

Dataset of Agricultural Resource and Environment Zoning of China

Xu, E. Q.

Key Laboratory of Land Surface Pattern and Simulation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

Abstract: The challenges from agricultural resources and environment have become increasingly prominent in China, but vary considerably by region. The dataset of agricultural resource and environment zoning of China was produced according to the agricultural production characteristics, suitability and environmental challenges. It is divided the specific regional spatial units of territories into different agricultural resource and environmental zones of China. Using the county as the basic mapping unit, the zoning is consisted of two levels. The ten first-level zones were identified according to regional differences in climate and geotectonic characteristics at the macro scale. Next, fifty-seven second-level zones were differentiated according to water resources, land resources, and environmental conditions. The zoning method is a dominant factor method based on comprehensive analysis of agricultural resources and environmental factors. The naming of the zones is based on the principles of simplicity, clarity and popularity. The first-level zones are mainly named according to the physical geographical location, and the naming of the second-level districts is in conjunction with geographic location and landform types.

Keywords: resource and environment; zoning; regional difference; China

Dataset Available Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: <https://doi.org/10.3974/geodb.2021.02.07.V1>.

1 Introduction

During the last half century, the agricultural development in China successfully solved the problem of feeding 1.4 billion people. However, agricultural environmental pollution has intensified, and agricultural resources and the environment are generally overloaded, which have been a substantial constraint on sustainable agricultural development^[1]. The vast territory presents significant differences in terrain in China, such as water and heat conditions, and different levels of regional socio-economic development. These have resulted in different constraints on agricultural resources and the agricultural environment in the different regions, with diverse reasons, types, and degrees of the regional constraints. Following certain principles and indicators, the “Dataset of agricultural resource and environment zoning

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Author Information: Xu, E. Q. U-9329-2017, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, xueq@igsnrr.ac.cn

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of China” was developed. This dataset diagnoses resource and environmental challenges and limiting factors in different districts and reveals the regional differentiation of agricultural production. It characterizes the agricultural production conditions, resource types and their combinations and existing problems in various regions of the country, as well as their favorable and unfavorable effects on agricultural production. The dataset describes similarities and differences in agricultural resource and environment problems according to their formation process, types and characteristics of problems in different zones in China. The dataset could be a reference in recognizing regional agricultural production and the rational use and protection of agricultural resources and environment in accordance with local conditions, which maintains and improves the health and sustainability of agricultural ecosystem of China.

2 Metadata of the Dataset

The name, authors, geographical regions, data date, temporal resolution, spatial resolution, data files, data publisher, and data sharing policy of the Dataset of agricultural resource and environment zoning of China^[2] are shown in Table 1.

Table 1 Metadata summary of the Dataset of agricultural resource and environment zoning of China

Items	Description			
Dataset full name	Dataset of agricultural resource and environment zoning of China			
Dataset short name	ChinaAgriREZone			
Authors	Xu, E.Q. U-9329-2017, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, xueq@igsnr.ac.cn			
Geographical region	China	Data date	2018	spatial resolution 1:1 million
Data format	.shp	Data size	48.8 MB	temporal resolution Year
Data files	A group of 7 documents, including 10 first-level zones and 57 second-level zones of agricultural resource and environment of China			
Foundation(s)	Chinese Academy of Sciences (XDA19040305)			
Data computing environment	ArcGIS, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences platform			
Data publisher	Global Change Research Data Publishing & Repository http://www.geodoi.ac.cn			
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China			
Data sharing policy	Data from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the <i>Digital Journal of Global Change Data Repository</i>), and publications (in the <i>Journal of Global Change Data & Discovery</i>). Data sharing policy includes: (1) Data are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use Data subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute Data subject to written permission from the GCdataPR Editorial Office and the issuance of a Data redistribution license; and (4) If Data are used to compile new datasets, the ‘ten per cent principal’ should be followed such that Data records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset ^[3]			
Communication and searchable system	DOI, DCI, CSCD, WDS/ISC, GEOSS, China GEOSS, Crossref			

3 Data Development Methods

3.1 Zoning Principle

The division of Agricultural Resource and Environment Zoning of China is based on the regional principles of similarity and difference, which integrate the following characteristics in carrying out the division of regions.

