

Limited understanding of climate change among tourism managers in the High Mountains of Veracruz, Mexico

Conocimiento limitado sobre el cambio climático entre gestores turísticos en la región de las Altas Montañas de Veracruz, México

Rosa Campos Pulido¹, Arturo Pérez Vázquez^{1*}, Felipe Gallardo López¹, Juan Valente Hidalgo Contreras²

¹ Campus Veracruz, Colegio de Postgraduados. Manlio Fabio Altamirano, Veracruz, México. CP. 91700. Tel. 2292010770. parturo@colpos.mx
ORCID: 0000-0001-8682-9431, ORCID: 0000-0002-8440-7814, ORCID: 0000-0003-1490-4919

² Campus Córdoba, Colegio de Postgraduados. Amatlán de los Reyes, Veracruz, Mexico. CP. 94953. ORCID: 0000-0002-4300-7777

*Autor de correspondencia

Abstract

Keywords:

Ecotourism; rural tourism; adventure tourism; perception.

Alternative tourism largely depends on climate and other natural resources available at the local level. This study aimed to analyze the perception of climate change among owners of touristic centers in the High Mountains Region of Veracruz. A simple random sampling was used, and a structured questionnaire was applied to 43 owners, of which 72% were men and 28% were women, aged 31 to 60 years. 77% reported knowing what climate change is, associating it mainly with rain, heat, and pollution, particularly with higher temperatures and stronger cyclones. Prior to analyzing perceptions, the observed climate impacts in the region were presented to provide context. 67% considered climate change a matter of concern, and 98% believed that the population should be involved in mitigation actions. It is concluded that the owners lack a clear understanding of climate change and the magnitude of its effects.

Resumen

Palabras clave:

Ecoturismo; turismo rural; turismo de aventura; percepción.

El turismo alternativo depende en gran medida del clima y otros recursos naturales disponibles en el ámbito local. El objetivo fue analizar la percepción del cambio climático entre los propietarios de centros turísticos en la región de las Altas Montañas de Veracruz. Se utilizó muestreo aleatorio simple y se aplicó un cuestionario estructurado a 43 propietarios. El 72% fueron hombres y el 28% mujeres, con edades entre 31 y 60 años. El 77% afirmó conocer el concepto de cambio climático, relacionándolo con lluvia, calor y contaminación, especialmente con altas temperaturas y ciclones más intensos. Previo al análisis de percepciones, se presentaron los impactos climáticos observados en la región para contextualizar la situación. El 67% lo considera un motivo de preocupación y el 98% estima que la población debería involucrarse en su mitigación. Se concluye que los propietarios carecen de una comprensión precisa sobre el cambio climático y la magnitud de sus efectos.

Recibido: 16 de octubre de 2025

Aceptado: 24 de marzo de 2026

Publicado: 23 de septiembre de 2026

Cómo citar: Campos, R.; Pérez, A.; Gallardo, F.; & Hidalgo, J. V. (2026). Limited understanding of climate change among tourism managers in the High Mountains of Veracruz, Mexico. *Acta Universitaria*, 36, e4884. doi: <http://doi.org/10.15174/au.2026.4884>

Introduction

Human beings are born with limited perception, as cognitive development is a continuous process of construction (Beroíza-Valenzuela, 2023; Ortiz, 2009). Throughout different stages of their life, individuals acquire knowledge and experience that shape their perceptual systems and cultural environments (Vargas, 1994). This construction also involves social processes, in which knowledge plays a fundamental role (Pasquaré & Oppizzi, 2012; Zorn *et al.*, 2023).

When perception is linked to climate change, it is influenced not only by knowledge but also by personal experiences of climatic events and the sense of individual responsibility derived from awareness (Patt & Schröter, 2008). Climate change is defined as "a change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and adds to the natural variability of the climate observed over comparable time periods" (Comisión Nacional de los Derechos Humanos [CNDH], 1993). It is currently recognized as a latent threat and an emerging global concern since the late 20th century (Estrada & Botzen, 2021; Intergovernmental Panel on Climate Change [IPCC], 2021, 2022). Due to its complexity, public perception has become an essential component in understanding this phenomenon (Ochoa & Travieso *et al.*, 2024; Ratter *et al.*, 2012; Villares & Roca, 2016; Wyss *et al.*, 2014).

The increasing magnitude of floods and droughts has caused significant human and material losses worldwide (Misra, 2014). It is estimated that the cost of mitigating the effects of climate change represents about 3.6% of the global gross domestic product (GDP) (Ackerman & Stanton, 2008). This makes it one of the greatest challenges facing humanity, as climate variability directly affects well-being and economic activities such as tourism, agriculture, and other productive sectors (Estrada & Botzen, 2021). Consequently, survival will depend on present and future actions aimed at reversing this phenomenon (Brooke, 2014; Estrada-Contreras *et al.*, 2015; Magaña *et al.*, 2004; World Health Organization [WHO], 2005).

