
Satellite map observation-based study of the inherent causes of formation of settlements

ZHOU Yixin^{1,2}, LI Xiaofeng¹

1. Department of Architecture and Urban Plan, Huazhong University of Science and Technology, Wuhan 430074, China;

2. Institute of Design, Shunde Polytechnic, Shunde Polytechnic, Foshan 528300, China

Abstract: According to legend, there are several settlements in the form of "Bagua" (also called the Eight Diagrams) in Guangdong Province of China. For a long time, the public propaganda and some scholars all consider the construction of such settlements are modeled after the Bagua of Tai Chi, that they are a imitation of the Bagua. Using satellite map observation technology, this study defined the preliminary concept of the settlements in the form of Bagua, collected the statistics of the quantity and location of these settlements, and gathered a description of the distribution and overall plane graph of them. Through graphic analysis and isomorphism method, it is found that isomorphic relation exists in many ways between the distribution region of those settlements and their surrounding geographical environment.

In the author's view, the form of Bagua is only the external appearance of the settlements, and there are more important inherent causes of formation for them. First of all it is the defense of floods, followed by the defense of human disasters, and last but not least it is the adaption to the forms of social organization. The formation of the settlements in the form of Bagua had an apparent cause of defending the natural and human disasters, and it adapted the forms of social organization; then in the development of these settlements, the influences of the Bagua of Tai Chi as well as feng shui are integrated. In nature, the purpose of this settlement form is to create optimal living environment.

Key words: Satellite map, form of settlement, inherent cause of formation, isomorphic, floods, human disaster, form of social organization

CLC number: TU-098

Document code: S4-9

Received: 空着 ; **Accepted:** 空着

Foundation: "Study of the Social Adaptability of Immigrant Settlements - Take the Gaoyao Region as Example", Humanities and Social Sciences Fund Programme of the Ministry of Education.

First author biography: ZHOU Yixin (1977—), female, Associate Professor. The author of this article graduated from Huazhong University of Science and Technology majored in Achitecture, with current research area of architectural history and theory, and has more than 20 papers published. E-mail:sherryx@163.com

1 INTRODUCTION

As a place of strategic importance in Xijiang River basin, Gaoyao Region in Guangdong Province is a geographical hub of Guangdong and Guangxi, and the convergence of ancient civilizations. It is said that in Gaoyao Region there are several settlements in the Form of Bagua, including Xiangang Town (Fig.1), Licha Village, Baizhang Village and Shangkong Village, etc.



Fig.1 Layout of Xiangang Town (quoted from Google maps)

This settlements form demonstrates significant differences from the settlements of other types in Cantonese Region. For a long time, Licha Village and Xiangang Town, etc are commonly known as "Gaoyao Bagua Villages". Some scholars, as well as in the official publicity materials, hold that these settlements are created based on the concept deriving from the Taoist Tai Chi and Bagua Thinking, and that they are simulated Tai Chi and Bagua forms. Many people think that the forms of these settlements derive from Tai Chi and Bagua views that "Tai Chi generates two complementary forces, two complementary forces generate four aggregates, four aggregates generate eight trigrams, eight eights are sixty-for trigrams, finally forming an endless circle".

2 SPACE OBSERVATION-BASED GRAPHIC ANALYSIS OF THE SETTLEMENTS IN THE FORM OF BAGUA

By using satellite map observation technology like "Google maps" and "Baidu maps", we observed the forms of the settlements of Gaoyao region, and found that in this region, there exist many settlements of special forms that remind people the Bagua. There are varieties of expressions of the Bagua diagram (Fig. 2), and the common distinguishing features of different Bagua diagrams are:

- (1) With clear morphological centers;
- (2) Showing radial cobweb form;

(3) There is explicit relationship between the form and the location.



Fig. 2 Bagua Diagram of Fu Hsi (Drawn from Baidu Images and edited by the author)

The settlements in the form of Bagua can be represented by the Licha village (Fig. 3). Using Licha village as the model, we preliminarily defined the settlement in the form of Bagua as: Nearly circular settlements with clear morphological centers, while roads are roughly distributed in the shapes of ring and radiation, and the orientations of the constructions accord with the locations.



