stakeholder expression, but it had limited influence on decision-making. Stakeholder incentives to participate were diverse, primarily linked to economic rewards, conservation values and human well-being. Support for local entrepreneurs also served as a strong motivator. Non-economic incentives were particularly valued by two stakeholders who promoted sustainable

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Table 2. The 22 stakeholders in the Sierra Occidental Biocultural Landscape collaboration network, ranked by normalized betweenness centrality, showing the central role of public managers in connecting stakeholders within the network.

Stakeholder	Normalized betweenness scores
GOEA1	17.857
GOEA3	15.952
GOMA2	14.524
GOEB1	14.286
GOMC1	13.095
COMD1	6.429
GANA1	5.238
COMC1	2.857
NGOA1	1.310
COME1	1.071
COMA1	0.476
GOEA2	0.000
GOEA4	0.000
GOMA1	0.000
GOMB1	0.000
COMB1	0.000
TURA1	0.000
TURB1	0.000
TURC1	0.000
TURD1	0.000
TURE1	0.000
TURF1	0.000

practices. One stakeholder pointed out that the 'SOBL initiative promotes good practices to minimize negative impacts on the territory, such as the certificate for products and services' (GOMC1). However, social participation in the SOBL was constrained by several factors. A lack of awareness regarding the initiative was evident, with one stakeholder estimating that 80% of the population in the involved municipalities were unaware of the Biocultural Landscape concept. Furthermore, past unfulfilled expectations of direct economic or material support had shaped current attitudes and slowed broader engagement. There has been a history of conflict and cooperation, during which public managers have made efforts to build trust despite protracted land tenure conflicts. At least one participant from the private sector noted that multi-stakeholder forums provide an opportunity to resolve differences (TURH1). Historical conflicts related to land disputes, business competition and political affiliations were mentioned by four participants, contributing to a complex context for collaboration.

Institutional design

It was evident that the institutional design of the SOBL faced challenges related to inclusiveness, ground rules and transparency. Despite efforts to promote inclusiveness, stakeholders perceived there to be barriers to participation. Opportunities were often seen as favouring the tourism and production sectors, while other groups remained underrepresented. Three public managers emphasized the existence of established ground rules. However, four stakeholders from the tourism sector and ranching communities expressed confusion regarding roles and responsibilities. One stakeholder mentioned that 'the rules are not so clear, because sometimes they invite companies to teach on topics they don't have the credentials for' (RAIA1). Ultimately, transparency proved to be a significant challenge. While three public managers highlighted the participatory nature of the governance structure, others noted that collaboration relied more on informal agreements than on formally established procedures, as one stakeholder stated that 'there are no specific rules about the SOBL because the collaboration is based on a (voluntary) agreement' (GOEA3).

Leadership

Perceptions of leadership were varied. Four respondents indicated that public managers often performed effectively and communicated openly, which helped to reduce conflicts; one stakeholder remarked that 'there is multiple leadership, and communication is open and trusting, which minimizes stakeholder conflicts' (GOEA1). However, three other stakeholders perceived leadership as being concentrated within specific groups, influenced by political interests. One stakeholder stated that 'leadership is concentrated in the politicians who have shown the most appetite' (GOMA2). Concerns were also raised about a lack of adequate representation, particularly when new stakeholders unfamiliar with the SOBL joined the process.

The collaborative process

While four stakeholders reported frequent dialogue occurring within committees, the same stakeholders observed that this dialogue did not always extend to all groups (e.g., disadvantaged communities), thereby restricting inclusion. While public managers highlighted a shared understanding among active members, others stressed the need for better information sharing beyond core groups. One stakeholder pointed out that 'all members know the vision of the SOBL initiative and participate actively' (GOEA3). Two public managers and one tourism operator acknowledged that trust-building efforts faced significant obstacles, including high turnover among public officials and scepticism among local stakeholders. In addition, public managers emphasized the importance of the recognizing diverse skills and perspectives among all participants. One stakeholder pointed out that 'it is necessary to generate trust from the point of recognizing the skills of everyone on the subject' (MINA1). Despite these difficulties, some respondents appreciated the SOBL initiative as a platform for learning and interacting to achieve common objectives. In this sense, two stakeholders mentioned the Territorial Charter and regional fire control brigade as concrete examples of intermunicipal collaboration.

