WEP Warwick Evans Publishing

International Journal of Natural Resources and Environmental Studies

ISSN: 3006-2012 (Print), ISSN: 3006-0834 (Online) | Volume 6, Number 1, Year 2025
DOI: https://doi.org/10.62051/ijnres.v6n1.12
Journal homepage: https://wepub.org/index.php/IJNRES/index

Evaluation of Water Resources Carrying Capacity in the Upper Reaches of Hanjiang River Based on Quantity and Mass Flow

Longyan Gan

College of Institute of Human Geography Tourism College, Xi'an International Studies University, Shaanxi, China

ABSTRACT

Water resources is one of the important resources of human society In order to scientifically analyze and promote sustainable development, it is necessary to build a comprehensive evaluation system of multiple elements of water resources carrying capacity. Therefore, based on the four dimensions of quantity, quality and flow of water resources, it is constructed by target layer, dimension layer This paper mainly uses analytic hierarchy process, AHP model and TOPSIS evaluation model to evaluate the current situation of water resources carrying capacity in Hanjiang River Basin, so as to provide theoretical support and foundation for ecological construction and urban development in the upper reaches of Hanjiang River, The evaluation results are as follows: ① the AHP model and TOPSIS evaluation model used in this paper can clarify the water resources carrying capacity and the water temporal and water spatial evolution of water resources in the upper reaches of the Han River; ② on the whole, the water resources carrying capacity in the upper reaches of the Han River is excellent, and thanks to the continuous improvement of the local water use system, the water resources carrying capacity is increasing year by year. Although there are individual differences in different regions, they all have their own rising space, among which Hanzhong City has the best performance.

KEYWORDS

Carrying capacity of water resources; Han River Basin; quantitative and qualitative domain flow.

1. INTRODUCTION

Currently, more and more experts and scholars pay close attention to the study of water resources, because with the development of society, the pressure on resources has brought insurmountable problems to the continuation of human society and the natural environment. With the development of the times, it can be seen that water resources are a very resource for humans. 12. Because water resources have brought all kinds of survival obstacles to human beings, it is necessary to construct a system that can evaluate its carrying capacity the right time. 3. The use of such an evaluation system can provide a foundation and theoretical support for social development and economic growth and the natural environment. 4. Finally it is possible to achieve a harmonious development between water resources and cities and population. The Hanjiang River Basin is rich in water resources, and with the increase in population density and water use and the change in residents' water use habits, it has brought increasing pressure to the water resources of the Hanjiang River Basin year by year. In this context, we to start paying attention to the effective use of water resources and constantly improve the utilization efficiency, and then introduce a complete set of water resource allocation system, so that the water resources in Hanjiang River Basin can be better utilized on the basis of the existing.

2. OBJECTIVE OF THE STUDY

2.1. The importance of water resources for urban development

Water is the foundation of all things and civilization, and together with sunlight and air, it constitutes the three major elements of life. Although some of resources we use on Earth can be replaced. For example, chemical plastic products can replace metal products. There are also alternative resources in terms of electricity resources, such as the development ofdropower resources and nuclear energy resources. But water resources are irreplaceable, water resources can provide a certain economic development power for society, and can have the same status as oil natural gas and other energy. Therefore, water resources play an increasingly important role in urban development, especially in cities built along the Han River Basin. Then, the situation of water resources utilization in urban development and residents' life and production life is very important. Therefore, through the analysis and research of the comprehensive water resources utilization situation in the Han River Basin, we better allocate water resources and more in line with the urban development fitness, and to a certain extent, provide reference basis and foundation for urban development and other issues.

2.1.1. The impact of water resources on the development of Han River Basin

First of all, several important grain bases in China, such as the Hanjiang River Basin, have a yearly output that can rank among the top few in country. In addition, different sizes of water conservancy projects have been built in areas such as Ankang and Shiquan, which have promoted the local social and economic development varying degrees. All aspects of production and life in society have different degrees of demand for water use, especially since 2000, the use of Hanjiang water sources has been increasing, so water resources play an important role in urban development.

