Exploring the Spatial Distribution of the Peasant Family Garden Based on the GIS in Xindu District, Chengdu City

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***Abstract*—Due to the increasing of the population and development of industry economy, many Peasant Family Gardens have been flocking to the Sichuan Basin and shows messy distribution pattern on spatial scale. In the present paper, total of 187 Peasant Family Gardens in the Xindu District, Chengdu City, are selected as the focus of the study. The Spatial Analysis and Geo-statistical Analysis of the ArcGIS software are used to analyze the distribution regularity of the Peasant Family Garden, and then to explore the contributory factors leading to the messy distribution patterns. The results show that the spatial distribution pattern of Peasant Family Garden belongs to cluster. There are five cluster zones of the Peasant Family Garden in Xindu district. The spatial distribution of the Peasant Family Gardens is relatively dense with the buffer distance from 2 to 6km.**

Keywords-component; the Peasant Family Garden, Spatial analysis, Geo-statistical analysis, the Xindu District

I. INTRODUCTION

The tourism of Peasant Family Garden has been increasing rapidly in China nowadays. Recently many researchers began to study the Peasant Family Garden. Mou 2008[1] analyzed the development of the Peasant Family Garden in Guizhou and the results show that the Peasant Family Garden has brought positive results in promoting the new countryside construction, adjusting rural industrial structure, enlarging rural employment channels and raising farmers' income. Peng et al., 2010[2] set the Peasant Family Garden tourism of the Changan District, Xi'an City as an example and concluded that the factors affecting tourists' decision included farm life atmosphere, farm entertainment and purchase conditions, accessibility and countryside characteristic. Li et al., 2011[3] used Logistic model to analyze the effect of different marketing strategies. He found that product strategy had the greatest impact on it among the 4P strategies.

GIS refers to a computerized database system for capture, storage, retrieval, analysis and display of spatial data. It is capable of assisting the storage, retrieval and manipulation of spatially referenced data such as street address or a census tract. Especially when used to perform spatial analysis, it is most useful. GIS has integrated multidisciplinary latest technology. Its analysis techniques such as spatial analysis, spatial statistical analysis and 3D analysis have been widely applied to Geoscience-related scientific research and engineering practice. Liu et al., 2010[4] discussed the role of GIS in Urban Planning Management Information System and started to use this system in planning achievements management and office automation. Han et al., 2001[5]summarized the application of GIS in urban planning field abroad and studied hotspot of typical examples of successful application of GIS strategies, hoping to provide some suggestions to the domestic application of GIS. An efficient, smooth flowing information network environment and management information network have been successfully built in Shanghai, greatly promoting the construction and implementation of information system [6]. Zhang et al., 2005[7] reforms and reprograms the soil resource utilization by means of the powerful spatial analysis of GIS and RS. Xiang et al., 1996[8] used Geosciences analysis of GIS to carry out mineral resources prediction. Yi et al., 2009[9] used analysis function of GIS to identify suitable location and appropriate development mode for the Peasant Family Garden in Beibei District.

Currently the research of Peasant Family Garden mainly focuses on socio-economic and industrial development and other related aspects. However, using GIS spatial analysis methods to analysis of the spatial distribution of Peasant Family Garden is relative rarely. The objectives of this paper are 1) to do system analysis for the Peasant Family Garden of the Xindu district and its surrounding geographical factors, 2) to explore the spatial distribution regularity of the Peasant Family Garden in Xindu district and 3) to discuss the related influencing factors of distribution regularity.

II. DATA COLLECTION

As the vice center of the north Chengdu City, the Xindu District is the base of machinery, electronics, food, bio-pharmaceuticals and tourism for the Chengdu City. In order to investigate the spatial distribution of the Peasant Family Garden of the study area, four data source such as landuse map, Baidu Map, Google Map and GPS data are used to create the point layer of the Peasant Family Garden. A total of 187 Peasant Family Gardens are collected by the four methods above and most of the Peasant Family Gardens are found in the land use map of the Xindu District (1:10000). Other

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coordination data of the Peasant Family Garden are collected from the Baidu Map and the Google Map, and have been validated by the onsite survey using GPS. The basic properties for each Peasant Family Garden such as name, address and contact telephone number have been added in the point layer by ArcGIS Desktop Software. In order to classify those Peasant Family Garden, those properties for each point in the point layer such as size and scale have been added in the point layer. Finally, the Projection Transformation and Geometric Correction were applied for the point layer data to spatial analysis and statistical analysis. The distribution map of the Peasant Family Garden is shown in the Figure.1.

