International Journal of Religion
2024
Volume: 5| Number 10 | pp. 4018 – 4028
ISSN: 2633-352X (Print) | ISSN: 2633-3538 (Online)
ijor.co.uk
DOI: https://doi.org/10.61707/67eg7b86

Limit of Acceptable Change, Sustainability Tool in a Tourist Attraction in Peru

Huaroc Ponce Edwin Jhon[1], Jurado Taipe Ralph Sandy[2], Raqui Ramirez Christian Efrain[3], Duran Ttito Corina Nanci[4], Huaroc Ponce Nilton Marx[5] and Zevallos Gallardo Zoila Verónica[6]

Abstract

Human activity has negative impacts; methods and techniques have been developed to achieve harmony in the ecosystem. One method in tourism is the Limits of Acceptable Change (LAC). The objective was to determine the acceptable limits of change in the Huagapo cave using a quantitative-qualitative approach through literature review, interviews, surveys, and the application of this methodology. It was found that zone 1 (parking area) has the presence of invasive vegetation. Zones 3, 4, and 5 have a high degree of impact on endemic vegetation. Zone 6, a primitive trail, has a medium impact on the trail width, with invasive vegetation (eucalyptus, cypress) and invasive animals (dogs, pigs) threatening endemic flora and fauna (quinumal, amphibians), affecting biodiversity and ecological balance. It is concluded that zones 1, 3, 4, and 6, with high and medium impact, require efforts in preventing deterioration and maintaining the balance of the tourist attraction.

Keywords: *Ecoturismo, Turismo Sostenible, Sostenibilidad, Ecología, Ambiente.*

INTRODUCTION

Tourism is one of the economic activities that generates the most income for the balance of payments in many countries (Laurente & Machaca, 2020; Picazo-Córdoba et al., 2021) and acts as a springboard for the development of other sectors, including construction, agriculture, food industries, biopharmaceuticals, foreign trade, transportation, and communications (Hosteltur, 2020). Currently, the tourism industry is experiencing one of its worst crises due to the spread of COVID-19 (Y. Yang et al., 2020), various countries have implemented policies to ensure the survival of companies and to encourage tourists to visit destinations for the proper reactivation of Tourism (Enseñat-Soberanis et al., 2020; Félix & Reinoso, 2020).

In recent years, tourist behavior has shifted towards connecting with natural spaces (Perruolo & Camargo, 2017; H. Yang, 2017), Ecotourism activities are part of sustainable practices that generate income and environmental education for both residents and visitors to maintain resources (Perruolo & Camargo, 2017; Yi et al., 2022). Sustainable tourism refers to the current and future care of social, economic, and environmental aspects (Blancas et al., 2010), it is crucial to establish limits to extend the lifespan of resources for future generations (Huaroc-Ponce et al., 2021; Segrado et al., 2017; Simancas, 2006).

For ecotourism activities to be significant, planning in natural spaces is necessary. Various methodologies exist to mitigate damage to the tourist resource (López & López, 2008; Varisto et al., 2009) such as Tourism Carrying Capacity (TCC), Visitor Impact Management (VIM), Limits of Acceptable Change (LAC), and Visitor Activity Management Program (VAMP). It is essential that these methodologies are studied and valued so that the sustainably managed resource can endure for many years (Gutiérrez, 2013; Gutiérrez-Fernandez et al., 2021).

All human activities have negative impacts on nature(Cornejo et al., 2019; Soria-Díaz et al., 2022), as a response, concepts such as sustainability were established, which are evident in tools like Tourism Carrying Capacity (TCC) and Limits of Acceptable Change (LAC). These tools help set limits to ensure that the tourist resource

[1] Universidad Nacional del Centro de Perú, Huancayo, Perú, https://orcid.org/0000-0001-5559-5054, Email: ehuaroc@uncp.edu.pe

[2] Universidad Nacional del Centro de Perú, Huancayo, Perú, https://orcid.org/0000-0002-5330-8434. Email: rjurado@uncp.edu.pe

[3] Universidad Nacional Intercultural de la Selva Central Juan Santos Atahualpa, Perú, https://orcid.org/0000-0003-1081-8773, Email: craqui@uniscjsa.edu.pe

[4] Universidad Nacional de San Antonio Abad del Cusco, Perú, https://orcid.org/0000-0002-2950-0223, E-mail: corina.duran@unsaac.edu.pe

[5] Universidad Nacional Daniel Alcides Carrión, Perú, https://orcid.org/0000-0002-7179-566X, Email: nhuarocp@undac.edu.pe

[6] Universidad César Vallejo, Perú, https://orcid.org/0000-0003-3213-8226, Email: zzevallos@ucv.edu.pe

does not degrade over the years (Muñoz & Cárdenas, 2019).