2.2. Literature Review

2.2.1. Current Research Status

The research on resources to date exhibits the following characteristics; from the perspective of theoretical foundation, more comprehensive results have been formed. For example, Yu Haozhe et al. used the A and entropy weight method to conduct a weighted analysis of the main indicators of the Beijing-Tianjin-Hebei region, evaluated the weights of different indicators, and then used topsis evaluation model to further analyze and evaluate the above calculation results, and the following conclusions were drawn: the water pressure in this region is relatively large, the water use problems are, and the per capita water volume of the three provinces is low. Because there are some problems in the utilization of water resources in the Beijing-Tianjin-Hebei, such analysis and evaluation should be carried out to find out the coping strategies and provide references for the development of the region.

2.2.2. Research method

By drawing on the existing analysis model, the methods that can be used in the literature are collated, mainly using objective weighting method, and the topsis evaluation model. The flow data of the upstream area are calculated, and the conclusion is drawn immediately.

2.3. Overview of the Study Area

The Han River is the longest tributary of the Yangt River, with its drainage basin covering Shaanxi and Hubei. The basin has a low-lying terrain that gradually declines to the east, reaching the hilly plain area a drop of one thousand nine hundred meters. The Han River basin covers an area of about 150,000 square kilometers, with 55% of the area being mountainous and one-fourth being hilly and distributed in the southern and peripheral parts. This paper mainly studies the main cities in the upper reaches of the Han River Basin including Hanzhong, Shangluo, and Ankang, which will be introduced in detail below.

2.3.1. Regional Profile of Hanzhong Cityos.

Hanzhong is located in the southern part of Shaan Province, which is the western section of the Qinba Mountains, known as the "Little Jiangnan" since ancient times. It is located between 105°2′14″—108°16′49″ east longitude and 32°08′52″—33°52′6″ north latitude, with mountains accounting for 75.2% of the total area of the city. In 2020, the average precipitation in Hanzh City was 923.4 millimeters, basically the same as the long-term average precipitation, and the precipitation in the Hanjiang River Basin was close to the normal. The distribution of precipitation in the area is generally greater in the west than in the east. The annual precipitation in each county (district) is between 500—600 millimeters. The Hanjiang River belongs to the Yangtze River Basin. Due to the precipitation replenishment, the precipitation in Hanzhong City.

2.3.2. Regional Profile of Ankang City

Ankang is located in the southeast of Shaanxi Province, covering an area of 23,50 square kilometers. To the north is the Qinling Mountains, to the south is the Ba Mountains, and the Han River runs through it. The Ankang Basin is in the middle, with a latitude range of 31°42′~33°49′ and a longitude range of 108°01′110°01′. There are many subtropical animals and plants in the territory, such as the protected animal red-crowned crane. It is also known China's Selenium Valley. The per capita freshwater possession in Ankang City is 310 cubic meters, which is 1.5 times higher than the level, ranking first in Shaanxi Province and accounting for more than half of the province. The Han River flows 340 kilometers in the territory, which is the largestributary of the Yangtze River, with a basin area of 5,900 square kilometers, and it is the only water-intensive area. The annual is abundant. Hydropower is an important clean energy. In addition, Ankang City is also a water source protection area in the country. The following uses the water volume of three administrative regions as the evaluation index.

2.3.3. Regional Profile of Shangluo City

Shangluo City is located in the southeast of Shaanxi Province, south the Qinling Mountains, bordering the provinces of Hubei and Henan. It borders Henan Province to the east; it is adjacent to Yunyang District andunxi County of Hubei Province to the south; and it is close to Hanbin District of Ankang City and Chang'an District and Lantian County of'an City to the southwest. The latitude range is from 108°34′20″ to 111°1′25″, and theitude range is from 33°2′30″ to 34°24′40″. Shangluo has a semi-humid mountain climate, located in the regions of the Yangtze River and the Yellow River. Ankang City has relatively abundant water resources, with a river area of nineteen thousand kilometers, accounting for one-tenth of the total area of the province.

