

Green Corridor for Social and Ecological Ingration with the Tablada de Lurín Archaeological Zone- Villa María del Triunfo District

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Abstract

The present research proposes a green corridor design that fosters social and ecological integration with the Tablada de Lurín Archaeological Zone. For this, a virtual meeting was carried out to know and consider the population's opinion; based on this, 92.7% of the people surveyed answered that the study area does not have enough green places. In this context, the proposal to design a green corridor in Tablada de Lurín is viable due to the evident lack of green regions and adequate spaces for interaction, integration of people, ecology, and nature; Likewise, a green corridor allows the connection with the archaeological zone, which enables the connectivity of people with the culture that this place houses.

Keywords: Green corridor; social integration; ecological integration; Archaeological Zone

1. Introduction

In the last 70 years, in Lima and Callao, the surface area multiplied by 42 in urbanization and the population growth by 13. Overcoming physical growth over demographic change has negatively impacted urban territorial metabolism and created unsustainable urban patterns and low density, putting the environment at risk [1].

Since ancient times, the population has been occupying spaces where they can obtain resources to survive, as is the case of Tablada de Lurín; the ancient inhabitants took advantage of the natural resources seasonally given by the phenomenon of the hills and the marine resources of the nearby beaches [2]. Today in this place is the Tablada de Lurín Archaeological Zone. However, over time, population and urban growth have drastically modified the landscape, significantly reducing green areas, fragmenting and deteriorating the ecosystem of hills in the area.

The urbanization process in Latin America has produced the appearance and consolidation of fragmented cities in its most recent phase, characterized by an insular structure where multiple urban nuclei are socially and ecologically disconnected [3].

The current landscape of Tablada de Lurín is mainly made up of urban areas with few green spaces. The WHO recommends that cities have a minimum standard of 9 m² of green areas per inhabitant [4]. However, Lima has 3.1 m² (effectively enabled site), according to figures from the Metropolitan Plan for Urban Development of Lima and Callao. As a result, the capital occupies the last place in the green spaces of the Index of Green Cities of Latin America [5].

Within the list of districts that do not meet the minimum requirement of green areas per inhabitant recommended by the WHO is Villa María del Triunfo, a community where the Tablada de Lurín Archaeological Zone is located, with only 1.2 m² of green areas per inhabitant, causing various problems, both as environmental and population health [1].

Apart from the few urban green areas in the area, most of the population has little or no knowledge of this Archaeological Zone, which is shocking since there is a prehistoric cemetery key to clarifying the origins of the origins within this complex Lima culture [6].

Together, all these problems highlight the lack of identity and connection with our history and nature and the ecosystems surrounding us. However, inhabiting an urban area does not

mean that we cannot create a symbiosis of ecology with the archaeological-cultural part; this would protect the environment, the archaeological zone, and the population at the same time.

2. Literature review

2.1. Green corridors

An ecological corridor is a site or channel with the capacity to make an animal, plant, or fungal species move or disperse. Its primary function is to mitigate the impacts of the different urban and rural uses on natural habitats, especially regarding their fragmentation when connecting natural areas with incredible biodiversity. Large wheeled mobility infrastructures or large sealed surfaces, be they industrial, commercial or residential, make up an artificial territory that is difficult to traverse. However, large agricultural or forestry operations, especially monocultures, also constitute almost insurmountable barriers to biodiversity [7]. The idea that green corridors are linear gives it a spatial function differentiated from other green infrastructure components: connectivity. The connectivity offered by green corridors would allow the purpose of green infrastructure to be fulfilled, that is, to configure a planned network of natural and semi-natural spaces designed and managed to offer a wide range of ecosystem services [8].

It is considered that proposing ecological corridors in urban areas is an issue that has not been touched much at present; it is known that the creation of these spaces is of great importance for the development and displacement of the fauna that inhabits these spaces, also, to provide an environmental improvement, offers benefits to human beings who live near them [9].

