



Biospheres reserves and social-ecological well-being: the case of Tehuacán-Cuicatlán, Mexico

Perla Sinco-Ramos¹ · Eduardo García-Frapolli¹ · Luciana Porter-Bolland² · Leticia Durand³

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Abstract

Biosphere reserves (BRs) have been effective in safeguarding biodiversity, yet their implementation has resulted in contentious outcomes for local communities. In this study, we examine the impact of a BR in southern Mexico on the social-ecological well-being (SEWB) of a peasant community. A total of 38 semi-structured and informal interviews were conducted with local residents and park rangers, and qualitative data collection and analysis methods were employed. The findings indicate that, while there are some similarities, there are also notable differences in the perceptions of local people and park rangers regarding the main components of the SEWB of the local population. Furthermore, our findings indicate that both local residents and park rangers perceive the positive impacts of the BR on the natural environment in a similar manner. However, there are discrepancies in their assessments of the social benefits generated by the BR's actions and projects. Additionally, the community exhibits disparate perceptions regarding the impacts of the BR contingent on people's land tenure regime. While *comuneros* hold positive perceptions, *ejidatarios* view the BR's actions and projects as exacerbating existing inequalities and social conflicts within the community. For the BR to meaningfully contribute to the SEWB of local people, its management must explicitly integrate a socio-ecological approach, ensuring a balance between the conservation of the natural environment and human well-being, and acknowledging local value systems and alternative perspectives on society-nature relationships.

Keywords Protected areas · Local communities · Land tenure · Conservation · Human well-being

1 Introduction

Biosphere reserves (BRs) represent a primary strategy for biodiversity conservation on a global scale. BRs facilitate the conservation of biodiversity, the sustainable utilization of natural resources, sustainable human and economic development, and scientific research and education (Reed, 2019). As several authors have emphasized (Coetzer et al., 2014;

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Stoll-Kleemann & O’Riordan, 2017), the concept of BRs is appealing due to its incorporations of local communities and their needs. However, in practice their implementation and management presents significant challenges.

For many years, BRs have been perceived as valuable for their genuine attempt to give value to the social aspects that go hand in hand with biodiversity conservation. As different studies have shown (Ferreira et al., 2018; Zeng et al., 2022), BRs have demonstrated effectiveness in reducing deforestation and safeguarding species and their habitats. In Mexico, where this research is conducted, BRs have been demonstrated to be the most effective category of protected area (PA) for regulating land-use change (Figueroa & Sánchez-Cordero, 2008; Porter-Bolland et al., 2012). While the efficacy of BRs in ecological terms is not widely disputed, their social impacts are a subject of considerable debate. The establishment of BRs frequently entails restrictions on local livelihoods and changes in the relationships between local people and nature (West et al., 2006).

In Mexico, it is crucial to comprehend the social consequences of BRs, given that approximately 84% of the local population residing in PAs (including the BRs) exhibit elevated rates of socio-economic marginalization (CNDH, 2019). Peasant and indigenous communities, which are among the most marginalized populations in Mexico, are responsible for the conservation of most of the country’s biodiversity (Sarukhán et al., 2012). These communities possess 51% of the country’s land, with 80% of that land consisting of forests and 20% consisting of water (Candelas, 2019). This implies that these communities serve as the primary custodians of the natural environment, while concurrently bearing much of the responsibility for its conservation (Boege, 2008).

BRs have been identified as optimal territories for the implementation of socio-ecological management approaches (Eugene et al., 2019; Palomo et al., 2014). However, in practice, the management of these areas has historically prioritized the ecological dimension of biodiversity conservation, while the social dimension has been largely overlooked (Coetzee, 2017; De Lange et al., 2016). While the achievement of conservation goals and the protection of the natural environment remain of paramount importance, a growing body of research has demonstrated that these goals cannot be attained unless human well-being and the needs of local communities are given due consideration (Chan et al., 2007; West et al., 2006). In the case of Mexican BRs, studies have demonstrated that when the social dimension is weakly integrated, there is a poor understanding of the socio-ecological dynamics, which has significant implications for the reserves’ viability from both a social and an ecological perspective (Figueroa & Durand, 2011, p. 7). It is therefore of the utmost importance that the processes implemented in BRs incorporate a more integrated view that brings together ecological and social considerations (Chan et al., 2007). Berkes and Folke (1998) underscored the significance of adopting a social-ecological systems (SES) perspective to comprehend the interconnections between ecosystems and social institutions. They posited that the social and ecological dimensions are intricately linked in a nested, multi-level system with interdependent relationships. While there is no consensus on the precise definition of an SES, there is a general consensus that the social and ecological dimensions are inextricably linked (Colding & Barthel, 2019). The boundaries between these dimensions are often perceived as arbitrary and artificial (Berkes & Folke, 1998).

In accordance with the SES vision, this study employs the concept of social-ecological well-being (SEWB) as an approach that considers well-being in a comprehensive manner. This approach encompasses the care of the human context in its social dimension and the

natural environment in its ecological dimension. The concept of well-being has traditionally been employed to examine living conditions exclusively within human contexts, whether at the individual or collective level. In contrast, frameworks such as ecological integrity (Parrish et al., 2003) are frequently utilized to comprehend the ecological conditions of a natural environment. However, maintaining this separation when addressing the conditions of well-being through an SES approach is not only an epistemic contradiction but also limits the interpretation of the results, as the integrity of nature and human well-being are directly linked. Consequently, the construct of SEWB, as conceptualized in this research, encompasses the preservation of the natural environment and the promotion of a fulfilling human life in harmony with it. The concept of SEWB does not entail the establishment of unique indicators for its study. This is because both qualitative (e.g., subjective well-being and environmental perception) and quantitative approaches (e.g., ecological integrity and objective well-being) can be used to assess it. The methods and parameters should be selected on an ad hoc basis according to the objectives and context of the research. In this case, indicators emerged from local stakeholders, for example, peasant labor, land ownership, access to water, contributions from the natural environment, among others. The approach does not seek to quantify the indicators; rather, it aims to understand the valuation that individuals make of their well-being. To that end, it considers individuals' aspirations, expectations, needs, and values, thereby reflecting the manner in which people evaluate their own life circumstances.

