

# A Study on the Development of the Urban and Rural Green Living Environments in the Qinba Mountains

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**Abstract:** The Qinba Mountains, which occupy a geographic space on a north-south trajectory, are China's central reservoirs and national green lung. Due to the topographical conditions, many conflicts occur around the issue of environmental protection and appeals for socioeconomic development. The Qinba Mountains region has gradually become a distressed area and a depressed economic zone, experiencing enormous conflict between the pressures of internal environmental protection and socioeconomic development. In this study, the authors first analyze the Qinba Mountains region's planning-related conflict between ecological protection and urban-rural development, as well as the disconnection between green development and urban-rural construction. They then put forward an "ecology pilot, green-oriented" development strategy. Using an ecology pilot strategy, the authors delineate the ecological security pattern in the Qinba Mountains region to realize the integration of the living environment with the population, industry, and urban and rural space distribution. With a green-oriented strategy, the authors sum up the urban and rural planning mode, devise special systems to support transportation, and propose a "green-oriented" model for urban and rural living environments. The ultimate objective is the green development of urban and rural living environments in the Qinba Mountains, thus providing a reference point for the construction of urban and rural living environments throughout China.

**Keywords:** Qinba Mountains; urban and rural living environment; green development; ecology; urban and rural space

## 1 Introduction

The Qinba Mountains, which traverse a geographic area from north to south, are China's central reservoirs and national green lung, and undertake a task of protecting national ecological security patterns. However, because of the topographical conditions, poor transportation, and division of government administration, conflicts between environmental protection interests and socioeconomic development ones are extreme, and the Qinba Mountains region has gradually become a distressed area, with Shaanxi, Henan, Sichuan, Hubei, Gansu, and Chongqing being economically depressed. Therefore, the realization of ecological security protection, the alleviation of poverty, and the construc-

tion of urban and rural green living environments are of great significance in building an ecological future.

## 2 Analyzing current problems

### 2.1 Overview

The Qinba Mountains, with a population of 61.64 million and an area of 308 634 km<sup>2</sup>, encompass Shaanxi, Henan, Gansu, Sichuan, and Chongqing. They comprise a total of 20 cities divided into districts, a Gannan Tibetan Autonomous Prefecture, a Shennongjia Forestry District, and 119 counties (district, county-level city), and have an urbanization rate of 40.08%. This region is

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surrounded by mountains that are home to many rivers. The Qinba Mountains region is primarily mountainous, comprising government-designated zones of prohibited or limited development, and ecological protection in such an area is more important than in the plains. In particular, the Qinba Mountains region that includes the Yangtze River, Yellow River, and Huai River is one of the most important areas for water conservation, accounting for 10.9% of the country's total water conservation functional zones. The Qinba Mountains region is one of 17 important ecological functional zones identified in the National Planning of Main Functional Areas, and comprises four world-class biological reserves, 40 national nature reserves, and 61 national forest parks.

Cities and towns within the scope of this research are gathered more from “point” to “axis” in states within the geographic area, and have not yet formed a networked system. The location and layout of cities and towns are characterized by their adaptation to the paths of the rivers they are built on. Currently, all the cities and towns in the region have different dominant industries and urban functions based on their rich ecological resources and the development of traditional agriculture. They can be divided into five categories based on the proportion of their respective functions, namely, industrial city, tourism city, transportation city, modern agricultural city, and integrated city (Table 1).

## 2.2 Analyzing the issues of urban and rural living environments

### 2.2.1 Layout conflicts between ecological protection and urban-rural development interests

Due to the constraints of the terrain and the environmental protection requirements in the Qinba Mountains, regional development encounters the following issues: ① uneven urbanization development (Fig. 1), for example, the south of Bashan and the central part of the Hanjiang River basin have experienced rapid

development, while the west and east in this region are relatively backward; ② low coordination of intraregional urban and rural living environments, a serious shortage of a development motive results in a wide range of regional poverty levels; and ③ scarcity of space suitable for construction, construction is thus dispersed and conflict with environmental protection interests occurs frequently. In summary, the urban and rural living environment spaces in the Qinba Mountains are in urgent need of integration.