In the case of tourism, over the last decade, research on the relationship between this sector and climate change has grown considerably. Since tourism is one of the major economic contributors to urban and regional development and depends largely on climatic conditions, such as temperature, sunlight, water, availability, and landscape, climate change represents a new challenge and a significant threat (Atstāja & Cakrani, 2024; Wijaya & Furqan, 2018).

Researchers and stakeholders in the tourism industry are therefore facing new problems and challenges, reflected in a growing interest and concern regarding the role of tourism in global environmental change (Loehr & Becken, 2021; Weir, 2017). Furthermore, highly vulnerable ecosystems, such as mountains and polar regions, are being directly affected by climate change (Estrada, 2001; Organización Mundial del Turismo [OMT] *et al.*, 2007). Recent research also highlights the increasing relevance of stakeholder perceptions in tourism destinations, particularly in fragile ecosystems (Shang *et al.*, 2025).

Research on climate change perception within the tourism sector began around 1979, but it was not until 2011 that studies increased significantly, highlighting the importance of this issue. In the subfields of alternative tourism, such as ecotourism, adventure tourism, and rural tourism, research growth became notable after 2017. Most studies focus on sustainability and sustainable development, particularly in countries like the United States and Australia. Recent studies also indicate that climate change is increasingly influencing tourist decision-making and destination choice (Özgit & Saleem, 2025).

However, the perception of climate change among those directly involved in alternative tourism activities remains poorly understood. To have a broad understanding of public perception is essential to design effective communication strategies, public policies, and technologies that mitigate its effects (Merino Pérez, 2025; Whitmarsh & Capstick, 2018).

Impacts of climate change in Veracruz and the High Mountain Region

The state of Veracruz exhibits high vulnerability to climate change due to its physiographic diversity, which includes coastal, tropical, and mountainous zones. Recent studies have documented increasing temperature trends, changes in precipitation patterns, and a higher frequency of extreme climatic events in the region factors that affect both ecosystem and climate, dependent productive, and recreational activities (Vargas Huipe & Rodriguez Van Gort, 2024; Scott *et al.*, 2011). Regional climate analyses have identified warning processes associated with both natural climatic variability and anthropogenic factors, contributing to shifts in thermal conditions and meteorological patterns in central Veracruz.

In the mountainous areas of central Veracruz, including the region commonly referred to as the High Mountains, these changes may translate into significant environmental and socioeconomic impacts. Greater variability in precipitation and the intensification of hydrometeorological events increase the risk of flooding, soil erosion, and landslides in sloped areas, affecting infrastructure and productive activities (Alcántara-Ayala, 2004; Zúñiga *et al.*, 2020). Furthermore, tropical cyclones and heavy rainfall events have been identified as major drivers of environmental disruption and agricultural losses in Veracruz, posing increasing risks to ecosystems and local communities (Márquez-Domínguez *et al.*, 2025; Valdés-Rodríguez *et al.*, 2023).

These environmental changes have direct implications for nature-based tourism destinations in the region as recreational activities in mountainous environments depend on safety, climatic stability, and ecosystem integrity of visited sites. Recent literature on tourism and climate change indicates that alterations in temperature, precipitation, and extreme events can influence risk perception and the decision-making processes of visitors and tourism stakeholders, potentially modifying tourism demand and destination planning (Deason *et al.*, 2023; Scott *et al.*, 2011). In this context, understanding local stakeholders' perceptions of climate change becomes essential for strengthening adaptation strategies and promoting the sustainable management of tourism in vulnerable mountainous regions.

The state of Veracruz, Mexico, is no exception to climate change impacts that affect the socioecological and economic conditions of its population. It is one of the country's most vulnerable regions (Athié *et al.*, 2019; Estrada *et al.*, 2012). Therefore, the objective of this research was to analyze the perception of climate change among the owners of alternative tourism sites located in the High Mountains Region of Veracruz.

Materials and methods

The research was conducted from August 2020 to March 2021 in the High Mountains Region of Veracruz, Mexico, where 48 alternative tourism sites were identified and considered to be part of the study population (Figure 1).

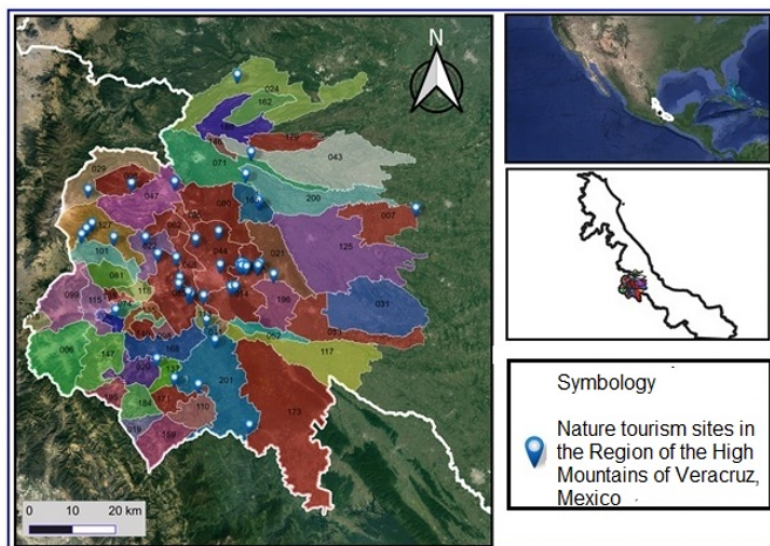


Figure 1. Location of the tourism centers in the High Mountains Region of Veracruz where the questionnaire was applied.