Theoretical Framework

Theory of Sustainability

Between the 1960s and 1970s, awareness of the environment began to grow, and all human activities were analyzed with the characteristic of rationality (Arévalo, 2020; Duque & Morère-Molinero, 2019), in 1972, "The Limits to Growth" was published, a scientific document commissioned by the Club of Rome. This document concluded that if pollution, population growth, resource depletion, and industrialization continue, our planet will reach its limits within the next 100 years (Meadows, 1972).

In 1987, the United Nations (UN) Environment Commission presented global economic development in relation to environmental sustainability (Castilla, 2009; Jaimes C. et al., 2017), marking the beginning of various congresses such as Agenda 21 in Brazil, which emphasized the preservation of natural resources (United Nations, 1992; Vázquez, 2009), starting in 1996, the Habitat conferences were established, with the third conference taking place in Ecuador in 2016. These conferences urged cities to become places of hope, health, happiness, and dignity, where economic and environmental development go hand in hand (Casas et al., 2018; Toriz G et al., 2018). Subsequent tourism conferences related to sustainability include: the Sustainable Tourism Charter in Lanzarote (United Nations et al., 1995), the renowned green economy with the conference "The Future We Want" (United Nations, 2012) and the three UN Sustainable Development Goals related to tourism activities (Global SustainableTourism Council (GSTC) & Responsible Tourism Institute (RTI), 2015).

The LAC Methodology

How much change is acceptable to enjoy a landscape in harmony is what the Limits of Acceptable Change (LAC) proposes, it provides suggestions when there are substantial changes in the natural environment (Stankey et al., 1985) and ensures the sustainable balance of the location and the social needs of both visitors and the surrounding population (Yusoh et al., 2020). In fact, this process was designed to demonstrate the failure of the "carrying capacity" approach in visitor management applications (Yusoh et al., 2020). The LAC concept is widely used in fields such as nature studies (Roggenbuck et al., 1993), tourism design and development (Ahn et al., 2002), environmental impact assessment of activities in the Great Barrier Reef Marine Park (Wachenfeld et al., 1997) and monitoring changes in the biology of non-latent organism populations (Marsh, 1995).

LAC In Tourism

The LAC methodology that will be used in this research provides a pathway to protect tourist resources, considering that everyone can enjoy nature with an excellent tourist experience while also doing so sustainably. It analyzes that visitor behavior is the main threat when visiting natural areas (Muñoz & Cárdenas, 2019).

The LAC methodology helps determine the rates or limits for the use, exploitation, and sustainable use of natural elements in a destination through public use planning actions (Natural Commision of Protected Natural Areas, 2018).

METHODOLOGY

Limits of Acceptable Change (LAC) Methodology

This methodology has 9 steps for implementation (Stankey et al., 1985).

Step 1 – Identify Problems and Concerns

The first step is essential as it seeks to manage public issues and the individual characteristics of the place of interest. It involves analyzing opportunities and problems that deserve attention. Managers and the local population describe the areas that need attention, poor management, and ways to solve these issues. Visitors also participate by providing their opinions about the place.

Step 2 – Define and Delimit Areas of Opportunity

Each tourist attraction has different zones with various characteristics. The delimitation of these areas for timely

and correct management is known as opportunity classes. Additionally, there is the Recreation Opportunity Spectrum, which takes into account the following: access, use of non-recreational resources, facility management, social interaction, visitor impact acceptability, and acceptable conditions.

Step 3 – Select Indicators for Natural Resources and Social Conditions

Indicators provide quantitative information related to the concerns of stakeholders in each opportunity class and the changes for recreational use. These procedures serve as a basis for the next step.

Step 4 – Inventory Existing Natural Resources and Social Conditions

An inventory and measurement of indicators are conducted, identifying their unit of analysis and obtaining more information to understand the actions needed and where to implement them.

Step 5 – Establish Standards for Indicators of Natural Resources and Social Components According to Each Opportunity Class

This step seeks to establish conditions for each indicator, ensuring they are acceptable and appropriate. This process uses the LAC (as the limit condition for each opportunity class), comparing existing conditions with what is deemed acceptable.

Step 6 – Definitively Identify Alternative Opportunity Class Designations

Using the problems and concerns identified in Step 1 and the inventory of conditions, opportunities are identified in each sector from Step 4. This results in decisions about the achievable conditions for the tourist attraction.

Step 7 – Identify Management Measures for the Opportunity Class

Specific identification of areas with problems and actions to solve them, achieved by combining Steps 4 and 5.

Step 8 – Evaluate the Best Alternative Opportunity Class

Select the best option by analyzing benefits, actions, and costs.

Step 9 – Monitor Conditions

This is the final step of the methodology and involves implementing the opportunity class. Monitoring is essential to ensure compliance with the proposed conservation measures.

