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Distribution Characteristics of Village-Level Place Names in Qinghai Based on GIS Analysis

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Abstract: Using mathematical statistics to quantitatively analyze the characters, words, sources and cultural landscapes of village-level place names in Qinghai Province, combining spatial data with place name attributes through GIS spatial analysis methods, and visualizing the spatial distribution differences of place names in the form of thematic maps. The following conclusions are drawn: There is a high positive correlation between the density of place names and the density of population in Qinghai Province, which shows the distribution characteristics of dense in the east and sparse in the west. The concentrated area of the nuclear density distribution of place names is Hehuang area and distributed in clumps. The naming of natural place names mainly reflects the characteristics of geographical orientation and topography. Humanistic place names mainly reflect the long nomadic culture, and immigrant culture of Qinghai Province.

Keywords: GIS Analysis; Qinghai Province; Village-Level Place Names

1. Introduction

Qinghai Province is located between 31°36′E-39°19′E, 89°35′N-103°04′N, with a total area of 722,300 square kilometers. The terrain of Qinghai Province is generally high in the west and low in the east, high in the north and south and low in the middle. The altitude of the west is high and the east is inclined to the east. The eastern region is the transition zone from the Qinghai-Tibet Plateau to the Loess Plateau, and the terrain is complex and diverse. More than four-fifths of Qinghai Province is the plateau, the eastern part is mountainous, and the western part is the plateau and basin. It has three landforms: the Qinghai-Tibet Plateau, the inland arid basin and the Loess Plateau. It belongs to the plateau continental climate and spans the Yellow River, the Yangtze River, the Lancang River, the Heihe River and the Datong River. According to the Statistical Yearbook of Qinghai Province in 2021, Qinghai Province has 2 prefecture-level cities, 6 autonomous prefectures, 45 counties, 406 townships and 4664 villages. The province has a population of 5.94 million, including 44 ethnic groups such as Han, Tibetan, Hui, Tu, Salar, and Mongolian.

Since the 1990 s, the study of place name culture through quantitative methods has become a new trend in the development of place name research. At the same time, the rise of computer technology is slowly changing the traditional research paradigm of place name culture. Nowadays, the "GIS spatial analysis method + quantitative research" model has become a new direction for the study of place name culture. Domestic scholars Dongfangjie, Nashundalai and Suduer take the spatial distribution of multilingual place names in Xinjiang as the research object, and explore the influence of language and culture between different ethnic groups in Xinjiang on the spatial distribution of place names through GIS kernel density estimation method and spatial smoothing method[1]; through the establishment of GIS database, Li Ding, Wang Wenqian and Ma Zhenbang extracted the elevation of various place names from DEM map, and studied the spatial distribution of cultural landscape of village place names in Lanzhou from three perspectives of qualitative, quantitative and visualization[2]; through quantitative methods, Li Jianhua, Mi Wenbao, Feng Cuiyue, etc.studied the cultural landscape characteristics of geographical names in Zhongwei County by using GIS spatial visualization[3]. It can be seen that the study of place name culture is developing from two-dimensional qualitative research to three-dimensional visual analysis, GIS.

There are eight kinds of ecological resources in Qinghai province, such as 'mountains, rivers, lakes, fields, forests, grasses, sand and ice'. Tibetan, Hui, Tu, Sala, Mongolia and other

ethnic minorities have been mixed here for a long time, which have a profound impact on the spatial distribution of place names. Previous studies on place names in Qinghai Province mainly focused on the etymology of place names and the cultural characteristics behind them. The quantitative research on the spatial distribution characteristics of place names is basically in a 'blank' state. Therefore, based on GIS spatial analysis, we take Qinghai village-level place names as the research object, and intend to further explore the spatial distribution characteristics of Qinghai place names.