Source: Author's own elaboration.

To determine the sample size of the owners to be interviewed (study units), a simple random sampling method was applied (Suchindran, 2005) using the formula $n = n' / (1 + n' / N)$, where N represents the population size (48), SE the standard error (0.015), p the reliability (0.90), n the sample size (unknown), and n' the unadjusted sample size. The randomization process consisted of consecutively enumerating the tourism sites from 1 to 48, simulating a lottery. As a result, 43 sites offering alternative activities were selected.

Structure of the questionnaire

The questionnaire included both open-ended and Likert-type questions. Five response options were used to assess reliability: 0 = very low, 1 = low, 2 = moderate, 3 = high, and 4 = very high. For the degree of agreement, the same scale was applied: 0 = totally disagree, 1 = disagree, 2 = neither agree nor disagree, 3 = agree, and 4 = totally agree. To measure the degree of impact, the options were: 0 = very low, 1 = low, 2 = moderate, 3 = high, and 4 = very high. Dichotomous (yes/no) and multiple-choice questions were also included.

These questions aimed to identify risks and impacts of the perception of climate change and to relate perception to the owner's profile, knowledge, information, and personal experience. The questionnaire was administered in person and online via Google Forms (Table 1).

Table 1. Sections of the questionnaire applied to the owners of the alternative tourism sites in the High Mountains Region of Veracruz.

Sections	Items
1. Owner information	Name, age (years), number of years living in the area, years of experience in the tourism sector, years of operation of the site, highest level of education, and main occupation.
2. Knowledge	Understanding of climate change, concern about climate change, main words associated with climate change, and the effects or benefits of climate change in the activities of their tourism site.
3. Information	Main sources of information to which they have access; main sources of information they normally consult for news about climate change; weather they keep informed about the effects of climate change; and their level of trust in the media reports concerning climate change.
4. Experience	Increase in rainfall over the last 10 years; greater intensity of winter cold compared with the previous 10 years; greater frequency and intensity of heat over the last year; greater frequency and intensity of southerly wind events (suradas) over the last years; degree of recent climate-related impacts in the region over the last years; degree of recent climate-related impacts at their ecotourism site over the last years; Degree to which climate has affected the region over the last 10 years; degree of recent climate-related impacts in the community; degree of climate affectation most recently in your ecotourism center in the last 10 years, current climate-related damage; perception of weather effects of climate change will be greater in the future; and perceived responsibility for climate changes.

Source: Author's own elaboration.

In the second phase, six tourist guides who provide professional services in the region were interviewed. Their perception was analyzed in relation to their profile, knowledge, and experience regarding climate change. The questionnaire was administered online using Google Forms (Table 2).

Table 2. Components of the questionnaire applied to tourist guides in the High Mountains Region of Veracruz.

Components	Items
1. Tour guide information	Name, age, years of experience in the tourism sector, highest level of education, and position in the company.
2. Experience	Do you know of any alternative tourism site that has been affected by climate change? Do you consider climate change an important factor affecting the permanence and viability of alternative tourism sites in the High Mountain Region of Veracruz?

Source: Author's own elaboration.

The third phase included interviews with the heads of the municipal tourism departments in the High Mountains Region, where at least one nature tourism center was located ($n = 23$). Their perception was analyzed in relation to their professional profile and experience regarding climate change. These questionnaires were applied in person (Table 3).

Table 3. Components of the questionnaire applied to municipal tourism department representatives in the High Mountains Region of Veracruz.

Components		Items
1.	Personal data	Name, Institution of origin or municipality of origin, years of experience in the tourism sector, work experience in the tourism sector, and current position.
2.	Experience	The main threats that you face in your alternative tourism site (adventure tourism, ecotourism, and rural tourism) in your municipality. Climate change is an important factor that threatens the presence and viability of alternative tourism sites (adventure tourism, ecotourism, and rural tourism) in the High Mountain Region of Veracruz.

Source: Author's own elaboration.

For the open-ended questions, content analysis was conducted using term co-occurrence maps generated with VosViewer version 1.6.14 (Van Eck & Waltman, 2010). Multiple-choice and Likert-type questions were analyzed through correspondence and factorial analysis, whereas dichotomous questions (yes/no) were examined using logistic regression. Statistical analyses were performed with R software (R Core Team, 2021), and spatial representation of the tourism sites was created using QGIS version 3.6 Noosa (QGIS Association, 2021).