(1) Consistency of agricultural resource and environment system. The agricultural resource and environment system is the basis of the zoning formation and differentiation. Ag-

gricultural production depends on the agricultural resource and the environment elements. The differences in the agricultural resource and environment system structure will inevitably lead to differences in the structure of agricultural production and the agricultural resource and environment zones.

(2) Consistency of agricultural production structure and function. The agricultural production structure is not only affected by the regional agricultural ecological environment structure, but is also restricted by the regional socio-economic structure and technical conditions. The two are comprehensively reflected in the agricultural production structure. Moreover, the agricultural production structure is closely related to the production development direction: the same agricultural production structure, the agricultural production direction is basically the same.

(3) Consistency of agricultural productivity level. System productivity is a comprehensive indicator that reflects the status of the agricultural resource and environment system. Thus, it is necessary to integrate the factors, such as climate, soil fertility, water supply, and management levels in the system result in the productivity level.

(4) Consistency of agricultural environment problems. The environmental problems in the agricultural ecosystem restrict the balance and development of the system, it may lead to the reduction of system functions and even the collapse of the entire system. Within each zone, the dataset puts forward countermeasures to the problems to make improvements and realize the normal exertion, virtuous circle and sustainability of system functions.

(5) Spatial continuity of each zone. A zone is mainly represented in the interaction between adjacent geographic sub-systems with similar agricultural resources and environment. Except for a few discontinuities caused by administrative demarcation, the emergence of enclaves, i.e. non-continuous spaces, should be minimized.

3.2 Partition Process

There are several products from zoning program of China, such as Integrated Physical Zoning^[4] and Integrated Agricultural Zoning^[5], which are the main reference materials for this dataset production. In addition, 1:1 million Land Resource Map of China^[6], 1:1 million Vegetation Map of China^[7], Landform Map of China in 1:4 million scale^[8] and the National Ecological Function zoning^[9] are additional zoning references.

Based on the division of agricultural resource factors, agricultural environmental issues and agricultural planting structure, this research aims to flesh out the division of first-level and second-level agricultural resource and environment zones of China's territories. The zoning method is the dominant factor method based on the comprehensive analysis of agricultural resource and environment factors. The division of zones into two levels is based on the following standards:

(1) First-level zones are mainly divided by climatic condition and geological structure, including (a) basic structure of the tectonic structure; and (b) agricultural resource endowment, i.e., agricultural production potential, which mainly includes regional hydrothermal conditions and matching relationships, and also involves the regional distribution of cropland and the level of agricultural production input.

(2) Second-level zones are mainly divided based on cropland resource factors and environment problems including (a) cropland resource factors, such as cropland composition, resource matching and limiting factors; (b) cropland environmental quality, including land element quality, mainland degradation and pollution problems; and (c) medium landform types, including mountains, hills, plains and their combinations.

The naming of zones is based on the principles of simplicity, clarity and popularity. The first-level zones are mostly named according to the physical geographical location. The naming of the second-level districts is in conjunction with geographic location and landform types.

4 Data Results

4.1 Data Sources

The dataset of agricultural resource and environment zoning of China is mainly analyzed and drawn based on China’s county-level administrative boundary data and socio-economic statistics data (2015)¹.

4.2 Data Results

Based on the county boundaries data as the spatial data, 10 regions were identified at the first-level zoning system, marked by Roman numerals I, II, and to X, respectively. They are the Northeast China Region, Inner Mongolia along the Great Wall Region, Huang-Huai-Hai Region, Loess Plateau Region, Northwest Arid Region, Plain and Hilly in the Middle and Lower Reaches of Yangtze River Region, Hilly and Mountain in the south of Yangtze River Region, Southeast China Region, Southwest China Region, and Qinghai-Tibet Plateau Region. In addition to the first-level zones, fifty-seven second-level zones are divided according to differences in land resources and numbered by Arabic numerals 1, 2, 3, etc. (Figure 1). The attributes of this dataset are mainly the serial numbers and names of agricultural resource and environment zoning of China, including the first-level and second-level zones (Table 2).