In light of the aforementioned considerations, the aim of this paper is to examine the influence of the Tehuacán-Cuicatlán Biosphere Reserve (TCBR) on the SEWB of a peasant community in Mexico. This study poses two questions. What are the principal elements of the SEWB of the peasant community, as perceived by the local population and park rangers? Furthermore, if the actions implemented by the TCBR contribute to an improvement in the community's SEWB? A key aspect of this research is to understand whether the perceptions of the two groups of stakeholders coincide. This is important because, as other studies have shown (Pelcastre et al., 2021), if there is no overall understanding of which are the drivers and constraints of local people's well-being, conservation and development objectives are unlikely to be met in BRs.

2 Methodology

2.1 The study site

2.1.1 Tehuacán-Cuicatlán biosphere reserve

The Tehuacán-Cuicatlán Biosphere Reserve is situated in the southern region of Mexico and was designated in 1998, encompassing an area of approximately 490,000 hectares. The TCBR is part of the Tehuacán-Cuicatlán Valley, which has been identified as the most biodiverse arid and semi-arid region in North America (Valiente-Banuet et al., 2000). In recognition of the area's numerous natural, historical, and cultural elements of exceptional value, UNESCO designated it a Mixed World Heritage Site in 2018. As is the case with all BRs in Mexico, the TCBR is managed by the National Commission of Natural Protected Areas (CONANP), which oversees the reserve's director and a team of park rangers in the field.

Prior to the establishment of the BR, one of the primary concerns was the trafficking of protected endemic flora. In addition to its rich biodiversity, the TCBR is significant for its cultural diversity, as it is home to eight indigenous groups. The majority of the local population resides in vulnerable circumstances, with 98% of the population classified as highly marginalized (CONANP, 2013).

2.1.2 Santiago Quiotepec

Santiago Quiotepec is a community situated within the Tehuacán-Cuicatlán Biosphere Reserve (see Fig. 1). The community occupies an area of approximately 44 km², and its predominant vegetation is tropical dry forest intermixed with xerophilous scrub. Despite its semi-arid climate, Santiago Quiotepec benefits from the presence of four rivers that facilitate agricultural activities, which represent the primary source of income for the community (Brunel, 2008a).

The livelihoods of households in the community are based on agriculture and other activities that are directly related to the natural environment. These include grazing, harvesting, hunting, fishing, and sand mining. In recent years, ecotourism activities have been developed and promoted in conjunction with the TCBR (Fig. 2).

The community, of Mazatec origin, is structured and administered at the local level by *usos y costumbres* (customary law). The social and ecological dynamics of the community are significantly shaped by the prevailing land tenure rights. In Mexico, the agrarian revolution of 1910 resulted in the distribution of land to rural peasants, who were collectively organized into *ejidos* and *comunidades agrarias* (agrarian communities). In both cases, decisions are made through the assembly, which serves as the decision-making body and is

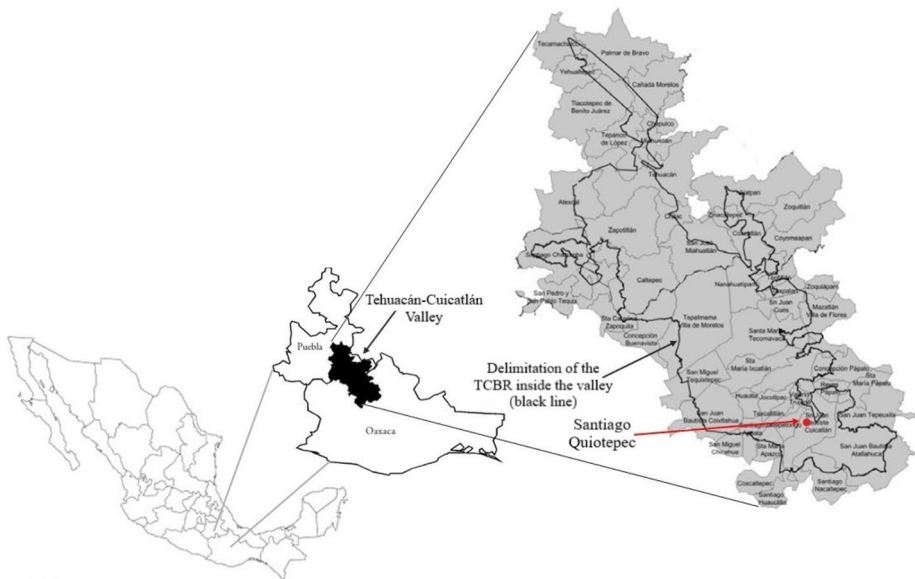


Fig. 1 Location of the Tehuacán-Cuicatlán Valley, of the Tehuacán-Cuicatlán Biosphere Reserve and the community of Santiago Quiotepec. The white polygon on the left is Mexico, and the polygon in the middle contains the states of Puebla and Oaxaca, where the valley and the reserve are located

