

# Research on the Coupling of Human Resource Structure and Industrial Structure: A Survey from Nine Provinces of the Yellow River Basin in China

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## Abstract

To realize the benign coupling between human resource structure and industrial structure, and promote high-quality economic development, the article analyzes the coupling relationship between human resource and industrial structure, conducts a comparative study on the coupling between human resource and industrial structure in nine provinces in the Yellow River Basin by using 2020 statistics. The results showed: the coupling degree of primary industry in each area is far less than 1, indicating a surplus of human resources. The coupling degree of the secondary industry is greater than 1, showing a shortage of human resources varies in the upper and lower reaches of the river. While the lake of human resources in the tertiary industry goes in the middle and upper reaches of the river, except for Ningxia Province, where there is a surplus of human resources. In this regard, the government needs strengthen the top-level design, promote the integration of human resources, and realize the positive coupling between the human resources structure and industrial structure in the Yellow River Basin.

**Keywords:** coupling degree, high quality development, human resources structure, industrial structure

## 1. Introduction

As a Yellow River Basin spanning China's eastern, central and western regions, it has various regional characteristics such as coastal, inland and border areas. It has nearly one-third of the total population, one-quarter of GDP and one-quarter of consumption. The practice has proved that in the development of modern regional economy and society, human resource and industrial structure promote, and restrict each other, which is an important force in promoting economic development. Therefore, realizing the benign interaction between human resources and industrial structure in the Yellow River Basin is significant for alleviating social structural contradictions and promoting high-quality economic development.

There are differences in the relationship between human and industrial structure at different stages of economic and social development (Xu Zhe, 2022), and issues concerning the relationship between the two remain a hot topic of discussion in industrial and population economics. Most of the current theories are based on independent studies of human resources and industrial structure; for example, population economic theory attaches importance to the development of human resources and considers them as the leading force for economic growth (Ma Mi, Zhou Yayun & Sun Huiyu, 2020), while industrial structure theory focuses on the opposite, emphasizing the impact of labor force quantity and structure on changes in industrial structure (Zhan Zhaolei, 2018). Some scholars pay more attention to the interaction between human resources and industrial structure, i.e., studying the "equal interaction" rather than the "master-slave decision" relationship. For example, Jin Weidong (2010), Zhang Manyin and Li Yangfan. (2018) pointed out that the construction of modern industry must realize the good interaction between human resources and industrial structure and attach importance to the upgrading of human resources. Zhao Jianji, Wang Yanhua, Zhang Jie, Feng Hailong and Miao Changhong(2019) found that the better the coupling between the human resource and industrial structure in the region, the higher the quality of economic development.

The Yellow River Basin is an important economic belt and ecological barrier in China. Since the environmental protection and high-quality development of the Yellow River Basin has been elevated to a major national strategy,

there has been an increasing amount of academic research on the economy of the Yellow River Basin, mainly focusing on the unbalanced green development and high-quality development of various sectors, such as studying the ways to promote high-quality development in agriculture, manufacturing and tourism economy, as well as the implementation of environmental protection strategies (Zhao Min, Xia Tongshui & Ma Zongguo, 2022; Hua Luojuan, 2018; Hua Ping, Wang Mingyue, Hua Lei, Zhang Sinian & Huang Wenwen, 2022; Zhao Zhongxiu, Yan Yunfeng & Liu Jiwen, 2022; Qu Xiaoshang; 2022), lacking an emphasis on the connection between human resource and industrial structure in the Yellow River basin. To realize the benign coupling between human resource and industrial structure, and promote high-quality economic development, the article analyzes the coupling relationship between human resource and industrial structure, conducts a comparative study on the coupling between human resource and industrial structure in nine provinces in the Yellow River Basin by using 2020 statistics.

## 2. Material Studies

### 2.1 Theoretical Analysis

Human resource structure refers to the design of human resources in terms of quantity, quality, industry and area within a certain period and region, where workers can transform various knowledge, skills and other factors into productivity through investment. The industrial structure, also called the industrial system, refers to the proportional relationships and linkages between sectors and the various elements of the industry. The optimization of industrial design is mainly reflected in two aspects: one is the optimization of vertical industrial design, i.e., the gradual transition from the primary industry to the secondary and tertiary sectors; the other is the optimization of horizontal industrial system, i.e., the rationalization of industrial system, which mainly optimizes the rational allocation between production and the proportion of sectors to achieve the goal of improving economic efficiency (Hu Yu, 2013). As the most active factor among the factors of productivity, human resources play a decisive role in whether the industrial design can be successfully optimized and adjusted, and the industrial structure adjustment cannot be separated from the quantity, quality and technological development level of human resources (Wang, 2018). Human resources must also be allocated according to the industrial structure to play maximum efficiency.