Northeast China Region (I) includes the three provinces of Liaoning, Jilin, Heilongjiang and eastern Inner Mongolia. The area is about 1.227,5 million km², accounting for approximately 12.79% of the country’s territory area. This zone is currently the only region in China that can export a large amount of commercial grains, and it is also the most concentrated area of forest resources in the country. The Songnen Plain Zone and the Sanjiang Plain Zone have a high quality of cropland resources, which plays an important role in the national food security. The Greater Khingan Mountain Zone, Lesser Khingan Mountain Zone and Baekdu Mountain Zone are the main forested areas in this zone.

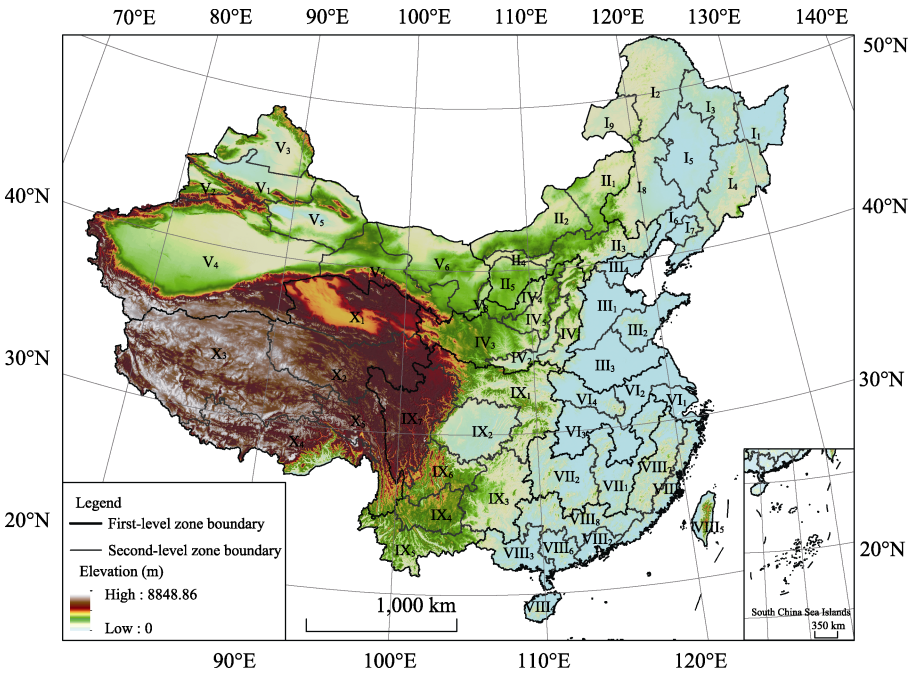


Figure 1 Map of agricultural resource and environment zones of China

¹ Resource and Environment Science and Data Center. <http://www.resdc.cn/data.aspx?DATAID=202>.

Table 2 Serial numbers and names of agricultural resource and environment zoning of China