2. Data Sources and Research Methods

2.1 Sources of Data

A total of 4664 place names were obtained through the query of China Toponym Network, Qinghai Statistical Yearbook, open Internet resources (Gaode Map), and the online service platform of the Ministry of Civil Affairs of the People's Republic of China.After the screening of its geographical coordinates, a total of 4639 place names were obtained. The difference between the two data is because some villages have been merged through the "ecological migration relocation project, "and the" new village" place names have appeared in different counties and townships.

The place name materials mainly include the administrative map of Qinghai Province, the topographic map of Qinghai Province, the population data distribution map of Qinghai Province (2020 data) and the information of villages, towns and settlements contained in the map. First of all, in the administrative division system, the place name information at the village level, which is at the bottom of the administrative division system, is a system unit that has the closest contact with the masses and the most reflects the relationship between people and land. At the same time, the place names at this level have strong stability and inheritance. Therefore, most of the collected place names are village names. Secondly, these villages are generally small in scale, far away from the power center and political center, and are less affected by the regime change. Toponym culture can reflect the most primitive regional characteristics. Therefore, it has unique advantages in understanding the local geographical characteristics, political, economic and cultural development and changes.

2.2 Research Methods

The research methods are GIS spatial visualization analysis and mathematical statistics. The specific operation steps are as follows: First, determine the name and number of village place names through the China Place Name Network and the Qinghai Provincial Statistical Yearbook, use the Gaode map to search the geographical coordinates of village names and compare and screen the existing place names, and perform Excel processing; 2.Take the place names in Excel as discrete points, import the coordinates of place names and other attributes (field information, townships, levels, etc.) into ArcGIS to establish a place name database and draw a place name vector map. The purpose is to realize the spatial visualization of place names; through the operation of kernel density estimation method and spatial smoothing method in SPATIAL expansion module, the distribution map of village-level place name kernel density in Qinghai Province is obtained, and the spatial distribution characteristics of place name kernel density are analyzed in detail.

3. Toponymic Statistics and Classification

The kernel density distribution map of place names in Qinghai Province (1:6 million) contains 4639 place names, and the average kernel density of place names in the province is 0.006 / km^2.

3.1 Statistics of Characters and Words of Place Names in Qinghai Province

In addition to Xining City and Haidong City in Qinghai Province, the remaining six states are ethnic minority autonomous prefectures, mainly Tibetan autonomous prefectures, and their place names are mostly named in ethnic languages, but there are many problems in the standardization of ethnic language place names. In Wen Shengyun's 'Problems and Thinking in Qinghai Ethnic Language Place Names', there is a detailed discussion[4]. Therefore, it is more difficult to count the geographical names of ethnic minorities. In order to cope with the difficulties, the article summarizes the commonly used words and words of ethnic minority place names and Chinese place names on the basis of consulting relevant literature. Through the statistics of 4639 place names in

Qinghai, combined with the field analysis of place names, place names are divided into two categories, 63.72% of place names are related to natural geographical entities, and 31.49 % of place names are related to human geographical entities. The geographical names of natural characteristics are divided into four categories: geographical orientation, topography, animals and plants, and hydrology. The place names of humanistic characteristics are divided into five categories: good wishes, settlements, military, religion, architectural gardens and immigrants.In addition, 10.13% of surname place names can be combined with settlement, topography and other place names. The statistical results are as follows: Table 1.

Table 1. Statistical Table of Place Names and Word Categories in Qinghai Province

