

Research paper

Prefeasibility of the installation of tourist services in the laguna de pampahuasi protected reserve, town center of lliupapuquio, district of San Jeronimo, province of Andahuaylas, Perú

Prefactibilidad de la instalación de servicios turísticos en la reserva protegida laguna de pampahuasi, centro poblado de lliupapuquio, distrito de San Jerónimo, provincia Andahuaylas, Perú

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ABSTRACT

The general objective of the research is to describe the feasibility of adapting complementary services for the enjoyment of the landscape in the protected reserve Laguna de Pampahuasi, Lliupapuquio Population Center, San Jerónimo district, Andahuaylas province, Perú. The methodology applied was the mixed approach with an impact on the quantitative, descriptive type, explanatory level, and non-experimental design, supported by documentary review, interviews, and on-site verification of the characteristics of the terrain, accessibility, signage, traffic risks, and rest points, among others. The instruments used were registration forms for on-site verification, interviews with groups of those involved, and a verification form for secondary source registration. In conclusion, there is feasibility because the real load capacity of 57 visits per day and 15,332 visitors for 270 days per year does not generate alteration and destruction of the ecosystem of the natural landscape: the investment cost of S/. 398,916.95 soles for its adaptation and implementation, the investment can be recovered in 5 years, by assigning a ticket office with an entrance price of S/. 5.00 per visitor, excluding other complementary income such as souvenirs, food sales, crafts, and guided tours.

Keywords: accessibility, adaptation, cost, investment, risk, signage, feasibility.

RESUMEN

El objetivo general de la investigación es describir la viabilidad de adecuar servicios complementarios para el disfrute del paisaje en la reserva protegida Laguna de Pampahuasi, Centro Poblado de Lliupapuquio, distrito de San Jerónimo, provincia de Andahuaylas, Perú. La metodología aplicada fue el enfoque mixto con incidencia en el cuantitativo, tipo descriptiva, nivel explicativo, diseño no experimental, apoyado en la revisión documental, entrevista y comprobación in situ de las características del terreno, la accesibilidad, señalización, riesgos de tránsito, puntos de reposo, entre otros. Los instrumentos usados fueron: fichas de registro para la comprobación in situ, entrevistas con grupo de involucrados y ficha de verificación registro de fuente secundaria. Conclusión, existe viabilidad por que la capacidad de carga real de 57 visitas por día y a 15,332 visitantes por 270 días al año, no genera alteración y destrucción del ecosistema del paisaje natural; el costo de inversión por s/. 398,916.95 soles para su adecuación e implementación, se puede recuperar la inversión en 5 años, al asignar un boletaje el precio de ingreso s/. 5.00 por visitante, fuera de otros ingresos complementarios caso de souvenirs, venta de alimentos, artesanías, guiado, entre otros.

Palabras clave: accesibilidad, adecuar, costo, inversión, riesgo, señalización, viabilidad.

INTRODUCTION

The subject of intervention is the Pampahuasi lagoon, located in the territory of the rural community of Lliupapuquio, district of San Jerónimo, province of Andahuaylas, department of Apurímac. The identified reason is that there is a huge potential to be harnessed; however, there is no infrastructure or service implemented related to tourist activity that allows initial and sustainable exploitation over time, despite the area's characteristics, landscape, and the sighting of native species, which is its main factor. The Pampahuasi lagoon, through Administrative Resolution No. 0342-2011-ANA-BAJO APURÍMAC-PAMPAS, is located from the progressive 0+000 km at coordinates 8479066N 690089E to the progressive 5+635 km belonging to the locality of Lliupapuquio, district of San Jerónimo, province of Andahuaylas, department of Apurímac. This tourist resource is approximately 4,200 and 4,300 meters above sea level, with an average temperature ranging from 6°C to 14°C. It is an area with strong winds surrounded by rocky mountains, where various tree species such as pine, queñua, and other wild plants grow; grass plants like straw and ichu; the surrounding geography is good for agriculture, particularly for increasing potato varieties. There are no houses or continuous public transportation in the area.