Serial number of first-level zone	Name of first-level zone	Serial number of second-level zone	Name of second-level zone
I	Northeast China Region	I ₁	Sanjiang Plain Zone
		I ₂	Greater Khingan Mountain Zone
		I ₃	Lesser Khingan Mountain Zone
		I ₄	Baekdu Mountain Zone
		I ₅	Songnen Plain Zone
		I ₆	Liaoning Plain and Hilly Zone
		I ₇	Central and Southern Liaoning Zone
		I ₈	Western Liao River Zone
		I ₉	Hulunbuir Grassland Zone
II	Inner Mongolia along the Great Wall Region	II ₁	Eastern Xilin Gol Grassland Zone
		II ₂	Western Xilin Gol Desert Steppe Zone
		II ₃	Yin Mountain along the Great Wall Zone
		II ₄	Hu-Bao Hetao Zone
		II ₅	Ordos Plateau Zone
III	Huang-Huai-Hai Region	III ₁	North China Plain Zone
		III ₂	Shandong Hill Zone
		III ₃	Huang-Huai Plain Zone
		III ₄	Bohai Gulf Zone
IV	Loess Plateau Region	IV ₁	Jin-Yu Earth-rock Mountain Zone
		IV ₂	Fen-he and Wei-he Valley Zone
		IV ₃	Loess Plateau Gully Zone
		IV ₄	Hill and Sandy Land in Northern Shaanxi and Eastern Ning-xia Zone
		IV ₅	Loess Hilly and Gully Zone
V	Northwest Arid Region	V ₁	North Slope of Tianshan Mountain Zone
		V ₂	Yili River Basin Zone
		V ₃	Ertix-Ulungur River Basin Zone
		V ₄	Tarim Basin Zone
		V ₅	Eastern Xinjiang Zone
		V ₆	Alxa-Ejina Plateau Zone
		V ₇	Hexi Corridor Zone
		V ₈	Yinchuan Plain Zone
VI	Plain and Hilly in the Middle and lower reaches of Yangtze River Region	VI ₁	Yangtze River Delta Zone
		VI ₂	Jianghuai Zone
		VI ₃	Plain of Mid-Yangtze River Zone
		VI ₄	Plain and Hill of Henan, Anhui and Hubei Zone
VII	Hilly and Mountain in the south of Yangtze River Region	VII ₁	Middle and Upper Gan River Basin Zone
		VII ₂	Middle and Upper Xiang River Basin Zone
VIII	Southeast China Region	VIII ₁	Coastal Plain and Hill in Zhejiang, Fujian and Guangdong Zone
		VIII ₂	Pearl River Delta Zone
		VIII ₃	Hill of Western Guangong and Southern Guangxi Zone
		VIII ₄	Hainan Island Zone
		VIII ₅	Taiwan Island Zone
		VIII ₆	Coastal Hill in Guangong and Guangxi Zone
		VIII ₇	Hill and Mountain in Zhejiang and Fujian Zone
		VIII ₈	Hill and Mountain in Northern Guangdong and Guangxi Zone
IX	Southwest China Region	IX ₁	Qinling, Funiu, Eastern Sichuan Mountains Zone
		IX ₂	Sichuan Basin Zone
		IX ₃	Karst Hill and Mountain in Guizhou and Guangxi Zone
		IX ₄	Yunnan Plateau Zone
		IX ₅	Hill and Mountain in Southern Yunnan Zone
		IX ₆	Mountain in upper reaches of Yangtze River Zone
		IX ₇	Garz-Ngaw Plateau Zone
X	Qinghai-Tibet Plateau Region	X ₁	Qaidam Basin Zone
		X ₂	Sanjiangyuan and Surrounding Zone
		X ₃	Northern Tibetan Plateau Zone
		X ₄	Midstream of Yarlung Zangbo and Two Tributaries in Southern Tibet Zone
		X ₅	Hengduan Mountain Zone

Inner Mongolia along the Great Wall Region (II) is located to the east of Helan Mountain and north of Yinshan Mountain. The scope of its administrative reach includes northwestern areas of Beijing and Hebei, central and northern Inner Mongolia, and western Liaoning. It is a vast area and sparsely populated, with a territory area of about 536,200 km², accounting for about 5.59% of the country's area. Almost all of this area is located in the temperate grassland climate, containing the semi-arid and arid grassland areas. It is an important pastoral area and farming-pastoral area in China. The Hu-Bao Hetao Zone is the main agricultural area in the region. The Ordos Plateau Zone and Western Xilin Gol Desert Steppe Zone have poor agricultural resources and environmental conditions.

Huang-Huai-Hai Region (III) is located south of the Great Wall, north of the Huaihe River, and east of Taihang Mountain. The scope of its administrative reach covers Tianjin, Shandong, southern Beijing, southeastern Hebei, northeastern Henan, Anhui, and northern Jiangsu. Its territory area is about 443,700 km², accounting for 4.62% of the country's area. The Huang-Huai-Hai region is densely populated and has the largest plain in China. It is composed of plains, including the North China Plain, Shandong Hills, and Huanghuai Plain. It is an important production base for grain—especially winter wheat, cotton, oil, meat, and fruit in China.

