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"INTERPRETIVE PATH TO STRENGTHEN THE TOURIST OFFER OF THE ARCHAEOLOGICAL COMPLEX OF CHOQUEQUIRAO - CUZCO, 2021"

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Abstract

This research aims to propose an interpretive trail design to strengthen the tourist offer of the Choquequirao archaeological complex, in the Cuzco region. The poor maintenance of the access roads, the insufficient and inadequate public tourist infrastructure and the intense rains that caused landslides and stones on the routes that lead to Choquequirao, generate the limitation of the growth of the tourist offer in Choquequirao. This is reflected in the decrease in the flow of tourists at a rate of 0.66% per year, economically affecting the population. Therefore, the methodology used for the proposal is quantitative since research on historical tourist demands and visits to the place were reviewed. As tools, we elaborate a data matrix and we use 3D programs to model the design of the proposal. As a result of the review of the studies carried out from 2014 to 2020, it was obtained that the average number of national visitors was 1,608, 28% of the total, and foreign visitors were a total of 4,138, the remaining 72%. . Likewise, in 2020 a decrease in visitors was reflected due to the closure of Choquequirao due to the pandemic produced by the new coronavirus (Covid-19). Finally, it is concluded that the proposal of an interpretive trail incorporating clean technologies, applying bioclimatic architecture and eco-friendly materials, strengthens the tourist offer of the Choquequirao Archaeological Complex.

Keywords: Interpretive Trail, Tourist Offer, Choquequirao.

1. Introduction

The interpretive trails are very important in the development of tourist activity since they help guides and tourists to have more information about the place visited. That is why it is important for tourist attractions to have an interpretive trail (Alfaro M, Rivera K. Esenarro D. Rodriguez C, Mendez R. 2021)

According to studies by the Tourism Organization, at the moment, there are gradual changes in behavior and the desire for new experiences that are closer to nature and the culture of the countries where the visit is made by the tourists (UNWTO, 2017).

According to the National Strategic Tourism Plan, PENTUR 2025, the development of quality tourism products and services constitutes the basis for the competitiveness of tourist destinations. In this sense, it is a priority to improve and develop the country's tourism offer, responding to the demands of national and international demand (Ancco, 2018).

As part of the tourism promotion policies deployed by the Government, visits to Choquequirao have been implemented for more than 10 years, allowing tourism activity to take off, but according to data from the Ministry of Foreign Trade and Tourism, the flow of Tourists decreased at a rate of 0.66%, due to poor maintenance of accesses, insufficient and inadequate public tourism infrastructure and the heavy rains that caused landslides and stones on the routes that lead to Choquequirao (Ortiz, 2019).

In addition, according to the surveys carried out on the current state of the tourist infrastructure, it is estimated that 78.8% of tourists believe that the pedestrian accesses of the routes that lead to the Archaeological Park of Choquequirao are unsafe and 21.20% believe the opposite, and when classified the current state of the situation of the tourist infrastructure in general, they maintain the following: very serious 47.1%, serious 49.4% and as not serious at 3.5 (Orue, 2020). In this sense, it is suggested that the low maintenance of accesses harms the tourist offer of the archaeological complex of Choquequirao, being necessary to implement an interpretive path in order to increase the ecotourism demand. The general hypothesis of the study is that the interpretive trail significantly allows the growth of the tourist offer of the archaeological complex of Choquequirao (Esenarro D, Cabello F, Amaya P, and Vargas C, 2020).

2. Methodology

The methodology used for this research has a quantitative character. In the first instance, it was carried out to identify the problem and existing competences on the access route to Choquequirao through a literature review, where information about the natural, cultural and economic aspects of the community was also extracted. Likewise, an analysis was made with the information collected

to evaluate and more accurately design our proposed trail. Therefore, in this project the inductive method was carried out since it was possible to obtain information and collect data for the theoretical basis.