Figure 1: Mountain



Note: The figure shows the mountain on the east side of Pampahuasi Lagoon. Source: Own elaboration.

Therefore, the set of public tourist services that will be provided by the project to turn it into a tourist attraction arises from the following causes: a) Adaptation of the lagoon: Currently, Pampahuasi Lagoon is considered a water reservoir useful for crop irrigation in the lower Chumbao Valley; b) Observation Services: Strategic points are sustained by mountain climbing characterized by height, ground adaptation, and accessibility, lacking equipment or other support means for climbing and protection; c)

Traffic safety: Currently, there are no routes that allow adequate visitor traffic; d) Tourist orientation and information services: There is no fixed or permanent operator that fulfills the role of disseminator.

Figure 2: Landscape



Note: The image shows the landscape above Pampahuasi Lagoon. Source: Own elaboration.

Additionally, the following causes were identified: e) Internal route services for the tourist resource: Trails are used without adequate infrastructure for the journey in several sections, with risks from wetlands, slopes, and landslides; f) Services for the exhibition of flora or fauna: Landscape and species observation is exploited without the necessary support to enhance the experience and improve photographic services; g) Parking and other services: There is no infrastructure in the study area to guide and organize the controlled use of parking; h) Recreation services: The geography of the study area will allow the implementation of activities such as trekking, fishing, climbing, picnicking, and cycling, which will not alter the lagoon's ecosystem and will be carried out with due care, seeking to protect the integrity of visitors and local biodiversity.

Among the involved institutions, we have: a) Town Center of Lliupapuquio: According to observations made during visits and dialogues with the residents, there is interest in carrying out activities that promote the growth and development of their community; however, the initiative of their authorities is null, and the advice they receive is insufficient. These reasons do not allow them to diversify their municipal activities to exploit and adapt the tourist attractions that could be utilized to benefit the local population. Local authorities and the general population must become aware of the importance of tourism as an engine of economic and social development; b) District Municipality

of San Jerónimo: The residents of Lliupapuquio, according to data collected through interviews, express concern about the lack of interest from the district municipality in promoting tourism in the area. Despite having natural landscapes of great beauty, the area has not received the necessary support to develop its tourism potential; c) DISA Apurímac II: The health center in the town center of Lliupapuquio has a large and adequate infrastructure, with several specialists such as doctors, nurses, and pharmacy technicians. Additionally, it has the necessary equipment to attend to cases of degree I-2; however, it is not adequately equipped for more serious and urgent emergencies, so patients are referred to health centers in Andahuaylas or San Jerónimo; d) UNAJMA: The National University José María Arguedas of Andahuaylas is interested in adapting and strengthening the Pampahuasi Lagoon tourist resource and other resources in the area through the initiative of professors and students through research and University Social Responsibility activities; e) Local Educational Management Unit: The entity has no commitment to promoting local tourism among students and the general population of the province and region; f) LOCAL WATER AUTHORITY: Carries out non-continuous monitoring of the state of the Pampahuasi Lagoon.

Figure 3: Panoramic photograph of the Pampahuasi Lagoon



Source: Own elaboration.

The identified hazards are as follows: The Pampahuasi Lagoon, despite its natural beauty, presents challenges that require attention to ensure a safe and pleasant experience for visitors. The high altitude, mountainous terrain, and lack of adequate infrastructure pose risks that need to be addressed through prevention and improvement strategies, as well as ensuring the long-term viability of tourism in the area and the conservation of the surrounding ecosystem. Regarding the vulnerability analysis: a) Exposure of the tourist resource: The