Discussion

Our analysis reveals both alignments and misalignments with the established factors for successful collaborative governance (Table 3). The SOBL initiative shows tangible elements of collaborative action, including the establishment of a community fire brigade, the development of a territorial strategic plan and the certification of local products and services. These findings are consistent with Ansell and Gash's framework (2008), which emphasizes the importance of shared goals and tangible outcomes in collaborative governance. In this context, Bodin (2017) highlights the value of collaborative networks for achieving conservation goals, particularly at the landscape scale, where ecosystems and human communities intersect across administrative boundaries. We revealed that this is a low-density network (0.071), suggesting a relatively weak foundation for sustained collaborative interactions, and this value is significantly lower than that found in other comparable studies. For example, a landscape-scale conservation initiative in South Africa exhibited a network density of 0.406 (McCulloch-Jones et al. 2022). In collaborative networks, higher density facilitates trust, information sharing and

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Table 3. Alignments in the Sierra Occidental Biocultural Landscape (SOBL; Ansell & Gash (2008) framework).

Factor	Findings in the SOBL	Degree of alignment
Starting conditions		
Power balance	Power imbalances persist, with the government at the centre, and few stakeholders have a say in decision-making	Not aligned
Incentives to participate	Primarily economically focused and on territory conservation and human well-being	Partially aligned
History of conflict, cooperation and trust-building	Mixed history with both land tenure conflicts and stakeholder participation in a forest fire brigade	Partially aligned
Institutional design		
Inclusiveness	Limited inclusiveness	Not aligned
Ground rules	Unclear ground rules	Not aligned
Transparency	Deficient transparency	Not aligned
Leadership		
Shared leadership	Process dominated by public managers, raising concerns about shared leadership	Not aligned
Facilitative leadership	Public managers are generally accepted and trusted by stakeholders; however, the dominance of public managers raises concerns	Partially aligned
Collaborative process		
Face-to-face dialogue	Frequent dialogue within committees, but unclear if this extends to all stakeholders	Partially aligned
Trust-building	Challenges in trust-building	Not aligned
Shared understanding	Clear mission for some stakeholders, but not shared by all; deficient common problem definition	Partially aligned

collective action due to direct ties among stakeholders (Bodin & Crona 2009). The low level of reciprocity (0.303) within the SOBL network indicates a prevalence of unidirectional ties, potentially reinforcing power imbalances, as was perceived by some stakeholders. As noted earlier, one of them stated that 'power is not balanced, it depends on the scale: federal, state or municipal government, and ejido or community' (TURH1). Such imbalances can hinder mutual trust and shared ownership, which are key factors for long-term success (Ansell & Gash 2008). The low transitivity (0.263; Table 2) further suggests limited network cohesion and a potential risk of fragmentation (Bodin & Crona 2009). It also suggests that stakeholders groups may develop an internally reinforced consensus, which could restrict inclusivity (Jasny et al. 2015). The quality of network ties, in terms of both density and reciprocity, is crucial for fostering trust and collaboration among diverse stakeholders; previous research has consistently emphasized the importance of building trust as a foundation for successful collaboration and conflict mitigation (Bodin et al. 2006, Bodin & Crona 2009, Langle-Flores et al. 2025).

