Pol. J. Environ. Stud. Vol. 32, No. 1 (2023), 321-330
DOI: *10.15244/pjoes/153423* ONLINE PUBLICATION DATE: 2022-11-14

Original Research

Evaluation of Rural Human Settlement Environment in the Middle and Lower Reaches of the Yellow River

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Received: 3 August 2022
Accepted: 1 September 2022

Abstract

It is related to the ecological well-being of the people and the high-quality development of the Yellow River Basin to protect the ecological environment of the Yellow River Basin and promote the construction of ecological belts. Henan Province is located in the middle and lower reaches of the Yellow River Basin. This article constructs an index system from five dimensions: residential environment, economic environment, public services, infrastructure and ecological environment. Based on the statistical yearbook of Henan Province in the past five years and the data of China Rural Statistical Yearbook, the entire Henan Province and the main 18 prefecture-level cities were evaluated using the entropy method for rural human settlement environment. On the whole, the rural human settlement environment in Henan Province has been in a slow growth stage in the past five years, and all cities have been in a fluctuating growth stage. The government should adjust measures to local conditions and strengthen ecological environment control on the premise of maintaining sustained and stable economic development.

Keywords: Yellow River Basin, Henan Province, rural human settlement environment, index system, entropy method

Introduction

As an important ecological barrier in China, the implementation of environmental protection policies for the Yellow River basin can first provide support for the ecological security of China and the world. Second, the establishment of an ecological protection mechanism system for regional collaborative governance around river basin governance, ecological protection and restoration, major ecological construction and other aspects has important reference value for the worldwide ecological basin governance. Third, Chinese profound, ancient culture is fully manifested in the Yellow River culture. Building a core demonstration area for ecological protection and high-quality development in the Yellow River Basin is very important to coordinate the various cultural tourism resources in the region and to show the Yellow River culture and the Central Plains culture to the world. In September 2019, General Secretary Xi Jinping hosted a symposium on ecological

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protection and high-quality development of the Yellow River Basin in Zhengzhou. He clearly pointed out that the ecological protection and high-quality development of the Yellow River Basin are as important national strategies as the coordinated development of Beijing-Tianjin-Hebei, the development of the Yangtze River Economic Belt, the construction of the Guangdong-Hong Kong-Macao Greater Bay Area, and the integrated development of the Yangtze River Delta. It is also pointed out that the Henan section has the heaviest task and the most difficulties in the ecological protection of the entire Yellow River Basin. At the same time, the construction of the ecological corridor along the Yellow River in Henan has the most conditions and the most promising prospects.

The ecological protection and high-quality development of the Yellow River Basin involve problems and research in many aspects. We should neither focus only on urban development nor ignore rural development. The goal of building a moderately prosperous society in an all-round way and achieving common prosperity means that in terms of rural areas, we not only demand a complete eradication of poverty, but also make great improvements in the improvement of rural human settlements. The "Three-Year Action Plan for the Improvement of Rural Human Settlement Environment" issued in 2018 proposed to improve the rural human settlement environment to "adjust measures to local conditions and categorize guidance." It also proposed that by 2020, "the rural human settlement environment will be significantly improved, the village environment will be basically clean and orderly, and the environmental and health awareness of villagers will generally increase."

Literature Review

The rural human settlement environment is not only one of the issues of great concern to the Party Central Committee and the State Council, but also one of the current hot issues in academic research.

Regarding the importance of the human settlement environment, Fu et al. (2019) analyzed the problems and causes of ecological construction in the Yellow River ecological zone in Henan Province, and put forward the importance of protecting the ecological construction of the Yellow River to the living ecological environment [1]. At the same time, Yu and Hao (2018) proposed that the quality or health of rural ecosystems, agricultural production systems, and rural human settlement systems would directly affect the health of rural residents [2]. Wang et al. (2018) believed that there was a clear positive correlation between a good living environment and longevity [3].

In terms of the content of human settlement environment research, most scholars mainly conduct satisfaction analysis and evaluation on the human settlement environment of a certain area. Ding and Xiao (2020) evaluated the high-quality development of the Yellow River Basin based on the panel data of 34 prefecture-level cities flowing through the Yellow River Basin from 2000 to 2017 when researching the urban agglomerations in the Yellow River Basin [4].

