ANALYSIS OF COUPLING STATE OF MAN-LAND RELATIONSHIP REGIONAL SYSTEM IN DAIHAI BASIN: A CASE STUDY OF ULANQAB, CHINA

Zheng Hui *

*1.Researcher of Faculty of Geography and Geoinformation systems, National University of Uzbekistan, Tashkent 100174, Republic of Uzbekistan

*2. Faculty of Geography and Planning, Jining Normal University, Ulanqab 012000, People's Republic of China

*3. Key Laboratory of Geospatial Big Data Application and Environmental Monitoring, Jining Normal University, Ulanqab 012000, People's Republic of China

Abstract: *This study investigates trends in the evolution of the coupling state of the man-land relationship and the primary barrier by using a model of the coordination and coupling of the man-land link to the regional system and the Ulanqab in the Daihai Basin as a topic. The next conclusions were reached: (1) Regional development intensity index, resource and environment level index, and trend in collaborative development after 2015 all demonstrated a varying and intertwined growing tendency. (2) After 2004, the coupling degree reached high-quality coupling, and after showing a weak upward trend, the coupling degree reached good coordination in 2012. (3) Effective irrigated area, total area of crops planted, effective irrigated area, and total population at the end of the year were the key barrier variables; (4) It is advised to support integrated urban and rural growth, uphold green development, and improve the hub economy's agglomeration function.*

Keywords: *Daihai Basin; Man-land relationship; Coupling coordination; Degree of obstacle*

INTRODUCTION

Man-land connections relate to the effects of human activity on the physical environment, the modifications and effects these activities have on resources and the environment, as well as the responses of the altered resources and environment to human activity [1]. Relationship between people and land area system is interaction between human activities and geographic environment on the earth's surface layer formed by the open complex giant system [2]. In this complex giant system, where people have always dominated, people interaction, relationship with the law of time and space, and relationship between man and the contradiction of coordinated process have always been the main research areas for geography and other related science [3-6].The relationship between people and the land area system is at the core of geography research spirit and theoretical foundation, and is to implement the global sustainable development strategy and the significant law of circular economy strategy. Relationship between man and the optimization of regulation directly determines the success or failure of the global and regional sustainable development strategies [7].

Chinese researchers have conducted systematic study on two key topics related to the interaction between people and the land, including dry desert regions, river basins, lakes, and wetlands, as well as diverse geographic locations on macro, meso and micro scales. Diversification of research techniques is on the rise. Widespread use is made of improved techniques like system dynamics [8], ecological footprint [9–10], and the coordinated coupling model [11–12]. One of the key areas for the future growth of geographical science in China is to strengthen research on how land-sea links have changed in common regions. Due to their relative complexity, it has been challenging to objectively distinguish between the various types of anthropogenic systems. Many common locations are frequently represented in the worsening land conflict across a wide range of geographical and chronological dimensions. At the same time, it will provide recommendations for typical areas to reduce land-use disputes and encourage sustainable development. This paper

examines trends in the development of people-place relations and the impact of barriers, using the Darjeeling Basin as an example of arid and semi-arid regions, in order to provide recommendations and reference points for sustainable development in the Darjeeling Basin and other arid and semi-arid regions.

MATERIALS AND METHODS

The Daihai Basin is located in Ulanqabu City in northern Inner Mongolia at the coordinates 112°10'E 112°59'E, 40°48'N 40°55'N, and has a watershed area of 2312.75km2. Between the Yongding River basin and the Yellow River basin, there is a confined inland salt lake basin, with a basin in the middle containing the Daihai River. The basin is surrounded by mountains. Long, cold winters and short, hot summers are characteristic of the temperate continental climate enjoyed by the Great Smoky Mountains. The average annual temperature is 5.0°C, the typical annual precipitation ranges from 350 to 450 mm, and the typical annual water surface evaporation capacity is around 1200 mm. With irregular flows, 22 different rivers supply water to the Daihai River basin.