3. THE CHARACTERISTICS OF THE SPATIOTEMPORAL EVOLUTION OF WATER RESOURCES UTILIZATION IN THE UPPER REACHES OF THE HAN RIVER

3.1. Analysis of water use structure

3.1.1. Analysis of total water consumption

The annual total water consumption data in the three regions include the following specific data: residential water consumption and vegetation irrigation water industrial production water, and urban ecological construction water. Among these indicators, the basic water consumption in various cities has remained stable in the past ten years. In terms of industrial water, Hanzhong has basically maintained a water consumption of 100 million cubic meters in the past eight years, with little fluctuation, indicating that the industrial development has been stable progressive in the past ten years;

the trend of residential water consumption is generally upward.For Shangluo, the amount of water used for industrial production and the amount of water used for residential life are both increasing year by, with the former rising slightly more than the latter. The two indicators in Ankang are also increasing year by year, with its residential water use slightly higher than that of Hanong, and the industrial water use is also increasing with the development of the city. Overall, the water use indicators are ranked first in Hanzhong, followed by Ankang Shangluo. The three regions have different levels of development, different agricultural production areas and different industrial scales, so their water use varies to different degrees. Since the difference in indicators is very small, the total water use of the three cities is compared here. In the following figure, the total annual water use of the three regions in the past years is shown. It can be seen that Hanzhong, as the largest city, has a total water use of more than 1.6 billion cubic meters, while Shango has only about 300 million cubic meters. In general, there has been no significant increase or decrease in the past ten years, with the peak water use in Hanong in 2017 and 2018. In addition, the water use in other provinces is relatively low. However, from 2013 to2020, the increase in Ankang was 8.3%, making it the fastest growing province in terms of water use among the three provinces, which also to some extent the slightly higher development speed of Ankang in recent years compared to the other two cities. Shangluo's increase was only 3%.

3.1.2. Water Efficiency Analysis

The following chart shows the water consumption per ten thousand yuan of GDP. It can be seen from the chart the overall trend is exponential change, and the overall discount is from rapid decline to gradual decline. It can be seen that the water consumption per ten thousand yuan of GDP has changed the three places in the past ten years. First, the city with the highest water consumption is Shangluo, followed by Ankang, and Hanzhong is the efficient in water use. The water consumption per ten thousand yuan of GDP in Shangluo City has been the highest among the three cities since 2011, it began to decline to a low level in 2013, benefiting from a series of water use policies and resource allocation planning measures issued by the government. The water of the three cities has increased rapidly during the period of 2011-2013. After 2013, it continues at a relatively slow speed Hanzhong City has always had the lowest water consumption per ten thousand yuan of GDP among the three provinces, and its water efficiency is also slightly higher than that of the other cities, so the urban, agricultural, and ecological development of Hanzhong is also the most prominent among the three. Since 2014, the three cities have further their water consumption per ten thousand yuan of GDP at almost the same speed, decreasing year by year. Shangluo has the fastest growth in water efficiency, with an annual of 30%. Hanzhong, Ankang, and Shangluo are developing at a relatively synchronous speed, constantly narrowing the gap in regional development initially achieving common prosperity.

3.1.3. Urban development water use

Water resources play an immeasurable role in urban development, specifically reflected in industrial water use, agricultural water, and urban construction water use, among others. The following chart shows the water use volume of various types of water use in recent years. To begin with, in terms of total use, Hanzhong's total water use is the highest and far exceeds that of Shangluo and Ankang, which is twice the water use of Shango City. In terms of agricultural water use, since Hanzhong and Ankang are major grain-producing cities, the average water use per mu is greater than that Shangluo. It can be seen that there is a process of rising and falling in irrigation water use. With the increase in population and grain demand, the water volume has been continuously increasing. From 2014 onwards, the average water use per mu in the three cities has decreased, benefiting from the improvement of agricultural production technology and the of irrigation technology. In order to continuously save water resources, the government should continuously promote the development of water-saving agriculture; in recent years, the country has continuously advocated the construction an ecological and livable city, so in terms of ecological environment water use, it is in the early stage of construction and has been continuously rising since 2017. them, Shangluo's water use has increased the most significantly. Hanzhong, Ankang, and Shangluo are not dominated by industry, and water use in this regard is slightly less than in other aspects.

3.2. The problems of water resources in the upper reaches of the Han River

Although the water resources in the upper reaches of the Han are relatively abundant, both surface water and groundwater are superior to other provinces, the rapid development of cities and the large amount of production wastewater discharged into rivers for industrial needs have to water pollution. The residents' awareness of water conservation is not high, and although the water resources are not in short supply, the water consumption is also greater than that of developed. At present, there are also problems of varying degrees in terms of water quality and quantity.

