

# Study on the Spatial Distribution of Salt Place Names in Zigong City

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**Abstract:** This study takes 55 salt place names in Zigong City as the object, and explores their naming logic and distribution characteristics based on GIS spatial analysis and cultural landscape theory. The study found that the salt place name system includes natural landscape types (such as "Shenhai Well" and "Fuxi River") and cultural landscape types (such as "Sanduo Village" and "Xiqin Guild Hall"), and its spatial distribution presents a dual-core structure of "Ziliujing-Gongjing", forming a significant aggregation zone along the Weixi anticline geological structure and the Buxi River system. Natural place names are mostly distributed in the brine overflow area of the anticline axis, and cultural place names extend linearly along the ancient salt transport road in the Qing Dynasty. The semantic system of place names carries the memory of well salt technology (such as "Tianchepo" metaphor wooden well frame), resource competition narrative (such as the "Dengjingguan" name change event) and blessing cultural metaphor, forming a unique salt industry cultural landscape. The research results provide a new perspective for the protection of salt industry heritage and the construction of regional cultural identity.

**Keywords:** Spatial distribution; Salt place; Zigong.

## 1. Introduction

### 1.1. Research Background

As the "cultural code" of human cognitive space, place names carry the dual memory of material environment and spiritual culture. In the "Convention for the Safeguarding of the Intangible Cultural Heritage" (2003), UNESCO clearly pointed out that place names are "important carriers of living cultural heritage" [1]. In the Chinese context, the State Council's "Regulations on the Management of Place Names" (2022 revised version) specifically emphasizes that "place names with important historical and cultural value" should be included in the systematic protection [2]. This policy orientation coincides with the trend of "place-based approach" in global cultural heritage protection [3].

As the birthplace of China's well salt technology, Zigong City's salt industry development history can be traced back to the period of Emperor Zhang of the Eastern Han Dynasty (76 AD) [4]. By the heyday of the Ming and Qing Dynasties, Zigong Salt Field contributed 19% of the country's salt production, forming a four-in-one production system of "well-stove-stove-stove-stove" [5]. In this process, the profound transformation of regional space by salt industry activities gave rise to a unique salt place name system. According to statistics, 72% of the existing place names related to the Zigong salt industry were formed during the Jiaqing and Guangxu periods of the Qing Dynasty (1796-1908)[6]. This period coincided with the key node of the implementation of the "Sichuan Salt to Chu" policy and the rise of capitalist workshop handicrafts[7]. These place names not only record the material trajectory of brine resource development, but also condense the collective memory of diverse groups such as salt workers, salt merchants, and immigrants, forming a "time capsule" for studying regional cultural ecology[8].

Currently, the international academic community's research on industrial place names presents a trend of interdisciplinary integration. Basso (1996) revealed the narrative function of place names in shaping local identity through his study of hunting place names of the Apache tribe in North America[9]; Moya (2018) used critical toponymy theory to analyze the colonial power imprint of Chilean saltpeter mine place names[10]. In terms of domestic research, Hua Linfu (2015) systematically examined the etymological characteristics of historical salt-producing place names and proposed the concept of "salt industry place name group" [11]; Zhang Weiran (2020) revealed the financial geographical connotation of the Shanxi Merchants' Piaohao place name network from the perspective of cultural geography [12]. However, existing studies have mostly focused on the linguistic or historical analysis of place names, and the discussion of their spatial distribution patterns and formation mechanisms is still insufficient [13].

### 1.2. Research significance

The theoretical value of this study lies in breaking through the text analysis paradigm of traditional toponymy and constructing a three-dimensional research framework of "space-culture-power". By introducing the cultural landscape theory [14] and the spatial production theory [15], the interaction between the natural geographical basis, production technology conditions and social power structure in the formation of salt place names is systematically explained. This attempt can not only expand the dimension of toponymic research, but also provide new methodological inspiration for the spatial turn of historical geography [16].