Fig. 3 Overall Layout of Licha Village (Quoted from Google Map)

According to this definition, it is found that the actual number of such settlements in the form of Bagua in Gaoyao region is 35, which is way more than the legendary number. Some of the typical cases are listed below:

Table 1 Space Observation-Based Cases of the Settlements in the Form of Bagua



Remark: Quoted from Google Map.

After collecting the statistics of the exact quantity and location of the settlements in the form of Bagua, the "Distribution of the Settlements in the Form of Bagua of Gaoyao " is plotted as below (Fig. 4).

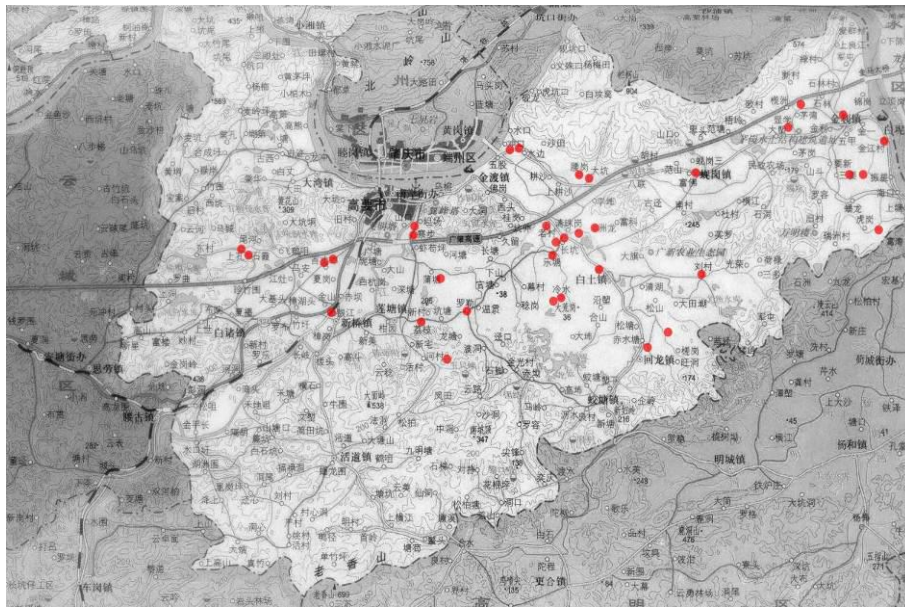


Fig. 4 Distribution of the settlements in the Form of Bagua of Gaoyao (Drew by the author with reference to “Map of Zhaoqing”)

3 ISOMORPHIC RELATIONSHIP BETWEEN THE GEOGRAPHICAL ENVIRONMENT AND THE DISTRIBUTION OF THE SETTLEMENTS IN THE FORM OF BAGUA

Found during the research, there are mysterious isomorphic relationships exist between the geographical environment of Gaoyao and the distribution of the settlements in the form of Bagua.

3.1 Isomorphic relationship between the landform and the distribution of the settlements in the form of Bagua

Superpose the "Topographic Map of Gaoyao" and the "Distribution of the Settlements in the Form of Bagua of Gaoyao", the "Diagram of the Relation between the Distribution of the Settlements in the form of Bagua and the Landform of Gayao" (**Fig. 5**) could be obtained. It can be seen from the diagram that Gaoyao has a terrain that the northwest is higher than the southeast, the settlements in the form of Bagua are all located in the south of the Xijiang River, and the located region has lower altitudes, while there is no such type of settlements in region of higher altitudes.