### 2.2.2 Separation of green development and urban-rural space construction

Currently, the Qinba Mountains region has developed primarily traditional industries, with serious industry homogenization and irrational spatial planning having taken place. The traditional urban and rural ecological balance has been gradually abandoned, but green space development patterns have not yet formed. Although the region has a unique landscape and ecological advantages with respect to resources, urban and rural space construction faces many practical issues due to the shock and impact of rapid urbanization, for example, the “mountains-water-city-human” pattern is blocked, the historical and cultural context has broken down, and the regional gene is missing. Native landscapes and environments have suffered constructive erosion, and traditional architectural features are gradually being replaced by reinforced concrete.

## 3 Development strategy for urban and rural green living environments

The “five coordination” strategy deployed by the Central Committee of the Communist Party of China identified the intention to “coordinate harmonious development between man and nature.” The fifth plenary session of the 18th Central Committee of the Communist Party of China clearly states the goals of “maintain green development, maintain sustainable

**Table 1.** Functional classification of cities and towns in the Qinba Mountains region.

City function	Counties and cities	Total	Percentage (%)
Industrial city	Liantian, Huxian, Taibai, Meixian, Fengxian, Huaxian, Zhashui, Zhen'an, Shanyang, Shangnan, Yangxian, Pingli, Baihe, Ziyang, Yiyang, Ruyang, Luanchuan, Yexian, Wolong, Fangcheng, Danjiangkou, Yunyang, Yunxi, Zhushan, Zhuxi, Fangxian, Laohekou, Baokang, Nanzhang, Gucheng, Lixian, Kangxian, Xuanhan, Kaijiang, Pingchang, Tongjiang, Jiangyou, Pingwu, Yilong, Nanbu, Yingshan, Yunyang, Kaizhou, Chengkou	44	37
Tourism city	Zhouzhi, Huayin, Zhenba, Liuba, Mianxian, Nanzheng, Ningqiang, Fuping, Xunyang, Shiquan, Hanyin, Langao, Ningshan, Zhenping, Neixiang, Xichuan, Xixia, Lushi, Shennongjia Forestry District, Tanchang, Maiji, Nanjing, Qingchuan, Beichuan Qiang Autonomous County, Zitong, Langzhong, Fengjie, Wushan, Wuxi	32	26
Transportation city	Lueyang, Shanzhou, Huixian, Liangdang, Wenxian	5	4
Modern agricultural city	Xixiang, Chenggu, Luoning, Chengxian, Xihe, Minxian, Zhangxian, Weiyuan, Diebu, Zhuoni, Lintan, Zhouqu, Wangcang, Jiange, Cangxi	15	13
Integrated city	Chang'an (Xi'an), Tongguan, Shangzhou, Luonan, Danfeng, Hantai, Haibin, Songxian, Linbao, Maojian, Zhangwan, Xiangzhou, Xiangcheng, Fancheng, Wudu, Qinzhou, Wanyuan, Tongchuan, Dachuan, Bazhou, Enyang, Lizhou, Zhaohua, Chaotian	24	20