RESULTS AND DISCUSSION

Step I: Identify Problems and Concerns in the Area

The key stakeholders of the Huagapo Cave tourist attraction can be considered to fall into four main groups: the cave's management committee (ticket office), tourists who visit the cave, tour guides and coordinators, and the nearby population that benefits directly and indirectly from tourism. Information is gathered regarding the concerns of these stakeholders.

Table 1Key actors and problems, concerns detected

Key Actor	Participant number	Problem and concern identified
The management committee	3	• The pandemic caused the closure of visits to the cave, preventing the entry of visitors.. • Before the pandemic, there were peaks in visits during the high season, which somehow caused annoyance to visitors due to overcrowding. • Currently, visits from local and national tourists are slowly increasing, especially on weekends when visits to the cave are more frequent. • There is invasive vegetation (pine, broom, eucalyptus, and barbasco) threatening the native vegetation. • The surrounding population providing complementary services to tourists does not offer the required quality of service.
Tourists	12	• There is limited complementary information about the cave.

		• There are no complementary activities to the visit. • The provision of complementary services is rudimentary.
Tourist guides and counselors	5	• Travel agencies and visitors often do not wish to hire the service offered for their satisfaction • The payment for the service provided to travel agencies and tourists is inadequate. • There is no formally established association to protect the rights of local guides and tour coordinators.
Nearby population	5	• The complementary services are sold out only during the peak high season. • There is unfair price competition among the providers around the attraction.

Step II: Define and Describe Opportunity Classes

Considering that the external and internal spaces, as well as the path leading to the cave, are not homogeneous and have sections with different characteristics, it facilitates a more straightforward and realistic evaluation of the cave. This involves assessing each external and internal space and path to determine the current state and the opportunity class.

Zone 1, 2, 3, 5

Current State: The delimitation of each zone is inadequate, especially for those that are adjacent (recreation, rest areas, park), presenting some difficulty in transitioning between zones. There are also some modern impacts in zones 1, 3, and 5 (infrastructure).

Opportunity Class: The zones can be better signposted, and the infrastructure can be improved to minimize impacts (degradation) on the cave.

Zone 4, 6

Current State: The external path to the cave is not precisely marked in the first section. The access in this section, as well as inside the cave, is compacted due to the number of visitors (foot traffic). The internal and external rest stations are not regularly maintained, leading to negative impacts (landscape distortion). During peak high seasons, the transit in the internal path of the cave is complicated due to its dimensions in some sections and the number of people entering.

Opportunity Class: In both the internal and external sections, which can be considered semi-primitive, infrastructure works should be adapted to minimize landscape deterioration. This aims to improve visitor satisfaction, enforce regulations and norms, and thus control the negative impacts on the tourist resource.

Figure 1. Huagapo Cave Areas

Note. (Huaroc et al., 2021)

Step III: Selection of Indicators for Natural Resources and Social Conditions

In this step, the concerns of the stakeholders in the cave and the opportunities were considered. This allows for the identification of the variables mentioned in Step IV, which help in identifying actions for their management..

Table 2Factors and Indicators of the Huagapo Cave

	Factor	Indicator	Indicator construction
Social	Tourist perceptions	Tourist dissatisfaction	Visitor dissatisfaction = the number of people who are not satisfied with the service provided and the condition of the terrain / Total number of people surveyed * 100
Resources	Trail conditions	Average trail width	Average trail width = (of the widths of the trails in meters) / (total data collected from trail widths)
		Percentage of trails	walking trails = (length of alternative trails in the section) / (total length of the section)*100
	Threatened and endangered plant species	Percentage of quinuals affected by tourist activity	% affectation of quinuals = (#affected quinuals) / (#total quinuals)*100
	Plant species that represent danger	Percentage of presence of pine, eucalyptus, broom and barbasco	% presence of pine = (#of individuals found) / (0.2* total length of the section)

Step IV: Inventory of existing natural resources and social conditions

Table 3The existing resources and social conditions for the 6 zones in the Huagapo Cave

The inventory of natural resources and social conditions were worked on the field.

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Tourist dissatisfaction	22%	12%	27%	15%	24%	10%
Dissatisfaction with average trail width	-	-	-	17%	-	9%
Percentage of Quinuales affected by tourism	19%	5%	12%	29%	9%	-
Percentage of presence of invasive plant species (pine, broom, eucalyptus and mullein)	28%	4%	22%	37%	11%	-

Step V: Standards for Indicators of Natural Resources and Social Components According to Each Opportunity Class.

The study aims to establish acceptable conditions for the indicators, considering their impact, importance, and opportunity class for each zone. The results show a 72% satisfaction rate in both internal and external sectors, with 28% of tourists dissatisfied with the quality of service and the conditions offered in these sectors.