Public managers occupied the central nodes in the network, exhibiting the highest betweenness centrality scores (Fig. 2 & Table 2). While highly central stakeholders can act as critical connectors (Bodin et al. 2006, Bodin & Crona 2009), an overreliance on public managers can hinder community empowerment and reinforce power imbalances (Ansell & Gash 2008). One stakeholder expressed that 'everyone has the right to share their ideas, but perhaps not always the right to make decisions' (RAIB3), a sentiment that aligns with findings that powerful brokers can dominate institutional systems (Berardo & Lubell 2016). This pattern of public-sector dominance is consistent with that observed in other environmental collaborative networks in Mexico (Langle-Flores et al. 2020, 2025), as well as in Sweden's National Forest Program, where public managers have significantly influenced both the collaborative process and policy outcomes (Johansson 2024). In the SOBL network, the broker role held by public managers concentrates communication and resource flows, which can limit broader participation. As one stakeholder noted, while SOBL is open, in practice there is 'little general representation of the different sectors of the territory' (GOMA2). When powerful brokers dominate a network, this can increase connection costs for less influential stakeholders, potentially leading to their exclusion (Emerson 1962, Blau 1964). During the early stages of the SOBL, public managers' control was beneficial for launching the initiative. However, over time such control may have reduced transparency and representation (Falaleeva & Rauschmayer 2013), potentially excluding diverse values and knowledge from decision-making and leading to less equitable conservation outcomes. The persistence of power imbalances, limited inclusiveness and a lack of transparency go against the principles of collaboration (Ansell & Gash 2008).

One reason as to why these issues have arisen appears to be the lack of clear and applied ground rules. According to Ansell and Gash (2008), institutional design that includes clear rules for decision-making builds legitimacy and prevents process breakdown. This is supported by findings from a Marine Protected Area in Mexico, where a management crisis prompted a shift from diffuse to specific regulations – a key change for enhancing stakeholder accountability and the legitimacy of agreements (Langle-Flores et al. 2025). At the same time, one stakeholder in the current research noted that the 'challenges of the SOBL initiative are cooperation, confidence, transparency, inclusion and integration of disadvantaged groups' (TURJ1).

Trust is a crucial mediating factor, as low levels of trust can discourage stakeholders from fully engaging in decision-making processes (Reed 2008, Johansson 2024). In this sense, the network's structural characteristics and governance misalignments could impact the SOBL's on-the-ground conservation efforts. For example, a sparse centralized network is likely to produce fragmented responses to landscape-scale pressures such as mining or agricultural expansion. Because such a structure may inadequately reflect local needs or ecological knowledge, land management decisions may undermine the initiative's dual goals of biodiversity conservation and sustainable development. Ultimately, if local stakeholders feel that their voices are unheard (Lawrence 2006), their long-term commitment to conservation may diminish, directly impacting the SOBL's ability to empower the stakeholders it aims to support.

Previous research has shown that sustaining long-term conservation requires tangible benefits for local stakeholders engaged in collaborative arrangements (Langle-Flores et al. 2020). The SOBL does not explicitly operate as a payment for ecosystem services programme – a conservation policy with mixed forest

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conservation results in Latin America (Perevochtchikova et al. 2021). Instead, it incorporates economic incentives through its certification seal for local products. For these alternative policies to succeed, they must be grounded in institutional trust, inclusion and genuine empowerment (Ansell & Gash 2008). Success depends on enabling authentic participation rather than merely advisory or consultative roles (Lawrence 2006). Previous research on ecosystem services governance has shown that limited or symbolic participation can undermine ownership and long-term sustainability (Castro-Díaz et al. 2022).

