

Analysis and Optimization Strategy Research on the Configuration of Basic Public Service Facilities in Li County of Sichuan Province

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Abstract: Basic public service facilities are an essential type of facilities that meet the daily needs of urban residents. Their reasonable distribution and configuration will affect the sense of gaining of local residents and improve the level of urbanization. For many years, the basic public service facilities in Li County have been limited by social and economic development, geographic a condition, and other reasons, resulting in certain problems in the allocation off facilities. Therefore, this paper hopes to analyze the quantity, distribution. Agglomeration and reach ability of basic public service facilities in Li County by using multi-source data, find out the problems in the facility configuration, and propose relevant optimization countermeasures based on these problems, so as to improve the service quality and supply level of basic public service facilities in Li County.

Keywords: Basic public service facilities; Spatial distribution; Reachability analysis.

1. Introduction

Public service facilities are often used as admeasure othe development leveofa city and as as patial carrier of various public goods and services in society Their reasonable distribution is of great significance forim proving the quality of life of residents. Compisd to public service facilities, basic public service facilities place more emphasis on the public welfare and inclusivity off acilities.which are provided by the government, the reasonable allocation of public service facilities aimed at ensuring the basic survival and development needs on fall citizens contributes to the process of urban-rura l integration. Li County is located in Aba Tibetan and Qiang Autonomous Prefecture, Sichuan Province.Due to its location on the banks of the Zagunao River, a tributary ofthe MinjiangRiver, its resources are abundant and its tourism industry is thriving. However limited by geographical conditions and imbalanced urban-rural development over the years, there have been configuration defects in the basic public service facilities in the county, which to some extent hinders the development process of Li County. Therefore, this papyruses the multi-source data such as POI data,land data, population data, etc. To analyze the spatial distribution characteristics and reachability of basic public service facilities in Li County, and put forward relevant planning suggestions, so as to provide relevant research basis for there asonable layout of basic public service facilities in Lixian County in the future.

2. Current research status at home and abroad

In recent years, the research focus on the configuration of basic publicservice facilities has focused on the "reachability", ""supply and efficiency" "spatial distribution", "equalization", and "layout research" of the configuration of basic public service facilities. Most of the configuration standards and specifications of basic public service facilities usually stipulate the configuration category, quantity, and scale of basic public service facilities at different levels. but different

levels of social development It is difficult to configure basic public service facilities with different geographical locations and demand characteristic using neat and uniform configuration guidelines. In addition, due to the fact that public service facilities can usually be used to measure the maturity of a city, sucre search is generally concentrated within the city and uses the city as their search unit, while the number of studies specifically focused on counties oru sing counties as the research object and scope is relatively small compared to the number of cities. Therefore, the research on the configuration of basic public service facilities in counties often uses urban research methods, which to some extent overlooks the fact that the level of urbanization in counties is different from that in cities. Therefore, in order to meet the actual needs of the people in the research area, it is necessary to analyze and optimize the configuration of basic public service facilities based on the local actual situation.

3. Research Area and Data Sources

3.1. Research Area

Li County is located in the north west of Sichuan Basin, southeast of Aba Tibetan and Qiang Autonomous Prefecture, adjacent to Wenchuan in the southeast, Xiaojin in the southwest, Malkang in the west, Mao County and Heishui in the north, and Hongyuan in the northwest; Geographical coordinates!30°54'43~31° 12'12 N, 102 3246~103 30'30 E: The county is 83 kilometers long from east to west and 78.2 kilometers wide from north to south. The county seat is located in Zagunao Town, 165 kilometers away from Chengdu City and 118 kilometers away from Malkang. National Highway 317 runs through the entire territory along the Zagunao River, approximately 175 kilometers from Chengdu and 136 kilometers from Malkang. According to the seventh population census report of Li County, there are a total of 36926 permanent residents in the county, of which the Tibetan ethnic group accounts for 48%, the Qiang ethnic group accounts for 32%, the Han ethnic group accounts for 19.5%, and other ethnic groups account for 0.5%. It is a typical resource rich county and population small county, known as

the "auspicious place and ideal county". The researches cope of this study includes a total of 11 townships in 6 towns and 5 town ships throughout Li County.

