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Original Paper

Study on the Spatial Network Structure Evolution and Influencing Factors of Tourism Economy in Gansu Province

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Abstract

Gansu Province possesses rich and diverse tourism resources as well as a profound cultural heritage, so investigating the evolution of its tourism economic linkage network is of practical significance for promoting coordinated regional tourism development. Based on panel data from 14 prefecture-level cities and autonomous prefectures in Gansu Province for 2013, 2016 and 2019, this paper uses a modified gravity model to measure the intensity of tourism economic linkages, applies social network analysis to characterize the structural features of the linkage network, and further employs a geographical detector to identify the driving factors of network evolution. The results show that the overall intensity of tourism economic linkages among the 14 cities and prefectures has increased, and the spatial distribution of the total linkage volume is broadly consistent with the level of regional economic and social development. Network density has risen year by year, the controlling power of the provincial capital Lanzhou has weakened somewhat, and the network structure has become more balanced across regions, although the development of peripheral areas still requires attention. The network has also displayed a multi-growth-pole evolution trend among cities, with the level of regional coordinated development continuously improving. Transportation conditions and tourism resource endowment are the key factors affecting changes in network structure.

Keywords

tourism economic linkage, network structure, gravity model, social network analysis, geographical detector

Introduction

Tourism economic linkage reflects the strength of factor flows and spatial interaction between tourist destinations, and constitutes an important entry point for understanding regional tourism spatial structure. In recent years the national level has continuously emphasized optimizing the spatial layout

of tourism and promoting coordinated regional development, and during the 14th Five-Year Plan period Gansu Province has explicitly proposed building four major tourism economic zones and deepening the integration of culture and tourism, providing policy guidance for integrated regional tourism development. The Gansu Province 14th Five-Year Plan Implementation Plan for Tourism Development, issued in 2022, states that the level of tourism development should be gradually raised and a modern tourism system improved, and that four major tourism economic zones should be built, namely the "Chinese Capital of the Yellow River" urban cultural tourism industry cluster, the "Longdongnan Ancestral Culture Tourism Economic Zone", the "Splendid Ethnic Culture Tourism Economic Zone" and the Greater Dunhuang Cultural Tourism Economic Zone. In 2023 Gansu Province issued related opinions to further promote the deep integration of culture and tourism, gathering strong momentum for advancing the modernization of Gansu and the building of a strong provincial culture and tourism sector.

Scholars at home and abroad have carried out in-depth research on the spatial structure of tourism economies. Since the 1960s, foreign scholars have used social network analysis, gravity models and other methods to investigate the strength of association between tourist destinations and the evolution of tourism linkage networks[1-2], with research perspectives concentrated mainly on the spatial behavior of tourism flows and the functional layout of scenic areas[3-4]. Domestic research on the spatial structure of tourism economies began in the 1980s, and as the methodological system has become increasingly diversified it now covers the gravity model[5], resilience measurement methods[6], social network analysis[7], and nearest-neighbor hierarchical clustering analysis[8], among others. Research topics have expanded from network structural morphology[9] and spatiotemporal differentiation[10] to spatial layout[11], development models[12] and driving mechanisms[8], while research scales are mostly at the medium-to-large scale, such as the whole country[13], the Guangdong-Hong Kong-Macao area[14], the Yellow River basin[15] and the Beijing-Tianjin-Hebei region[16]. There remains a lack of systematic discussion of the tourism economic network structure of northwest China, and Gansu Province in particular, which is not conducive to building a complete research framework for tourism economic network structure.

Gansu is located at the meeting point of nomadic and agrarian civilizations and of Central Plains and Western Regions cultures, and possesses rich and varied tourism resources whose abundance ranks among the highest in the country. However, the contribution of Gansu's tourism economy to the national tourism industry is relatively limited, revenue growth from tourism has been slow in some cities and prefectures, and tourist flows have not been effectively converted into economic benefits, constraining the overall improvement of the regional tourism economy. From the perspective of regional economics, the formation of a tourism economic linkage network is essentially the outcome of spatial interaction and factor diffusion working together. Growth pole theory holds that economic development does not necessarily unfold evenly across space, but instead first concentrates at a small number of poles with locational and resource advantages, and then drives the development of

surrounding areas through diffusion effects; in the extreme case, the core area comes to dominate the periphery by virtue of its advantages in capital, information and technology, but as transportation conditions improve and the division of labor deepens, the diffusion effect of the core area gradually comes to outweigh the polarization effect, and regional disparities tend to converge[17-18]. These theories provide an analytical framework for understanding the evolutionary logic by which Gansu's tourism economic network has moved from single-pole dependence toward multi-pole balance. Based on this, the present paper takes the 14 prefecture-level cities and autonomous prefectures of Gansu Province as its research object, uses a modified gravity model and social network analysis to characterize the spatiotemporal evolution of Gansu's tourism economic linkage network from 2013 to 2019, and employs a geographical detector to reveal the main driving factors of network structure evolution, in the hope of offering some reference for the coordinated development of Gansu's tourism economy.

