DOI: 10.24850/j-tyca-2024-05-03

Articles

The social valuation of a free-flowing river: A comparative analysis between two communities using semantic networks

La valoración plural de un río de flujo libre: análisis comparativo entre dos comunidades usando redes semánticas

Aurora Cortés-Espino[1], ORCID: https://orcid.org/0000-0002-6863-3184

Alfonso Langle-Flores[2], ORCID: https://orcid.org/0000-0003-2585-8049

Carlos Gauna Ruíz de León[3], ORCID: https://orcid.org/0000-0002-8325-9397

Rosa María Chávez Dagóstino[4], ORCID: https://orcid.org/0000-0001-9063-2957

[1]School of Sustainable Development, Universidad Autónoma de Guerrero, Guerrero, Mexico; aurocortz@gmail.com

[2]Centro Universitario de la Costa, Universidad de Guadalajara, Jalisco, Mexico; alfonsolangle@gmail.com

[3]Centro Universitario de la Costa, Universidad de Guadalajara, Jalisco, Mexico; carlos.gauna@academicos.udg.mx

[4]Centro Universitario de la Costa, Universidad de Guadalajara, Jalisco, Mexico; rosa.cdagostino@academicos.udg.mx

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

Abstract

Free-flowing rivers (FFRs) are characterized by their integrated river connectivity and their potential to provide multiple benefits to communities settled along them. Nevertheless, the construction of infrastructure poses a threat to these types of rivers on a worldwide scale. Often in planning development projects, the plurality of values that communities assign to these rivers are disregarded, which could trigger environmental conflicts. This study analyzed the social values associated with the Los Horcones River (LHR) between two localities, one downstream (Boca de Tomatlán) and one upstream (Las Juntas y Los Veranos). Based on the analysis of thirty-five interviews and the use of semantic networks, we found that both communities have a common interest in the protection and conservation of the Los Horcones River. However, there is a differential weighting of specific values by locality. Downstream (Boca de Tomatlán) intrinsic and relational values prevail, given that the LHR is fundamental to their diversified livelihood. In contrast, upstream (Las Juntas y Los Veranos) relational and instrumental values dominate due to their economic dependence on the nature tourism that takes place in LHR. The recognition of the plurality of values associated with free-flowing rivers is essential for the formulation of water resource management and conservation strategies.

Keywords: Freshwater, social network analysis, semantic network analysis, watersheds, ecosystem services, rivers, free-flowing rivers, nature valuation, plural valuation.

Resumen

Los ríos de flujo libre (RFL) se caracterizan por su conectividad fluvial íntegra y por proveer múltiples beneficios a las comunidades asentadas en ellos. Sin embargo, a nivel mundial estos tipos de ríos se encuentran amenazados por la construcción de obras de infraestructura. En ocasiones, la pluralidad de valores que las comunidades le atribuyen a estos ríos no se toma en cuenta, particularmente al momento de planificar proyectos de desarrollo, lo que podría detonar conflictos ambientales. Se analizaron los valores sociales asociados con el río Los Horcones (RLH) entre dos localidades, río arriba (Las Juntas y Los Veranos) y río abajo (Boca de Tomatlán). A partir del análisis de 35 entrevistas y el uso redes semánticas, se encontró que ambas comunidades tienen un interés común por la protección y conservación del río Los Horcones. Sin embargo, se observa una ponderación diferencial de valores específicos por localidad. Río abajo (Boca de Tomatlán) predominan los valores intrínsecos y relacionales, dado que el RLH es fundamental para la diversificación de sus medios de vida. En contraste, río arriba (Las Juntas y Los Veranos) predominan los valores relacionales e instrumentales debido a la dependencia económica del turismo de naturaleza que se realiza en el RLH. El reconocimiento de la pluralidad de valores asociados con los ríos de flujo libre es esencial para la formulación de estrategias de manejo y conservación de los recursos hídricos.

Palabras clave: agua dulce, análisis de redes sociales, análisis de redes semánticas, cuencas, servicios ecosistémicos, ríos, ríos de flujo libre, valoración de la naturaleza, valoración plural.

Received: 01/18/2023

Accepted: 04/18/2023

Published Online: 17/05/2023

Introduction

The causes of the global biodiversity crisis are strongly linked to how nature is valued in political and economic decisions (IPBES, 2022). When planning and approving infrastructure projects, the diversity of meanings, values, and associated uses that the surrounding communities give to free-flowing rivers (FFR) are not considered (Ioris, 2012). Therefore, the lack of identification of the social value that water resources have for the inhabitants could be a trigger for socio-environmental conflicts (Kati & Jari, 2016; Opperman, Grill, & Hartmann, 2015; Tabi & Wüstenhagen, 2017; Valencia-Vargas, 2015).

Valuation of ecosystem services (ES) is a challenge due to its intangibility and the complexity of relationships that occur within socio-ecosystems and constitutes an intentional process to make explicit the values that individuals and communities have towards nature based on the contributions they receive and the way they link to it (IPBES, 2022). The focus of ecosystem valuation has primarily been on the ecological and

economic aspects (Van Riper, Kyle, Sherrouse, Bagstad, & Sutton, 2017), while little attention to its social value. Which refers to the collection of emotions, feelings, memories, or motivations associated with a certain place or natural good (Kati & Jari, 2016). Social value is defined by Felipe-Lucia, Comin, and Escalera-Reyes (2015) as the value that society attributes to each ecosystem service. Social values have two features: an economic dimension (job opportunities, tourism potential, regeneration of the area) and an intangible non-financial dimension (values associated with quality of life such as food security, social inclusion, sense of place, and identification of a particular lifestyle) (Saxon, 2005).

These social dimensions can be integrated into the concept of specific values which refers to "how people express the importance of particular elements or relationships with nature in given situations and contexts" (Anderson *et al*., 2022, p. 4). Arias-Arévalo, Martin-López, & Gomez-Baggethun, 2017). Arias-Arévalo *et al*. (2017) classified specific values into three value domains:

1. Intrinsic value: The value of nature, ecosystems, or life as ends in themselves, irrespective of their utility to humans.

2. Instrumental value: The value of an entity as merely a means to an end.

3. Relational value: The importance attributed to meaningful relations and responsibilities between humans and between humans and nature (Arias-Arévalo *et al*., 2017, p. 2).

In brief, "the articulated values are the concrete expressions of the value domains, derived from the valuation processes"(Arias-Arévalo, Gómez-Baggethun, Martín-López, & Pérez-Rincón, 2018, p. 33).

Regarding the valuation of the riverine ecosystem services multiple objectives and methodological approaches have been used (Felipe-Lucia *et al*., 2015). Notably, quantitative methods such as economic and ecological valuation have been prevalent (Van Riper *et al.*, 2017). In contrast, social assessment has largely relied on qualitative studies with an emphasis on participatory and deliberative approaches (Jorda-Capdevila *et al*., 2021). Some studies combine the qualitative approach with the use of Geographic Information Systems (GIS) for mapping social and economic values (Zhang, Yu, Wu, Pereira, & Borja, 2020).

FFRs can be described as socio-ecosystemic hybrids, where the distribution and movement of water are not solely influenced by hydrological factors but are also governed by social values, relationships, and socioeconomic interests (Shah & Rodina, 2018). Rivers are essential cyclical units for the existence of living beings that provide multiple benefits to society (Mendoza-Cariño *et al*., 2014). Rivers are also the axis of human settlements, they contribute to the economy since they allow the production of 25 % of food, and they generate commercial and tourist activities (Getzner, 2015; Opperman *et al.*, 2018). Rivers play a role in nurturing cultural and spiritual/psychological aspects of human communities (Ávila-García, 2006).

FFRs also provide several benefits (ecosystem services) to society such as groundwater recharge and flood regulation, among others (MEA, 2005; Perry, Harrison, Fernandes, Burnham, & Nichols, 2021). These rivers maintain their full fluvial connectivity (without interruptions by reservoirs and dams). In this effluvia, the free exchange of water, energy, materials, and species is maintained within the river system and the

surrounding landscapes (Grill *et al*., 2019). In summary, these rivers provide environmental, social, and economic benefits to society, which is the reason they have a high intergenerational value (Corraliza & Collado, 2019; Jackson, Stoeckl, Straton, & Stanley, 2008; Kati & Jari, 2016; Khan, Lei, Ali, Ali, & Zhao, 2019).

However, FFR rivers are being compromised by anthropogenic activities of various kinds (agricultural, tourism, energy, etc.). In this sense, it is estimated that by 2050 many of the world's FFRs will be subject to the construction of hydroelectric dams (UNESCO, 2021). These infrastructure projects can generate negative impacts on hydrological watersheds such as the reduction of hydrological flow, impacting the retention of sediments necessary for aquatic life and agricultural production. On occasions, hydroelectric infrastructure can also limit the transit of migratory aquatic and riparian species, which generates a loss of biodiversity and alteration of the landscape (Perry *et al*., 2021). And finally, the reservoirs can generate psychological and social impacts in the riverside localities by seeing their livelihoods, such as agriculture and fishing, diminished, as well as alterations in the quality of water for human use (Sousa, Botelho, Pinto, & Valente, 2019).

Los Horcones River is an FFR and the main source of water for the inhabitants of the localities of Las Juntas y Los Veranos (upstream) and Boca de Tomatlán (downstream). The two locations belong to different jurisdictions, the first one to Cabo Corrientes and the second one to Puerto Vallarta. The scenic beauty of LHR is an attraction for tourist activities, which are one of the economic engines of both locations. However, social, and economic activities are impacting LHR such as wastewater

discharges, unregulated water intakes, and the use of the channel as parking for boats. In addition, these negative impacts can be exacerbated if the construction of the mini hydroelectric is completed. The such plan has generated social mobilizations and legal disputes to deflect it (Guzmán-Mejía, Márquez-Rangel, & Ibarra-Rubio, 2021).

Determining and understanding the social value of FFRs can contribute to the definition of priorities for the protection and restoration of river ecosystems (Khan *et al*., 2019). Therefore, it is crucial to identify the social values attributed to the FFR to define management strategies and the conservation of water resources. This study aims to analyze the plural values that two neighboring communities attribute to a free-flowing river. Therefore, we propose a series of specific objectives to achieve the holistic valuation: i) To compare the global and the nodal properties between the semantic networks that emerge from the river's discourse of the two localities; ii) To classify the river's discourse of each locality, using modularity algorithms; iii) to assess intrinsic, relational and instrumental values that the two localities assigned to the Los Horcones River.

The originality of this study is the holistic valuation of nature goods that have no market value, such as ecosystem services. This is how communities appropriate a fluvial territory, giving it social meaning. The main contribution of this work is the integration between three elements: 1) the classification of social values proposed by Arias-Arévalo *et al*. (2017); 2) the thematic groups that emerge from the discourse analysis of each locality, using semantic networks, and 3) the examples of plural values about the river in the words of the local inhabitants. This study is a pioneer in the visualization of the contrasting values, interests, and

visions of two communities on an FFR and its threats, which precede the potential development of a hydroelectric project.