We have created a comprehensive system of evaluation metrics for man-land interaction regional systems, based on the findings of prior studies and adhering to scientific, regional, and data availability criteria. The volume system of human exploitation consists of land use, economic development intensity and population growth. Twelve indices made up three subsystems, including intensity (Table 1), The Resource Environmental Carrying capacity System, which is supported by the Resource Utilization Level, Ecological Environmental Stress, Ecological Environmental Protection, and an additional 3 subsystems, consisting of 12 indicators (Table 2).

Table 1. Evaluation index system of human development activity intensity subsystem

System layer	Subsystem layer	Entropy weight	Index layer	Units	Index attribute	Entropy weight
Intensity of human exploitation activities	Population size expansion (PSE)	0.1412	Year-end Population	Person	+	0.4631
			Urbanization rate	%	+	0.1589
			Natural population growth rate	%	+	0.1484
			The proportion of non-farm employment	%	+	0.2296
	Economic development intensity (EDI)	0.2409	Gross regional product	Yuan	+	0.2858
			Per capita gross regional product	Yuan	+	0.2593
			Urban fixed-asset investment	Yuan	+	0.3010
			Proportion of non-agricultural output value	%	+	0.1539
	Land use intensity (LUI)	0.6179	Urban built-up area	Km^2	+	0.1132
			Total power of agricultural machinery	KWH	+	0.1625
			Effective irrigated area	Hm^2	+	0.3092
			Road eara per sitizen	m^2/ Person	+	0.4150

Table 2. Evaluation index system of resource and environmental carrying capacity subsystem

System layer	Subsystem layer	Entropy weight	Index layer	Units	Index attribute	Entropy weight
Resource environmental carrying capacity	Resource utilization level (RUL)	0.5501	Total Sown Area	Hm^2	+	0.2055
			Grain total output	Ton	+	0.1414
			Greenery coverage of urban area	%	+	0.4528
			Per capita park green area	m^2	+	0.2004
	Ecological environmental stress (EES)	0.2300	Total annual water supply	Ton	-	0.2649
			Industrial Waste Water Discharged	Ton	-	0.1925
			Industrial sulfur dioxide emissions	Ton	-	0.4251
			Industrial soot (powder) emissions	Ton	-	0.1175
	Ecological environmental protection (EEP)	0.2199	Planting area	Hm^2	+	0.1610
			Treatment rate of domestic sewage	%	+	0.4073
			Harmless disposal rate of household garbage	%	+	0.1462
			Comprehensive utilization rate of industrial solid waste	%	+	0.2855

The main research area for this study is Ulanqab in the Daihai Basin, and the data was gathered from the Inner Mongolia Statistical Yearbook and the Ulanqab Statistical Yearbook between 2004 and 2019 to thoroughly assure the originality, authority and reliability of the raw data.

The human activity intensity metric and the resource and environment carrying capacity metric are derived after the initial data has been standardized and the weights of each metric have been established using the entropy weighting method.

Coordination degree and coupling degree model of man-land relationship

Based on the coupling degree model between the domestic and foreign scholar systems, we construct the coupling degree model for the man-land relations regional system[12]:

$$H = \sqrt{L \times T}, \quad L = \frac{2\sqrt{HA \times RE}}{HA + RE}, \quad T = \lambda_1 HA + \lambda_2 RE$$

Where, ***H*** is the coupling degree of man-land relationship; ***L*** Coupling coordination degree of man- land relationship; ***T*** is the integrated man-land relationship index, ***HA*** is the intensity index of human activity, ***RE*** is the resource and environment carrying capacity index; λ_1, λ_2 are set parameters, there is in, $\lambda_1 + \lambda_2 = 1$, according to the man-land relationship interaction mechanism and research needs, set $\lambda_1 = \lambda_2 = 1$, the larger ***H***, the higher the degree of coupling, the larger ***L***, the better the degree of coordination.

Obstacle factor diagnosis model

The obstacle factor diagnostic model is used to objectively identify the major influences affecting the coordinated development of the man-land relations regional system, which is calculated as follows[13] :

$$O_j = \frac{I_j \times \omega_j}{\sum_{j=1}^{m} I_j \times \omega_j}$$

Where: ω_j is the weight of the JTH index; I_j is the difference between the optimal target value and the actual value of each index, which can be expressed as $1 - r_{ij}$ (the difference between the normalized value of each index and 1).

