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Coordination Relationship and Spatial Differentiation between Industrial Structure and Water Use Structure in Gansu Province

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Abstract: Taking Gansu Province as the research area, the coordination level and relationship between industrial structure and water use structure in Gansu Province were analyzed by the coordination degree and structure coefficient. On this basis, it is further divided into five regions, and the spatial differences of intra-regional and inter-regional coordination levels are explored by Gini coefficient. The results indicate that :(1) After the adjustment of industrial structure and water consumption structure, the proportion of secondary industry is reduced, and the water consumption is reduced. (2) The development of coordination degree is good, and the overall trend is low consumption, low efficiency and medium coordination water consumption mode. (3) The regional differences in industrial structure and water use structure in Gansu Province are prominent, especially in Hexi region and Gannan region, with a decreasing trend.

Keywords: Industrial Structure; Water Structure; Coordination Degree; Spatial Differentiation.

1. Introduction

With the transformation of the main contradiction in our society, people's demand for water resources has increased further. Many cities in our country have different degrees of water shortage problems, so there are more stringent and urgent requirements to manage water resources from the fine [1,2] .With the growth of economic and social scale and the expansion of production scale, water demand also increases. In recent years, while vigorously developing economic construction, relevant departments have continued to promote the construction of water management, which not only emphasizes economic growth, but also requires the further optimization of water resources while ensuring the economic development of different regions [3,4] .

Gansu Province has a rich and profound industrial history, and is an important old industrial base in the western layout of the country during the "First Five-Year Plan" period. During the "three-line" construction period, key enterprises moved from all over the country, making Gansu take the lead in forming a relatively solid industrial foundation in Northwest China. However, in recent years, the contradiction of industrial structure is prominent, and the problems such as excessive energy consumption of pillar industries occur frequently, leading to the economic development of Gansu [5,6]. The optimization and upgrading of industrial structure is a key way to improve the economy. Promoting the adjustment and transformation of traditional industries can foster new business models, optimize regional structure, improve energy efficiency, promote scientific and technological innovation and progress, and ultimately enhance the quality of the economy. Therefore, adjusting the industrial structure is the only way to promote the economic revitalization and modernization of Gansu [7-9] . In the action mechanism of industrial structure and water use structure, industry provides the foundation for water use, and water use provides the element support for industrial development. The two are embedded and integrated and influence each other. In the process of the rapid transformation and development of traditional industries, the restriction of water resources cannot be avoided, and the change of industrial structure will also affect the water use structure . In this context, it is more necessary to follow the local actual situation and development conditions to study the two [10,11] .

In 2011, Zhai Yuanzheng and others[12] studied the evolution of water consumption and water structure in Beijing with the adjustment of industrial structure as one of the driving factors, and believed that the adjustment of agricultural and industrial structure was the main reason for the change of water consumption in the primary and secondary industries. Wu Li [13]and others analyzed the gray correlation between industrial structure and water use structure, hoping to provide a basis for the optimization of industrial structure and water resources, and further confirmed the correlation between industry and water use. Liu Shan [14] and others established a coordinated evaluation model of water use structure and industrial structure on the premise of rational utilization of water resources, and proposed a coordination level evaluation method on the basis of establishing the correlation between the two. In addition, Liu Yang[15]and others studied the development of industrial structure and water use structure in the Beijing-Tianjin-Hebei region by using the index of skew and extensive degree. Liu Yifang[16] and others discussed the degree of imbalance between industrial structure and water use structure by using the coefficient of structural deviation. In order to better implement the results of coordination level research and play a regional guiding role, this study uses Gini coefficient method on the basis of previous studies to analyze their spatial differences. In this paper, Gansu Province is selected as the research object. Under the background of adjusting industrial layout in Gansu Province and developing characteristic industries based on geographical advantages, the change process of industrial structure and water use structure in Gansu Province in recent years is observed, the coordination relationship between the two is analyzed, and the spatial differentiation of the coordination between industry and water use in Gansu Province is investigated. In order to accelerate

the development of modern industrial system and adjust economic structure, Provide guidance for achieving high-quality development in the region.

2. Materials

2.1. Study Areas

Gansu Province is located in the northwest, the entire $42.58\times10^4 km^2$, narrow and complex terrain, located in the eastern monsoon region, Qinghai-Tibet Plateau region, northwest arid region of the three natural areas, Loess Plateau, Qinghai-Tibet Plateau, Inner Mongolia Plateau three plateau intersection area. The climate is changeable and the unique natural conditions greatly enrich the regional natural resources. The three major inland rivers, Shiyang River, Shule River and Heihe River, are distributed here, providing water for the production and life of Gansu Province. Under the jurisdiction of 12 prefecture-level cities and two autonomous prefectures, Gansu has developed pillar industries such as petrochemicals, metallurgy and equipment manufacturing by utilizing energy and mineral resources. Due to various factors, Gansu Province mainly develops agricultural economy, and relies on agricultural resources to build a number of characteristic industries, focusing on water-saving agriculture, dry farming agriculture and Gobi ecological agriculture. At the same time, in order to save water efficiently, in recent years, Gansu Province has strengthened the construction of high-standard farmland, vigorously promoted the high-efficiency water-saving technology of dry farming, and reduced agricultural water consumption and adjusted the water structure.