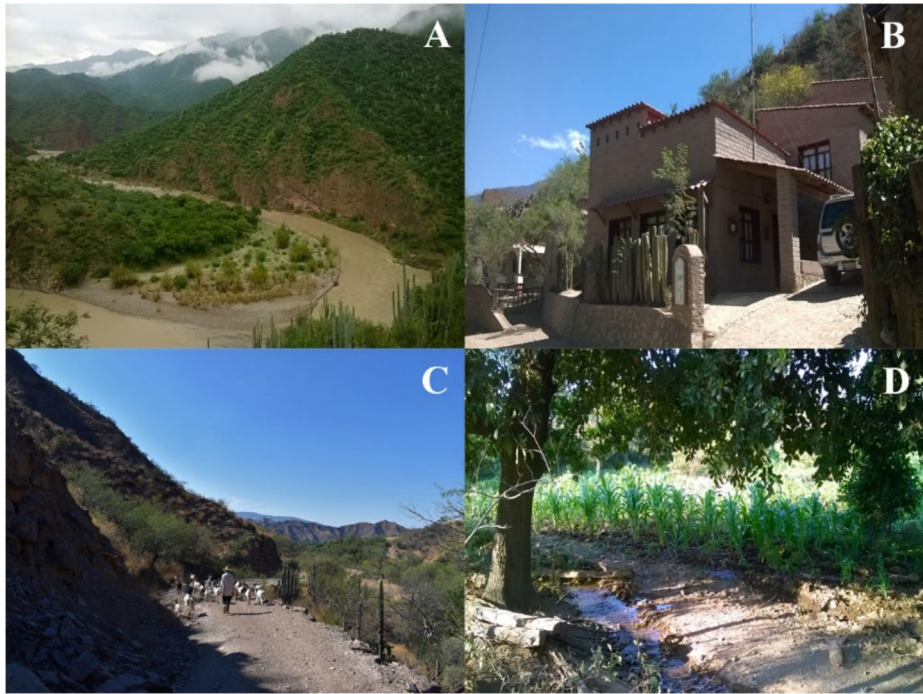


Fig. 2 Livelihoods in Santiago Quiotepec. (A) Río Grande: the main water source for the community and economic activities; (B) Ecotourism lodges financed by the TCBR; (C) Grazing goats; (D) Maize plot with fruit trees and irrigation

comprised of individuals with land tenure rights, who are entitled to vote. Those who belong to *ejidos* are designated as “*ejidatarios*,” while those who belong to agrarian communities are referred to as “*comuneros*”. Additionally, there are individuals residing in the community who do not possess land tenure rights, classified as “*avecindados*” (tenants). Finally, there are small landowners who have purchased land but are not part of the *ejidos* or agrarian communities, and thus are not eligible to vote in the assemblies.

In contrast to most rural communities in Mexico, which are characterized by a singular social land tenure regime, Santiago Quiotepec is distinguished by the coexistence of the two distinct forms: *ejido* and agrarian community. This is due to the fact that in 1927, a group of peasants submitted a petition to the federal government requesting land, which was subsequently granted to them in the form of *ejido*. This land represents approximately 17% of the territory of Santiago Quiotepec. Subsequently, in 1969, another group of local people petitioned the federal government for land, which was granted in the form of an agrarian community, covering approximately 83% of the total territory (Brunel, 2008a). The coexistence of these two forms of land tenure within the same community has resulted in the division of the local people, both in terms of the activities they engage in and the alliances they have established with external institutions.

The permanent population of Santiago Quiotepec is approximately 350 individuals. Despite historically low population density, the number of inhabitants has decreased over the past five decades, primarily due to migration to urban centers in Mexico and the United

States (Brunel, 2008b). Local sources indicate that migration has ceased in recent years, with some migrants returning due to the advent of remunerative employment opportunities stemming from government-led initiatives, such as those of CONANP (personal communication with inhabitants).

2.2 Methods of data collection and analysis

This research was conducted as a case study analysis, based on the perceptions of local people and park rangers of the TCBR. Perception can be defined as the process by which individuals recognize and interpret experiences in any context, thereby ascribing meaning and value to them. Interpretation and evaluation can be applied to a multitude of subjects, including objects, actions, experiences, individuals, policies, and outcomes (Bennett, 2016). This process entails the generation of knowledge from the learning derived from the experience, which, in turn, allows for the formulation of judgments and the qualitative description of such experiences, their stimuli, and contexts (Durand, 2008). In the context of conservation, local perceptions are of paramount importance. While ecological parameters serve as a crucial guide for conservation actions, these processes are primarily driven by social actors, particularly those who inhabit protected areas (PAs). A growing body of research (Allendorf, 2007; Bennett et al., 2019) has underscored the pivotal role of local perceptions in shaping attitudes towards conservation. These studies have demonstrated that the acceptance, participation, and support for conservation are largely contingent upon local perceptions of ecological efficacy, social impacts, and the governance processes. Moreover, these studies have revealed that people tend to prioritize social benefits over ecological efficacy.

Two fieldwork sessions were conducted in the community: the first in February 2018 and the second in March and April 2019. Data were collected through semi-structured and informal interviews, a field diary, and participant observation. The interviews were conducted with the informed consent of the respondents. The selection of interviewees was conducted using the non-probabilistic snowball method and quota sampling, with the saturation principle employed to determine the requisite sample size (Newing, 2011). The participants were selected based on gender, age, and land property rights (*ejidatarios*, *comuneros*, tenants, and small landowners). In total, 38 interviews were conducted: 12 with tenants and small landowners, 12 with *comuneros*, 11 with *ejidatarios*, and 3 with park rangers (director, project officer, and regional liaison officer).