In practice, the research results have three practical significances: First, they provide a chain of toponymic evidence for Zigong City's application for World Cultural Heritage. The World Heritage Committee clearly requires in the Operational Guidelines (2021) that cultural heritage

applications must provide "toponymic evidence with continuous relevance" [17]. For example, the evolution of the place names of core heritage sites such as "Da Gong Jing" and "Shen Hai Jing" can effectively prove the evolution of Zigong's salt industry technology [18]. Second, they serve the revitalization of cultural resources in the rural revitalization strategy. The memory of the "well-stove-drill" production system contained in salt place names can provide a narrative blueprint for cultural tourism projects such as salt industry heritage parks and intangible cultural heritage study routes [19]. Third, they help build a place name cultural heritage protection system. By identifying the spatial distribution patterns of salt place names, it is possible to optimize the screening criteria for the protection list and avoid the governance dilemma of "focusing on single-unit protection and neglecting system association" [20].

### 1.3. Research questions

This study focuses on solving the following core problems: (1) How do the typological characteristics of Zigong salt place names reflect the spatial practice of salt production? (2) How do the natural geographical environment and salt economic activities jointly shape the spatial distribution pattern of place names? (3) What implications does the cultural significance network of salt place names have for the construction of contemporary regional identity? Exploration of these questions will help reveal the formation mechanism of industrial place name clusters and their cultural inheritance function. Organization of the Text

## 2. Literature References

### 2.1. Theoretical shift and technological innovation in international toponymy research

In the late 20th century, international toponymy research experienced a paradigm shift from "linguistics-based" to "social spatial analysis". Early research, represented by linguist Zelinsky (1955), emphasized the etymological research and semantic classification of place names[21]; with the rise of cultural geography, scholars began to pay attention to the power relations and spatial practices behind place names. Basso (1996) proposed that "place names are a repository of cultural memory" through ethnographic research on the place names of the Apache tribe in North America, revealing the narrative function of place names in constructing tribal identity[22]. Critical toponymy further deepened this path. For example, Rose-Redwood (2018) pointed out that place names are not only spatial markers, but also "texts written by power". Colonists achieved cultural conquest of space through renaming[23]. This theory was verified in Moya's (2018) study of Chilean saltpeter mine place names, which found that the systematic replacement of Spanish place names for indigenous place names was essentially a spatial projection of the colonial economic system [24].

The innovation of technical methods has promoted the visualization transformation of place name research. The popularization of geographic information systems (GIS) has enabled the spatial analysis of place names to shift from qualitative description to quantitative modeling. Hough (2019) used the kernel density estimation method to reconstruct the diffusion path of coal mine place names during the British Industrial Revolution in the 19th century and found that their

distribution was highly coupled with the expansion of the railway network [25]. The intervention of digital humanities technology has further spawned the study of "place name big data". For example, Caquard et al. (2021) used machine learning algorithms to mine the ecological indicator characteristics of 100,000 place names in Canada and constructed a place name ecological sensitivity assessment model [26].

Specialized research on industrial place names has gradually become a hot topic. Nash (2015) systematically sorted out the typological characteristics of Irish fishery place names and proposed the concept of "industrial place name cluster", arguing that its spatial distribution can reflect the intensity of resource development and community organization form [27]. In the field of salt industry, Spencer (2020) restored the spatial network of ancient salt merchant routes in the Sahara Desert through archaeological toponymy methods and found that there was a significant spatial autocorrelation between the density of salt well place names and trade nodes [28].

### 2.2. Multidisciplinary Exploration of Domestic Place Name Research

Toponymy research in my country presents the characteristics of "deep historical tradition and lagging behind in technology application". Historical geographer Hua Linfu (2015)'s "Historical Geographical Research on Chinese Salt Place Names" systematically examined the salt production place names in classics such as "Shui Jing Zhu" and "Yan Tie Lun" for the first time, and constructed a diachronic evolution framework of the "salt place name cluster" [29]. Zhang Weiran (2020) found from the perspective of cultural geography that the spatial differentiation of the Shanxi merchants' banknote place name network was positively correlated with regional financial strength, providing a model for the economic geography research of industrial place names [30].