Figure 1. the distribution map of the Peasant Family Garden

III. RESEARCH METHOD

A. *Buffer Analysis*

A GIS Buffer is a proximity analysis used to create polygons based on a specified distance from the original geographic feature. The process involves generating a buffer around existing geographic features and then identifying or selecting features based on whether they fall inside or outside the boundary of the buffer. In a GIS Application, buffer zones are always represented as vector polygons enclosing other polygon, line or point features. The present paper creates buffer zones around Xindu Town and Xinfan Town. The Xindu Town is buffered with distances of 2, 4, 6, 8km and the center of buffer zone is in the middle of Huangguoshu square. The core of buffer zone of Xinfan Town is the Xijie Community and is described with the same buffer distances.

B. *Trend Analysis*

Trend is a global polynomial interpolation that fits a smooth surface defined by a mathematical function to the input sample points. The trend surface changes gradually and captures coarse-scale patterns in the data .Trend surface analysis is a surface interpolation method that fits a polynomial surface by least-squares regression through the sample data points. This method results in a surface that minimizes the variance of the surface in relation to the input values. The resulting surface rarely goes through the sample data points. Trend surface analysis is used to find general tendencies of the sample data, rather than to model a surface precisely. To get the overall trend of Peasant Family Garden, the ArcGIS is used to do trend analysis.

C. *Thiessen Polygons Analysis*

Thiessen polygons define the individual regions of influence around each point of a set of points. Thiessen Polygons divide a plane, assigning the area to point in the set such that any location within a particular polygon is nearer to that polygon's point than to any other point. In GIS and geographic analysis, thiessen polygon analysis is used as a tool for fast interpolation and analysis of geographical entities of regional to solve the problem of adjacent. Those thiessen polygons have the unique property that each polygon contains only one input point. In this study, many new thiessen polygons are built by fast interpolation using the point layer of Peasant Family Garden. The Voronoi maps are created by Thiessen polygons. Some sampling point which may have influence on the accuracy of interpolation have been deleted.

D. *Density Analysis*

Density is expressed by points and lines in the space polymerization. Density analysis takes known quantities of some phenomena and spreads it across the landscape based on the quantity that is measured at each location and the spatial relationship of the locations of the measured quantities. The density was got in this research by calculated each point's density value of point layer of Peasant Family Garden.

E. *Nearest Neighbor Analysis*

Nearest neighbor analysis is a technique for re-sampling raster data in which the value of each cell in an output raster is calculated using the value of the nearest cell in an input raster. Calculates a nearest neighbor index based on the average distance from each feature to its nearest neighboring feature. CrimeStat analysis software is used as a tool to do nearest neighbor analysis in this study.

IV. DISCUSSION

A. *Buffer Analysis*

The Figure 2. shows that there are 35 Peasant Family Gardens (18.7%) with the buffer distances less than 2km. The buffer distance between 2 and 4km has 50 Peasant Family Gardens (26.7%). The buffer distance between 4 and 6km has 43 Peasant Family Gardens (22.9%). The buffer distance between 6 and 8km has 30 Peasant Family Gardens (16%). Hence, when the buffer distance is less than 8km, the number of Peasant Family Garden occupies 84.3% in total. The rest of the Peasant Family Gardens is located with the buffer distance over 8km. This implies 8km forms the watershed in the spatial distribution of the Peasant Family Garden.

It can also be seen that the spatial distribution of the Peasant Family Gardens is relatively dense with the buffer distance from 2 to 6km. The number of the Peasant Family Garden in this buffer zone is at about 53.8%. This indicates the buffer distance between 2 and 4km is the densest area filled with Peasant Family Gardens which account for 49.6% in total.

A further summarized above all results is the number of the Peasant Family Garden is declined after increased with the buffer distance between 2 and 8km.