category	Proportion / %	type	frequency of occurrence	Occurrence ratio / %	Words, word types
Natural class	63.72	Geographical location	976	21.04	East, West, South, North, Front, Back, Upper, Lower, Yin, Yang
		Topography	1102	23.76	Wall, Cliff, Pass, Terrace, Mountain, Slope, Flatland, Ridge, Pass, Mouth, Valley, Hill, Cave, River Channel, Fork, Dam, Kiln, Gorge
		Animals and plants	368	7.93	Horses, Cattle, Sheep, Dragons, Tigers, Pigeons, Mice, Willows, Pines, Birches, Grass, Leeks, Vegetables, Cypresses, Lotuses, Apricots
		Hydrology	510	10.99	Water, River, Spring, Bay, Pond, Sweet, Beach, Channel, Well, Wave, Bend, Sea, Lake
humanities category	31.49	Good wishes l	335	7.22	Happiness, Unity, Prosperity, Health, Peace, Vitality, People, Flourishing, New, Abundance, Joy, Tranquility, Harmony, Progress, Friendship, Love, Victory, Clarity, Virtue
		Settlements	458	9.87	Village, Stockaded Village, Fort, Home, Town
		Military	130	2.8	Battalion, Fortress, Stockade, Military, Win, Army, Block, Mound
		Religion	228	4.91	Monasteries, Temples, Buddha, Pagodas, Zen
		Architectural garden	84	1.81	Tower, Fort, City, Ditch, Temple, Bridge, Enclosure, Checkpoint, Tower, Garden, Factory, House
		Immigrants	226	4.87	New Village, New Town, United, Xin 'an, Miscellaneous Households
Surname		—	470	10.13	Zhang, Wang, Li, Zhao, Yang, Cao, Zhu Shen, Chen, Yin, Mo, Xie, Bao, Du, Song, Tao, Sun, Mao, He.....
Other	4.79	Other	222	4.79	
Subtotal		Subtotal	4639	100	

3.2 Classification Statistics of Geographical Names in Qinghai Province

A place name is a proper name given to a natural or human geographical entity in a particular spatial location.[6] According to the classification form of place names, it can be divided into two categories: natural geographical entity names and human geographical entity names. Natural geographical entity names include: mountains, glaciers, rivers, lakes, oceans, etc. Human geographical entity names include: villages, settlements, buildings, streets, visions and many other types. Place names carry the geographical, historical and cultural characteristics of a certain time and space. They can not only reflect the characteristics of the past and present natural geographical environment on the time scale, but also understand the local political changes, social development, human activities, historical rise and fall and other information through the analysis of place name culture. Therefore, the analysis and research of place name culture is an important way for us to understand the evolution of a local natural environment and how human beings live in harmony with the natural environment.

According to the results of the classification, the reasons for the naming of each place name were studied and counted.

First of all, statistics and analysis of the source of place names. Statistics show that most place names represent a natural place name entity. For example, shady slope, sunny slope, east village

and west village represent geographical orientation, and gang fork and gorge mouth represent topography ; however, there are also many place names with various meanings, which are mostly manifested in human geographical entities. For example, Zhangjiazhai and Lijiaying represent surnames and military affairs, while Shangwangjia and Xiawangjia represent both directions and settlements. In order to reduce the final statistical error, we divide the multi-source place names into at most two categories for statistics.

Among the 4639 place names in Qinghai Province, there are 3041 place names from natural geographical entities and 2109 place names from human geographical entities. In the classification of these collected place names, the number of the first place is from the geographical environment of the topography and geographical location of the place names, reached 2165. This shows that the naming of village morphology and village location in Qinghai Province is deeply influenced by its geographical environment; there are 1124 place names closely related to population distribution, which are mostly reflected as surnames and settlements. There are 511 place names from hydrology, most of which are near a river or reflect water supply facilities such as canals and wells. A total of 367 were derived from animals and plants. The plants were mainly drought-tolerant cypress and birch, and the animals were mainly horses, cattle and sheep. There are 345 from the good vision, which express the unity of all ethnic groups, the friendly coexistence of all ethnic groups and the yearning of the people of all ethnic groups for a better life. There are 228 religious sources, which mostly express the beliefs of local people, such as naming temples, temples and pagodas; there are 225 places from immigrants. These place names mostly follow the village names before the migration, such as 'Haixi Mongolian Tibetan Autonomous Prefecture', 'Golmud City', etc.; from the building, mainly reflects the local construction facilities, such as tower, city, bridge, building; there are 221 minority language place names we have collected, which are attributed to others because they cannot distinguish their sources.