In terms of the human settlement indicator system, Dai and Xu (2019) used the entropy method to evaluate the quality of human settlements in Liaoning Province, and conducted index evaluation and measurement in four aspects: environmental quality, economic development, living conditions, and social environment [5]. Li et al. (2019) used the four comprehensive indicators of living conditions, urban ecological environment, urban infrastructure and urban economic development level to evaluate the human settlement environment when evaluating the human settlement environment of the Yellow River Basin based on the factor analysis method [6]. There is also Ma and Xu (2020) for the evaluation of the seven urban agglomerations in the Yellow River Basin from the five dimensions of innovation, coordination, greenness, openness, and sharing [7].

In terms of the method of human settlement environment research, Yu and Li (2019) used the entropy method and spatial analysis method to study the spatial difference of the rural human settlement environment quality when evaluating the human settlement environment of the villages in Zhejiang Province [8]. Wu et al. (2019) used the entropy method to assign the weights of indicators when researching 18 villages in Lichuan City, Hubei Province as an example, and conducted a comparative analysis of data from 2014 to 2018 [9].

At present, most scholars studying the Yellow River Basin are mostly focused on studying how to promote the high-quality development and ecological environment protection of the Yellow River Basin, and they generally focus on urban agglomerations. Few specific studies and discussions have been given on the development of human settlements in a specific province that the Yellow River Basin flows through. This paper conducts a comprehensive analysis of the human settlement environment data of Henan Province and 1 8 prefecture-level cities in the past five years. And we put forward a summary and opinions on the comprehensive development of Henan Province in the past five years, and make suggestions for the future development of the human settlement environment in Henan Province.

Method

Study Site

"One part of Henan history, half of Chinese history." The Central Plains region is the regional geographic center and ideological content center of the Yellow River culture, and has been leading and promoting

the development and progress of the Yellow River civilization for a long time.

The middle and lower reaches of the Yellow River flows through Inner Mongolia, Shaanxi, Shanxi, Henan, and Shandong provinces. Henan is the first most populous province in the Yellow River Basin and the fifth largest economic province in China. The Henan section of the Yellow River is 711 kilometers long and flows through 26 counties (cities, districts) among the 8 cities of Sanmenxia, Jiyuan, Jiaozuo, Luoyang, Zhengzhou, Xinxiang, Kaifeng, and Puyang. The drainage area is 36,000 square kilometers, accounting for 5% of the total area of the Yellow River Basin and 21.6% of the province's area. The economic output of the areas along the Yellow River has reached 53.1% of the province's total. The Yellow River in Henan Province is located in the transitional section from mountain to plain. The special geographical location and complex channel shape make it have outstanding characteristics different from other sections of the Yellow River [10, 11].

Evaluation Index

The evaluation of the quality of rural human settlements is a complex systematic project involving economic, social, resource, ecological and other aspects [12]. When selecting indicators, this article combines the research indicators of predecessors and scholars and follows the principles of data availability, scientificity, and people-oriented selection of indicators [13], and strives to be able to comprehensively and scientifically reflect the development of various aspects of the rural human settlement environment. This paper selects five first-level indicators of living environment, economic environment, infrastructure, public services, and ecological environment, and includes 20 second-level indicators (Table 1) to evaluate the human settlement environment in Henan Province.

Evaluation Methodology

On the basis of previous scholars' research, this paper selects the entropy method to determine the weight. The use of entropy method to objectively weight selected index data can overcome the arbitrariness brought by subjective weighting method, and has strong operability and objectivity [14-16]. The data used comes from the statistical yearbook of the Henan Bureau of Statistics from 2014 to 2018, the national statistical yearbook, relevant news from the People's Government

Table 1. Comprehensive evaluation index of human settlement environment.

Index classification	Specific evaluation index	Unit	Direction
A Living environment	A1 Rural electricity consumption	100 million kW / h	Positive
	A2 Housing value of rural households	Yuan/square meter	Positive
	A3 Rural housing area per capita	Square meters per person	Positive
	A4 brick and wood structure	Square meters per person	Negative
	A5 reinforced concrete structure	Square meters per person	Positive
B Ecological Environment	B1 Amount of agricultural chemical fertilizer applied	Tons	Negative
	B2 Actual amount of pesticide application	Tons	Negative
	B3 Plastic film usage	Tons	Negative
C Infrastructure	C1 Cultivated land area	Thousands of hectares	Positive
	C2 Total power of agricultural machinery	10 megawatts	Positive
	C3 Number of reservoirs	a	Positive
	C4 effective irrigation area	Thousands of hectares	Positive
D Public Service	D1 Number of township health centers	a	Positive
	D2 Hygienic toilet penetration rate	%	Positive
	D3 Number of public libraries	a	Positive
E Economic Environment	E1 Per capita living consumption expenditure of rural residents	Yuan	Positive
	E2 Number of rural employees	Ten thousand people	Positive
	E3 disposable income per capita	Yuan	Positive
	E4 Amount of investment by farmers in fixed assets	One hundred million yuan	Positive
	E5 GDP per capita	Yuan	Positive

of Henan Province, and the third agricultural census data of Henan Province.

