

# The layout and Material Development of Sports Facilities based on GIS in Tibetan Plateau Environment in Gansu Province

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**Abstract.** This paper studies the layout and material development of sports facilities in the plateau environment of Gansu Tibetan Plateau by means of literature data, GIS spatial analysis and mathematical statistics. Based on the correlation analysis between population size and community area, it is concluded that the population size and community area of Gansu Tibetan areas are unreasonable; the number of public sports facilities in urban communities is not coupled with the community area; the layout of sports facilities is unreasonable and the number is biased. Strategies based on GIS system: strengthen the rational layout of sports facilities; focus on equipment research and development, combine regional characteristics, and manufacture suitable sports equipment; use composite reinforcement materials to improve the controllability of local mass fitness.

## 1. Research Objects and Methods

### 1.1. Research Objects

The layout and material development of sports facilities based on GIS in the Tibetan Plateau environment of Gansu province.

### 1.2. Research Methods

*1.2.1. Document Data method.* According to the research purposes, this paper makes a study on the Tibetan Plateau environment by GIS, sports equipment materials research and other academic papers, and searches the relevant literatures and materials for screening, analysis and collation.

*1.2.2. GIS Spatial Analysis.* Based on the information of the public sports facilities in urban communities in Gansu Tibetan areas, the spatial distribution and statistical data of 9 squares and community public sports grounds in 8 counties and cities in Gansu Tibetan areas are the research objects, and the exact location is marked on the map. Then, the attribute information of each public stadium is imported into ARCGIS, and the spatial analysis is completed by ARCGIS.



*1.2.3. Mathematical Statistics.* Using SPSS software, using the correlation research and regression analysis in statistics, using the street as the basic unit, calculate the reasonable extent of the area and population distribution of the eight squares and community public sports facilities in the Tibetan area of Gansu, and the community public sports facilities. The distribution of the site was quantitatively and qualitatively studied.

## 2. Natural Geographical Features of Tibetan Areas in Gansu

Gansu Tibetan Area is located in the south of Gansu Province, China. It is located on the northeastern edge of the Qinghai-Tibet Plateau. The geographical coordinates are located between 100°46'~104°44' east longitude and 33°06'~36°10' north latitude. The altitude is 1100~4900 meters in the territory, and most areas are above 3,000 meters. The main climate characteristics of Gannan Tibetan Autonomous Prefecture are plateau continental monsoon climate, high cold and humid, long cold season, short warm season, large temperature difference between day and night, and the average temperature is 1~13°C. The hottest year is July, the average temperature is 17.9 °C, the coldest is December, and the average temperature is -6.8 °C. The plateau in the Tibetan Plateau of Gansu Province is sparsely populated, with many rocks on the surface, fast heat absorption and fast heat dissipation, resulting in high temperature at noon and low temperature in the morning and evening. The annual sunshine time is long, the UV burning ability is strong, the ultraviolet radiation amount is the smallest in winter, and the largest in summer, especially the highest level in June to September, which is 7~10, the intensity is the strongest, and the spring and autumn are in the middle. The daily variation of ultraviolet rays is regular, small in the morning and early in the morning, and basically symmetrical in the afternoon and afternoon. The air is thin, the water vapor content is small, and the climate is cold, dry, low pressure and oxygen deficiency.

## 3. Analysis on the Rationality of Fitness Equipment Layout based on GIS

The rationality of the distribution of fitness equipment in 8 fitness squares and street offices in Tibetan area of Gansu Province is calculated and analyzed by using the consistent index of building public sports venues and population distribution, that is  $R_{xy} = \left[ 1 - \frac{1}{2} \sum_{i=1}^N \left| \frac{X_i}{\sum X_i} - \frac{Y_i}{\sum Y_i} \right| \right] \times 100\%$ , in the formula, R is the consistency index, the number of people in Xi Square and street office, Yi is the number of public sports venues in the corresponding region,  $\sum X_i$ ,  $\sum Y_i$  for the total population and the number of public sports venues.  $R_{xy} = 47.42$  is calculated according to the formula, which shows that the coupling degree of the number of public sports venues and population density is not high, and the distribution of fitness equipment is unreasonable.