Based on the water consumption data and economic development data of Gansu Province, this paper discusses the coordination relationship between industrial structure and water consumption structure in Gansu Province, in order to provide suggestions for industrial development and water consumption structure adjustment of Gansu Province.

2.2. Data Sources

This study takes 2010-2020 as the research period, and uses the economic development data of 14 cities and states under the jurisdiction of Gansu Province from the *Gansu Development Yearbook 2011-2021* and the statistical yearbook of each city and state. The water consumption data of various industries were collected from the *Water Resources Bulletin of Gansu Province 2010-2020*. Based on the data results, the coordination relationship between industrial structure and water consumption structure in Gansu Province was further analyzed.

3. Methods

3.1. location Entropy

In the study of regional industrial structure, it is used to analyze the degree of specialization, status and role of a certain industrial sector [17], the calculation method is as follows:

$$LQ_{ij} = \frac{q_{ij}/q_j}{q_j/q} \quad (1)$$

In the formula, it refers to the location entropy of i industry in j region in the whole country; Is the output value of the i industry in region j; Is the gross regional product of region j; Refers to the output value of the i industry throughout the country; Gross domestic product. The greater the location entropy, the higher the level of industrial agglomeration and the better the degree of specialization in this region.

3.2. Coordination Degree and Structural Coefficient

The degree of coordination between industrial structure and industrial structure is quantitatively described by introducing the degree of skew of industrial structure (P), the degree of extensive water use structure (C), and the degree of coordination between water use structure and industrial structure (H). The skew degree of industrial structure (P) refers to the degree that the industrial structure in the city is biased towards the industry with more water consumption per unit output; the extensive degree of water structure (C) refers to the degree that the water consumption structure is biased towards the industry with high water consumption; and H describes the coordination degree of urban industrial structure and water consumption structure by combining two indicators [18].The specific formula is as follows:

$$P = \frac{N*E-\sum_{i=1}^{N} E_i*i}{(N-1)*E} \quad (2)$$

$$C = \frac{N*W-\sum_{i=1}^{N} W_i*i}{(N-1)*W} \quad (3)$$

$$H = 1 - \sqrt{PC} \quad (4)$$

Considering the availability of data, the industry is merged into three industries. i represents the ranking of industries from high to low water consumption per unit output in Gansu Province, and N represents the number of industries. In this paper, N=3; E is the gross regional product, Ei is the gross industrial product of the city i; W is the total water consumption of the region, and Wi is the water consumption of industry i in the region. The closer P and C are to 1, it indicates that the industrial structure or water use structure tends to the industries with large water consumption and low water use efficiency. The closer P and C are to 0, it indicates that the industrial structure and water use structure tend to be the industries with small water consumption and high water use efficiency, and the larger H indicates that the industrial structure and water use structure are more coordinated. The closer P and C are to 1, it indicates that the industrial structure or water use structure tends to the industries with large water consumption and low water use efficiency. The closer P and C are to 0, it indicates that the industrial structure and water use structure tend to be the industries with small water consumption and high water use efficiency, and the larger H indicates that the industrial structure and water use structure are more coordinated.

The structural deviation coefficient is introduced to analyze the balanced development degree of industrial structure and water consumption structure by using the relationship between the output value ratio of each industry and the water consumption ratio [19]. The calculation formula is as follows:

$$\varepsilon_{ij} = \log(\frac{w_i-p_j}{p_i-w_j})\ i \neq j \quad (5)$$

In the formula, $\varepsilon_{ij}$is the structural deviation coefficient, w_i, $w_j$is the proportion of the water consumption of industry i or industry j in the total water consumption, p_i and p_j is the proportion of the output value of industry i or industry j in the total output value. When ε_{ij} 's value is positive, it indicates that there is a large space for adjustment of water use structure. When it is negative, it indicates that there is a large space for adjustment of industrial structure. When it is close to 0, it indicates that the industrial structure and water consumption

structure are in a relatively balanced development state.

3.3. Gini Coefficient

The Dagum Gini coefficient was used to analyze the regional differentiation characteristics considering the cross between samples. The Dagum Gini coefficient divides the spatial and temporal differences of regions into three parts: intra-regional differences, inter-regional differences and inter-group hypervariable density, which solves the source of spatial differences and puts forward corresponding economic explanations [20].

$$G = G_w + G_{nb} + G_t \quad (6)$$

$$G = \sum_{j=1}^{k} G_{jj} P_j S_j + \sum_{j=1}^{k} \sum_{h\neq j}^{1} p_j s_h D_{jh} + \sum_{j=1}^{k} \sum_{h\neq j}^{1} G_{jh} p_j s_h (1 - D_{jh}) \quad (7)$$