Petty-Clark 's law holds that upgrading industrial structure is closely related to the structural flow of human resources. The overall trend is to migrate along the primary, secondary and tertiary sectors. Optimizing and upgrading industrial structures can significantly improve high-quality economic development ( Huang Dunping & Ye Lei. 2022 ). Coupling refers to the phenomenon that two or more systems affect each other through interaction and can work together on another system. The coupling of human resource and industrial design refers to the sum of the interaction between human resources and industrial structure through different media. The interaction and mechanism of the two can be described from the perspective of supply and demand coupling, as shown in Figure 1.

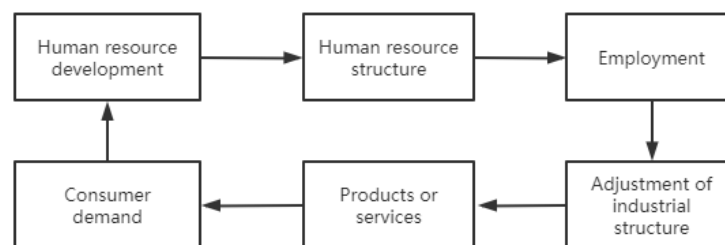


Figure 1. Coupling relationship between human resource and industrial structure

From the perspective of the market supply and demand mechanism, human resources and industry are not only the supplier and demand of the labor force but also the demander and supplier of products and services. Only when the two promote each other can they produce economic efficiency of one plus one greater than two ( Huang Jizhong & Ji Gang, 2018 ). Generally speaking, the coupling relationship between human resource and industrial structure is mainly carried out from two paths: first, the development of human resources produces the change in human resource structure, increases the quantity and quality of the labor force, and the adjustment of industrial structure creates a specific number and different levels of jobs, resulting in a specific amount and quality of labor demand. Suppose the speed of human resource development lags behind the labor demand generated by the adjustment of industrial structure. In that case, it will restrict the adjustment of the industrial structure and produce labor spillover. Secondly, the adjustment of human resource structure makes the expansion

of labor scale and the improvement of quality products the demand of more extensive scale and higher consumption level. In contrast, the adjustment of industrial structure provides products and services. The balance of the two aspects also promotes the adjustment of human resource and industrial design. Similarly, if the adjusted industrial structure cannot meet the needs of human resources, the adjustment of the human resources structure will also be restricted.

Through the analysis of human resources, industrial structure and human resources structure-industrial structure coupling matching, it can be seen that the high-quality development of the economy is inseparable from people and industry, and the coupling matching of human resources structure-industrial structure is still the focus of economic research in the past, present and future. Human resources can support and promote the transformation of industrial structures. Similarly, the industrial structure also plays a role in promoting the development of human resources. If the two are coordinated and optimized under the interaction, the coupling effect of the two will be maximized.

### 3. Area Descriptions

Due to the different resource endowments and economic development levels among provinces in the Yellow River Basin, the industrial development status is quite different, the attraction of local human resources is different, and the labor force is easily transferred between regions. This paper selects the statistical data of the provinces in the Yellow River Basin in 2020 to analyze the current situation of the coupling of human resource and industrial structure in the basin.

### 4. Methods and/or Techniques

#### 4.1 Analysis of Industrial Structure

The Yellow River Basin has an arid and semi-arid area and a Qinghai-Tibet Plateau area, accounting for about 43 %. At the same time, it has a characteristic grassland animal husbandry and has a large energy advantage. The endowment and development conditions of the factors have laid the industrial type of the Yellow River Basin, with resource exploitation and processing as the primary support. Livestock products, agricultural and animal husbandry products, energy and raw material sectors have considerable competitive advantages. The primary processing industry accounts for a large proportion, the mining industry has outstanding characteristics, and the primary industry is the economic subject. Correspondingly, the service industry and advanced manufacturing industry are in their infancy. Except for Shandong, the industrial structure of the other eight provinces in the basin is relatively lagging. Various areas and regions have accelerated the transformation of economic development direction, continuously optimized the industrial structure, and the overall industrial structure level has been significantly improved.

