



Research Article

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Ecosystem Vulnerability System in Mining City

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ABSTRACT

Mining city in the central plains is an important energy production and heavy industry in China, studying its ecosystem vulnerability is helpful to improve the regional environment deterioration, the condition of ecological system imbalance, offering the decision basis for its sustainable development. The paper Based on the mining urban compound ecosystem connotation, establishes the evaluation index system of mining vulnerability in the central plains, puts forward ecological system coordination degree, and sets its vulnerability and coordination classification standard. Results show that in 2010, mining in the central plains urban ecosystem vulnerability in metastable state, the main limiting factors for the resource matching index, the index of environment quality and economic development index; Mining cities in the central plains ecological system in the coordination, which is slightly lower than the coordination, benxi in low-alcohol disorder. Anshan resources matching index is in a disorder, The evaluation model in real world reflecting the mining cities in the central plains ecological system vulnerability, coordination, and puts forward the main limiting factors restricting its development.

Keywords: ecosystem vulnerability; vulnerability and coordination; evaluation model

INTRODUCTION

Resources are growing, this contradiction is mainly human unrestrained development of nature, causing worsening environment, ecological increasingly fragile. Vulnerability research, therefore, more and more gets people's attention. Global change human behavior plan (HDP) In the sixth session, Marco Janssen said in its report [1] over the past 30 years, 2 286 authoritative publications, the fragility of the term appeared 939 times, in the past ten years, a trend of increased year by year. Research involving geological hazard -formative factors [2-4], climate change [5-8] and land use change [9-11], risk research [12-14] and regional sustainable development [15, 16], etc. Based on existing research at home and abroad believe that regional vulnerability refers to within a certain time and space, under the natural and human activity disturbance, the regional ecological system, group or individual to suffer loss or damage to a certain extent, this kind of loss or damage of ecosystem function in terms of natural damage, environmental deterioration, biodiversity decrease, etc., characterized by slow growth or even stagnation in the humanities, people's living standards decline, social property damage, etc. Mining cities is refers to the formation or development for mineral resources development, main functions and important function to the society to offer its minerals and raw products of the city. Mining resources development cause serious damage in the regional environment, and with the depletion of mineral resource, the mined-out area take up a lot of ground subsidence, waste land, the pollution of the environment, the enterprise economic efficiency decline, loss of enterprise than the big, many laid-off workers. Therefore, the development of the mining cities, is from a typical agricultural and pastoral areas, forests and other natural or semi-natural ecological system, and different from modern cities, in terms of ecological, economic and social development has distinguishing feature alone. Previous study of mining cities should be environmental pollution control, economic structure adjustment, social development and population change evaluation, regional planning, etc., and mining city sustainable development from the perspective of vulnerability analysis is less. Therefore, the author discusses the mining cities in the central plains vulnerability index

system and evaluation method, analyzes the degree of ecological fragility and its forming reason, can provide decision-making basis for the sustainable development in the region.

RESEARCH AREA AND RESEARCH METHODS

THE RESEARCH DOMAIN

China's important energy base, has a wealth of coal, iron, oil and other resources, developed on the basis of many rely on mineral extraction, processing of mining city, mining city standards according to the definition of shen radium [18]: Engaged in the mining industry the number of 15% of all workers, or mining output value accounts for more than 10% of urban industrial output, the city is the mining city. Mining cities in the central plains, including anshan, fushun, benxi (figure 1). The main mineral of Anshan of are iron ore, magnesite, jade and talc. fushun's main mineral are shale, coal, copper and zinc which of benxi are iron ore, coal, copper, zinc and limestone. Total area of the three cities is 28 955 k m², 19.63% of the total area of liaoning province. All and anshan, fushun, benxi, east to liaodong mountain foothills, anshan other than the eastern region belongs to the liaohe plain zone. The area is the warm temperate zone continental monsoon climate, annual average temperature of 7 ~ 10, the average annual rainfall of 650 ~ 900 mm, frost-free period of 130 ~ 170 days. Shortage of water resources, cultivated land resources more, percapita is far lower than the world average. Forest coverage rate is higher, at 48% in anshan, fushun to 64.5%, benxi is 69.1%. In 2005, the region's population reached 728. 2005, accounting for liaoning province 17.26%, GDP at 1, 751. 5.3 billion yuan, accounting for liaoning 21.88%. The first, second and third industries output value ratio of 5.5:55.7:38.8, The leading industry is processing, steel smelting and building materials for oil production and machinery manufacturing.