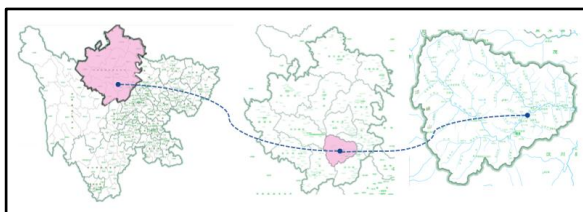


Figure 1. Location Map of Lixian District

3.2. Data sources

The study starts from the number of basic public service facilities in Li County, uses the standard deviation ellipse to study the spatial distribution characteristics of basic public service facilities, uses the kernel density analysis to study the spatial aggregation of basic public service facilities, and uses the service area analysis and buffer zone construction to study the reachability of facility points from the point level and the traffic network level. The data used in the study can be divided into three types. The first type is Pol (Point of Interest), which represents the location of basic public service facilities. It is obtained through Python on the open platform of Gaode Map. In combination with the research needs, it mainly includes four types of facilities: basic education, medical care, culture and sports, and social welfare. The specific data content is as follows (Figure 2-2), and the acquisition time is September 2022. The second type is the administrative boundaries used in the research, including the administrative boundaries of Li County and various townships. This type of data comes from the third national land survey data. By using the land use status data in the "Three Surveys", traditional research can break through the limitation of data acquisition difficulty and be limited to cities, and the research area can be extended to the entire county. The third kind of data is the road data of Li County needed to analyze the reachability of basic public service facilities. It is mainly obtained from the open street map open map website and combined with the road network data of Li County obtained by mapsharper to obtain a relatively complete road network of Li County. According to the road network attributes, the road network can be classified into expressway, national road, provincial road, urban first-class road, urban second-class road, urban third-class road, residential road Service roads, paths, etc, subsequently, considering the particularity of road above the secondary trunk road, the center line of the road above the secondary trunk road will be extracted to avoid double calculation of travel costs in the later stage. In addition, since the walking speed of ordinary adults is 60-100meters/minute, according to the different conditions of the road, the standards of 60 meters/minute, 70 meters/minute and 80 meters/minute were selected for reachability research.

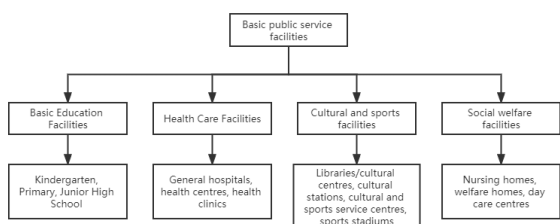


Figure 2. Classification of Basic Public Service Facilities

4. Current Situations of Basic Public Service Facilities Allocation in Li County

In order to understand the current configuration of basic public service facilities in Li County, the quantitative indicators, spatial distribution indicators, spatial aggregation indicators and reachability indicators related to basic public service facilities is selected for analysis and research. Among them, the study of quantitative indicators used processed POI data combined with the seventh population census data of each township in the county, and analyzed based on the "Town Planning Standards [with explanatory notes]" (GB 50188-2007) "Rural Public Service Facility Planning Standards" (CECS 354:2013), and "Sichuan Basic Public Service Standards" (2021 version) as references; The spatial distribution characteristics of basic public service facilities are analyze using standard deviation ellipses based on the scope of Li County and facility points; The spatial clustering features are obtained through kernel density analysis method; In order to get a more realistic reachability result, the reachability analysis of basic public service facilities will be carried out based on the construction of multi ring buffer zones at facility points and the construction of traffic network data sets, with traveling distance as the cost and travel time as the impedance.