3.2.1. Eutrophication of water bodies

The figure is a table of the scores for the eutrophication index of the water bodies in the three regions. Its scoring scale is often divided into three evaluation levels: poor,, and eutrophic. The evaluation scores are divided into three levels: TLI (∑) < 30 for poor nutrition, 30 ≤ TLI () ≤ 50 for moderate nutrition, TLI (∑) > 50 for eutrophication, 50 < TLI (∑) < 0 for mild eutrophication, 60 < TLI (∑) ≤ 70 for moderate eutrophication, and TLI (∑) > 0 for severe eutrophication. The higher the evaluation score value, the more serious the eutrophication of the water bodies in this region. The excessive use of chemicalizers in agriculture is an important cause of eutrophication, and chemical substances such as nitrogen, phosphorus, and potassium in pesticides will be over-discharged into rivers, pollution of the river basin. The discharge of industrial wastewater, domestic sewage, the use of chemical fertilizers, and pesticides are all contributing factors. Among them, the bodies in Hanzhong are the most eutrophic, and the water environment in Shangluo is the best. Therefore, in view of such problems, relevant departments should corresponding measures to reduce sewage discharge, optimize the sewage treatment process, and reduce the use of chemical fertilizers. This will enable the ecological environment to be restored as soon as and reach a state of harmony and unity between man and nature.

3.2.2. Lack of Water-saving Awareness

The total amount of water resources does not mean that water resources can be used wasted infinitely. The figure below reflects the per capita water use in the three regions in recent years. First of all, the overall water use in the three regions has been increasing year year, with Hanzhong and Shangluo's growth rate at about 3%, and the growth is not very obvious. However, the increase in per capita use in Ankang City from 2013 to the present is 14.7%, which is the highest among the three regions. Social and economic development water, but water-saving awareness is also very important. While developing the economy, it is also necessary to cultivate residents' awareness of environmental protection and water saving. From the of domestic water use, before 2019, the three regions were on the rise but with a slow growth rate, among which Ankang's growth rate was than the other two regions, reaching a peak in 2019, and then, thanks to the policy and people's awareness of water saving, the domestic water use significantly. Among them, Hanzhong's domestic water use is the highest, but Hanzhong City's total water resources are not the highest, which reminds people and government to publicize information related to water saving and cultivate residents' awareness of water saving, so as to make water resources sustainable.

4. EVALUATION INDICATORS AND METHOD CONSTRUCTION

4.1. The Concept of Water Resources Carrying Capacity Based on Quantity-Quality-Flow

With the development of the times and the continuous expansion of water use methods and ways, it not only necessary to consider the development of water resources, but also the river and lake pollution capacity, the development and occupation of aquatic space, and the development and utilization of hyower resources are also very important ways of utilization, which reflect the quantity of water resources, the environmental capacity of water resources, the scope of aquatic space, and the flow dynamics In the following text, it is simply referred to as quantity, quality, domain, flow. Therefore, when the research is carried out in depth, it is necessary to have a understanding of the causes of water resources overload, which theoretically includes the following four aspects: ①The residents have no sense of saving water, and the water consumption is much higher than supply amount of local water resources, which will lead to the continuous reduction of urban water storage and the continuous decline of groundwater level; ②The production and living will produce a amount of sewage and wastewater, and if there is no sewage treatment, it will be directly discharged into natural water bodies, which will cause the destruction of water quality ③Occupying and developing the water environment in the natural world will lead to the sharp decline of the water ecological environment; ④Human beings develop water resources in an endless, and carry out engineering development for any river section, and the unreasonable planning and utilization of water resources will bring serious consequences to local water resources.