lagoon is in a mountainous environment, making it susceptible to landslides, especially during the rainy season. Future constructions may be affected if not built in suitable spaces; b) Accessibility: Access to the lagoon by road is difficult due to the poor condition of the roads, increasing the risk of accidents. Additionally, poorly maintained paths hinder transit and increase vulnerability to accidents; c) Visitor exposure: Visitors are exposed to dangers such as lightning, landslides, traffic accidents, and falls on trails. The lack of signage and safety measures at some points of the route increases their vulnerability; d) Fragility: The lagoon and its infrastructure are considered moderately fragile in the face of identified dangers. Landslides could cause considerable damage to the lagoon, trails, and viewpoints, while traffic accidents and falls could result in injuries or even death to visitors or staff; e) Resilience: The lagoon and its surroundings have low resilience to hazards. Rehabilitation or reconstruction of tourist facilities affected by landslides or accidents could take a considerable amount of time. Additionally, the lack of contingency measures and adequate evacuation plans could hinder emergency response. The general objective of the research was to describe the feasibility of adapting complementary services for the enjoyment of the landscape in the Laguna Pampahuasi protected reserve, located in the town center of Lliupapuquio, district of San Jerónimo, province of Andahuaylas, Perú.

METHODOLOGY MATERIALS AND METHODS

Based on Hernández and Mendoza (2016), the approach was mixed, with a focus on quantitative, descriptive, and explanatory levels. The non-experimental design was supported by documentary review, interviews, and on-site verification of terrain characteristics, accessibility, signage, traffic risks, and rest points, among other things. The instruments used were registration forms for on-site verification, interviews with involved groups, and verification records from secondary sources. The methodological source was the Investment Projects Manual for the Tourism Sector.

RESULTS AND DISCUSSION

Workshops developed with the involved groups allowed for identifying and verifying problem causes and the consequences if the problem persists. We developed problem trees, objective trees, and stakeholder matrices, arriving at the following results: the main problem is that visitors arriving at the Pampahuasi Lagoon enjoy the landscape with limitations because there is no compre-

hensive infrastructure; that is, a regular state access road, signage based on ancient livestock route marks, mountain lookout points without complementary means for rest. This originated from a) inadequate conditions and ease of access to the Pampahuasi Lagoon, b) inadequate conditions on the internal trail limiting visits, and c) deficient municipal management in the tourism sector. These direct causes stem from indirect causes, which

are: a.1) deficiencies in entry attention; a.2) deterioration of rudimentary signage and access road; a.3) weak maintenance of the access road; b.1) inadequate conditions of the internal trail; b.2) impact of climatic hazards; b.3) deficient management and enabling of the internal trail; c.1) weak tourism management by authorities; c.2) low tourism culture among the local population; c.3) lack of mobile coverage and assistance.

Table 1. Problem Tree

Problem formulation	Visitors receive inadequate complementary services to enjoy the landscape in the Laguna de Pampahuasi protected reserve.
Causes	
Direct	a) Inadequate conditions and tourist facilities for entry to the Pampahuasi lagoon, b) Poor conditions within the natural resource Laguna Pampahuasi, c) Poor municipal tourism management for the Pampahuasi lagoon
Indirect	a.1) Visible deterioration of the road and lack of signage, a.2) Poor maintenance of the road and lack of wider access; b.1) Inadequate conditions for the internal route, b.2) Impact of climatic hazards; c.1) Low tourist culture of the population, c.2) Lack of mobile coverage, support and assistance service.
Effects	
Live	a.1) Poor access routes generate dissatisfaction and danger among visitors; a.2) Weak image and demand for the preservation and promotion of the tourist resource.
Indirect	b.1) Loss of ability to improve income for families of community tourism operators.