2. Study Area and Research Methods

2.1 Overview of the Study Area and Data Sources

Gansu is located in northwest China and administers 14 prefecture-level cities and autonomous prefectures. It has a long and narrow shape, diverse landform types, and a long history, and is one of the important birthplaces of the Chinese nation. The province is rich in tourism resources, with 8 World Heritage sites, 140 scenic areas rated 4A or above, 11 national geoparks, and 131 national key cultural relics protection units (Note 1). Located at a strategic point on the ancient Silk Road, Gansu contains the most representative section of the Silk Road within China. In 2019 the province received 374 million visitor trips, accounting for 27.1% of the five northwestern provinces, and generated comprehensive tourism revenue of 268 billion yuan, accounting for 36.7% of the five northwestern provinces, making it one of the more economically active tourism regions in northwest China. This paper selects 2013, 2016 and 2019 as time cross-sections; the relevant data are drawn from the Gansu Provincial Statistical Yearbook, the Communiqué on National Economic and Social Development, and related government documents, covering indicators such as the number of tourists, tourism revenue, per capita GDP, tertiary-industry regional GDP and the number of star-rated hotels, while inter-city transportation data are drawn from the province's basic geographic information database.

2.2 Research Methods

2.2.1 Modification of the Gravity Model

A modified gravity model is used to measure the intensity of tourism economic linkages among the 14 cities and prefectures of Gansu. Following previous research, per capita GDP is chosen as the correction coefficient[19]; compared with total GDP, per capita GDP better reflects a region's level of economic development and the living standards of its residents. The modified gravity model is as follows:

$$R\text{ij} = \text{kij}\frac{\sqrt{Pi \cdot Vi}\sqrt{Pj \cdot Vj}}{Dij} \tag{1}$$

$$\text{kij} = \frac{gi}{gi + gj} = \frac{Gi/di}{\left(Gi/di + Gj/dj\right)} \tag{2}$$

$$M\text{i} = \sum_{1}^{n} Rij \tag{3}$$

Here, R_{ij} denotes the intensity of tourism economic linkage between cities/prefectures i and j; P denotes the total number of tourists in the region (10,000 persons); V denotes the total tourism revenue of the region (100 million yuan); D_{ij} is the shortest highway distance between city i and city j (kilometers); Kij is the correction coefficient; gi is the per capita GDP of region i; d_i is the resident population of region i; G_i is the total GDP of region i; and the tourism economic linkage volume M_i of region i is the sum of its tourism economic linkages with all other regions.

2.2.2 Social Network Analysis

Social network analysis studies the collection of social members and the relationships among them. This paper uses UCINET software to analyze Gansu's tourism economic linkage network in terms of network density, network centrality, and core-periphery structure. Network density is the ratio of the actual number of connections in the network to the theoretical number of connections, generally taking values in the interval [0,1]; a larger value indicates closer tourism economic linkages among the cities and prefectures of Gansu. Network centrality analysis includes degree centrality, closeness centrality and betweenness centrality, which respectively reflect a node's central position in the network, the degree to which it is not controlled by other nodes[20], and the intermediary role it plays in connecting other nodes[21]. Core-periphery analysis divides the network into a densely linked core area and a more sparsely linked periphery area according to the coreness of each node[22].

2.2.3 Geographical Detector

The geographical detector is a statistical method for detecting spatial differentiation and revealing its causes[23]. This paper uses the geographical detector to identify the main factors affecting the structure of Gansu's tourism economic linkage network, and further explores the effects produced by the interaction between factors. Its formula is as follows:

$$q_D = 1 - \frac{1}{N\sigma^2}\sum_{i=1}^{m} N_{Di}\,{\sigma_i}^2 \tag{4}$$

Here, q denotes the degree to which each influencing factor explains the structure of the tourism economic network; i=1,2,…,m denotes the classification of influencing factors; N_{Di} and N denote respectively the number of samples within stratum D_i and the total number of samples in the whole

study area; ² and denote respectively the variance of stratum *i* and the variance of the tourism economic linkage volume; and and *N* ² denote respectively the sum of within-stratum variances and the total variance of the whole area. The value of q ranges over [0,1]; the larger the value, the stronger the explanatory power of the influencing factor for the structure of the tourism economic network, and vice versa.