RESULTS

Analysis on the coupling evolution trend of the regional system of man-land relationship

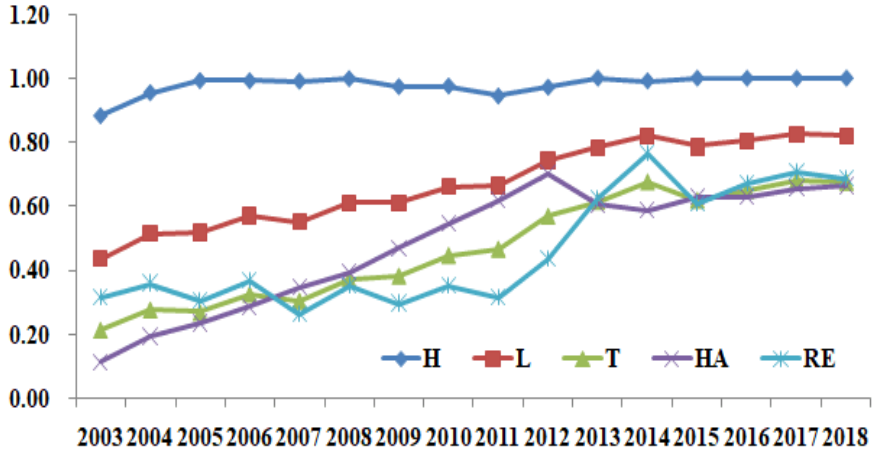

Figure 1. Variation of human activity intensity, resource and environment carrying capacity and coupling degree

According to the comprehensive analysis in Fig. 3, the intensity of human development activity and the resource and environmental carrying capacity index show co-evolutionary features. The resource and environmental carrying capacity fluctuated from 2003 to 2011 and has shown a rapid growth trend since 2012. The intensity of human activity is continuously within a controllable threshold of resource and environmental carrying capacity. The evolution process of coupling degree of man-land relationship regional system from 2003 to 2018 was from High level coupling (2003) to High quality coupling (2004-2018), and the average coupling degree of 16a was 0.9794.

The study period is stable in the high-quality coupling phase for a lengthy period of time, which comprehensively reflects the long-term process of mutual integration, promotion, coordination and synchronous development and evolution of man-land relations in the Daihai Basin regional system. The coupling coordination curve shows

a steady and continuous upward trend, increasing from 0.4532 in 2003 to 0.8217 in 2018 with an increase value of 0.3685 and an average annual growth rate of 2.30 percent. In the latest 16a, the mean coupling coordination is 0.6701 and the coordination type is moderate. Evolution process of coupling coordination from 2003 to 2018: Mild disorder (2003) -Moderate coordination (2004-2011) -Good coordination (2012-2018) and other three coupling coordination evolution processes, the coupling coordination degree can still be improved.

Diagnosis of obstacle factors in man-land relationship regional system

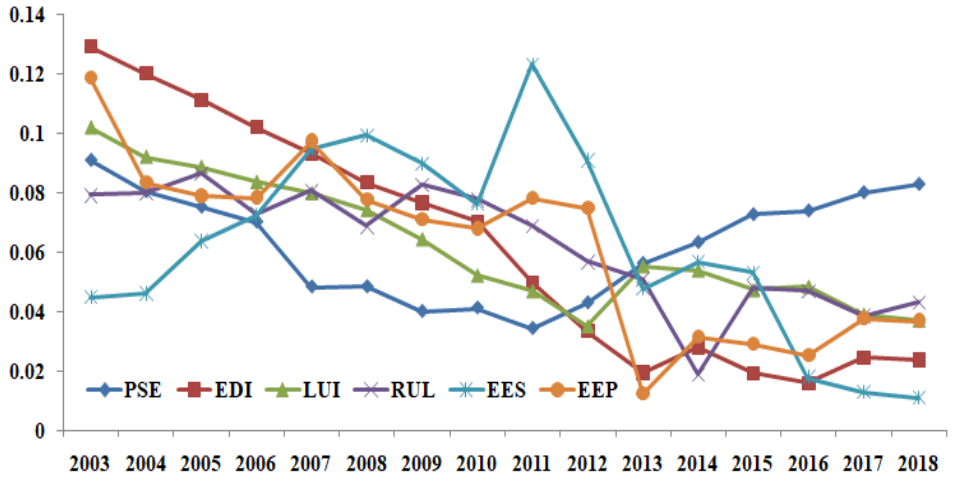

Figure 2. Changing Trend of the barrier subsystem of the regional system of man-land relationship