Source: Own elaboration

Table 2. Objective Tree

Objective formulation	Visitors receive adequate complementary services to enjoy the landscape in the Laguna de Pampahuasi protected reserve.
Media	
Live	a) Adequate conditions and tourist facilities for entry to the Pampahuasi lagoon, b) Sufficient conditions within the natural resource Pampahuasi Lagoon, c) Improvement in municipal tourism management for the Pampahuasi lagoon
Indirect	a.1) Improvement of the road and lack of signage, a.2) Sufficient maintenance of the road and lack of wider access; b.1) Adequate conditions for the internal route, b.2) Minimization of the impact of climatic hazards; c.1) Strengthening of the tourist culture of the population, c.2) Existence of mobile coverage, support, and assistance service.
Finnish	
Live	a.1) Restoration of access routes generate satisfaction and security for visitors; a.2) Strengthening of the image and demand for the preservation and promotion of the tourist resource.
Indirect	b.1) Expansion of the capacity to improve income for families of community tourism operators.

Source: Own elaboration

The main objective is for visitors arriving at the Pampahuasi Lagoon to enjoy the landscape without limitations because there is comprehensive infrastructure; that is, a regular state access road, signage based on location marks, interpretation points, mountain lookout points with complementary means for rest, access to a secure parking center, and safety on the internal trail. This originated from: a) adequate conditions and ease of access to the Pampahuasi Lagoon; b) adequate conditions on the internal trail that limits its visit; c) sufficient municipal management in the tourism sector. These direct causes stem from indirect means, which are: a.1) adequate entry attention; a.2) improvement of rudimentary signage and access road; a.3) sufficient maintenance of the access road; b.1) adequate conditions of the internal trail; b.2) mitigation of climatic hazards; b.3) sufficient management and enabling of the internal trail; c.1) secure tourism management by authorities; c.2) expansion of tourism culture among the local population; c.3) existence of mobile coverage and assistance.

The physical load or gross capacity of the tourist resource allows identifying the number of visits per day that it can support, creating some alterations that may deepen if not controlled. For the study topic, the physical carrying capacity is 1,750 visits per day and 472,500 visits per year during 270 days per year, managing 3 groups of visits per day.

Table 4. Physical Carrying Capacity

Physical Carrying Capacity	Path
Circuit length	1000 ml
Section of the circuit	2 ml
Length used by the person	1.2 ml
S	1000 m2
Sp	1.2 m2
Hv	8 hours/day
TV	5 hours/day
Number of working days for visit	270 days a year
Calculations	
Hv	3 visits/day
Physical load capacity (CCF per day)	1750 visits/day
Physical carrying capacity (CCF per year)	472500 visits/year

Source: Own elaboration.

The real carrying capacity applies when the tourist resource is not yet an attraction but is in process and is characterized by having restrictions related to the proper use and provision of the tourist service to visitors or tourists. Therefore, the real carrying capacity is subject to various fac-

tors that allow adjusting the visitor flow without altering the conditions of the area or natural reserve. The visits per day are 57, and the annual visits reach 15,332 during 270 days of operation per year.

Table 5. Real Carrying Capacity

Real Carrying Capacity	Path
Actual load capacity	1750 visits/day
Social correction factor	0.231
Erodibility correction factor	0.357
Accessibility correction factor	0.543
Precipitation correction factor	0.833
Sunlight correction factor	0.87
Calculations	
Actual load capacity per day	57 visits/day
Actual load capacity per year	15332 visits/year

Source: Own elaboration.

Before 2019, visitors to the Apurímac region reached over 700,000. We have spent three years overcoming the Covid-19 pandemic and have not exceeded the number of visitors in 2019. The same happens with overnight stays; before the Covid-19 pandemic, we exceeded 900,000 visitors, and three years later, in 2024, we have not surpassed this benchmark.

Table 6. Number of Visitors and Overnight Stays in the Apurímac Region

Years	N° de visitors	N° overnight stays
2013	308122	422541
2014	359532	444657
2015	408129	515935
2016	489533	644658
2017	532431	690181
2018	563429	675188
2019	732843	919994
2020	213537	270666
2021	284944	335053
2022	384651	425028

Source: National Institute of Statistics and Informatics/ Statistical Compendium of the Apurímac Region 2022 referenced from the Regional Directorate of Foreign Trade and Tourism - Tourism Directorate.