2.2.4 Weighted Average Travel Time

Regional transportation conditions are influenced not only by infrastructure and natural geographical factors but are also closely related to the level of regional economic development. This paper uses weighted average travel time to examine the transportation accessibility between scenic areas, so as to accurately reflect the time cost between origin and destination. The formula is as follows:

$$A_i=\frac{\sum_{j=1}^{n}(T_{ij}*\ M_j)}{\sum_{j=1}^{n}M_j} \tag{5}$$

Here, A_i is the weighted average travel time for scenic area *i*; T_{ij} is the shortest time distance from city/prefecture *j* to scenic area *i*, i.e. the value taken in formula (5); M is the weight of city/prefecture *j*, taken here as the geometric mean of tourism revenue and the number of tourists; $M_j=\sqrt{P_j*\ G_j}$, where P_j is the number of tourists and G_j is tourism revenue.

3. Empirical Analysis

3.1 Analysis of Tourism Economic Linkage Degree and Linkage Volume

According to the results calculated with the modified gravity model, in 2013 the overall linkage degree among the cities and prefectures of Gansu remained relatively low; the combinations with higher linkage degree were mainly Jiuquan and Jiayuguan, Lanzhou and Baiyin, and Lanzhou and Longnan, while linkages among the remaining cities and prefectures were relatively weak, indicating that Lanzhou occupied a leading position in tourism economic development. In 2016, linkage degree improved for most pairs of cities and prefectures, with the increase in linkage between Lanzhou and Zhangye, the Gannan Tibetan Autonomous Prefecture, and Jiuquan being particularly notable, and Lanzhou's radiating and driving effect continued to become more apparent. In 2019, linkage degree rose substantially overall, although regional differences remained. On the whole, tourism economic linkages tend to be closer between cities with higher levels of economic development and better tourism resource endowment, which is also consistent with the general pattern of tourism economic development among cities.

In terms of linkage volume, the total tourism economic linkage volume of the 14 cities and prefectures of Gansu Province in 2013, 2016 and 2019 was 112.6, 427.7 and 1,781.3 respectively (see Table 1), representing growth of 2.81 times in 2016 relative to 2013 and growth of 3.18 times in 2019 relative to 2013. Lanzhou, Jiayuguan and Jiuquan have consistently ranked among the top three in total linkage

volume, owing mainly to their advantages in economic development level, transportation and tourism resources, and constitute the regions where tourism factors flow most actively. Qingyang, Dingxi, Jinchang and Longnan, constrained by geographic location, tourism resource endowment and infrastructure conditions, have long had low linkage volumes, with the bottom three together accounting for less than 2% of the total. This indicates that although tourism economic linkages among the cities and prefectures are generally becoming more optimized, regional disparities still exist, and peripheral cities and prefectures still require more policy attention.

Table 1. Tourism Economic Linkages in Gansu Province

City/Prefecture	2013		2016		2019	
	Volume	Rank	Volume	Rank	Volume	Rank
Lanzhou	26.22	2	116.78	3	367.56	3
Jiayuguan	47.83	1	146.02	1	752.84	1
Jinchang	0.69	12	2.08	13	10.57	12
Baiyin	5.43	4	3.19	9	65.98	4
Tianshui	2.42	5	8.14	4	32.78	5
Wuwei	1.03	11	3.17	10	17.15	10
Zhangye	1.05	10	6.14	5	31.29	6
Pingliang	1.79	6	5.82	6	23.81	8
Jiuquan	23.81	3	125.48	2	392.65	2
Qingyang	0.67	13	2.79	11	9.73	14
Dingxi	1.08	9	1.91	14	16.61	11
Longnan	0.63	14	2.37	12	9.94	13
Linxia Hui Autonomous Prefecture	1.37	7	3.54	8	28.03	7
Gannan Tibetan Autonomous Prefecture	1.24	8	4.71	7	23.11	9

3.2 Structural Characteristics of the Tourism Economic Linkage Network

Based on the historical tourism data of the 14 cities and prefectures of Gansu, this paper constructs three 14×14 tourism economic linkage matrices, selects a reasonable threshold in UCINET to convert the linkage-degree matrices into binary relational data, and then analyzes network density, network centrality and core-periphery structure.

3.2.1 Network Density

The theoretical number of network linkages among the 14 cities and prefectures of Gansu is 182. Analysis of the data shows that in 2013 network density was 0.4231, with 77 effective relationships; in 2016 network density was 0.5055, with 99 effective relationships; and in 2019 network density rose to 0.6154, with 112 effective relationships. Between 2013 and 2019 the tourism economic linkage network gradually became denser, regional tourism economic cooperation continued to deepen, and the overall pace of network evolution remained steady.