The average width of the internal and external paths, the minimum and maximum range, depends on the segments of the route, visitation conditions, seasonality, and the load on the tourist attraction, excluding alternate paths.

An endangered species is the quinual or queñoal, an ancient tree in high Andean forests. This species plays a crucial role in water regulation, soil protection, and carbon capture. Invasive plant species include pines, eucalyptus, broom, and barbasco, which alter the ecosystem of the tourist attraction. The presence of visitors at the attraction does not pose a significant threat to endemic species.

Table 4Evaluation scale for each indicator of the 6 zones in the Huagapo Cave

Opportunity class	Factor	Indicator	Rule	Risk scale
Semi-primitive / Semimodern	Tourist perceptions	Visitor dissatisfaction	There cannot be a dissatisfaction greater than 50%	Low = 0% - 10 Medium = 11% - 40% High = 41 en adelante
	Area conditions	Average trail width	Optimal width between 50cm and 150cm	Low = 50 cm to 150 cm Medium = les than 50 cm or greater than 150cm a 200cm High = greater than 200cm
	Threatened and endangered	Percentage of quinuals affected	The percentage of affectation of the	Low =0%

	plant species	by tourist activity	quinuals must be 0%	Medium= 0.1% - 50% High = greater than 50%
	Plant species that represent danger	Percentage of presence of pine, barbasco, eucalyptus and broom	The presence of invasive species in the attraction must be 0%	Low = 0% Medium =5% - 15% High= greater than 15%

Step VI: Identification of Opportunity Class Alternatives, Concerns, Social Conditions, and Existing Resources

To assess the risks, it was necessary to evaluate the opportunities, stakeholders' concerns, social conditions, and existing flora. This was done using four-level ranges with a color and score for visualization and identification of intervention priorities based on the indicators' scores.

Table 5

Range for risk assessment

Color	Intervention priority	Intervention Scale Range
	Low	4-6
	Medium	7-8
	High	≥9

Tabla 6

Range to identify priorities

Color	Scale	
	Risky	Rank
Verde	Low	1
Anaranjado	Medium	2
Rojo	High	3

According to the established range and proceeding with the evaluation of the four indicators for the six defined zones in the Huagapo Cave, the following results are shown.

Table 7.Conditions of the Evaluated Indicators for Each Section and Score on the Intervention Scale

Zone	% of Affected Quinual Trees	Average Width of the Paths	Presence of Invasive Vegetation	Visitor Satisfaction	Total
1	2	2	3	1	8
2	1	2	2	1	6
3	3	2	2	1	8
4	3	2	1	1	7
5	3	3	1	1	8
6	1	2	1	1	5

According to the ranges observed in Table 7, the priority for intervention in each of the zones of the Huagapo Cave can be identified:

Zone 1: High level of intervention priority due to the presence of invasive vegetation.

Zone 2: Medium level of intervention priority due to the average width of the path and the presence of invasive vegetation.

Zones 3, 4, and 5: High level of intervention priority due to affected quinual trees, with Zone 5 also having a high priority for the width of the path and Zones 3 and 4 having a medium priority for the width of the path.

Zone 6: Medium level of intervention priority due to the width of the path.

Step VII: Identification of Measures for Opportunity Management

During visits to the "Huagapo Cave" tourist site, insufficient infrastructure and service were observed, especially during peak seasons, along with some negative impacts on the ecosystem that could degrade the area. Therefore, it is necessary to implement measures to reduce certain alterations or modifications to the current situation, considering four categories for this step:

Preventive Measures: To avoid the negative effects of visits and the use of spaces.

Mitigation Measures: To reduce the negative effects of certain uses of the attraction zones.

Corrective Measures: To repair what has been affected in the area.

Compensation Measures: To compensate the area for the negative actions that affect it.

For certain measures and opportunities, it was considered to implement them in each previously mentioned section. In the case of preventive and compensation categories, these measures are general for the entire site and are as follows:

Preventive Management Measures:

Education Plans for Sustainable Development: These will contribute to the knowledge of the social environment and its conservation.

Awareness Talks: Focused on ecological importance, social aspects, preservation, signage, waste management, and the removal of invasive species.

Cifuentes Methodology (1999): Suggests considering the maximum number of visits to a tourist site to avoid environmental degradation.

Control of Endemic and Non-Endemic Species: Non-endemic species may appear for various reasons and need to be controlled through monitoring, as they could affect the endemic species of the area.

Provision of Services: Services should be adequately managed through a control post with the necessary amenities, including meeting areas, health areas, recreational areas, and dining spaces to satisfy visitors.