2.1.1. Urban green corridors

They are urban strips with a dominant presence of vegetation and the exclusive use, or at least priority, of pedestrians and bicycles, which cross an urban fabric. The urban ecosystem's complexity makes it necessary for the urban corridor to consider in the context issues such as availability of public space, characteristics of the urban fabric, etc. [10].

The connection of the green spaces must be guaranteed, which serves as a transition between the urban environment and the natural environment, taking advantage of the natural geography.

2.1.2. Green corridor indicators

Connectivity: A variable that directly affects the biodiversity of habitat is ecological connectivity, capable of describing how the spatial arrangement and the quality of the landscape elements affect the movement of organisms between ecosystems, within ecosystems, and between patches of habitats. In this way, it has been defined as the degree to which the landscape prevents or facilitates movement between patches of habitats where the resources are found [11].

There are two main ways to promote landscape connectivity:

The comprehensive management of the set of landscape mosaics to facilitate the movement and continuity of populations.

The specific management of habitats within the landscape by managing continuous corridors between these natural habitats. Examples of these corridors include boundaries in certain agricultural landscapes, river beds and riverbanks, more or less linear wooded masses of forest vegetation, and, in Spain, livestock routes.

The main potential positive effects generated by connectivity areas or ecological corridors are:

- They facilitate the movement of fauna through transformed landscapes.
- They benefit from the great diversity of species, such as those with large range areas, migratory ones, or multi-habitats.
- Immigration rates of individuals of species sensitive to fragmentation increase in the habitat fractions.
- They allow the recolonization of habitats and the reestablishment of populations after episodes of local extinction.
- They provide habitat, shelter, and other necessary resources to numerous wild species.
- They increase landscape diversity.
- **Trees:** Road trees are one of the main plant elements in cities; therefore, it is a structural element of biodiversity in the urban ecosystem. The tree-lined streets of a city can be considered potential corridors as they improve the urban ecosystem's connectivity, allowing certain species to survive and reproduce. [12]
- **Biodiversity:** Biodiversity has an intrinsic value and is a critical element of any landscape, including cities. Habitat fragmentation is the greatest threat to the

conservation of wildlife and natural ecosystems in urban areas. Increasing and restoring urban and peri-urban natural landscapes' functionality and connectivity can be valuable for conserving natural resources and biodiversity. [11]

- Air quality: Green spaces can help maintain and improve air and water quality in and around cities. Trees in cities can enhance air quality through various chemical reactions and capture and retain air pollutants. By lowering the air temperature, trees also help reduce air conditioners' use while saving energy consumption and reducing pollutant emissions. [10]

2.1.3. Functions of green corridors

The role of landscape elements as ecological corridors began to be studied in depth in the

early 1990s. A key characteristic of ecological corridors is that matter and energy flows are more significant than in the adjacent plots [13]. Passages result from the natural functioning of the landscape (for example, streams) or human influence (for instance, undisturbed areas). In addition to increasing connectivity, corridors are also often valuable for their role as habitat, and confusion between habitat and corridor role is common [14].

2.1.4. Ecosystem services provided by green corridors

Ecosystem services can be classified into four broad groups: support, regulation, provision, and cultural [15].

Table 1. Green corridors provide ecosystem services. Source: Green infrastructure, ecosystem services, and their contributions to face climate change in cities [26].

Support	Regulation	Provision	Cultural
Soil formation	Protection against natural hazards	Provision of habitat	Cultural heritage
Photosynthesis Primary	Pollination	Water	Educational value
Production Nutrient Cycle Water Cycle	Noise reduction	Natural resources	Social integration
	Gas regulation (+ O ₂ and -CO ₂)	Biodiversity	Mental and physical health of people
	Carbon sequestration	Genetic resources.	

2.2. Social and ecological integration

A recent initiative originated by ecologists to integrate the environmental issue's ecological and human dimensions [16]. Their motivation arises from the recognition that 1) natural scientists will not be able to solve environmental problems on their own and that 2) purely natural ecological systems (those without direct or indirect human intervention) hardly exist and, what each more and more we are experiencing situations in which the human dimension is an integral part of the ecosystem. These authors consider that it is inevitable to include the social and human element in what has traditionally been studying natural ecosystems.