Materials and methods

Study site

The Los Horcones River is in the sub-basin Tecomala (RH13Aa) that belongs to the Hydrological Region number 13: Río Huicila. The RLH has a contribution area of 770.07 km^2 and an available volume of 179.37 Mm^3 (Comisión Estatal del Agua del Estado de Jalisco, 2015, p. 22). The Los Horcones River micro-basin (13-053-01-006) occupies 33.06 % of the sub-basin territory. It descends from the eastern mountain range of the Sierra Madre del Sur and flows into the sea, in the locality of Boca de Tomatlán (Figure 1) (Guzmán *et al*., 2021).

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

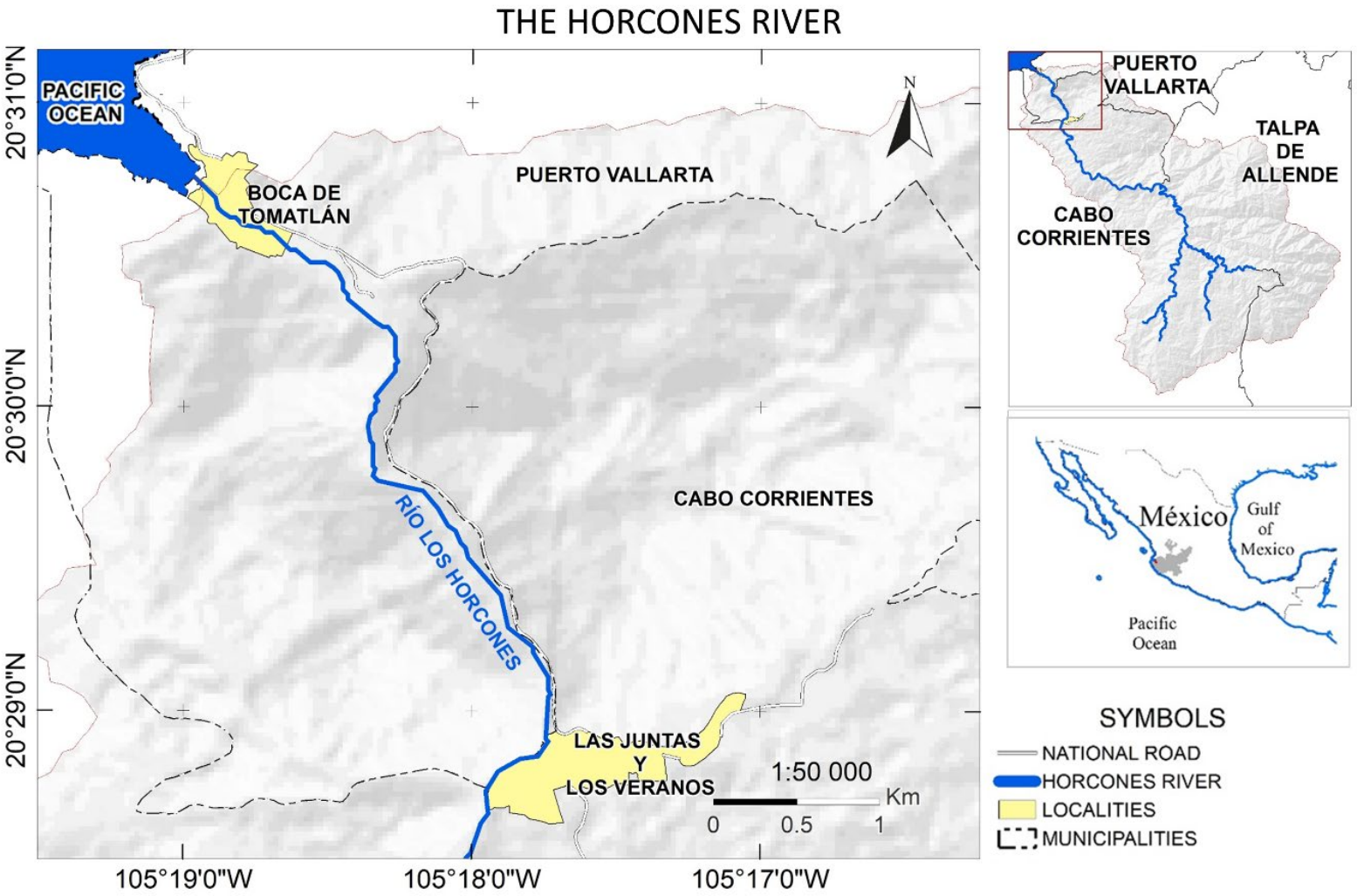


Figure 1. Location of the Los Horcones River micro-basin, Jalisco, Mexico. Source: Own elaboration based on the Mexican elevation continuum (CEM 3.0) and vector data from topographic maps F13C69 and F13C79 from INEGI.

The river belongs to three municipalities of Jalisco: Talpa de Allende, Cabo Corrientes and Puerto Vallarta (Secretaría General de Gobierno del

Estado de Jalisco, 2014). In the RLH watershed, there are 12 towns with a total of 1,178 inhabitants (see Table S1 in supplementary materials) (INEGI, 2020). The land tenure is distributed as follows: Ejido de Las Juntas y Los Veranos with 9,060.63 hectares and Ejido Boca de Tomatlán-Mismaloya with 1,927.59 hectares (RAN, 2021). Most of the population is engaged in agricultural activities and employees in the service sector (INEGI, 2020).

Tourism is the main source of employment for the inhabitants of the region, Puerto Vallarta is one of the most important beach destinations in Mexico. In 2019, it received almost 6.5 million tourists, generating significant economic benefits (Secturjal, 2020). This destination has natural and cultural tourist attractions, where climatic conditions allow the development of sun-beach activities and those associated with nature, such as The RLH (Gauna-Ruíz-de-León, & Oliveros-Ocampo, 2021).

In Las Juntas y Los Veranos there is a wide offer of nature tourism such as canopy, zip line, and guided tours, also the restaurants are located on the banks of the RLH. In contrast, in Boca de Tomatlán beach tourism is the main economic activity, combined with the maritime transportation of inhabitants and tourists to neighboring beaches through water taxis. The Los Horcones River provides shelter for boats, tourist activities, and commerce. Another difference is the location of the town concerning the river, while in Las Juntas y Los Veranos, the river flows on the periphery, in Boca de Tomatlán the river constitutes the center of the town.

However, the initiative for the potential construction of a mini hydroelectric plant in the Los Horcones riverbed has generated a social

conflict with the inhabitants of the watershed. The proposed dam is a Mini-hydroelectric that would have a total generation capacity of 2.95 MW, with an estimated annual production of 14.7 GWh. It would be located on the right bank of the Los Horcones River, at kilometer 1.9, upstream of its mouth in the Pacific Ocean (near the town of Boca de Tomatlán). It would have a construction investment of 109 111 931.62 pesos (Gea Sostenible, 2021).

According to estimates, the project would have the capacity to generate electricity that feeds a thousand houses per MW/hour (Gea Sostenible, 2021). "This project is considered as flowing water, where part of the river water is diverted, through conduction channels are taken to the power station where the turbine is obtained and once the electrical energy is obtained, the diverted water is returned to the riverbed" (Gea Sostenible, 2021, p. 17).

The theoretical framework of the method

By using semantic network analysis, it is possible to visually depict relational patterns among various concepts in a text, as well as examine the connections between these concepts and analyze the resulting structures that emerge from their co-occurrence. It is also possible to understand the extent to which two concepts share meanings and why they appear together on several occasions within a text (Doerfel, 1998). This method of analysis has been applied to the results of semi-structured interviews with open questions to obtain narrative data since this

qualitative approach allows for obtaining less tangible values, benefits, and services (Chan *et al*., 2012).

The use of both methods: semi-structured interviews with open questions (Chan *et al*., 2012), and semantic networks allow the structuring of data that is initially unstructured (Doerfel, 1998). In this way, it is possible to know globally and systematically the characteristics and relationship between thematic groups of the discourse of each locality and the expressions of plural values on the river (Table 1).

Table 1. The link between the specific objectives, disciplines, methods, and data analysis.

Specific goal	Disciplinary approaches	Methods and data analysis
1. Compare the global and nodal properties between the semantic networks of the two locations	A. Networks social (Doerfel, 1998; Wasserman & Faust, 1994)	Analysis of metrics on the structure of semantic networks: density and exponential regression model of the frequency distribution Analysis of degree centrality metrics of semantic network terms
2. Classify the discourse of each locality in thematic groups	B. Networks social (Doerfel, 1998; Newman, 2006; Wasserman & Faust, 1994)	Discourse content analysis of each locality using modularity algorithms
3. Classify the specific values (intrinsic, relational, and instrumental) that two localities attribute to the Los Horcones River	C. Valuation of ecosystem services (Arias-Arévalo *et al*., 2017)	Analysis of open questions about the importance of the Los Horcones River Content analysis to classify the discourse into three value domains (intrinsic, instrumental, and relational) and at least fifteen articulated values
4. Compare the social values that localities attribute to the Los Horcones River	Integration of B and D	

Source: Adapted from Arias-Arévalo *et al*. (2017).

Population

Twelve towns are located within the RLH watershed, of which nine belong to the municipality of Cabo Corrientes, two to Puerto Vallarta, and one to Talpa de Allende, with a total of 1178 inhabitants (INEGI, 2020) (Table S1, supplementary material). For this research, we chose the two towns with the largest population: Boca de Tomatlán (585 inhabitants) and Las Juntas y Los Veranos (537 inhabitants). Together, both localities represent 95.24 % of the total population settled in the RLH watershed. However, as it is a qualitative study, the interviewees were chosen using the snowball technique based on the inclusion and saturation criteria (Etikan, Alkassim, & Abubakar, 2016).

Data collection

Through the semi-structured interview with open questions, a guided collective narrative was obtained (Chan *et al*., 2012; Schettini & Cortazzo, 2015). Thirty-five key stakeholders were interviewed: 19 in Boca de Tomatlán and 16 in Las Juntas y Los Veranos. The interviewees were identified with the one-wave snowball technique (Parker, Scott, & Geddes, 2019). The selection criteria were: a) residing in the study localities; b) men or women over 18 years of age, and c) carrying out actions to protect and/or conserve the Los Horcones River. The application of interviews was carried out face-to-face during the period from November 2021 to February 2022. The interviews were fully transcribed, to safeguard the

identity of the participants, and the names of the interviewees were anonymized with the use of codes.