In the formula: j, h stands for some region. G_w is the difference within the region, G_{jj} is the Gini coefficient of region j, $P_j=n_j/n$, and n is the sample size and the number of cities in region j. Represents the proportion of h region coordination level in the sample;$G_{nb}$is the net contribution of inter-regional fit difference, G_{jh} is the Gini coefficient between region j and sub-region h,$s_h=n_h\overline{y}_h/n\overline{y}$ represents the proportion of region h's coordination degree in the sample. D_{jh} is the relative influence of the fitness between j and h regions; G_t denotes super-variable density. If the presence of the cross term of fitness in the subregion will affect the spatial difference within the region, then Gt>0; if the cross term does not exist or its effect is minimal, then Gt=0.

$$D_{jh} = \frac{d_{jh} - p_{jh}}{d_{jh} + p_{jh}} \quad (8)$$

$$d_{jh} = \int_0^{\infty} dF_i(y) \int_0^{y} (y - x) dF_h(x) \quad (9)$$

$$p_{jh} = \int_0^{\infty} dF_h(y) \int_0^{y} (y - x) dF_j(x) \quad (10)$$

Among them, F_i and F_h are the cumulative distribution functions of the coordination degree of region j and region h, respectively. D_{jh} and p_{jh} represent the mathematical expectations in regions j and h that satisfy the sum of samples with $y_{ji} - y_{hr}>0$ and $y_{hr} - y_{ji}>0$, respectively.

4. Result Analysis

4.1. Analysis of Industrial Structure and Water Use Structure Characteristics in Gansu Province

The figure 1 shows the location entropy of three major industries in Gansu Province from 2010 to 2020. As shown in the figure, the primary industry in Gansu province, whose location entropy is always greater than 1, has a higher proportion than the national level, and has a growing trend in fluctuations, which has a greater impact on the development of the province's economy, and belongs to the regional advantage industry. But the secondary industry showed a downward trend, dropping to less than 1 after 2014. At the same time, the regional entropy of the tertiary industry increased and gradually reached the national average level. The geography of Gansu Province is complex, and agriculture has formed Hexi commodity grain base area, Longnan characteristic agricultural production area, Longzhong and Longdong traditional Chinese medicine planting area, with obvious regional characteristics. However, at the same time, due to terrain factors and the education level of agricultural employees, the structural efficiency of the primary industry is low, while the proportion of the secondary industry is out of proportion, the innovation and development of technical level is insufficient, and the development of emerging industries is relatively lagging, thus delaying the adjustment of the overall industrial structure. To sum up, the advantages of the primary industry in Gansu Province still exist and have increased, the second advantage has decreased, and the tertiary industry has gradually increased and approached the national average level.

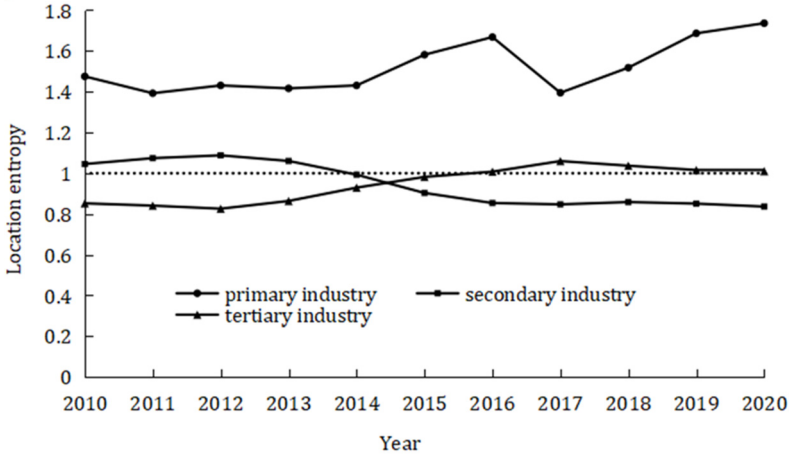

Figure 1. Location Entropy of Three Major Industries in Gansu Province from 2010 to 2020

According to the output value of the three major industries in Gansu Province from 2010 to 2020, the change trend chart is drawn, as shown in Figure 2. It can be seen from Figure 1 that the total output value of Gansu Province showed a significant growth trend during the study period. The primary industry as a whole showed a steady growth trend, the change is not large, the proportion is relatively small, between 10.4%-13.8%. The proportion of the output value of the secondary industry showed a decreasing trend, and after 2016, it ushered in a flat, stable at about 33%. From 2012 to 2016, the proportion of output value of the secondary industry and the tertiary industry changed greatly. In 2014, the two sides completed the exchange of the first proportion of output value, and since then the proportion of output value of the tertiary industry has gradually increased, which proves that at this time node, Gansu Province has completed the initial industrial transformation and structural change. The change trend of the output value of the tertiary industry is basically the same as that of the total output value, showing a significant increase trend, and its proportion also shows a significant increase trend. The proportion of the three industries is 13.8:48.6:37.6 in 2010 to 13.3:31.6:55.1 in 2020, which confirms the

continuous adjustment of the industrial structure. From the above results, it can be seen that the structure of the three major industries in Gansu Province has been significantly adjusted and transformed. The proportion of the primary industry has decreased slightly while that of the secondary industry has decreased significantly. On the contrary, the tertiary industry has gradually increased and gradually replaced the secondary industry. The whole industrial structure of Gansu Province has been adjusted to some extent.