The interviews addressed the following themes: (1) The state of social-ecological well-being in the community; (2) The establishment of the Tehuacán-Cuicatlán Biosphere Reserve and its relationship with the community; (3) The consequences of the presence and regulations of the Tehuacán-Cuicatlán Biosphere Reserve on the social-ecological well-being of the community; (4) The impact of the Tehuacán-Cuicatlán Biosphere Reserve on the social and ecological well-being of the community.

The research approach centered on ascertaining, from the perspective of local stakeholders, the elements deemed crucial to their well-being. Subsequent analysis delved into the relationships between these elements and their pertinence at both the personal and BR management levels. The data were subjected to qualitative analysis, employing the techniques of category and code creation for the purpose of analysis. First, the data obtained from the field diary and participant observation were organized and systematized. Subsequently, the audio recordings of the interviews were transcribed, and a summary was produced for each inter-

view. The systematization and summarization of the interviews constituted a preliminary analysis, which enabled the formulation of overarching categories of information. These categories served as the foundation for an in-depth analysis of the interviews using the qualitative analysis software Atlas.ti (version 8), which facilitated the generation of more precise categories, subcategories, and explanatory codes. Additionally, techniques were employed to validate the findings, such as data triangulation and continuous verification of coherence between the data obtained and the codes generated.

3 Results

3.1 Perceptions on the social-ecological well-being of Santiago Quiotepec

In order to comprehend the influence of the TCBR on the SEWB in Santiago Quiotepec, it is essential to ascertain the perceptions of local residents and park rangers regarding the factors that contribute to and impede the SEWB. Figure 3 illustrates the primary components identified by local individuals and park rangers as influencing the SEWB at the local level.

In terms of the state of their SES, local people perceive that their natural environment is in good condition, citing substantial forest cover and high levels of biodiversity in flora and fauna as evidence. For these individuals, the natural ecological richness and scenic beauty are of great value and contribute significantly to their SEWB. However, they acknowledged that their natural environment is experiencing some anthropogenic pressures. For example, the extraction of river sand without supervision has been identified as a damaging factor for

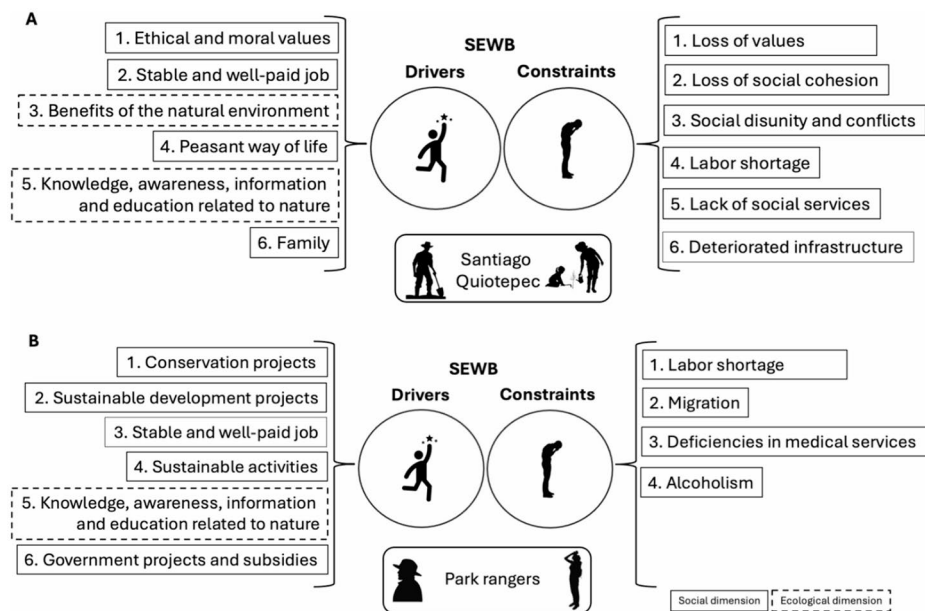


Fig. 3 Santiago Quiotepec Social-Ecological Well-Being main drivers and constraints according to perceptions of local people (A) and park rangers (B). The ordering of the components (codes) is based on frequency. Black boxes show components of the social system and dotted boxes show components of the ecological system

the riparian ecosystem. Additionally, extensive goat grazing has been observed to erode the land and create plant succession inhibition. Interviewees have also noted a decline in deer (*Odocoileus virginianus*) and rosette (*Echeveria laui*) populations, as well as local extinctions of eel and giant river shrimp, which have been occurring for several decades, even before the creation of the TCBR.

In terms of the social aspect, local residents are aware that this domain is in a more challenging state than the natural environment. The situation is having a detrimental impact on their SEWB. The interviewees indicated that there has been a notable increase in community disunity over time, which has led to a rise in intracommunity conflicts. They posit that there has been a transformation in local values, customary practices, and social obligations, which are pivotal for the community's unity, stability, and well-being. These conflicts impede the formation of agreements between individuals and impede economic opportunities for local development. Interviewees have indicated that on several occasions, they could have benefited from the financing of services and infrastructure projects by the state and federal governments. However, they were unable to reach consensus on various aspects of the projects, and thus they were not financed. Additionally, there is a recognition that paid employment opportunities are scarce in the community and that agricultural activities are insufficient to meet household needs.