The calculation method is as follows:

1) Standardization of indicators. The indicators selected in the thesis have different dimensions, magnitudes and positive and negative orientations, and need to be standardized. The formula is as follows:

When x_{ij} is a positive indicator, $y_{ij} = \frac{x_{ij-minx_{ij}}}{maxx_{ij}-minx_{ij}}$

When x_{ij} is a negative indicator, $y_{ij} = \frac{maxx_{ij-x_{ij}}}{maxx_{ij}-minx_{ij}}$

In the formula, y_{ij} is the standardized index value, and x_{ij} is the original data of a certain sub-item.

2) Calculation of indicator contribution. Construct a judgment matrix for comprehensive quality evaluation of rural human settlements as follows:

$$A = \begin{bmatrix} y_{11} \cdots & y_{1m} \\ \vdots & \vdots \\ y_{n1} \cdots & y_{nm} \end{bmatrix}_{nm}$$

Calculate p_{ij}, the formula is as follows:

$$p_{ij} = \frac{y_{ij}}{\sum_{i=1}^{n} y_{ij}}, \text{ j = 1, 2, 3……m}$$

In the formula, y_{ij} is the proportion of the i-th evaluation unit under the j-th index in the index.

3) Calculate the index entropy value. The formula for calculating the entropy value of the j-th index is:

$$e_j = \left(-\frac{1}{ln\, m}\right)\sum_{i=1}^{m} p_{ij}\, ln\left(P_{ij}\right)$$

And $0<e_{ij}<1$.

4) Determine the index weight.

$$w_j = \frac{\left(1-e_j\right)}{\sum_{j=1}^{m}\left(1-e_j\right)}$$

5) Calculate the comprehensive evaluation score.

$$z_i = \sum w_j \times y_{ij}$$

Table 2. Weight analysis of comprehensive indicators of human settlement environment in Henan Province.

Criterion layer	Weight	Index layer	Weight	Sort
A Living environment	0.211122	A1 Rural electricity consumption (100 million kilowatts/hour)	0.043528	12
		A2 Housing value of rural households (yuan/square meter)	0.064757	6
		A3 Rural housing area per capita (m2/person)	0.031938	18
		A4 brick and wood structure (m2/person)	0.035505	16
		A5 reinforced concrete structure (m2/person)	0.035394	17
B Ecological Environment	0.210752	B1 Amount of agricultural chemical fertilizer applied (tons)	0.063003	7
		B2 Pesticide application in kind (tons)	0.069293	4
		B3 Plastic film usage (tons)	0.078456	1
C Infrastructure	0.214746	C1 Cultivated land area (thousand hectares)	0.074577	3
		C2 Total power of agricultural machinery (10 megawatts)	0.065765	5
		C3 Number of reservoirs (a)	0.046338	9
		C4 Effective irrigation area (thousand hectares)	0.028066	19
D Public Service	0.158163	D1 Number of township health centers (a)	0.037121	15
		D2 Hygienic toilet penetration rate (%)	0.075995	2
		D3 Number of public libraries (a)	0.045046	10
E Economic Environment	0.205218	E1 Per capita living consumption expenditure of rural residents (yuan)	0.044969	11
		E2 Number of rural employees (ten thousand)	0.027441	20
		E3 Per capita disposable income (yuan)	0.042383	13
		E4 Amount of investment by farmers in fixed assets (100 million yuan)	0.041990	14
		E5 GDP per capita (yuan)	0.048434	8

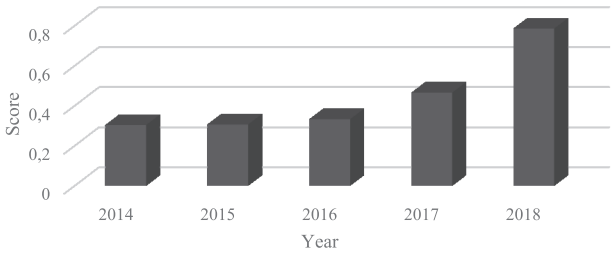

Fig. 1. Comprehensive management of the human settlement environment in Henan Province in the past five years.