Loess Plateau Region (IV) is located west of Taihang Mountain, east of Qinghai Riyue Mountain, north of Qinling Mountains, and south of the Great Wall. Its scope of administrative reach includes Shanxi, western Henan, most of Shaanxi, northeastern Gansu, eastern Qinghai, and southeastern Ningxia. Its territory area is about 496,800 km², accounting for about 5.18% of the country's area. It is the region with the most concentrated and largest coverage of loess distribution in the world. It is also one of the high-quality production areas of wheat, corn, and fruits in China. The Fen-he and Wei-he Valley Zone is a high-quality agricultural area, but other zones within this region have considerable agricultural resource and environment problems.

Northwest Arid Region (V) is located to the west of Helan Mountain, north of Kunlun Mountain and Qilian Mountain, and includes in its administrative scope Xinjiang, central and western Gansu, western Inner Mongolia, and northwestern Ningxia. The territory area is about 2.209 million km², accounting for about 23% of the country's area. This region is rich in light and heat resources but has an extremely dry climate with sparse vegetation across its landscape. The agriculture here is oasis irrigated agriculture and has the largest high-quality cotton base in China. Except for the limited areas in the Yili River Basin, the northern and southern slopes of the Tianshan Mountain, the Hexi Corridor, and the Yinchuan Plain, the agricultural resources and environmental conditions in this region are relatively poor.

Plain and Hilly in the Middle and lower reaches of Yangtze River Region (VI) is located south of the Huaihe River and east of the western Hubei mountains. Its administrative scope includes Shanghai, southern Jiangsu, northeastern Zhejiang, central Anhui, northwestern Jiangxi, southwestern Henan, eastern Hubei, and northeastern Hunan. Its territory area is about 375,600 km², which occupies about 3.91% of the country's total territory area. The region is a traditional base of commercial grain, cotton, oil and freshwater aquaculture production. This region is dominated by plains, consisting of the plains in the middle and lower reaches of the Yangtze River and several mountains in northern Hubei and southern Henan. Plains include the Jiangnan Plain, Dongting Lake Plain, Poyang Lake Plain, Jianghuai Region, Lixiahe Plain, Taihu Plain and Yangtze River Delta. The light, water and heat conditions are well suitable for agricultural production. The golden waterway of the Yangtze River runs through the whole region and yields rich river runoff. The region is a rare area in China in that it has good matching of water, heat and resources, with suitable land development and ability to utilize it as well as high agricultural production.

Hilly and Mountain to the south of Yangtze River Region (VII) refers to the low mountain

and hilly area to the south of Dongting Lake Plain and Poyang Lake Plain, north of Nanling Mountain, east of Xuefeng Mountain, and west of Wuyi Mountain. The territory area is about 358,100 km², accounting for about 3.73% of the country's total area. This region is an important base of rice production and fast-growing, high-yielding forests in China. It is also known for its production of tropical fruits and vegetables in China. With complex landforms of plains, low hills, basins and mountains, this region forms a unique three-dimensional agricultural model.

Southeast China Region (VIII) includes the administrative scopes of southeastern Zhejiang, Fujian, Guangdong, most of Guangxi, Hainan and Taiwan. Its territory area is about 653,500 km², accounting for about 6.81% of the country's area. This region is suitable for multiple agricultural products. The production of rice, sucrose, peanuts, mulberry, hemp, tea, fruits and vegetables takes place here and is important in China. More importantly, this region is the most vital for sucrose production in China, and also an important base of rice production and the most suitable base for the tropical and subtropical crop development. The sucrose production is concentrated in the Hill of Western Guangong and Southern Guangxi Zone, and the tropical crop productions are mainly distributed in Hainan Island Zone and Taiwan Island Zone. The agricultural resources and environmental conditions in the plain areas are also relatively good in the region.

Southwest China Region (IX) is composed of the Sichuan Basin, the Qinba Mountains, the Yunnan-Guizhou Plateau, and the Western Guizhou Karst Area. The administrative scope covers eight provinces (Municipality), including Sichuan, Chongqing and Guizhou, most areas of Yunnan, southern Shaanxi and Gansu, eastern Hubei and the western edge of Henan. The territory area is about 1,333,700 km², accounting for about 13.89% of the country's area. This region has the most complex and diverse physical conditions and agricultural resources in China, with limited flatland resources and significant variation in elevation. It has the second largest forest district in China. The Sichuan Basin Zone and the Hill and Mountain in Southern Yunnan Zone are important agricultural production areas in China.