Most of the world's population lives in urban areas, and it is through urban systems, humans generate much of their environmental impacts locally and globally. These initiatives have brought together groups of natural scientists with social scientists, although the majority remain natural scientists. An important document explaining the approach proposed to

promote this integration as part of the National Science Foundation initiative is Integrative Science [17].

2.2.1. Sustainable urbanism

The urban approach that is related to the environment as a system has led to the conclusion that the conservation of the environment, its natural resources, the balance between the built and natural environment, and the conservation of the natural and rural landscape as public heritage are closely related to urban morphology and transport patterns [18].

Therefore, urban planning must be a fundamental part of any strategy to achieve more efficient land use and protect our ecological, landscape, and agricultural interests while creating a more livable urban environment.

2.2.2. Sustainability of urban green spaces

Managing ecological sustainability involves four ideals: Provide a long-term balance between society and resource, today and in the future; try to increase the relationship between

environmental possibilities and community wishes; develop assessment tools for both the help and its outputs and restore ecosystems [15].

The most essential characteristics of the sustainability of urban green spaces are the general character of the sustainability of urban green space; that provide more services than direct goods that provide habitat for wild and urban fauna, tourist services, landscape architecture, etc.; in the management of a sustainable urban green space, a balance must be sought between the different benefits and not maximizing one at the expense of the others [16].

3. Materials and methods

3.1. Study area

The investigation was specifically delimited in the Tablada de Lurín sector, in the Villa María del Triunfo district.

Location: Tablada de Lurín represents the 5th. Administrative zone of the Villa María del Triunfo district having as geographical coordinates: longitude: $076^{\circ} 55'28.38''$ and latitude: $S12^{\circ} 11'12.19''$ at 286 masl.

Its territorial extension is 15.06 km², and its limits are: To the north with the Nueva Esperanza Zone, to the South with the Nuevo Milenio Zone, to the east with Atocongo, and to the west with the Villa El Salvador district.

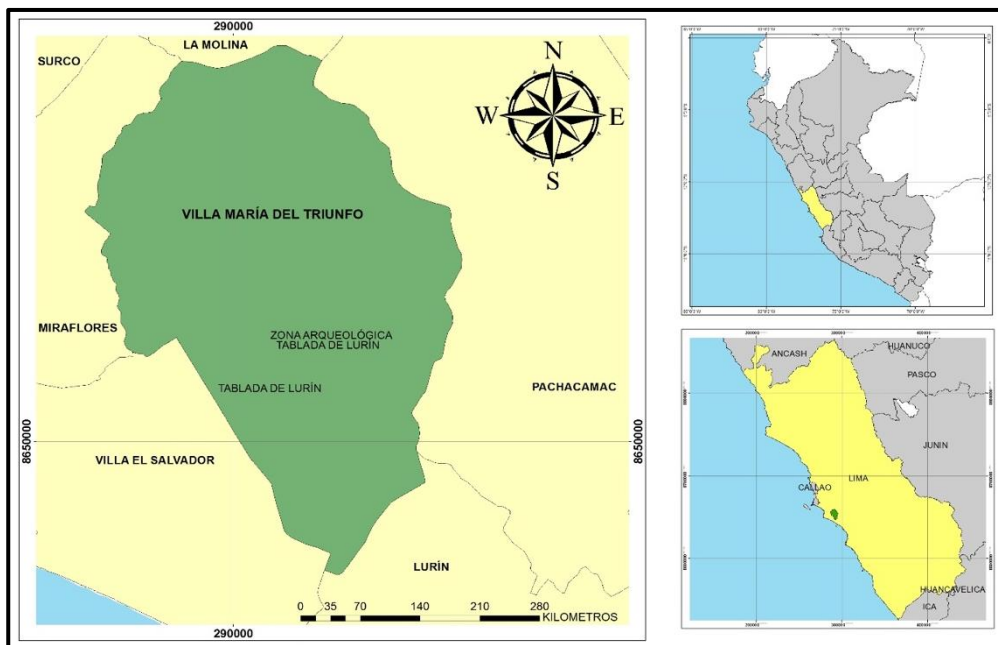


Figure 1. Location Map of Tablada de Lurín-Villa María del Triunfo. Source: owen

Figure 1 shows the location map of the study area made by superimposing shapefiles with ArcGIS 10.5 software.