RESEARCH METHOD

THE ESTABLISHMENT OF EVALUATION INDEX SYSTEM

Currently at home and abroad, the regional ecological fragility carried out extensive and in-depth research, because the cause of ecological vulnerability is varied, the different regional ecological vulnerability of forms are also different. Based on the characteristics of mining cities large resource consumption, serious environmental pressure, and the social burden heavier, vulnerability at home and abroad for reference, the content of the evaluation index eliminate the overlap of the index between information, an analysis of the relevant indicators, the correlation coefficient reaches 0.9 indexes merge. The resulting ecosystem vulnerability evaluation index system of mining cities is in the central plains (table 1). In this paper, combined with the specific situation of the mining cities in the central plains, in the evaluation of urban ecological system vulnerability, divides the evaluation of five levels: stability, the stability, the stability, the fragile and vulnerable. The different principles of the standard of evaluation of indicators exist to determine the level evaluation standard. Generally can be divided into three types of index: class A positively correlated indexes and fragility, the bigger the index, the higher the regional ecological fragility. Such as the degree of desertification, land destroyed in mining area rate, industrial solid waste emissions and loss of enterprise scale, etc. Which the index of national or regional planning ideal value to stabilize the standard, cause harm to the environment value as a fragile accepted standards, divided in proportion among various standards. Class B index and negatively correlated with vulnerability, that is, the parameter values, the greater the regional ecological fragility is lower. Such as per capita arable land, water resources, the per unit area yield of grain per capita, per capita GDP, per capita housing area, etc. The class indicators have maximum theoretical or stable good value as the standard, theory of the minimum or not good value for the fragile standards. Such as grain yield meet the demand of regional population lives to stabilize the value, the theoretical value in the history of severe drought's value per unit area yield of grain is fragile. Class C is index correlation or skewness distribution, such as the city's population density, the third industry share of GDP, etc. The class index get the standard recognized at home and abroad the status quo of ecological status to stabilize.

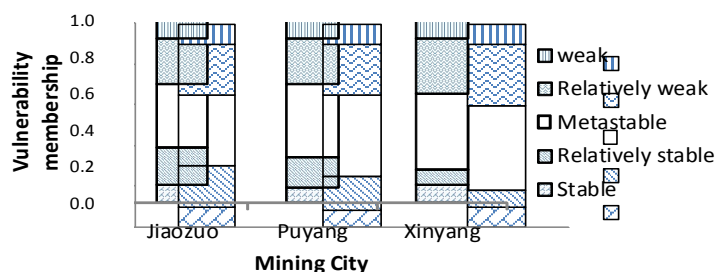


Fig.1 Mining City

THE ESTABLISHMENT OF THE EVALUATION MODEL

At present, the regional ecological fragility evaluation method is still not very perfect. Given area has a wide field in evaluation of ecological vulnerability, and the evaluation index is more comprehensive, integrated, so this article

USES the ecological field is relatively commonly used comprehensive evaluation method to evaluate mining cities in the central plains ecological system vulnerability. The expression is as follows: $V = W \times R$, V is the regional ecological system vulnerability, W is the weight of each index, this paper use AHP method first weight, and then using information entropy to modify, R is the index of vulnerability standards at all levels of membership degree.