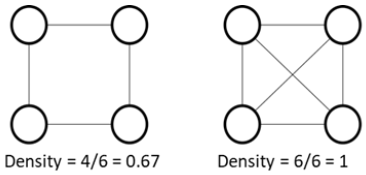
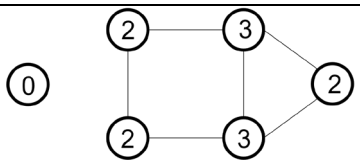
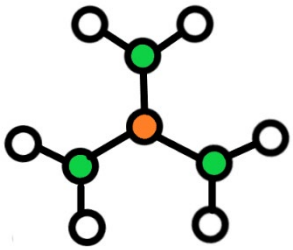
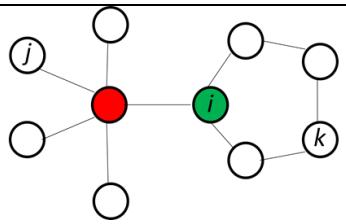
Analysis of data

For the modeling of the semantic networks of this work, five steps were followed: 1) construction of a corpus from the transcription of the interviews: 3 287 terms for Las Juntas y Los Veranos and 4 595 for Boca de Tomatlán; 2) construction of semantic networks (concepts or terms) with the Context software (Diesner, 2014; 3) network filtering obtained with the UCINET software (Borgatti, Everett, & Johnson, 2013); 4) the terms "river" and "water" were eliminated from the analysis, to avoid concentration of the network in these two terms; 5) visualization with the VOSviewer software (Van Eck & Waltman, 2017).

In addition, with the UCINET software, global metrics such as network density and nodal metrics, such as centralities by degree, eigenvector, and betweenness, were calculated. To compare the consistency between terms, an adjusted exponential regression was used (Bates & Watts, 1998). Subsequently, with a modularity analysis (Van Eck & Waltman, 2017), the network was divided into groups of nodes that are densely interconnected internally and weakly connected externally (Waltman, Van Eck, & Noyons, 2010). The metrics used in the analysis are defined in Table 2. Finally, the textual citations of the qualitative interviews were analyzed and interpreted to deepen the identification and understanding of plural values.

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

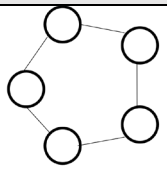
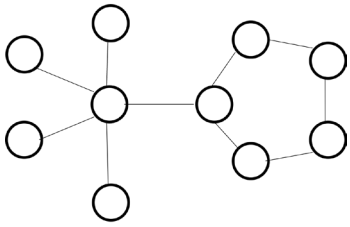
Table 2. Definition of global metrics used in semantic network analysis.

Metrics	Definition	Example
Density	It corresponds to the number of links observed between the maximum number of possible links. Its value can vary between 0 and 1, where 0 corresponds to an empty network and 1 to a network with the maximum degree of saturation (Wasserman & Faust, 1994)	
Degree centrality	For undirected networks, the degree is the sum of the number of links that a node has (Borgatti *et al*., 2013)	 The numbers within each node indicate the degree of centrality
Eigenvector centrality	The eigenvector centrality influences a node, based on how connected that node is to highly connected neighboring nodes (Bonacich, 1987)	 The orange node is connected to three highly connected green nodes
Betweenness centrality	The betweenness centrality of node *i* is proportional to the number of shortest distances (geodesics) between nodes *j* and *k* that pass through node *i* (Freeman, 1977)	 Node *i* lies on the shortest paths that can be traced between nodes *j* and *k*

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

Metrics	Definition	Example
Modularity	The network is divided into groups of nodes that are densely interconnected internally and loosely connected externally (Waltman *et al*., 2010). This property can indicate thematic groups in the text (Langle-Flores & Cupul-Magaña, 2021)	 Una subred  Dos subredes

Results

Thirty-five actors were interviewed in Las Juntas y Los Veranos (16) and Boca de Tomatlán (19). 51 % of the interviewees were men and 49 % were women. Regarding their age, 32 % were in the range of 20-39 years; 28 % from 40-59, and 40 % from 60-79. According to the level of studies, the interviewees had incomplete basic education (9 %), basic education (59 %), incomplete university studies (9 %), university studies (17 %), and a small fraction had postgraduate studies (6 %). The distribution of the socioeconomic level of the interviewees was: A+B (high) (17 %); C+ (medium-high) (17 %); C (medium) (26 %); C- (emerging medium) (23 %); D+ (bass) (14 %), and D (extreme bass) (3 %). Regarding religiosity, 63 % of those surveyed were Catholic, 11 % Christian, 9 % Jehovah's Witnesses, 3 % spiritual, 3 % other, and 11 % none. Regarding the use of the river, 34 % of those surveyed carry out economic activities directly

linked to the river, while 66 % mention having no economic use of the river. Finally, 86 % of those surveyed do not agree and 14 % do agree with the construction of the mini-hydroelectric plant.

Comparison of global and nodal properties of semantic networks between localities

The semantic network of Las Juntas y Los Veranos (Figure 2) showed a lower density value of 0.279, in contrast, the Boca de Tomatlán network showed a higher density value of 0.377 (Figure 3). Regarding the frequency distribution of the 20 most used terms, the value of the exponent of the adjusted exponential regression model was 0.064 for Las Juntas y Los Veranos and 0.057 for Boca de Tomatlán (see Figure S1 and Figure S2 in the supplementary material).

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

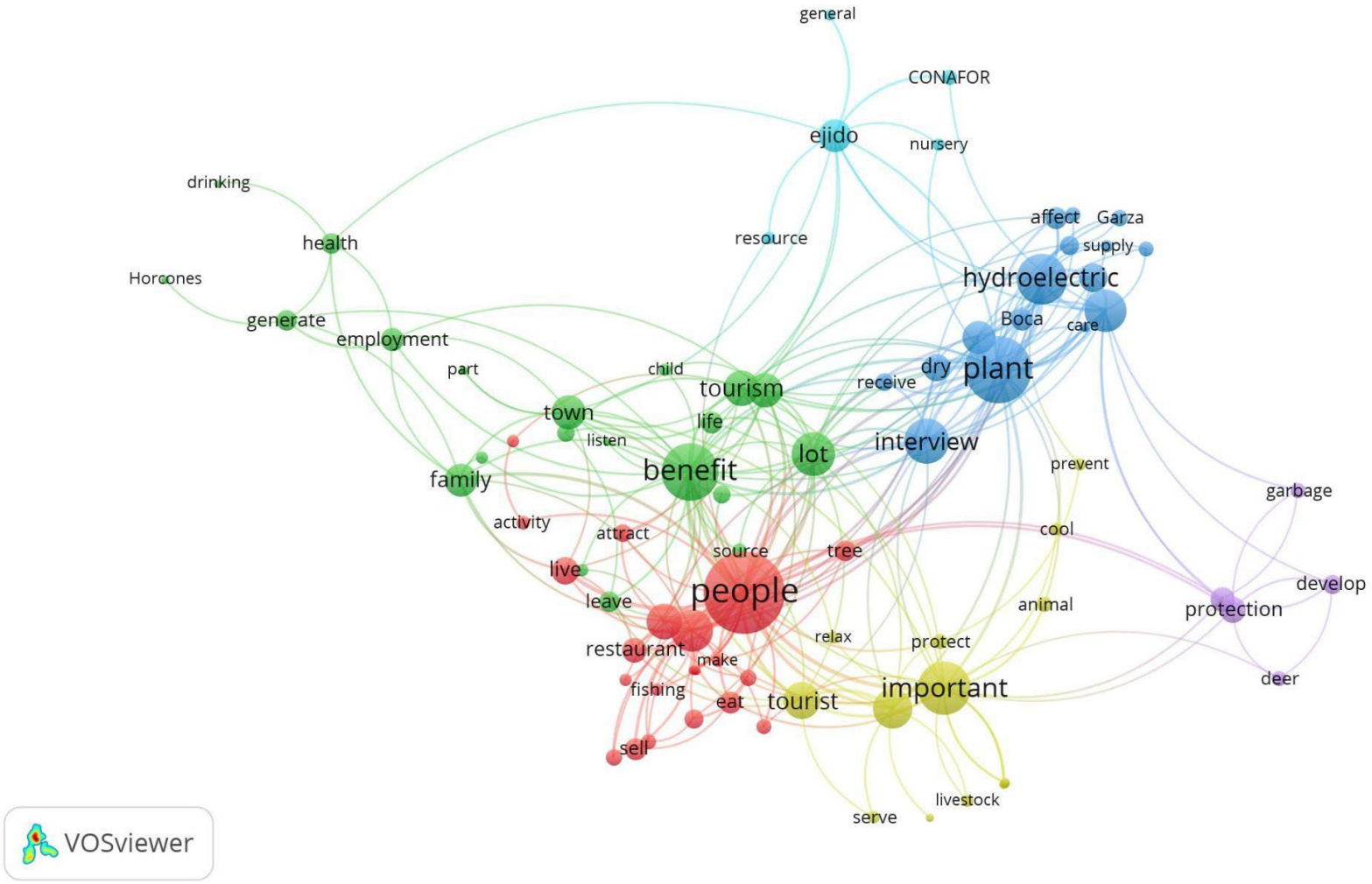


Figure 2. The semantic network of Las Juntas y Los Veranos shows the 83 most common terms (two standard deviations from the mean). The size of the label represents the degree of the term; the thickness of the link between the terms symbolizes the frequency of co-occurrence between the terms; while the color of the links shows the group to which the term belongs.

