

## *Original Paper*

# Accessibility Analysis of A-level Lin Pan Scenic Spot in Dayi County Based on Road Network

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Received: October 21, 2023    Accepted: November 10, 2023    Online Published: December 3, 2023  
doi:10.22158/uspa.v6n4p136    URL: <http://dx.doi.org/10.22158/uspa.v6n4p136>

### ***Abstract***

*Chengdu vigorously promotes the construction and development of Lin Pan. Aiming at the distribution of A-level Lin Pan in Dayi County, this study analyzed the accessibility of A-level Lin Pan by using ArcGIS software, OD cost matrix analysis method and two-step mobile search method, and found that: (1) Accessibility of different A-class Lin Pan varies greatly, and the longest arrival time is almost twice that of the shortest. (2) The A-level Lin Pan scenic spot has A general economic driving effect on the local economy, and it is suggested to increase the construction of Lin Pan scenic spot according to the distribution of Lin Pan.*

### ***Keywords***

*reachability, OD cost matrix, two-step mobile search method*

## **1. Introduction**

Lin Pan is a unique architectural settlement in Chengdu, bearing and representing thousands of years of farming culture in Shu. In order to better protect the Lin Pan, show the local culture of Lin Pan, promote the development of rural economy, improve the quality of rural life and culture, and make the protection and construction of Lin Pan sustainable development, Chengdu City vigorously promote the construction of Lin Pan scenic spot, so far A total of 5 batches of A-level Lin Pan assessment, a total of 123 Lin Pans have been approved. Dayi County, as the only demonstration county for Lin Pan protection and restoration in western Sichuan, has A total of 1025 Lin Pans, including 7 Lin Pan scenic spots above grade A. To study the accessibility of A-level Lin Pan scenic spots in this county can serve as a reference for the development of Lin Pan scenic spots and tourism routes in this county.

From the perspective of graph theory, reachability is the ease of getting from one point to another. The quality of reachability directly reflects the local traffic situation of the scenic spot, and also directly affects the development of the scenic spot and its effect on the local economy. In recent years, there have been many researches on the accessibility of scenic spots in China, and the research methods include: (1) GIS was used to analyze accessibility of China's A-level tourist attractions by using raster cost-weighted distance algorithm, (2) OD cost matrix was established by GIS and accessibility was analyzed by calculating the average time to arrive at the scenic spot, (3) Accessibility was analyzed by using two-step mobile search method or improved Gaussian two-step mobile search method. This paper analyzes Linpan Scenic Spot in Dayi County from two angles: (1) The convenience of traveling to Linpan in the surrounding area of Dayi County should be based on A motorway intersection within Dayi County and the intersection point between the boundary of Dayi County and main road.

## 2. Overview of the Research Area

Dayi County, located in the west of Chengdu, is a crossing area between the Chengdu Plain and the West Sichuan plateau. According to historical records, there was Chengxian County in the Tang Dynasty, where a large number of buildings and garden arrangements inherited and developed Sichuan and Shu culture. Dayi County has A total of 7 A level above the Lin Pan scenic spots. Dayi County is divided into 9 towns and 2 streets, which contains a total of 147 villages (communities), of which 123 villages and agriculture-related communities, accounting for 83.7%. The population is mainly distributed in the south and southeast of Jinyuan Street, Qingxia Street and Anren town. According to the 7th census, the permanent population of Dayi County was 515,962, of which 30.07 million were agricultural, accounting for 58.27%. The development and utilization of A-level Lin Pan tourism resources in Dayi County will be beneficial to the economy of the local agricultural population and the improvement of living standards.

## 3. Sources of Data

(1) The administrative boundary data of town (street) in Dayi County comes from the 2021 Administrative Zoning Map of Dayi County (source: Dayi county people's government of the network (<http://www.day.gov.cn/>)) and in combination with the open street map (<https://openmaptiles.org/>) to download the vector map, administrative map, for reproduction, paint dayi county town (street) administrative boundaries, Finally, a vector map of Dayi County was obtained. The WGS1984 coordinate system is used in this study. Various road and waterway data from the open street map (<https://openmaptiles.org/>), and according to the China highway and urban and rural road mileage atlas road network layout, road name, check the basic information of road level. The permanent resident population data of Dayi County is derived from the 7th national Population Census bulletin data of the official network of Dayi County People's Government.