THE CALCULATION OF COORDINATION DEGREE

For mining city ecological system, the development of a certain elements may be come at the expense of other elements, or system damage or even destroy, and maintain good relationship between each system sustainable development, emphasizes the system as a whole, global optimization and common development. Therefore, this article introduces coordination degrees supplement mining urban vulnerability evaluation indexes. Expression is as follows:

$$HD = n \sqrt[n]{\prod_{i=1}^n A_i}$$

RESULTS AND DISCUSSION

THE ANALYSIS OF SYSTEM VULNERABILITY

By the method of the ecological vulnerability assessment, mining in the central plains urban ecosystem vulnerability evaluation results are shown in table 1. Overall, in 2010, mining in the central plains urban ecosystem vulnerability in metastable state, the humanities environment vulnerability slightly better than the natural environment vulnerability, but all are metastable levels, shows that the region ecosystem development potential is large, if the proper ecosystem management scheme, reduce the limiting factors of ecological system vulnerability, the region ecosystem vulnerability will be significantly reduced, and achieve a steady state. From different mining cities (figure 2), anshan ecosystem vulnerability is stable, relatively stable and metastable proportion is the largest, fushun, benxi, at least show that on the whole, although the three urban ecological system vulnerability are generally, but anshan relatively best ecological construction, ecological system vulnerability minimum; benxi in ecosystem vulnerability and the stability degree of membership degree is the largest, benxi ecological system development potential is great, if eliminate ecosystem vulnerability of limiting factors, can be developed to the direction of healthy and stable. Specific to each system vulnerability can be seen that the natural environment vulnerability benxi lowest, fushun second, anshan is the highest, is the degree of stability; Human environment vulnerability in anshan, fushun, in metastable state, benxi weaker. Among them, the climate index of coordination of three cities are higher, shows that the region climate condition is good, low vulnerability; Land health index in anshan is fragile, fushun is stable, metastable benxi, anshan shows that land use is not reasonable, especially the land destroyed in mining area of rate is larger, the influence on ecosystem vulnerability; Resource matching and environmental quality index in three cities are more fragile and vulnerable, shows that the two are the major limitations of mining cities in the central plains ecological system vulnerability factor, protect arable land, water conservation, improve environmental quality, will be reduce the vulnerability of the ecosystem in the region must be the problem to be solved; Economic development index in anshan is stable, fushun, benxi, weaker, showed better efficiency of anshan economic system, fushun, benxi further economic structure optimization and adjustment; Social development index of three cities are the degree of stability, still need to further optimize the structure of social system, to improve people's living standards; Stable mining development index of anshan, fushun, benxi weaker fushun membership degree is 0.61, shows that the mining economic development better industrial structure adjustment, the effective benxi to intensify efforts to governance the mining problem, especially the loss of enterprise's management and the off-duty workers again obtain employment problem.

Tab.1: The assessment on ecological vulnerability of mining cities in Central Plains in 2010

Index	Jiaozuo	Puyang	Xinyang
Climate Coordination Index	(0,0,0.70,0.30,0)	(0,0.44,0.56,0,0)	(0,0.16,0.69,0.15,0)
Land Health Index	(0.28,0,0.24,0.48,0)	(0.28,0.32,0.2,0.2,0)	(0.28,0,0.48,0.24,0)
Resource matching index	(0.1,0.14,0.04,0.48,0)	(0.07,0,0.12,0.63,0.18)	(0.1,0.06,0.3,0.2,0.34)
Environmental Quality Index	(0.17,0.10,0.27,0.06,0.4)	(0.24,0.08,0.28,0.1,0.3)	(0.24,0.17,0.2,0,0.39)
Economic development index	(0,0.56,0.44,0,0)	(0,0.18,0.36,0.46,0)	(0,0,0.4,0.58,0.02)
Social Development Index	(0.25,0.19,0.44,0.12,0)	(0.25,0,0.4,0.35,0)	(0.25,0,0.4,0.25,0.1)
Mining Development Index	(0,0.2,0.48,0.32,0)	(0,0.04,0.61,0.35,0)	(0,0,0.4,0.6,0)
Natural Factor	(0.14,0.06,0.31,0.33,0.16)	(0.16,0.2,0.3,0.23,0.11)	(0.15,0.1,0.42,0.17,0.16)
Humanities factor	(0.07,0.34,0.45,0.14,0)	(0.1,0.1,0.45,0.35,0)	(0.1,0,0.4,0.5,0)
Comprehensive Index	(0.11,0.2,0.38,0.23,0.08)	(0.1,0.14,0.4,0.3,0.06)	(0.12,0.05,0.46,0.3,0.07)