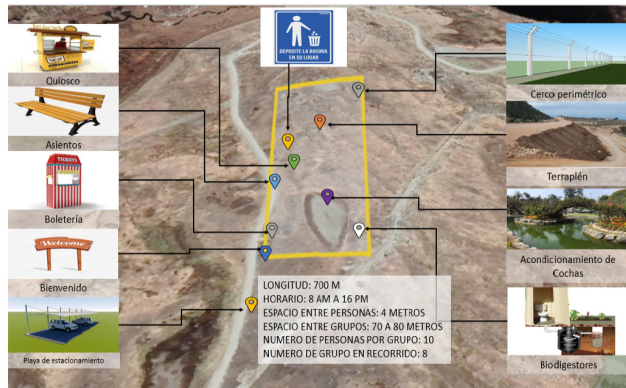
The linear regression method by least squares allowed us to know the preliminary behavior of the Tourism sector's recovery, but it is not adequate, especially considering the three consecutive years of recession in the Tourism sector, affecting projections of a favorable to regular scenario. However, given the vulnerability of the Tourism sector, it is linked to forecasts of Perú's GDP growth rates; thus, if the national growth rate is 3.6% for 2024, the Tourism sector may grow by a third. The technical part of the proposal involves designing the trail sectioning and implementing complementary works necessary to turn the tourist resource into a tourist attraction.

Figure 16: Trail Sectioning



Note: In this image, the distances in meters of the route are detailed, as well as the number of people per group and the space between groups to better manage the recreational activity. Own elaboration.

Figure 2: Projection of Complementary Works for the Improvement of Tourist Services



Note: The image shows icons of the various services that will be implemented in the tourist resource, which will improve the service for tourists or visitors. Own elaboration.

Figure 3: Summary of Projected Activities and Tourist Facilities



Note: The image shows the location of each of the facilities that will be implemented to improve the tourist service. Own elaboration.

Figure 4: Satellite view of the project intervention in Pampahuasi lagoon



Note: The approximate satellite coordinates, where the lagoon is located with UTM data: 13°44'55.01" south and 73°14'05.81" west at an altitude of 4,216msnm. Own elaboration

Table 7. Identification of Hazards in the Pampahuasi Lagoon

Hazards identified	Record	Studies	Frequency			Intensity			Description
			Low	Half	High	Low	Half	High	
1. Heavy Rains	Yeah	Yeah		x				x	Heavy rains can cause landslides and affect roads and the safety of visitors.
2. Electric shocks	Yeah	No		x				x	Electrical shocks can be extremely dangerous for visitors, especially if they are in open areas or high on rocks.
3. Landslides	Yeah	Yeah	x					x	The Pampahuasi lagoon is located in a rocky mountainous area, which increases the risk of landslides.
4. Roads in poor condition	Yeah	No		x			x		Poor road maintenance can result in potholes, sinkholes and uneven surfaces, which can be dangerous for vehicles and visitors.
5. Trails	Yeah	No		x			x		The trails are often in poor condition, especially during the rainy season, and have no signage or lighting.
6. Narrow Roads	Yeah	No		x			x		Narrow roads can make it difficult for vehicles to pass and increase the risk of accidents.
7. Lack of nearby medical center	Yeah	No		x				x	In case of a medical emergency, there is no medical center close to Laguna de Pampahuasi. The nearest medical center is located in the city of Andahuaylas approximately 1 hour away.
8. Lack of Communication	Yeah	No		x				x	at Laguna de Pampahuasi . In the event of an emergency, it may be difficult to contact emergency services.
9. Lack of security	Yeah	No	x					x	Due to its location in a remote environment with a sparse population, the Pampahuasi Lagoon lacks permanent surveillance or security personnel.
10. Frost	Yeah	No		x				x	Frosts occur seasonally and also restrict accessibility.