In 2020, the Yellow River Basin realized the transformation of industrial structure from 'two three one' to 'three two one', and the development speed of the tertiary industry is apparent. However, from the perspective of the industrial development pattern of the Yellow River Basin, restricted by the resource factors in the Yellow River Basin, the industrial structure level is low, as shown in Table 1. Except for Shandong and Shanxi, the balance of primary industry in other provinces is more outstanding than the national average. The overall proportion of the secondary industry in the Yellow River Basin is relatively high, and the secondary industry is dominated by traditional sectors, lacking integration with the tertiary industry. From the perspective of industry segmentation, most of the sectors with high market share are concentrated in primary energy processing and heavy chemical industry, such as agricultural and sideline food processing, chemical raw materials and products manufacturing, and various metal smelting, and higher than the overall market share of the Yellow River manufacturing industry. The advanced manufacturing industry has fewer advantages; only medicine, general equipment, special equipment and other claim are slightly higher. The development of the tertiary and middle, and high-end sectors in the Yellow River Basin lags behind, which is significantly lower than that in the developed coastal areas. According to the proportion of tertiary industry output value to describe the degree of an industrial structure optimization, the development of tertiary industry in Shaanxi and Shanxi in the middle reaches of the Yellow River is lagging, lower than the national average, and the degree of an industrial structure optimization is poor. In 2020, the market share of the tertiary industry in the Yellow River Basin was 25.8 %, slightly higher than the national share of GDP in the nine provinces, but the overall trend is downward. In the tertiary industry market segment, the market share of the public service industry is high, and the remaining sub-sectors are lower than the national level. In the traditional tertiary industry, the market share of the wholesale and retail sector and the accommodation and catering industry is less than a quarter in 2020 and the first five years. In the modern service industry, the share of information technology and software has declined significantly, from 20 % to 17 % between 2015 and 2020, while rental and business services have been below 18 % (Huang & Ji, 2022).

Therefore, the industrial structure gap between the provinces in the Yellow River Basin is noticeable, and it is necessary to promote the transformation of the industrial structures according to local conditions.

Table 1. GDP and the proportion of the three sectors in the nine provinces of the Yellow River in 2020

	Proportion of primary industry(%)	Proportion of secondary industry(%)	Proportion of tertiary industry(%)	GDP(100 million yuan)
Qinghai	11.1	38.1	50.8	3005.9
Sichuan	11.4	36.2	56.4	48598.8
Gansu	13.3	31.6	55.1	9016.7
Ningxia	8.6	41.0	50.4	3920.6
Neimenggu	11.7	39.6	48.8	17360.0
Shaanxi	8.7	43.4	47.9	26181.9
Shanxi	5.4	43.4	51.2	17650.0
Henan	9.7	41.6	48.7	54997.1
Shandong	7.3	39.1	53.6	73129.0
Total	7.7	37.8	54.5	1015986.0

Data source: provincial statistical yearbooks and statistical bulletins.

#### 4.2 Analysis of Human Resource Structure

The number of employees in the three sectors in the Yellow River Basin has reached 29.5 % of the total number of people in the country. Rich human resources provide a good foundation for economic development. From the data of employees in various sectors in each province in the Yellow River Basin in 2020, it can be seen that the labor force population in the Yellow River Basin is concentrated in Shandong Province and Henan Province in the lower reaches of the Yellow River and Sichuan Province in the upper reaches. According to the industry, the proportion of employees in the primary sector in Gansu and Inner Mongolia accounts for more than one-third of the total number of employees. Especially in Gansu Province, the proportion of employees in the primary industry accounts for 44.9 % of the total number of employees in the tertiary sector, much higher than in other provinces. Compared with the country's overall level, only the proportion of employees in the primary industry in Shanxi Province is lower than the national average. The remaining provinces are higher than the overall level of the country; in the secondary sector, only the proportion of employees in the secondary industry in Henan and Shandong provinces in the lower reaches of the Yellow River exceeds the national average, and the least is Inner Mongolia. Only 17 % of the employees are engaged in the secondary industry. In the tertiary industry, Qinghai, Ningxia, Shanxi and Shaanxi provinces are higher than the national average. Gansu Province has the lowest proportion of tertiary industry employees, accounting for 37.3 % of the total number of employees, as shown in Table 2.