Results

Interviewees profile

In the first stage, 43 interviewees participated: 72% (31) were men and 28% (12) were women, whose ages ranged from 27 to 78 years. Among them, 37% provide tourist services, while the majority have other sources of income (Table 4).

Table 4. Profile of the owners of alternative tourism sites in the High Mountains Region of Veracruz.

Variables	Frequency (n)	Percentage (%)
Gender		
Female	12	28%
Male	31	72%
Age		
Under 18	0	-
19-30	3	6.97%
31-45	15	34.88%
46-60	18	41.86%
Over 60	7	16.27%
Education level		
No studies	1	2.32%
Primary Education	12	27.90%
Middle school	3	6.97%
Technical degree	1	2.32%
High school	6	13.95%
Degree course	17	39.53%
Masters' degree	3	6.97%
Main occupation		
Agriculture	22	51.16%
Commerce	3	6.97%
Employees	1	2.32%
Touristic services	16	37.20%
Technical	1	2.32%

Source: Author's own elaboration.

In the second stage, six tour guides responded: 33% (2) men and 67% (4) women, ages 28 to 59, with experience ranging from 2 to 45 years in the tourism sector. Regarding educational level, 33% (2) had upper secondary education and 67% (4) had higher education.

In the third stage, 26 municipal tourism managers from the High Mountains Region of Veracruz participated, with an equal gender distribution (50% men and 50% women). Educational levels were as follows: 3.85% (1) technical, 11.54% (3) high school, 57.69% (15) bachelor's degree, 3.85% (1) master's degree, and 23.07% (6) did not respond. Experience in the tourism sector ranged from 0 to 10 years.

Knowledge about climate change

Among nature tourism site owners, 77% (33) reported that they knew the meaning of climate change. All tour guides (100%) indicated that they understood the concept. A co-occurrence map was created based on the responses to the question "What does climate change mean?" From 216 terms, 130 were selected for the map, forming eight clusters, with the term *climate* as central. Other frequently associated terms included change (12), rain (6), heat (5), and pollution (5) (Figure 2).

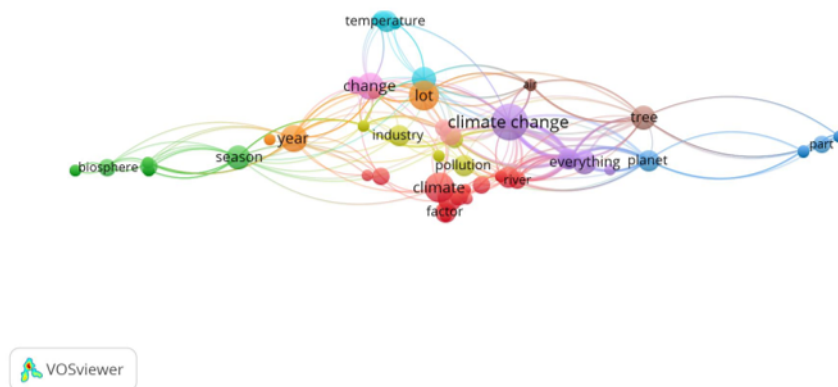


Figure 2. Co-occurrence map based on the question "What does Climate Change mean?".
Source: Author's own elaboration.

Table 5 presents the terms within each cluster, with colors assigned randomly by VosViewer 1.6.14 (Van Eck & Waltman, 2010).

Table 5. Terms identified in each cluster referring to the question "What does climate change mean?".

Cluster	Color	Items	Terms
1	Red	30	Fashion; events; nature; tree planting
2	Green	16	Cold; seasons; heat; duration; impact; modification; patterns; change
3	Blue	14	Deforestation; snowmelt; seasons; fertilizer; indiscriminate practices; industry; pollution; change; monoculture; volcanoes; nature; chemicals
4	Yellow	12	Crops; season; avoidance; sunshine potato
5	Purple	9	Cold; climate change; duration; states; heat; weather; changes
6	Sky blue	9	Climate change; air; glacial conditions; rain; deforestation; effects; water level; planting; trees felling
7	Standard orange	8	Atmosphere; extreme heat; extreme cold; climate change; pollution; world; planet
8	Dark orange	4	Environment, rivers; drying

Source: Author's own elaboration.

When asked which words they most associate with climate change, owners could select multiple options. High temperatures (41) were the most frequent term, while stronger and more frequent cyclones (29) were the least frequent (Figure 3).