Results

Result Analysis of Human Settlements in Henan Province

Using the above calculation method to calculate the collected data, we can get the relevant indicator weights of the human settlement environment improvement in Henan Province from 2014 to 2018, as shown in Table 2.

Table 2 shows the comprehensive scores of the human settlement environment of Henan Province in the past five years. The weight of infrastructure is the largest at 0.214746, followed by the weight of residential environment at 0.211122, and the weight of public services is at least 0.158163. Based on the analysis of the entire secondary index, the weight of the plastic film in the ecological environment is 0.078456. The weight of plastic film is relatively large, but from the annual use data, the use of plastic film is showing a downward trend compared with the previous year. In 2018, the amount of plastic used has reduced from 157300 tons in 2017 to 152800 tons. And the use of chemical fertilizers and pesticides has shown a downward trend every year. The weight of the penetration rate of sanitary toilets is 0.075995, which is inseparable from the achievements of the toilet revolution promoted in recent years. In 2018, the penetration rate of sanitary toilets in Henan Province has reached 81.15%. The lowest weight of the secondary indicators is the number of rural employees, which dropped from 48.07 million in 2017 to 46.75 million in 2018. This is mainly related to farmers' low level of education and lack of professional skills. Correspondingly, the government should introduce certain policies that benefit the people to promote the employment of villagers in the countryside.

Fig. 1 shows the comprehensive scores of the human settlement environment in Henan Province in the past five years. It can be seen that the comprehensive management of the human settlement environment in Henan Province has been in a slow upward trend in the past five years, especially in 2018 compared with 2017, which has a relatively large increase. In the 21st century, the overall level of the human settlement environment has been improving continuously, and the quality of the human settlement environment has also been greatly improved.

Fig. 2 shows the evolution of the various subsystems of the human settlement environment improvement in Henan Province in the past five years. From this chart, it can be seen that the various subsystems are in a stage of fluctuating growth.

The score of infrastructure part has a significant decline in 2016, because the total power of agricultural machinery in the infrastructure in 2016 dropped from 117100.8 thousand kilowatts in 2015 to 98588.2 thousand kilowatts. But there was a slow upward trend in 2017 and 2018. The ecological environment has increased greatly in 2017 compared with 2016, and the increase in 2018 compared with 2017 is also relatively large. Overall, the ecological environment of human settlements in Henan Province has been in a situation of rising scores. This is inseparable from the results of Henan Province's active implementation of the "two-mountain theory" to protect the ecological environment and rural revitalization strategies.

The score of the living environment rose from 0.035506575 in 2014 to 0.174861152 in 2018. The per capita residential living area increased from 39.2 square meters/person in 2014 to 45.8 square meters/person in 2018. The housing value of rural households increased from 740.9 yuan/square meter in 2014 to 961.8 yuan/square meter in 2018;

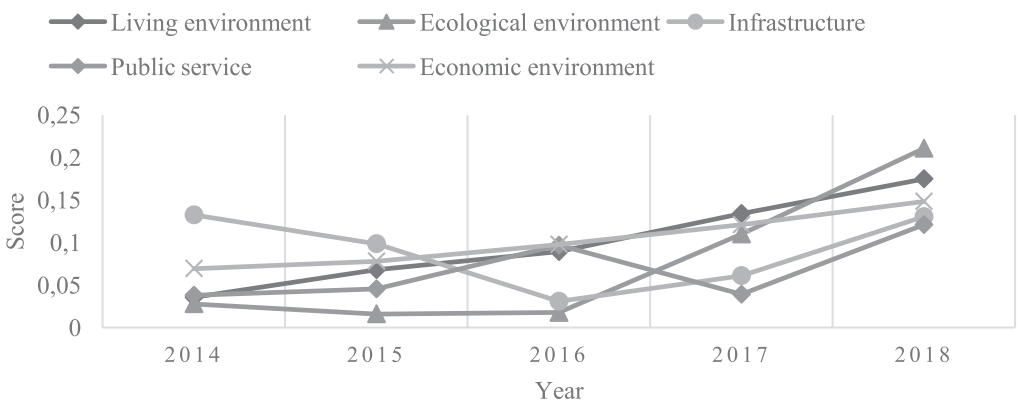

Fig. 2. Evolution of various subsystems in Henan Province in the past five years.

the brick-wood structure dropped from 32.87 square meters/person in 2014 to 14.33 square meter/person in 2018; concrete structures increased from 6.083 square meters/person in 2014 to 26.7287 square meters/person in 2018. This stems from the establishment of a corresponding planning system in Henan Province and the realization of a planning map for each village. At the same time, the reform of homesteads will be implemented, and the loose construction will be gradually controlled, measures such as the overthrow of dilapidated houses, one household, one house, etc., and corresponding land management policies will be implemented.