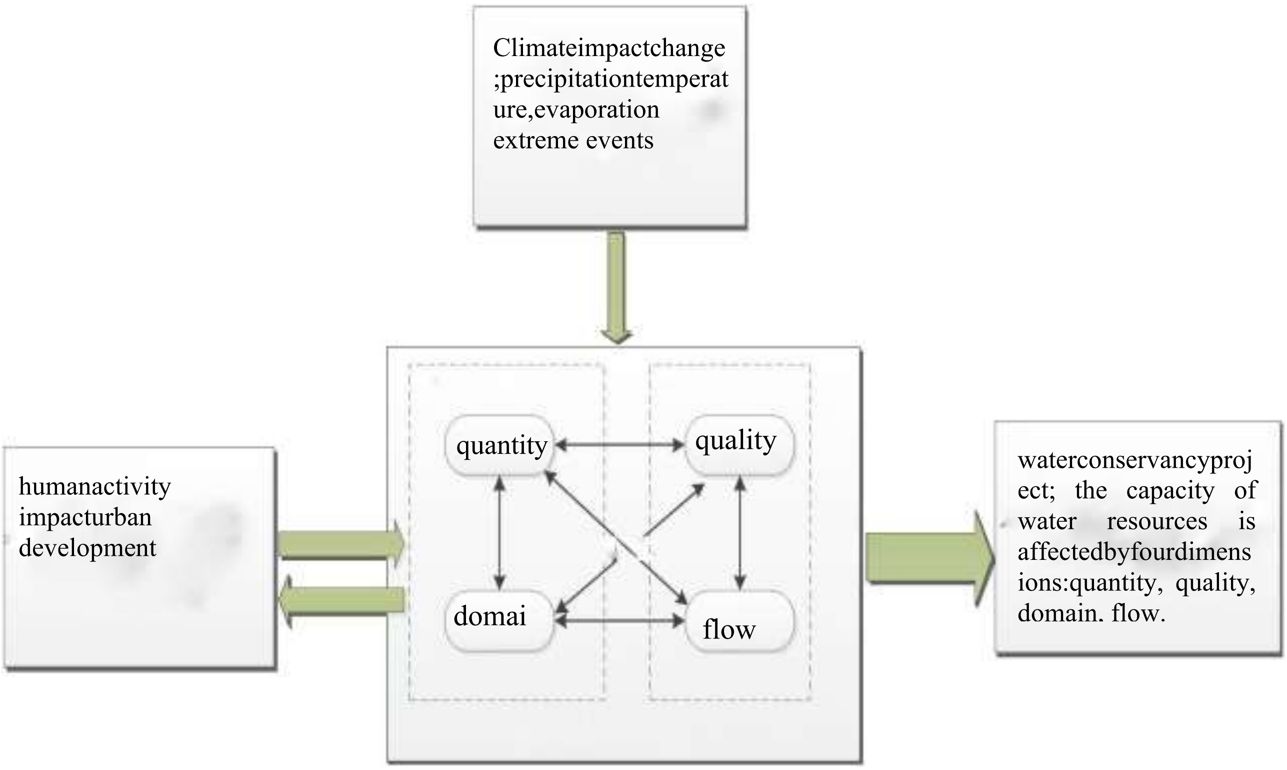

Fig 1. The concept connotation of water carrying capacity based on “quantity-quality-domain-flow”

4.2. The evaluation index of water resources carrying capacity based on quantity-quality-domain-flow in the upper reaches of Han River Basin

The evaluation of water resources carrying capacity is based on the concept of sustainable development, and the research focuses on the study of the influencing factors of water resources carrying capacity the related issues of carrying population, economic and social development scale, etc. In this paper, the data studied is divided into four levels, based on complexity and diversity of the water resources system and the complexity of the influencing factors, so it is divided into four levels, as follows; (1) The first level is the level, and the evaluation goal of this study is the comprehensive evaluation of water resources carrying capacity in the upper reaches of the Han River. (2) The second level is the level, and the evaluation system of water resources carrying capacity based on water quality, water quantity and water ecology is established. The first is the water quantity dimension: the endowment of resources is an important factor affecting the carrying capacity of water resources. On the scale of the water area: sufficient vegetation coverage, diverse water space, ecological support, water resources maintenance natural basic space. On the size of the water flow: the construction and engineering of the dam will cut and block the river, resulting in the normal transmission of matter and energy in upper and lower reaches of the river, such as blocking the reproduction of organisms in the river; the diversion project not only changes the pattern of the river itself, but also reduces biological environment in the river, resulting in the reduction of the ecological environment.. (3) The third level is about the index level, which is the aspects of the selected indicators following the specific requirements of each level. Therefore, the data should be scientifically and systematically selected and screened in the relevant literature, closely around the connotation of resources carrying capacity and the actual situation of the study area, and finally the comprehensive evaluation index system of water resources carrying capacity in the upper reaches of the Han River is constructed.