2.1 Study Area

2.1.1 Santa Teresa district

The District of Santa Teresa is located in the jurisdiction of the province of La Convencion in the department of Cusco. Exactly 130 kilometers northwest of Cusco; between geographic parallels 13º 14´ and 13º 34´ south latitude and meridians 75º 68´ and 73º 22´ west longitude (Bressner and Mejia, 2019). The boundaries of the Santa Teresa district according to Bressner and Mejia (2019) are as follows: to the North: Districts of Vilcabamba, Maranura and Huayopata (Province of La Convencion); to the West: District of Vilcabamba (Province of La Convencion); to the South: Districts of Mollepata, Limatambo (Province of Anta); and, to the East: Districts of Machupicchu (Urubamba Province). The approximate altitude of the district of Santa Teresa is settled from 500 to more than 5000 meters above sea level; whose populated center (district capital) is at an altitude of 1811 m.a.s.l. The district of Santa Teresa has a territorial extension of 1 340.38 km² and belongs to the Ceja de Selva region (Bressner and Mejia, 2019).

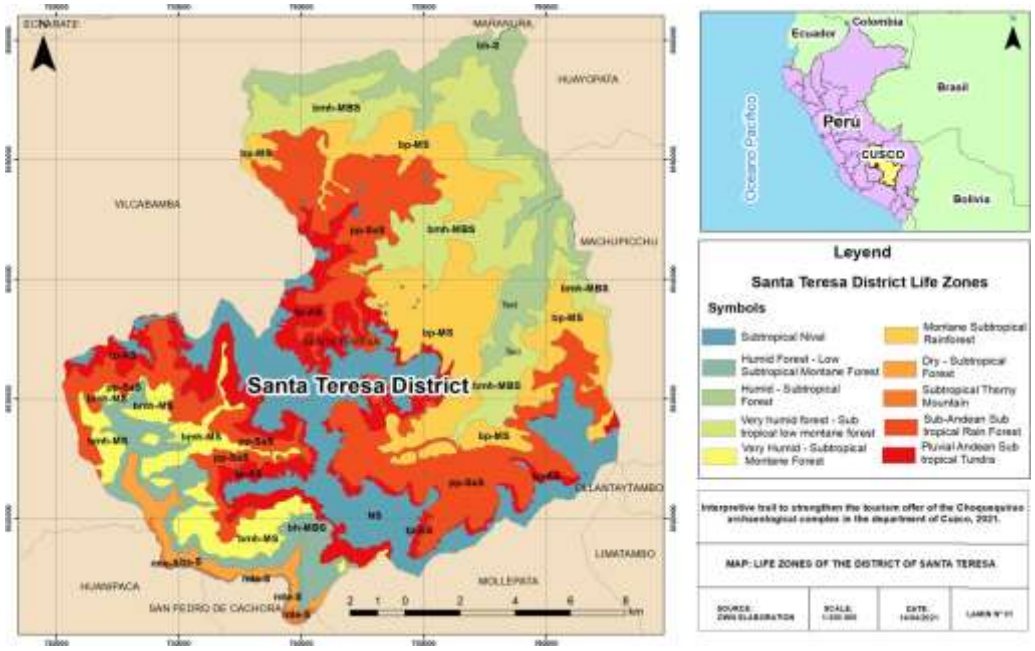

Figure 1. Map of the Santa Teresa District. Source: Self made.

In figure 1 we observe the life zones of the Santa Teresa district in order to identify the key areas of biological conservation and to know the flora and fauna of the place.

2.1.2 Choquequirao Geographical Location

The archaeological zone of Choquequirao is located in the west of the Vilcabamba mountain range, on the right bank of the Apurímac River, over 3,100 meters above sea level, more than 1,500 m above the river bed (Figure 2), 100 km west of the city of Cuzco and 27 km north of the city of Abancay. The central part of the archaeological zone is located on a natural spur of the Choquequirao hill, which dominates the landscape of the Apurímac canyon and is an intermediate point between different ecological zones or niches (Quiñones, 2019).

Figure 2. Map of the geographical location of Choquequirao. Source: self made.