In the past five years, the economic environment has been in a stage of slow growth, and its contribution to the quality of human settlements has risen from 0.069432651 in 2014 to 0.148419903 in 2018. Moreover, with the rapid expansion of the economic scale of Henan Province and the continuous improvement of the level of economic development, the per capita economic indicators have also achieved rapid growth. The per capita disposable income of rural residents in Henan Province rose from 9,966.07 yuan in 2014 to 13,830.74 yuan in 2018, and the per capita living consumption expenditure of rural residents rose from 7,277.21 in 2014 to 10,392.01 yuan in 2018. The improvement of the economic level also provides a certain economic foundation for the improvement of the environmental level, the improvement of living conditions, and the improvement of infrastructure in rural areas.

Result Analysis of Human Settlements in Prefecture-Level Cities in Henan Province

Corresponding index data were collected for 18 prefecture-level cities in Henan Province, and the calculation results are as follows.

Table 3 reflects the scores of human settlement improvement in the 18 prefecture-level cities in Henan Province in the past five years. On the whole, the development of the human settlement environment of each city is roughly in line with the overall development of Henan Province. The 2018 data show that the overall human settlement environment is in a situation where the score is relatively high. Fig. 3 clearly reflects the development of the various subsystems of each city with a chart. Fig. 4 shows the average scores of the human settlement environment improvement of the prefecture-level cities in the past five years, and Table 4 classifies these prefecture-level cities according to the environmental scores of rural human settlements in Henan Province.

According to Fig. 4 and Table 4, the cities in the premium development zone include Zhengzhou, Xinyang and Nanyang. As the provincial capital of

Table 3. Scores of human settlements in prefecture-level cities in Henan Province in the past five years.

	2014	2015	2016	2017	2018	Mean	Variance
Zhengzhou	0.6539	0.6042	0.5990	0.5954	0.5424	0.5990	0.0354
Kaifeng	0.2811	0.2802	0.3062	0.2964	0.2789	0.2886	0.0109
Luoyang	0.4176	0.3959	0.4112	0.4072	0.3564	0.3977	0.0218
Pingdingshan	0.2998	0.2859	0.2940	0.2953	0.2691	0.2888	0.0108
Anyang	0.3693	0.3197	0.3385	0.3458	0.2755	0.3298	0.0314
Hebi	0.2609	0.2632	0.2609	0.2616	0.2560	0.2605	0.0024
Xinxiang	0.4106	0.3906	0.4070	0.4028	0.3808	0.3984	0.0111
Jiaozuo	0.3798	0.3616	0.3698	0.3619	0.3246	0.3596	0.0187
Puyang	0.2151	0.2339	0.2532	0.2370	0.2549	0.2388	0.0146
Xuchang	0.3362	0.3429	0.3502	0.3553	0.3057	0.3381	0.0174
Luohe	0.2593	0.2540	0.2392	0.2551	0.2226	0.2461	0.0135
Sanmenxia	0.2754	0.2510	0.2716	0.5346	0.2186	0.3102	0.1140
Nanyang	0.5005	0.5378	0.5423	0.5190	0.4059	0.5011	0.0498
Shangqiu	0.3315	0.3585	0.3797	0.3658	0.3904	0.3652	0.0201
Xinyang	0.5050	0.5809	0.5890	0.5726	0.5314	0.5558	0.0322
Zhoukou	0.3310	0.3689	0.3862	0.3537	0.3901	0.3660	0.0218
Zhumadian	0.4077	0.4439	0.4575	0.4319	0.3940	0.4270	0.0232
Jiyuan	0.3485	0.3252	0.3006	0.3071	0.3041	0.3171	0.0178

