Coverage Evaluation for Recreational and Cultural Facilities through Accessibility in Pitalito, Colombia

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Abstract
The promotion and development of cultural and recreational activities, facilitates the integral formation of youth and society in general, indirectly guaranteeing the reduction of health problems, citizen behavior, security, among others. For this reason, it is proposed to perform the coverage evaluation through accessibility of the set of cultural and recreational facilities in the municipality of Pitalito, Huila, in order to promote their use and growth, and activities for the population development. The research methodology addressed considers the use of digital elements (software), in order to perform more accurate calculations and easy interpretation from geostatistical models.

Keywords: Accessibility, recreation, culture, coverage, geostatistics

1. Introduction
The cultural and recreational elements, as nodes of primary activity [6], facilitate
the growth and integral development of the citizen, compromising values and primordial strategies for the strengthening of a society. For this reason, it is essential to ensure optimal distribution and accessibility of equipment throughout a municipality, guaranteeing access to each population center without risk of social exclusion. Taking this into account, it is proposed to evaluate the condition of accessibility to cultural and recreational facilities of the municipality of Pitalito, Huila, in order to determine the impact on the population and leave precedents in the future formulation of new strategies for their empowerment. The municipality of Pitalito is located towards the Colombian south western region, in the vicinity of the department of Huila; on the point of origin of the central and eastern mountain ranges with geographic coordinates $1^\circ 51'14"N - 76^\circ 03'05"O$ [1] (figure 1). It has an estimated population of 133,205 inhabitants at 2018 [5] on a total area of 666 km$^2$, as well as an average temperature and altitude of 19 °C and 1318 m.a.s.l respectively [1]. Within the different cultural and recreational activities of the municipality, flaws in both sectors are perceived, not achieving an identity of artistic production, in addition to focusing the activities on competitive and formative matters and not on the promotion of physical activity [2].

Some cultural activities that take place within the municipality: Andean Music Festival, Integration Beauty Contest, Dance Departmental Encounter, Laboyano Cultural Festival, Traditional Music Encounter. In recreation and sports there is a great variety of sports, however, there is strong encouragement for the incorporation of citizenship in sports such as football and indoor football, mainly, which cover more than 40% of the total users of the registered disciplines [2]. Among the different competitions and recreational and sports activities are: Intercollegiate Games, Communal Games, Special Olympics, among others. It is then necessary, taking into account the above, to carry out an objective evaluation of the condition
Accessibility as such, links the ease of movement of users to an activity or point of interest, taking as reference the different centers of activity or services offered by the city, in addition to the possible modes of transport to be used [17]. Currently there are many definitions of the term [10, 14, 21], however, all start with the same basis established by Hansen in 1959 "The potential of opportunities for interaction" [8]. Some variations of accessibility make it possible to carry out studies depending on each requirement, within these measures there are relative accessibility, comprehensive accessibility, global average accessibility [7, 9, 21]; for our case study we will focus on the comprehensive average accessibility which relates the ease of movement from the different nodes of the network to a specific one. Some applications of accessibility from various existing fields of science: sustainable development [6, 12], public transport [18, 19], sustainability [4, 6], demography [11], social cohesion and exclusion [3, 13], among others.

2 Methodology

The elements and sequences used in the present investigation consider the fundamental characteristics for the preparation of the evaluation through accessibility, based on the collection of information and as a final element the coverage evaluation. Figure 2 shows the developed methodological sequence.

![Methodological sequence addressed](image)

Figure 2. Methodological sequence addressed.

2.1 Collection and decantation of information

As a fundamental pillar for the preparation of the research, the collection of existing information in the physical and virtual databases related to recreation, culture and
infrastructure of the municipality of Pitalito is made, after which a decanting of the obtained information is done with the intention of avoiding the use of incorrect data for the investigation.

2.2 Structuring of the road network and georeferencing of cultural and recreational facilities in 2015

Once the required data has been decanted, the road network of the municipality is structured, starting from the base established for 2015, in which the different physical and operational components are considered [15]; likewise, existing recreational and cultural facilities are incorporated, taking into account the spatial coordinates of each one of them (figure 3).

Within the georeferenced facilities are: Coliseum of Fairs, Sports Covered Coliseum, Manzanares Recreational Park, Sports Fields, La Pradera Social Hall and the Olympic Village. It is important to keep in mind that through digitalization, road networks are broken down into 2 characteristic elements for the correct interpretation of information (see Figure 4) [15]; nodes: Points representative of intersections or road ends; and arcs: Representative line for the road segments.

2.3 Accessibility and coverage calculation for the 2015 structure.

After building the road network and incorporating the facilities, the accessibility and coverage evaluation is made, where the elements of the ArcMap tool are included under conditional circumstances necessary for the evaluation. Each conditional fulfills a specific function within the extension Network Analyst - New Closets Facilities. [16]. Facility; Node on the road network to which a trip is intended; Incident: Node on the road network from which a trip is intended; and Rute: Set of links on which the trip is made.
After incorporating the elements to the tool, the calculation code is executed with which the travel time vector is obtained, where the displacement cost values from an incident to one of the facilities are stored. Within this calculation code is the *Dijkstra algorithm*, which evaluates the possible paths for the completion of the trip, selecting the lowest cost route \([20, 22]\). Subsequently, the geospatial coordinates of each facility are linked to which the trip is made and thus enter a new extension, *Geostatical Wizard*, with which the accessibility curves are constructed. Finally, the information obtained from accessibility is crossed with the sociodemographic composition of the municipality through polygon, and by means of Microsoft Excel, construct the respective coverage graphs.