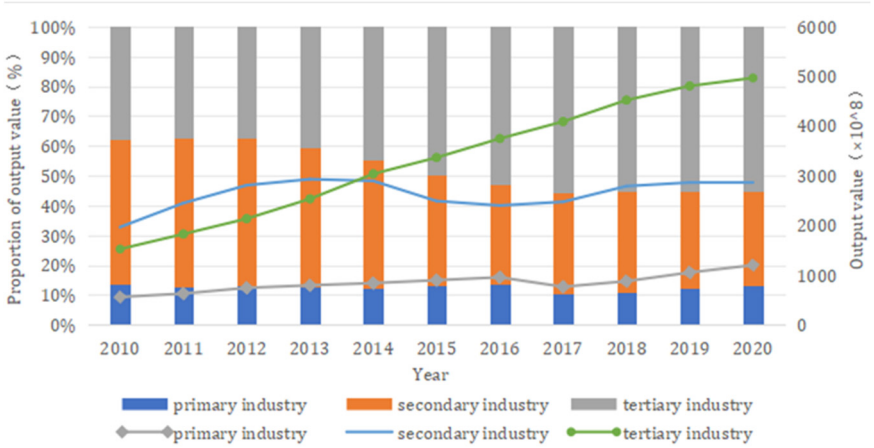

Figure 2. Industrial Structure of Gansu Province from 2010 to 2020

As shown in the figure 3, the total water consumption of Gansu Province showed a fluctuating downward trend during this period, and the water consumption continued to decline after 2012. Among them, the primary industry accounted for the largest proportion of water consumption, accounting for about 79%, and the second and third industries accounted for a similar proportion, about 10%. During the study period, the proportion of water used in the secondary industry increased first and then decreased, which was consistent with the change of the overall water consumption, while the proportion of water used in the tertiary industry increased slightly in recent years. In general, the main reason for the change of total water use in the province is the reduction of water consumption in the primary industry. In Gansu Province, the proportion of water used by the primary industry is too heavy, which is higher than the overall level of the country, while the proportion of water used by the secondary industry is relatively low, which is related to the overall industrial structure of Gansu Province, the proportion of the primary industry is relatively large, and the development of the secondary and tertiary industries is relatively insufficient. To sum up, the water consumption structure of Gansu Province shows that the primary industry is the largest, the secondary and tertiary industries are less, and the water consumption shows an obvious decreasing trend.

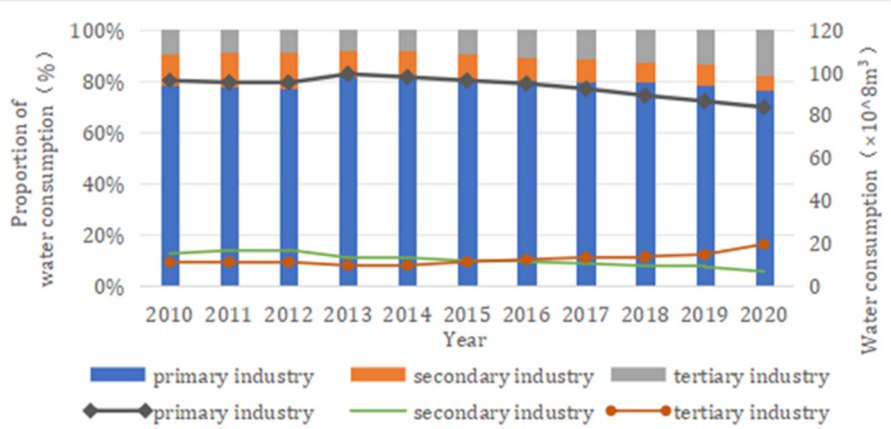

Figure 3. Water use for various industries in Gansu Province from 2010 to 2020

4.2. Coordination between Industrial Structure and Water Consumption Structure

The coordination degree of the three industries is shown in the figure 4. The skewness (P) of industrial structure in Gansu Province showed a state of decline and recovery, mainly around 0.3, and the industrial structure tended to the direction of lower water consumption. From 2010 to 2020, the extensive degree (C) is relatively high and stable, between [0.8 and 0.9]. In Gansu Province, the agricultural irrigation volume is high, the proportion of primary industry water is high, and the water use structure of Gansu Province is more inclined to the industry with low water use efficiency. The curves of coordination degree (H) and water deviation degree show a "symmetrical" distribution in the figure, mainly around 0.45. The level of coordination degree between industrial structure and water consumption structure is in the middle, rising after 2013, and the development direction steadily tends to coordination.

The balance of industrial structure and water consumption structure among the three major industries in Gansu Province from 2010 to 2020 is shown in the figure. The structural deviation coefficient of the primary industry and the secondary industry gradually decreased from the original greater than 1 in the fluctuation, and the influence on the deviation value changed from the industrial output value to

the dominant water use. The transformation of the dominant factors indicates that the water use efficiency has been improved after the adjustment, and the development has a good coordination trend.