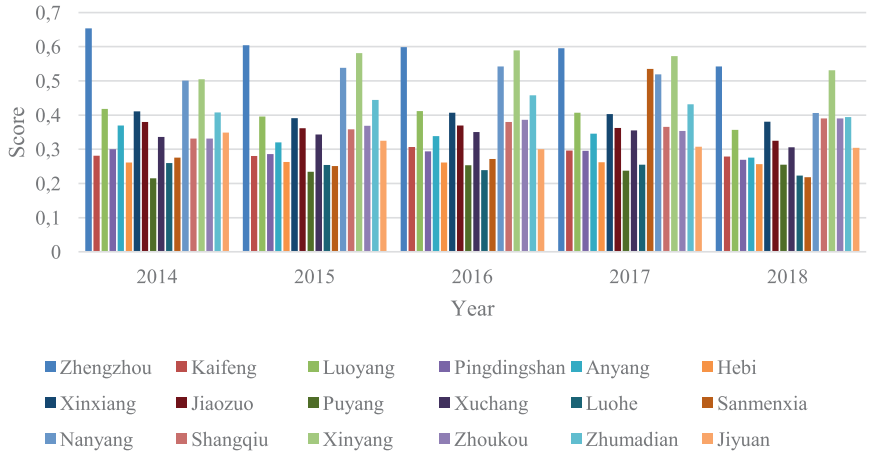

Fig. 3. Comprehensive analysis of human settlement environment improvement in prefecture-level cities.

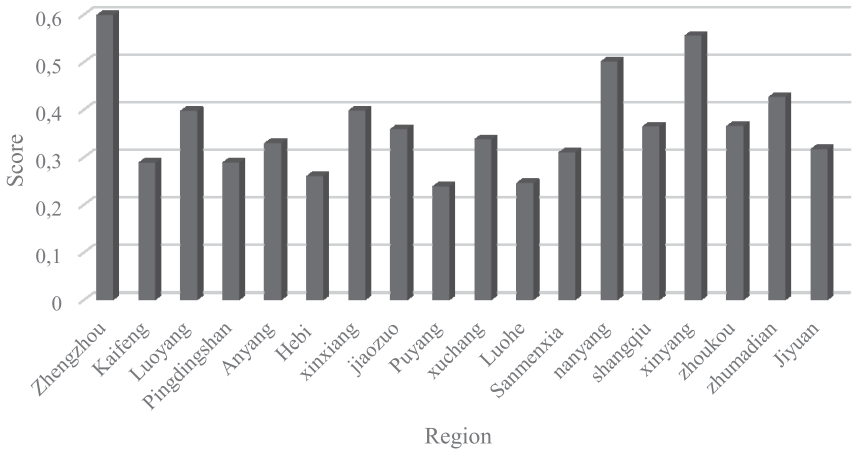

Fig. 4. Average scores of human settlements in prefecture-level cities in the past five years.

Henan Province, Zhengzhou is in a leading position in the province in terms of comprehensive regional strength and economic development level. Rural areas are driven by the radiation of the urban economy, with strong economic strength and a good level of development. The overall development level of rural areas and the living standards of residents far exceed those of other cities. Nanyang is the largest city in Henan with a population of over 10 million. Nanyang has a huge demographic dividend in the overall economy. Since Xinyang is located in the middle of the two major economic circles of Wuhan and Central Plains, it naturally has the benefits of economic transportation. The good development zones mainly include Zhumadian, which has a lot to do with the large amount of foreign investment attracted by Zhumadian in recent years, which has driven the local economic development. The general development areas are: Sanmenxia, Jiyuan City, Anyang, Xuchang, Jiaozuo, Shangqiu, Zhoukou, Luoyang, Xinxiang. Analysis of the data found that it was mainly due to the lack of local rural economic development, infrastructure and public service facilities, as well as the quality of the rural ecological environment and social stability.

Table 4. Standards for the classification of rural human settlements in Henan Province.

Development zone level	Scoring interval	City
Premium development zone	0.5-0.6	Zhengzhou, Xinyang, Nanyang
Good development area	0.4-0.5	Zhumadian
General development area	0.3-0.4	Sanmenxia, Jiyuan, Anyang, Xuchang, Jiaozuo, Shangqiu, Zhoukou, Luoyang, Xinxiang
Poor development zone	0.2-0.3	Pingdingshan, Kaifeng, Hebi, Luohe, Puyang

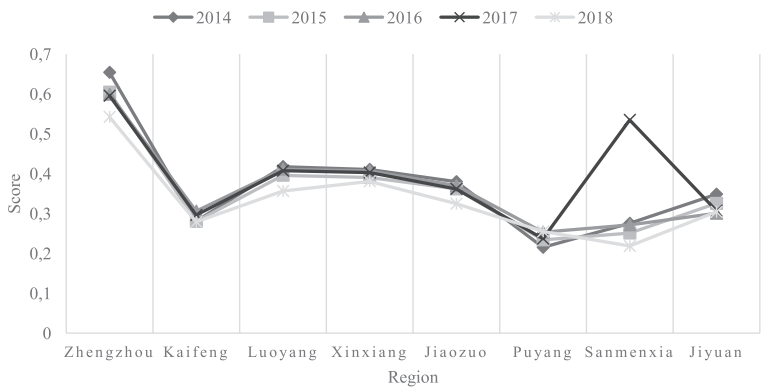

Fig. 5. The comprehensive scores of the municipal human settlement environment of the Yellow River Basin flowing through Henan in the past five years.