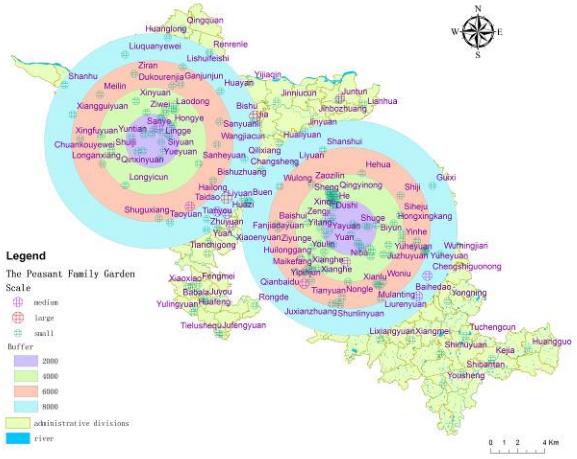

Figure 2. Buffer analyses for the Peasant Family Garden

B. *Trend Analysis*

The result of this method indicates the spatial distribution of the Peasant Family Garden presents random in the north part of the Xindu district. However, it takes on radiation in the eastern part. This suggests, compared to the east part of the Xindu district, the development of the Peasant Family Garden is relative balanced in the northern district.

C. *Thiessen Polygons*

The Thiessen polygon is shown in the Figure 3. Owing to clustered around the Huangguoshu square and the Xijie Community, the development of the Peasant Family Garden may interact with one another.

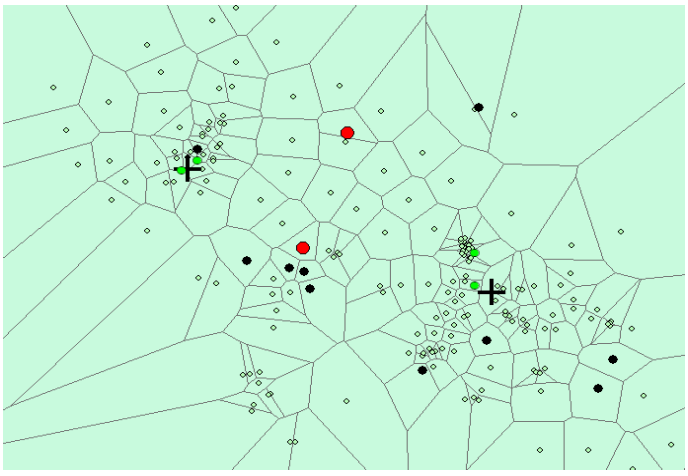

Figure 3. Thiessen polygons for the Peasant Family Garden

D. *Density Analysis*

From the density distribution map, the maximum density area for the Peasant Family Garden distribution exists in the Xibei Community, Xindu Town. There are 18 Peasant Family Garden and account for 9.7% in total. For the other communities, there are 7, 7, 6, 5, 4, 4 Peasant Family Garden for the Jijia Community, the Huayuan Community, the Gaoqiang Community, the Puhe Community, Machao Community and Mulan Community, respectively. And the corresponding percentage in total for the above six communities are 3.8%, 3.8%, 3.2%, 3.2%, 2.2%, 2.2%. As the Figure 4. demonstrates, several dense distributions for the Peasant Family Garden locate in the area around the Xindu and Xinfan town. In addition, there are a few medium Peasant Family Garden in the Banzhuyuan town.