As can be seen in Fig. 2, the inter-site barrier fraction as a function of the inter-site barrier fraction typically shows a fluctuating and decreasing trend, with the dominant barrier subsystems and barrier factors exhibiting phase differences. (1) From 2003 to 2013, the Daihai Basin was in the stage of rapid urbanization development. The size of the population continued to increase, and both GDP and urban fixed-asset investment increased year-on-year. In 2007, the intensity of human development activities exceeded the carrying capacity of resources and the environment, and the man-land relationship began to evolve in a discordant direction, with contradictions in the man-land relationship coming to the fore. The strength of economic development and the level of resource utilization are the main barriers for

subsystems to affect the degree of coupling coordination of the system during this period. Urbanization rate, GDP per capita, urban sewage treatment rate and per capita area of park green space are major obstacles. (2) 2014-2018, guided by the idea of ecological civilization in the regional economic structure transition iteration upgrade, people-centric efforts to build a different type of urbanization continues, surrounding the overall economy better the siphon effect of central cities, population outflow is more outstanding, population scale expansion to become main obstacle subsystem of this phase, the effective irrigation area, The total population at the end of the year, the natural growth rate of population, the total sown area of crops, and the afforestation area were the main obstacle factors.

CONCLUSION AND SUGGESTIONS

Conclusion:

In this study, we have scientifically developed a comprehensive system of evaluation metrics for regional man-land interaction systems based on the concept of cooperative development. The integrated development level and coupled state evolution of Ulanqab in the Daihai Basin from 2003 to 2018 was evaluated using a coordination and coupling degree model of man-land relations and an obstacle factor diagnostic model to comprehensively examine the primary barriers. The main conclusions are as follows:

1) From the perspective of the comprehensive development level of the system, the regional system development index of man-land relationship showed an increasing trend of staggered fluctuation from 2003 to 2018, and the resource and environment carrying capacity continued to strengthen. The intensity of human activity is continuously within a controllable threshold of the carrying capacity of resources and the environment.

2) From the perspective of the evolution process of coupling degree and coupling coordination degree, the coupling evolution process of man-land relationship regional system showed a continuous upward evolution trend and reached good coordination in 2004. It remains necessary to continue to increase the

intensity of human development activities and the capacity of resources and environments for collaborative and interactive development.

3) From the perspective of main barrier factors, the score of subsystem and index barrier factors showed a decreasing trend year by year, and the barrier subsystem gradually shifted from the intensity of economic development and the level of resource utilization to the expansion of population scale; more recently, the main barriers have been: total crop sown area, effective irrigation area, and total population at the end of the year.

Suggestions:

1) Putting ecology first and pursuing green development. The ecological and safety in a more prominent position, balanced economic, social, cultural and other diverse demand, strengthen the function of central city services, reasonable control development intensity and population density, optimized development pattern, improve the function of municipal facilities, strengthen the construction of digital city, improve the ability of intelligent management, promote urban development from the extension expansion to connotation lift.

2) Focus on improving the agglomeration function of hub economy. Play location convenient transportation, livestock products high quality, excellent ecological environment, the advantages of the port hinterland are linked together, to develop an open economy, creating central trains, the goods collection center, building a green livestock products brand development area, graphite new materials production base of well-known destinations, tourism, leisure vacation, green data center, national logistics hub essential nodes in the network.

3) Promoting integrated development between urban and rural areas. We will improve the systems, mechanisms and policies for integrated urban and rural development, coordinate urban and rural development, improve planning for county and rural development, and make appropriate spatial arrangements for industrial agglomeration, village distribution, ecological conservation, and farmland protection, so as to form a new pattern of villages with rational distribution, complete functions, and coordinated and orderly distribution. We will improve the living environment of cities, improve their integrated functions and guide people to concentrate in cities and towns.

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