Table 2. Human resources structure of the nine provinces of the Yellow River in 2020

	Total number of employees (ten thousand)	Proportion of employees in primary industry (%)	Proportion of employees in the secondary industry (%)	Proportion of tertiary industry employees (%)
Qinghai	279	31.9	20.4	47.7
Sichuan	4745	32.5	23.1	44.4
Gansu	1331	44.9	17.8	37.3
Ningxia	344	24.2	23.8	52.0
Neimenggu	1242	35.7	17.0	47.3
Shaanxi	2105	30.0	20.0	50.0
Shanxi	1738	23.1	23.8	53.1
Henan	4884	25.0	29.5	45.4
Shandong	5510	24.9	33.4	41.7
Total	75064	23.6	28.7	47.7

Note. Data source from provincial statistical yearbooks and statistical bulletins

Combined with the industrial structure of various regions, Qinghai Province, Inner Mongolia in the upper reaches of the Yellow River, Henan Province and Shandong Province in the lower reaches of the Yellow River, the proportion of employees in the primary sector is much higher than that of the primary industry. There is a severe problem that the general labor supply is greater than the demand. The proportion of employees in the secondary industry is far lower than that of the secondary industry, indicating that there is a shortage of technical talents in the secondary industry, and the demand for labor is greater than the supply; the proportion of employees in the tertiary industry is slightly smaller than that of the tertiary industry, indicating that the tertiary industry is somewhat insufficient in high-level and knowledge talents. Still, the severity is marginally smaller than that of Sichuan and Gansu. The proportion of employees in the primary industry in Sichuan Province and Gansu Province is much higher than that in the primary industry. The problem of general labor supply exceeding demand is equally severe. The proportion of employees in the secondary and tertiary sectors is far less than that of the industry. There is a shortage of technical talents and high-level talents; the proportion of employees in the primary industry in Ningxia Province in the upper reaches of the Yellow River, Shaanxi Province and Shanxi Province in the middle reaches of the Yellow River is much higher than that in the primary industry, the general labor supply is greater than the demand. The proportion of employees in the secondary industry is much lower than that in the secondary industry, and the supply of technical talents is less than the demand. The proportion of employees in the tertiary industry is higher than that in the tertiary industry. In summary, the provinces in the Yellow River Basin still have imbalances in labor supply and demand between the upper, middle and lower reaches of the three sectors and among the areas in the upper reaches.

Human resources play a fundamental, strategic and decisive role in the economic and social development of the Yellow River Basin. Although the base of human resources in the Yellow River Basin is large, the reasonable utilization rate is low and cannot be dominant. Suppose the problem of an unbalanced distribution of human resources cannot be effectively solved. In that case, the gap in human resources between the middle and upper reaches of the Yellow River and the lower reaches of the Yellow River, the upper reaches of the Yellow River, Sichuan and other provinces, and the lower reaches of the Yellow River will still expand, which is not conducive to the development of the secondary industry and the tertiary industry in the nine provinces of the Yellow River Basin. All provinces in the Yellow River Basin need to guide the transformation of a general labor force to a low-level service industry and processing and manufacturing industry, cultivate and introduce technical and knowledge-based talents, and promote the flow of human resources among regions to make up for the imbalance of human resources distribution among regions and sectors (Liu Zhiyong, Li Haizheng & Hu Yongyuan, 2018 ).

#### 4.3 Coupling Analysis of Human Resource and Industrial Structure

The coupling degree of human resource and industrial structure is the relationship between the proportion of three sectors and the proportion of employees in three sectors, which is used to measure the rationality of employment structure in a region. The formula is

$$a_i = A_i / B_i \quad (1)$$

(Zhang Tongquan & Gao Jianli, 2013 ).  $A_i$  refers to the proportion of the third industry in the third industry, and  $B_i$  refers to the ratio of employees in the third industry. The closer  $a$  is to 1, the more coupling the industrial structure and human resource structure, the more reasonable the employment structure.  $a > 1$ , indicating that the greater the industrial labor demand, the greater the  $a$ , the more serious the shortage of human resource;  $a < 1$  suggests that the labor force is seriously stranded, and the smaller  $a$ , the more serious the labor spillover phenomenon.