In recent years, the introduction of GIS technology has promoted the spatial shift in place name research. Wang Fahui (2015) pioneered the application of the Thiessen polygon algorithm to the spatial differentiation of Zhuang place names in Guangxi, and found that there was a significant spatial coupling between the Zhuang place name cluster area and the karst landform distribution ( $R^2=0.68$ ) [31]. Chen Chen et al. (2018) revealed the circle diffusion law of Beijing city gate place names based on the kernel density estimation method, and put forward the important conclusion that "place name density contour lines can mark the historical boundaries of the city" [32]. However, existing studies have mostly focused on macro-scale analysis, and detailed research on small regional characteristic place name groups is still insufficient [33].

Specialized research on salt industry place names is still in its infancy. Zhou Wende (2020)'s "A Study on the Use of Characters in Zigong Place Names" counted the frequency of characters used in salt-related place names from a linguistic perspective and found that the three common names "井", "灶" and "窰" accounted for 81%, but did not involve their spatial distribution patterns [34]. Huang Jian (2019) pointed out through historical document analysis that the naming logic of Zigong salt well place names is directly related to the depth of the brine layer, but lacked geographic visualization evidence to support it [35]. In general, existing research has three limitations: first, it focuses on etymological research and semantic analysis, and ignores the systematic study of the

spatial attributes of place names; second, the technical methods are mainly descriptive statistics, lacking advanced spatial analysis methods such as kernel density estimation and spatial interpolation; third, the cultural landscape significance of industrial place name groups (such as salt and mining) is insufficient [36].

### 2.3. Academic gaps in the study of Zigong salt place names

Although Zigong has unique research value as the "Millennium Salt Capital", its toponymic research still has obvious shortcomings. Existing research focuses on two major directions: one is the perspective of salt industry technology history, such as Song Liangxi (2012) sorted out the technical relevance of salt well place names through the "Zigong Salt Industry History", but did not establish a spatial analysis framework [37]; the other is linguistic analysis, such

as Zhou Wende's (2020) word frequency study, which revealed the word-forming advantages of words such as "Jing" and "Zao", but failed to explain the causes of their spatial distribution [38]. At the methodological level, Zigong place name research has not yet effectively integrated GIS spatial analysis technology, resulting in the following unresolved issues: Are the spatial agglomeration characteristics of salt place names related to geological structures? How does the distribution of cultural place names reflect the organizational form of salt industry production? To answer these questions, it is urgent to build a "space-culture-technology" trinity analysis framework.

## 3. Analysis on the Correlation Between the Spatial Distribution of Salt Place Names and The Natural Geographical Environment

