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Cable Car with Water Collection for Afforestation of the Solar Hill in Chorrillos, Perú

Doris Esenarro[1] ,Ciro Rodriguez[2],Cristian Aquije[3], Nicasio Obregon[4] ,Luis Anicama[5],Cesar Arguedas[6]

[1,2]Specialized Institute for Ecosystems and Natural Resources Research (INERN)
[3,4,5,6] National University Federico Villarreal. Lima, Perú

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Abstract

The present investigation raises a perspective regarding the implementation of the morro solar phone - swamps of villa in chorrillos, incorporated with a trapper system, of 12L of water production per day, to look for viable alternatives that meet the demand for water required for afforestation of the area and thereby achieve a scenario that can be used as a frame of reference in the reduction of water stress in other districts of Lima Lima, the second-largest city built on a desert, has a water deficit of 5, 3 m ^ 3 / s and about 7.7% of homes do not have potable water service. This research includes the analysis of the climatological information and the evaluation of technical variables to prepare the telephone proposal. The project increases the reception capacity of tourism and increases the tourist offer, benefiting local communities economically, improving environmental and tourist conditions.

INTRODUCTION

Peru megadiverse country with a vast cultural and historical heritage presents in its geography the Andes mountain range that together with the currents of the Pacific Ocean give rise to a variety of climates, landscapes, and scenic beauties; features that make it one of the favorite destinations for thousands of tourists, increasing tourist demand every year. However, in many places in the country that, despite having a good product and tourism potential, are not adequately exploited due to the lack of tourist infrastructure, becoming obstacles to the success and development of the country

According to the Inter-American Development Bank (IDB), “Among the productive options that our country has, tourism represents a powerful tool to generate income and jobs, it is the third source of foreign exchange and exceeds one million jobs. By 2021 it could be the second most important sector of the Peruvian economy.” [1]

In Chorrillos, Lima district with a territorial extension of 38.94 km2, a great variety of tourist attractions such as the jump of the friar, the MaleuGrau, the freshwater tourist complex, the solar planetarium of Lima, the swamps of the villa, the hill are concentrated solar, among others. However, previous research in the study area has revealed the general problems found in the district.

The lack of tourist and recreational conditioning in the Morro Solar, added to the security problems, does not allow it to be developed and used as a tourist product; This attraction does not have adequate pedestrian and vehicular access to reach the top, as it lacks paved roads, signs, parking lots, ramps and lighting, these being its main deficiencies. [2]

The problem of water scarcity throughout Lima, even though Peru has an extraordinary water supply (4.6% of the volume of world runoff), the country is considered to be devoid of water, this causes considerable differences in terms of Availability of this resource. [3]. The origin of this problem is the supply of water resources from the Chillón, Rímac, and Lurín river basins, seasonal rivers, which in

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March - April 2020
ISSN: 0193-4120 Page No. 9236 - 9242

times of prolonged drought, make the provision of water to the city highly vulnerable. [4].

The thermal investment caused by the cold sea of the Peruvian current, which prevents the vertical development necessary for the formation of heavy rains on the coast of Peru, is another cause of the absence of water availability and plant cover in the hill solar and much of the coastal coast [5]; This has prompted the study and evaluation of new supply technologies such as the trapper, an alternative and viable source of water supply, to make them one of the priorities in research and development in Peru.
Another problem is the traffic congestion caused by the inefficient use of public space, with small units such as rural vans and taxis that occupy large areas of empty roads or at medium capacity. According to the Lima and Callao Master Plan, the percentage of empty taxis is 26% (from 7:00 am to 10:00 am) and reaches 39% (from 11:00 am to 2:00 pm: 00 pm). In turn, this causes, in addition to pollution, the decrease in average speed on the tracks and increases the average travel time. [6]

According to the Urban Transportation Master Plan, for the Lima and Callao Metropolitan Area, in 2004, the average travel speed was 16.8 km / h and the average travel time was 44.9 minutes; If no project promotes an improvement in the urban transport service, in 2025, the average speed will be 7.5 km / h and the average travel time will be 64.8 minutes. These figures are detrimental to the quality of the transport service that is provided to the user since it is obliged to spend an important part of their time in the use of the urban transport service, time that could be dedicated to other productive activities. [6]

The present work was born from the initiative to improve urban transport, promote sustainable tourism development in the study area, and the concern for the search for viable alternatives that help improve water availability for afforestation, increasing the quality of the landscape and Enjoy visitors.