Table 3. The proportion of employees in the three sectors and the coupling degree of the three sectors in the nine provinces of the Yellow River

	Proportion of employees in three sectors	The coupling degree of the first industry	The coupling degree of secondary industry	The coupling degree of tertiary industry
Qinghai	31.9: 20.4: 47.7	0.35	1.87	1.06
Sichuan	32.5: 23.1: 44.4	0.35	1.57	1.27
Gansu	44.9: 17.8: 37.3	0.30	1.78	1.35
Ningxia	24.2: 23.8: 52.0	0.36	1.72	0.97
Neimenggu	35.7: 17.0: 47.3	0.33	2.33	1.03
Shaanxi	30.0: 20.0: 50.0	0.29	2.17	0.96
shanxi	23.1: 23.8: 53.1	0.23	1.82	0.96
Henan	25.0: 29.5: 45.4	0.39	1.41	1.07
Shandong	24.9: 33.4: 41.7	0.29	1.17	1.29

Based on the above data on the industrial structure and human resource structure of the areas in the Yellow River Basin, the coupling degree of industrial design and human resource structure of the provinces in the Yellow River Basin is obtained, as shown in Table 3 and Figure 2.

According to the industry, the coupling degree of human resources structure and industrial structure of the primary industry in the nine provinces of the Yellow River is the same and poor, and there are problems of labor retention and surplus ( $a$  is far less than 1). From the perspective of human resources structure in each province, nearly one-third of the labor force is concentrated in the primary sector. In contrast, the primary industry accounts for only about 10 % of the three sectors. Therefore, in the coupling optimization of industrial structure and human resources, we should focus on solving the mismatch problem between primary industry and human resources, such as encouraging the flow of labor force engaged in primary industry to service sector and processing manufacturing industry.

The secondary industry has a labor shortage problem in all provinces. The coupling degree in the middle reaches of the Yellow River is worse than that in the upper and lower reaches of the Yellow River, followed by the five provinces in the upper reaches and Henan and Shandong in the lower reaches of the Yellow River. It can be seen from Figure 2 that the more the five provinces in the upper reaches of the Yellow River are biased towards the central region, the worse the coupling between the human resource structure and the industrial structure of the secondary industry is. Between the middle and lower reaches of the Yellow River, the closer it is to the east, the better the coupling between the human resource structure and the industrial structure of the secondary industry is, showing a poor pattern in the middle, a better pattern in the east and west, and the best pattern in the east. Among them, Shandong Province has the best coupling degree of the two chains ( $a = 1.17$ ), the perfect employment structure, and the worst coupling degree of the second industry in Inner Mongolia ( $a = 2.33$ ). Therefore, the government, universities and enterprises should increase the training and introduction of labor professionals in the secondary industry to compensate for the lack of human resources.

The coupling of Sichuan, Gansu and Shandong provinces in the tertiary industry is poor, and there is a problem of human resource spillover. The spillover problem in Gansu Province is relatively severe, but the coupling degree of Qinghai, Ningxia, Shanxi, Shaanxi and Henan provinces is better. The coupling degree of human resources and industrial structure in Ningxia, Shaanxi and Shanxi is less than 1, and there is a negligible human resource spillover. The coupling degree of human resources and industrial structure in the remaining six provinces is greater than 1, and there is more or less a shortage of human resources. Therefore, it is necessary to encourage the cross-regional flow of human resources in the tertiary industry, strengthen inter-regional labor supply and demand cooperation, and effectively improve the unbalanced distribution of human resources among regions.