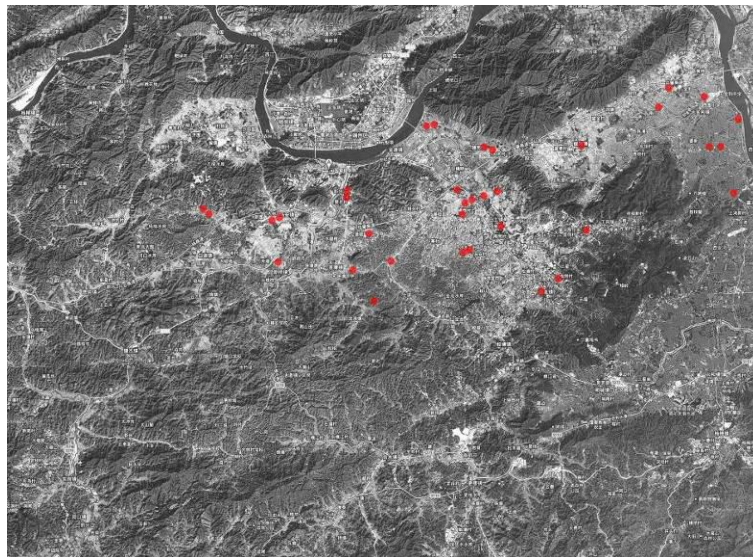


Fig. 5 Diagram of the Relation between the Distribution of the settlements in the form of Bagua and the Landform of Gayao ¹ (Drew by the author with reference to Google Map)

3.2 Isomorphic relationship between the historical flood inundated area and the distribution of the settlements in the form of Bagua

Superpose the "Diagram of the Flood Inundated Area of 1915² of Gaoyao" and the "Distribution of the Settlements in the Form of Bagua"³, the "Diagram of the Relationship between the Flood Inundated Area of 1915 of Gayao and the Distribution of the Settlements in the Form of Bagua" (**Fig. 6**) is obtained. According to the diagram, all the settlements in the form of Bagua are located within the inundated area except for one (which is located in the valley region).



Fig. 6 Diagram of the Relationship between the Flood Inundated Area of 1915 of Gayao and the Distribution of the Settlements in the Form of Bagua (Drew by the author with reference to the "Diagram of the Flood Inundated Area of 1915 of Gaoyao"⁴)

¹Light color indicates the region with lower altitudes; dark color indicates the region with higher altitudes. Red spots are the location of the settlements in the form of Bagua.

²In June and July of 1915, an extreme flood occurred at Xijiang River; it is the worst flooding ever recorded for the River. Peak discharge of Wuzhou station reached 54500m³/s, which is the highest record in history; the dike of the Xijiang River almost all burst, with countless wound and casualties; the losses caused by the disaster was serious. As recorded by the "Amended County Annals of Gaoyao": "In the summer, excessive rain lasted for months, the Xijiang River rose suddenly and sharply, all the dikes of the county burst (include Jingfu dike and 35 other dikes). It was the most severe disaster since Daoguang Jiachen of Qing dynasty. The whole city was inundated, with water of several feet in depth in the city. Guangzhou was also impacted by the flooding because of the burst of Jingfu dike.

³Drew by the author.

⁴Water and Power Department of Gaoyao, Guangdong. Water Conservancy Annals of Gaoyao (First Edition). 1990. Page 51.

Based on the two diagrams above, it is proven that important correlations exist between the land form and floods and the distribution of the settlements in the form of Bagua. We speculate that the formation of this form derives from the landform and flood prevention.

4 STUDY OF THE INHERENT CAUSES OF THE FORMATION OF THE SETTLEMENTS IN THE FORM OF BAGUA

In the formation of traditional settlements, defense is the primary concern, and the objects of the defense include natural and human disasters. Owing to the strong ancestral sense of the Cantonese, the forms of social organization also played an important role in the formation of the forms of settlements.

4.1 Defense of floods

Common natural disasters in Gaoyao include floods, droughts, storms, pests, etc. In the various natural disasters, floods are the most harmful, frequent and with the most far-reaching impact. Therefore, in the disaster prevention strategies of the settlements of Gaoyao, the most critical one is the defense of the floods.