The research consists in propose a new means of transport that is more environmentally friendly since it will reduce pollution due to its structural and operational characteristics; Besides, it will contribute to afforestation in the solar hill due to the water availability obtained from the trapper, of 12L of water production per day, which will be incorporated into the cable car towers made of steel an reinforced concrete.

II. METHODOLOGY

Please follow these instructions as carefully as possible, so all articles within a conference have the same style to the title page. This paragraph follows a section title, so it should not be indented.

The project for the solar nose - marshes of the village will be with the mechanisms and components used in monocable cable cars widely used in South America, but implementing a trapper in the support towers of the cable cars due to the high concentration of fog in the solar nose.

III. STUDY AREA

Cable cars are mainly tourist attractions in rich western countries, but in places like Chorrillos, they have also been implemented as transportation systems to connect isolated low-income neighborhoods. The cable cars offer multiple advantages over metro or light rail systems since their construction period is shorter and is more suitable for cities with mountainous geography, such as the Morro Solar in Chorrillos. [7]

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March - April 2020
ISSN: 0193-4120 Page No. 9236 - 9242

Figure 1.Project of the Morro Solar-Pantanos de Villa cable transport system consisting of seven stations that connect the Morro Solar with the locations of AH San José I, Bello Horizonte and San Juan Bautista along with the La Granja Villa and Los Pantanos recreational center.

IV. TOPOGRAPHY

Chorrillos is formed by two plains and a rugged area:

• The plain of Chorrillos corresponds to the high type coast, where the soils are regularly homogeneous but formed by clayey, salty and sandy soil, not very resistant but suitable for cultivation. [8]

• The coastal plain or plain of the villa presents swamp areas with little drainage and outcrop of the water table very close to the surface. It is also homogeneous topography, and soils have salinity and drainage problems. [8]

• The rugged area consists mainly of the hills: Morro solar, zigzag, La Chira, among others and those that surround the marshes of the villa [8]

Elevation profile of the cable route

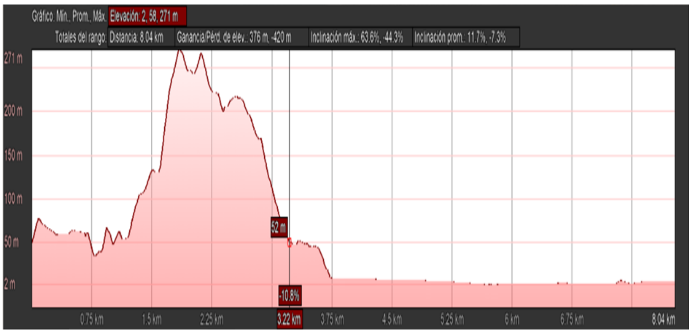

Figure 2. Elevation profile of the 8.04km path of the Morro solar- Pantanos de Villa cable car with an average elevation of 258.27m in the first 3.75km and 6m in the remaining route

Source: Google Earth Pro

4.1 Weather characteristics

The Chorrillos district has a variable climate, being generally mild and humid. During the winter months, the humidity is intense due to the presence of mist during the morning, especially in the places closest to the sea.

Table 1.climatic characteristics of Chorrillos

Weather characteristics	Data
RH	It varies between 90 and 65% with greater incidence in the winter.
Hours of sun	-April - December 6 hours/days -May November 2 to 3 hours/day
Cloudiness	The annual average of 6/7 being considered high since it covers 74.95% of the sky.
Winds	They are coming from the south having an average annual speed of 13.9 km / hour

V. TEMPERATURE

Summer: from December to April, they have temperatures ranging between 28 and 32 ° C.

Winter: from June to September, with temperatures range between 16 and 13 ° C.

Spring and autumn: from September to May with mild temperatures between 23 and 17 °.