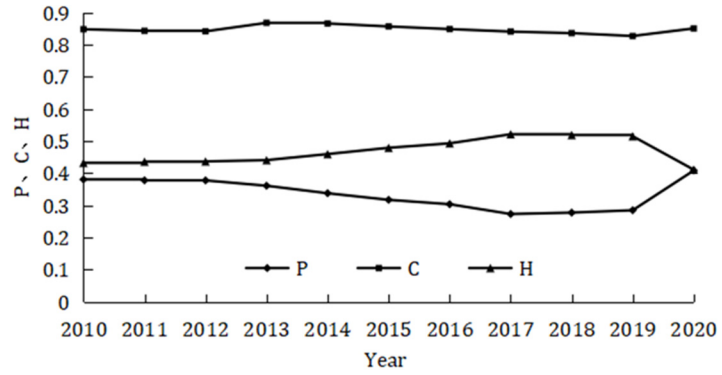

Figure 4. Coordinated Degree of Industrial Structure and Water Use Structure in Gansu Province from 2010 to 2020

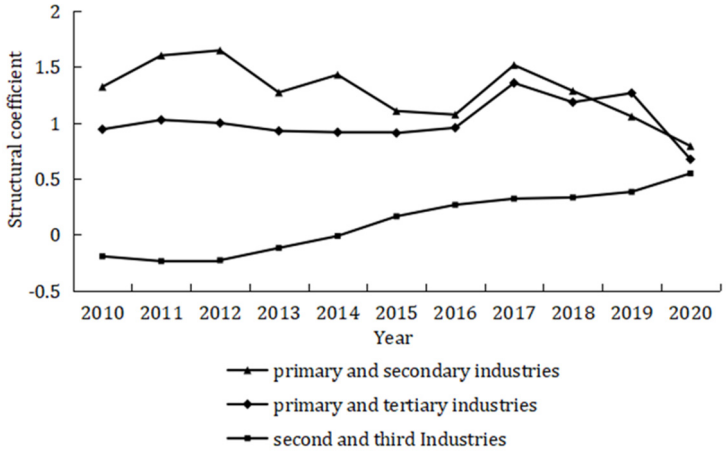

Figure 5. Deviation coefficients of the three major industrial structures in Gansu Province from 2010 to 2020

The structural coefficient of the first and third industries as a whole approaches to 1, and the influence of output value and water consumption on the deviation is the same in this process, and there is still some room for adjustment. The structural coefficient of the secondary and tertiary industries changed from negative to positive and gradually increased. The industrial structure was gradually coordinated, but the water consumption structure was unbalanced and the degree of coordination showed a decreasing trend. From the whole point of view, the water use structure of the primary industry and other industries still has a large room for adjustment. The degree of coordination between the primary industry and the secondary industry, the primary industry and the tertiary industry is not as good as the secondary and tertiary industries, but there is a trend of coordinated development. The reason is that the proportion of primary industry in Gansu Province is high, the water consumption is large, and the industrial development is unbalanced.

4.3. Spatial Differences of Coordination Degree Between Industrial Structure and Water Use Structure

Table 1. Gini coefficient in Gansu region from 2010 to 2020

Year	G	intra-regional differences					Contribution (%)		
		Hexi	Long-zhong	Long-dong	Longnan	Gan-nan	Within group	Inter group	Supervari-able density
2010	0.15	0.06	0.19	0.08	0.04	0.02	21.71	42.36	35.93
2011	0.15	0.07	0.19	0.11	0.04	0.02	21.60	45.83	32.57
2012	0.15	0.09	0.19	0.11	0.03	0.03	22.69	37.70	39.61
2013	0.10	0.08	0.07	0.04	0.01	0.07	14.82	69.05	16.13
2014	0.10	0.08	0.07	0.01	0.07	0.01	14.40	67.81	17.79
2015	0.10	0.08	0.03	0.06	0.09	0.10	18.90	42.25	38.85
2016	0.11	0.08	0.01	0.07	0.12	0.11	20.83	36.16	43.01
2017	0.12	0.08	0.08	0.07	0.13	0.10	18.95	42.66	38.39
2018	0.13	0.09	0.08	0.07	0.13	0.14	20.68	32.93	46.39
2019	0.14	0.14	0.06	0.16	0.11	0.03	22.88	15.92	61.20
2020	0.13	0.01	0.08	0.17	0.03	0.00	20.26	42.28	37.46

In order to describe the spatial and temporal differences within the region, Gansu Province is divided into five regions: Hexi (Wuwei, Zhangye, Jinchang, Jiuquan, Jiayuguan), Longzhong (Lanzhou, Baiyin, Dingxi), Longdong (Pingliang, Qingyang), Longnan (Tianshui, Longnan) and Gannan (Linxia, Gannan) according to the distribution locations of prefecture-level cities. Through the decomposition of the overall Gini coefficient, the intra-regional and inter-regional differences and their contribution to the overall Gini coefficient are obtained respectively.