(2) according to chengdu culture tourism administration of radio, film and television website, and get the Lin Pan scenic spot in the villages and towns and streets, and then by tencent location service (<https://lbs.qq.com/getPoint/>) to obtain the latitude and longitude, because tencent location service coordinate system for GCJ - 02, It is necessary to use the coordinate conversion software to convert the longitude and latitude of the A-class Lin Pan scenic spot.

#### 4. Research Method

##### 4.1 OD Cost Matrix Analysis of Network Analysis

Based on Arcgis, this study uses OD cost matrix analysis of network analysis to obtain the shortest path, and calculates the time required for the shortest path according to the category speed of the road. Taking the expressway intersection in Dayi County and the intersection point between the boundary of Dayi County and main road, expressway road and sub-arterial road as the starting point, taking A-level Lin Pan as the end point, GIS software was used to obtain the shortest path, and the speed of vehicles on different roads was estimated according to the road length owned by the unit population of different towns (streets) as the influencing factor, regardless of road congestion. The time to reach the Lin Pan from different starting points is obtained, and the average is calculated according to the time to reach the Lin Pan from all the shortest paths. The shorter the average time is, the better the accessibility is.

According to the road situation in Dayi County, based on the road length owned by the unit population of each town (street) as the influence weight of the speed, the speed was calculated (the calculation formula is shown as (1)).

$$v_i = f_i \cdot v \quad (1)$$

$v_i$  is the corresponding speed of different roads in each town.  $f_i$  is the accessibility speed influence factor, which is based on the analysis of road length per capita in each town.  $v$  is for the speed of vehicles on different roads. Among them, the highway 110 (km/h); Expressway 80 (km/h); Main road 60 (km/h); Secondary road 45 (km/h); Branch 30 (km/h).

Using different road entrances in Dayi County, the shortest time to get to Lin pan was calculated by using arcgis. According to the arrival time of Lin Pan in different paths, different paths reach the average time of Lin Pan. Reachability is calculated as follows.

$$A_i = \frac{\sum_j^n T_{ij}}{n} \quad (2)$$

$A_i$  is the average reachable time of research unit  $j$  to reach Lin Pan  $i$ , and  $n$  is the number of paths to reach Lin Pan  $i$ .  $T_{ij}$  is the shortest time to arrive at Lin Pan  $i$  of research unit  $j$ .

##### 4.2 Two Step Mobile Search Method

The two-step mobile search method is used to evaluate the accessibility of Lin pan scenic spot from the perspective of supply and population demand, that is, the more Lin Pan residents enjoy, the higher the accessibility level of Lin Pan. The research methods are as follows:

The first step is to take the entrance and exit of Lin pan scenic spot as the supply point  $j$ . The spatial distance  $d_0$  is set to form its spatial scope. By referring to Gauss equation, the number of demanders  $P_k$  (the population of each administrative village or street) in each demand unit  $k$  within the scope is accumulated and summed to obtain the number of potential demanders of Linpan Scenic spot  $j$ , and then the ratio of supply capacity  $S_j$  to the number of potential demanders of  $j$  is the supply-demand ratio of  $j$   $R_j$ :

$$R_j = \frac{S_j}{\sum_{k \in \{d_{kj} \leq d_0\}} G(d_{kj}, d_0) P_k} \quad (3)$$

$$G(d_{kj}, d_0) = \begin{cases} \frac{e^{-\frac{1}{2} \times \left(\frac{d_{kj}}{d_0}\right)^2} - e^{-\frac{1}{2}}}{1 - e^{-\frac{1}{2}}}, & d_{kj} \leq d_0 \\ 0, & d_{kj} > d_0 \end{cases} \quad (4)$$