3.2.2 Network Centrality

Regarding degree centrality, in 2013 the provincial mean was 6.429 and the standard deviation was 2.871; Lanzhou and six other cities were in the high-value zone, while Jiayuguan, Jinchang and other cities and prefectures were in the low-value zone, showing marked spatial disparity. In 2016 the mean rose to 7.17 and the standard deviation to 3.304, and the emergence of sub-high-value centers such as Gannan Tibetan Autonomous Prefecture and Zhangye eased the pattern of single-pole dominance. By 2019 the mean had risen further to 8.857 while the standard deviation fell to 2.875; ten cities had degree centrality above the mean, Lanzhou's spillover effect drove the development of neighboring cities such as Tianshui and Baiyin, the centrality of formerly low-value cities and prefectures rose to varying degrees, and relative disparities among regions narrowed.

Regarding closeness centrality, in 2013 only Lanzhou had the highest closeness centrality, while all other cities and prefectures were generally low, showing a marked two-tier split. In 2016, closeness centrality rose in Tianshui, Linxia and other places, whose tourism economic linkages with other cities became increasingly close. By 2019, closeness centrality in most cities and prefectures exceeded the average, with Zhangye emerging as a new high-value zone, indicating that as economic development and transportation conditions improved, the ability of each city to connect externally generally strengthened and the regional tourism economy moved toward balance.

The higher the betweenness centrality, the more dominant a region's role in linkages and interaction with other regions. In 2013, Lanzhou's value of 67.667 was markedly higher than the mean of 8.071, while Qingyang, Longnan and other areas had values of 0, reflecting a wide gap between high and low values and Lanzhou's prominent intermediary role in the network. In 2016, Lanzhou's betweenness centrality declined somewhat while low-value areas such as Gannan Tibetan Autonomous Prefecture rose, easing the trend toward polarization. By 2019 Lanzhou's betweenness centrality had fallen further to 28.950, with notable increases in Jiuquan, Longnan and other areas, indicating that the provincial capital's control over information and resources has gradually weakened and the network structure has become more optimized, although betweenness centrality in Qingyang, Jinchang, Longnan and other cities and prefectures remains at a relatively low level.

Overall, in the earlier period Gansu's tourism economic linkage network was highly dependent on the single core node of the provincial capital Lanzhou; in the later period, as secondary growth poles such as Tianshui and Zhangye formed, regional disparities gradually narrowed, linkages and interactions among network nodes strengthened markedly, the degree of polarization declined, and the overall

network structure moved toward more balanced development.

3.2.3 Core-periphery Analysis

According to the core-periphery analysis (see Table 2), in 2013 only Lanzhou was in the core area; the internal network density of the core area was 1, while the internal network density of the 13 peripheral cities and prefectures was only 0.333, indicating that the core area's radiating and driving capacity toward the periphery was limited (see Table 3). As the number of core cities increased, the internal network density of the periphery rose to 0.5 by 2019, and the density gap with the core area narrowed markedly. This change owes mainly to the continuous increase in interaction between the core and the periphery and within the periphery itself. Lanzhou and Tianshui, by virtue of their outstanding tourism economic appeal, have continued to exert a radiating and driving role within the core area; transportation, tourism resources and policy support have together driven the strengthening of Lanzhou's tourism economic strength, while the emergence of growth poles such as Baiyin and Zhangye has also, to some extent, dispersed Lanzhou's control over the network as a whole. Interaction between peripheral and core cities and prefectures has become increasingly active, and the structure of the province's tourism economic linkage network has grown increasingly complex. Following the explanatory logic of core-periphery theory, core areas in the early stage of development tend to rely on polarization effects to concentrate factors; as infrastructure improves and market integration deepens, capital, visitor flows and information return to the periphery through diffusion effects, and the sustained rise in peripheral network density in Gansu's tourism economic network is a concrete manifestation of this diffusion process within the regional tourism economy.

Table 2. Gansu Province Tourism Economic Linkage Core Area, Edge Area

Year	Core area	Peripheral area
2013	Lanzhou, Jiayuguan, Baiyin, Tianshui, Wuwei, Zhangye, Jiuquan, Linxia Hui Autonomous Prefecture	Jinchang, Pingliang, Qingyang, Dingxi, Longnan, Gannan Tibetan Autonomous Prefecture
2016	Lanzhou, Jiayuguan, Baiyin, Tianshui, Zhangye, Pingliang, Jiuquan, Linxia Hui Autonomous Prefecture, Gannan Tibetan Autonomous Prefecture	Jinchang, Wuwei, Qingyang, Dingxi, Longnan
2019	Lanzhou, Jiayuguan, Baiyin, Tianshui, Wuwei, Zhangye, Pingliang, Jiuquan, Linxia Hui Autonomous Prefecture, Gannan Tibetan Autonomous Prefecture	Jinchang, Qingyang, Dingxi, Longnan

Table 3. Density Matrix of Core and Fringe Areas of Tourism Economic Linkages in Gansu Province