4.1. Distribution characteristics of the number of basic public service facilities

Using Python to excavate the locations included in the four types of facilities listed in the above text on the Gaode map, and remove the locations that are related to fields but not related in nature, a total of 48 basic public service facilities in Li County was obtained, with the highest number of medical and health facilities, followed by basic education facilities, and relatively fewer cultural, sports, and social welfare facilities (Table 1).

Table 1. Statistics on the Number of Basic Public Service Facilities

| category | quantity |
|--------------------------------|----------|
| Basic education facilities | 18 |
| Medical and health facilities | 22 |
| Cultural and sports facilities | 6 |
| Social welfare facilities | 2 |

Due to the special geographical conditions of Li County (Figure 3), there are 580.35 hectares of concentrated urban development and construction. Area boundaries within the county area, with a terrain trend from northwest to southeast; the remaining part mainly the Miao Provincial Nature Reserve, with an ecological protection red line area of 208458.17 hectares. Although the county covers an area of 430000 hectares, the proportion of land that can be used for urban development is relatively low, which is one of the reasons for the low number of basic public service facilities in Li County.

After processing and importing the obtained facility points, it can be found that the basic public service facility points are mainly concentrated in Zagunao Town, which is the location of Li County, while the number of other township facility points is relatively small. Based on the population density analysis of the population of each township in the seventh population census bulletin of Li County, it can be seen that the densely populated townships in Li County are mainly

Zagunao Town, Xuecheng Town, and Putou Town. Therefore, the number of basic public service facilities in the local area is more numerous and diverse compared to other townships thanks to the natural climate and geographical conditions of the Mengtun River Valley and Zhegu Mountain, there are Mengtun River Valley Ski Resort and Zhegu Mountain Nature Park Ski Resort in Shangmeng Township and Mialuo Town, respectively.

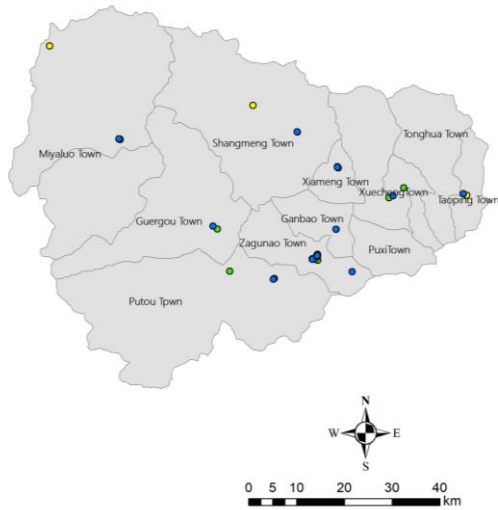


Figure 3. Distribution of Basic Public Service Facilities

4.2. Spatial distribution characteristics of basic public service facilities

The standard deviation ellipse method is usually used to summarize the spatial characteristics of geographical elements and display the central, discrete and directional trends of geographical elements. Therefore, using the standard deviation ellipse method to analyze the spatial distribution of existing basic public service facilities in Lixian can explore its spatial distribution characteristics (Figure 4). As shown in the figure, the distribution of basic public service facilities in Lixian County shows a "northwest southeast" trend, which is basically consistent with the direction of the administrative region of Lixian County; there is a significant difference in the length and half axis of the ellipse, and the current distribution direction of basic public service facilities is obvious; The short semiaxis of the ellipse is short, and the spatial distribution of basic public service facilities has a strong centripetal force and is concentrated in the county seat area: Most of the facilities are concentrated in the county town and surrounding townships, with poor balance and obvious urban-rural imbalance.