3.3 Statistics of Spatial Distribution of Place Names

3.3.1 Kernel Density Analysis

Kernel Density Analysis(KDA) is a geographical concept, which is used to calculate the unit density of the measured values of point and line elements in the specified neighborhood. In simple terms, it can intuitively reflect the distribution of discrete measurements in the continuous region. The result is a smooth surface with a large intermediate value and a small peripheral value. The grid value is the unit density, which is reduced to 0 at the neighborhood boundary. KDA can be used to calculate population density, building density, obtain crime report, monitor population density in tourist areas, analyze the operation of chain stores and so on. For example, there are many chain retail stores in a certain area. It is assumed that customers will choose which store to visit according to the distance. It is assumed that any customer will always choose the nearest store. According to the distance field from the customer to the store, the grid surface of the customer distribution of each store is obtained. Here, we mainly use the KDA to calculate the unit density of the measured value of the point element of the place name within the specified neighborhood.

3.3.2 Working Principle Of Kernel Density Analysis

The kernel function used in kernel density analysis is:

$$D = \frac{3(1 - scale^2)^2}{\pi r^2} \quad (1)$$

Among them, r is the search radius, and scale is the ratio of the distance from the grid center point to the point and line object to the search radius.

For the point object, the volume of the space surrounded by the kernel density surface and the lower plane is similar to the measured value of this point. For a line object, the volume of the space enclosed by the kernel density surface and the plane below it is approximately the product of the measured value of the line and the length of the line. At the neighborhood superposition of points or lines, the density values are also added. The density of each output grid is the sum of all kernel surface values superimposed on the grid. The unit of the result grid value is the reciprocal of the square of the unit of the original data set, that is, if the unit of the original data set is meter, the unit of the result grid value is per square meter. Note that for the geographic coordinate data set, the unit of the result grid value is 'per square meter', which is of no practical significance.

We take the county as the division unit to count the number of inland names in the unit and calculate the kernel density of each division unit. We use GIS to make the population density distribution map of Qinghai Province (Figure 1) and the kernel density map of Qinghai Province (Figure 2) in the form of thematic map.

Figure 1. Distribution Map of Population Density in Qinghai Province

Figure 2. Kernel Density Distribution Map of Geographical Names in Qinghai Province

From the kernel density distribution map of place names in Qinghai Province, it can be concluded that the spatial distribution of place names shows unbalanced characteristics, which is characterized by dense in the east and sparse in the west. According to Figure 1 and Figure 2, we can conclude that the population of Qinghai Province is mainly distributed in the east, especially in the Hehuang area. The density of place names is the most concentrated, exceeding 0.03/km^2, especially in Minhe County, Ledu County, Huzhu County, Xining City, Datong County, Huangyuan County, Huangzhong County, Haiyan County in the Hehuang Valley, Xunhua County, Hualong County, Jianzha County and Guide County in the Yellow River Basin. The density of place names is much larger than other areas in the east, reaching more than 0.09/km^2. Comparing the population density distribution map and the place name kernel density distribution map, we can draw the following conclusions: the place name distribution is positively correlated with the population distribution.

4. Distribution of Place Names in Qinghai Province

The distribution of place names is closely related to the density of population distribution. The central and western regions of Qinghai Province are sparsely populated. The three prefectures of Haixi Mongolian Tibetan Autonomous Prefecture, Yushu Tibetan Autonomous Prefecture and Guoluo Tibetan Autonomous Prefecture have a total area of 580112km^2, but only 885 villages are distributed, accounting for 19.1% of the total number of place names. The average density of place names is 0.001/km^2, while the total area of the eastern states is 116471km^2, with 3754 villages distributed, accounting for 80.9% of the total number of place names. Therefore, this paper mainly discusses the place names in the densely populated eastern Hehuang area.