4.3.1. Differences in Coordination Degree among Regions

As shown in the table 1, the Gini coefficient (G) of Gansu Province as a whole during the study period was between [0.1 and 0.15], decreasing first and then increasing. From 2010 to 2012, the first stage, with 2013 as the turning point, the spatial difference of coordination degree decreased to 0.1. After the stable second stage from 2013 to 2015, it entered the growth period from 2016 to 2019, and there was a slight decline in 2020, with obvious imbalance on the whole. From the perspective of intra-regional spatial differentiation, the intra-regional Gini coefficient of the five regions is low, and the average value is smaller than the overall Gini coefficient, indicating that the differences in coordination degree are mainly due to inter-regional differences. Among them, the average Gini coefficient in Longzhong region is 0.09, with the largest degree of differentiation.

The main reason is that Lanzhou, as the high-quality development core of Gansu Province's industrial layout, has strong innovation ability, high-end equipment manufacturing industry and fine chemical industry initially formed a high-level industrial structure, more inclined to low water consumption, high efficiency, Baiyin, Dingxi region compared with the development direction is the same but the pace is different, overall Longzhong region imbalance problem is slightly prominent. The average Gini coefficient of Gannan region is 0.05, the degree of differentiation is the smallest, indicating that its industrial structure is similar. The region vigorously develop animal husbandry, while driving agricultural product processing industry, which should also pay attention to industrial reform and upgrading, with the help of structural optimization reasonable water saving. Hexi region as a whole formed industrial agglomeration belt, the development trend is good. The differences in the east and south of Gansu Province are not prominent. From the point of view of the change trend, the change range of Hexi region is small, and Longzhong and Longdong regions first decline and then rise, which echoes the change trend of the whole province. The regions of Longnan and Gannan showed an overall trend of first rising and then falling. The above results show that there are obvious spatial differences between industrial structure and water use structure in Gansu Province. The degree of differentiation in eastern Gansu showed an expanding trend, while the degree of differentiation in the other four regions gradually showed a decreasing trend.

4.3.2. Differences in Coordination Degree among Different Regions

The Gini coefficient was used to observe the inter-regional differences of the coordination degree between industrial structure and water use structure in Gansu Province, and the calculated results of 6 years were selected as shown in the figure.

From the overall trend, the shadow area showed a trend of decreasing and increasing, and the differentiation trend of coordination degree decreased in general, corresponding to the Gini coefficient of the province. This shows that the province through industrial transfer, undertake projects, activate regional development momentum to optimize the industrial layout according to local conditions, so that the overall industrial structure and water structure tend to be consistent. From the perspective of difference, the Gini coefficient varies greatly between the western region and the southern region, and the difference between Hexi and Gannan region is the most significant. The difference between southern regions is small, and the difference between Longnan and Gannan is the smallest. The average difference between Hexi and Gannan is 0.16, while the average difference between Longnan and Gannan is only 0.09. Among the five regions, Hexi region vigorously develops high-end equipment manufacturing industry and new energy, Longdong region as a chemical energy area to develop industrial cluster, Longzhong and Longdong region rely on their own advantages, and Longnan and Gannan region, although the industrial structure conversion capacity has increased, but there is still a lot of room for adjustment. The difference distribution of several groups of Gini coefficients is exactly corresponding to the real situation, and also confirms from the side that for the regions with large environmental constraints, the original industrial structure of the city with high energy consumption as the pillar industry, after the transformation of the industrial structure, it has much driving force for its own coordinated development. During the study period, the difference between Hexi and Gannan, which has the most significant difference, has a trend of fluctuation and decline, and the difference between Longnan and Gannan has a process of rise and fall. In the past few years, the rate of change between regions has gradually become consistent, and there will be differences at the beginning of the new five-year plan, which is because the planning of characteristic industries between regions is carried out according to local advantages, and thus affects the coordination level of industry and water use.

4.3.3. Overall Difference and Decomposition of Coordination Degree

The overall difference of the five regions from 2010 to 2020 is decomposed, including intra-group contribution, inter-group contribution and super-variable density, and the change trend of their contribution rate is studied.

As can be seen from the figure, the net contribution rate of inter-regional differentiation is the largest, with an average contribution rate of 43.2%, while the contribution rate of intra-regional differentiation to the overall population is the smallest, with an average of 19.8%. According to the above analysis results, the spatial differences between industrial structure and water use structure in Gansu Province are mainly caused by regional differences. The contribution rate of intra-group difference to the overall differentiation showed a steady trend, while the contribution rate of inter-regional difference and super-variable density showed a completely opposite change process. The two nodes with obvious fluctuations were 2013 and 2019. The inter-regional difference reached a peak at this time node in 2013, accounting for 69%, and then reached a trough in 2019, accounting for 15.9%, while the contribution rate of supervariable density changed completely in the opposite direction. All the above results show that interregional differentiation is the main source of population differentiation.

Therefore, while making full use of its regional advantages, actively attracting the construction of low-energy and low-consumption high-tech industries and weakening regional differences is an important direction to effectively adjust the industrial layout and optimize the water structure.