Figure 2 shows the archaeological centers, populated centers and the water network that are around Choquequirao. Likewise, its provincial and departmental limits.

2.1.3 Environmental Physical Characteristics of Choquequirao

Variable	Description
Location	Province of La Convencion, Cusco region Province of Abancay, Apurímac region
Altitude	3033 masl - In the canyon you descend to 1,800 masl
Reference	In the foothills of the Nevado Salkantay, north of the Apurímac river valley, in the province of La Convencion in the department of Cusco
Relief	Ecosystems that vary from glaciers at 6000 meters above sea level to hot tropical valleys at 1800 meters above sea level.
Hydrography	At various points there are very careful hydraulic engineering works, expressed in a network of ditches and an extensive network of agricultural terraces scattered on the slopes until reaching the bed of the Apurímac River
Seismicity	There is a recorded danger of landslides, floods, seeps
Climate	Temperate to cold and semi-dry, with abundant cloudiness. Average temperature: 13.35 ° C (maximum 19.6 ° C and minimum 4.2 ° C) Rainy season covers the months of December to April Humidity: 60%. Average rainfall: 800 mm per year
Sun	On sunny days there are approximately 3-4 hours of intense sun being even stronger between 12 and 1 pm
Biological Characteristics	The Choquequirao Regional Conservation Area has 10 life zones, out of the 84 life zones recognized in Peru. In the seasonally dry forests of the inter-Andean valley, according to the rapid ecological evaluations carried out by different researchers, they point out that the floristic composition in the dry forest of the inter-Andean valley in Santa Teresa, Choquequirao and Apurímac, are different from those of Quillabamba and Tarapoto, for what its study and conservation are important for this type of forests of special characteristics in the region. According to research carried out in 2016 (Núñez), only in Apurímac an amount greater than 275 species is calculated and in Choquequirao a number greater than 150 species. The humid mountain forests, there are considerable extensions of humid montane forests in the sectors of Choquequirao, which are species of jungle such as: Zanthoxylum Mantaro (Rutaceae), Alnusacuminata (Betulaceae), Cedrellalilloi (Meliaceae), Ceiba mandonii (Malvaceae) , Clusiasandiensis (Clusiaceae), Cytharexylumcf. Integrifolium (Verbenaceae), Escallonia resinosa, Escalloniaherrerae, Escalloniamyrtilloides (Escalloniaceae), Erythrinafalcata, Hesperomeles lanuginosa (Fabaceae), Eriothecavargasii (Malvaceae), Juglansneotropica (Juglandaceae), Sambucus peruvianiaceae (Weambucusaceae), Teambucusaspiniaceae (Weambucus peruvianiaceae).
Wild flora	A great variety of wild flora and fauna is registred, which includes: phanerogamic flora and cryptogamic biota. On the routes of Santa Teresa, Churubamba, Lluscamayo, Collpahuayco,

	Platerayoc, Totora, Yanama, Mina Victoria, Maizal, Pinchaunuyoq, Choquequirao, SantaRosa, Rosalina, Chikiska, Cocamazana, and through the district of Mollepata, Corralpata, Chaupilomay Abuela; 7 taxonomic groups have been registered and they are: algae, fungi, liverworts, lichens, ferns, Monocotyledons, Dicotyledons
Wildlife	Se encontraron en las evaluaciones realizadas un registró total de 208 especies de aves, de las cuales las familias más representadas son: Thraupidade (34 spp.), Tyrannidae (31 spp.) y Trochilidae (25 spp.). Según el estudio realizado para el informe técnico para el establecimiento del área de conservación regional de Choquequirao, se registraron 07 nuevos registros de aves, así como 16 especies endémicas. Entre los mamíferos registrados destacan el "oso de anteojos" Tremarctosornatus, el"osccollo" Leopardusjacobitus y el "venado" Mazamachunyii, considerados comoamenazados en el país. Registrándose 19 especies distribuidas en 13 familias y 5 órdenes. Entre los lepidópteros evaluados destacan Actinotesp. Nueva especie, solo conocida del Oestedel Cusco (Lamas 2015) Endémica del área. En total 21 especies distribuidas en 04 familias.Entre los arácnidos encontrados se presenta 05 especies distribuidos en 05 familias, lasespecies que destacan, Loxosceleslaeta, Anyphaenasp., Peucetiasp., Pamphobeteussp. Entre los reptiles encontrados se presenta 05 especies distribuidos en 02 familias, las especies.Chironiussp., Tachymenis peruviana, Erythrolamprussp., Dipsas peruana., Proctoporussp., y en los anfibios destacanRhinellaspinulosa, Gastrothecamarsupiata (Cheqlla).