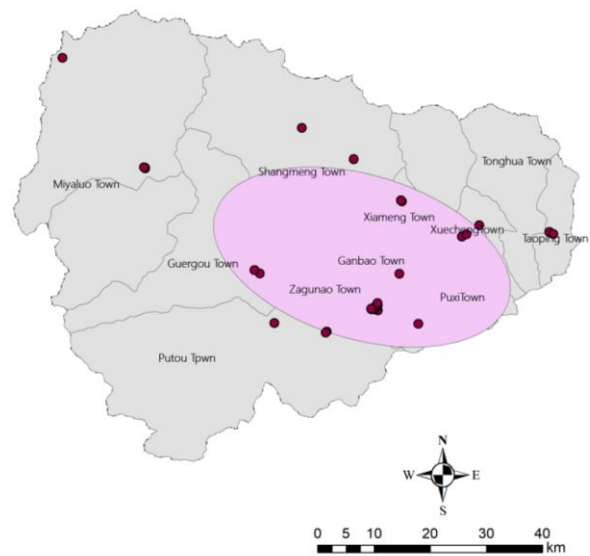


Figure 4. Ellipse Analysis of Basic Public Service Facilities Standards

4.3. Spatial clustering characteristics of basic public service facilities

The kernel density analysis method can be used to calculate the density values of POI points within a certain range. Due to the denser the feature points, the higher the kernel density analysis result, it can strongly express the differences in the distribution of a certain point in space. It is commonly used to calculate and describe the spatial distribution of urban public facilities. By using the kernel density analysis method to analyze the agglomeration of basic public service facilities in Li County, the spatial agglomeration characteristics can be obtained. Firstly, a kernel density analysis was conducted on basic public service facility points with a search radius of 1000, and the kernel density analysis results were presented in five levels using the geometric interval method (Figure 5).

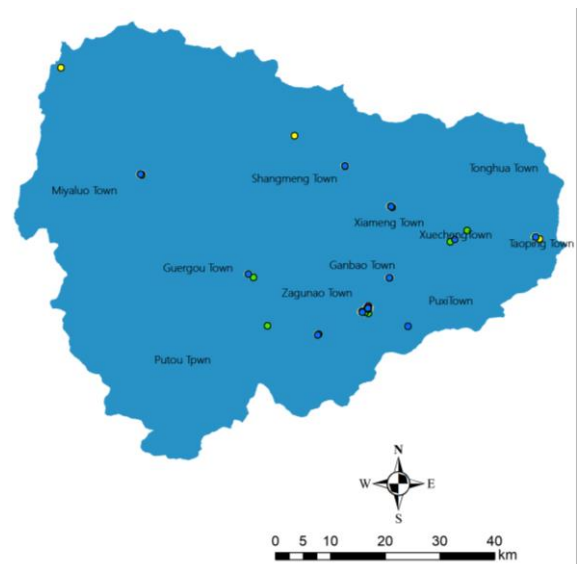


Figure 5. Analysis of Core Density of Basic Public Services

It can be concluded that the most obvious spatial agglomeration of basic public service facilities in the county is in Zagunao Town, and the agglomeration effect of basic public service facilities is the most obvious and has scale advantages within the county town; based on the boundary of Meng Township, Li County is divided into two parts: east and

west. The agglomeration effect, quantity, and type of basic public service facilities in the eastern townships are significantly better than those in the western townships. The core density of basic public service facilities is located in the center of Li County; compared to the eastern region, the basic public service facilities in western townships have not yet shown significant agglomeration effects and the degree of agglomeration is not high. However, it is worth noting that the development trend of basic public service facilities centered around Miyaro Town is good. According to the "Overall Plan for Land and Space in Li County (2021)," a three-level public service system that integrates counties, towns, and villages, coordinates areas, and improves quality is being constructed Promoting the construction of "livable living circles" in urban and rural areas, Miyaro Town also has the possibility of becoming the core supply of basic public service facilities in western townships. Finally, the coupling relationship between the two can be found by over laying the results of kernel density analysis with standard deviation ellipses. The basic public service facilities analyzed by both methods run from northwest to southeast, with the strongest concentration located in Zagunao Town.(Figures6).