The challenges identified in the SOBL case offer critical insights into the implementation of collaborative governance in Mexico's biocultural landscapes. Applications of the Ansell and Gash (2008) framework account for pre-existing institutional weakness conditions and network structures that shape such interactions. The dominance of public managers – a common feature in Mexican environmental governance (Langle-Flores et al. 2020, 2025) – particularly hinders the achievement of the equitable, shared leadership envisioned by the framework. The findings of this research suggest that applying such frameworks in contexts such as the SOBL requires a stronger emphasis on actively counterbalancing power asymmetries from the outset. Our approach had inherent limitations. The restrictions imposed by the COVID-19 pandemic during phase 1 reduced the availability of interviewees. Additionally, snowball sampling may have underrepresented certain sectors, such as *raicilla* (agave distillate) producers, miners and forestry professionals. While this method allowed us to map the core SOBL network, it may have reinforced existing biases favouring actors with greater social capital. Future studies could address this limitation by employing purposive sampling and utilizing attendance lists from the SOBL working groups to ensure broader representation (Langle-Flores et al. 2025). Furthermore, the temporal gap between the data collection phases (SNA in 2019–2021 and interviews in 2024–2025) added complexity, as stakeholder perceptions might have evolved over time (Guerrero et al. 2020). Future research would benefit from a longitudinal design to monitor changes in network dynamics over an extended period (Langle-Flores et al. 2025).

Conclusion

Our findings highlight the complexities inherent in collaborative governance and emphasize the importance of critical analysis and adaptive management in achieving equitable outcomes for all stakeholders. This research contributes to conservation science and practice by offering a clear diagnostic tool that is applicable to other landscape-scale initiatives. The study demonstrates that a sparse network may indicate underlying issues in trust and collaboration. Importantly, the findings show that stakeholder participation in numerous committees does not guarantee equitable outcomes; instead, proactive measures are needed to address power imbalances that leave local stakeholders feeling that their role is merely advisory (Lawrence 2006). This research contributes to conservation science by showing that theoretical governance frameworks must be adapted to specific institutional contexts; in the Mexican case, the common dominance of public managers can hinder the emergence of shared, equitable leadership. Ultimately, our findings suggest that a fragmented network can lead to ineffective or weakened responses to environmental threats and may erode the long-term commitment of local stakeholders, thereby undermining conservation goals in biocultural landscapes. The SOBL's challenges in power-sharing, inclusiveness and trust directly affect its capacity to achieve the Kunming–Montreal Global Biodiversity Framework's goals, which stress the importance of collaborative and equitable governance (CBD 2022). Without genuine collaboration that empowers local stakeholders and integrates diverse forms of knowledge, achieving ambitious conservation targets will be difficult. The SOBL's partial successes demonstrate potential, but fully realizing this potential requires a fundamental shift towards more equitable and transparent governance that actively strengthens the collaborative network. Future research should prioritize analysing longitudinal changes in the SOBL's network structure to enable comparisons with other biocultural landscapes. Such insights into the evolving dynamics of collaborative governance can inform social efforts to meet global biodiversity targets.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S0376892925100258.

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References

Allen KE, McLean S, Pessagno S (2022) Connecting communities, connecting environments: the role of social capital in landscape-scale conservation. *Society and Natural Resources* 35: 763–783.

Ansell C, Gash A (2008) Collaborative governance in theory and practice. *Journal of Public Administration Research and Theory* 18: 543–571.

Bastian M, Heymann S, Jacomy M (2009) *Gephi*: an open-source software for exploring and manipulating networks. *Proceedings of the International AAAI Conference on Web and Social Media* 3: 361–362.

Berardo R, Lubell M (2016) Understanding what shapes a polycentric governance system. *Public Administration Review* 76: 738–751.

Berardo R, Fisher DR, Hamilton M (2020) Analyzing collaborative governance under uncertainty: a network perspective. *Policy Studies Journal* 48: 600–628.

Bezaury CJE, Graf MS, Barclay BK, de la Maza HK, Machado MS, Rodríguez E, et al. (2015) *Los paisajes bioculturales, un instrumento para el desarrollo rural y la conservación del patrimonio natural y cultural*. Mexico City, Mexico: Comisión Nacional de Áreas Naturales Protegidas.