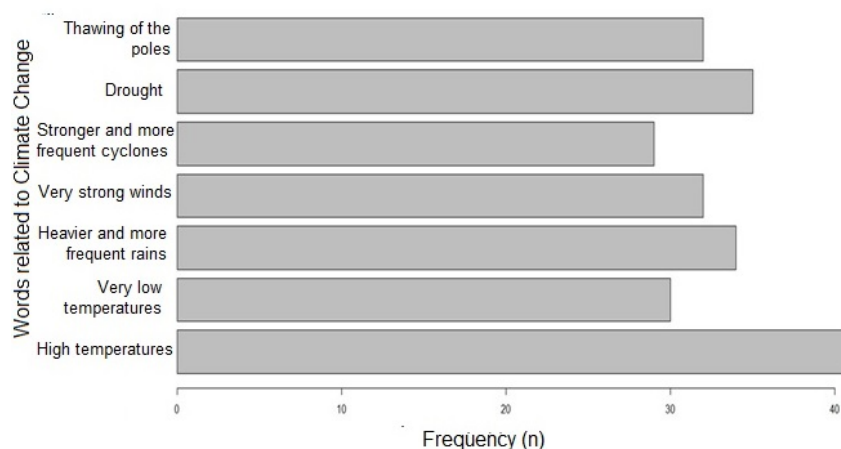


Figure 3. Frequency of the main words associated with climate change by owners of tourism sites.

Source: Author's own elaboration.

Regarding concern about climate change, 67% (29) of owners considered it a problem. Co-occurrence mapping of the responses revealed 88 relevant terms out of 147, forming three clusters. The term *rain* was central and linked to water channel impacts, water-related damage, and agricultural impacts (Table 6).

Table 6. Terms identified in each cluster referring to the question "Why does climate change represent a problem that you should be concerned about?".

Cluster	Color	Items	Terms
1	Red	17	Canal; layer; cities; scarcity; countryside; diseases; negative impact; industries; pollution; fertilizers; monocultures; nature; problems; ozone; skin
2	Green	8	Agricultural; custom; cycle; rain; sowing; season
3	Blue	6	Creation; excess; air; risks; scarcity

Source: Author's own elaboration.

Owners indicated that the general population (98%) should be primarily responsible for addressing climate change, followed by the federal government (79%), state government (74%), and municipal government (74%).

When asked whether climate change affects their tourism activities, 60% (26) reported that negative impacts exceed benefits, while 40% (17) identified more positive effects. Major impacts included low temperatures, drought, rainfall variability, pests, and reduced tourist inflow. One positive effect was the increase in heat, attracting more visitors to local sites (Figure 4).

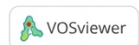


Figure 4. Co-occurrence map showing the main effects or benefits of climate change on tourist sites.
Source: Author's own elaboration.

The co-occurrence map for this question considered 108 terms and formed 16 clusters, with *impact* as the most prominent term (Table 7).

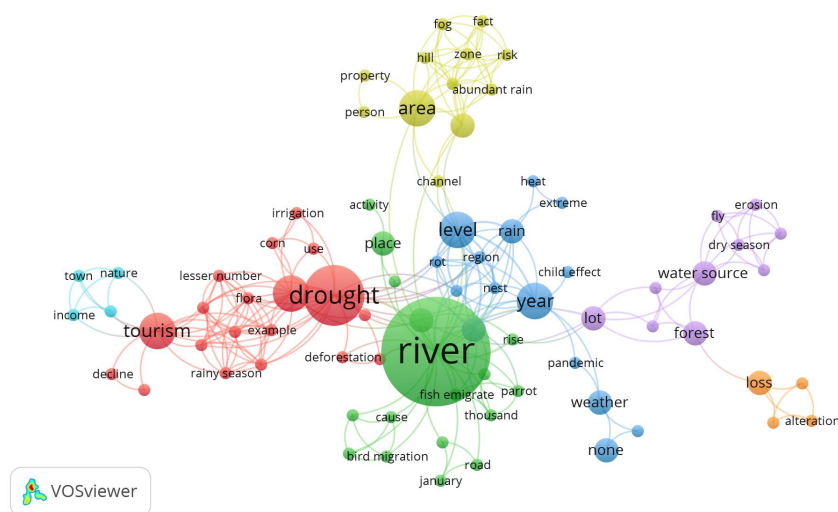
Table 7. Terms identified in each cluster referring to the question “What are the main effects or benefits of climate change in your tourist site?”.

Cluster	Color	Items	Terms
1	Red	16	Chiapas; corn; climate change; migration; parrots; complaints; pests; infection
2	Green	13	Activities; alterations; conservation; ecotourism; seasonal; nature; productive tourism; repair; deteriorations; become awareness
3	Blue	12	Changes; drought; affected; insects; torrential rains; mosquitoes; tourism; temperature; season
4	Yellow	11	Climate; area; cold; hot; places; beach
5	Purple	8	Intense heat; climate; cold; town; ecotourism
6	Sky blue	7	Effects; cold; drought; loss; temperatures; planting; tourists come
7	Standard orange	7	Heat; climate change; flight; occupation; crop irrigation
8	Dark orange	5	Fruit trees; pollution; fauna; production
9	Purple	4	Sometimes; heavy rain; growth; heat
10	Dark red	4	Low tourist demand; covid-19
11	Light green	4	Volcano; snowfall; tourists sightseeing tours
12	Ligh blue	4	Rain; drought; frequency
13	Yellow	3	Outdoors; degradation
14	Light lavender	2	River; drying
15	Light blue	2	Rain
16	Golden yellow	2	Temperatures; predictability

Source: Author's own elaboration.