4.1.1 Floods in Gaoyao

Gaoyao is located in the middle and lower reaches of the Xijiang River. Xijiang River enters China from western Gaoyao, meandering through the county, with up to 90km of length in the county. Xijiang River is a main stream of the Pearl River, which has the runoff that ranked the second in China, and the per capita water of the watershed ranks the first among the seven major rivers of China. Gaoyao region is located in the critical sector of the Xijiang River's main stream. The Xijiang River basin has the most frequent floods of the Lingnan area.⁵

The climate of Gaoyao is mainly subtropical monsoon climate; subtropical monsoon brings abundant rainfall, making the average annual rainfall reach 1647.9mm; meanwhile the region suffers from the attack of typhoons every year, and the rainfall could reach more than 100mm in a short period of time. Flood season of the Xijiang River is April to September, contributing 83% of the annual rainfall; in particular, the rainfall of May, June, and August is the most, accounting for 48% of the annual rainfall.⁶

The specific geographical environment and climatic conditions of Gaoyao caused constant serious floods for the region. Since the Song Dynasty, 33 times of large floods and 402 times of small floods are recorded, in average one large flood for each 30 years, and one small flood for each 2~3 years. For the 202 years from the Qianlong 12th year (1747)⁷ to 1949, there were 56 years when the floods caused dike burst, the disaster incidence is 27.7%. The total farmland of Gaoyao is 748,700mu; along the Xijiang River and the two shores of Xinxing River, 637,200mu of farmland (85.1 of the total farmland) is threatened by floods.

4.1.2 Flood defense strategy of the settlements

Gaoyao region is not only a typical mountainous and hilly zone in Guangdong region, with many hills of gentle slope in the territory, but also a typical water land in Lingnan area, with intensive rivers, lakes, and numerous low-lying

⁵SITU, S.J. Historical Human Geography of Lingnan - Comparative Study of Cantonese, Hakka, and Hoklo Civilian Departments. Sun Yat-sen University Press, 2001. 68

⁶Water and Power Department of Gaoyao, Guangdong, Water Conservancy Annals of Gaoyao (First Edition), 1990, Page 26~27

⁷For Qing Dynasty, dike bursts are recorded more completely since Qianlong 12th year (1747).

wetlands. First, the villagers take advantage of towering mountains to form natural high pedestal, to protect the building from flooding; secondly, make use of mountain elevation difference to drain precipitation as quickly as possible, to prevent retained precipitation from affecting roads and building foundations; thirdly, make use of surrounding waterways and fish ponds to form protective ponds, to create stagnant water and water storage barriers of the Settlements.

The road system perpendicular to the contour line forms the shortest drainage channel with largest height difference (Fig.7). The roads are paved with cobblestone or red sandstone, to achieve waterproofing and roadbed protection effect.



Fig.7 Schematic diagram of longitudinal drainage system in Xiangang Village (Drew by the author with reference to Google Map)

4.2 Defense of human disasters

For the defense of human disasters, the comb-like settlements of Guangdong is not superior, while Hakka Round House is the most typical defensive Settlements, but for the hot and humid climate in the Pearl River Delta, it has such disadvantages as poor ventilation and moisture resistance. The Settlements in the Form of Bagua, in fact, absorbs both advantages. It takes the form of island village surrounded by water, leaving only a few roads into the village, with towers and gates at the entrance (dismantled now), serving as the first level of defense; the doors of peripheral buildings are opened inward, with the peripheral buildings serving as the enclosing wall of the settlement. Several entrance gatehouses are set along the peripheral settlement, similar to Round House, forming the second level of defense; the internal roads in the settlement are full of twists and turns, and outsiders can easily be trapped, thus forming the third level of defense (Figure 8). The Japanese invaders were once trapped in Xiangang Village.