Network density	2013		2016		2019	
	0.4231		0.5055		0.6154	
	Core	Periphery	Core	Periphery	Core	Periphery
Core	1.000	0.310	1.000	0.697	1.000	0.917
Periphery	0.239	0.333	0.284	0.318	0.417	0.500

4. Analysis of Influencing Factors of the Tourism Economic Linkage Network

4.1 Indicator Selection

The formation of Gansu's tourism economic spatial network is the result of the combined action of multiple factors. Drawing on a review of the existing literature[24-25] and taking account of the actual conditions in Gansu, this paper selects indicators from five dimensions, namely level of economic development, industrial structure, transportation factors, human capital and tourism resource endowment (see Table 4). Level of economic development is represented by fiscal revenue X1; sufficient funding facilitates the construction of tourism infrastructure and the improvement of the tourism environment. Industrial structure is represented by the ratio of total tourism revenue to GDP, X2, and the rationalization of industrial structure is represented by the ratio of tertiary- to secondary-industry output value, X3, reflecting the scale of the tourism industry and the degree of rationalization of the industrial structure. Transportation factors are represented by weighted average travel time, X4, measuring the level of regional transportation accessibility. Human capital is represented by the number of persons employed in the tourism industry, X5, reflecting the capacity to supply tourism services. Tourism resource endowment is represented by the number of star-rated hotels, X6, and the number of tourist attractions, X7, reflecting regional tourism reception conditions and resource abundance.

Table 4. Influencing Factors of the Spatial Network Structure of Tourism Economy in Gansu Province

Target layer	Criterion layer	Indicator layer
Level of economic development	Economic base	X1 Fiscal revenue
Industrial structure	Tourism industrial structure	X2 Total tourism revenue / GDP
Industrial structure	Rationalization of industrial structure	X3 Ratio of tertiary- to secondary-industry output value
Transportation factors	Transportation capacity	X4 Weighted average travel time
Human capital	Personnel engaged in the	X5 Number of tourism industry

	tourism service industry	employees
Tourism resource endowment	Tourism development base	X6 Number of star-rated hotels; X7 Number of tourist attractions

4.2 Analysis of Results for Influencing Factors

The results of the geographical detector (see Table 5) show the extent to which each detection factor can explain the tourism economic spatial network structure through its q value; the larger the q value, the greater the factor's influence on the structure of the tourism economic spatial network. The detection p values for all factors were below 0.05, and transportation factors and tourism resource endowment had the strongest explanatory power for the structure of Gansu's tourism economic network.

For the level of economic development, the q value of fiscal revenue showed an upward trend from 2013 to 2019, rising from 0.212 in 2013 to 0.312 in 2019, with a mean of 0.267, indicating that stronger regional fiscal capacity helps improve tourism infrastructure and enhance industrial competitiveness. For industrial structure, the q values of tourism industrial structure and industrial rationalization both showed an increasing trend, with the mean q value of tourism industrial structure at 0.284 and that of industrial rationalization maintaining a relatively strong influence as well, indicating that the rationalization of industrial structure plays a substantial role in the spatial network structure of Gansu's tourism economy. The development of tourism needs to be built on a foundation of rationalized industrial structure; the integrated development of industries plays a vital and positive role in complementing tourism resources, building tourism infrastructure and raising the level of tourism economic development. Gansu should therefore advance industrial transformation and upgrading, actively cultivate and develop distinctive competitive industries, extend industrial chains, and achieve differentiated, distinctive development across regions. For transportation factors, the mean q value of weighted average travel time was 0.399, the highest among all the factors, indicating that improved transportation conditions have markedly shortened the spatiotemporal distance between regions and constitute the core driving force behind the evolution of the network structure. Tourism development is an important means of helping cities achieve economic growth and enhance residents' sense of well-being[26]. The mean q value for the number of tourism industry employees was 0.099; although relatively low, it maintained steady growth overall, reflecting the foundational role of human capital in improving the quality of tourism services. The mean q values for the number of star-rated hotels and the number of tourist attractions were 0.361 and 0.383 respectively, indicating that the continued enhancement of tourism resource endowment plays an important role in strengthening regional tourism appeal and deepening tourism economic linkages between cities.