Location of the Tablada de Lurín Archaeological Zone: The Tablada de Lurín Archaeological Zone is a complex of pre-

Hispanic sites on the Central Coast of Peru, in the Atocongo stream, on the right bank of the Lurín River, south of Lima ($12^{\circ} 11'$ South Latitude, $76^{\circ} 55'$ Longitude West [16].

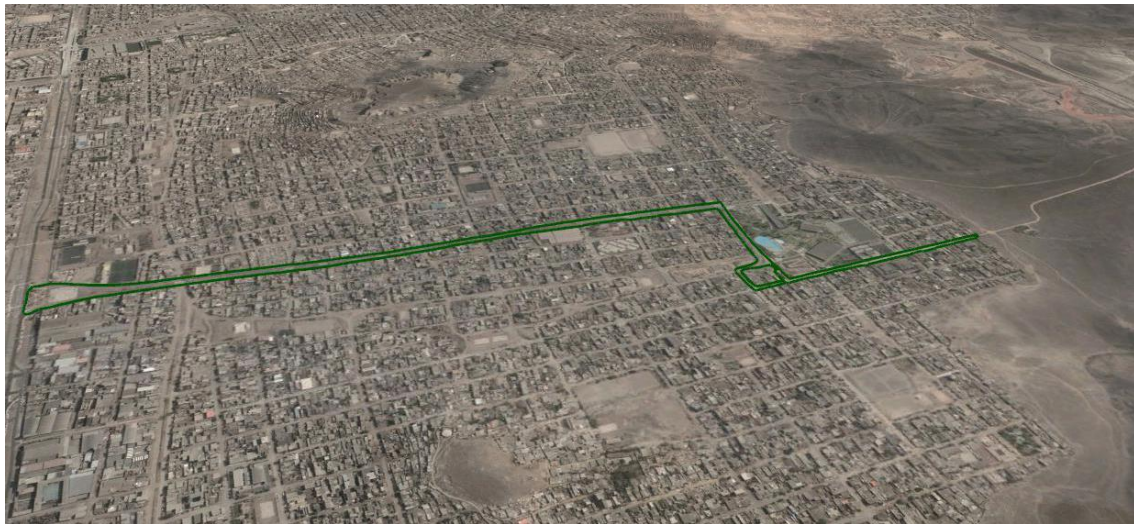


Figure 2. Satellite image of the location of the green corridor.

In Figure 2, a satellite image of the location of the designed green corridor is observed. This satellite image is georeferenced in the Google Earth Pro software, where the gallery is seen, from beginning to end.

3.2. Characteristics of the study area

➤ **Climatology:** A semi-hot, desert climate zone, with a rain deficiency in all

seasons, with relative humidity classified as very humid [18].

➤ **Geological units:** the Villa María del Triunfo district predominantly has two Geological units: Ks-pt / gbdi (Diorite) and Ks-at / mzgr (Monzogranite).

➤ **Geomorphological Units:** Geoforms of denudational, fluvial-alluvial, aeolian, and Arroyada origin are identified.

Table 2. Geomorphological Units of the Tablada de Lurín Area. Source: Modified table of the report on “Information gathering on vulnerabilities of men and women in the district of San Juan de Miraflores - Villa María del Triunfo against climate change”.

Zone	Origin	Unit
Tablada de Lurín	Denudational	Intrusive Hills and Lomas
	Arroyo	Glacis (spilled in the bush)
	Gravitational	Debris slope
	Anthropic	Quarry

3.3. Materials

Virtual survey: Used to obtain relevant information from the population to carry out the research.