Guides: Should be trained and fully knowledgeable about their service, including control, accompaniment, and monitoring, to prevent aggression and littering in the area.

Compensation Measures:

Implementation of Conservation Plans for Endemic and Migratory Species: A control or monitoring system for local and migratory species should be considered, including a census and characterization for conservation purposes. Additionally, the funding sources and feasibility of the procedure should be analyzed.

Mitigation Measures

Signage: Signs should be well-identified and placed in visible areas to prevent people from getting lost or engaging in unauthorized activities in designated spaces. They should indicate paths and the boundaries of each section approximately every 100 meters.

Visibility and Clarity of Signs: Signs should be visible and clear from a distance.

Path Width: Paths should be standardized to prevent the creation of new routes that could compromise planned conservation efforts.

Path and Space Delimitation: To control and manage spaces, especially during peak seasons, all sectors should be clearly marked with signs, posts, ropes, or fences to prevent visitors from impacting the area's flora and fauna.

Corrective Measures

Concrete Benches: These are used for visitors to rest during the tour, especially in zones 4 and 5. However, they detract from the natural appearance of the area and should be made from local materials to avoid altering the surroundings.

Natural Shade: The areas where visitors stay should have natural shade (local trees) to prevent visitors from becoming overheated during their visit and to avoid cutting down trees, especially endemic ones.

Steps: In some parts of the tour, particularly in zone 4, steps should be implemented for both ascent and descent to prevent accidents due to the excessive slope of the path.

These proposals can increase the tourist carrying capacity of the resource, leading to higher income for the local population, as well as enhancing service provision and visitor satisfaction.

Table 7. Proposed Management Measures for each section

Types of Measures	Management Measure	Z1	Z2	Z3	Z4	Z5	Z6
Preventive Measures	Education Plans for Sustainable Development	X	X	X	X	X	X
	Awareness Talks	X	X	X	X	X	X
	Carrying Capacity	X	-	X	X	X	X
	Control of Endemic and Non-Endemic Species	X	-	X	X	X	X
	Provision of Services	X	X	X	X	X	X
	Guides	X	-	X	X	X	X
Compensation	Implementation of Conservation Plans for Endangered Endemic and Migratory Species	X	-	X	X	X	X
Mitigation	Signage	X	X	X	X	X	X
	Path Width	-	-	-	1.50*	-	0.50*
	Space and path delimitation	X	X	X	X	X	X
Correction	Rest Benches	X	-	X	X	X	-
	Natural Shade	X	-	X	X	X	-
	Steps	-	-	-	X	-	X

Step VIII: Evaluation of the Best Opportunity Class Alternative

The proposed alternatives for improving the environment in the Huagapo Cave are the most suitable so far, given the particularity of the area and its resources. Therefore, this part is not developed as it is a medium-term task that will need to be carried out by the stakeholders.

Step IX: Monitoring Conditions

The proposed methodology requires a series of actions, particularly monitoring and evaluating the execution of the implemented actions. It is important to note that the research work only proposes the indicators, as their implementation for evaluation has not yet been carried out.

Subsequently, the data obtained from monitoring can help evaluate the proposed actions. If this process determines that conditions have improved, these actions should be maintained. Conversely, if conditions have deteriorated, they should be evaluated and revised with new actions.

DISCUSSION

The use of the Limits of Acceptable Change (LAC) methodology and the involvement of stakeholders in the Huagapo Cave helped identify their concerns through teamwork.

According to the evaluated areas, zones 3, 4, and 5 are more affected concerning the quinual trees (Polylepis racemosa), and zone 6 regarding the average width of the path. Additionally, zones 1, 3, 4, and 5 are affected by the presence of invasive vegetation. These factors must be considered as they are indicators for the Limits of Acceptable Change (LAC) in the Huagapo Cave. Corrective measures should be taken to avoid modifying or disturbing the ecosystem of this tourist resource..

As mentioned by (Gómez et al., 2016) , the previous results obtained with the tourism carrying capacity methodology proposed by Miguel Cifuentes facilitate easier management and quicker application of the Limits of Acceptable Change (LAC), considering the demand of visitors to the site or tourist attraction. The author also notes that the LAC methodology focuses on addressing the concerns of stakeholders involved in the tourism activity to ensure better visitor satisfaction, proper host service, and minimal resource deterioration without damaging the ecosystem of the area.