Table 5. Detection Results of Tourism Spatial Network Structure Driving Factors in Gansu Province (q value)

Driving factor	2013	2016	2019	Mean
X_1	0.212	0.276	0.312	0.267
X_2	0.235	0.291	0.326	0.284
X_3	0.217	0.203	0.219	0.213
X_4	0.312	0.406	0.478	0.399
X_5	0.077	0.119	0.101	0.099
X_6	0.304	0.372	0.408	0.361
X_7	0.275	0.397	0.476	0.383

4.3 Analysis of Combined Factor Effects

Pairwise interaction detection of the seven factors (see Table 6) shows that the effect of factor interactions on network structure exceeds that of any single factor in every case, indicating that the formation of Gansu's tourism economic network structure is the result of multiple factors acting together. In 2013 the network structure was mainly influenced by tourism resource endowment; in 2016 this shifted to the joint effect of tourism resource endowment and industrial structure; and in 2019 the interaction between industrial structure and transportation factors became dominant. From 2016 to 2019, tourism industrial structure remained one of the leading factors driving the evolution of network structure. As residents' travel patterns continue to diversify and emerging forms of tourism such as self-driving trips and short getaways gain popularity, the influence of transportation conditions and the quality of tourism resources on network structure will continue to strengthen, and the optimization of industrial structure, the improvement of the transportation network and the upgrading of tourism resources will become key paths for the continued development of Gansu's tourism economic network.

Table 6. Impact Factors for the Top Four Rankings of Interaction Detection

Rank	2013	2016	2019
1	$X_6 \cap X_7$	$X_2 \cap X_6$	$X_2 \cap X_4$
2	$X_7 \cap x_3$	$X_2 \cap X_7$	$X_2 \cap X_6$
3	$X_4 \cap X_1$	$X_1 \cap X_7$	$X_2 \cap X_7$
4	$X_2 \cap X_6$	$X_6 \cap X_1$	$X_1 \cap X_3$

5. Conclusions and Recommendations

5.1 Conclusions

This paper uses a modified gravity model to measure the intensity of tourism economic linkages among the 14 cities and prefectures of Gansu Province, applies social network analysis to reveal the structural characteristics and evolutionary pattern of the tourism economic linkage network, and uses a geographical detector to identify the main driving factors of network structure evolution. The following

conclusions are drawn.

First, from 2013 to 2019 tourism economic linkages among the cities and prefectures of Gansu continued to strengthen, total linkage volume rose substantially, multiple growth poles gradually formed within the network, and the controlling role of the core city weakened somewhat, so that the network structure tended to become more optimized, although regional disparities remained. Lanzhou, Jiayuguan and Jiuquan have long led in tourism economic linkage intensity; Tianshui and the Linxia Hui Autonomous Prefecture also have relatively high linkage volumes owing to their tourism resource advantages; while Dingxi, Jinchang, Qingyang and Longnan, constrained by multiple conditions, remain in a relatively weak position within the linkage network. The spatial distribution of linkage volume is broadly consistent with the level of regional economic development.

Second, from the perspective of overall network characteristics, the density and connectivity of the tourism economic network continuously rose from 2013 to 2019, the network structure became increasingly complex, and the degree of regional tourism cooperation continued to deepen. From the perspective of core-periphery structure, Lanzhou and Tianshui exert a notable radiating and driving effect on surrounding cities; increased tourism economic interaction both within the core area and between the periphery and the core has promoted the rise in overall network density, though interaction within the periphery still warrants attention.

Third, from the perspective of individual node characteristics, the network centrality of Lanzhou, Baiyin, Tianshui and other cities and prefectures has remained relatively high over the long term, giving them a clear radiating and controlling effect on other cities. As closeness centrality has risen overall and the polarization of betweenness centrality has diminished, the pattern centered on Lanzhou as the sole core has gradually shifted toward a multi-center pattern, with the regional tourism economy moving toward balanced development.

Fourth, from the perspective of driving factors, transportation conditions and tourism resource endowment are the dominant factors influencing the evolution of Gansu's tourism economic network structure, while the influence of industrial structure rationalization is comparatively limited. The dominant driving factor of network structure has shifted from tourism resource endowment toward a combination of industrial structure and transportation factors, reflecting an ongoing adjustment in the driving structure of Gansu's tourism economic development. From 2016 to 2019, tourism industrial structure was the main factor influencing the spatial network structure of tourism economies across the various node cities and prefectures of Gansu.

5.2 Recommendations

Gansu's tourism economic linkage network continues to become richer, and tourism economic l inkages among cities and prefectures are growing increasingly close; however, problems of pola rization and weak internal linkages within the periphery remain. The following recommendation s are therefore proposed.

First, growth poles should be cultivated by zone, and the coordinating role of core cities should be

strengthened. Following the basic logic of growth pole theory, regional development should prioritize the cultivation of a number of growth poles with driving capacity, which can then gradually benefit surrounding areas through diffusion effects, avoiding the excessive spatial dispersion of resources. The core driving roles of Lanzhou, Jiuquan and Tianshui within their respective tourism economic zones should be leveraged, secondary growth poles such as Zhangye and the Gannan Tibetan Autonomous Prefecture should be linked with the core cities, and a multi-layered, multi-centered pattern of regional tourism cooperation should gradually be built to promote balanced and coordinated development of the province's tourism economy.