Based on the analysis of the correlation between the total street population and the square and community public sports site area, the correlation coefficient formula between area (x) and total

population (y) was adopted.  $r = \frac{n \sum xy - \sum x \sum y}{\sqrt{n \sum x^2 - (\sum x)^2} \sqrt{n \sum y^2 - (\sum y)^2}}$  The calculation shows that  $r = 0.3686$ ,

which indicates that there is a positive correlation between area and population, but the correlation is weaker. It is indicated that the area distribution of Community public sports field and the total population in Gansu Province are unreasonable, and there is serious irrationality in the layout of sports equipment, which needs further improvement in the later construction.

## 4. Optimization Layout Strategy of Sports Equipment based on GIS

The number of public sports venues in the Tibetan area of Gansu Province is less coupled with the population density and is in an unreasonable state. The specific performance is large area, small population density, the total population and community sports public space ratio is unreasonable. Therefore, according to the number of population, street area, fitness equipment quantity and distribution, the author puts forward the optimization strategy: firstly, the construction location of physical fitness path should be chosen strictly according to the size of community population density; Secondly, there should be more distribution of fitness paths in densely populated areas; third, in a large population

density, small street area, Lack of the building of fitness Plaza space, should be actively dispatching social forces, and nearby units or schools to work together to share the fitness path; the space location between each fitness path is set to be calculated and measured in ArcGIS software, which conforms to the spatial layout of the GIS technology system. The demand for sports for the masses.

## **5. Research and Development of new Sports Equipment based on GIS and Application of Advanced Materials**

### *5.1. The Development of new Sports Equipment tends to Traditional Sports of Ethnic Minorities*

The Tibetan Area of Gansu Province is a multi-ethnic area with rich and rich national traditional sports. The cultural heritage of ethnic minorities is profound. Therefore, the research and development of sports equipment should fully consider the national and regional characteristics, combined with the traditional sports of the local ethnic groups, and develop fitness equipment with national characteristics that can be of interest to the local people.

### *5.2. Development Equipment use Monitoring Function, install Tibetan Operation Reader*

Before the launch of sports equipment, the monitoring function used in the development and installation of sports equipment can monitor the usage rate of each sports equipment in real time, and whether the sports equipment is in normal operation state. Each sports equipment has a background data system to facilitate the management department to master the fitness. Situation and maintenance. The Tibetan fitness population is mainly Tibetan population, and their education level is generally low. Therefore, it is necessary to install a Tibetan operation reader for easy use.

### *5.3. Sports Equipment Materials should be Suitable for the Natural Environment of the Tibetan Plateau, Durable*

The obvious characteristics of the plateau environment in the Tibetan areas of Gansu are high and cold anoxic, low temperature all year round, etc. This natural environment will cause different degrees of damage to buildings and equipment. The research and development of sports equipment materials should fully consider the climate characteristics, resistance to high cold, low temperature resistance, and avoid the shortening of service life due to natural environmental factors.

### *5.4. Application of Composite Reinforcement Materials in Sports Equipment*

The composite reinforcing material Fiber-reinforced polyurethane (FRP) has the characteristics of light weight, high strength, large elastic modulus PRP, good mechanical properties, environmental protection, high corrosion resistance, large design freedom, and easy processing. According to these advantages, special equipment suitable for local environmental carbon fiber can be made in combination with the environmental characteristics of the Tibetan Plateau in Gansu Province, in order to solve the problem that the general wood materials and metal materials are difficult to adapt to the characteristics of the plateau natural environment.

There are many types of composite reinforcing materials, and glass fiber, boron fiber, silicon carbide fiber, aramid fiber, ultra-high modulus polyethylene fiber, and hybrid fiber are often used in the manufacture of sports equipment. Considering the factors of fraud, it is recommended to add high-performance composite reinforcement materials in key technical aspects in the development of sports fitness equipment.

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