For park rangers, the SEWB of Santiago Quotepec is primarily contingent upon the fulfillment of fundamental necessities, including sustenance, access to potable water, and secure housing. Furthermore, the importance of maintaining the natural environment in a pristine state is underscored, as it provides for numerous needs. The participants identified several problems, including a lack of employment opportunities, emigration, inadequate health services, alcoholism, and deteriorated social relations. They emphasized the importance of education and government programs in improving well-being. From their perspective, the lack of monetary resources is a significant challenge in Santiago Quotepec, and the reserve's conservation and sustainable development initiatives have helped families address this issue.

Figure 4 provides a summary of the primary components identified by both groups in relation to the SEWB of Santiago Quotepec. It highlights the aspects where there is consensus and those where there is disagreement. The components mentioned by local people and park rangers that diverge are shown on the far right and left of the figure, while the components mentioned by both groups are shown in the centre.

3.2 Perceptions on the impacts of the Tehuacán-Cuicatlán biosphere reserve

3.2.1 Local people's perception

The reserve has had a significant impact on the SEWB, particularly in terms of ecological dimensions. The regulations governing the use of natural resources and financed projects have contributed to a greater understanding, awareness, and appreciation of biodiversity. These projects have also facilitated the recuperation and stewardship of the natural environment, particularly the restoration of habitats, the safeguarding of species, and the observation of fauna, which have enhanced various aspects of the natural environment that had been degraded. Figure 5 illustrates, according to the interviewees, the diverse actions that have

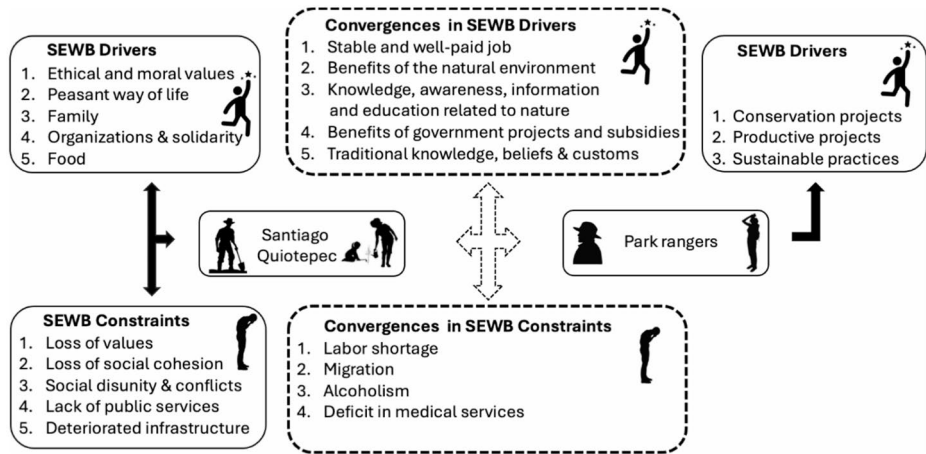


Fig. 4 Drivers and constraints of the Social-Ecological Well-Being in Santiago Quiotepec from the perceptions of local people and park rangers from the Tehuacan-Cuicatlán Biosphere Reserve

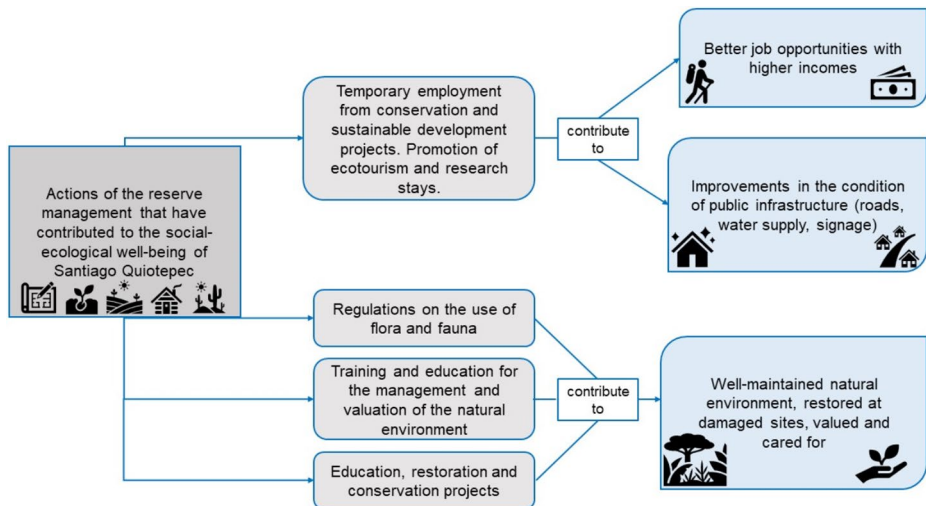


Fig. 5 Main impacts of the Tehuacán-Cuicatlán Biosphere Reserve on the social-ecological well-being of the community. The grey boxes show the actions implemented by the reserve and the blue boxes show the positive outcomes of the actions

been implemented by the BR and the outcomes they have generated on the socio-ecological system.

Following the establishment of the TCBR over two decades ago, most local residents appear to have adopted a passive acceptance of the reserve's presence in their community. Most interviewees indicated that they had become reliant on the reserve and believed that, in the absence of the reserve, the situation would revert to a state of excessive exploitation of nature. This perception was held despite an increase in awareness of the value and care of the environment. The local population does not perceive the reserve as an integral part

of their community, yet they do not actively reject it. They have indicated that, while the reserve has not led to a notable improvement in their socio-economic circumstances, it has at least enhanced their ecological well-being.