Second, relevant institutional policies should be introduced and factor allocation optimized to further advance the development of Gansu's tourism economy. Using the concept of all-region, panoramic tourism development, the various node cities and prefectures of Gansu should be planned as a whole, creating a Gansu-Qinghai tourism space that combines points, lines, areas and regions, supported by a modern network and integrating culture, natural ecology and other comprehensive tourism formats. The existing spatial pattern, which has focused on individual cities or individual scenic spots, should be broken through in favor of coordinated planning of tourism resource allocation across the whole province, forming a new networked spatial pattern in which tourism factors are interconnected and mutually reinforcing. The sound development of regional tourism in Gansu requires targeted legal and policy safeguards; the government should, in light of actual conditions in tourism development, formulate tourism cooperation regulations suited to the province, support investment promotion, and encourage capital to enter the market. Investment should be used scientifically, with the annual tourism investment budget planned systematically and the proportion and structure of investment allocated reasonably, so as to maximize the driving role that capital investment can play.

Third, transportation network construction should be accelerated to raise the level of regional accessibility. In light of the characteristics of each tourism economic zone, distinctive tourism routes should be developed along railways, expressways and other transportation corridors, seamless connections between the transportation network and key scenic spots should be promoted, the time cost of visitor travel should be reduced, and the efficiency of tourism factor flows between regions should be enhanced. In addition, governments in Gansu's various cities and prefectures should use the transportation network to connect scenic spots, reduce the time visitors spend in transit, improve convenience between origin markets and destinations, strengthen tourism exchange between regions, and promote the development of Gansu's tourism economy.

Finally, distinctive regional tourism brands should be established and marketing models innovated. Gansu is rich in tourism resources and has a profound cultural heritage. In building distinctive tourism brands, marketing can be organized by type, category and zone based on tourism resources. For example, the Greater Dunhuang Cultural Tourism Economic Zone can draw on resources such as the Zhangye Rainbow Danxia landform, the Jiayuguan Great Wall, the Dunhuang Mogao Grottoes, Jinchang industrial tourism and Wuwei's historical culture to promote the "Silk Road" cultural brand;

the “Chinese Capital of the Yellow River” urban cultural tourism industry cluster can integrate Yellow River culture and landscape resources to promote a Yellow River tourism brand, allowing Lanzhou to continue exerting its radiating and driving role as the provincial capital toward surrounding cities, so that the value of regional tourism resources is fully realized and balanced, coordinated development of the regional tourism economy is promoted. The “Longdongnan Ancestral Culture Tourism Economic Zone” can rely on ancestral culture, folk culture and red tourism resources to fully develop distinctive cultural brands such as Tianshui’s “Little Jiangnan,” Longnan’s ecological tourism, Pingliang’s wellness tourism, and Qingyang’s farming and folk-culture tourism. The “Splendid Ethnic Culture Tourism Economic Zone” can draw on the distinctive religious cultures of the Linxia and Gannan areas to build an ethnic-culture tourism brand. In the era of big data, the building of distinctive tourism brands can make use of mobile internet and related technologies, intensify the promotion of tourism information on internet platforms, and attract domestic and international visitors; through the promotion of regional tourism brands and the innovation of marketing methods, the integrated development of culture and tourism in Gansu Province can be promoted, driving the optimization and upgrading of the tourism economic structure.

References

[1] HWANG Y H, GRETZEL U, FESENMAIER D R. Multicity trip patterns: Tourists to the United States [J]. *Annals of Tourism Research*, 2006, 33(4): 1057-1078.

[2] PAVLOVICH K. The evolution and transformation of a tourism destination network: The Waitomo caves, New Zealand [J]. *Tourism Management*, 2003, 24(2): 203-216.

[3] UAN C G, JAVER G E, CARMEN M. Identification of tourist hot spots based on social networks: A comparative analysis of European metropolises using photo sharing services and GIS [J]. *Applied Geography*, 2015, 63(12): 408-417.

[4] PENG H, ZHANG J, LIU Z, et al. Network analysis of tourist flows: A cross-provincial boundary perspective [J]. *Tourism Geographies*, 2016, 18(5): 561-586.

[5] GUO Y P, CHEN H J. Characteristics and optimization model of the tourism economic s patial network structure of Shanxi Province based on the gravity model [J]. *Journal of Human Settlements in West China*, 2022, 37(2): 56-64. (in Chinese)

[6] WANG X Y, MA Q, ZHAO S Y. Resilience evolution and driving factors of the tourism economic network structure of major Chinese cities [J]. *Economic Geography*, 2026, 46(2): 21 5-224. (in Chinese)

[7] WANG Z, LI T, YANG S. Spatial relationship between inbound tourism distribution adva ntage and tourism economic efficiency among China’s provinces [J]. *Geographical Research*, 20 20, 39(4): 892-906. (in Chinese)