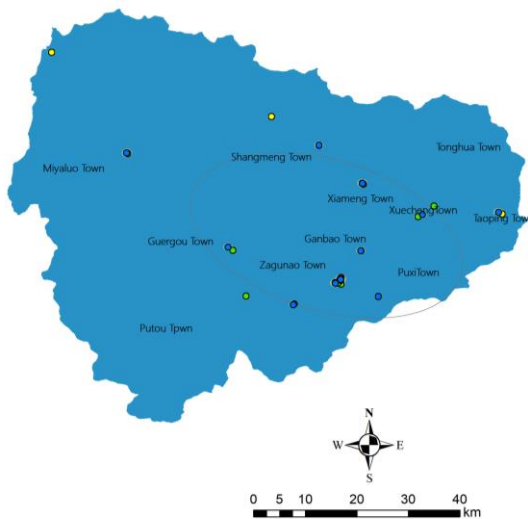


Figure 6. Standard Deviation Ellipse of Basic Public Service Facilities

4.4. Evaluation on reachability of basic public service facilities

Reach ability evaluation is usually one of the criteria for judging the supply of basic public service facilities. For the evaluation methods of reachability, the current commonly used research methods include cost matrix method, network analysis method, Huff model method, buffer zone analysis method, etc. Different methods have their own advantages and disadvantages in analyzing reachability. Among them, the buffer analysis method is an information analysis method that forms a polygon entity with a certain range around a group of geographical elements (points, lines, and surfaces) according to the set distance conditions, so as to expand data in two-dimensional space. This method focuses on calculating the services range from the point level, Able to quickly calculate the coverage of facility points within the set interval; the network analysis method is to calculate the time cost of arriving at the destination from the starting point base dona certain speed resistance by simulating the road network structure in reality.so as to obtain the results of reachability

within the region. It is a more accurate analysis method. Considering that the number of basic public service facilities in Li County is scattered and the road network with complex terrain is sparse this study studies the service scope off acilities in each township by constructing a multi ring buffer zone, and combines network analysis and service area analysis to study the reachability off acilities.

(1) Multi ring buffer analysis method

Based on the administrative area of Li County and considering that the pedestrian walking speed is 60-80 meters/minute, the buffer zone coverage is calculated based on the 5, 10, and 15 minutes living circle. Multiple ring buffer zones are set up at intervals of 300, 500m, and 800m, respectively. The following results can be obtained (Figures7): Except for individual facility point sall four basic public service facilities can be reached within the 15 minutes living circle, There are a total of 16 basic public service facilities within the five minute living circle, including 8 basic education facilities, 5 medical and health facilities, 2cultural and sports facilities, and 1 social welfare facility, There are a total of 17basic public service facilities within the 10 minutes living circle, including 6 basic education facilities, 11 medical and health facilities, and 1 social welfare facility.

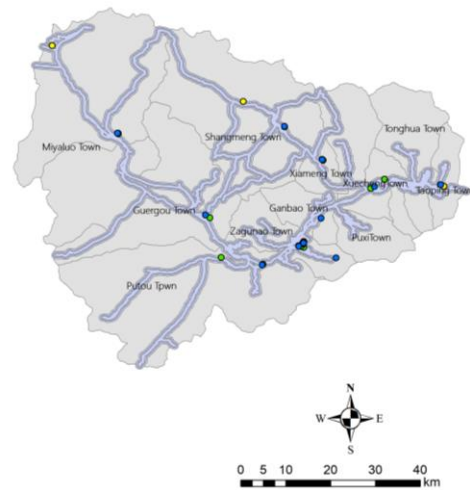


Figure 7. Analysis of Multi ring Buffer Zones for Basic Public Service Facilities

There is a total of 12 basic public service facilities within the 15-minute living circle, including 4 basic education facilities, 6 medical and health facilities, and 2cultural and sports facilities. (Figure8)