### 2.4 Formulation and execution of analysis for the year 2031

Once the calculations have been made and the necessary results have been obtained for the evaluation, we proceed to observe and determine the possible road interventions and equipment to improve the conditions of accessibility and population coverage (see figure 5), considering the population expansion (150,532 inhabitants) projected to the year of study \([5]\). After linking the new information, the respective geostatistical tools mentioned are executed and the graphs of accessibility and coverage necessary for the study are constructed.
2.5 Savings gradient calculation

As a last methodological sequence, we proceed to construct the savings gradient in order to evaluate accessibility from another perspective; with it, the travel time obtained for each year of study is considered and by means of the equation 1, the percentage of savings is determined. Then, the results obtained are linked to the tools and extensions already mentioned and with them the construction of curves and graphs of savings percentage.

\[
\text{Saving per}_{\text{x}} \ (\%) = \left( \frac{t \cdot \text{time}_{x(\text{act})} - t \cdot \text{time}_{x(\text{fut})}}{t \cdot \text{time}_{x(\text{act})}} \right) \times 100
\]

3 Results and discussion

3.1. Accessibility and coverage for the year 2015

The results of the evaluation of accessibility to cultural and recreational centers in the municipality of Pitalito, end in a high coverage towards the eastern part of the map (figure 6); the observed variation is established at intervals of 0.5 minutes, with a localized maximum of 16 minutes at the western end of the municipality. This way, it is possible to confirm the need to incorporate facilities of this type on the western zone, improving the access conditions to the resident population and locating them on the sector with the highest network density, since towards the westernmost end it is composed of the industrial sector and does not require high priority attention. Additionally, the coverage chart (figure 7) is shown by area and population generated by cultural and recreational facilities in the municipality; an
early growth of the variables is evident, requiring a travel time of less than 5 minutes to cover 70% of each variable, which refers to a good distribution of the equipment. The small discrepancy in coverage of both graphs can be assumed by the population density in the south west boundary of the map, which consumes more time to access this sector despite the fact that the area coverage continues to increase.

Figure 6. Territorial accessibility for cultural and recreational facilities by 2015.

Figure 7. Coverage by population and area towards cultural and recreational facilities by 2015.

3.2 Accessibility and coverage for the year 2031

After the incorporation of equipment and restructuring of the road network to the year 2031, it was possible to obtain as a result of accessibility, figure 8, in this we can see the access behavior at intervals of 2.5 minutes for the municipality.
Figure 8. Territorial accessibility for cultural and recreational facilities by 2031.

A localized maximum of 15 minutes is observed towards the south western part of the map; similarly, the industrial sector is eliminated, in order to minimize calculation costs and obtain coverage at the urban level. It is possible to observe the behavior in the accessibility generated by road interventions and the incorporation of equipment, decreasing in some sectors the travel time in relation to the year 2015, likewise, conserves the central part as the sector with the best access of the municipality. The variation in coverage with respect to the year 2015, presents significant changes, largely due to the incorporation of the population to the year 2031, as well as the modification in area due to the expansion of the urban perimeter. The requirements in time for the same percentage of coverage with respect to 2015 (70%), need a minimum of 8 minutes; the growth of the curves compared to the previous scenario is more moderate, however, the separation between curves appears close to the origin and is sustained until reaching 100% (Figure 9).

3.3 Savings Gradient

Figure 10 shows, in a different way, the impact generated by road interventions and the incorporation of cultural and recreational facilities in the municipality; it is noted that about 70% of the map does not perceive savings, however, it is possible to improve the condition of access and coverage to the eastern part, with up to 88% savings compared to the current situation where it presented difficulties. Additionally, in Figure 11, the percentage of savings perceived by area and population is shown, where around 40% in both variables perceives up to 10% savings, which represents a strong impact considering the population growth by 2031, in the same way the behavior of the ogives allows to observe a considerable up to 50% savings, even though the level of population coverage and area decreases.
Coverage evaluation for recreational and cultural facilities

Figure 9. Coverage by population and area towards cultural and recreational facilities by 2031.

Figure 10. Savings gradient for cultural and recreational facilities in the municipality of Pitalito.

4. Conclusions

The evaluation in accessibility to the recreational and cultural centers in the municipality of Pitalito, Huila, evidences negligence on the part of the municipal administration towards the western sector of the city, which incurs in a possible exclusion of the citizenship to the year 2015, in the same way, the road network limits the possibility of access from this sector to the nearest facilities.
Figure 11. Perceived savings percentile of for population and area towards cultural and recreational facilities in the municipality of Pitalito.

The level of general coverage by population shows that despite not providing access to the resident population of the western sector, it manages to cover the largest proportion of citizens with a total of 70% in a travel time of less than 5 minutes, which is significantly low.

After the implementation of road interventions and linking of new equipment, the level of access for citizens did not have a significant impact at the global level, however, the western sector with deficiencies by 2015 achieved significant improvement.

It is logical that the behavior in population coverage by the year 2031 present increases in travel time, since the larger the population, the greater the saturation of the road network, which requires a slightly longer travel time to achieve to cover the same population percentage to the year 2015; for this reason it can be argued that accessibility to the year 2031 presents important gains.

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