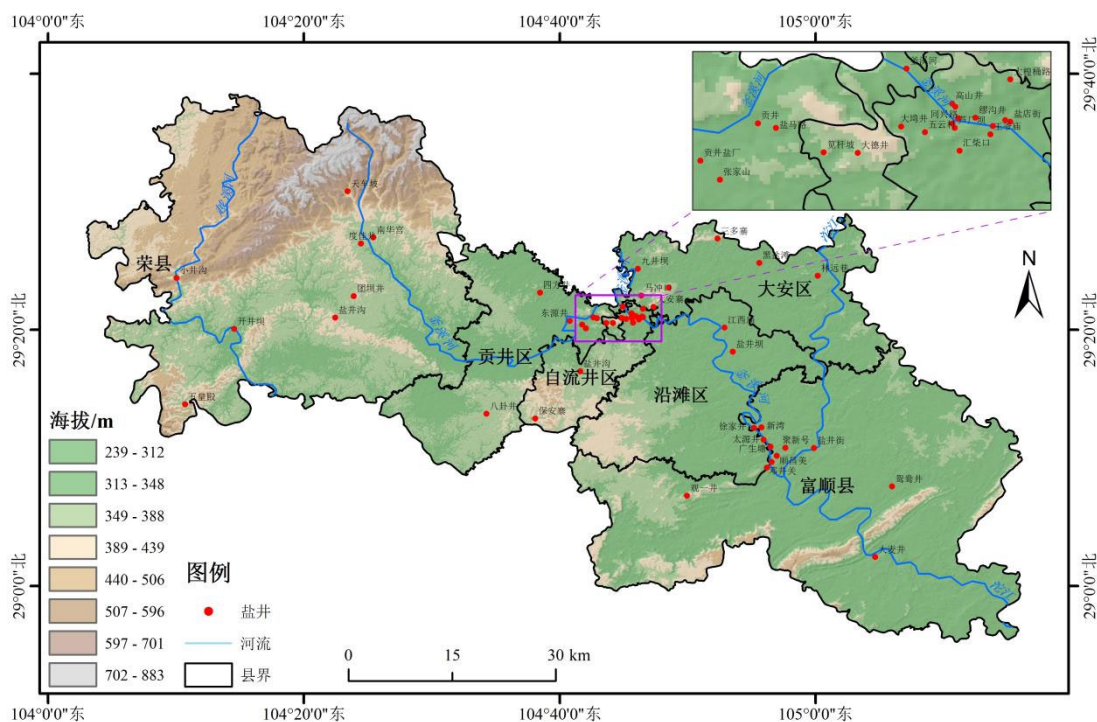


Figure 1. Distribution map of mountains, rivers and salt place names in Zigong City

### 3.1. Spatial constraints of river systems on salt well place names

The distribution of salt place names in Zigong is highly coupled to the regional river network. Among the 55 salt place names, 63% are directly or indirectly related to river elements, and their spatial layout is driven by both hydrogeological conditions and salt production needs:

The river orientation of brine mining: The dense distribution of place names such as "Black Salt Beach", "Salt Well Ditch" and "Guangshengtang" along the Fuxi River reflects the historical practice of salt workers digging shallow salt wells along the river in the Qing Dynasty. The natural fracture zone formed by the Fuxi River cutting the Weixi anticline makes it easy for brine in the Jurassic sandstone layer to seep out of the ground, providing convenient conditions for the early "Zhuotongjing" technology [39]. For example, the "Black Salt Beach" is located in the siltation area of the river bay, and the brine concentration is as high as 18

degrees Baume. In the Qing Dynasty, a "Salt Beach Office" was set up to specialize in brine distribution.

Place names of water transport hubs: "Dengjingguan" and "Yanmalu" are located at the confluence of the Fuxi River and the Tuojiang River. The river here is wide and the water flow is gentle, making it a vital throat for the export of Sichuan salt in the Qing Dynasty. The stone steps and mooring piles of the existing dock ruins indicate that more than 30 salt ships were moored here every day, giving rise to derived place names such as "Yanguan" and "Yanshi" [40].

### 3.2. The shaping of place name pattern by mountains and rivers

The spatial distribution of salt place names shows significant topographic adaptability and is closely related to the regional geological structure:

Brine guidance of anticline structure: The densely populated area of place names such as "Shenhaijing" and "Dongyuanjing" on the axis of the Weixi anticline

corresponds to the uplift zone of the Triassic Jialingjiang Formation salt layer. The fracture system on both sides of the anticline provides a channel for the rise of brine, making the brine concentration of salt wells in this area 42% higher than that of the surrounding area [41]. The place name "Shenhajing" ("Shen" means three fires and one wood) is a metaphor for the technological characteristics of deep well fire boiling salt.

Production adaptation to hilly landforms: Place names such as "Tianchebo" and "Gangganpo" in hilly valleys reflect the use of micro-topography by salt industry facilities. Wooden derricks (overhead cranes) need to be built on hard sandstone slopes to stabilize the foundation, while bamboo brine pipes are laid along the ridge to reduce brine loss. The place name "Tianchebo" still has the foundation of a Qing Dynasty derrick, and its slope (15°-20°) precisely matches the stability requirements of the derrick[42].