Mining cities in the central plains ecological system vulnerability in the metastable state, this is not only a few major limiting factors, and is the result of interaction between systems. Therefore, this article through the analysis of mining cities in the central plains coordination degree between systems, further explore the connotation of the region's vulnerability (table 3). Overall, in 2005, the state of ecosystem in mining cities in the central plains and the coordination, is slightly lower than the coordination, benxi in low-alcohol disorder state. Natural environment between the coordination and low misadjustment, each system show that the region's natural environment system is quite unstable stage, if to strengthen environmental management, pay attention to the overall development, natural environment system it can develop to the coordination degree, the opposite will low-alcohol disorders or disorders; Humanities environment system of coordination between the regional difference is larger, anshan is coordinated, fushun and coordination, and low imbalance, benxi showed that anshan in economic development, social progress, the mining enterprise reform aspects of common development, harmony is higher. Specific to each subsystem can be seen that mining cities in the central plains in climate coordination index, the index of land health, the environment quality index, the index of social development, mining development index achieves the coordination or the coordination state, the subsystem of the overall harmonious development, to the region ecosystem vulnerability reduction plays a positive role; On the other hand, the anshan resources matching index is in a disorder, fushun, benxi resources matching index is in a state of disorder, index of economic development in the state of disorder. Wooden barrel theory tells us that the bucket volume depends on the shortest board length, increase the length of the shortest board is the key to improve the whole bucket volume. Therefore, change the mining city in the central plains are cultivated land and per capita water resources, mineral resources saving, further optimization and adjustment of industrial structure, improve the economic benefit, reduce energy consumption, will be the key to improve the region ecosystem vulnerability.

Tab.2 The assessment on ecological hamony degree of mining cities in Central Plains in 2010

Index [↗]	Jiaozuo [↗]	Puyang [↗]	Xinwang [↗]	↗
Climate Coordination Index [↗]	0.424 [↗]	0.627 [↗]	0.498 [↗]	↗
Land Health Index [↗]	0.538 [↗]	0.671 [↗]	0.575 [↗]	↗
Resource matching index [↗]	0.235 [↗]	0.150 [↗]	0.176 [↗]	↗
Environmental Quality Index [↗]	0.449 [↗]	0.471 [↗]	0.487 [↗]	↗
Economic development index [↗]	0.554 [↗]	0.281 [↗]	0.207 [↗]	↗
Social Development Index [↗]	0.649 [↗]	0.496 [↗]	0.446 [↗]	↗
Mining Development Index [↗]	0.643 [↗]	0.455 [↗]	0.450 [↗]	↗
Natural Factor [↗]	0.397 [↗]	0.415 [↗]	0.401 [↗]	↗
Humanities factor [↗]	0.611 [↗]	0.402 [↗]	0.346 [↗]	↗
Comprehensive Index [↗]	0.491 [↗]	0.407 [↗]	0.371 [↗]	↗

CONCLUSION

According to the specific situation of the mining cities, in the central plains from the natural environment, social economy, the level of mining development from several aspects, and evaluation of the ecological system vulnerability and introducing the coordination degree of supplement mining urban vulnerability evaluation indexes, makes up for the previous research on mining cities overall evaluation defects of less contact each subsystem, it is a beneficial supplement vulnerability case study.

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