What have you been the impacts of climate change on your resort in the last 10 years? Being the terms water availability (3) and river (3), those that have caused a major impact (Figure 5).

(Figure 5).



Source: Author's own elaboration.

(Table 8).

climate change in your tourist center in the last 10 years?"

Cluster	Color	Items	Terms
1	Red	12	Changes; drought; insects, torrential rains; lower number, mosquitoes; tourism; temperature.
2	Green	10	Year, level; impact, nests; drought, concerning; region; season.
3	Blue	7	Increasing; deforestation; palapas; places; river; drought, spring.
4	Olive green	3	Weather; pandemic.

Source: Author's own elaboration.

significant ($\beta = 5.55, p < 0.05$), while other variables showed no statistically significant effects.

Information and communication

and specialized magazines (4) as least frequent. For sources of climate change information, the Internet (26) was most frequently consulted, while specialized magazines were not used (0). Factorial analysis revealed a correlation of 0.92, grouping respondents into four clusters based on access and consultation patterns.

Approximately 51% of nature tourism owners reported checking the weather daily, while only 28% reported on climate change effects. The Internet and specialized magazines were considered the most reliable sources of information (Figure 6).

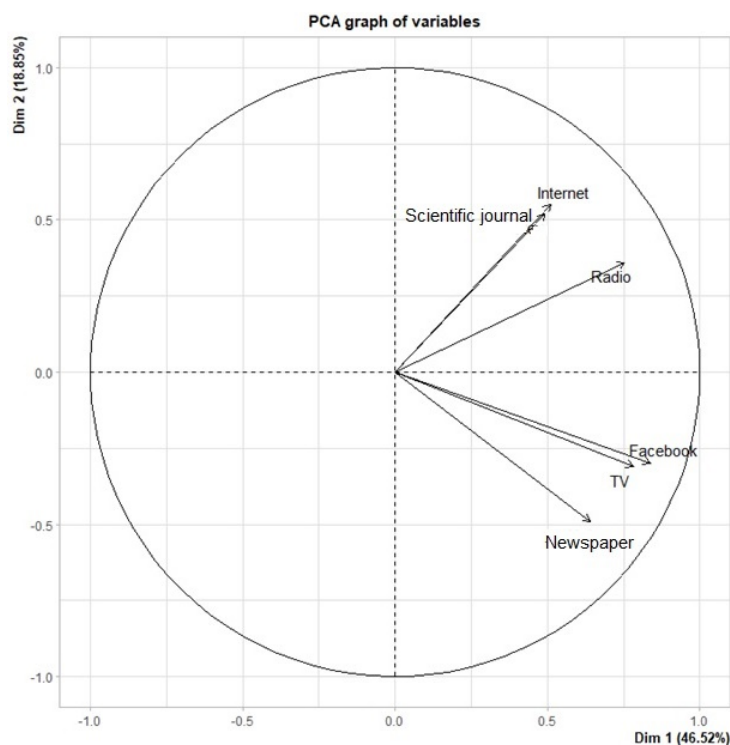


Figure 6. Perceived reliability of media reports on Climate Change.
 Source: Author's own elaboration.

Logistic regression showed that the likelihood of reporting weather daily increased by 0.168 units per unit increase in education level, while the likelihood decreased by 0.016 units per year of residence in the area. Reporting on climate change effects decreased by 0.014 units per unit increase in education level; however, none of these results were statistically significant.

Experience with climate change

Owners reported that cold and rainfall have increased over the last 10 years (Figure 7). They also observed more frequent and intense heat events.

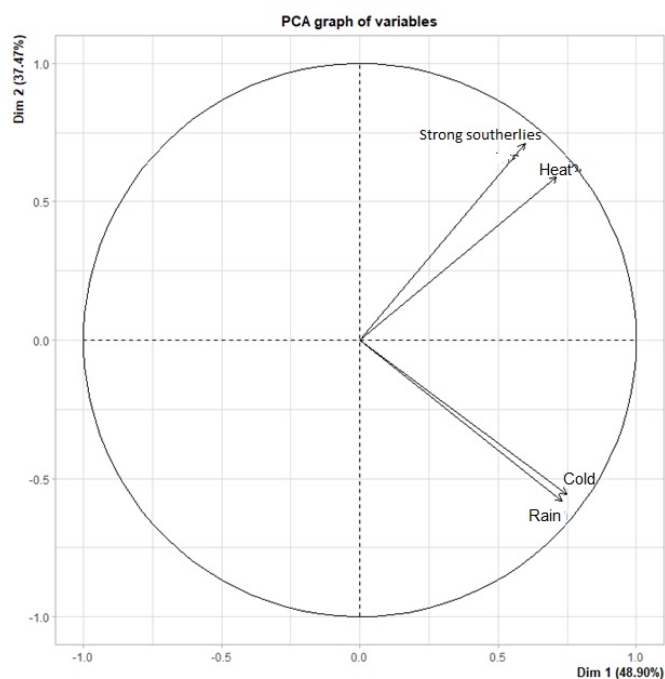


Figure 7. Owner perceptions of changes in rain and cold over the last 10 years.
 Source: Author's own elaboration.