For those residing in the area, there is a discernible distinction between the influence of the reserve's regulatory framework and that of its initiatives. Initially, the regulations of the TCBR were met with disapproval by the majority of residents due to the implied restrictions they imposed on the use of wildlife, the cutting of trees for firewood, commercial hunting, and the removal of endangered plants, such as the *biznaga* (an edible cactus). As time elapsed, the regulations were regarded as advantageous because they facilitated the conservation of the natural environment and its restoration. It was observed that the regulations had a minimal impact on livelihoods, as the utilization of plants and animals for subsistence has historically been permitted, and restrictions were imposed based on the intensity of use, with penalties imposed on those caught selling the prey. Additionally, fishing, hunting, and plant gathering are significant secondary activities, but not the primary source of income.

With regard to the projects implemented by the TCBR, perceptions of their positive and negative impacts are markedly divergent in accordance with the land tenure regime of the local population. The TCBR's primary areas of focus are soil restoration, reforestation, environmental education, and fauna monitoring. Additionally, the organization has been engaged in ecotourism for the past 15 years. Irrespective of the objective, all projects typically entail the creation of temporary remunerated jobs, along with the provision of equipment and financial assistance to facilitate their implementation. These projects have become the primary source of intracommunity conflict, as they have been targeting a single group of local people, the *comuneros*, for many years. This is due to the fact that the *comuneros* were the proprietors of the largest and most well-preserved portion of the community's forest, and because they were the sole group of people from the community to attend the initial meetings with the reserve's authorities when the TCBR was established. The *comuneros* have historically demonstrated a high level of organization and engagement with the reserve's initiatives, positioning them as TCBR's most prominent ally. This has led to the *comuneros* assuming a leading role in the management of the reserve's ecotourism activities, with a focus on employing only *comuneros* and distributing benefits among them. Consequently, there are two distinct perceptions regarding the impact of the reserve's projects, one from the *comuneros* and their families and another from the non-*comuneros* (*ejidatarios*, tenants, and small landowners).

For the *comuneros* and their families, the reserve's projects have had a profound impact on the community, benefiting all members through the preservation of the natural environment, the stimulation of tourism, and the creation of remunerative temporary employment opportunities. Moreover, the *comuneros* posit that the projects have also facilitated the development of the community's infrastructure, particularly in the context of ecotourism. They further contend that the capacity-building meetings, workshops, and fairs organized by the reserve have contributed to the promotion of tourism, technical training, and personal growth. In contrast, those who are not *comuneros* tend to perceive the majority of the disadvantages. One of the most significant disadvantages is the monetization of all forms of labor. Some individuals have indicated that the reserve's reliance on compensated labor has led to a decline in interest in *tequio*, a traditional form of unpaid community work that is viewed as a moral obligation. *Tequio* is considered a significant practice by local residents, as it is conducted in areas of shared usage, fostering community values, a sense of belonging, and

social cohesion. However, non-*comuneros* interviewees also highlighted that the direct and tangible benefits did not fully benefit the community as a whole, leading to unrest, dissatisfaction, and a sense of exclusion among the general population.

3.2.2 Biosphere reserve park rangers' perception

The park rangers from CONANP in charge of the TCBR posit that the forest in Santiago Quiotepec remains in good condition due to the historically balanced relationship between the local population and their environment. For the local population, this balanced relationship has been reinforced through the implementation of sustainable development projects (PROCOCODES) by CONANP, which primarily target local livelihoods and biodiversity conservation. These projects provide employment opportunities, facilitate capacity-building, conduct technical studies, and implement restoration projects for productive purposes that are aligned with conservation and sustainable use.

As stated by TCBR park rangers, the following methods are employed to enhance the SEWB of local communities: direct contributions are made to household incomes, economic activities are made more profitable and sustainable, skills and knowledge are strengthened, and people's participation and appreciation of the natural environment are encouraged. Additionally, the recovery of habitats and flora and fauna populations is facilitated.

Additionally, park rangers highlighted the pivotal role of community leaders in facilitating access to programs and projects, as they serve as the primary conduit between the community and the reserve. They acknowledge the existence of an inequity in the participation of local people and the distribution of monetary and material resources, which primarily benefits a single group within the community. However, they contend that this is largely due to the fact that *comuneros* are the primary stakeholders who express interest in engaging in such projects, whereas *ejidatarios* have historically demonstrated reluctance to contribute to conservation efforts.

Furthermore, park rangers engaged in a discourse on the obstacles they are encountering due to the persistent diminution of personnel and financial resources. This has resulted in heightened challenges in addressing local necessities and providing assistance. The operational reductions have also impacted the reserve's capacity to contribute to the long-term well-being of the community. The necessity for funding initiatives that are not directly related to conservation but are crucial for enhancing local livelihoods and communities' social cohesion was emphasized.

