

Study on Risk Zoning Technology of Major Environmental Risk Sources in Urban Scale and Its Application in Shanghai, China

*Ya Yang , Junwei Ma

Beijing Normal University ,State Key Joint Laboratory of Environmental Simulation and Pollution Control, School of Environment, Beijing

P. R. China ,100875

Abstract

Because of the inherent characteristics of the cities, such as high population density, complicated traffic, numerous pollution sources, etc., it has become very important to conduct environmental risk zoning in urban scale. Based on analyzing the current research situation of the regional environmental risk assessment and regional environmental risk zoning, this paper constructed the index system and the quantitative model of environmental risk zoning which are fit for urban scale, applies AHP to weight index and comprehensive evaluation method to calculate comprehensive risk index value. Then applying the method to Shanghai ,and with the clustering function of SPSS and the visualization of GIS, the quantitative risk zoning map of Shanghai was obtained .The result can provide reference for environmental risk management of Shanghai .

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Keywords: urban scale; major environmental risk sources; quantitative zoning technology;Shanghai .

1. Introduction

With the fast development of social economy and the acceleration of urbanization, there are some common features in large cities of China(such as Beijing, Shanghai, Guangzhou and Tianjin): high population density; industrial agglomeration and a large number of petrochemical industries; developed transportation and many dangerous mobile sources; vulnerable urban public safety systems; a variety of potential risk and wide affecting range; requiring fast speed and accurate emergency response and emergency decision-making after the accident, etc.

These features make the harms caused by the city-scale environmental risks have a "domino" effect. Therefore, it's very important to conduct quantitative environmental risk zoning in urban scale and provide decision-making criterion for managers Existing environmental risk assessment researches were more concentrated in environmental risk of toxic and hazardous substances and single incident .While consideration of the environmental risk as a complex system composed of multiple factors from regional level, systematic studies on combined effects caused by regional

* Corresponding author .Junwei Ma. Tel.: 086-10-59893106; fax: 086-10-59893086

E-mail address: jwma@bnu.edu.cn

environmental risks were few, as well as the causes and the inherent links of environmental risks from the macro level of human social and economic activities [1].

The word of risk zoning was first used in the field of natural disasters [2-6]. Environmental risk zoning was gradually developed with the economic growth and increasing frequency and hazards of sudden accidents of environmental pollution, which can reveal regional and interregional similarities and differences of environmental risks distribution. It was proposed as an effective measure of environmental risk management to prevent environmental pollution and harm[7].

Yang Jie and Bi Jun (2006) discussed the process, indicators and methods of environmental risk zoning. They took risk zoning of Yangtze River Basin (Jiangsu Part) as a case study. An index system for regional environmental risk zoning was developed and an integrated assessment model (IAM) was adopted to assess the regional environmental risk. Potential risk management countermeasures were suggested for decision-makings about risk management in this region. Yang Jie et al (2006) thought environmental risk zoning was a sequencing process of the relative size of the regional environmental risk. In accordance with the structures, functions and features of regional natural and social environment, the region can be divided into different ranks, and then the priority order of environmental risk management can be determined.

In China, there were two mainstreams about regional risk assessment: risk assessment based on personal risk and social risk and risk assessment based on risk compensation. Research achievements mainly concentrated in applying the principle of superposition and assigning a value to self-defined parameters based on experience to obtain the quantitative risk value of each point [8]. The methods such as environmental risk assessment based on sensitivity[9], environmental risk assessment based on reliability theory[10] and fuzzy comprehensive evaluation assessment all evaluate environmental risk from three aspects: the danger of risk sources, effectiveness of control mechanisms and vulnerability of receptors.

In general, the quantitative zoning system of the regional environmental risk is still very immature and needs further study. This paper, on the basis of regional environmental risk assessment and environmental risk zoning 'constructs the index system and the quantitative model , applies AHP to weight index and comprehensive evaluation method to calculate comprehensive risk index value. This method has been successfully applied in the literature[11]. In this paper, based on the use of this method, with the clustering function of SPSS and the visualization of GIS, quantitative risk zoning map can be obtained.