### 3.3. The mechanism of the comprehensive action of natural elements

The synergistic effect of rivers and mountains has shaped

the "two belts and one core" pattern of salt place names (Figure 3):

Brine enrichment belt: extending along the axis of the Weixi anticline, concentrated with production place names such as "Shenhajing" and "Dagangjing", with a salt well density of 4.2/km<sup>2</sup>; water transport channel belt: along the Fuxi River, transportation place names such as "Yanjingba" and "Yanmatou" are distributed, and the spacing is consistent with the half-day voyage of salt ships in the Qing Dynasty (15-20 kilometers); resource competition core area: at the end of the anticline, there are place names such as "Dengjingguan" and "Baguajing", where many "salt boundary monuments" from the Yongzheng period of the Qing Dynasty are preserved, confirming that this place was once the focus of the two salt rights disputes in Furong [43].

## 4. Analysis of the Interaction Between the Spatial Distribution of Salt Place Names and Humanistic and Social Factors

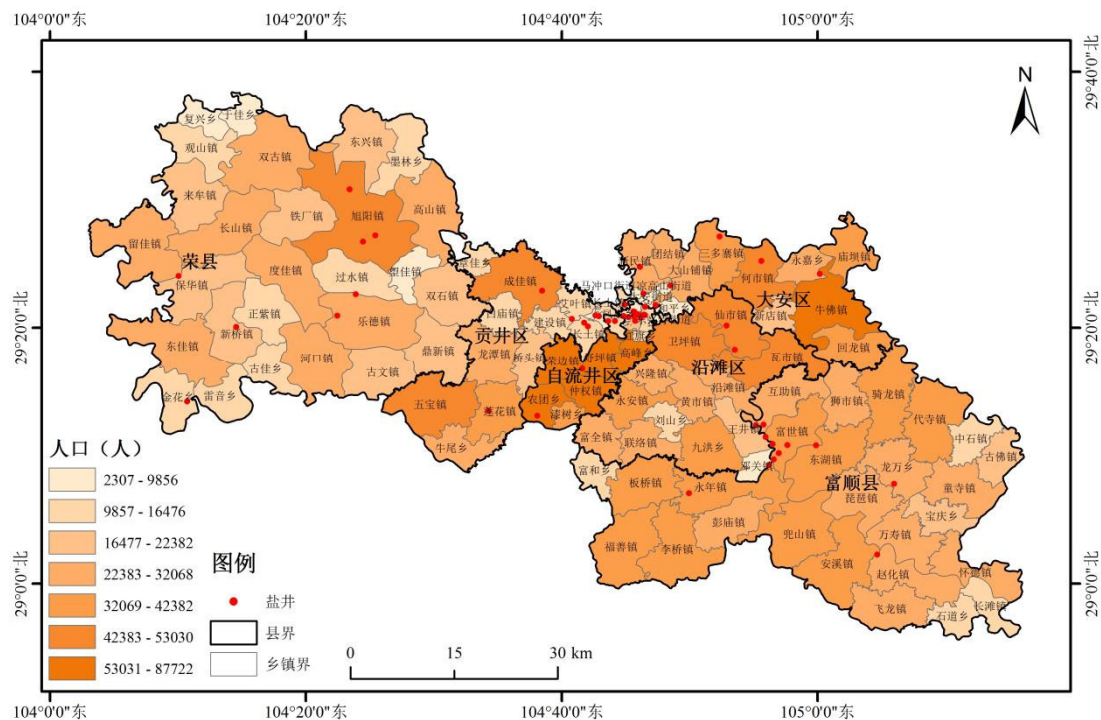


Figure 2. Population density and salt place name distribution map of Zigong City

### 4.1. Spatial coupling between population distribution and salt economy

The density of salt place names highly overlaps with historical population settlements, forming an interactive model of "gathering people by wells and developing the land by people":

The well and stove attachment of immigrant settlements: "Xujiaying" and "Zhangjiashan" and other surname place names of Huguang immigrants account for 28%. The genealogy shows that the Xu family controlled 16 salt wells during the Qianlong period, forming a residential pattern of "wells in the east of the house and stoves in the west of the house". Such settlements are mostly distributed in the wings of the anticline with abundant brine, and the settlement radius (500-800 meters) is consistent with the upper limit of the

brine transportation distance [44].