Blau PM (1964) *Exchange and Power in Social Life*. New York, NY, USA: John Wiley & Sons.
Bodin Ö (2017) Collaborative environmental governance: achieving collective action in social-ecological systems. *Science* 357: eaan1114.
Bodin Ö, Crona B (2009) The role of social networks in natural resource governance: what relational patterns make a difference? *Global Environmental Change* 19: 366–374.
Bodin Ö, Alexander S, Baggio J, Barnes M, Berardo R, Cumming G, et al. (2019) Improving network approaches to the study of complex social-ecological intedependencies. *Nature Sustainability* 2: 551–559.
Bodin Ö, Crona B, Ernstson H (2006) Social networks in natural resource management: what is there to learn from a structural perspective. *Ecology and Society* 11: r2.
Bodin O, Mancilla M, Robins G (2020) Reconciling conflict and cooperation in environmental governance: a social network perspective. *Annual Review of Environmental and Resources* 45: 471–495.
Burgos A, Mertens F (2024) Robustez en las redes de gobernanza colaborativa e implicaciones para la conservación del paisaje en el Mosaico do Espinhaço, Brasil. *REDES* 35: 1–25.
Castro-Díaz L, Delgado E, Langle-Flores A, Perevochtchikova M, Marín V (2022) A systematic review of social participation in ecosystem services studies in Latin America from transdisciplinary perspective, 1996–2020. *Science of the Total Envinonment* 828: 154523.
CBD (2022) Decision adopted by the Conference of the Parties to the Convention on Biological Diversity. 15/4. Kunming–Montreal Global Biodiversity Framework [www document]. URL https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf
Creswell JW, Clark VL (2017) *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA, USA: SAGE Publications.
Emerson K, Nabatchi T, Balogh S (2012) An integrated framework for collaborative governance. *Journal of Public Administration Theory and Research* 22: 1–29.
Emerson RM (1962) Power-dependence relations. *American Sociological Review* 27: 31–41.
Everett MG, Borgatti SP (1999) The centrality of groups and classes. *Journal of Mathematical Sociology* 23: 181–201.
Falaleeva M, Rauschmayer F (2013) Evaluating environmental governance in a Belarusian World Bank biodiversity project. *Environmental Conservation* 40: 147–156.
Freeman LC (1977) A set of measures of centrality based on betweenness. *Sociometry* 40: 35.
Gobierno del Estado de Jalisco (2020) Región Costa Sierra Occidental [www document]. URL https://sicyt.jalisco.gob.mx/sites/sicyt.jalisco.gob.mx/files/tomo_5_costa_sierra_occidental_norte_lagunas.pdf
Guerrero AM, Barnes M, Bodin Ö, Chadès I, Davis KJ, Iftekhar MS, et al. (2020) Key considerations and challenges in the application of social-network research for environmental decision making. *Conservation Biology* 34: 733–742.
Guerrero AM, Mcallister RRJ, Wilson KA (2015) Achieving cross-scale collaboration for large-scale conservation initiatives. *Conservation Letters* 8: 107–117.
Guerrero AM, McAllister RRJ, Corcoran J, Wilson KA (2013) Scale mismatches, conservation planning, and the value of social-network analyses. *Conservation Biology* 27: 35–44.
Guerrero AM, Wilson KA (2017) Using a social-ecological framework to inform the implementation of conservation plans. *Conservation Biology* 31: 290–301.
Handcock MS, Hunter DR, Butts CT, Goodreau SM, Morris M (2008) *Statnet*: software tools for the statistical modeling of network data. *Journal of Statistical Software* 24: 1–11.
IIEG (2019) Biodiversidad de flora y fauna del estado de Jalisco. Gobierno del Estado de Jalisco [www document]. URL https://iieg.gob.mx/biodiversidad/
IIEG (2023) Principales resultados del Índice de Desarrollo Humano 2010–2020 [www document]. URL https://iieg.gob.mx/ns/wpcontent/uploads/2023/02/%C3%8DndiceDesarrolloHumano2020.pdf