In the second step, the spatial accessibility  $A_k^p$  of population  $p$  in unit  $k$  can be obtained by weighting and summing the supply and demand ratio  $R_j$  of Lin Pan area  $j$  in the scope with a given spatial distance  $d_0$  for each population  $p$  in unit  $k$ , and then assigning it to population  $p$  by  $w_p$ . The calculation formula is as follows:

$$A_k^p = \sum_{j \in \{d_{kj} \leq d_0\}} w_p \times G(d_{kj}, d_0) \times R_j \quad (5)$$

## 5. Conclusion

### 5.1 OD Cost Matrix Analysis Results

By analyzing the intersection point of road network in Dayi County and the boundary of Dayi County, 60 entrances into Dayi County can be obtained, and A total of 406 routes to 7 Linpan scenic spots above grade A can be obtained from this starting point (as shown in Figure 1). Based on the network analysis tool, it is found that the average time to reach the Lin Pan is as short as 20 minutes and as long as 44.9 minutes. The arrival time of the Lin Pan is shown in Table 1 below.

**Table 1. The Average Arrival Time of Lin Pan Scenic Spot**

| project | Name of Lin pan scenic spot | Average arrival time (minutes) |
|---------|-----------------------------|--------------------------------|
| 1       | Daoxiangyuge                | 32.75                          |
| 2       | Lao guanding                | 44.95                          |
| 3       | Donglin                     | 27.66                          |
| 4       | Xieyuantaiping              | 40.17                          |
| 5       | Green Manor                 | 20.06                          |
| 6       | Fenshui                     | 31.33                          |
| 7       | Nan anmeicun                | 21.17                          |

### 5.2 Two-step Mobile Search Results

This study is to analyze the accessibility of 147 villages and streets in Dayi County. Car travel was taken as the mode of travel, and 20 minutes was taken as the analysis range. The calculation results are shown in the table below. Among them, the accessibility of Lin Pan in the middle of Dayi County is the best, and the accessibility in the west is the worst.

**Table 2. Accessibility Analysis of Each Village (street)**

| level           | Reachable value | Quantity accounts for(%) |
|-----------------|-----------------|--------------------------|
| high            | 0-200           | 15                       |
| Relatively high | 200-400         | 23                       |
| Relatively low  | 400-600         | 42                       |
| low             | 600-1000        | 20                       |

### 6. Suggestions

In combination with the actual situation of Dayi County and the results of the study, the construction of the road to Lin pan scenic spot still needs to be strengthened. Many of the roads to Lin pan scenic spot are secondary or even branch roads, which are relatively narrow, reducing tourism efficiency and tourism experience. Strengthening the integration of traffic and tourism is an urgent topic for Dayi County to develop Lin pan tourism and strengthen rural tourism in the whole area. Based on the appellate study, this text is suggested as follows:

(1) Strengthen the horizontal cooperation between towns and cities to create a boutique tourism route in Lin pan.

The linkage between Lin pan scenic spot in Dayi County is poor, and there is no coherent tourist route for tourists' reference. Tourists mostly leave after visiting one or a few Lin Pan scenic spots, and their stay is relatively short, bringing relatively little income. Therefore, it is necessary to combine the local traffic conditions and township resources to create several boutique Lin Pan tourism routes with complementary tourism resources to create high-quality tourism experience for tourists.

(2) With the help of hot tourist attractions, to create a theme tourism route

With the help of high-quality tourism resources in ancient town and snow Mountain, a series of high-quality tourism routes have been launched. Let high-quality tourism resources drive the development of Lin pan scenic spot. For example, the Lin pan - Hot Springs - Snow Mountain tour route allows travelers to experience the beauty of nature at different altitudes, from flowers on the plain to autumn on the mountainside to snow on the top of the mountain. To achieve the county point with the surface, drive the development of the whole rural tourism.

## Acknowledgement

Thanks for the support of project launched by 2022 Chengdu Transportation and Tourism Big Data Application Technology Research Base (Project name: Research on “Lin Pan +” tourism routes in western Sichuan under the background of rural revitalization: A case study of Dayi; Project number:2022116)

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