4.3. Sources of data

The data of the water resources index, the data of the environmental index and the data of the economic index in this article from the "Water Resources Bulletin of Shaanxi Province" and the "Statistical Yearbook of Shaanxi Province" from 2011 to 200; the "Annual Report on the Environmental Conditions of Shaanxi Province"; the bulletin of the national economy and social development, statistical yearbooks, etc.

Table 1. Evaluation index situation description

Indicator		Unit Indicator	Explanation
Total Water ResourcesX1	+	108 m3	The amount of water on the surface and underground
Water YieldX2	+	104 m3/km2	The amount of water resources per unit area
Drought IndexX3	-	/	The ratio of annual evaporation to annual precipitation
Water Use per 10,000 Yuan of GDP X4	-	m3/104yuan	The amount of water used divided by GDP
Per Capita Water UseX5	-	m3/person	The amount of water used divided by the population at the end of the year
Utilization Rate of Water ResourcesX6	-	%	The amount of water used divided by the total amount of water resources
Pop DensityX7	-	person/km2	he total population at the end of the year divided by the area of the administrative region
Per Capita GDP X8	+	yuan/person	GDP divided by the total population at the end of the year
Treatment Rate of WastewaterX9	+	%	The amount wastewater treated divided by the amount discharged
Proportion of Rivers of Grade III and AboveX10	+	%	Proportion of Rivers of Grade III and Above X10
The proportion of high-quality river length Wewater Emission per Unit AreaX11	-	104 t/ km2	The amount of wastewater emitted divided by the area of the administrative region
Emission per 10,000 Yuan of Industrial Output ValueX12	-	kg/104yuan	The amount of COD emitted by the industrial output value
Forest Cover RatioX X13	+	%	The area of forest divided by the total area of land
Ratio of Water AreaX14	+	%	The ratio of the area of water bodies to the total area
Groundwater Extraction RateX15	-	%	The amount of groundwater divided by the amount of groundwater resources
Ecological Environment Replenishment Rate X16	+	%	The amount of water used for the ecological environment divided the total amount of water resources
Ecological Environment Water Shortage Rate X17	-	%	The difference between the amount of water needed and the amount used for ecological environment divided by the amount needed for the ecological environment

4.4. Evaluation Model of Water Resources Carrying Capacity

4.4.1. The Method of Index Weighting

In order to avoid subjective and objective errors caused by the use of a single weight, the accuracy of the weight calculation process can be improved. Then the entropy weight method is used for objective weighting and the hierarchy process is used for subjective weighting. Entropy is a concept in information theory, which is a systematic measurement of imprecision. The entropy weight method uses the information entropy to calculate value of each index according to the degree of change of each index. The greater the amount of information, the smaller the uncertainty, the smaller the entropy, and vice versa. Use analytic hierarchy process (AHP) to calculate subjective weights Where is the weight of the indicator, where represents the objective weight; represents the subjective weight the combined coefficient, generally 0.5

4.4.2. TOPSIS evaluation model

TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) model belongs to the method of multi-objective decision making. Its principle is to rank the evaluation objects by calculating the distance between the evaluation objects and the optimal and worst ideal solutions. has been widely used in fields such as resource environment and energy development assessment

①

$$\boldsymbol{A} = \begin{bmatrix} a_{11} & \cdots & a_{1j} \\ \vdots & \ddots & \vdots \\ a_{1i} & \cdots & a_{ij} \end{bmatrix} \tag{6.1}$$

a_{ij}remains j indicator

②

$$u_{ij} = \frac{a_{ij} - min(a_{ij})}{max(a_{ij}) - min(a_{ij})} \tag{6.2}$$

$$u_{ij} = \frac{max(a_{ij}) - a_{ij}}{max(a_{ij}) - min(a_{ij})} \tag{6.3}$$

③

$$\boldsymbol{B} = \begin{bmatrix} \omega_1 u_{11} & \cdots & \omega_j u_{1j} \\ \vdots & \ddots & \vdots \\ \omega_1 u_{1i} & \cdots & \omega_j u_{ij} \end{bmatrix} = \begin{bmatrix} b_{11} & \cdots & b_{1j} \\ \vdots & \ddots & \vdots \\ b_{1i} & \cdots & b_{ij} \end{bmatrix} \tag{6.4}$$