4.1 Name of Natural Geographical Entity

In the Dictionary of Chinese Historical Place Names, it is pointed out that 'Hehuang refers to the land of the Yellow River and Huangshui River basins in Qinghai'[7]. The east and south of the Yellow River Valley are connected to Gansu by Jishi Mountain and Qingsha Mountain watershed respectively, and the north is adjacent to Huangshui Valley by Laji Mountain, showing a typical valley basin landform with high north and south and low along the Yellow River. Huangshui Valley is located in the north of Daban Mountain, west of Riyue Mountain and south of Laji Mountain. In general, the Huangshui Valley is a geomorphological form of interphase distribution of mountain and river basins. The geographical location and topography of Qinghai Province are output in the form of thematic maps (see Figure 3, Figure 4). From the map, we can see that both geographical location and topography are densely distributed in the Hehuang Valley area.

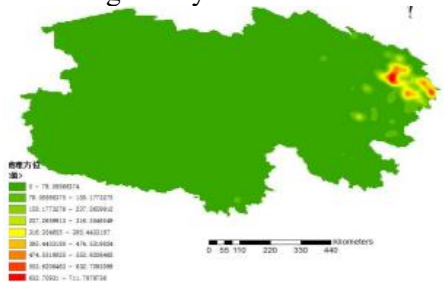

Figure 3. Kernel Density Map of Geographical Location Names in Qinghai Province

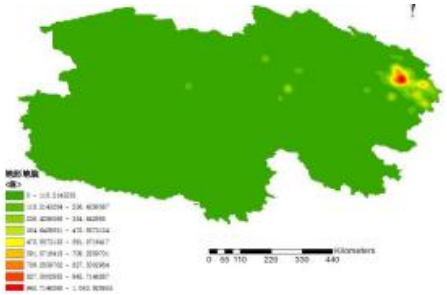

Figure 4. Kernel Density Map of Topographic and Geomorphological Place Names in Qinghai Province

The geographical location names are mostly related to mountains and ravines, and are concentrated in clumps in Huangzhong, Minhe, Ledu, Hualong and other places. In the word formation, the geographical entities of nature are often used as reference objects, such as Laji Mountain, Riyue Mountain, Daban Mountain and other entities, combined with upper, lower, left, right, front, back, East, West, South, North, Yin, Yang and other words, sometimes combined with certain humanistic elements, so as to enhance the sense of position and direction of place names in the surrounding geographical environment. Such as Huangyuan County's 'Shanglang Bay', 'Xialang Bay'. Location names provide convenience for people living here on the one hand, and on the other hand, because the geographical location is close to life, it is also convenient for them to remember things they know well. The topographies are mainly distributed in the vicinity of cliffs, gullies and springs. They show a core-edge distribution pattern in Xining City and Huangyuan County, but they are different in specific manifestations. In the naming of Huangshui Valley, most of them appear in the form of ditches, bays and beaches, such as 'Jiucaigou, Tarwan and Weijiatan'; the names of places in the Yellow River Valley are mostly in the form of platforms, mountains, ridges and cliffs, such as 'Dongtai Village, Guanjia Mountain, Wudaoling and Huaya'. The location names and topography names are scattered in the vast western region. We believe that there are two reasons: First, the geographical environment is poor, the food that can provide human survival is less, and the population distribution in the vast western region is sparse. The western region is dominated by nomadic people, people generally live by water and grass, and there are few fixed settlements, so the distribution of place names is sparse.

The frequency of place names named after animals and plants is small. There are 9 kinds of plant place names: willow, pine, birch, grass, leek, cabbage, cypress, lotus and apricot. Such as Songjiagou, Liushuzhuang, Hualin Township, grassland, Jiucaigou, Caizikou, Baishutang, Lianhu and so on. There are 7 kinds of animals in the place names: horses, cattle, sheep, dragons, tigers, pigeons and mice. Such as horse ranch, bison ditch, sheep pen, tiger ditch, rat bay, etc. Among them, horses, cattle and sheep are the important basis for the development of local animal husbandry, so the place names are mostly named after livestock. The dragon is a mythological creature, which is named by religious place names, reflecting the local people's humility and awe of God.