Mapping

The cartographic material used in the present investigation:

National Letter at 1: 100,000 scale, which was downloaded from the Geoportal of the National Geographic Institute, mainly to use the shapes file and create thematic maps according to the research.

Sheet-25j

Shape file district, provincial, South American continent, and ocean.

3.4. National portals

Geoportal of the National Geographic Institute: used to download national charts and visualization of the studied space.

Geoportal of the Ministry of Culture: used to locate, view, and obtain information on the Tablada de Lurín Archaeological Zone.

3.5. Software

ArcGIS 10.5: It is a system that allows you to collect, organize, manage, analyze, share, and distribute geographic information. It is used to make thematic maps.

Google Earth Pro: Used to make the route of the green corridor.

SketchUp: It is a face-based three-dimensional modeling and graphic design program. They are used for modeling the project.

Microsoft Office: Word was used to make the report, and Excel to store the coordinates used in ArcGIS.

4. Results and Discussion

4.1. Results of the hypothesis

This research's central hypothesis is that a green corridor's design allows social and ecological integration with the Tablada de Lurín Archaeological Zone. To verify the idea; A virtual survey was carried out; the survey consists of 14 questions and is directed to a population sample of 96 inhabitants of the study area.

Figure 3 is the graphic representation of question 11 posed in the virtual survey, where the population was asked what they would prefer to have in the parks near their homes; for such a question, you could choose more than one option, To which 87.5% responded that

they would prefer there to be more vegetation since previously they were asked if Tablada de Lurín had enough green areas, where 92.7% answered that there are not enough green areas. There are in a fair, harmful, or worse state of conservation; most respondents chose this option.

As the second most scored option, there are recreational games for children, obtaining a score of 64.6%; Given that 68.8% of those surveyed are between 25 and 44 years of age, this means that it is likely that most of these people have young children whom they would like to take to parks that are adequately equipped with recreational games where children can have fun and be in contact with nature. The third most scored, with 52.1%, are the vegetable gardens, representing specific needs that the population needs to meet.

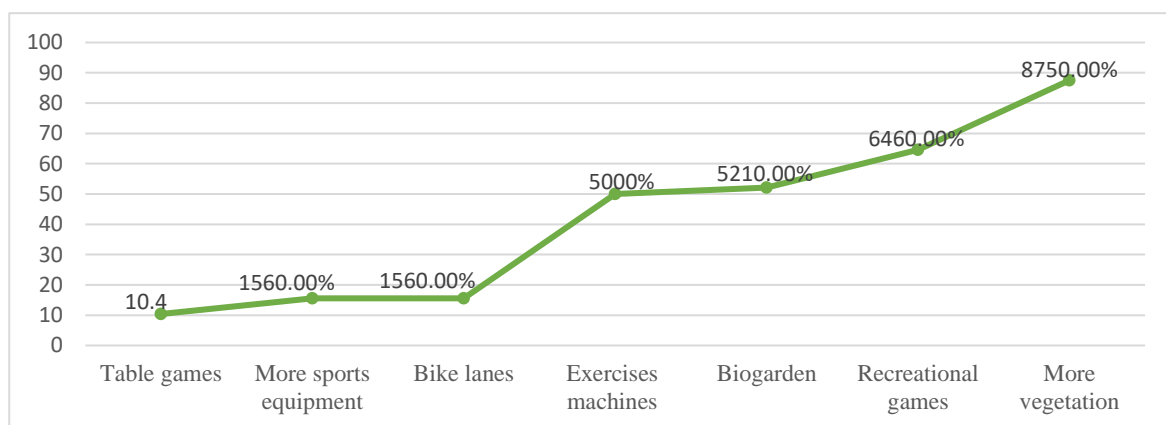
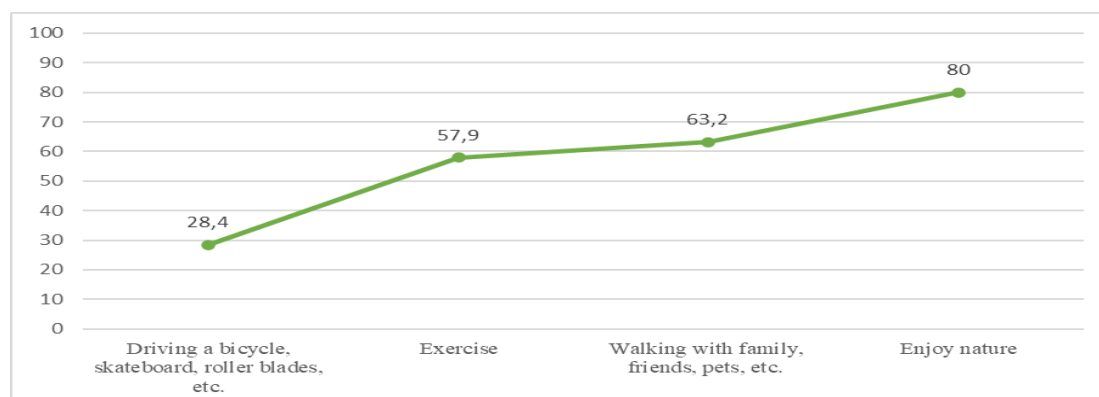