The degree of recent climate impacts was assessed at the regional, community, and site levels. Overall, owners reported varying degrees of current climate impacts (Figure 8).

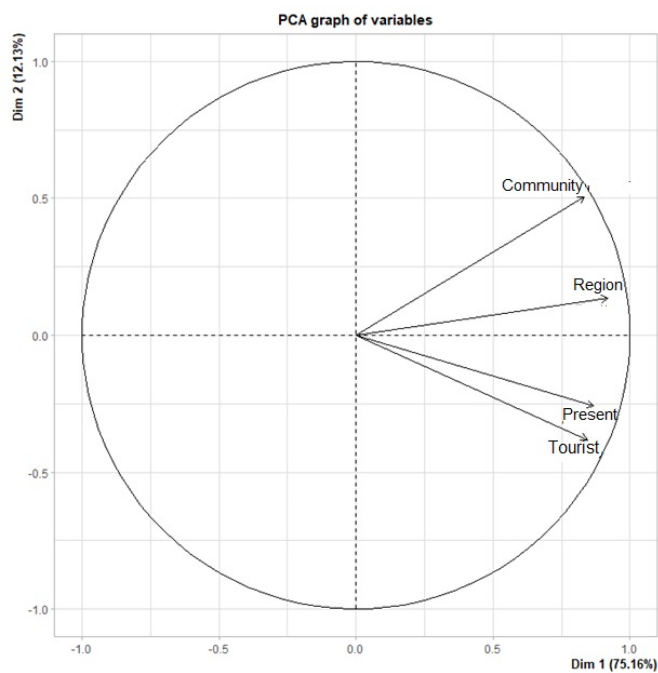


Figure 8. Degree of recent climate impacts at regional, community, and site levels in the last 10 years.
 Source: Author's own elaboration.

Logistic regression indicated that future expected climate effects increased by 0.4532 units per unit increase in education level, while decreasing by 0.016 units per year of residence; these effects were not statistically significant.

Municipal tourism managers identified 20 main threats to nature tourism sites (Table 9).

Table 9. Main threats faced by alternative tourism sites according to municipal managers.

	Threat	Frequency (n)	Percentage (%)
Environmental	River pollution	6	23%
	Damage to flora and fauna	1	4%
	Deforestation	8	31%
	Lack of marketing	1	4%
	Lack of awareness	3	12%
	Cattle-induced erosion	1	4%
	Pests	1	4%
	Illegal hunting	1	4%
	Lack of information dissemination lacking	2	8%
Social	Lack of information dissemination	2	8%
	Lack of training	2	8%
	Lack of cultural tourism	3	12%
	Lack of appreciation of historical heritage	1	4%
	Lack of organization	3	12%
	Lack of security lacking	8	31%
Economic	Lack of economic resources	7	27%
	Changes in political leadership	1	4%
Policy	Lack of government support	4	15%
	Lack of management tourism	1	4%

Source: Author's own elaboration.

All managers (100%) considered climate change a critical factor threatening the sustainability and viability of ecotourism sites. Water-related events, such as extreme rainfall and landslides, were highlighted as significant threats affecting activities like birdwatching (Figure 9).

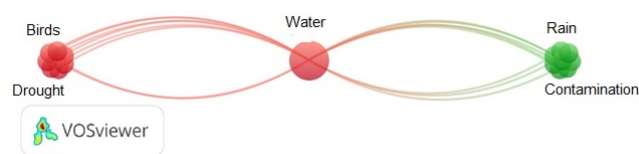


Figure 9. Climate change as a threat to the sustainability and viability of alternative tourism sites.
Source: Author's own elaboration.

Discussion

The profile of the interviewees reveals that the owners of alternative tourism sites are predominantly men, which may reflect the economic diversification strategies commonly used in rural contexts, where tourism complements agricultural income. In contrast, women are more frequently represented among tour guides and municipal tourism managers, assuming different social and professional roles within the sector. Across all three groups, higher education is prevalent, which, according to Barnes *et al.* (2013), is associated with greater awareness of environmental risks. Nevertheless, as Van der Veecken *et al.* (2016) emphasize, continuous education remains essential to strengthen knowledge related to climate change.

The triangulation of perceptions among owners, guides, and tourism managers coincides with the domains of knowledge described by Loehr & Becken (2021) –academic, practical, and political–, confirming the relevance of considering these different actor groups. However, despite expressing awareness of climate change, only 40% of owners demonstrated a coherent social representation of the phenomenon. Their responses reveal a limited conceptual understanding, mainly associating climate change with agricultural impacts and, to a lesser degree, with tourism. This interpretation appears to be influenced by land use and the owners' dependence on primary activities.