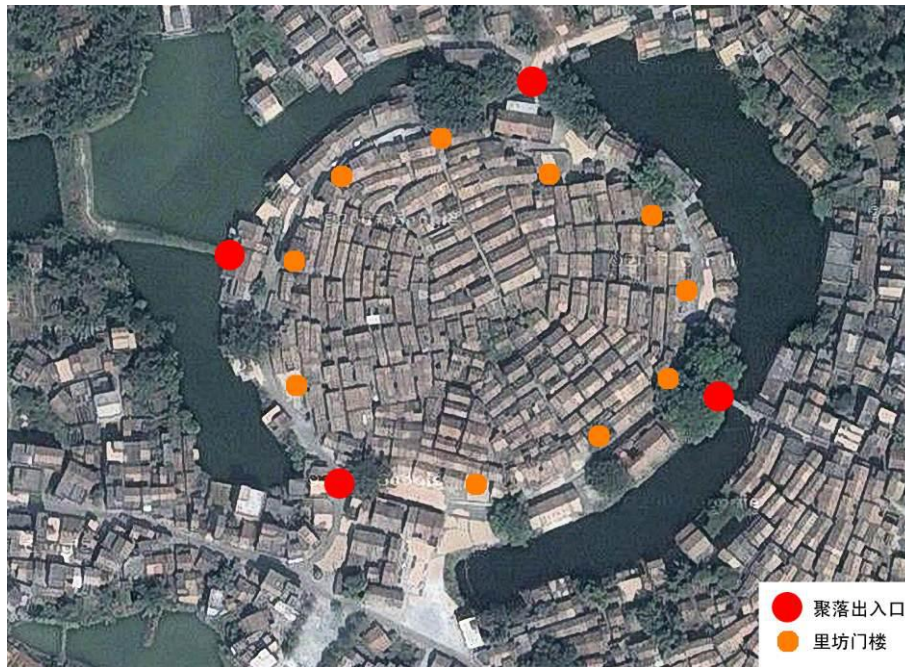


Fig.8 Entrances location in Xiangang Village (Drew by the author with reference to Google Map)

From the morphological point of view, circular shape is the best for defense, with the spiritual function of internal uniting. The form of Bagua is the best choice for settlements that fulfill optimal defense.

4.3 Social organizational forms

The Guangfu people have a strong clan tradition. The gathered dominant clan is divided into several branches. The clan has ancestral hall, and each branch has its branch ancestral hall and family ancestral hall (called "ancestral temple" by villagers). Xiangang Village has the most typical characteristics. There are 16 ancestral halls and the two study halls along the settlement periphery, known as "Bagua and 16 Ancestral Halls" (Figure 9), and scattered within the village are dozens of ancestral halls (more than 50 according to preliminary estimation, requiring further investigation). Along the periphery of Licha Village, there are 10 entrance gate towers (nine neighborhoods and one memorial gateway) instead of large ancestral hall, and there are also 16 ancestral temples in the village (Figure 10). The ancestral hall in Xiangang Village or gate tower in Licha Village, representing a clan, cuts the whole settlement into several groups. These groups, just like their social relations, are not only divided and separated, but also fused and bound, jointly forming a dominant clan in the same region.



Fig. 9 Distribution of the Ancestral Constructions of the Xiangang Town(Drew by the author with reference to Google Map)