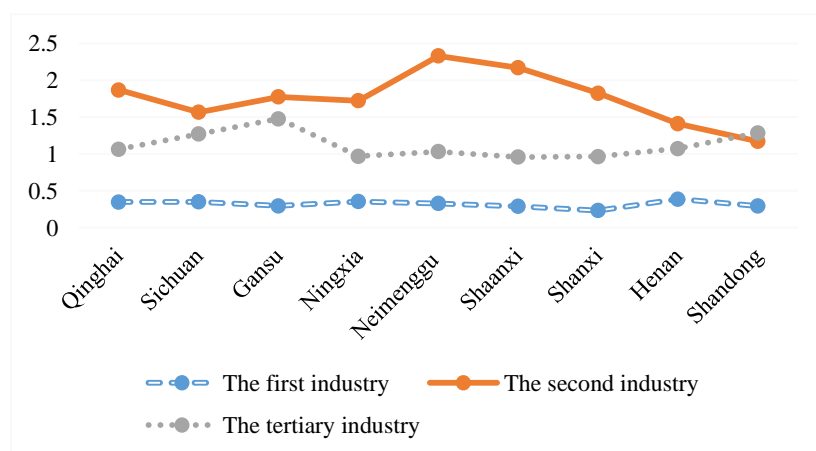


Figure 2. Three sectors coupling line chart of the Yellow River nine provinces

Overall, the coupling degree of human resource and industrial structure of the tertiary industry in the Yellow River Basin is better than that of the first and second sectors, and the coupling degree of the second industry is the worst, especially in the middle and upper reaches. The reason may be due to the 'national main functional area planning' approved by the State Council in 2010, which clarifies the development of critical areas in the Yellow River Basin. Most of the Lanxi region, Ningxia Economic Zone along the Yellow River, Hubao Eyu, Taiyuan urban agglomeration, and Central Plains Economic Zone include the construction of energy raw material industrial bases. The secondary industrial system in the middle and upper reaches is single, most

labor-intensive and capital-intensive sectors, and labor demand is strong; the critical development areas in the upstream have established historical and cultural tourism bases and logistics centers. The tertiary industry has developed rapidly, and the development of human resources has lagged, resulting in an insufficient supply of human resources in the secondary and tertiary sectors.

The actual development of industry and human resources in the Yellow River Basin lies in the differences in natural resources, population resources, economic foundation and development potential in different regions. Figure 2 shows that the coupling of the industrial and human resource structure of the three sectors in Shandong Province is relatively good among the nine provinces. In 2020, the real GDP and fiscal revenue of Shandong Province were much higher than the other eight provinces in the Yellow River Basin. The real GDP of Shandong Province in 2020 was 73129 billion yuan, which is almost equal to the total GDP of the six provinces except for Henan and Sichuan. It is 24 times the GDP of Qinghai Province, 19 times the GDP of Ningxia Province, and eight times the GDP of Gansu Province. From the perspective of the development of the secondary industry, the increment of high-tech sectors in Shandong Province accounts for 45 % of the industrial increment in 2020, while Ningxia, Inner Mongolia, Shanxi and Shaanxi are only 17 %, 24 %, 25 % and 26 % respectively (Yang Wei & Zheng Tengfei, 2022 ). The quality and speed of industrial development are significantly higher than those of the other eight provinces, mainly due to the coupling of the industrial structure and human resource structure of the secondary industry in Shandong Province. Therefore, the coupling of industrial structure and human resources structure is necessary to improve the industrial structure with human resources, layout the human resources structure with industrial structure, and achieve high-quality economic development.

## 5. Results

In 2020, the Yellow River Basin transformed industrial structure from 'two three one' to 'three two one.' However, due to other resource endowments, the Yellow River Basin has formed different industrial design and human resource structure coupling statuses. However, the coupling of the industrial construction and human resource structure of the three sectors in each province is different. Among them, the coupling degree of the first industry in the nine areas is far less than 1, and there is a problem of general labor surplus in the first industry. The coupling degree of the secondary industry is greater than 1. There is a shortage of technical human resources in the secondary industry, and the severity of the problems in the upper, middle and lower reaches is different, and the middle reaches are relatively worse than the upper and lower reaches; the coupling degree of the tertiary industry varies greatly among the upper, middle and lower reaches of the river basin and within the upper reaches of the river basin. In addition to the small shortage problem in Ningxia Province in the middle and upper reaches of the Yellow River, the remaining provinces and cities have spillover problems, of which the upper reaches of Gansu Province is the most serious. The coupling of the tertiary industry's human resources structure and industrial structure is unbalanced among regions.

## 6. Discussion

The paper concludes that the coupling of human resources structure and industrial structure in nine provinces; the collar of three departments in various provinces is uneven; the Yellow River basin needs to improve its industrial development model and promote the integration of human resources. Conclusion To provide the experience and direction for the areas in the Yellow River basin to improve the high-quality economic development. Aiming at the industrial structure, human resource structure and their coupling problems in the Yellow River Basin, this paper puts forward the following countermeasures and suggestions.