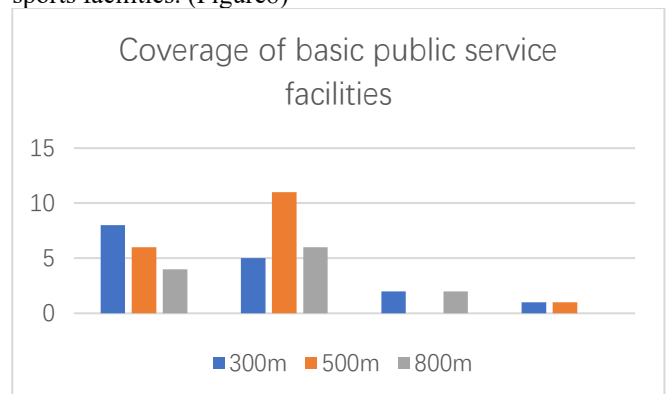


Figure 8. Statistical Chart of the Coverage of Basic Public Service Facilities

(2) Network analysis method

The network analysis method is one of the main methods

to analyze the reachability of urban public service facilities, which abstracts the network relationship system in real life into the representation of line network shape. In the research on analyzing the reachability of public service facilities, its basic principle is to build a network model similar to the road structure through simulation. The composition of the network consists of the network center, edges, nodes and resistance. Therefore, this part first extracts the road network of Li County from the openstreetmap website. Combining the road network data of Lixian County obtained by mapsharper, the road data includes its spatial location, road name, grade, length and other information. The final road network data is obtained after intersection, projection, screening and topological processing of the road network data in Arcgis. Then, according to different road grades, the distance is taken as the cost, and according to the pedestrian speed on various roads, the time impedance is set to 5, 10, 15, 30, 60 minutes to analyze the reachability range under different travel speeds on different roads. The analysis results are as follows (Figure9): similar to the buffer zone analysis results, most basic public service facilities have good reachability, and there are many facilities within the 15-minute life circle. From the county level, the reachability of all kinds of basic public service facilities within the county level is quite different, and the overall distribution shows the trend of "two cores, one axis, and multiple points", which is closely related to the spatial distribution of basic public service facilities. From the township level, the accessibility of basic public service facilities in each township is quite different. Most of the townships with good reachability of basic public service facilities are concentrated in the east of the county, while the coverage and reachability of basic public service facilities in western townships are relatively weak than those in the east.

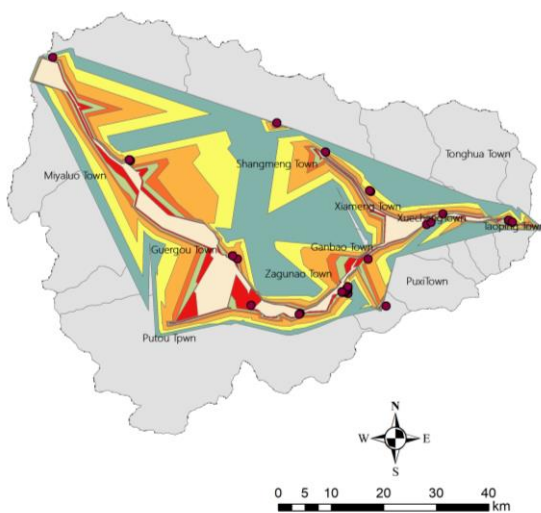


Figure 9. Analysis of Basic Public Service Facilities and Service Areas

5. Conclusion and Optimization Strategy

5.1. Research Conclusion

In order to study the configuration of basic public service facilities at the county level in Li County, this study starts with local land data, road data and population data, obtains four types of POI points representing basic public service facilities from the open platform of Gaode Map, and uses geographical research methods to analyze the number, spatial distribution

and agglomeration, and reachability of basic public service facilities in Li County. The following research conclusions are obtained:

(1) Quantity and type

The overall number is insufficient. The population of the whole county is nearly 40000. Although the basic public service facilities have good reachability the service efficiency of the facilities will be greatly reduced due to the insufficient number, which cannot meet the needs of every resident for basic public service facilities. In addition, there are significant differences in the number of various facilities. Apart from the reasonable number of medical and health facilities and basic education facilities, the number of cultural and sports facilities and social welfare facilities is very scarce, unable to meet the needs of local people.