CONCLUSIONS

The study of the limit of acceptable change (LAC) in ecosystems is crucial for the sustainable management of tourism, evaluating its impact on ecological balance. Invasive vegetation can significantly alter ecosystems by competing with native species for resources. In this study, three species of invasive plants were identified:

eucalyptus (Eucalyptus globulus), cypress (Cupressus sempervirens), and barbasco (Lonchocarpus urucu). These species have demonstrated a remarkable ability to adapt and proliferate, displacing native flora (Lone et al., 2019). In contrast, endemic vegetation, such as quinumal (Okisuar), plays a fundamental role in preserving local ecosystems. Quinumal is essential for maintaining soil structure and providing habitat for various fauna species. The conservation of these endemic plants is vital to protect regional biodiversity (Werneck, 2011). Invasive domestic animals, such as dogs (Canis lupus familiaris) and pigs (Sus scrofa domesticus), pose a significant threat to native fauna. These animals can prey on or compete with local species, altering food chains and negatively impacting endemic animal populations (Glen & Dickman, 2005). Endemic animals, especially amphibians like frogs and toads, have faced an alarming decline in their populations, reaching the point of local extinction in some cases. The loss of these amphibians not only represents a loss of biodiversity but also disrupts insect control and other ecological functions these animals perform (Stahl, 2013).

Zone 1 (parking) has a high level of impact concerning invasive vegetation and a medium level of impact concerning the average width of the path and the depredation of the quinual, a typical shrub. Zone 2 (restrooms) has a medium level of impact concerning the average width of the path and the presence of invasive vegetation. Zone 3 (recreation) has a high level of impact concerning the typical shrub and a medium impact on the indicators of the average width of the path and the presence of invasive vegetation. Zone 4 (external path) has a high level of impact concerning the disappearance of typical vegetation and a medium impact concerning the average width of the path. Zone 5 (rest area) has a high level of impact concerning the depredation of native vegetation and the average width of the path. Zone 6 (internal path) shows a medium impact concerning the average width of the path.

Finally, implementing measures for the proper management and handling of the Limits of Acceptable Change (LAC) significantly aids in the comprehensive management of the resource or tourist attraction or the area of tourism development. This, in large part, helps or allows an increase in carrying capacity and enhances the visitors' experience. It also helps identify the areas that require more attention and management from stakeholders, thus avoiding the deterioration of the tourist attraction, in this case, the Huagapo Cave.

REFERENCES

Ahn, B., Lee, B., & Shafer, C. S. (2002). Operationalizing sustainability in regional tourism planning: An application of the limits of acceptable change framework. Tourism Management, 23(1), 1-15. https://doi.org/10.1016/S0261-5177(01)00059-0

Arévalo, G. J. (2020). Modelos turísticos y desarrollo sustentable: Análisis teórico: Vol. II. Universidad Nacional Autónoma de México y Asociación Mexicana de Ciencias para el Desarrollo Regional A.C, Coeditores. http://ru.iiec.unam.mx/5123/

Blancas, F., Gonzales, M., Guerrero, F. M., & Lozano, M. (2010). Indicadores sintéticos de turismo sostenible: Una aplicación para los destinos turísticos de Andalucía. Revista Electrónica de Comunicaciones y Trabajos de ASEPUMA, 11, 85-118.

Casas, U., Carrillo, A., & Rodríguez, R. (2018). Ciudad inteligente: Una aproximación epistemológica. (Vol. 1). Universidad Nacional Autónoma de México y Asociación Mexicana de Ciencias para el Desarrollo Regional A.C, Coeditores. http://ru.iiec.unam.mx/4211/

Castilla, C. (2009). Sostenibilidad, concepto guía para el eterno debate entre economía y medio ambiente. Revista Economía, 15, 105-122.

Comisión Nacional de Áreas Naturales Protegidas. (2018). Estudio de Límite de Cambio Aceptable Parque Nacional el Chico.

Consejo Global de Turismo Sostenible (GSTC) & Instituto de Turismo Responsable (RTI). (2015). Carta Mundial de Turismo Sostenible ST+20. Cumbre Mundial de Turismo sostenible, Vitoria-Gasteiz, País Vasco, España. http://cartamundialdeturismosostenible2015.com/wp-content/uploads/2016/05/Carta-Mundial-de-Turismo-Sostenible-20.pdf

Cornejo, J. L., Chávez, R. M., & Bravo, M. L. (2019). Capacidad de carga turistica de la Playa Punta Perula y Playa Isla Cocinas como estrategia para un uso turistico sustentable. CIMEXUS, 14(2), Article 2.