④

$$\mathrm{T}^{+} = \{(max(b_{ij}) | j \in J^{+}),\ (min(b_{ij}) | j \in J^{-})\} = (\mathrm{T}_1^{+},\ \mathrm{T}_2^{+},\ \cdots,\ \mathrm{T}_j^{+}) \tag{6.5}$$

$$\mathrm{T}^{-} = \{(min(b_{ij}) | j \in J^{+}),\ (max(b_{ij}) | j \in J^{-})\} = (\mathrm{T}_1^{-},\ \mathrm{T}_2^{-},\ \cdots,\ \mathrm{T}_j^{-}) \tag{6.6}$$

⑤

$$\mathrm{S}_i^{+} = \sqrt{\sum_{j=1}^{m} (b_{ij} - \mathrm{T}_j^{+})^2},\ j = 1,\ 2,\ \cdots,\ m \tag{6.7}$$

$$\mathrm{S}_i^{-} = \sqrt{\sum_{j=1}^{m} (b_{ij} - \mathrm{T}_j^{-})^2},\ j = 1,\ 2,\ \cdots,\ m \tag{6.8}$$

⑥

$$\mathrm{C}_i = \frac{\mathrm{S}_i^{-}}{\mathrm{S}_i^{+} + \mathrm{S}_i^{-}},\ j = 1,\ 2,\ \cdots,\ m \tag{6.9}$$

5. RESULTS AND ANALYSIS

5.1. Calculation Results of Weights

The comprehensive evaluation index system of water carrying capacity was constructed by using the data of each in the upper reaches of the Han River from 2011 to 2020. The subjective and objective weights were calculated successively according to the calculation formula ofHP and entropy weight method, and the final calculation results are shown in Table 2.

Table 2 The comprehensive evaluation index system of water

Indicator	Entropy weight method	AHP method	Composite weighting
Per capita water resources	0.118	0.182	0.150
Water yield	0.041	0.034	0.038
Water resources development utilization rate Precipitation	0.042	0.032	0.037
Water resources development	0.098	0.056	0.077
COD emission per ten thousand yuan of industrial added value;	0.015	0.082	0.049
Ammonia nitrogen emission per ten thousand yuan of industrial added value;	0.025	0.082	0.054
astewater treatment rate	0.082	0.064	0.073
Ecological environment water consumption	0.019	0.084	0.052
Reservoir storage capacity	0.051	0.025	0.038
Water consumption per ten thousand yuan of GDP	0.117	0.141	0.129
Water consumption per ten yuan of industrial added value	0.056	0.045	0.051
Per capita water consumption;	0.045	0.031	0.038
Acreage of cultivated land irrigation water;	0.023	0.014	0.019
Population density	0.056	0.033	0.045
Per capita GDP	0.058	0.044	0.051
Urban rate.	0.154	0.051	0.103

5.2. The comprehensive evaluation score of water resources carrying capacity in the upper reaches of the Han River

The comprehensive evaluation scores of water resources carrying capacity in Hanong, Ankang, and Shangluo cities were scored, and different colors were used to indicate the carrying capacity scoring situation in different regions. The score greater than .5 is excellent, the score between 0.3 and 0.5 is medium, and the score less than 0.3 is poor, and its comprehensive evaluation distribution is shown in the above figure: all three cities are greater than 0.5, so the carrying capacity is in the excellent range. However, there are differences between other, Hanzhong city's comprehensive carrying capacity is the best, Shangluo is the worst, which indirectly reflects that Hanzhong's urban development, ecological, and economic development are all in the leading position. The main problems in Shangluo City are the discharge and treatment of sewage and the imperfect water use system. Although comprehensive score is at a backward level, there is still a lot of room for improvement.