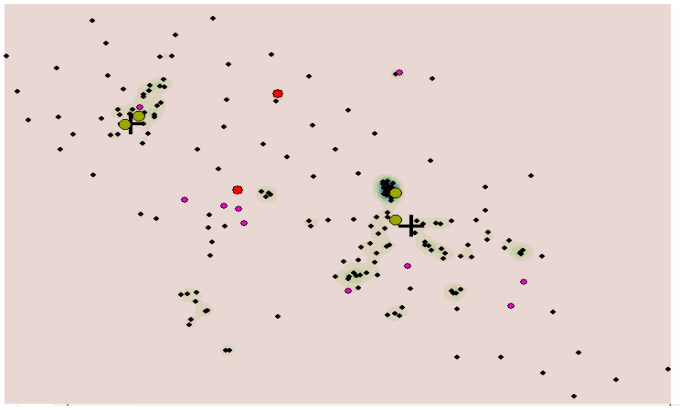

Figure 4. Density analyses for the Peasant Family Garden

E. *Nearest Neighbor Analysis*

By using the CrimeStat analysis software, the average shortest distance between Peasant Family Garden and Peasant Family Garden is 766.25 meter. Among them, the longest distance is 39632.68 meter, while the shortest is 60.02meter. So the standard deviation is 710.6. Meanwhile, by calculating the collected data, the average shortest distance is 766.2484meter and the expected nearest distance is 1102.1011meter. The spatial distribution pattern of Peasant Family Garden belongs to cluster by referring to the nearest neighbor index which is 0.69526.

In order to compare to the collected data, values of the CrimeStat analysis software for the average shortest distance and the expected nearest distance, as well as the nearest neighbor index for the10-order operations are shown in the Table I. After the 10-order operations, the nearest neighbor index is still smaller than 1.

TABLE I. RESULT OF 10-ORDER OPERATIONS

Times of Operation	The Average Shortest Distance	The Expected Nearest Distance	The Nearest Neighbor Index
	meter	***meter***	
1	766.25	1102.10	0.70
2	1098.12	1653.15	0.66
3	1366.87	2066.44	0.66
4	1616.88	2410.85	0.67
5	1811.41	2712.20	0.67
6	1995.02	2983.42	0.67
7	2159.54	3232.04	0.67
8	2333.97	3462.90	0.67
9	2483.72	3679.33	0.68
10	2656.79	3883.74	0.68

V. CONCLUSION

A. Spatial Distribution Regularity of the Peasant Family Garden of the Xindu District

The spatial distribution pattern of Peasant Family Garden is cluster. There are 50 Peasant Family Gardens which are at 26.7% locate in the buffer zone of 2 to 4km. When the buffer radius is less than 8km, the number of Peasant Family Garden account for 84.3% in total. The peasant Family Gardens which do not exist in that area became less dependent to the center of buffer zone, thus forming its own center-secondary center.

The spatial distribution of the Peasant Family Gardens is relatively dense with the buffer distance from 2 to 6km. The number of the Peasant Family Garden in this buffer zone is at 53.8% of total Peasant Family Gardens. This indicates the buffer distance between 2 and 4km is the densest area filled with Peasant Family Gardens which account for 49.6% in total. A further summarized above all results is the number of the Peasant Family Garden is declined after increased with the buffer distance between 2 and 8km.

There are five cluster zones of the Peasant Family Garden in Xindu district. It includes center district of Xindu town, the Huayuan Community, the Gaoqiang Community, the Machao Community and the Banzhuyuan Community. Similarly, the spatial distribution of the Peasant Family Garden can also classify seven density areas. These areas are the Xibei Community, the Jijia Community, the Garden Community, the Gaoqiang Community, the Puhe Community, the Ma Chao Community, and the Mulan Community. The peasant Family Gardens are so dense in some of these areas that they can not have a well development. Compared to southeastern Xindu district, the spatial distribution of the Peasant Family Garden is balanced in the northwest part.

The peasant Family Garden is well developed in Xindu and Xinfan town. There are some huge Peasant Family Gardens in Banzhuyuan town, while the Peasant Family Gardens grow slowly in the rest of towns. Limited resource, topography, as well as policy support can explain the present development of the Peasant Family Garden situation in different towns.

B. Influencing Factors

From the above analysis, the spatial distribution of the Peasant Family Garden is affected by the following factors:

1) The Peasant Family Garden is likely to locate near the scenic spot and industrial zones.

2) Owing to the radial-gathering phase of population of Xindu and centrifugal tendency of its industry, the distribution of Peasant Family Garden is random.

3) Some factors such as the supporting policies of the government and a better transport system all contribute to the well development of the peasant Family Garden in Xindu, Xinfan and Banzhuyuan town.

C. The Issues to be Studied

In the present paper, the Spatial Analysis and Geo-statistical Analysis of the ArcGIS software can explore the distribution regularity of the Peasant Family Garden. But there still exist some problems like the changing roads, rivers, population and the limited information. So the varied time, types and cities of the spatial distribution of the Peasant Family Garden need to go on further study.

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