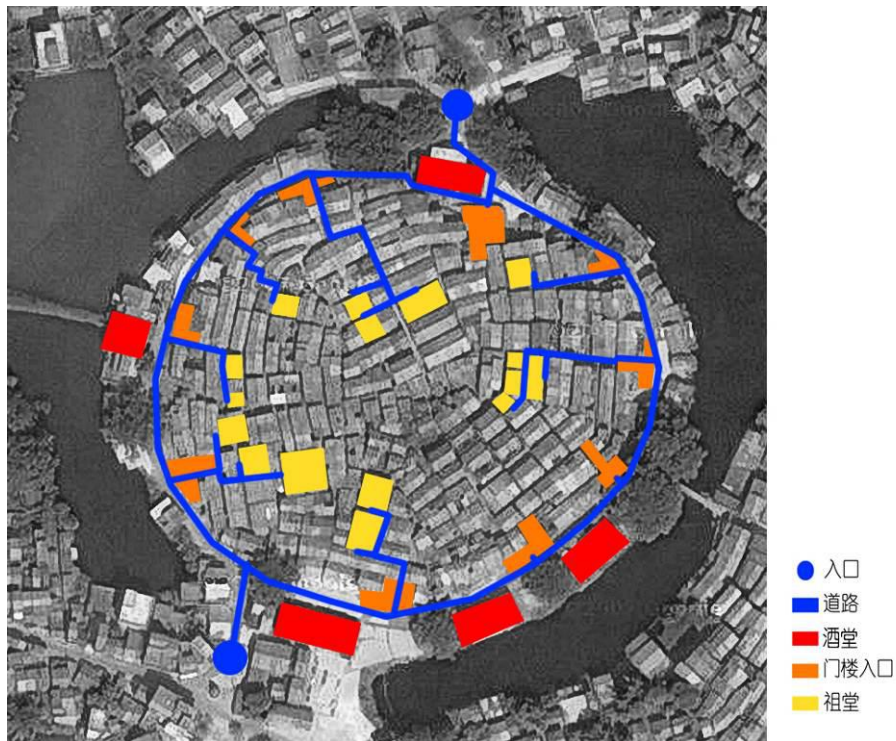


Fig. 10 Distribution of the Ancestral Constructions of the Licha Village(Drew by the author with reference to Google Map)

There are some public spaces in the settlements, of which the public area at the center of form of Bagua is the most important. The center of Xiangang Village occupies an area about two *mu*, with the hillock top paved with pattern of Tai Chi and Two Complementary Forces, and an ancestral temple as well, where weddings and funerals are held. At the center of Licha Village are Fortune Platform (pattern of Tai Chi and Two Complementary Forces), the largest ancestral temple and Dunshan Academy, the sole academy in the village.

5 CONCLUSIONS

In summary, although the settlements in the form of Bagua in Gaoyao region has certain features of the Bagua of Tai Chi, they shouldn't be simply classified to settlements built with the idea of Tai Chi without tangible demonstration, where the essence of this form is ignored and the wisdom and experience of the ancestors who created these villages are cramped.

The most important inherent cause of the formation of the forms of settlements is disaster defending. The form of Bagua is actually a fortuitous product of the settlements' defense of floods. This study proposes the idea that the formation of the settlements in the form of Ba gua has obvious inherent cause of natural and human disaster prevention, while adapting the forms of social organization; and during the development of the settlements, the influences of the Bagua of Tai Chi as well as Feng Shui are integrated, thus forming the current form of the Bagua. Creating optimal living environment is the nature of these settlements in the form of Bagua, and it is not in contradiction with the ideas of Fengshui. These settlements went through continuous enrich and perfection and become such peculiar landscape. If the mysterious Fengshui of their appearance is constantly emphasized, the further exploration of the deeper meaning of these settlements might be impacted.

Acknowledgements: The images were kindly offered by Lv Tangjun and Dongyu Design Studio.

REFERENCES

Basic Summary of the Surface Climate Documents of Gaoyao

Climate Department of Guangdong. 1987. Climate of Guangdong. Guangzhou: Guangdong Technology Press

Gaoyao Archives. 1981. Natural Disaster History of Gaoyao (internal document)

Han J F, Ye C (Daoguang) County Annals of Gaoyao

Li X F. 2005. Vernacular architecture - theory and methods of interdisciplinary study. Beijing: China Architecture & Building Press

Ma C T. (the Republic of China) County Annals of Gaoyao

Tan H, Liang D Y. (Kangxi) County Annals of Gaoyao

The Local Chronicles Compiling Committee of Gaoyao. 1996. County Annals of Gaoyao. Guangzhou: Guangdong People's Publishing House

Water and Power Department of Gaoyao, Guangdong. 1990. Dike Annals of Gaoyao

Water and Power Department of Gaoyao, Guangdong. 1990. Water Conservancy Annals of Gaoyao

Wu Q Z. 2009. Study of China's Ancient City Flood Control. Beijing: China Architecture & Building Press

Zhou Y X, Li X F. 2011. Study of the social morality adaptability of immigrant settlements - take the settlements in the form of Bagua in Gaoyao,

Guangdong as Example. *Architectural Journal*, 2011(11): 6-10