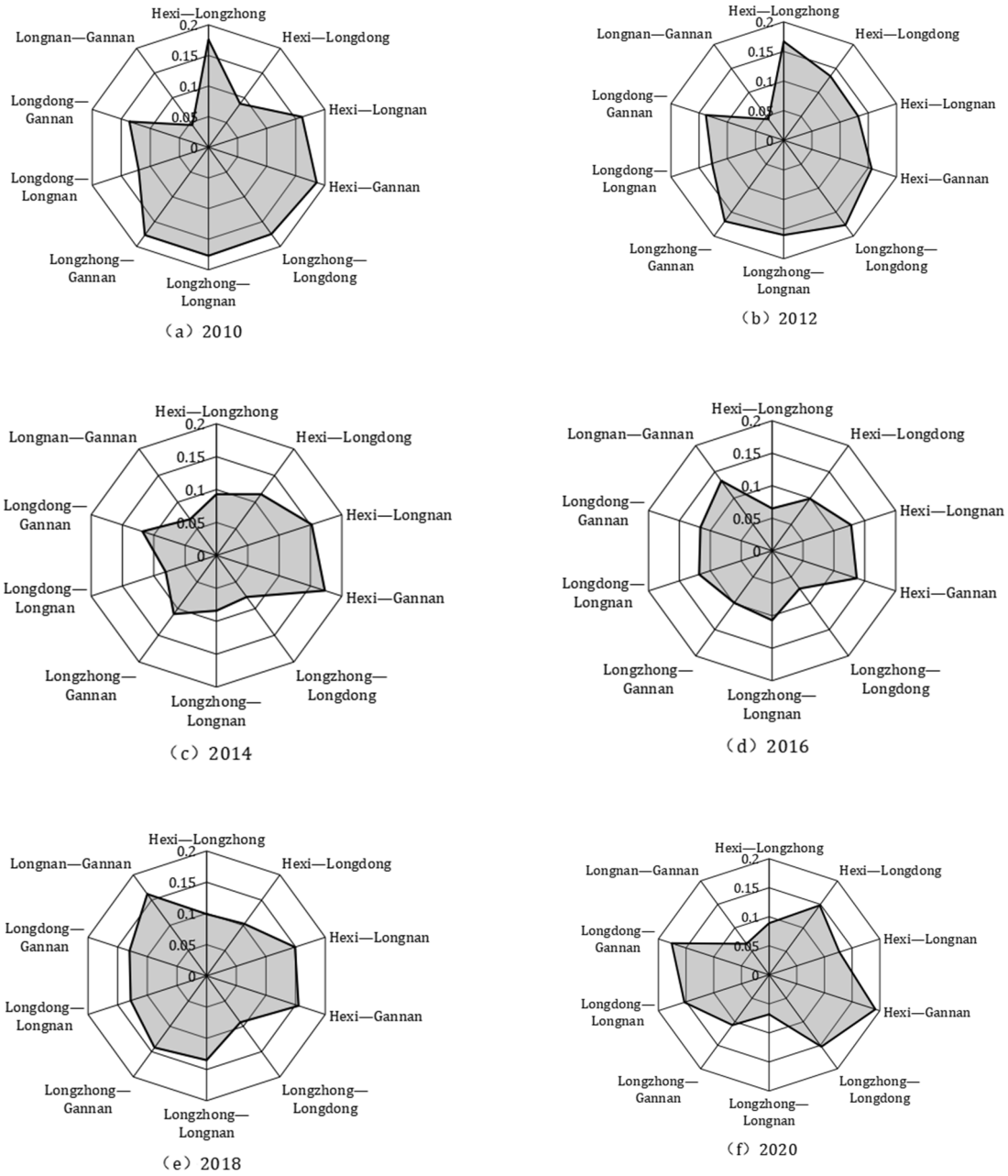

Figure 6. Inter-regional differences in Gansu

5. Conclusion

Based on the data of industry and water use in Gansu Province from 2010 to 2020, this paper calculates the coordination relationship between industry and water use in Gansu Province, adopts the Gini coefficient method to investigate the spatial differentiation degree of the coordination degree between industry and water use in Gansu Province, and explores the coordination approach between industry and water use in Gansu Province on this basis. The main conclusions are as follows:

a. During the study period, there were obvious changes in industrial structure in Gansu Province. The first major is still dominant, the status of the output value of the second and third industries has changed, the proportion of the second industry has decreased, the output value has decreased, and the proportion of the third industry has increased. With the adjustment of industrial structure, the overall water consumption has decreased significantly, of which the water consumption of the primary and secondary industries has decreased significantly, and the water consumption of the tertiary industry has gradually increased.

b. The extensive degree of the three industries in Gansu Province is at a low level, the partial water degree is at a high level, and the coordination degree has a good trend of development, and the overall trend is low consumption, low efficiency and medium coordination water use mode; There is a certain adjustment space for the water use structure among the three major industries, among which the coordination degree of the structure of the second and third

industries decreases, while the first and second industries and the first and third industries all have a trend of coordination to varying degrees.

c. The spatial difference of the overall industrial structure and water use structure coordination degree in Gansu Province has a decreasing trend, and the inter-regional difference is the main factor of the spatial difference, corresponding to the overall trend change. Among the five regions, the most significant difference exists between Hexi and Gannan, and the smallest difference is between Longnan and Gannan, indicating that weakening regional differences is an important direction to promote the coordination of regional industrial structure water use structure.