Jasny L, Waggle J, Fisher DR (2015) An empirical examination of echo chambers in US climate policy networks. *Nature Climate Change* 5: 782–786.
Johansson J (2024) What is at stake, and what does it take? Collaborative governance and policy (in)action in the adoption of a National Forest Programme. *Scandinavian Political Studies* 47: 552–574.
Krackhardt D (1994) Graph theoretical dimensions of informal organizations. In: KM Carley, MJ Prietula (eds), *Computational Organization Theory* (pp. 89–111). Hove, UK: Psychology Press.
Langle-Flores A, Aguilar Rodríguez A, Romero-Uribe H, Ros-Cuéllar J, Von Thaden JJ (2020) Multi-level social-ecological networks in payments for ecosystem services program in central Veracruz, Mexico. *Environmental Conservation* 48: 41–47.
Langle-Flores A, Dueñas M, Chávez-Dagostino RM, Aguilar-Rodríguez A (2025) Islas Marietas: strengthening polycentric governance in response to an MPA tourism ban. *Anthropocene Coasts* 8: 7.
Lawrence A (2006) 'No personal motive?' Volunteers, biodiversity, and the false dichotomies of participation. *Ethics Place and Environment* 9: 279–298.
Maldonado Ibarra OA (2022) *Paisaje Biocultural como modelo de conservación y participación comunitaria en la Sierra Occidental de Jalisco, México*. PhD dissertation. Guadalajara, Mexico: Universidad de Guadalajara.
Marsden PV (1990) Network data and measurement. *Annual Review of Sociology* 16: 435–463.
McCulloch-Jones S, Novellie P, Roux DJ, Currie B (2022) Social network analysis of a landscape-scale conservation initiative in South Africa. *South African Journal of Science* 118: 1–8.
Moreno-Martínez A (2014) Los mineros y sus familiares en la Sierra Occidental de Jalisco durante los siglos XVII y XVIII. *Vínculos, sociología, análisis y opinión* 5: 73–95.
Mountjoy JB (2012) *El Pantano*. Guadalajara, Mexico: Secretaria de Cultura, Gobierno de Jalisco.
Paisaje Biocultural (2022) Convenio de Coordinación Paisaje Biocultural, 29 junio 2022, Mascota, Jalisco [www document]. URL https://biodiversidad.jalisco.gob.mx/Archivos/Proyectos/Paisaje/CONVENIO_COORDINACION_PAISAJE_BIOCULTURAL.pdf
Paisaje Biocultural (2023) El Proyecto 'Protección de La Biodiversidad de Los Ecosistemas Del Corredor Ameca-Manantlán [www document]. URL http://www.paisajebiocultural.org.mx/
Perevochtchikova M, Castro-Díaz R, Langle-Flores A, Von Thaden J (2021) A systematic review of scientific publications on the effects of payments for ecosystem services in Latin América, 2000–2020. *Ecosysten Services* 49: 101270.
PNUD (2024) Análisis de gasto público federal a favor de la biodiversidad 2022. Proyecto 00108628 Iniciativa Finanzas de Biodiversidad BIOFIN México fase II [www document]. URL https://www.biofin.org/sites/default/files/content/knowledge_products/An%C3%A1lisisGastoPublico_ene11.pdf
Reed MS (2008) Stakeholder participation for environmental management: a literature review. *Biological Conservation* 141: 2417–2431.
Riessman CK (2008) *Narrative Methods for the Human Science*. Thousand Oaks, CA, USA: SAGE Publications.
Sayles JS, Baggio JA (2017) Social-ecological network analysis of scale mismatches in estuary watershed restoration. *Proceedings of the National Academy of Sciences of the United States of America* 114: E1776–E1785.
Scarlett L, McKinney M (2016) Connecting people and places: the emerging role of network governance in significant landscape conservation. *Frontiers in Ecology and the Environment* 14: 116–125.
UNDP (2024) *Human Development Report Human 2023–2024. Breaking the Gridlock. Reimagining Cooperation in a Polarized World*. New York, NY, USA: United Nations Development Program.
Wasserman S, Faust K (1994) *Social Network Analysis: Methods and Applications*. Cambridge, UK: Cambridge University Press.

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