### 6.1 Improve the Industrial Development Pattern

According to the decision-making and deployment of the "Yellow River Basin Ecological Protection and High-Quality Development Plan." Supporting policies should be launched in the Yellow River Basin to improve the connection between upstream and downstream sectors, realize the layout of the overall industrial structure from basic R & D to high-end manufacturing, and help the high-quality development of the industry.

First, China's food security guarantee areas are optimized for primary industry. Sichuan, Inner Mongolia, Henan and Shandong. It is necessary to ensure and promote grain production capacity, optimize grain planting structure and plant green agricultural products ; build agricultural ecological protection areas and characteristic planting areas, accelerate the development of agricultural product processing industry, comprehensively promote the transformation of terraces to alleviate soil erosion, and build high-standard farmland (Zhang Mengwu & Han Baoli, 2022 ); control the planting of high-consumption aquatic products and reduce the exploitation of groundwater; optimize the treatment of agricultural waste, promote the conversion of agricultural waste into feed, fertilizer and other energy; consolidate the construction of animal husbandry additional industry characteristic products ; improve the rotation and rest grazing system of grassland in the upper reaches of the Yellow River ;

improve the modern slaughtering and processing circulation system and shift the focus of slaughterhouses to aquaculture areas (Xu Tianwei, Zhao Xinquan & Geng Yuanyu., 2020 ); promote the integration of agriculture and tourism services, and create an eco-tourism industry with the characteristic culture of the Yellow River Basin.

Second, transform traditional manufacturing. On the one hand, we will realize the digital intelligence empowerment of conventional manufacturing sectors, transform traditional sectors such as coal, petroleum, electricity, and chemical sectors in the middle and upper reaches of the Yellow River, and promote the Internet information flow of electronic information, food and other sectors in the lower reaches of the Yellow River ( Zhang Liao & Wang Junjie, 2018 ). On the other hand, promote the green energy industry. According to the carrying capacity of the ecological environment, the management and control of mineral resources should be carried out according to local conditions, and the scale and intensity of development should be limited and standardized ( Zhang Zhuoqun, Chen Yao & Shan Jingjing, 2022 ); promote the development of intelligent technology to reduce the risk of accidents; accelerate the renewal of energy-saving and emission-reduction equipment, vigorously develop clean energy such as hydropower, wind energy and solar energy instead of coal in energy consumption, and promote the green development of energy.

Third, accelerate the construction of high-tech sectors. Relying on the radiation of high-tech zones and regional central cities, we will promote the development of new energy, new materials, electronic information, biology and other high-tech sectors, as well as future sectors such as quantum physics and genetic technology, and construct new sectors with industrial characteristics in the Yellow River Basin (Jin Fengjun, Lin Yinghua, Ma Li & Chen Zhuo, 2022).

Fourth, enhance innovation investment. On the one hand, increase the government's investment in scientific research funds while increasing the supervision of the use of funds to ensure the rational and practical use. On the other hand, strengthen regional innovation linkage. By giving full play to radiation of scientific and technological innovation in the lower reaches of the Yellow River, the sectors in the Yellow River Basin will be transformed from resource-dependent to innovation-driven, and the economic construction of modern sectors will be promoted through scientific and technological innovation (Gou Wenfeng & Zhao Lun, 2021 ).

#### *6.2 Improve the Integration of Human Resources*

First, the freedom of labor mobility and allocation optimization is the key to integrating regional human resources in the Yellow River Basin. The research shows that the matching degree of human resources and economic structure indicates the quality of regional economic development. The more optimized the human resource structure, the more in-depth the development of regional integration (Kang Cong, 2018). The cooperation level of human resources in the provinces and cities of the Yellow River Basin is not high, the integration of human resources has not formed a system, and the overall coordination mechanism has not been perfected.

Second, lead enterprises and drive the formation of a good order of labor mobility environment. Leading enterprises should be committed to establishing an excellent human resources ecosystem while stabilizing and optimizing their development, creating an excellent industrial development environment, and building regional stakeholders into a community of benefit sharing and risk sharing.