Duque, C. M., & Morère-Molinero, N. (2019). Analysis of social carrying capacity of the French Way for the Camino de Santiago: A quantitative approach. Boletin de la Asociacion de Geografos Espanoles, 82. https://doi.org/10.21138/bage.2682

Enseñat-Soberanis, F., Blanco-Gregory, R., & Mondragón-Mejía, J. A. (2020). Perception of congestion and social dimension of the carrying capacity in Yucatan cenotes. Cuadernos de Turismo, 45, 93-112. https://doi.org/10.6018/turismo.426051

Félix, Á., & Reinoso, N. (2020). Estudio de pérdidas y estrategias de reactivación para el sector turístico por crisis sanitaria COVID-19 en el destino Manta (Ecuador). 4(1), 79-103. https://doi.org/10.21071/riturem.v4i1.12743

Glen, A. S., & Dickman, C. R. (2005). Complex interactions among mammalian carnivores in Australia, and their implications for wildlife management. Biological Reviews of the Cambridge Philosophical Society, 80(3), 387-401. https://doi.org/10.1017/s1464793105006718

Gómez, J., Sánchez, A., & Gutierrez, F. (2016). Calculo de los límites de cambio aceptable (lac) en el sendero lagunas de siecha, parque nacional natural Chingaza – Colombia. Revista de Tecnología, 15(2), 75-88.

Gutiérrez, L. (2013). Funciones de valor para construir un indice de sostenibilidad para la evaluación de áreas naturales con uso turístico. Revista de Tecnología, 12(1), 110-117.

Gutiérrez-Fernandez, L. F., Martínez-Daza, S., Acosta, C. G., Perez, V. G., & Pinzón, L. C. (2021). Calculation of the carrying capacity and multi-criteria tourist reception capacity for Encenillo Biological Reserve, Guasca-Cundinamarca, Colombia. Investigaciones Turisticas, 21, 224-255. https://doi.org/10.14198/INTURI2021.21.11

Hosteltur. (2020). Los frenos e impulsos para el turismo en 2020. Hosteltur: Toda la información de turismo. https://www.hosteltur.com/135081_los-frenos-e-impulsos-para-el-turismo-en-2020.html

Huaroc, E., Raqui, C., Jurado, R., & Huaroc, N. (2021). Capacidad de carga Turística, base para el manejo sustentable: Gruta de Huagapo. PURIQ, 3(1), Article 1. https://doi.org/10.37073/puriq.3.1.114

Huaroc-Ponce, E. J., Jurado-Taipe, R. S., Raqui-Ramirez, C. E., Huaroc-Ponce, N. M., & Calderon-Cahue, J. J. (2021). Cálculo de acogida turística con metodología multicriterio en la gruta de Huagapo: Análisis en pandemia. Investigación Valdizana, 15(3), Article 3. https://doi.org/10.33554/riv.15.3.1112

Jaimes C., E. J., Reibán L., M. S., Orellana M., R. A., González R., J. C., & Barriga U., T. M. (2017). Carrying capacity and pressure of land use in four sectors of the river deleg subbasin, Cañar Province, Ecuador. Revista de La Facultad de Agronomia, 34(3), 270-297.

Laurente, L., & Machaca, R. (2020). Modelamiento y proyección de la demanda de turismo internacional en Puno-Perú. Revista Brasileira de Pesquisa em Turismo, 14(1), Article 1. https://doi.org/10.7784/rbtur.v14i1.1606

Lone, P., Dar, J., Subashree, K., Raha, D., Pandey, P., Ray, T., & Khare, P. (2019). Impact of plant invasion on physical, chemical and biological aspects of ecosystems: A review. Tropical Plant Research, 3, 528-544. https://doi.org/10.22271/tpr.2019.v6.i3.067

López, J. M., & López, L. M. (2008). La capacidad de carga turística: Revisión crítica de un instrumento de medida de sostenibilidad. El Periplo Sustentable, 15, 123-150. https://doi.org/10.21854/eps.v0i15.938

Marsh, H. (1995). The limits of detectable change. Conservation through sustainable use of wildlife. Centre for Conservation Biology. Brisbane, Australia, 122-130.

Meadows, D. H. (1972). Los límites del crecimiento: Informe al Club de Roma sobre el predicamento de la humanidad. Fondo de Cultura Económica.

Muñoz, A., & Cárdenas, G. (2019). Determinación del límite de cambio aceptable, como una herramienta de planificación eco-turística en la reserva natural la sonadora, Calarcá – Quindío. https://ridum.umanizales.edu.co/xmlui/handle/20.500.12746/3460

Organización de la Naciones Unidas (ONU) (Ed.). (1992). Declaración de Río sobre el Medio Ambiente y el Desarrollo. http://portal.uned.es/pls/portal/docs/PAGE/UNED_MAIN/LAUNIVERSIDAD/DEPARTAMENTOS/0614/ASIGNAT/MEDIOAMBIENTE/TEMA%201/%20%20%20%20%20DECLARACI%C3%93N%20DE%20R%C3%8DO%201992.PDF

Organización de las Naciones Unidas (ONU). (2012). El futuro que queremos. 59. https://rio20.un.org/sites/rio20.un.org/files/a-conf.216-l-1_spanish.pdf.pdf