5.3. Conclusions

This paper classifies and studies the utilization mode of water resources, carrying objects and the carrying bodies in the upper reaches of the Han River Basin, including Hanzhong City, Ankang City, and Shangluo City. Firstly, spatial-temporal change trend of water resources in the three regions was analyzed, and the contradiction and problems of water use were proposed through horizontal and vertical comparison. According to the water resources system of quantitative and qualitative fields, the subjective weighting method and topsis model were used to study, and the following conclusions were drawn: (1) The AHP model and tops evaluation model used in this study can better clarify the water carrying capacity problem and the spatial-temporal evolution problem of the upper reaches of the Han River, and can better complete the process to draw a relatively complete conclusion. Therefore, it can be concluded that this research method is applicable to the comprehensive evaluation of water resources in the Han River Basin. (2) speaking, the water carrying capacity in the upper reaches of the Han River is excellent, and the water carrying capacity is on the rise year by year, benefiting from the continuous improvement the local water use system. Although there are individual differences in different regions, they all have their own room for growth, among which Hanzhong City has the best performance.

REFERENCES

[1] Zuo Qitiang, Zhang Xiuyu. Research on the Dynamic Carrying Capacity of Water Resources under Climate Change. Journal of Hy Engineering, 2015, 46(4): 387-395. [ZUOQT, ZHANGXY. Dynamic carrying of water resources under climate change. Journal of Hydraulic Engineering, 2015, 46(4): 387-395

[2] Jin Juliang, Dong Tao, Li Jianqiang, et al. Evaluation of Water Resources Carrying Capacity under Different Carrying Standards. Advances in Water, 2018, 29(1): 31-39. [JINJL, DONGT, LIJQ, et al Water resources carrying capacity evaluation method under different carrying standards. Advances in Water Science, 2018, 29(1): 31-39.

[3] Wang Jiayang, Li Zuoyong, Yu Jing. The Half-Increased Γ-Type Distribution Index Formula for Water Resources Carryingacity Evaluation. Journal of Natural Resources, 2014, 29(5): 868-874. [WANGJY, LIZ, YUJ. Water resources carrying capacity evaluation based on Γ-type distribution function. Journal of Natural Resources, 2014, 29(5): 68-874.

[4] Jiang Qiuxiang, Fu Qiang, Wang Zilong. Evaluation of Water Resources Carrying Capacity Regional Differences in the Sanjiang Plain. Transactions of the Chinese Society of Agricultural Engineering, 2011, 27(9): 184-90. [JIANGQX, FUQ, WANGZL. Evaluation and regional differences of water resources carrying capacity in Sanjiang Plain. TransactionsoftheSAE, 2011, 27(9): 184-190.

[5] Xinjiang Water Resources Soft Science Research Group. Research on the carrying capacity of water resources in Xinjiang and its development strategyJ]. Water Conservancy and Hydropower Technology, 1989, (6): 2-9

[6] Xinjiang Water Resources Soft Science Research Group. Research on the carrying capacity of water resources in Xinjiang and its development strategyJ]. Water Conservancy and Hydropower Technology, 1989, (6): 2-9

[7] [7] Research on Current Situation and Carrying Capacity of Water Resources in the Hanjiang River Basin Gu Zhiqiang Gao Fei Wang Zhouyuan

[8] Ningning, Su Xiao Ling, Zhou Yun Zhe, Niu Ji Ping (Northwest A&F University, Yangling 71200) Evaluation of the carrying capacity of water resources in the Yellow River Basin Journal of Natural Resources, 2019, 34(8): 179-1770

[9] Comprehensive evaluation of the carrying capacity of water resources in Beijing-Tianjin-Hebei based on quantity-quality--flow Yu Haozhe 1,2

[10] Lü Yihe, Fu Wei, Li Ting, et al. Progress and Prospect Regional Comprehensive Carrying Capacity of Resources and Environment [J]. Progress in Geography, 2018, 37(1)

[11] Ding Jing, Qin Guanghua, Li Hongxia. Discussion on the Design Carrying Capacity of Water Resources [J]. Journal of North China Institute of Water Conservancy and Hydroelectric Power (Natural Science Edition)

[12] Zuo Qiting. Construction and Research Prospect of the Most Strict Water Resources Managementurance System [J]. Journal of North China Institute of Water Conservancy and Hydroelectric Power (Natural Science Edition)