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

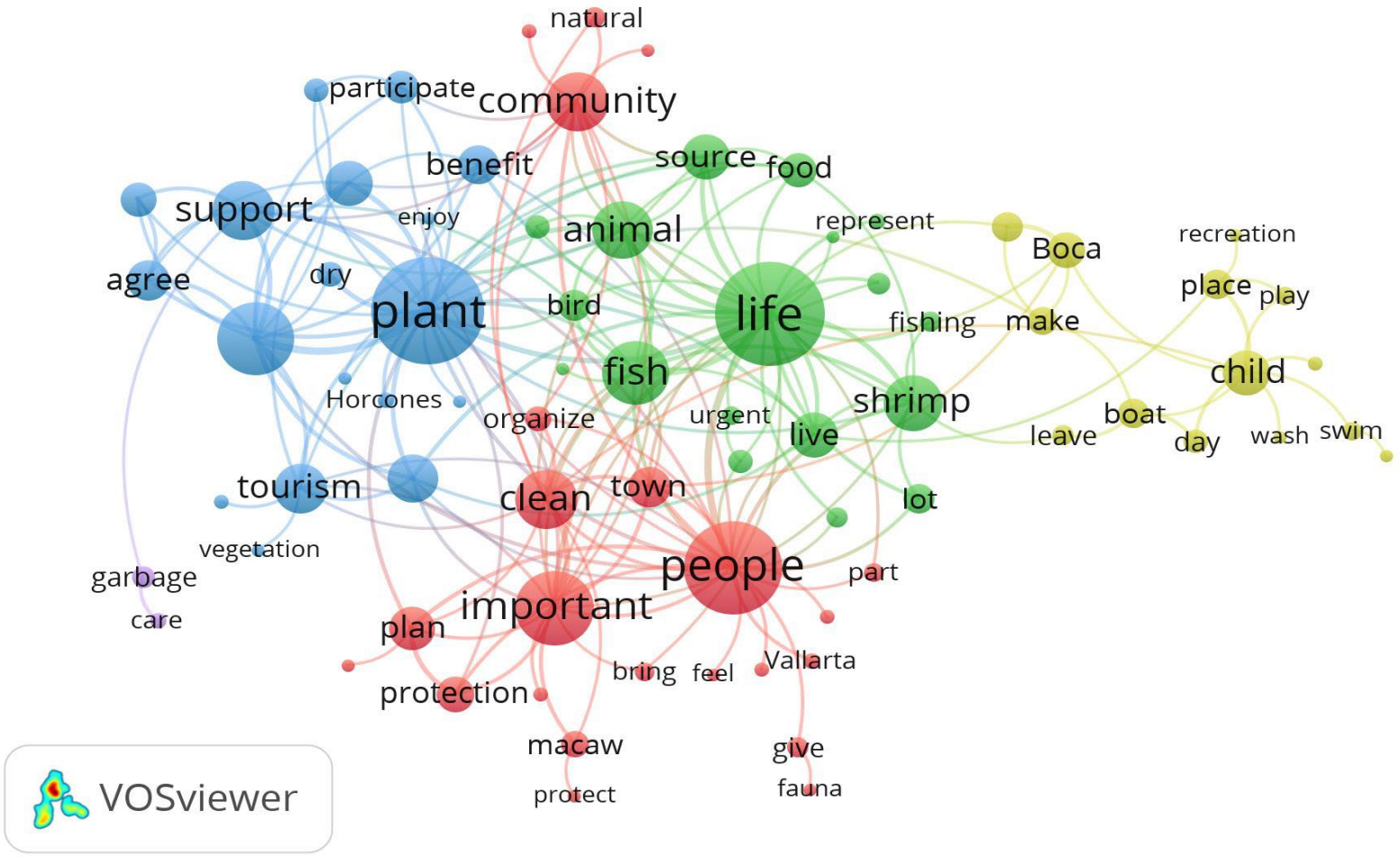


Figure 3. The semantic network of Boca de Tomatlán shows the 74 most common terms (two standard deviations from the mean). The size of the label represents the degree of the term; the thickness of the link between the terms symbolizes the frequency of co-occurrence between the terms, while the color of the links shows the group to which the term belongs.

The terms "town", "plant", "benefit", "important" and "hydroelectric" were the most central in the semantic network of Las Juntas y Los Veranos. Instead, the most central terms of Boca de Tomatlán were: "plant", "life", "people", "important" and "hydroelectric" (Table 3). Although in each network the central terms are similar, the main difference was found in the order of the terms based on their centrality scores. For example, "people" ranked first in Las Juntas y Los Veranos, while "people" in Boca de Tomatlán ranked third. In addition, unique terms were found that occupied central positions in both semantic networks, for example, *"benefit"* in Las Juntas y Los Veranos, in contrast to the term "life" in Boca de Tomatlán.

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

Table 3. Comparison of the nodal properties (degree centrality) of the terms associated with the Los Horcones River between the localities of Las Juntas y Los Veranos and Boca de Tomatlán, Jalisco.

Degree centrality			
No.	**Term**	**Las Juntas y Los Veranos**	**Boca de Tomatlán**
1	People	**2.708**	**3.882**
2	Plant	**1.833**	**5.059**
3	Benefit	**1.354**	0.753
4	Important	**1.156**	**2.541**
5	Hydroelectric	**1.042**	**2.424**
6	Life	0.208	**4.824**
7	Fish	0.115	1.882
8	Support	0.708	1.624
9	Community	0.49	1.6
10	Animal	0.104	1.576
11	Shrimp	0.75	1.459
12	Tourism	0.51	1.2
13	Children	0.063	0.988
14	Fountain	0.094	0.965
15	Town	0.479	0.8

We also found differences in the number of concepts (terms) associated with the river and with weighting (degree centrality) between the localities. Downstream (BT) there are 11 terms with a weighting

greater than 1, in contrast to the upstream location (LJLV) where only 5 terms have a weighting greater than 1 (Table 3).

Classification of the discourse of each locality in thematic groups

Las Juntas y Los Veranos

The modularity analysis classified the Las Juntas y Los Veranos semantic network into six thematic subgroups (Table 4). The terms: "people", "shrimp", "enjoy" and "restaurant" was located in the first subgroup with 23 nodes, corresponding to 27.7 % of the total (*n* = 83). The terms of this cluster correspond to relational values such as subsistence (food supply) and livelihoods such as fishing and selling river shrimp (*Macrobrachium tenellum*) and enjoying the day in the place. These values correspond to a lifestyle defined by the river and the benefits it provides to people. In this sense, relational values of identity, dependency, and sense of place were also found.

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

Table 4. Association between thematic groups, value domain, articulated values, and examples for Las Juntas y Los Veranos.

No.	Cluster thematic	Value domain	Articulated value	Example
1	"people" "shrimps" "enjoy" "restaurant"	Relational	Subsistence livelihoods	"In the river, we can swim, camp, and fish shrimp to eat and sell, there are many people who sell shrimp" (E11:1) "If the river dried up, we would starve" (E28:2)
			Identity Dependence Sense of place	"It has great value because without the river the common land or the town would not exist, nor would anyone know us, it is a value that is part of the life of the town, inhabitants, and tourism. It provides economic benefits for all who live here. There is shrimp fishing, walks, and horseback riding" (E10:2)
2	"benefit" "tourism" "employment"	Instrumental	Employment generation Monetary benefits, economic development	"Several companies are installed on the banks of the Los Horcones river and generate employment for the people who live in the town and generate families benefit within their homes and good health for their families" (E10:1) Its value is recreational and economic." (E18:1)
3	"plant" "hydroelectric" "ejido"	Intrinsic	Life support Moral duties to other organisms and ecosystems	"We have pine plantation nurseries, we clean areas for planting (...) we have the fire brigade, and we have paid for environmental services, the ejido manages the resource following the provisions of the General Assembly of Ejidatarios. Seed, bags, land, fertilizers, and labor are purchased" (E10:6) "This river is fundamental in Las Juntas y Los Veranos (...) because it is very important to take care of it, we have 900ha of forest destined for conservation with the support of Conafor" (E28:1)
		Relational	Altruism Justice environmental	"I do not agree with the hydroelectric, if they do it the river will dry up, apart from the people of Boca they would be in danger due to the floods, there would be no gate that could stop them" (E16:5)

No.	Cluster thematic	Value domain	Articulated value	Example
4	"tourist" "attraction"	Relational	Aesthetic Nature-based Tourism Recreation, leisure	"It is important because it is beautiful (…), in addition to attracting tourism and we all benefit from it. It gives us many benefits such as relaxation, space for my children, and economic gains, and tourism itself leaves work and tips" (E29:1)
5	"protection" "animals" "garbage"	Intrinsic	Moral duties to other organisms and ecosystems	"A protection plan must be developed because many people think that the river is a garbage dump, they dump sewage into the river" (E15:6) "The jaguar, the white-tailed deer, the macaw, and the parakeet live here and are protected, but even so, people come and take them, if there were a type of ranger to care for and protect the rivers and streams and there is continuous supervision and help us maintain things to continue enjoying them" (E19:3)

The second subgroup, "benefit", "tourism" and "employment" contains 22 nodes, which represents 26.5 %, such terms refer to tourism, benefits for the community, generation of employment for families, and drinking water. This cluster corresponds to the instrumental values that upstream inhabitants perceive as a support for the local economy.

In the third subgroup "plant", "hydroelectric" and "ejido", this cluster is formed by 18 nodes that correspond to 21.6 % of the total. On one hand, this group refers to contrasting visions such as the agreement/disagreement on the construction of the mini-hydroelectric plant and its potential environmental impacts. On the other hand, in this group, the links (conflicts) between supporters and detractors of the dam emerge. In addition, in this cluster, intrinsic values arise such as livelihood and moral duties. It also shows relational values such as altruism and

environmental justice that emerge from the need to preserve the river for present and future generations.

The fourth subgroup, "tourist" and "attraction", contains 16 nodes that correspond to 19.7 % of the total. Here, elements such as the "landscape" and "tourist attraction" correspond to relational values. The services of temperature regulation, fluvial provision, and life support are part of the intrinsic values of the river. As a whole, this cluster shows that the intrinsic values are part of the aesthetics of the place and serve as a tourist attraction. The fifth group refers to the need to create waste management and biodiversity protection plans; this group comprises five nodes that correspond to 6 % of the total. And finally, the sixth group, with two nodes.

Boca de Tomatlán

The modularity analysis classified the Boca de Tomatlán semantic network into five thematic subgroups (Table 5). The terms: "people", "community", "clean" and "macaw" were in the first subgroup with 23 nodes, corresponding to 31 % of the total (n = 74). The terms in this group correspond to intrinsic values (altruistic and moral duties) such as community organization to clean the river and protection of the military macaw (*Ara militaris*) and other species populations.

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

Table 5. Association between thematic groups, value domain, articulated values, and examples for the Boca de Tomatlán.

No.	thematic group	value domain	articulated value	Example
1	"people" "community" "clean" "macaw"	Intrinsic	Moral duties to other organisms and ecosystems Community organization	"I have participated in cleaning up the garbage on the river limits constantly, the people on each side clean their part, and we organize ourselves by the group. It can be every week or every 15 days. Summon the community or the boatmen or the association (civil association to protect the Los Horcones river)" (E3:4) "Here the military green macaw, orchids, and other species such as the jaguar and the papelillo plant are protected. A protection plan must be drawn up because that way we can take better care of the species that live in the environment, such as shrimp, trout fish and thus have more and more generations can enjoy these species" (E8:6)
2	"life" "fish" "shrimp" "beautiful" "mountain"	Relational	Subsistence livelihoods Place dependency Aesthetic Sacredness, religious value	"It is important because it provides us with clean water and provides water for the animals that live in the environment, and it gives us food such as fish and shrimp called prawns" (E8:1) "It is important because it is beautiful, it is used to bathe, the birds come, the sound is pleasant. It gives fish, shrimp and the breeze is refreshing. (...) it gives me beauty and peace" (E1:1) "The river gives life to the whole mountain and the mountain gives life to all the people, many Americans are here for that" (E23:6)

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

No.	thematic group	value domain	articulated value	Example
3	"hydroelectric" "tourism" "benefit" "participate"	Relational	Environmental justice Altruism Nature-based Tourism	"I participate in the fight to prevent the construction of the hydroelectric dam on the Los Horcones River; we reject it because we are based on real impact data. The community convenes and we all participate. We have also held festivals to raise awareness among the population. In addition, we have independently carried out impact measurement studies" (E4:5) "For the community, it is a great benefit, so much so that we do not allow the hydroelectric plant to be built, without a river, people will not come and we all work in tourism" (E24:2)
4	"boy" "swim" "bath" "boat"	Relational	Identity Social cohesion Recreation, leisure Mental and physical health Education and cognitive development	"It is where everyone supports each other, at the end of the day it is where everyone rests, we know that we have a river that gives us peace of mind. When the water runs out, no one cares because the river is there" (E4:2) "It is a place of recreation, a "Giant Picnic". Children play in the river and swim, moms wash clothes. It is a family gathering place" (E5:2)
		Instrumental	Monetary benefits, economic development	"My young children have grown up there. For Boca it represents everything because most of us here live from tourism and all the boats are sheltered in the river" (E23:2) "On weekends people come to live on the banks of the river, even people from Puerto Vallarta come and people who have kayaks rent them. People come by the river and the local people put up their umbrellas and their stalls. Fishing, trade" (E23:3)

The second subgroup, "life", "fish", "shrimp", "beautiful" and "mountain" contains 18 nodes, which represent 24.3 %, its terms refer to relational values such as subsistence values (water supply and food) and aesthetics.