Poor development areas include Puyang, Luohe, Hebi, Kaifeng and Pingdingshan. The primary constraints are the low level of economic development, the single source of farmers' per capita income, and the incomplete infrastructure facilities. Therefore, the level of economic development, the infrastructure of rural facilities and the supporting conditions of human settlements all need to be improved urgently.

Fig. 5 shows the comprehensive scores of the human settlement environment of the city-level human settlements in the Yellow River Basin flowing through Henan Province in the past five years. Compared with the comprehensive scores of the human settlements of other cities, Zhengzhou is the only premium development area. Most cities are located within the general development zone. This shows that the level of development of the human settlement environment in the Yellow River Basin is not high. In order to promote the high-quality development of the Yellow River Basin and the improvement of the human settlement environment in Henan Province, great efforts are needed.

Discussion and Conclusions

Yellow River Basin is a long-term and complex system engineering. Strengthening the ecological protection of the Yellow River Basin is the primary issue and key link [17, 18]. As the middle and lower reaches of the Yellow River Basin, Henan Province, where rural and urban areas differ greatly in nature, geography, history, population, functions, and scale. There is also a large gap between the rural areas of the Yellow River Basin along the river basin and the non-riverside basin. Therefore, the construction of rural human settlement environment cannot simply follow the concepts and ideas of urban development, but should comprehensively consider regional factors such as nature, geography, economy, culture, history, and ecology. It should be based on the ecological background, development foundation, living customs and economic conditions of different regions, and seek suitable technologies suitable for the local sustainable development at that time [19].

Through the above simple research, it can be concluded that, on the whole, the effect of comprehensive improvement of the human settlement environment in Henan Province has gradually improved in the past five years. For each subsystem, the proportion of public services is relatively low, and the proportion of public services should be actively increased. Based on the analysis of the situation of each prefecture-level city, the premium rural human settlement environment development zone should strengthen the management and control of the ecological environment on the premise of maintaining sustained and stable economic development. No economic development can be at the expense of the ecological environment.

The development zone of the rural human settlement environment in the good-grade area should improve the level of rural public services and strengthen the construction of the ecological environment. The government should actively speed up the development of rural public utilities and improve the supply of rural public products. In terms of education and medical care, the modern distance education project for rural primary and secondary schools should be fully implemented to promote the sharing of high-quality educational resources between urban and rural areas, and improve the level of education management and teaching quality in rural areas. Promote the standardized construction of township (town) health centers and village clinics to provide rural residents with safe and effective basic medical protection. It is necessary to further improve the social welfare security system, improve rural pensions, medical treatment and relief for extremely poor households [20]. In terms of community and village culture, the spiritual needs of farmers are increasing day by day, and farmers' spare-time life should be actively enriched so that they can also have some recreational activities in their leisure time. For example, increase

some basic facilities such as fitness plaza and cultural plaza. Implement the rural cultural talent training project to support the development of local cultural groups. Among them, we must also pay attention to the development of the Yellow River culture. The Yellow River culture is the root and soul of the Chinese nation. The Central Plains culture is at the center of the Yellow River culture. It is necessary to vigorously promote the Yellow River culture, which has a very special and important significance for Henan Province.

The general rural human settlement environment development zone should coordinate the development of rural infrastructure, public services, ecological environment, and social economy. It is necessary to actively utilize the resource advantages of various regions and combine local characteristics to vigorously support the secondary and tertiary industries in the local rural areas, and strive to create high-quality agriculture, so as to achieve one village, one product and increase the income of local farmers. In addition, the level of rural public services should be improved to build a solid material foundation for the development of agriculture and the rural economy. The farmers' awareness of improving the living environment should be improved, and farmers' sense of responsibility should be cultivated and farmers' sense of participation should be improved in the process.