[8] HUANG H P, QIAO X Z, ZHANG J, et al. Spatiotemporal differentiation and influencin g factors of regional tourism carbon emissions under the background of green development: A

case study of the Yangtze River Economic Belt [J]. *Economic Geography*, 2019, 39(11): 214-224. (in Chinese)

[9] MA L J, ZHANG J F. Evolution of spatial disparities and interactive relationships between tourism and economic development in the middle Yangtze River urban agglomeration [J]. *Ecological Economy*, 2020, 36(5): 116-121+134. (in Chinese)

[10] XUE M Y, WANG C X, ZHAO J L, et al. Spatial differentiation pattern and influencing factors of the tourism economy in the Yellow River basin [J]. *Economic Geography*, 2020, 40(4): 19-27. (in Chinese)

[11] WANG H Q, YUAN J D, MENG X J. Spatial distribution characteristics and influencing factors of A-level tourist attractions in Northeast China [J]. *Scientia Geographica Sinica*, 2017, 37(6): 895-903. (in Chinese)

[12] YANG Y B, WANG R C, LI Q Y, et al. Evolution of tourism resource endowment and spatial restructuring of the tourism industry in Northeast China [J]. *Economic Geography*, 2015, 35(10): 194-201+209. (in Chinese)

[13] WANG J, XIA J C. Spatial network structure of provincial tourism economies in China and its influencing factors: An examination based on the QAP method [J]. *Tourism Tribune*, 2018, 33(9): 13-25. (in Chinese)

[14] XIAN J Y, QIN Q, XIE Y X, et al. Evolution of the tourism economic structure of the Guangdong-Hong Kong-Macao Greater Bay Area based on radiation effects [J]. *Resource Development & Market*, 2024, 40(2): 283-291. (in Chinese)

[15] GENG X Q, LEI C F, XU H. Characteristics of the tourism economic network structure of the Shanxi-Shaanxi-Henan Yellow River section based on social network analysis [J]. *Journal of Northwest Normal University (Natural Science)*, 2021, 57(5): 18-25. (in Chinese)

[16] YANG L H, LIU N, BAI C L. Study on the spatial structure of the tourism economy of Beijing, Tianjin, Hebei and Xiong'an [J]. *Scientia Geographica Sinica*, 2018, 38(3): 394-401. (in Chinese)

[17] MENG Z Y, ZHOU C B. The effect of the integration of culture and tourism industries on tourism economic growth: A test based on data from 58 tourism cities [J]. *Productivity Research*, 2021(10): 74-78+86. (in Chinese)

[18] LIU A L, YANG C Y, MING Q Z, et al. Spatial spillover effects of county-level tourism economic growth on economic development and their boundary detection [J]. *Tropical Geography*, 2025, 45(7): 1201-1213. (in Chinese)

[19] ZHENG B M, LIU A L, HAN J L, et al. Evolution of the tourism economic linkage network structure and construction of a coordinated development model in Yunnan Province [J]. *Economic Geography*, 2021, 41(2): 222-231. (in Chinese)

[20] WANG K, WANG M H, GAN C, et al. Evolution of the tourism economic spatial netwo rk structure of contiguous poverty-stricken areas: A case study of the Wuling Mountain area [J]. *Areal Research and Development*, 2021, 40(2): 86-91. (in Chinese)

[21] YIN J J, CAO X J, YANG W H, XIONG Y, LI X M, ZHANG X. Spatial structural cha racteristics and driving factors of tourism economic linkages in the Dabie Mountain area [J]. *J ournal of Central China Normal University (Natural Sciences)*, 2022, 56(1): 201-210. (in Chine se)

[22] ZHU A Q, CAO F D, ZHOU C L. Spatiotemporal evolution characteristics and driving f actors of the tourism economic linkage network of the Yangtze River Delta urban agglomeratio n [J]. *Journal of Nanjing Normal University (Engineering and Technology Edition)*, 2020, 20(4): 83-92. (in Chinese)

[23] WANG J F, XU C D. Geographical detector: Principles and prospects [J]. *Acta Geograph ica Sinica*, 2017, 72(1): 116-134. (in Chinese)

[24] WANG L, ZHANG Y H. Analysis of the spatiotemporal evolution of disparities in Gansu' s tourism economy [J]. *Gansu Finance*, 2021(7): 35-40. (in Chinese)

[25] SHI W J, WAN H L, MAO N, et al. Study on the contribution of tourism economies of cities along the Silk Road driven by the Belt and Road strategy: A case study of Zhangye Ci ty, Gansu [J]. *Journal of Gansu Sciences*, 2020, 32(3): 139-145. (in Chinese)

[26] BA D X, HE L X. The humanistic economics logic of culture-tourism integration driving urban development for the people [J]. *Reform & Strategy*, 2026, 42(1): 10-19. (in Chinese)