In the third subgroup "hydroelectric", "tourism", "benefit", and "participate" with 18 nodes that correspond to 24.3 % of the total, on the one hand, this group refers to values such as agreement/disagreement on the construction of the hydroelectric and its potential social, environmental and economic impacts on the livelihoods and lifestyle of the inhabitants. On the other hand, this cluster shows the relational value of social justice in its dimension of social participation, mobilization, and protest against the hydroelectric (social resistance), as well as personal and community commitment through campaigns to clean the river and protect the Biodiversity. In addition, in this group, there are terms associated with a drinking water supply and cultural services (vegetation and tourism).

The fourth subgroup, "boy", "swim", "bath", and "boat" contains 14 nodes that correspond to 18.9 % of the total. This cluster shows essential relational values such as social cohesion and recreation, with the river being the place where children play and learn to swim, fish, and interact. On the one hand, this group shows a variety of uses of the river, such as swimming, bathing, washing clothes, and kayaking. On the other hand, identity values and place dependence are identified. Instrumental values are also present as support for the economy: in this case, the river provides opportunities such as tourism, fishing, navigation, and commerce. In addition, the river functions as a dock for tourist boats.

These values show a lifestyle defined by the river, where the river is the center of the community and the life of the locals. And finally, the last cluster only contains two terms, which represent 2.7 % of the total.

Integration of value domains, values articulated with the thematic groups, and the narrative of the local inhabitants

The classification of the main thematic groups allowed the identification of the value domains, and the articulated value based on the discourse of the interviewees. In this way, the classification of social values according to thematic groups can be observed. These groups are mechanically generated by the modularity software from the discourse of each locality; the domain of value and articulated value is based on the classification of Arias-Arévalo *et al.* (2017); finally, the classification of the examples of expressions of values is our elaboration (Table 4 and Table 5).

Discussion

In terms of plural valuation, we find that both communities have an interest in the protection and conservation of the Los Horcones River. However, each locality gives different weights to each group of specific values (See differences in degree centrality between the terms by locality in Table 2). In the downstream locality (Boca de Tomatlán) intrinsic and relational values predominate, in contrast to the upstream locality (Las

Juntas y Los Veranos) relational and instrumental values prevail (see Table 4 and Table 5).

Downstream, intrinsic values such as moral duties and community organization stand out. These differences are exemplified in Table 5, where the terms "plant", "life", "people", "important" and "hydroelectric" have a higher degree centrality in Boca de Tomatlán than in the Las Juntas y Los Veranos. This is consistent with Anderson *et al*. (2022) and Arias-Arévalo *et al*. (2017), who argue that social actors who defend natural resources prioritize biospheric and altruistic motivations over private interest.

In contrast, in the locality upstream the terms with the highest degree centrality are: "people", "plant", "benefit", "important" and "hydroelectric". Which corresponds to relational values such as subsistence, livelihoods, identity, dependency, and sense of place. This coincides with Kaiser *et al*. (2021), who indicate that relational values provide a high benefit for river users and are linked to landscape aesthetics.

In the town upstream thematic groups linked to instrumental values emerge in the discourse. In contrast, in the town downstream thematic groups linked to intrinsic values emerge. However, in both localities, the relational values are important (Table 4 and Table 5). Upstream instrumental values such as job creation and economic benefits emerge in thematic group 2 with the terms: "benefit*", "tourism" and "employment"* (Table 4). This matches Oppermann *et al*. (2018), who establish that rivers generate economic opportunities such as agriculture and tourism. Nevertheless, Getzner (2015) argue that FFRs, such as the

Los Horcones River, are more appreciated by tourists for their landscape value.

In contrast, in downstream (BT) locality, intrinsic values such as moral duties and community organization emerge in thematic group 1, with the terms: "people", "community", "clean" and "macaw" (Table 5). This is in line with Arias-Arévalo *et al*. (2017), who found that rural populations were more likely to attribute intrinsic values to rivers because there is a direct dependence on natural resources and a closer relationship with nature. This is also consistent with IPBES (2022), which shows that the protection of nature is largely based on intrinsic values.

The common relational values for both localities are environmental justice, livelihoods, place dependence, and altruism. In the locality upstream these values are associated with three thematic groups (clusters 1, 3, and 4) and correspond to: "people", "shrimp", "enjoy" and "restaurant". In contrast, in the downstream locality, these same values emerge in several groups (clusters 2, 3, and 4) and are expressed with terms such as: “life”, “fish”, “shrimp”, “beautiful”, and “mountain”. The river provides water and food to the inhabitants, it is part of their identity, and it fosters well-being and social cohesion (Mooney & Tan, 2012).

The relational values that local communities assign to rivers are based on recreational and aesthetic uses (Fitton, Moncaster, & Guthrie, 2016). This coincides with IPBES (2022), which states that the riverside landscape is valued because it contributes to people's sense of place and identity. The relational values also show the importance of rivers for leisure and recreation activities, generating learning links, since the river provides opportunities for parents to teach their children to swim, fish,

and row. This coincides with Corraliza & Collado (2019), who demonstrated that early childhood experiences with the natural environment foster pro-environmental values and beliefs in adults. Garcia, Villar and Crespo (2020), mention that leisure in natural environments fosters an emotional connection with nature, which will generate future pro-environmental attitudes.

The results show a greater relevance of the intrinsic and relational values for the town of Boca de Tomatlán, explained in part by the perception of threat from the potential construction of the mini-hydroelectric plant and the possible negative impacts both for the environment and for its livelihoods. This coincides with Sousa *et al*. (2019), who state that the construction of hydroelectric dams generates social impacts, decreasing the quality of life in the towns surrounding the infrastructure projects (García-Sánchez & Güereca, 2019; Perry *et al*., 2021; Sousa *et al*., 2019). Finally, the aesthetic value is essential for the development of tourist activities, so it must be considered in public decision-making on regulations that protect natural resources (including rivers) (Van Riper *et al*., 2017).

An unexpected result was finding so many differences in this regard between both localities. We considered that there is a relation between the socioeconomic structure (the upstream locality is focused on agriculture and logging and the downstream is oriented on services) and the specific values found, despite their geographical proximity. This is in line with Chan *et al.* (2012); McNally, Gold, Pollnac, and Kiwango (2016), and Paudyal, Baral and Keenan (2018), who affirm that the perception of

the value of ecosystem services varies between communities, genders, occupations, and sociopolitical contexts.

The locality upstream is more cohesive around the common land and instrumental values predominate. This agrees with Romero, Arteaga-Reyes, Héritier, Thomé-Ortiz and Galicia (2021), who underline the role of the ejidos as prestigious actors with intermediation capacity for the management of natural resources. On the other hand, in the locality downstream, there is an intense tourist and real estate activity associated with the river and the oceanfront. Such elements have caused greater pressure and social organization within the community promoted by external actors, where intrinsic and relational values are shown to be more prevalent. These results are in line with a quantitative study, using a larger sample, concerning both localities. Those from Boca de Tomatlán show greater social appropriation of the river in terms of their willingness to pay than residents of Las Juntas y Los Veranos (Cortés-Espino, Langle-Flores, & Gauna-Ruíz-de-León, 2023).

Combining the theory, interviews, and analysis of semantic networks enable us to a more precise identification of values associated with nature, specifically in the context of free flowing-rivers. It also shows that stakeholders can express multiple values for the same ecosystem (Arias-Arévalo *et al*., 2017). Future studies should include actors from various social sectors (government, tourists, NGOs, and businessmen).

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

Conclusions

This study shows the diversity of plural values that residents attribute to the Los Horcones River; locals value the rivers because they are fundamental in human-nature relationships (Arias-Arévalo *et al*., 2018). The social valuation of the ecosystem services of free-flowing rivers is influenced by the occupations of its inhabitants, the uses they give to the river, and the benefits they receive from the goods they value. These set of articulated values are generated by the place´s dependence, they also model the identity and sustainable lifestyle of residents.

Sometimes, development planning projects in water resources only take into account instrumental values, without considering the intrinsic and relational values that residents have. The exclusion of these values often leads to socio-environmental conflicts and exacerbates power asymmetries (IPBES, 2022).

The preponderance of intrinsic and relational values in the discourse of the residents of the downstream communities reflects the man-nature relationships at risk (the ecological integrity of the river and sustainable livelihoods) in the face of potential development projects. The holistic valuation of free-flowing rivers has different implications: 1) the generation of scientific knowledge about the diversity of values that the residents have towards rivers and the benefits (ecosystem services) that they provide; 2) the recognition of this plurality of values in the planning and management of water resources can reduce socio-environmental conflicts; 3) some of the intrinsic and relational values observed in this study are linked to the protection actions of free-flowing rivers; 4) the

integration of holistic assessments in strategies for the conservation of water resources directly affects the inclusion of values and interests of social groups (sometimes) excluded in decision-making, which would improve the governance of rivers and their watersheds (Cortés-Espino *et al*., 2023).

Public development planning policies should have mechanisms to incorporate the plural values that local communities have towards free-flowing rivers. By integrating the diverse values held by residents of riverside communities, it becomes possible to formulate management and conservation strategies for water resources that are better-informed and more widely accepted.

Acknowledgments

Aurora Cortés-Espino was financed by Conacyt, doctoral scholarship number 545040, and by the Universidad Autónoma de Guerrero for academic improvement scholarship number 15418. Alfonso Langle-Flores was financed by postdoctoral scholarships I1200/94/2020 & I1200 /320/2022 also from CONACYT. The authors thank the Centro Universitario de la Costa from Universidad de Guadalajara for their support, as well as Rafael Guzmán Mejía for his fieldwork advice. Finally, we express our gratitude to each of the 35 participants in this study.