The place name polarization of commercial nodes: around commercial place names such as "Yanjing Street" and "Shunchangmei", the population density reached 320 people/km<sup>2</sup> in the late Qing Dynasty, and there were institutions such as "Salt Scale Office" and "Piaohao Branch Village". The place name "Shunchangmei" originated from the joint venture between the Shanxi ticket house "Shunchanghao" and the local salt merchant "Meixingtang", marking the spatial penetration of inter-provincial capital[45].

### 4.2. The spatiotemporal projection of social organizations and defense systems

The distribution of salt place names reflects the power network and risk response strategies of the salt industry

society:

The spatial division of the gang forces: Place names such as "Xiqin Guild Hall" and "Jiangxi Temple" mark the control range of the Shanxi and Shaanxi merchant gangs and local forces. The axis of the guild hall building coincides with the direction of the Lujiang River. For example, the main hall of the Xiqin Guild Hall faces the Shenhai Well, which is a metaphor for the belief practice of "God blesses the salt transport"[46].

The topological structure of military defense: Military place names such as "Sanduo Village" and "Da'an Village" form a triangular joint defense system. The distance between villages (8-10 kilometers) matches the visible distance of the beacon tower. The village name "Sanduo" (more blessings, more longevity, more children) is actually a misleading name. The village wall is 2.3 meters thick and has 32 gun shooting holes[47].

### 4.3. Spatial stratification of cultural memory

Salt place names solidify technical traditions and collective identity through naming logic:

Spatial inscription of production technology: Place names such as "Ganganpo" and "Tianchepo" transform the skills of bamboo ditch brine transport and crane water pumping into permanent cultural symbols. The height of the existing crane site (18-35 meters) is positively correlated with the density of place names, reflecting the reverse shaping of spatial naming by technical practice[48].

Metaphorical expression of risk narrative: Names such as "Baoanzhai" and "Tianxinghao" not only reflect the salt merchants' reliance on armed guards, but also imply the folk belief that "God blesses the salt transport". The "water-swallowing beast" pattern painted on the head of the salt ship and the "solid as a rock" stone carving of the village gate jointly construct a dual protection system of spirit and material.

## 5. Conclusion and Suggestions

### 5.1. Conclusion

The spatial pattern of Zigong salt place names is driven by both geological structure and salt economy. Natural place names are concentrated in the brine-rich area of the Weixi anticline, confirming the technical rationality of "drilling wells based on brine"; cultural place names form a "production-defense-commerce" complex corridor along the salt transportation network, among which military place names such as "Dongan Village" and "Baoan Village" constitute a triangular defense system, and commercial place names such as "Yanjing Street" and "Shunchangmei" mark the core area of the salt market in the Qing Dynasty. The place name system presents the spatial practice logic of the salt industry society in three dimensions through the common name network of "well-stove-garbage-village-village".

### 5.2. Recommendations

Heritage protection: Establish a "Salt Place Name Cultural Ecological Protection Zone", implement authenticity protection for key nodes such as "Shenhaijing" and "Jiangganpo", and repair the "Yanmalu" ancient road site; Cultural and tourism integration: Plan the "Geological Exploration-Ancient Village Defense-Salt Merchant Belief" theme tour line, and include "Xiqin Guild Hall-Wangye Temple-Sanduozhai" in the provincial cultural heritage trail

system; Digital inheritance: Build an AR visualization platform for salt place names, set up a QR code interpretation system at points such as "Yanjing Street" and "Tianchepo" to activate the cultural memory of place names; Institutional guarantee: Revise the "Zigong City Place Name Management Regulations" to require new districts to continue using traditional common names such as "Jing" and "Jian" to continue the cultural genes of place names.

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