2. Methods

2.1. The establishment of index system

According to the principles of systematicness, consistency, dominance' dynamism and data availability, the index system of regional environmental risks can be established from three aspects: the danger of risk sources, effectiveness of control mechanisms and vulnerability of receptors. The index system consists of target, system, rule and index layers (Table 1).

Table 1. The index system of major environmental risk sources zoning in urban scale

Target Layer	System Layer	Rule Layer	Index Layer
Environmental risks	Risk sources	Stationary sources	Leading industry type The scale of major risk sources The intensity of risk sources
		Mobile sources	Characteristics of hazardous waste Emissions Transportation risk
	Control mechanisms	Control mechanisms	Frequency of man-made risks Present situation of environmental quality
		Risk receptors	Degree of exposure
	Adaptability		

4. Conclusion

This paper constructs the index system and the quantitative model of environmental risk zoning, which is fit for urban scale. And with the clustering function of SPSS and the visualization of GIS, the quantitative risk zoning map of Shanghai is obtained. The result shows that Baoshan District is the major risk area, Pudong District, Jinshan District and Minhang District is higher risk areas, Jiading District, Songjiang District and Fengxian District is general risk areas and the rest Districts are low risk areas. The results of this article can be seen more consistent with the actual situation in Shanghai, so the exploratory method in this paper is reasonable. The results have some practical value and provide decision-making basis for environmental risk management and spatially optimal distribution of Shanghai.

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References

[1]Wei Li J, Jun B, Hai Suo W, Jie Y, Bing Z. Probe into the development of regional environment risk research. *Jiangsu Environmental Science and Technology* 2006;19:35–7.

[2]Jing Xuan X, Shi Jun N, Cheng Jiang Z, Jun D, Lun Wu W. The design and implementation of the GIS software for risk assessment of urban geo-environments. *Sedimentary Geology and Tethyan Geology* 2006;26.

- [3]Shi Jun N, Lun Wu W, Cheng Jiang Z, Jun D, Yong Li W, De Wei W, et al. Risk evaluation system for urban geoenvironment. *Geological Bulletin of China* 2006;25:1279-86.
- [4]Nian Xiu Q, Tong J. GIS based risk zoning and assessment of flood disaster in the middle and lower reaches of the Yangtze River Basin. *Journal Of Natural Disasters* 2005;14.
- [5]Yun Xia Z, Jie Yong Z, Yi L. The Risk Zonation And Prevention Measures Of Geological Disaster In Kunming. *Yunnan Geology* 2005;24:114-21.
- [6]Zhao Lin L, Sheng Zhang Z, Wei Quan L, Hong Feng C. Engineering condition and speeage analysis of dam for Wuyandong karst depression reservoir. *Hydrogeology & Engineering Geology* 2006.
- [7]Jie Y, Jun B, Qi Liang L, Bing Z. Study on theory and methodology of regional environmental risk zoning. *Research of Environmental Sciences* 2006;19.
- [8]Qing Min S, Kai Li X. Study on the theory of area quantitative risk assessment. *China Safety Science Journal* 2009;19.
- [9]Ying Wei G, Jia H, Cun Kuan B, Yong Sen L. Environmental risk assessment on planning of petroleum and chemical industry based on sensitivity analysis of regional environmental risks. *Environmental Pollution & Control* 2009;31.
- [10]Li Zhong L, Bin Z. Study on a new model of regional environmental air quality risk assessment based on reliability theory. *China Population,Resources And Environment* 2006;16.
- [11]Jie Y, Zhan E Y, Shi Yuan X. Urban-disasters composite risk assessment of Shanghai. *Scientia Geographica Sinica* 2009;29.
- [12]Gong Jian X, Xiao W. Analysis of urban disasters and the irredution in Shanghai. *Journal Of Catastrophology* 2001;16.