Third, improve human resources scheduling, and fulfill the structure of human resources. With the continuous development of regional economic integration, to improve the speed and quality of products and fully realize the value of various human resources, the regulation and control of human resources must be a part of the focus ( Song Benjiang, 2022 ). Strengthen the cultivation of technological innovation talents, such as technical training for the stranded labor force in the primary industry, and guide them to flow from the primary industry to the secondary and tertiary sectors. The government and enterprises should improve the human resources dispatching department to effectively meet different regions' and enterprises' human resources needs.

Fourth, consolidate the talent base and improve the level of human resources. Strengthen the reform of secondary and higher vocational education, formulate career-oriented training programs in close connection with the needs of industrial development ( Xu Weishen, 2022 ), and accelerate human resource development. And to implement international high-quality talent training, break through the current situation of industry-driven innovation in the Yellow River Basin, and transform it into scientific and technological innovation to promote industrial development ( He Weihua & Liu Baoliang, 2022 ).

#### *6.3 Improve the Institutional Environment*

First, strengthen the top-level design of industrial structure adjustment. On the one hand, it is necessary to



improve the flow of factors among the nine provinces, increase the support of the government system, and weaken the homogenization of industrial structures among areas. It is suggested to formulate a scientific and reasonable industrial upgrading target plan for the Yellow River Basin, learn from the successful experience of industrial development in the Yangtze River Economic Belt, gradually explore the optimal layout of the Yellow River Basin, accelerate the transformation of traditional sectors to emerging sectors, and the rational integration of traditional sectors and emerging sectors. On the other hand, we should adhere to the dialectical unity of industrial structure adjustment, high-quality economic development and ecological protection, improve the environmental protection policy and the power and responsibility supervision system, clarify the division of labor and responsibilities of departments, establish and improve the ecological compensation system and take the road of sustainable development ( Jia Demin, 2022 ).

Second, improve the human resources integration policy. The root cause of the unbalanced development of human resources in the Yellow River Basin lies in the gap of institutional mechanisms. To solve this obstacle, it is necessary to establish an authoritative coordination agency to build an efficient human resources training, introduction and application model by focusing on the advantages of resources in the Yellow River Basin and the rights and interests of stakeholders. Secondly, according to the development goal of economic integration in the Yellow River Basin, the key strategy of human resource integration is established. According to the resource differences, potential advantages and disadvantages of each basin, the stage and main goal of human resource development are established. Finally, improve the service policy to ensure the retention of talents. The Yellow River Basin should jointly build a human resources service platform and build a human resources treatment policy at different levels in children 's education, health care and housing.

Third, improve the coupling mechanism of human resource and industrial structure. In order to accelerate the integration of the two, first of all, it is suggested to formulate a collaborative planning project book of human resource and industrial structure in the Yellow River Basin. Based on the existing sectors in the Yellow River Basin, we should find industrial complementary points, promote industrial convergence, deploy human resource structure around the industrial structure, realize the multiplier effect of the coupling of human resource and industrial structure, and promote the coordinated, high-quality development of the provinces in the Yellow River Basin. Secondly, we should focus on the cultivation and flow of the labor force, accurately cultivate and introduce supporting industry talents according to industrial development, and promote the two-way integration of human resources and industry. Finally, establish a regular evaluation system for the integration of human resource and industrial structure in the Yellow River basins, including the combination of self-evaluation and third-party evaluation, propose countermeasures and suggestions through the problems that arise, and further dynamically improve the coupling system and policies of the two (Dong Xiaohong, Sun Yongjun & Wu Xing, 2022 ).

## 7. Conclusion

Exploring the human resource structure, industrial structure and the coupling between the two in the nine provinces of the Yellow River, helps to understand the current situation of human resources and industrial development in the nine provinces of the Yellow River at this stage. It provides a basis for the formulation of economic development policies in the provinces of the Yellow River Basin in the future. Based on the current situation, this paper proposes countermeasures and suggestions for industrial transformation and population flow in the Yellow River Basin.

However, there are still many deficiencies in this study. Due to the lag of provincial statistical yearbooks, the article can only collect data for 2020, which may deviate from the data for 2022. Based on panel data, future research can better reflect the coupling trend of human resource and industrial structure; for this study, we can further explore the flow of human resources between regions.

Although the article provides some contribution, there are still limitations, and the coupling degree can be calculated in more precise methods in the future.

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