3.2.3 A comparison of the differing perceptions of the impacts of the Tehuacán-Cuicatlán biosphere reserve

Table 1 illustrates the actions undertaken by the RBTC administration in Santiago Quiotepec community, derived from conservation and development projects and the regulations of this protected area. The impact of these actions on the SEWB may be perceived as either positive (✓) or negative (X) by the various groups involved in the study. A ✓ means that the group considers that an action from the TCBR is having that outcome; a X means that the group considers that an action is not having that outcome. For instance, *monetary income from projects and temporary work* is perceived by park rangers and *comuneros* as a positive

Table 1 A comparison of the perceptions of local people and park rangers regarding the impact of the Tehuacán-Cuicatlán biosphere reserve on the social and ecological Well-Being of Santiago Quioitepec

		Park rangers	Comu-neros	Ejidatarios, Tenants, Small landowners
TCBR actions perceived as positive	Care and improvement of the natural environment	✓	✓	✓
	Increase of knowledge and appreciation of the natural environment	✓	✓	✓
	Recovery of wild and at-risk populations	✓	✓	✓
	Improvement of the built environment	✓	✓	✓
	Promotion of the community through ecotourism activities	✓	✓	✓
	Indirect monetary benefits from ecotourism	✓	✓	✓
	Monetary income from projects and temporary work	✓	✓	x
	Diversification of monetary earning activities	✓	x	x
	Personal and capacity-building training	✓	✓	x
	Promotion of sustainable natural resources management	✓	x	x
TCBR actions perceived as negative	Restrictions on the use of the natural environment	✓	✓	✓
	Communication of TCBR's reserve managers with local people	✓	x	✓
	Distribution of financial aid and paid jobs throughout the community	✓	x	✓
	Equal treatment of reserve managers to all members of the community	x	x	✓
	Increased social and economic inequalities due to differential treatment of TCBR's managers	x	x	✓
	Monetary payment in all types of work has discouraged local people from continuing to do volunteer community work.	x	✓	✓

TCRB, whereas *ejidatarios*, small landowners and tenants do not view this as a positive TCBR action.

The majority of the factors on which all the groups agree pertain to direct benefits to the natural environment and indirect benefits derived from ecotourism. Notwithstanding, there are discernible divergences with respect to the social benefits. The non-*comuneros* (*ejidatarios*, tenants, and small landowners) report a greater number of negative impacts resulting from the reserve's actions. This is because they perceive themselves to be affected by these impacts, in contrast to the *comuneros*, who are primarily concerned with the unequal distribution of social benefits. Consequently, there is an imbalance between the perceived positive and negative effects, with the non-*comuneros* believing that the majority of direct benefits accrue to the *comuneros* and the natural environment.

4 Discussion

This research documents how local people and TCBR park rangers perceive the shaping of the SEWB of Santiago Quíotepec, including which aspects are considered to trigger it and which are seen as constraints. Furthermore, we demonstrated the perception held by both groups regarding the impacts of TCBR actions aimed at achieving biodiversity conservation and local development objectives. We believe that our findings contribute significantly to enhancing understanding of the SES and providing more precise information for more effective TCBR management.

The local population's SEWB is based on three fundamental pillars: firstly, ethical and moral values; secondly, the existence of stable and well-paid employment opportunities; and thirdly, the benefits derived from their natural environment. It is noteworthy that the local population ascribes considerable importance to the peasant way of life as a significant component of their SEWB. In contrast, for park rangers, the primary drivers of SEWB are associated with the actions they undertake, including conservation and sustainable development projects, as well as the employment opportunities these projects create. With regard to the factors that impede the SEWB, both groups concur in identifying the dearth of secure and remunerated employment opportunities and shortcomings in public services (the park rangers specifically highlighted deficiencies in the healthcare sector), whereas for the local population, their primary concern pertains to the social decline within the community, which has been exacerbated by the actions of the TCBR.

These results are relevant in at least two respects. The first issue pertains to the objectives of BRs, which aim to conserve biodiversity while also underscoring the significance of the local population, their cultural heritage, and their socioeconomic development. In the absence of a clear understanding of the elements that comprise the SEWB of a local population, it will be challenging for BR managers to implement actions that genuinely enhance the SEWB of local communities. In light of these considerations, it is unsurprising that there are such discrepancies in perceptions. TCBR managers perceive the primary drivers of local SEWB to be associated with the projects they promote, rather than with local ethical and moral values, the peasant way of life, or the organization and solidarity mentioned by the local population. Consequently, there is no consensus that the reserve's actions are resulting in improvements to the conditions of the local population, which may ultimately lead to a decline in their participation in conservation initiatives. For park rangers, who are responsible for designing and implementing projects, there is a clear perception that they are making a significant contribution to the SEWB of the local population. However, this is not a view that is shared by the local population. As Krishnakumar and Roy (2021) have observed, this phenomenon is not uncommon in the context of conservation. Indigenous and peasant communities are frequently regarded as passive recipients of institutional interventions, with minimal consideration given to their values, customs, and relationships with nature. Consequently, while the authorities may believe they are contributing to the well-being of local communities, local people may perceive the opposite to be true.

Secondly, these results are significant in light of the existing literature on the subject, which indicates that the objectives of PAs will not be met if local communities do not feel included in the conservation process. This is evidenced by the findings of Berkes (2004), Brondizio and Le Tourneau (2016), and Brown (2003). It is erroneous to assume that inclusion necessitates merely extending invitations to local people to participate in projects that

have been defined by external agents. The *a priori* definition of conservation projects by external agents infringes upon the rights of local communities to self-determine their SEWB, maintain the social institutions that sustain it, and exercise collective decision-making structures for that SEWB to exist and evolve (Schreckenberg et al., 2016). It is illustrative to note that the population of Santiago Quotepec has adapted to the TCBR over the course of nearly three decades, yet they do not perceive it as an integral part of their community. This perception is not exclusive to this case study. Guibrunet et al. (2021) documented how in numerous conservation initiatives in Mexico, including BRs, the lack of sensitivity to local cultural norms impeded the capacity of local populations to communicate with external agents responsible for designing and executing conservation actions.