Human beings often live in water, and hydrology is very important to the development of settlements. In order to highlight the importance of water, people often name settlements with nearby rivers and lakes. In the place names of Qinghai Province, although the place names about hydrology account for only a small part, they are reflected in a variety of place names. Hydrological place names are often named after bays, rivers, springs, beaches and wells, mainly distributed in the eastern Hehuang Valley. In the vast Tibetan areas, 'Qu' is used to express river water and Cuo represents lake. For example, Dangqu represents the water of Dangxianggou, Yaqu represents the wild yak river, Junqu represents the Tibetan wild donkey river, Cuoduo represents the upstream of the lake, Cuomei represents the downstream of the lake, and Cuosang represents the north of the lake. From the naming of place names, we can not only feel the language and culture of the Han nationality, but also feel the language and culture of ethnic minorities.

Geographical naming reflects people's cognition and expression of the surrounding natural environment. We can understand the evolution of human-land relationship through the study of place names. The natural environment precedes the place names. In the process of naming place names, people are deeply influenced by the surrounding environment. Therefore, the study of place names is of great help for us to understand the geographical environment of a region. In addition, place names have stability and inheritance. Through this feature, we can not only understand the connotation of place names, but also understand the local history and culture through place names.

4.2 Name of Human Geography Entity

4.2.1 Place Names Related to Nomadic Culture

The vast area of Qinghai has always been a stage for nomadic people to multiply and gallop, and it is one of the main settlements of nomadic people in China. Tibetan, Mongolian and Tu are traditional nomadic people in Qinghai. Nomadic people do not have a fixed place to live, generally living in settlements as a unit of living by water and grass, nomadic culture is gradually formed on this basis. From the nuclear density distribution map of settlement place names in Qinghai Province (see Figure.5), we can see that the settlement distribution in the eastern Hehuang area shows a northwest-southeast trend, extending from Xining City to Minhe County, forming a banded distribution. Tibetan and Tu people have basically evolved into an agricultural life in the current Hehuang Valley, but there are genes of nomadic culture in history, which can be seen from the inherited place names. We can perceive their lifestyles from place names, such as 'Saishiku Village' Xincaoshangou,' Suhua' (Tibetan) grazing, 'Lalongwa' (Tibetan) tent ditch, 'Walong' (Tibetan) cattle place, as well as Gangchagongma, Jiaoshikegongma, Yaxiu, Shangmuduo, Yagongma, Jiaoshikexiuma and other place names are named because of the pasture where the tribe is located. Nomadic life makes the industrious ancestors of Qinghai need to establish clan tribes linked by blood relationship, and maintain nomadic life through collective grazing. This shows that in China, patriarchal clan rules and consanguinity have a profound impact on society, which is applicable to both Han and ethnic minorities. In Hehuang area, nomadic life still has a great influence, which runs through the whole history and culture of Hehuang.

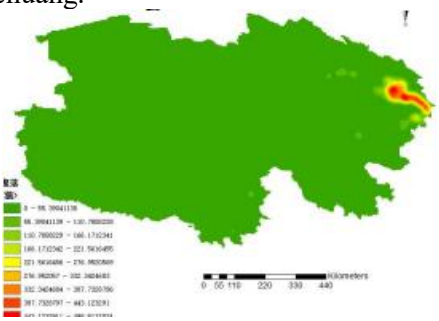

Figure 5. Kernel Density Distribution Map of Settlement Place Names in Qinghai Province