(2) Space distribution

The distribution of basic public service facilities in Lixian County shows a "northwest southeast" trend, with most of them concentrated in the county seat and surrounding areas, with poor balance and obvious urban-rural imbalance. The agglomeration effect, quantity, type, and service efficiency of basic public service facilities in eastern townships within the county are significantly better than those in western townships.

(3) Facility reachability

From the perspective of overall reachability, the reachability of various facilities is good, which meets the requirements for public service facilities in the 15-minute living circle in the town planning. However, there are great differences in the type and quantity of facilities themselves, or in the reachability, service scope, and supply efficiency of facilities in various towns. The reachability of various facilities are quite different, and the reachability level of facilities in various towns is also inconsistent, excessive concentration of resources is a problem that needs to be addressed and addressed.

5.2. Suggestions for optimizing basic public service facilities

According to research findings, there are still many shortcomings in the allocation of basic public service facilities in Li County. In order to promote the improvement of the public service facility system in Li County, meets the wishes of urban and rural residents for a better life, and achieve rural revitalization and urban-rural coordinated development, by analyzing the allocation of basic public service facilities within Li County, referring to the "Overall Plan for Land and Space in Li County (2021-2035)" and the allocation of relevant districts and counties, based on the previous research, the following suggestions are proposed:

(1) Increase the number of basic public service facilities and improve their service quality

According to the research results, it can be seen that the total number of basic public service facilities in Li County is relatively small, and there are significant differences in the number of various facilities, resulting in an imbalanced allocation of facilities. Firstly, it is necessary to increase the number of basic public service facilities, balance the number of various facilities, and balance the significant differences in facilities among different townships. For areas with incomplete basic public service facilities, basic public service facilities should be supplemented to achieve full coverage across the entire region. Secondly, for areas with relatively complete basic public service facilities, emphasis should be

placed on improving the quality and level of public service facilities, with a focus on the rationality of the spatial layout of public service facilities and the distribution of the proportion of different types of public service facilities.

(2) improving the road network construction and rationally arrange the location of basic public service facilities

Improving the urban road network is a way to improve the reachability of facilities and the level and radiation range of basic public service facilities in the county. Due to the influence of local geographical conditions, Li County is located in the central part of the Longmenshan Fault Zone, surrounded by high mountains, resulting in poor local transportation and incomplete road network system. The feasibility between basic public service facilities and residential areas is largely related to the traffic conditions between them. Therefore, the improvement of the road network can effectively improve the reachability of facilities and improve the use efficiency of facilities. In addition, the basic public service facilities in Li County are mostly concentrated in the county seat and eastern townships, and the location of the facilities is not reasonable, resulting in a small number of facilities that are difficult to reach. In the subsequent layout, it is necessary to start from building a three-level county public service system of "county town township", promote the construction of urban and rural living circle and sink basic service facilities to the town and village levels to facilitate the use needs of residents.

(3) Pay attention to the issue of uneven development of public service facilities and achieve equalization of basic public services

The equalization of public service facilities is an important component of achieving social equity. The uneven development of basic public service facilities in Lixian County will seriously affect the local sustainable development and people's pursuit of a better life. The next step in planning should take into account the actual situation of urban and rural development, improve the construction of the public service facility system in batches and in an orderly manner, promote the development of rural basic public service facilities, and improve the service level of basic public service facilities, strive to achieve equal access to basic public services as soon as possible.

(4) Pay attention to the needs of different groups and improve the construction of pedestrian transportation system

When improving basic public service facilities, full consideration should be given to the needs of different groups. There are significant differences in the demand for public service facilities among different groups such as the elderly, children, young people, and people with disabilities. Especially in the special period when China is entering an aging society, the elderly population in China is large and growing rapidly, and there is a clear supply-demand contradiction in elderly service facilities. In future public service facility planning, more attention should be paid to the special requirements of special groups and reasonable arrangements should be made for various facilities. In addition, attention should also be paid to the construction of pedestrian traffic system, improve the pedestrian road

network, and improve the comfort and safety of pedestrian traffic.

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