Organización de las Naciones Unidas (ONU), Organización Mundial del Turismo (OMT), & Unión Europea (UE) (Eds.). (1995). Carta del Turismo sostenible. http://www.datosdelanzarote.com/uploads/doc/20051226123220895CartaTurismoLanzarote.pdf

Perruolo, G., & Camargo, C. (2017). Estimación de capacidad de carga turística en el área Chorro El Indio, estado Táchira, Venezuela. Cuadernos de Geografía: Revista Colombiana de Geografía, 26(2), 77-90. https://doi.org/10.15446/rcdg.v26n2.59259

Picazo-Córdoba, H., Belmonte-Serrato, F., & Ballesteros-Pelegrín, G. A. (2021). Study of the load capacity in river areas with intensive recreational use. El Salto del Usero Murcia, Spain. Revista Geografica Venezolana, 62(2), 446-466.

Roggenbuck, J. W., Williams, D. R., & Watson, A. E. (1993). Defining acceptable conditions in wilderness. Environmental Management, 17(2), 187-197. https://doi.org/10.1007/BF02394689

Segrado, R., González, C. A., Arroyo, L., & Quiroga, B. (2017). Capacidad de carga turística y aprovechamiento sustentable de Áreas Naturales Protegidas. CIENCIA ergo-sum, 24(2), 164-172.

Simancas, M. R. (2006). Los modelos de uso turístico de las áreas protegidas de Canarias: Una propuesta metodológica. Investigaciones Geográficas, 39, 25-45. https://doi.org/10.14198/INGEO2006.39.02

Soria-Díaz, H. F., de Graça, P. M. L. A., & Soria Solano, B. (2022). Analysis of the carrying capacity of tourist attractions in Central Amazonia, Brazil. Investigaciones Geograficas, 108. https://doi.org/10.14350/rig.60531

Stahl, P. W. (2013). Early Dogs and Endemic South American Canids of the Spanish Main. Journal of Anthropological Research, 69(4), 515-533. https://doi.org/10.3998/jar.0521004.0069.405

Stankey, G. H., Cole, D. N., Lucas, R. C., Petersen, M. E., & Frissell, S. S. (1985). The limits of acceptable change (LAC) system for wilderness planning. The Limits of Acceptable Change (LAC) System for Wilderness Planning., No. INT-176. https://www.cabdirect.org/cabdirect/abstract/19861835269

Toriz G, E., Aparicio P, M., & Ruiz L, R. (2018). Modelo para Evaluar la Capacidad de Carga Turística y Fortalecer el Liderazgo de Ingenieros Conservacionistas. 2018-July. https://doi.org/10.18687/LACCEI2018.1.1.122

Varisto, Y., Rosell, P., & Rosake, P. (2009). Capacidad de carga turística en área de humedales. Aportes y Transferencias, 2(13), 44-64.

Vázquez, A. (2009). Desarrollo local, una estrategia para tiempos de crisis. Apuntes del Cenes, 117-132.

Wachenfeld, D., Oliver, J., & Davis, K. (1997). State of the Great Barrier Reef World Heritage Area Workshop: Proceedings of a technical workshop held in Townsville, Queensland, Australia [Report]. Great Barrier Reef Marine Park Authority. https://elibrary.gbrmpa.gov.au/jspui/handle/11017/259

Werneck, F. P. (2011). The diversification of eastern South American open vegetation biomes: Historical biogeography and perspectives. Quaternary Science Reviews, 30(13), 1630-1648. https://doi.org/10.1016/j.quascirev.2011.03.009

Yang, H. (2017). Study on the optimization model of tourism environmental carrying capacity based on tourism planning. Revista de La Facultad de Ingeniería, 32(12), 1082-1089.

Yang, Y., Zhang, H., & Chen, X. (2020). Coronavirus pandemic and tourism: Dynamic stochastic general equilibrium modeling of infectious disease outbreak. Annals of Tourism Research, 83, 102913. https://doi.org/10.1016/j.annals.2020.102913

Yi, L., Zheng, M., & Liu, Z. (2022). Evaluation on the coupling coordination of economic development and ecological envirenment carrying capacity: Case study in Jiangxi province, China. Revista Internacional de Contaminacion Ambiental, 38, 255-263. https://doi.org/10.20937/RICA.54458

Yusoh, M. P., Mapjabil, J., & Hanafi, N. (2020). HAD-HAD PERUBAHAN BOLEH DITERIMA DALAM PELANCONGAN: SATU TINJAUAN TEORI DAN KONSEPTUAL: LIMIT OF ACCEPTABLE CHANGE IN TOURISM: A REVIEW OF THEORY AND CONCEPTUAL. Journal of Borneo Social Transformation Studies, 6(1), 278-288. https://doi.org/10.51200/jobsts.v6i1.2809.