4.2.2 Place Names Related To Immigrant Culture

In the process of place name statistics in Qinghai Province, the word "new village" has appeared many times in different counties, which is related to the recent "ecological immigration relocation project." There are also a large number of records about immigrants in the historical and cultural books and documents about Qinghai Province, which is actually caused by the integration of immigrants from the Central Plains Dynasty to Qinghai in different historical periods. Xining, known as Xiping County and Qingtang City in ancient times, takes the meaning of 'peace in the western border'. The Hehuang area represented by Xining has always been the western border under the rule of the Central Plains dynasty. In the long river of history, Qinghai has always been a place where the Central Plains Dynasty and the minority tribes have competed with each other. However, after each game, the population of the region will decrease. In order to have sufficient troops to guard this fertile soil, the Central Plains Dynasty emigrated from the Central Plains, Jiangsu and Zhejiang and other populous regions to defend the city and guard the border. This can not only effectively use the land here for production, but also occupy the connecting plate of Hehuang to effectively block the invasion of ethnic minorities in the Western Regions to the Central Plains. In the nuclear density map of immigrant place names in Qinghai Province (see Figure.6), the place names related to immigration are mainly concentrated in Hualong, and Datong and Huzhu in the north are also distributed. According to the collected data, the main ways of immigration in these areas are as follows : military tun, civilian tun, distribution, garrison, business, agricultural reclamation, exile and so on. Among them, the culture of immigrants is widely spread in Hehuang area as 'Zhujixiang immigrants'. Professor Zhao Zongfu interpreted the legend of 'Zhujixiang immigrants' in Nanjing of Han people in Hehuang.He believed that these legends were generated due to the needs of time and place, and had irreplaceable social and cultural functions in a specific time and space background.[5]

4.2.3 Place Names Related To Religious Culture

Edward Taylor believes that the close relationship between nationality and religion is a remarkable fact that 'a nation has its own unique clothing, unique tools and weapons, unique marriage law and property law, unique moral

doctrines and religious doctrines'[8]. We can understand that religious belief is an important feature of a nation. Religion and nation blend with each other and are closely linked. Due to the special geographical environment and immigrant cultural background, Qinghai Province has become a multi-ethnic region. Among them, the Han, Tibetan, Hui, Mongolian, Tu and Salar ethnic groups have the largest number and most or basically all of these ethnic groups believe in religion. From the nuclear density map of religious place names in Qinghai Province (see Figure.7), it can be seen that there are three concentrated areas related to religion in Datong Hui Autonomous County, Huangzhong County and Hualong Hui Autonomous County, which are closely related to the prevalence of religious culture in this area.Religion in Qinghai is an indispensable part of people 's life, which can be seen from the landscape of place names. The names of 'Mani', 'Banzhong' (Tibetan) monk Zhuangzi, 'Duanba' (Tibetan) Buddha, 'Yixixie' (Tibetan)' the place where the god lives', 'Hera' (Tibetan) sacred mountain. The religious culture reflected by place names is mainly reflected in the culture spread by Tibetan Buddhism and Islam, among which the names of place names are mostly named by fables, myths, doctrines and creeds in Tibetan Buddhism. This also shows that Tibetan Buddhism has a large number of people, covers a large area and has a great influence.

Although the influence of various religions on the naming of place names is different, it shows the symbiotic characteristics of various religious cultures, which is also the characteristic of religious culture in Qinghai Province.It is precisely because of the symbiotic characteristics of religious culture that social stability and national unity in Qinghai Province are made.

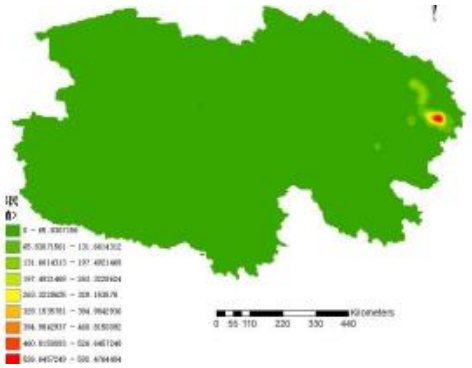

Figure 6. Kernel Density Distribution Map of Immigrant Place Names in Qinghai Province