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

Supplementary material

Table S1. Number of inhabitants by locality in the Los Horcones River micro-basin.

No.	Location	Guy	Population	State	Municipality	X	AND
1	Boca de Tomatlán	Rural	585	Jalisco	Puerto Vallarta	-11723493.37	2333791.016
2	Las Juntas y Los Veranos	Rural	537	Jalisco	Cabo Corrientes	-11721136.8	2329933.818
3	El Izote	Rural	2	Jalisco	Cabo Corrientes	-11719530.3	2330879.63
4	Rancho Los Veranos	Rural	1	Jalisco	Cabo Corrientes	-11720000.23	2329748.906
5	Rancho Viejo	Rural	15	Jalisco	Puerto Vallarta	-11718782.61	2331256.278
6	La Pintada	Rural	1	Jalisco	Cabo Corrientes	-11720550.89	2328891.808
7	Cerro Verde	Rural	1	Jalisco	Cabo Corrientes	-11718540.95	2331037.352
8	Los Horcones	Rural	9	Jalisco	Cabo Corrientes	-11720638.24	2328231.659
9	Coyonzalo	Rural	5	Jalisco	Cabo Corrientes	-11721651.81	2327378.164
10	Emiliano Zapata	Rural	14	Jalisco	Cabo Corrientes	-11719745.86	2325663.505
11	El Potrero	Rural	1	Jalisco	Cabo Corrientes	-11714478.75	2316144.489
12	Mesa Colorada	Rural	7	Jalisco	Talpa de Allende	-11709564.67	2319057.024

Note: XY geographic coordinates where X: longitude and Y: latitude.

Source: Prepared with information from the 2020 Population and Housing Census, of the National Institute of Statistics, Geography, and Informatics (INEGI, 2020).

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

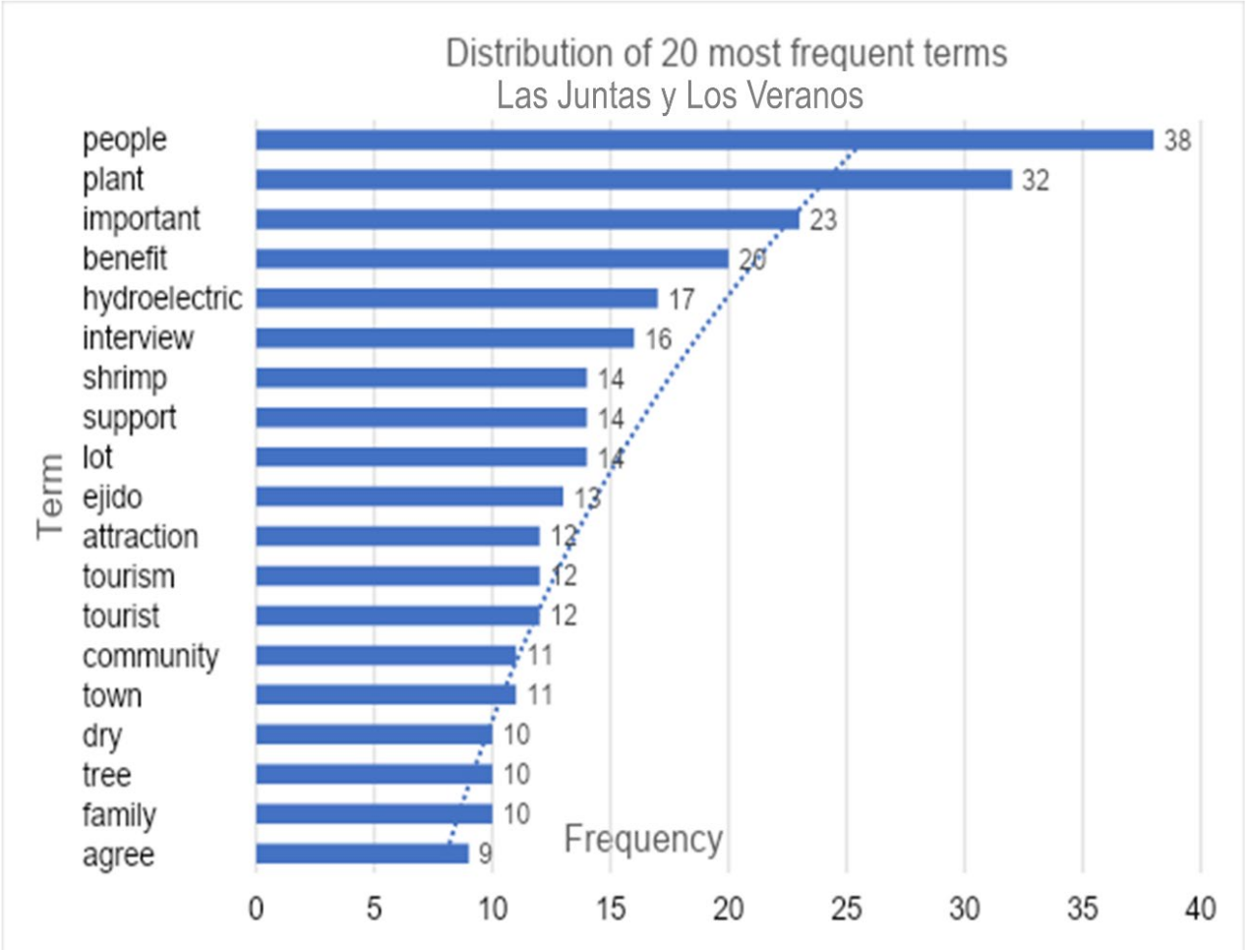


Figure S1. Distribution of frequencies of the 20 most used terms in the interviews of Las Juntas y Los Veranos. The dotted line corresponds to the representation of the adjusted exponential regression model (y = 7.5431. e 0.0647 x) for the comparison of the equality between the terms (R^2 =0.7982; correlation coefficient of the model).

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

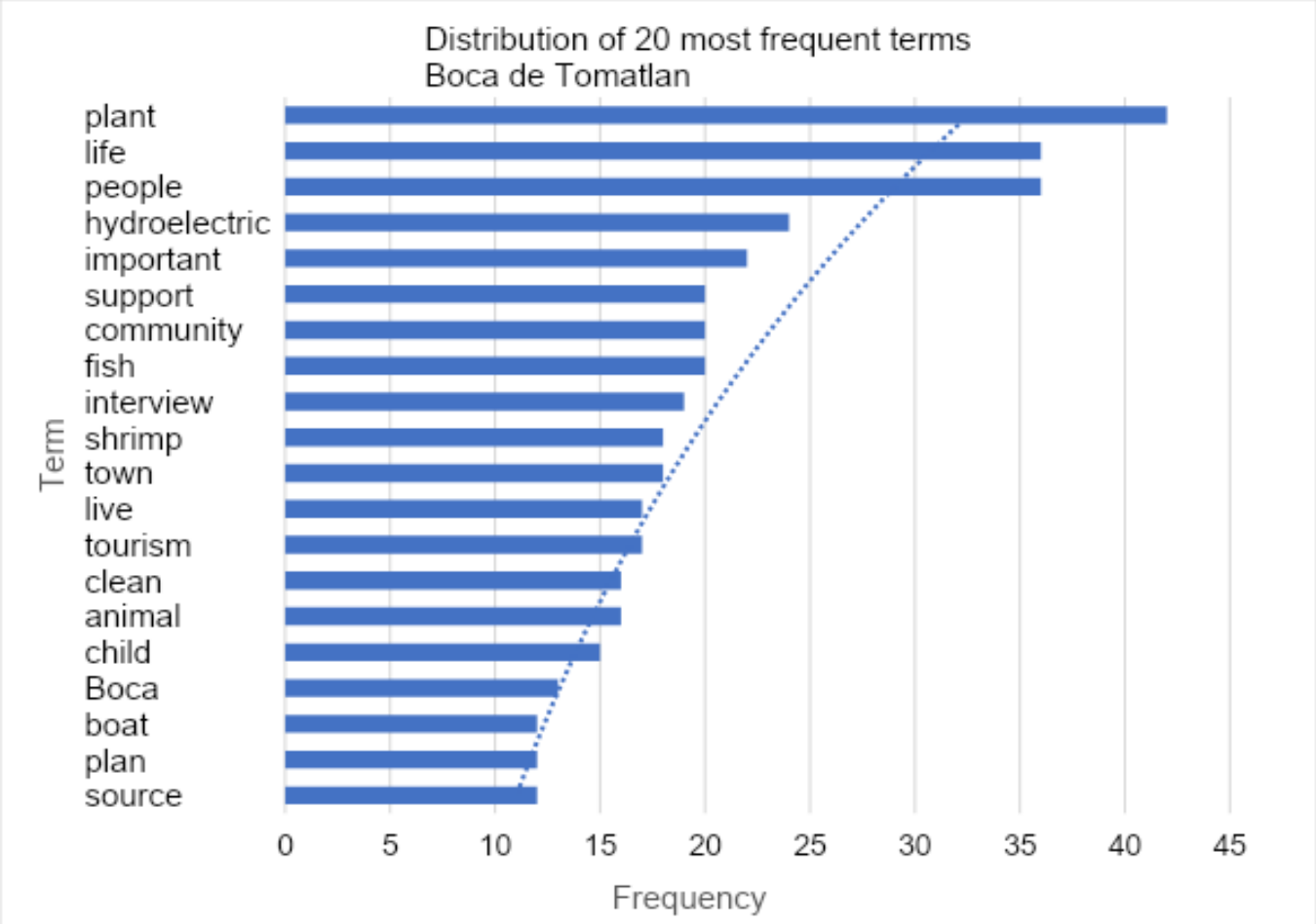


Figure S2. Distribution of frequencies of the 20 most used terms in the interviews of Boca de Tomatlán. The dotted line corresponds to the representation of the adjusted exponential regression model (y = 10.406 and 0.057 x) for the comparison of the equality between the terms (R^2 = 0.8403; correlation coefficient of the model).

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

Table S2. Degree values (G), betweenness centrality (I), eigenvector (VP), and cluster or group (C) for the terms of the interviews in Las Juntas y Los Veranos.