The existence of discrepancies between the perceptions of what is and what determines the SEWB of a local population also impedes the implementation of an SES approach to BRs management. The existing literature, as evidenced by Brechin et al. (2010) and Oliva and García-Frapolli (2024), indicates that biodiversity conservation through protected areas has historically placed greater emphasis on the ecological dimension than on the social. Furthermore, evidence from Ferreira et al. (2018) and Mutanga et al. (2015) indicates that when considering enhancements to the social well-being of local communities within a PA, managers tend to prioritize economic considerations. In the practical pursuit of reducing the financial burden of conservation and enhancing the well-being of PAs' residents, monetary compensation and direct payments have emerged as prevalent strategies (Santangeli et al., 2016). However, as evidenced by our case study, the ecological dimension is more than simply a conserved area, and the social dimension is more than merely jobs created or monetary income derived from ecotourism. For the local population, the primary components of their SEWB are associated with social and cultural aspects that are subjected to pressure from internal dynamics surrounding conservation. It is therefore crucial to recognize that conservation initiatives in TCBR, and indeed in all other protected areas in Mexico, cannot be considered in isolation from the value that local communities ascribe to the peasant way of life. This is identified as a significant driver of the SEWB of Santiago Quotepec. A narrow focus on the monetary dimension can be detrimental. As several studies have argued (Allendorf, 2007; Soliku & Schraml, 2018), the use of monetary compensation to incentivize conservation in PAs is controversial because it can lead to difficulties in the equitable distribution of benefits among local populations. In contrast, other non-monetary strategies, such as infrastructure development, can be more equitable.

Guibrunet et al. (2021) and Chan et al. (2016) posit that prevailing conservation practices privilege the intrinsic and instrumental values of nature over other values, impeding the acknowledgment of alternative perspectives on society-nature relationships. In this sense, it is necessary to adopt approaches and dynamics that more effectively couple the understanding of SES in PAs and that allow us to prioritize the conceptualization of local communities' SEWB. To develop strategies that can contribute more fully to SEWB, future feasibility studies must incorporate robust social and social-ecological components to facilitate a more comprehensive understanding of community contexts, dynamics, needs, priorities, and aspirations. It is imperative that communities perceive clear and direct links between the natural environment, their livelihoods, and conservation strategies. This is because the perception of social benefits resulting from the presence of PAs has greater relevance for people than the ecological effectiveness of such areas (Bennett et al., 2019; Htay et al., 2022; Nepal & Spiteri, 2011). This represents a significant challenge to the evolving logic of dominant

management approaches to BRs and to the shrinking resources available to them, which impedes their capacity to expand their scope, scale, and reach. Nevertheless, even with restricted financial resources, BRs can attain superior outcomes in SEWB by eschewing the pursuit of maximalization in a single system dimension (either ecological or social). As Ferraro and Hanauer (2011) posit, reserves can attain favorable outcomes in both dimensions if managers are willing to accept modest results for each component.

5 Conclusion

This study contributes to the ongoing discourse surrounding the necessity for novel approaches to the management of BRs. Due to their intrinsic characteristics, BRs encompass a multitude of stakeholders with disparate perspectives on the interrelationship between society and nature, as well as on the components that comprise the SEWB of a local population. This research posits the necessity for an SES approach to mitigate the imbalance in the care of the ecological and social dimensions. The challenge persists in prioritizing local people's value systems when designing conservation strategies and programs. Otherwise, these programs will be targeting objectives that lack contextualization at the local level.

According to what was expressed by the stakeholders, we believe that there are some areas that the reserve and the population of Santiago Quioitepec could work to improve: (1) working conditions, (2) infrastructure and public services, (3) community cohesion, and (4) preservation of the natural environment. Accordingly, we found that it is very important for the population to preserve traditional practices, such as peasant agriculture, the cargo system, and the tequío, while incorporating more modern aspects, especially in terms of services, infrastructure, and opportunities for young people.

We acknowledge that this research represents an initial conceptualization of well-being that is more comprehensive and balanced. We also acknowledge that caution must be asserted. As with any research, our approach to participant selection through the snowball method may have resulted in the exclusion of individuals who could possess divergent interpretations of well-being and relationships with the reserve. Finally, this research provides an initial insight into the divergences that commonly exist among the stakeholders involved in BRs' management. To contribute to a more just and informed management of BRs, it is necessary to conduct further, more in-depth research over a longer period of time.

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Data availability Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

Declarations

Ethical approval Permission to run the research was granted by the community authorities, following the National Autonomous University of Mexico (UNAM)'s standards of Free, Prior and Informed Consent. Each person who was interviewed gave their consent in advance, both for the interview to take place and so that it could be recorded.

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Authors and Affiliations

Perla Sinco-Ramos¹  · Eduardo García-Frapolli¹  · Luciana Porter-Bolland²  · Leticia Durand³ 

✉ Eduardo García-Frapolli
eduardo@cieco.unam.mx

Perla Sinco-Ramos
psinco@cieco.unam.mx

Luciana Porter-Bolland
luciana.porter@inecol.mx

Leticia Durand
leticiad@unam.mx

¹ Universidad Nacional Autónoma de México, Instituto de Investigaciones en Ecosistemas y Sustentabilidad, Morelia, Michoacán, México

² Instituto de Ecología, A. C, Red de Ecología Funcional, Xalapa, Veracruz, México

³ Universidad Nacional Autónoma de México, Centro Regional de Investigaciones Multidisciplinarias, Cuernavaca, Morelos, México