Figure 3. Graphic representation of question 11 of the virtual survey.

Figure 3 and 4 is the graphic representation of question 12 posed in the virtual survey. According to question 12 posed in the virtual poll, the population sample was asked what activities they would prefer to carry out in the parks near their homes, to which 80% responded that they would choose to enjoy

nature, reflecting a need of the population to be in contact with nature, which cannot be done at the moment, since Tablada de Lurín does not have enough green areas for the public to enjoy the benefits and services offered by an environment with sufficient vegetation. The next most voted option was: walking with



family, friends, pets, etc., which obtained 63.2% of votes; when combining the two most voted

options, it reflects that social and ecological integration is effectively achieved because the congregation of the public in spaces with enough green areas will encourage and promote the integration of users with nature, creating in them the will protect and conserve such spaces since they generate benefits, be it a better view of the landscape, more excellent ventilation, shade, reduction of noise and air pollution, as well as offering moments of relaxation and fun for everyone.

Figure 4. Graphic representation of question 12 of the virtual survey.

4.2. Green corridor proposal

This research proposes to design a green corridor that connects the main avenues with the Tablada de Lurín Archaeological Zone, which achieves the social and ecological integration of people with the environment. When designing the green corridor, the surrounding green areas are implemented and improved. The gallery, such as parks, includes organic gardens and recreational games, among

According to question 14 of the virtual survey, when proposing to design a green corridor in Tablada de Lurín that connects the main avenues with the Archaeological Zone, 97.9% of those surveyed answered that they would prefer to choose this path. This is beneficial for people and the Archaeological Zone since it is not as well known or frequented; according to question 5 posed in the virtual survey, the respondents are asked if they know or have heard about the Archaeological Zone of Tablada de Lurín, from which it was obtained that 41.7% of the respondents had visited the AZ, 44.8% of the respondents answered that they have heard about the place but have not visited it and 13.5 % of those surveyed said they were unaware of the existence of such an archaeological site. With the following results, we can see that most of the population has not visited or does not know of such a place. Therefore, designing the green corridor that connects with the AZ would achieve social and ecological integration and integration with the culture that such a place has.

Figure 5. a) Full view of the green corridor design. b) Front view of the green corridor.



other factors, since it is what the population sample preferred to choose.

Figure 5 is composed of two images of the green corridor, designed with the SketchUp software; image (a) shows a



complete view of the designed green corridor, it has a length of 2.54 km, and image (b) shows Observe a frontal view of the green corridor,

where the tracks, sidewalks and the central berms are visualized, where the trees would go.



Figure 6. Designed the implementation of recreational games for children in the parks surrounding the green corridor.