References

[1] J.D.Tao: Reflection on Accelerating the Development of Gansu Industrial Clusters, Gansu Finance, 11(2021) p.8-10.

[2] G. Z. Chang, W. X. Zhang and L. Wang: Influential factors on location selection and development of industrial enterprises in gansu inland river basin, Chinese Desert, Vol. 35 (2015) No.5, p.1376-1381.

[3] Y. J. Fu, Q. Jin, Z. B. Zhang, X. D. Zhang and W. H. Bai: Relationship between industrial structure and water use structure in old industrial base of northeast china--taking benxi city of liaoning province as an example, Ecology Letters, Vol. 41 (2021) No.22, p.9029-9038.

[4] J. Hua, Y. Y. Zhang, D. Wang and L. Deng: Impact of water consumption on economic growth in five northwest provinces, Water Conservancy Economy, Vol. 36 (2018) No.4, p.1-6, 75.

[5] S. X. Jiao, Q. Y. Li, A. Z. Wang, Y. Q. Liu, Y. X. Yin, R. Zhao, Q and J. W. Zhang: Dynamic evolution analysis of water use structure and industrial structure in anyang city based on ecological niche, Water Conservation, Vol. 37 (2021) No.1, p.79-85, 109.

[6] L. Li, J. G. Wang and P. A. Wang: The factor effect of industrial structure change and the transformation and upgrading of gansu industry, Geography of Arid Zones, Vol. 39 (2016) No.3, p.671-677.

[7] Y. Y. Li, H. R. Wang, M. Y. Yang, X. Y. Pan and J. X. Xu: Analysis of the relationship between water use and industrial development in china based on the multiple testing ekc, Water Conservation, Vol. 39 (2023) No.2, p.190-198.

[8] H. J. Liu, M. Y. Fan, Q. H. Guan, C. H. Liu, Z. Wu and H. B. Zhao: Evaluation and application of the harmonization of the "four waters and four decisions" in the county area, Arid Zone Resources and Environment, Vol. 37 (2023) No.4, p.194-200.

[9] Y. Liu and L. J. Li: Relationship between changes in industrial structure and water use structure in the beijing-tianjin-hebei region, South-to-North Water Diversion and Water Resources Science and Technology, Vol. 17 (2019) No.2, p.1-9.

[10] Y. F. Liu, Y. B. Liu and S. S. Huang: Study on the correlation between industrial structure and water consumption structure, Systems Engineering Theory and Practice, Vol. 34 (2014) No.4, p.861-869.

[11] C. Lu, P and Y. T. Huo: Spatial evolution and spillover mechanism of industrial ecologization in gansu section of the yellow river basin, Geosciences, Vol. 43 (2023) No.6, p.1122-1130.

[12] Z. C. Pan, L. Y. Ma, P. P. Tian and Y. C. Zhu: A study on the spatio-temporal evolution and regional differences of rural-urban integration and development in the three northeastern provinces and their convergence, Journal of Natural Resources, Vol. 38 (2023) No.12, p.3093-3115.

[13] C. Z. Sun, Y. Q. Wei and L. S. Zhao: Synergistic evolution of water-energy-food nexus systems in arid zones: A case study of northwest china, Journal of Natural Resources, Vol. 37 (2022) No.2, p.320-333.

[14] C. Z. Sun and J. W. Zheng: Structural path analysis of water consumption in china based on input-output tables, Progress in Geosciences, Vol. 40 (2021) No.3, p.370-381.

[15] L. Wang and Q. Gao: Study on the impact of economic performance on the spatial structure of city clusters in the middle reaches of the yangtze river, Humanities and Geography, Vol. 33 (2018) No.6, p.96-102.

[16] Z. Wang, S, J. Zheng and F. Y. Wang: Industrial structure, financial scale and high-quality economic development: Empirical evidence based on 11 provinces and cities in the yangtze river economic belt, Statistics and Decision-making, Vol. 35 (2019) No.19, p.121-124.

[17] L. Wu and J. F. Tian: Optimization model and evaluation of regional industrial structure and water use coordination, South-to-North Water Diversion and Water Resources Science and Technology, Vol. 9 (2011) No.4, p.51-54, 72.

[18] B. B. Yu: The economic growth effects of industrial restructuring and productivity improvement: An analysis based on a dynamic spatial panel model of chinese cities, China's Industrial Economy, Vol. (2015) No.12, p.83-98.

[19] Y. Z. Zhai, J. S. Wang, J. Q. Zheng and H. Xun: Evolution of beijing's water use structure over the past 30 years and driving forces, Journal of Natural Resources, Vol. 26 (2011) No.4, p.635-643.

[20] X. W. Zhao, H. B. Zhang, T. F. Li, Z. X. Ye, C. W. Xue, Y. R. Zhang and Z. F. Yang: Identification of water scarcity types and development trajectories in chinese cities - a case study of 32 major cities, Journal of Natural Resources, Vol. 38 (2023) No.10, p.2619-2636.

[21] Z. H. Zhou: Analysis of the general dynamics of industrial structure evolution, Financial Sciences, Vol. (1990) No.3, p.1-6.