Table N° 1. Environmental Physical Characteristics. Source: self made

Table 1 summarizes in detail the physical environmental factors of Choquequirao, which help to better understand the ecosystem where Choquequirao is located because the relief, hydrography, climate among other environmental characteristics are described.

2.2 Climate and meteorology in Choquequirao

As you pass the Apurímac River and ascend the almost vertical slope of the stream of this river, in the direction of the Marampata pampa (natural terrace of colluvial deposits), you enter a cover of humid forests on rugged topographies, characteristic of the Quechua region. This is the first vision of a geography contrasted between large mountains, which cover high areas, up to the Puna region, and forested ecological niches (Echeverría, 2019).

Crossing the archaeological zone, heading north, towards the archaeological sites of Pajonal and Pinchaunuyoq, one enters, again, a Yunga geography, hot and semi-desert, which corresponds to the ravine of the Victoria River. In this basin the ascent towards the pass of the same name begins, passing through different ecological niches and semi-desert areas interspersed with humid forests. The initial and final point of the journey, Capuliyoq and Victoria, respectively, are small places within the Puna region, which complements a remarkable journey through the entire territory that frames Choquequirao (Echevarría, 2019). According to Senamhi (2018) it presents 2 seasons: (a) Dry season: During the months of April to October, the dry season occurs in Choquequirao. On those days, the weather is warmer in the day and colder at night. Rains happen very infrequently. The temperature ranges between 25ºC and 4ºC. And, (b) Rainy season: The rainy season in Choquequirao runs between November and March. During those months, the climate is characterized by the highest frequency of river rainfall. Maximum temperatures reach 23ºC. while the minimum is 6ºC.

2.3 Flow of tourists

In the Choquequirao regional conservation area, they usually arrive with great expectations of knowing tourist attractions such as: Salkantay, Machu Picchu and the Sacred Valley, etc. However, on the access routes to Choquequirao, tourists do not have adequate furniture, such as railings, garbage cans and hygienic services, these services can only be found when entering the park in the sector called Sunchupata and in this place you can also find It locates the ticket office administered by the Decentralized Directorate of Culture of Cusco- DDC (Crispin and Jimenez, 2018).

Flow of tourists to Choquequirao by origin						
Years	Nationals A	Foreign B	Total	% National Tourists	% Foreign tourists	Variation %
2014	1825	3043	4868	37%	63%	
2015	1255	3682	4937	25%	75%	1.4
2016	1249	4634	5883	21%	79%	19.2
2017	2051	5972	8023	26%	74%	36.4
2018	1696	5323	7019	24%	76%	-12.5
2019	3184	6313	9497	34%	66%	35.3
2020	663	1315	1978	34%	66%	-79.2

Table 2. Flow of tourists to the Choquequirao Archaeological Park by origin. Source: self made.

Table 2 shows the flow of tourists to the Choquequirao Archaeological Park by origin and its variation with respect to previous years. The table shows us that the highest percentage of visitors are foreigners and also that the variation is positive with an exception for 2018.

2.4 Limits of the interpretive trail and route description

Santa Rosa Baja is located between latitude -13.417517952949778 and longitude - 72.84755626660144. While Marampata is located between latitude -13.402802494839623 and longitude -72.85400902635645.