Terms	Degree	Eigenvector	Intermediation
People	2.708	0.676	0.289
Plant	1.833	0.502	0.226
Benefit	1.354	0.417	0.158
Important	1.156	0.332	0.162
Hydroelectric	1.042	0.341	0.048
Interview	0.833	0.368	0.014
Batch	0.781	0.286	0.026
Shrimp	0.750	0.282	0.035
Support	0.708	0.210	0.045
Attractions	0.625	0.258	0.042
Tourists	0.552	0.234	0.012
Enjoy	0.510	0.207	0.032
Tourism	0.510	0.190	0.031
Community	0.490	0.199	0.018
Town	0.479	0.131	0.053
Build	0.448	0.217	0.002
Family	0.438	0.149	0.028
Common	0.438	0.080	0.050
Accept	0.333	0.145	0,000
Dry	0.323	0.147	0.004

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

Terms	Degree	Eigenvector	Intermediation
Live	0.313	0.154	0.001
Protection	0.292	0.077	0.012
Plan	0.260	0.072	0.009
Restaurant	0.250	0.140	0,000
Employment	0.219	0.044	0.005
Eat	0.208	0.099	0.001
Affect	0.208	0.071	0.001
Trigger	0.208	0.027	0.026
Life	0.208	0.087	0.003
Sell	0.198	0.089	0,000
Mouth	0.198	0.102	0.001
Abandon	0.177	0.076	0.001
Tree	0.167	0.089	0.006
Health	0.167	0.014	0.022
White	0.146	0.059	0,000
Develop	0.146	0.017	0.001
Represent	0.146	0.043	0.002
Economy	0.135	0.035	0,000
Attract	0.135	0.063	0,000
Take a bath	0.125	0.073	0,000
Receive	0.125	0.069	0,000
Heron	0.115	0.048	0,000
Fish	0.115	0.047	0,000

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

Terms	Degree	Eigenvector	Intermediation
Privilege	0.115	0.032	0.001
Animal	0.104	0.054	0,000
Trash	0.104	0.017	0,000
Protect	0.104	0.048	0.004
Beautiful	0.104	0.058	0,000
Truth	0.104	0.030	0,000
Money	0.094	0.040	0,000
Deer	0.094	0.017	0.001
Municipality	0.094	0.043	0,000
Conafor	0.094	0.015	0,000
Fountain	0.094	0.038	0,000
Activity	0.083	0.037	0.003
Service	0.083	0,000	0,000
Pay	0.073	0,000	0,000
Essential	0.073	0.010	0,000
Fishing	0.073	0.048	0,000
Well	0.073	0.029	0,000
Atmosphere	0.073	0,000	0,000
Resources	0.073	0.032	0.001
Attend	0.073	0.023	0,000
Cold	0.073	0.041	0,000
Kindergarten	0.063	0.024	0,000
Place	0.063	0.036	0,000

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

Terms	Degree	Eigenvector	Intermediation
Spend	0.063	0.025	0,000
Supply	0.063	0.034	0,000
Cattle	0.063	0.024	0,000
Prevent	0.063	0.016	0,000
Child	0.063	0.025	0,000
Relax	0.063	0.030	0,000
Do	0.063	0.012	0,000
General	0.052	0.005	0,000
Day	0.042	0.036	0,000
To drink	0.042	0.018	0,000
Air-conditioned	0.042	0.018	0,000
Time	0.031	0.027	0,000
Drinking	0.031	0.001	0,000
Careful	0.031	0.020	0,000
Hear	0.031	0.017	0,000
Forks	0.031	0.001	0,000
Rock	0.031	0.013	0,000
Part	0.031	0.005	0,000
Home	0.031	0.027	0,000
Home	0.031	0.013	0,000
Summers	0.031	0.001	0,000
Directly	0.031	0.010	0,000
Give	0.031	0.013	0,000

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

Terms	Degree	Eigenvector	Intermediation
Depends on	0.031	0.020	0,000
Wash	0.031	0.027	0,000
Great	0.031	0.005	0,000
Income	0.031	0.020	0,000
Stuff	0.031	0.027	0,000
Sit	0,000	0,000	0,000
Jaguar	0,000	0,000	0,000

Table S3. Degree (G) values, betweenness centrality (I), eigenvector (VP), and cluster or group (C) for the terms of the interviews in Boca de Tomatlán.

Terms	Degree	Vector own	Intermediation
Plant	5.059	0.607	0.194
Life	4.824	0.579	0.170
People	3.882	0.484	0.198
Important	2.541	0.332	0.075
Hydroelectric	2.424	0.382	0.014
Fish	1.882	0.312	0.036
Support	1.624	0.277	0.049
Community	1.600	0.200	0.066
Clean	1.600	0.200	0.120
Animal	1.576	0.284	0.010
Shrimp	1.459	0.247	0.029

Tecnología y Ciencias del Agua
OPEN ACCESS
Check for updates

Terms	Degree	Vector own	Intermediation
Tourism	1.200	0.179	0.048
Interview	1.129	0.245	0.003
Build	0.988	0.182	0.004
Child	0.988	0.013	0.117
Fountain	0.965	0.186	0.004
Live	0.965	0.193	0.040
Plan	0.894	0.145	0.023
Town	0.800	0.141	0.003
Accept	0.776	0.138	0.000
Benefit	0.753	0.168	0.003
Protection	0.635	0.116	0,000
Mouth	0.612	0.043	0.021
Food	0.588	0.116	0.000
Municipality	0.565	0.100	0.000
Participate	0.518	0.097	0.003
Bird	0.494	0.107	0.000
Ship	0.447	0.004	0.010
Place	0.447	0.011	0.032
Tomatlan	0.424	0.036	0.001
Batch	0.424	0.101	0.000
Do	0.400	0.041	0.019
Macaw	0.353	0.039	0.020
Organize	0.329	0.049	0.000

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

Terms	Degree	Vector own	Intermediation
Dry	0.329	0.094	0.000
Mountain	0.282	0.054	0.002
Protest	0.282	0.054	0.000
Day	0.282	0.001	0.000
Continue	0.282	0.072	0.000
Trash	0.235	0.014	0.020
Atmosphere	0.235	0.059	0.000
Natural	0.212	0.022	0.000
Fishing	0.212	0.048	0.000
Abandon	0.212	0.012	0.003
Depend	0.212	0.059	0.000
Give	0.212	0.030	0.020
Urgent	0.188	0.031	0.000
Swim	0.188	0.001	0.020
Part	0.188	0.052	0.000
Bring	0.188	0.045	0.000
Play	0.188	0.001	0.000
Pitchforks	0.141	0.045	0.000
Represent	0.141	0.043	0.000
Careful	0.141	0.001	0.000
Vallarta	0.141	0.036	0.000
Bank	0.118	0.030	0.000
Kayak	0.118	0.030	0.000

Tecnología y Ciencias del Agua

OPEN ACCESS

Check for updates

Terms	Degree	Vector own	Intermediation
Stuff	0.118	0.020	0.000
Activity	0.118	0.012	0.000
Take a bath	0.118	0.001	0.000
Drinking	0.118	0.011	0.000
Run	0.094	0,000	0.000
Major	0.094	0.010	0.000
Tree	0.094	0.029	0.000
Fauna	0.094	0.001	0.000
Wildlife	0.094	0.000	0.000
Tap	0.094	0.000	0.000
Develop	0.094	0.007	0.000
Recreation	0.094	0.001	0.000
Belong	0.094	0.030	0.000
Feel	0.094	0.024	0.000
Enjoy	0.094	0.030	0.000
Wash	0.094	0.001	0.000
To Drink	0.094	0.030	0.000
Flora	0.094	0,000	0.000
Beautiful	0.094	0.015	0.000
Protect	0.094	0.002	0.000
Vegetation	0.094	0.009	0.000
Home	0.000	0.000	0.000
Beach	0.000	0.000	0.000

Terms	Degree	Vector own	Intermediation
Bathrooms	0.000	0.000	0.000
Fun	0.000	0.000	0.000
Supply	0.000	0.000	0.000
Time	0.000	0.000	0.000
Extract	0.000	0.000	0.000

References

Anderson, C. B., Athayde, S., Raymond, C. M., Vatn, A., Arias-Arévalo, P., Gould, R. K., Kenter, J., Muraca, B., Sachdeva, S., Samakov, A., Zent, E., Lenzi, D., Murali, R., Amin, A., & Cantú-Fernández, M. (2022). Chapter 2. Conceptualizing the diverse values of nature and their contributions to people. In: *Methodological assessment report on the diverse values and valuation of nature of the intergovernmental science-policy platform on biodiversity and ecosystem services.* (p. 121). Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Recuperate the https://zenodo.org/record/7701874

Arias-Arévalo, P., Gómez-Baggethun, E., Martín-López, B., & Pérez-Rincón, M. (2018). Widening the evaluative space for ecosystem services: A taxonomy of plural values and valuation methods. *Environmental Values*, 27(1), 29-53.

Arias-Arévalo, P., Martin-Lopez, B., & Gomez-Baggethun, E. (2017). Exploring intrinsic, instrumental, and relational values for

sustainable management of social-ecological systems. *Ecology and Society*, 22(4). DOI: 10.5751/ES-09812-220443

Ávila-García, P. (2006). El valor social y cultural del agua. *Gestión y Cultura del Agua*, 2, 233-248.

Bates, D., & Watts, D. (1998). *Análisis de regresión no lineal y sus aplicaciones*. Nueva York, USA: Wiley.

Bonacich, P. (1987). Power and centrality: A family of measures. *American Journal of Sociology*, 92(5), 1170-1182.

Borgatti, S., Everett, M., & Johnson, J. (2013). *Analizando redes sociales*. Londres, UK, Thousand Oaks, USA: Sage Publications.

Chan, K. M., Guerry, A. D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., Bostrom, A., Chuenpagdee, R., Gould, R., Halpern, B. S., Hannahs, N., Levine, J., Norton, B., Ruckelshaus, M., Russell, R., Tam, J., & Woodside, U. (2012). Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience*, 62(8), 744-756. DOI: 10.1525/bio.2012.62.8.7

Comisión Estatal del Agua del Estado de Jalisco. (2015). *Ficha técnica hidrológica del municipio de Puerto Vallarta*. Puerto Vallarta, México: Comisión Estatal del Agua del Estado de Jalisco.

Corraliza, J. A., & Collado, S. (2019). Conciencia ecológica y experiencia ambiental en la infancia/Ecological awareness and children's environmental experience. *Papeles del Psicólogo/Psychologist Papers*, 40(3), 190-196. DOI: 10.23923/pap.psicol2019.2896

Cortés-Espino, A., Langle-Flores, A., & Gauna-Ruíz-de-León, C. (2023). Valuing free-flowing rivers: The influence of social value on

willingness to pay for ecosystem services protection. *Water*, 15(7), 1279. DOI: 10.3390/w15071279

Diesner, J. (2014). *ConText: Software para el análisis integrado de datos de texto y datos de red*. 64ª Conferencia Anual de la Asociación Internacional de Comunicación, Seattle, Washington.

Doerfel, M. (1998). ¿Qué constituye el análisis de redes semánticas? Una comparación de investigación y metodologías. *Conexiones*, 21(12), 16-26.

Etikan, I., Alkassim, R., & Abubakar, S. (2016). Comparision of snowball sampling and sequential sampling technique. *Biometrics and Biostatistics International Journal*, 3(1), 55.