Qinghai-Tibet Plateau Region (X) starts from the Himalayas in the south, the Pamirs and Karakoram Mountains in the west, and the Yulongxue Mountain, Daxue Mountain, Jiajin Mountain, Qionglai Mountain, and southeastern foothills of the Min Mountain in the east. Its east and northeast boundary borders the western section of Qinling Mountains and Loess Plateau. The territory area is about 1,965,900 km², accounting for about 20.48% of the country's area, which is the largest region among the ten first-level regions. This region is located in the uppermost step of China's three geomorphological steps from west to east, forming a high-cold agriculture and animal husbandry adapted to a low-oxygen environment. The area of cropland in this region only accounts for 0.78% of the country's total area. The water resources are rich here, but the natural environment is extremely harsh, which has resulted in a landscape dominated by pastures and a very fragile agricultural system.

4.3 Data Verification

The first-level zones of "Dataset of agricultural resource and environment zoning of China" are mainly divided according to the climatic conditions of and regional differences in geotectonics related to China's agricultural production. The aforementioned zoning divisions have not changed much since the dataset's compilation, so the boundary of the first-level zone is generally stable within the dataset. The second-level zones are mainly divided by the characteristics and problems of China's agricultural resource and environment in the year 2015. With the development of regional agriculture, the resource and environmental problems may change, and the scope of agricultural zoning for the second-level zones can be

revised accordingly.

5 Discussion and Conclusion

Based on the regional differentiation of agricultural resources and environment in China, China's territory is divided into 10 first-level zones and 57 second-level zones, and the resulting of "Dataset of agricultural resource and environment zoning of China" was produced. It should be noted that the division of agricultural resource and environment zones is to guide regional agricultural production, development, and distribution. This call for a focus on the social and economic factors, and thus the zones are produced with the administrative county as the basic unit. Therefore, when the administrative boundary changes in county level, the boundary of zones should be revised accordingly. This dataset clarifies the interrelationships among the various zones and components of each zone in China, and reveals the regional differences of agricultural development status, as well as resource and environmental issues in China. On one hand, from the perspective of sustainably utilizing resources and the environment, the dataset identifies the main constraints in each zone which can provide guidance for the development direction, layout, and construction pathway of China's differentiated agricultural production. On the other hand, from the perspective of national territory spatial utilization and layout, the dataset displays the spatial distribution and regional differences of the agricultural resource suitability and production potential in China. This provides a basis for formulating agricultural production development strategies, and proposes ways to realize the optimal allocation and improvement of agricultural resources and environment in the various agricultural zones, ultimately assisting in practical decision-making.

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Conflict of interest statement

The authors declare no conflicts of interest.

References

- [1] Shi, Y. L., Tang, H. L., Gao, Z. Q., *et al.* Research on Key Strategic Issues of Agricultural Resource and Environment in China [M]. Beijing: China Agriculture Press, 2019.
- [2] Xu, E. Q. Dataset of agricultural resource and environment zoning of China [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2021. <https://doi.org/10.3974/geodb.2021.02.07.V1>.
- [3] GCdataPR Editorial Office. GCdataPR Data Sharing Policy [OL]. <https://doi.org/10.3974/dp.policy.2014.05> (Updated 2017).
- [4] Physical Regional Working Committee of Chinese Academy of Sciences. Comprehensive Physical Regionalization of China (Preliminary Draft) [M]. Beijing: Science Press, 1959.
- [5] Agricultural Regional Planning Group in National Agricultural Regional Committee of China. China Agriculture Zoning [M]. Beijing: China Agricultural Press, 1981.
- [6] Shi, Y. L. Atlas of China's Land Resources [M]. Beijing: China Land Press, 2006.
- [7] China Vegetation Map Editorial Committee, Chinese Academy of Sciences. 1:1 million Vegetation Map of People's Republic of China [M]. Beijing: Geology Press, 2007.
- [8] Li, B. Y., Li, J. Z. China's 1:4 Million Geomorphic Map [M]. Beijing: Science Press, 1994.
- [9] Ministry of Environmental Protection of the People's Republic of China and Chinese Academy of Sciences. National ecological function zoning [R]. 2008.