Figure 6 shows the design of the implementation of games for children in the parks surrounding the green corridor. In the

surveys carried out, people believed that they would prefer more vegetation in these places and recreational games for the little ones.



Figure 7. Design of a bio-garden in a park adjacent to the green corridor

Figure 7 shows a vegetable garden design in a park adjacent to the green corridor, available to people. This space would achieve the

population's integration with part of nature since there must necessarily be an interaction



Figure 8. a) Trees in the green corridor. b) Internal design of the green corridor and bike path

Figure 8 is composed of two images of the green corridor, designed with the SketchUp software; image (a) shows the trees' arrangement along the green corridor, and to the side, there is a park that connects with a said corridor. In figure (b), it is observed that there is a space where people can walk or ride a bicycle in the green gallery and see the public lighting and garbage cans.

5. Discussion

According to Martínez García, he maintains that proposing ecological corridors in urban areas is an issue that has not been touched much at present, since the metropolitan area is being

overpopulated, leaving aside the environmental aspect, creating a deficit of green places, for This is essential to create green corridors that are of great importance for the development and displacement of the fauna that inhabit these spaces, in addition to providing an environmental improvement, it offers benefits to the human beings who live near them [19]. Alvarado argues that green corridors provide multiple ecosystem services, making it possible to reconcile the preservation of critical ecological functions, the satisfaction of social needs, and the increase in levels of environmental and social integration, which is why he presents green corridors as recreational

spaces, recreation, and beautification that allow interaction between people and with nature. Despite the benefits that green corridors provide, they are not studied in Latin America and are much less implemented [18].

According to Giraldo, firstly, the thinking and needs of people must be understood and understood; based on this, he proposes to develop a system of public space to promote leisure and encounters with the development of new ways of occupying space, which is innovative and responds to future needs, making the most of every area both horizontally and vertically. In his proposal, he indicates the improvement of avenues, blocks, and a green corridor design; this is proposed as a connecting street for activities and coexistence functions, where there are also spaces for different activities in the public space, which achieves integration and interaction of people with green areas [20].

In this research, a green corridor design is proposed to achieve social and ecological integration; for them, a survey was carried out where it was possible to observe the perspective that the population has of the current situation of green areas and the needs they need to meet in the socio-environmental aspect. The design of a green corridor in Tablada de Lurín would be beneficial for the neighboring inhabitants given the ecosystem services and complements that the implementation of the project entails, despite specific problems detected, such as lack of education and environmental awareness, lack of cultural identity, lack of actions on the part of the municipality, among others; people show a willingness to integrate with nature since it is a growing need to have appropriately implemented spaces.

6. Conclusions

The design proposal of a green corridor in the Tablada de Lurín area to achieve social and ecological integration is viable since the results of the virtual surveys confirm this since most of the people surveyed made known the socio-environmental needs that they currently present; therefore, by implementing more green areas, games, exercise machines, orchards, among others; social integration with the environmental aspect is being achieved.

There is a clear social need to be in contact with nature, which generates dissatisfaction in the population; this could diminish by causing more recreation spaces duly implemented and

with more vegetation, so that people are in direct contact with the nature of accessible and close to their homes, benefiting from the ecosystem services they provide.

A green corridor that connects the main avenues with the Tablada de Lurín Archaeological Zone would be achieving the integration of people with the culture that houses such a place, thus increasing the cultural identity of the surrounding population, in addition to integration with nature by doing the route of the green corridor.

Having a green corridor and more vegetation would reduce the deficit of green areas that Tablada de Lurín currently has, trying to meet the minimum requirement of the green regions per inhabitant recommended by the World Health Organization.