Felipe-Lucia, M. R., Comin, F. A., & Escalera-Reyes, J. (2015). A framework for the social valuation of ecosystem services. *Ambio*, 44(4), 308-318. DOI: 10.1007/s13280-014-0555-2

Fitton, S. L., Moncaster, A., & Guthrie, P. (2016). Investigating the social value of the Ripon rivers flood alleviation scheme. *Journal of Flood Risk Management*, 9(4), 370-378. DOI: 10.1111/jfr3.12176

Freeman, L. (1977). Un conjunto de medidas de centralidad basado en la intermediación. *Sociometría*, 40(1), 35-41.

García, R. M., Villar, M. B. C., & Crespo, L. V. (2020). El ocio en el medio natural como promotor de la conexión emocional con la naturaleza. Un estudio en clave ambiental con adolescentes pontevedreses (Galicia-España). *Pensamiento Educativo, Revista de Investigación Latinoamericana (PEL)*, 57(2), 1-16.

García-Sánchez, M., & Güereca, L. P. (2019). Environmental and social life cycle assessment of urban water systems: The case of Mexico City. *Science of the Total Environment*, 693, 133464. DOI: 10.1016/j.scitotenv.2019.07.270

Gauna-Ruíz-de-León, C., & Oliveros-Ocampo, C. A. (2021). Dinámica evolutiva de Puerto Vallarta a partir de la teoría de la dependencia de la Trayectoria (path dependence). En: *El desarrollo turístico en México. Revisión general y casos de estudio* (pp. 405-429). Jalisco, México. Universidad de Guadalajara.

Gea Sostenible. (2021). *Manifestación de impacto ambiental modalidad particular del proyecto central mini hidroeléctrica Las Juntas*. Jalisco, México: Secretaría del Medio Ambiente y Recursos Naturales Jalisco.

Getzner, M. (2015). Importance of free-flowing rivers for recreation: Case study of the River Mur in Styria, Austria. *Journal of Water Resources Planning and Management*, 141(2), 04014050. DOI: 10.1061/(ASCE)WR.1943-5452.0000442

Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., Babu, S., Borrelli, P., Cheng, L., Crochetiere, H., Ehalt-Macedo, H., Filgueiras, R., Goichot, M., Higgins, J., Hogan, Z., Lip, B., McClain, M. E., Meng, J., Mulligan, M., Nilsson, C., Olden, J. D., Opperman, J. J., Petry, P., Reidy-Liermann, C., Sáenz, L., Salinas-Rodríguez, S., Schelle, P., Schmitt, R. J. P., Snider, J., Tan, F., Tockner, K., Valdujo, P. H., van Soesbergen, A., & Zarfl, C. (2019). Mapping the world's free-flowing rivers. *Nature*, 569(7755), 215-221. DOI: 10.1038/s41586-019-1111-9

Guzmán-Mejía, R., Márquez-Rangel, N., & Ibarra-Rubio, R. (2021). *Agenda Ambiental 21 Bhaía de Banderas. Para un Bienestar Común*. Guadalajara, México: Universidad de Guadalajara.

INEGI, Instituto Nacional de Estadística y Geografía. (2020). *Censo de Población y Vivienda*. Recuperate the https://www.inegi.org.mx/programas/ccpv/2020/

Ioris, A. A. (2012). The positioned construction of water values: Pluralism, positionality and praxis. *Environmental Values*, 21(2), 143-162.

IPBES, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. (2022). *Summary for policymakers of the methodological assessment of the diverse values and valuation of nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)*. Bonn, Germany: Zenodo. DOI: 10.5281/zenodo.7075892

Jackson, S., Stoeckl, N., Straton, A., & Stanley, O. (2008). The changing value of Australian tropical rivers. *Geographical Research*, 46(3), 275-290.

Jorda-Capdevila, D., Iniesta-Arandia, I., Quintas-Soriano, C., Basdeki, A., Calleja, E. J., DeGirolamo, A. M., Gilvear, D., Ilhéu, M., Kriauciuniene, J., Logar, I., Loures, L., & Padlo, T. (2021). Disentangling the complexity of socio-cultural values of temporary rivers. *Ecosystems and People*, 17(1), 235-247. DOI: 10.1080/26395916.2021.1912186

Kaiser, N. N., Ghermandi, A., Feld, C. K., Hershkovitz, Y., Palt, M., & Stoll, S. (2021). Societal benefits of river restoration. Implications from social media analysis. *Ecosystem Services*, 50, 101317.

Kati, V., & Jari, N. (2016). Bottom-up thinking. Identifying socio-cultural values of ecosystem services in local blue–green infrastructure planning in Helsinki, Finland. *Land Use Policy*, 50, 537-547.

Khan, I., Lei, H., Ali, G., Ali, S., & Zhao, M. (2019). Public attitudes, preferences and willingness to pay for river ecosystem services. *International Journal of Environmental Research and Public Health*, 16(19), 3707. DOI: 10.3390/ijerph16193707

Langle-Flores, A., & Cupul-Magaña, F. G. (2021). Análisis de redes semánticas de los artículos y notas de la revista *Ciencia y Mar* (1997-2020). *Ciencia y Mar*, 25(73), 3-9.

McNally, C. G., Gold, A. J., Pollnac, R. B., & Kiwango, H. R. (2016). Stakeholder perceptions of ecosystem services of the Wami River and Estuary. *Ecology and Society*, 21(3), 34. DOI: 10.5751/ES-08611-210334

MEA, Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Wetlands and water*. Washington, DC, USA: World Resources Institute.

Mendoza-Cariño, M., Quevedo-Nolasco, A., Bravo-Vinaja, Á., Flores-Magdaleno, H., De-la-Isla-de-Bauer, M. de L., Gavi-Reyes, F., & Zamora-Morales, B. P. (2014). Estado ecológico de ríos y vegetación ribereña en el contexto de la nueva ley general de aguas

de México. *Revista Internacional de Contaminación Ambiental*, 30(4), 429-436.

Mooney, C., & Tan, P.-L. (2012). South Australia's River Murray: Social and cultural values in water planning. *Journal of Hydrology*, 474, 29-37. DOI: 10.1016/j.jhydrol.2012.04.010

Newman, M. E. (2006). Modularity and community structure in networks. *Proceedings of the National Academy of Sciences*, 103(23), 8577-8582.

Opperman, J., Grill, G., & Hartmann, J. (2015). The power of Rivers: Finding balance between energy and conservation in hydropower development. *The Nature Conservancy*, 56. DOI: 10.13140/RG.2.1.5054.5765

Opperman, J., Orr, S., Baleta, H., Garrick, D., Goichot, M., McCoy, A., Morgan, A., Turley, L., & Vermeulen, A. (2018). *Valuing Rivers: How the diverse benefits of healthy rivers underpin economies*. WWF: Gland, Switzerland. Recuperate the https://awsassets.panda.org/downloads/wwf_valuing_rivers__final_.pdf

Parker, C., Scott, S., & Geddes, A. (2019). *Snowball sampling*. SAGE Research Methods Foundations. DOI: 10.4135/9781526421036831710

Paudyal, K., Baral, H., & Keenan, R. J. (2018). Assessing social values of ecosystem services in the Phewa Lake Watershed, Nepal. *Forest Policy and Economics*, 90, 67-81. DOI: 10.4135/9781526421036831710

Perry, D., Harrison, I., Fernandes, S., Burnham, S., & Nichols, A. (2021). Global analysis of durable policies for free-flowing river protections. *Sustainability*, 13(4), 2347. DOI: 10.3390/su13042347

RAN, Registro Agrario Nacional. (2021). *PHINA, Padrón e Historial de Núcleos Agrarios*. Recuperate the https://phina.ran.gob.mx/buscarNucleoAgrario.php

Romero, N. I. G., Arteaga-Reyes, T. T., Héritier, S., Thomé-Ortiz, H., & Galicia, L. (2021). Dinámica relacional de las actividades recreativas en el Área de Protección de Flora y Fauna Nevado de Toluca, México: El enfoque del Análisis de Redes Sociales. *PASOS Revista de Turismo y Patrimonio Cultural*, 19(3), 477-494. DOI: 10.25145/j.pasos.2021.19.031

Saxon, R. (2005). *Be valuable: A guide to creating value in the built environment*. London, UK: Constructing Excellence.

Schettini, P., & Cortazzo, I. (2015). *Análisis de datos cualitativos en la investigación social*. La Plata, Argentina: Editorial de la Universidad Nacional de La Plata (EDULP).

Secretaría General del Gobierno del Estado de Jalisco. (31 de octubre, 2014). Acuerdo que establece la regionalización administrativa del estado de Jalisco para impulsar el desarrollo de la entidad. *El Estado de Jalisco Periódico Oficial*, p. 3.

Secturjal, Secretaría de Turismo. (2020). *Estadísticas del sector turístico*. Recuperate the https://secturjal.jalisco.gob.mx/invierte-en-jalisco/estadisticas

Shah, S. H., & Rodina, L. (2018). Water ethics, justice, and equity in social-ecological systems conservation: Lessons from the Queensland Wild Rivers Act. *Water Policy*, 20(5), 933-952. DOI: 10.2166/wp.2018.016

Sousa, S., Botelho, A., Pinto, L. M. C., & Valente, M. (2019). How relevant are non-use values and perceptions in economic valuations? The case of hydropower plants. *Energies*, 12(15), 2986. DOI: 10.3390/en12152986

Tabi, A., & Wüstenhagen, R. (2017). Keep it local and fish-friendly: Social acceptance of hydropower projects in Switzerland. *Renewable and Sustainable Energy Reviews*, 68, 763-773. DOI: 10.1016/j.rser.2016.10.006

UNESCO, United Nations Educational, Scientific and Cultural organization. (2021). *The United Nations world water development report 2021: Valuing water*. Recuperate the https://unesdoc.unesco.org/ark:/48223/pf0000375724

Valencia-Vargas, J. C. (2015). Desarrollo de la región hidrológica del Balsas mediante la modificación de su veda. *Tecnología y ciencias del agua*, 6(1), 81-97.

Van Eck, N. J., & Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics*, 111(2), 1053-1070.

Van Riper, C. J., Kyle, G. T., Sherrouse, B. C., Bagstad, K. J., & Sutton, S. G. (2017). Toward an integrated understanding of perceived biodiversity values and environmental conditions in a national park.

Ecological Indicators, 72, 278-287. DOI: 10.1016/j.ecolind.2016.07.029

Waltman, L., Van Eck, N. J., & Noyons, E. C. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of Informetrics*, 4(4), 629-635.

Wasserman, S., & Faust, K. (1994). *Análisis de redes sociales. Métodos y aplicaciones*. Cambridge, UK: Prensa de la Universidad de Cambridge.

Zhang, W., Yu, Y., Wu, X., Pereira, P., & Borja, M. E. L. (2020). Integrating preferences and social values for ecosystem services in local ecological management: A framework applied in Xiaojiang Basin Yunnan province, China. *Land Use Policy*, 91, 104339. DOI: 10.1016/j.landusepol.2019.104339