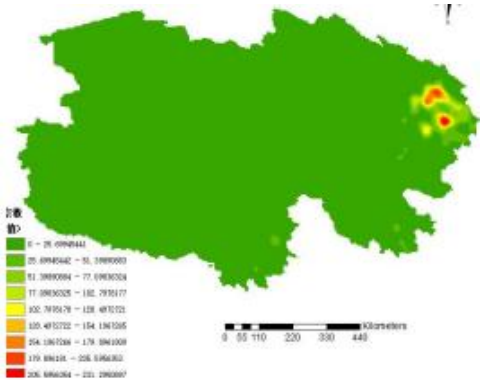

Figure 7. Kernel Density Map of Religious Place Names in Qinghai Province

5. Conclusion

According to the different attributes of place names, we first divide place names into two categories: natural and human, and then divide natural place names into four sub-categories: geographical location, topography, animals and plants, and hydrology. Humanistic place names are divided into six categories: beautiful vision, settlement, military, religion, architectural garden and immigration. Through the quantitative analysis and statistics of different types of place names, supplemented by the kernel density analysis method of GIS, the characteristics of the spatial distribution of place names in Qinghai Province are studied:

First, the spatial distribution of geographical names in Qinghai Province is consistent with the spatial distribution of population, and the density of geographical names is positively correlated with the density of population, both of which are the distribution characteristics of dense east and sparse west, especially in Hehuang area.

Second, in natural place names, there are many place names that reflect geographical orientation and topography, mostly distributed in clumps. Geographical location names are mostly related to mountains and gullies. In order to increase their sense of orientation, 'geographical entity + location word' is often used in word formation. Topographic and geomorphological place names are generally distributed in cliffs, gullies and spring bays. The place names of Huangshui Valley are mostly distributed in areas with low altitude and close to water sources. The place names of the Yellow River Valley are mostly distributed in areas with high altitude and undulating terrain. The place names of animals and plants appear less frequently. The plants on the plateau are mainly pine, cypress and birch with strong adaptability to survival, and the

animals are common animals such as horses, cattle and sheep. Among the hydrological place names, the place names distributed in the Hehuang area are mostly named after rivers, springs, beaches, and wells, while the western Tibetan areas are mostly named after Qu and Cuo.

Third, humanistic place names are mainly reflected in three aspects: nomadic culture, immigrant culture and religious culture. Tibetan, Tu and Mongolian are traditional nomadic people. Their settlements show a northwest-southeast banded trend in Hehuang area. Although they now live a semi-agricultural and semi-pastoral life, nomadic culture runs through the whole history of Hehuang. The place names of immigrants are concentrated in Hualong, Datong and other places. Qinghai, as the western border under the rule of the Central Plains Dynasty, has repeatedly carried out large-scale immigration through military and civilian villages in different historical periods. The immigrant culture is very long ; the religious place names in Datong, Huangzhong, Hualong and other places are distributed in clumps. Qinghai is a multi-ethnic region, where religious culture is prevalent and almost all the people believe in religion, among which Tibetan Buddhism has the greatest influence.

In this paper, the spatial distribution characteristics and rules of place names in Qinghai Province are analyzed intuitively by means of mathematical statistics and GIS spatial visualization. It goes beyond the previous paradigm of using qualitative methods to explore the cultural connotation of place names in Qinghai Province, and expands the research methods of place names in Qinghai Province. It is a useful attempt to study place names in Qinghai Province. However, this article has not been able to conduct in-depth research on ethnic minority place names. It is hoped that scholars will pay more attention to ethnic minority place names in future research. We can try to establish a database of ethnic minority place names to lay a foundation for in-depth understanding of Qinghai 's place name culture.This research was supported by the 2024-2025 Research Project of Chongqing University of International Business and Economics: Research on the Coupling Relationship between Spatial Distribution and Topographic Features of Chongqing Place Names Based on GIS Technology (No. KYSK2024141).

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