Local experience with extreme events, such as hurricanes Karl in 2010 and Earl in 2016, illustrates how direct exposure shapes perception. While Karl was widely remembered for its strong effects, Earl was largely overlooked, suggesting that isolated and infrequent events do not consolidate climate change as a tangible threat among participants. As Wyss *et al.* (2014) point out, climate variability is rarely integrated into tourism management decisions, and in this region, adaptation strategies linked to ecosystems remain absent. The lack of leadership or proactive attitude toward climate change observed in this study reflects this pattern.

Perceptions of tourism fluctuation further support this interpretation. Sixty percent of the owners perceive climatic variations as negative for their activity, especially temperature and rainfall changes. Similar findings were reported by De Urioste-Stone *et al.* (2016), who observed that tourists' decisions are influenced by perceived climatic risks. Consequently, tourism in the High Mountains Region of Veracruz shows high dependence on weather conditions, consistent with the observations of Méndez-Lázaro *et al.* (2014).

Information access also shapes perception. Although 81% of respondents reported Internet access, only 60% seek climate-related information online. In some cases, owners still rely on traditional practices –such as cloud observation– to predict weather conditions, indicating intergenerational knowledge transmission. According to Becken *et al.* (2013) and Torres *et al.* (2017), exposure to climate information through media increases public awareness and risk perception, a relationship that appears weak in this context.

Overall, the owners' moderate perception of climate risks may be attributed to the limited impact of extreme events on most tourism sites and their stronger identification with immediate environmental conditions. As Gómez *et al.* (2017) and Agyeman (2019) suggest, people with direct connections to nature exhibit higher ecological cognition, yet this does not necessarily translate into adaptive actions. Thus, while alternative tourism in this region can benefit from climatic variability, it also faces growing vulnerability to its effects, including hydrometeorological disturbances and associated public health risks (Scott *et al.*, 2011).

Recent official reports and scientific assessments indicate that Veracruz is one of the Mexican states most exposed to climate change-related risks, including rising temperature, variability in precipitation patterns, and an increased frequency of hydrometeorological events such as heavy rainfall, flooding, and landslides (Gobierno del Estado de Veracruz, 2025; Instituto Nacional de Ecología y Cambio Climático, 2020). These impacts are particularly significant in mountainous regions, where steep topography and ecosystem sensitivity amplify vulnerability to extreme climatic events. In this context, the limited and fragmented perception of climate change observed among tourism sector stakeholders contrasts with the documented regional climatic trends and risks. This discrepancy highlights a gap between scientific or institutional knowledge and the perceptions of local tourism actors, underscoring the need to strengthen communication channels and knowledge-transfer mechanisms regarding the impacts of climate change on the tourism sector.

Conclusions

Although most owners of nature tourism centers in the High Mountain Region of Veracruz reported being aware of climate change, their understanding remains superficial and primarily linked to observable consequences, especially in agriculture. Few recognize climate change as a significant problem, and many believe that the general population, rather than local actors, should address it. Media and formal education play a limited role in shaping their perceptions, while personal experiences, such as temperature or rainfall changes, are more influential. Overall, the owners lack a clear conceptual understanding of what climate change entails, its magnitude, and how it differs from natural climate variability. Strengthening environmental education, integrating local knowledge, and promoting adaptation strategies within the tourism sector could enhance their awareness and resilience.

To address this limited understanding, a series of targeted measures could be implemented to enhance climate change awareness among stakeholders in the tourism sector within the High Mountains Region of Veracruz. Firstly, structured training programs and workshops directed at tour operators and guides should be developed, emphasizing the impacts of climate change, risk management strategies, and principles of environmental sustainability. Secondly, improving access to reliable and timely climate information through digital platforms, social media channels, and local tourism networks could substantially enhance the stakeholders' knowledge and perception of climate-related risks. Thirdly, fostering collaboration among universities, government agencies, and local tourism organizations could facilitate the dissemination of scientific knowledge and the incorporation of climate considerations into tourism planning and decision-making processes. Collectively, these initiatives could strengthen the adaptive capacity of tourism stakeholders and promote a more resilient and sustainable management of nature-based tourism in the region.

Acknowledgements

This research was supported by the National Council of Science and Technology (CONACYT), currently the Secretariat of Science, Humanities, Technology and Innovation (SECIHTI), through a doctoral scholarship in Tropical Agroecosystems Sciences. Additional funding was provided by the College of Postgraduates, Campus Veracruz. The authors thank Dr. Catalina Frank Hoeflich, Deputy Director of Academic Dissemination, and Dr. Adriana Elisa Espinosa, Deputy Director of Knowledge Dissemination, for their valuable assistance during the Scientific Writing Workshop in English (CEMAI).

Conflict of interest

The authors declare that there are no conflicts of interest.

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