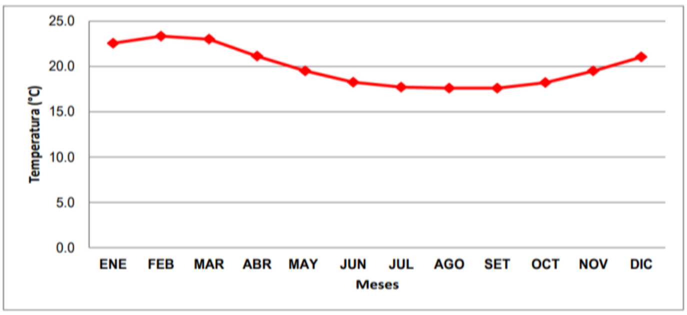

Figure 3.Comportamiento de la temperatura media mensual(°C) - estaciónmeteorológicaPantanos de Villa quecuenta con información del año 1996 al

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2006 disponible, de acuerdo a los últimosregistrosrealizados en dichaestación, indicanque la temperaturapromedio en el áreaes de 20°C, con unavariaciónanual de 15,8°C a 26,6 °C

Fuente: EstaciónPantanos de Villa (1996-2006) SENAMHI

VI. RH

La estaciónPantanos de Villa periodo 1996-2006, señalaunahumedadrelativa media mensualque se encuentra entre 71,5% a 96,1%, sin unavariaciónanualsignificativa, característicapropia de estas latitudes y unahumedadrelativapromedioanual de 86,8%. La humedadrelativamáxima media mensualesestabledurante el año, con promedio de 92,3%, y la mínimamensual, promedioes 81,5%

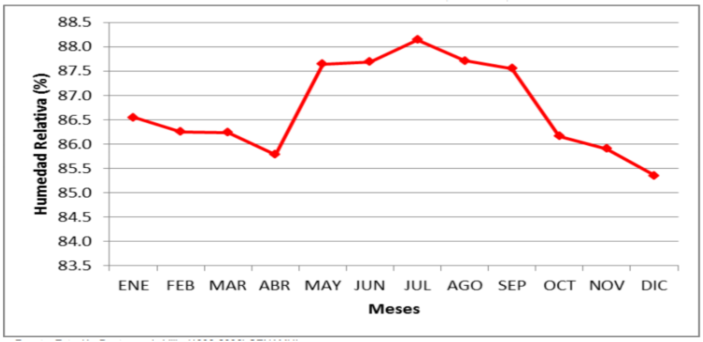

Figure 4.Comportamiento de la HumedadRelativapromediomensual. Se observaque entre los meses de mayo a setiembre la humedadrelativaesalta; mientrasque en diciembre se presenta el menorporcentaje de humedad.

Fuente: EstaciónPantanos de Villa (1996-2006) SENAMHI

Seasons

Figure 5. Satellite map of the seven stations of the cable car and the distribution of its turrets

The Morro Solar - Pantanos de Villa cable car will have three types of stations:

Figure 6. Transmission station: generally located at one end of a

Figure 7. Return station: located at the opposite end of a system from a driving station, the return stations include the necessary mechanical components necessary to return the cabins to the transmission station. [10]

Figure 8. Intermediate station: Located at one or more points between the two endpoints of the system. The stations offer additional opportunities for passengers to board and get off a system. [10]

March - April 2020
ISSN: 0193-4120 Page No. 9236 - 9242

Table 2. The geographical location of the cable car stations

Station	Location
Station 1	12°10’ 5,52” S < 77° 2’ 8,44” O
Station 2	12° 11’ 15.31” S 77° 1’ 24,20” O
Station 3	12° 11’ 50,56” S 77° 0’ 36,34” O
Station 4	12°12'7.37"S 77° 0'18.73"O
Station 5	12°12'19.62"S 77° 0'5.06"O
Station 6	12°12'1.64"S 76°59'47.81"O
Station 7	12°12'34.30"S 76°59'14.77"O

6. The cabins

They will have modern infrastructure containing a solar panel that will be used for lighting inside the cabin, and for the use of WIFI, each cabin can board six passengers and will have an average speed of 6m / s.