The development zone of the rural human settlement environment in the poor zone should vigorously develop the rural economy and increase the income level of rural residents. In the process of human settlements improvement, attention should also be paid to increasing farmers' income as the core, with strategic adjustment of agricultural structure as the main line, and vigorously developing characteristic agriculture and ecological agriculture. Because what the farmers are most concerned about is their own income. We must first improve the basic lives of farmers and meet their basic needs. On the premise of ensuring the growth of the rural economy, increase investment in rural infrastructure and public services, improve the living conditions of farmers, and improve the quality of life of farmers. At the same time, a long-term environmental facility maintenance funding system should be established, and an overall investment mechanism of government-led, collective supplement, villager participation, and social support should be established to ensure the implementation of remediation funds.

Acknowledgments

This work was supported by the National Natural Science Foundation of China [71573019].

Conflict of Interest

The authors declare no conflict of interest.

References

1. FU B., TANG Z., SHI T., RAO Q., ZHANG X., He C. Research on the Yellow River Ecological Belt Construction in Henan Province. Research on Land and Natural Resources, (06), 13, **2019**.
2. BAI S., CHEN Z., HUO Y. The main points that Henan should grasp when compiling the territorial and spatial planning of the Yellow River Basin. Resource Guide, **03** (01), 22-23, **2020**.
3. CHEN M. Evaluation of Chongqing Rural Human Settlement Environment Quality and Its Differentiation and Optimal Control. Science and Technology Wind, **36**, 116, **2019**.
4. DAI F., XU T., ZHAO X. Evaluation of rural human settlement environment in Liaoning Province. Regional Governance, **38**, 11, **2019**.
5. DING S., XIAO G. Research on the high-quality development of cities in the Yellow River Basin. China Economic and Trade Guide (Part 2), **05**, 7, **2020**.
6. GAO H., JIN J., LI F., ZHOU C. Evaluation and development countermeasures of rural human settlement environment construction in China. Journal of Ecology and Rural Environment, **31** (06), 835, **2015**.
7. GENG Y., CHEN W., ZHANG F., MA Y. Research on the trajectory evolution and driving mechanism of cultivated land in the middle and lower reaches of the Yellow River – A case study of Henan Province. Journal of Agricultural Resources and Environment, **38** (02), 249, **2021**.
8. KONG D., XIE S., LIU Z., LIU Y. Research on the evaluation of rural human settlement environment based on AHP method – Taking Zhaohe Town as an example. Forestry Inventory and Planning, **40** (03), 99, **2015**.
9. LI X., LI X., WANG T., LI L. Human settlement environment assessment in the Yellow River Basin based on factor analysis. Environmental Science and Technology, **33** (06), 189, **2010**.
10. LI Y. Give full play to Henan's unique advantages in the Yellow River Basin. Henan Daily, 2019-12-20 (008), **2019**.
11. LIN Y. Promote the high-quality development of the Yellow River Basin with the construction of central cities. Study Times, 2020-06-01 (005), **2020**.
12. MA H., XU L. High-quality development assessment and spatial pattern differentiation of urban agglomerations in the Yellow River Basin. Economic Geography, **40** (04), 11, **2020**.
13. PENG C., ZHANG C. Research on the quality of rural human settlement environment and its influencing factors. Macro Quality Research, **7** (03), 66, **2019**.
14. SUN H., ZHAO X. China's rural human settlement environment quality evaluation and differentiated governance strategies. Journal of Xi'an Jiaotong University (Social Science Edition), **39** (05), 105, **2019**.
15. WANG X., YUAN X., CHENG Q. China's rural human settlements, income and farmers' health. Ecological Economy, **34** (06), 150, **2018**.
16. WANG X. Strive to build a national central city with distinctive features of ecological protection and high-quality development in the Yellow River Basin. Zhengzhou Daily, 2020-06-05 (001), **2020**.
17. WU W., SHI Y., ZHOU B. Evaluation of traditional village human settlement environment based on the theory of human settlement environment system – Taking 18 villages in Lichuan City, Hubei Province as an example.

Journal of Hubei University for Nationalities (Natural Science Edition), **37** (03),353, **2019**.
18. YU F., HAO X. Research status and prospects of rural human settlement environment improvement. Ecological Economy, **35** (10), 166, **2019**.
19. 19. YU Y., LI S. Comprehensive evaluation and spatial differentiation of rural human settlements in Zhejiang Province. Western Economic Management Forum, **30** (01), 37-44+78, **2019**.
20. ZHU B., MA X. Research on Environmental Quality Evaluation of Rural Human Settlements in Jiangsu Province Based on Entropy Method. Research on Yunnan Geographical Environment, **23** (02), 44, **2011**.