References

- [1] Del Castillo Cáceres, JM, & Castro De la Borda, M. 2015. The strategy for the integration of open spaces and heritage in the Lima-Callao 2035 Metropolitan Urban Development Plan. *Devenir - Journal of Studies on Built Heritage*, (4), 27-44.
- [2] Almasri, Abdelfatah & Ozden, Ozge & Kara, Can. 2019. Green Corridor Development as an Approach for Environmental Sustainability in Jordan. *European Journal of Sustainable Development*. 8. 10.14207/ejsd.2019.v8n3p418.
- [3] Stuardo, V, 2014 Evaluation of ecosystem services and their “trade-offs” along the Balmaceda green corridor - Uruguay. Santiago.
- [4] UN Habitat. 2015. Habitat iii issue papers: 11-public space. New York: United Nations.
- [5] Esenarro D, Rodriguez C, Huachaca K, Cachay B & Aylas C. 2020. Classification and Characterization of the Sustainable Wetland Bello Horizonte “Test Engineering & Management”, ISSN: 0193-4120 Page No. 13453 – 13458
- [6] Alvarado, J., 2016. Green corridors in Santiago de Chile: types and users. Santiago de Chile.
- [7] Holler Branco, J.E. 2020. Bartholomeu, D.B.; Alves Junior, P.N.; Caixeta Filho, J.V. Evaluation of the economic and environmental impacts from the addition of new railways to the Brazilian's transportation network: An application of a network equilibrium model. *Transp. Policy* 2020
- [8] Scholastic, C. 2015. Environment and green spaces. Editorial UNED.

- [9] Gonzales Culqui, JF, 2018. Urban rehabilitation as an integrating element of sectors 5 and 6 in the green corridor, Mashcón Cajamarca river basin. Cajamarca.
- [10] García, & Abad., 2014. Ecological corridors and their environmental importance: Proposals for action to promote permeability and connectivity applied to the surroundings of the Cardeña river.
- [11] FAO. , 2018. World Forum on Urban Forests. Mantova.
- [12] Gavira, O, 2018. Analysis of a floristic corridor between the Sierra de Grazalema and Sierra de Las Nieves natural parks , Cádiz and Málaga ., *Anales De Biología*, (28), 45-72.
- [13] Esenarro D, Cabello F, Amaya P, and Vargas C. 2020. Camping Area and Dock with Viewpoint to Promote Sustainable Ecotourist in the Ticllacocha Lagoon, Tanta-Peru, "International Journal of Environmental Science and Development", ISSN 2010-0264, pag. 268-272 doi: 10.18178, Vol. 11, No. 51261.
- [14] Vásquez, A. , 2016. Green infrastructure, ecosystem services and their contributions to face climate change in cities: the case of the Mapocho river riparian corridor in Santiago de Chile. *Journal of Geography Norte Grande*, (63), 63-86.
- [15] Esenarro D, Escate I, Anco L, Tassara C, and Rodriguez C. , 2020. Proposal for an Ecological Research Center for the Recovery and Revaluation of Biodiversity in the Town of Quichas-Lima, Peru. " International Journal of Environmental Science and Development, ISSN 2010-0264, DOI: 10.18178, Vol. 11, No. 4. 212-216
- [16] Ramos, L, Esenarro, D, Rodriguez C. and Lagos J, 2020. Recovery of public spaces for the conservation of green areas in Tablada Lurin, IOP Conf. Series: Materials Science and Engineering 910 , 012020, doi:10.1088/1757-899X/910/1/01
- [17] Carranza S, 2018 Proposals for the recovery, generation and sustainable management of urban green spaces in the urbanizations of the Nuevo Chimbote district (Ancash, Peru). Chimbote.
- [18] FOVIDA, 2017. Information gathering on vulnerabilities of men and women in the district of San Juan de Miraflores - Villa María del Triunfo in the face of climate change. Lima.
- [19] Wang, J.; Pauleit, S.; Banzhaf, E. 2019. An Integrated Indicator Framework for the Assessment of Multifunctional Green Infrastructure—Exemplified in a European City. *Remote Sens*, 11, 1869
- [20] Vega V, Esenarro D, Maldonado C, Rodriguez C, Córdova A Green infrastructure design for connectivity in the villa wetlands wildlife refuge, *Journal of Green Engineering (JGE) Journal of Green Engineering (JGE) Volume-10, Issue-12, December 2020.*