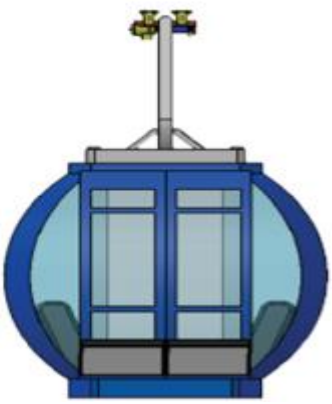

Figure 9. Front view

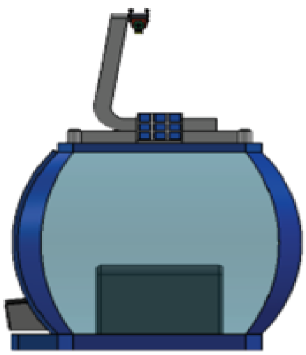

Figure 10. Left side view

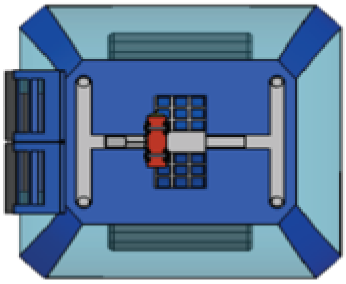

Figure 11. Top view

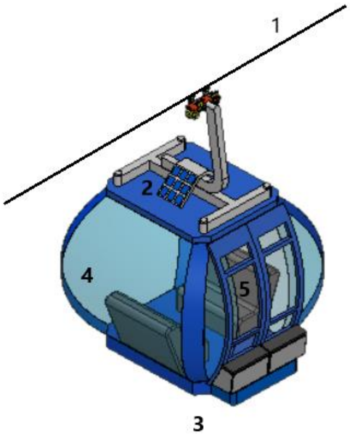

Figure 12. Turrets

Table 3.cabin structure and composition

N°	MATERIALS
1	Steel cable
2	Solar panel
3	Aluminum structure
4	Acrylic window
5	Seating

Support of mobile phones in a separation of 200 to 300 meters seeing the availability of urban space of the district of Chorrillos and for the relief provided by the solar nose will be a distance of 60 to 100 meters. Due to the difficulty of the geographical, urban space, and the need to make a 90-degree turn for better handling of the telephone route, a turned tower will be moved.

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VII. CLEAN TECHNOLOGY

7.1 Turret implemented with a trapper

It incorporates four collectors of trappers in each of the 16 turrets of the cable car in the solar area, each collector integrates in its structure plastic meshes of 3.0m x 3.5m of catchment area, with a metallic coating called Aluminet, which it is 50% more efficient in collecting mist water than the Raschel mesh [9]; The cable car turrets were used as supports, to take advantage of its infrastructure and reduce construction costs.

Figure 13. The cable car systems, given the circumstances, require bending 90 ° due to restrictions on the road or in the natural environment. This can be achieved with either turning towers, or more commonly, turning terminals. At turning terminals, passenger cabins slow down to a speed of approximately 300 feet per minute to transfer from one cable loop to another and change course. [10]

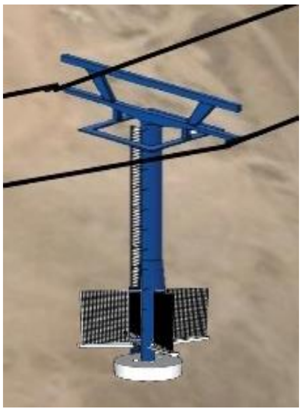

Figure 14. Turret implemented with four fog collectors and a water storage tank.

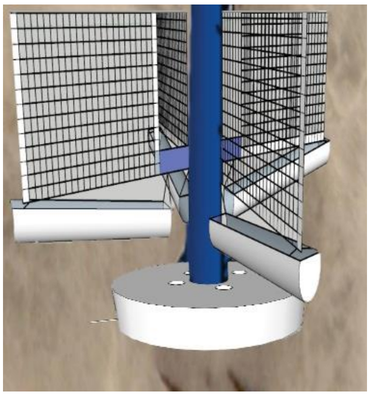

Figure 15. Meshes, collecting pipes and water storage tank implemented in the turret

The distribution begins with the water collected and collected in the pipe located at the base of the mesh, where a PVC pipe is attached, which directs the liquid directly to the 20L storage tank. [9] The tank will have an integrated water distribution system that, thanks to the advantage of the height resource, the water conduction will not require any energy since it is low by gravity.