Santa Rosa and Marampata are considered hamlets attached to the district of Santa Teresa, department of Cusco. Santa Rosa is located approx. 2,100 masl, km 24.5; while Marampata is located at 2918 m.a.s.l. Likewise, it is within the limits established as the Choquequirao Archaeological Park by Directorial Resolution No. 949 / INC since 2002 (Julca, E., 2017).

Route via Cachora

From Cachora to the place called Capuliyoc, there is a recently built carriageway with a length of 11 km. From this place Capuliyoc to the bridge over the Apurímac river is 9 km, the Apurímac river crosses with Oroya, from the Apurímac bridge to Marampata the distance is 9.56 km, the distance from Cachora to Marampata being 29.56 km and the distance from Marampata to Choquequirao is 3.50 km (good road), along this road from Cachora, Marampata and Choquequirao in good years, tourism according to data in the entrance gate to the Choquequirao sanctuary is 40,000 to 50,000 visits per year. The road along this route is full of very steep descents and ascents (Ortiz, P., 2017).

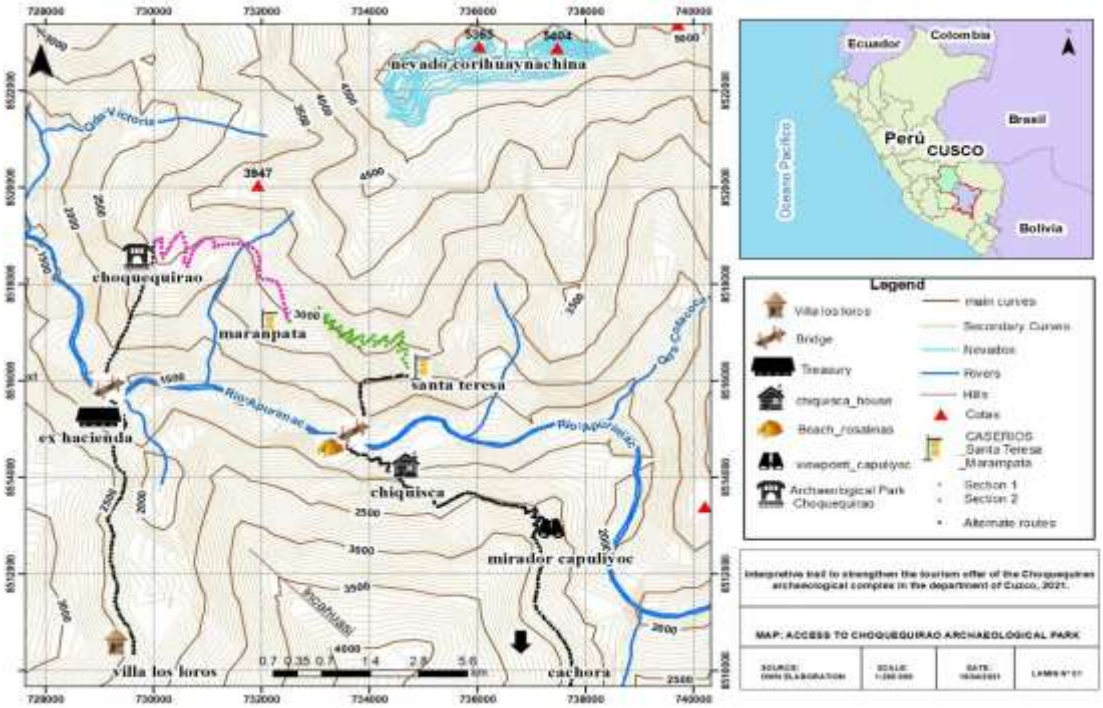

Figure 3. Access map to Choquequirao. Source: self made

In Figure 3 we observe the location of section 1 (Santa Rosa-Marampata) and section 2 (Marampata-Choquequirao), obtaining 6.2km in total.