Source: own elaboration

Table 8. Summary of Private Costs

COST SUMMARY		
No.	DETAIL	AMOUNT
1	TICKET OFFICE	S/4,521.38
2	PARKING LOT	S/22,661.30
3	WAITING HUT	S/2,573.00
4	WELCOME SIGN	S/1,076.26
5	GENERAL SIGNAGE	S/4,034.28
6	CONSTRUCTION OF ACCESS TO THE VIEWPOINT (FIRST ROCK)	S/54,117.65
7	RAILINGS	S/27,443.24
8	PERIMETER FENCE	S/1,462.48
9	ADMINISTRATOR'S CABIN	S/6,136.30
10	LIGHTNING ROD	S/11,750.66
11	KIOSK CABIN	S/5,891.30
12	BANKING IMPLEMENTATION (4 UNITS)	S/4,148.78
13	TOURIST VIEWPOINT	S/18,885.30
14	CONSTRUCTION OF GABIONS	S/13,337.60
15	CONSTRUCTION OF 1 WOODEN BRIDGE - 4 METERS	S/9,717.75
16	CONSTRUCTION OF DAIRY HOUSE	S/6,730.50
17	CONDITIONING OF CASKS	S/67,000.00
18	ECOLOGICAL TRASH CANS	S/8,825.00
19	CONSTRUCTION OF 2 BIODIGESTORS	S/3,732.18
20	SENSITIZATION	S/3,850.00
21	OPERATOR FORMALIZATION PROGRAM	S/3,850.00
22	DISSEMINATION PROGRAM	S/4,600.00
23	Promotional Fair	S/6,600.00
24	MAINTENANCE OF FACILITIES AND TRAIL	S/25,136.29
25	IMPLEMENTATION OF FIRST AID KITS	S/660.70
26	WORKER PROTECTION AND SAFETY IMPLEMENTATION MATERIALS	S/10,175.00
TOTAL		S/328,916.95

Source: Own elaboration.

The real carrying capacity of 57 visits per day and 15,259 visitors for 270 days a year represents a moderate visitor flow that does not generate alteration or destruction of the natural landscape ecosystem. The investment cost is calculated at S/. 398,916.95 for its adaptation and implementation is sufficient; however, it must be adjusted according to price inflation behavior. The investment can be recovered in 5 years by assigning a ticket price of S/. 5.00 per visitor, taking into account the scenario of the state's protective and subsidiary role to guarantee a permanent budget for maintenance by the District Municipality of

San Jerónimo. However, another form of administration could involve granting the administration to a tourism operators' association, with the General Sales Tax (IGV) percentage going to the State, from which the Municipality would receive 2% for the Municipal Compensation Fund, plus this second form does not generate permanent payroll expenses for the local Municipality, in addition to other complementary income sources such as souvenirs, food sales, crafts, guided tours, among others offered by the bidding association. For this second form, 18% of IGV is added to the cost of S/. 5.00 soles.

CONCLUSIONS

The development of tourism services in Pampahuasi Lagoon promotes environmental sustainability by implementing conservation practices and responsible management of natural resources. This project ensures that economic growth does not endanger the integrity of the local ecosystem. In social terms, the project will promote the inclusion and participation of the local community, who will benefit directly by obtaining the bidding to manage the future tourist complex. The economic opportunities generated from tourism will lead to personal development. Moreover, they will be responsible for ensuring the project's sustainability. The first scenario is a fixed entry fee of S/. 5.00 soles with municipal budget injection is not sustainable in the long term; the second mode of administration through bidding favors sustainability because the winning legal entity will be responsible for the maintenance and administration of the future tourist complex, which will also implement other complementary services for the enjoyment of the landscape.

This investment project in Pampahuasi Lagoon's total market cost is estimated at S/. 328,916.95 soles for the year 2024. Despite this initial investment, it is recommended to update it after the year due to inflationary effects. The project launch will drive the economic development of Liupapuquio through the promotion of sustainable tourism and the creation of new business opportunities.

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