Table 4. Shows information on collectors by location and installation site, as well as their geographical information (coordinates and altitude)—this latest information obtained through Google earth pro.

Atrapanieblas	% de captación	Elevación (m.s.n.m)	S	O
1	30%	75	12°10'8.68"	77° 2'5.41"
2	30%	73	12°10'12.18"	77° 2'2.26"
3	30%	74	12°10'15.91"	77° 1'59.33"
4	30%	84	12°10'19.18"	77° 1'58.12"

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March - April 2020
ISSN: 0193-4120 Page No. 9236 - 9242

5	30%	60	12°10'23.29"	77° 1'55.61"
6	30%	66	12°10'29.37"	77° 1'52.19"
7	30%	51	12°10'34.86"	77° 1'49.19"
8	30%	73	12°10'37.97"	77° 1'46.02"
9	40%	110	12°10'41.18"	77° 1'44.56"
10	40%	137	12°10'44.74"	77° 1'42.60"
11	45%	175	12°10'49.31"	77° 1'40.09"
12	45%	215	12°10'51.91"	77° 1'39.49"
13	50%	250	12°10'54.54"	77° 1'38.52"
14	50%	271	12°10'56.37"	77° 1'38.25"
15	50%	241	12°10'58.22"	77° 1'37.01"
16	45%	220	12°11'0.04"	77° 1'35.75"
17	45%	239	12°11'0.49"	77° 1'34.17"
18	50%	257	12°11'4.28"	77° 1'32.05"
19	45%	206 m	12°11'11.34"	77° 1'26.48"

VIII. DISCUSSION

The implementation of a cable car will directly benefit the residents of Chorrillos due to the presence of tourists, which allows generating greater sources of work due to the increase in economic activity, improving the socioeconomic quality; in this way, this project meets the sustainable development district.

At present, the number of visitors in the solar hill is approximately 1000 visitors per month with the implementation of the cable car this number of visitors would increase by 60%, in the same way, the number of visitors in Pantanos de Villa would increase, but this would also imply that visitors can generate negative impacts for this Wildlife Refuge having to change the amount of capacity per daily visit, even to implement a better interpretation center for the reception of these visitors, since by connecting the cable car of the solar hill towards villa marshes It will have a positive and negative impact on these tourist areas of Chorrillos.

REFERENCES

9.1. Internet Magazine Article

[1] GESTIÓN, «BID: The tourism sector could be the second largest source of foreign exchange in Peru in 2021,» 11 JULIO 2013. [En línea].Available: https://gestion.pe/economia/bid-sector-turismo-segunda-fuente-generadora-divisas-peru-2021-43097-noticia/. (2013)

[2] V. R. BARRANTES CHAVEZ, «PROPOSAL FOR TOURIST CONDITIONING OF MORRO SOLAR TO STRENGTHEN THE TOURIST OFFER OF THE CITY OF LIMA » VERITAS LIBERABIT VOS, LIMA, (2019).

[3] L. Oblitas, R. Warner y L. Flores, «Water for the 21st Century for South America from the Vision to Action,» GWP SAMTAC, LIMA, (2004).

[4] C. Pinto, Formation process of the Water Resources Council of the Chillón, Rímac and Lurín Interregional Basin, Peru, quito: Future Latin American Foundation (FFLA), 2015, pp. 29.30 (2015).

[5] R. Woodman Pollitt and K. Takahashi Guevara, «Why does it not rain on the coast of Peru (except during El Niño)? » Geophysical Institute of Peru, vol. 1, pp. 4,5, (2014).

[6] B. Merino Lucero, «Urban Transport in Metropolitan Lima: A challenge in defense of life » Belgian Technical Cooperation, Lima, (2008)

[7] S. Martínez , R. Sánchez y P. Yañez-Pagans , «Getting a Lift : The Impact of Aerial Cable Cars in La Paz Bolivia,» IDB, Washington, DC, (2018).

[8] M. D. CHORRILLOS, «CONCERTED DEVELOPMENT PLAN 2017-2021 » LIMA, (2016)