2.5 Climatological Characteristics of the Archaeological Park of Choquequirao

Given that the solar observation instruments used in Cusco and their application to the calendar, it is first of all to summarize the essential solar and lunar observations that can be made from latitudes in the area of Cuzco, capital of the Inca Empire. Lunar observations have been used in many cultures, including our own, to establish the month on the calendar. The positions and appearance of the Sun and the Moon that are observed are a consequence of the apparent movement of these stars with respect to

the Earth, due to the combination of the two basic movements of the latter around its own axis and the Sun (Callasi, 2020).

Figure 4. Gnomon for the latitude of Cuzco. Source: Impacts of the integration of distributed generation with photovoltaic solar energy in medium voltage networks of the city of Cusco - Callasi, 2020.

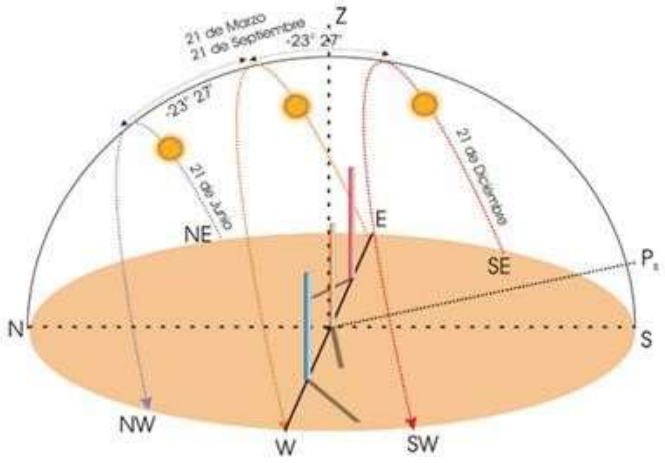

Figure 4 shows how the shadow produced by a vertical pole varies according to the time of day and the day of the year when it is observed. Therefore, it can be used as a watch or as a calendar monitoring tool.

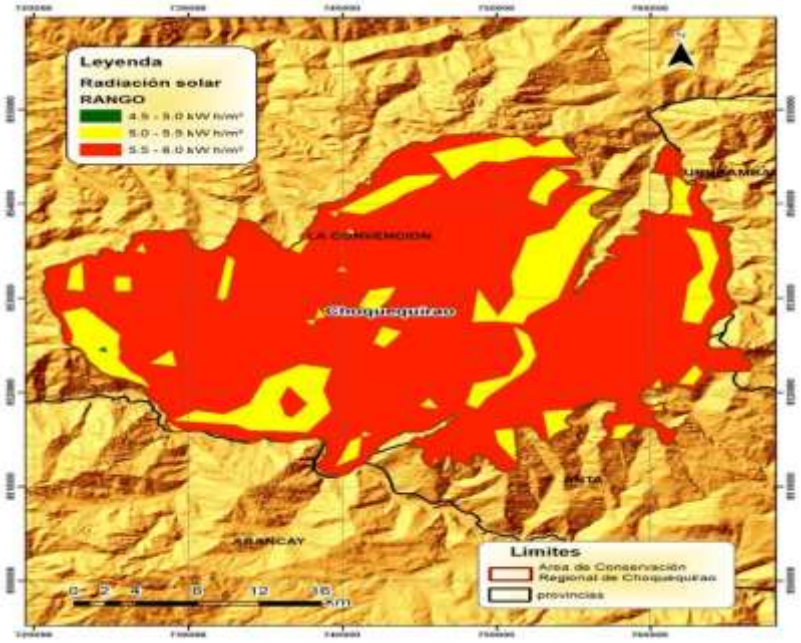

Figure 5. Solar radiation in the Choquequirao Regional Conservation Area, Cuzco Source: self made.

Figure 5 shows the solar energy that arrives as radiation or light during the year 2019 in Choquequirao, which is represented by colors and the interval of kWh / m2 was given.

3. Results

3.1 Clean Technologies Implementation

Renewable energies and clean technologies are widely developed and have been slowly being implemented in our country, despite the fact that their application generates a high economic, social and environmental impact (Saettone et al., 2016). That is why on the access route to Choquequirao it is also proposed to implement clean technologies for the benefit of the local population and for the greater comfort of visitors.

3.2 Calculations for the installation of the panel system and rain catchment

3.2.1 Solar panel system at stops on the interpretive trail

For the implementation we will use the Solar Panel 150w 12 volt AE Solar model, 12 volt 150w AE Solar Solar Panel, made in Germany. The 150w solar module is ideal for its dimensions for caravans, boats and small isolated solar installations. AE Solar has a 10-year warranty against manufacturing defects and 25 years in power (Pozuelo, 2018).

- Power: 150W
- Voltage: 17.49 Vp
- Intensity: 8.58 Ah

Formula	**Energy calculation**	**Panel Calculation**	**No. of panels**
EPT= Pmax*HSP (Vpmax / Vp) EPT= 150W * 6h/day (17.49v/12v) EPT= 1318Wh	Ntp= E.demandada /Ept = 28.996 Wh / 1.318 Wh Ntp= 22 Total panels	Nps = Vtworking/Vnp ; entonces 36v/12 v = 3 panels in series	Npp= Ntp/Nps = 22/3 = 7.3 rounding to 7 panels in parallel
Where: Pmax= Maximum power; HSP= Peak solar hour; Vpmax= Tension; Vp= Voltage; EPT= Total Potential Energy	Where: E.demandada= Energy Demand; EPT= Total Potential Energy; Ntp= Total number of panels	Where: Nps= Number of panels in series; Vworking= working voltage; Vnp= Panel voltage	Where: Npp= Number of panels in parallel; Ntp= Total number of panels; Nps= Number of panels in series

Table 3. Calculations for the installation of solar panels Source: Own elaboration.

In table 3 we use calculations to determine the total energy of the panels, the amount we should use and how to install them.

3.2.2 Calculation of liters of water in rain catchment

To calculate the liters of water in the rain catchment, it was necessary to know the millimeters of annual average precipitation of the Choquequirao Archaeological Park (Senamhi, 2020). The annual mean is reported to be 16 mm; then if we relate it, it is established that 1 millimeter (mm) of fallen water is equivalent to 1 liter of rain fallen in one square meter, and when it is heard that, for example, 10 mm of rain have fallen, it means that 10 have actually fallen liters of water in one square meter. That is why it only remains to make a rule of three simple ones, which consists of:

Millimeters	Liters
1mm	1
16mm	**X =16**

Then X = 16 liters of water fall on rainy days in Choquequirao for which we will use gallons of 70 liters for its collection.

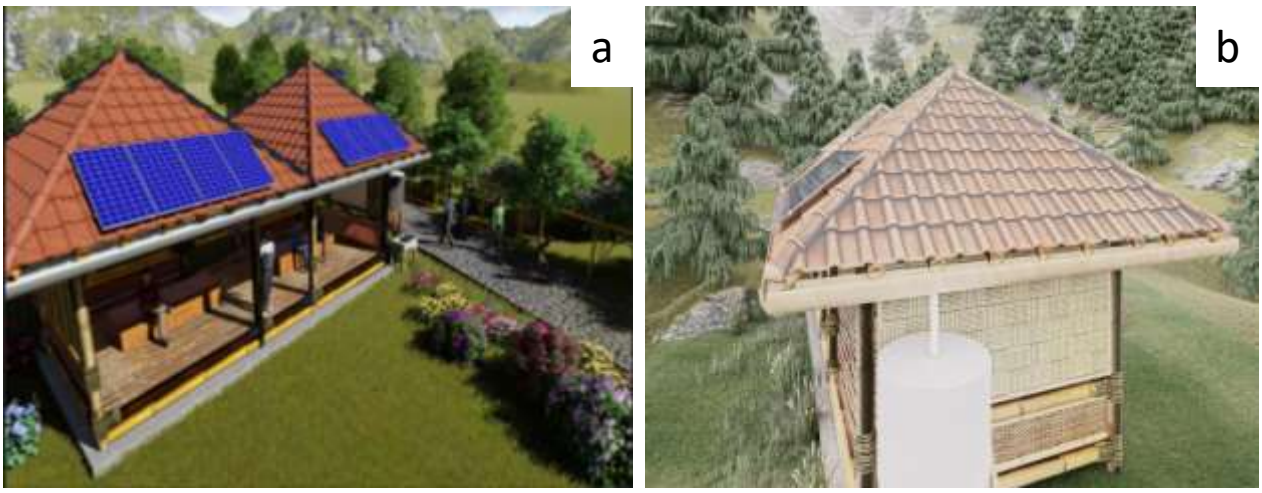

Figure 6. Design of the roof of the interpretive trail stop. Source: self made

Figure 6 (a) shows the modeling of the roof with outlets at the ends for the escape of water in the rainy season, in addition to the implementation of the solar panels with their respective installation. Figure (b) shows the water collection tank at the trail stop (Rodriguez C, Esenarro D, Alburquerque C , Vega M, and Ramirez V. 2021).

Figure 7. View of the infrastructure of the interpretive trail stop. Source: self made

In figure (c) you can see the interior furnishing of the stop where it consists of two armchairs, a lamp powered by solar energy and the interpretive posters on the walls. Figure (d) shows the installation of the pipe that will go directly to the tank and the water from which it can be used will arrive through the motor. This water reservoir is extremely important for the dehydration of the visitors due to the constant walking. Figure (e) shows the design of the path for better accessibility and comfort for the visitor.

Figure 8. Location panels and bamboo railings. Source: self made

Figure (f) shows the organic bins for proper recycling storage, as well as the location panel for greater visitor orientation. In the figure (g) the railings made of bamboo, an ecological material, are observed for greater safety of the visitor within the route to Choquequirao.

The research has made it possible to propose a technical design for an interpretive trail with the necessary planning and sustainable management, thus achieving harmony between man and nature for their care, safeguarding natural resources for future generations.

The interpretive trail has a distance of 6.2 km, where during the tour, you can see a great variety of flora and fauna, as well as various ecosystems. In addition, within the route there are rest areas, interpretation areas, information panels, signs, elements necessary for the environmental education process; as well as the signaling of the route with continuity markings, direction path and prohibition, which will serve so that the tourist can make their journey safely and at their own pace.

4. Conclusions

It is considered that the Archaeological Park of Choquequirao is unsafe but 21.20% of visitors believe the opposite, and when they

qualified the current state of the situation of the tourist infrastructure in general, they maintain the following: very serious 47.1%, serious 49.4% and as not serious in 3.5% "(Orue, 2020). Therefore, we can consider that this deserves a main attention and intervention to improve access to Choquequirao.

The importance of strengthening the tourist offer in the south of the country should maintain the government's interest in continuing to promote the development of tourist activity in the country because it plays an important role in the economy of the local population. That is why facilitating access to the archaeological complex of Choquequirao will allow the diversification of tourism in the south of the country, for the benefit of the Cusco and Apurímac regions. In addition, the enhancement of this tourist attraction will allow the development of new economic activities in the area.

The implementation of an interpretive trail strengthens the identity of the local population because it values the elements of the ecosystem that surrounds them. Therefore, it is extremely important to implement clean technologies in projects on nature tourism to promote new technologies in local populations (Esenarro D, Escate I, Anco L, Tassara C, and Rodriguez C. 2020).

Both the general and specific hypotheses are approved because they are directly proportionally related to a better trail and better comfort of the tourist, so that the tourist when investing in his visit to Choquequirao would generate economic income for the inhabitants and as well as greater well-being in the quality of life. Therefore, it is important to study the area in depth in its social, environmental and economic scope for the development of research. Finally, the results obtained are confirmed with the different documents obtained in recent years, which show data and economic income thanks to tourism activity.

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