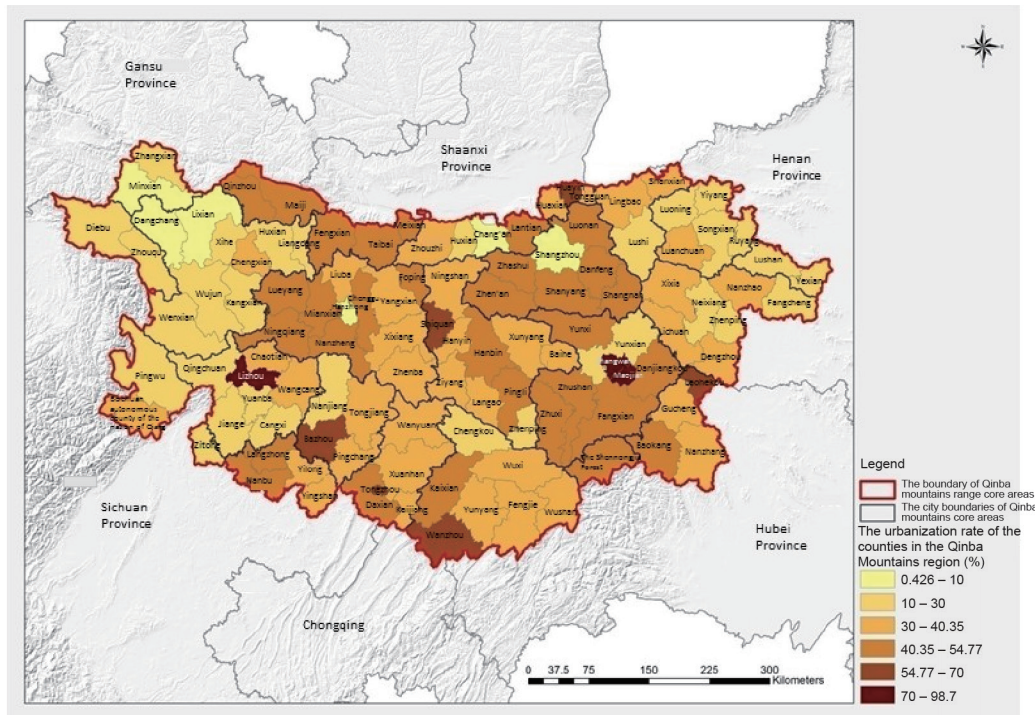


Fig. 1. Urbanization level in the Qinba Mountains region

development, and realize harmony between human beings and nature, advance the program of building a beautiful China, and make new contributions to global environmental security.” This illustrates that green development has become the development strategy of the new century. Although development of the living environment discipline demonstrates some rigidity, as in the development of other disciplines, there is a basis to gradually adapt, systematize, and improve [1]. With regard to the future development of the Qinba Mountains, this project focuses not only on ecological and environmental protection, but also on methods for achieving green development in the region.

“Region” is an important spatial concept defined academically in the science of living environments [2]. Construction of a living environment should focus on ecological needs, the basic interests of the people, the requirements of economic and social development, and support and guarantees from science and technology, and other factors [3]. In connecting the Qinba Mountains’ supreme ecological conditions with the actual situation of regional economic development lag, the authors explore a reasonable way to approach ecological protection and economic development, easing population distribution, coordinating industrial planning, and achieving an “ecology pilot” living environment space that clarifies the overall ecological security pattern. Based on this, the paper further constructs a green-oriented urban and rural planning mode, relying on support of transportation systems and special zones to achieve green-oriented coordinated development of living environments. In short, this

paper presents an “ecology pilot, green-oriented” urban and rural living environment development strategy.

## 4 Integrating ecology pilot with living environment spaces

### 4.1 Identifying and clearly defining ecological space

Ecology is the foundation and medium for human production and life activities, providing accommodation and related services to support human economic activities, and it is thus a determinant for quality of life [4]. Through overlay analysis of the importance of water conservation, biotechnology, windbreaks and sand fixation, and water and soil conservation in the region by using the ArcGIS, this paper summarizes three categories from the core ecological space of the Qinba Mountains, comprising the development prohibition zones, ecological function zones, and ecologically sensitive zones. The development prohibition zone is strictly protected by Chinese law, and the Qinba Mountains’ core area includes four world-class global biosphere reserves and 40 important national nature reserves (Table 2). The main ecological functional zones are relatively concentrated, but unevenly distributed, being located mainly in Gansu, Shaanxi, Chongqing, and Hubei. There are a lower proportion of ecologically sensitive zones, and they are concentrated in terms of distribution.

Evaluation of the development prohibition zones, ecological

function zones, and ecologically sensitive zones reveals that they are divided into ecological coordination zones, ecologically important zones, and ecologically vital zones based on their ecological importance, and this provides a comprehensive ecological security pattern for the core areas of Qinba Mountains (Fig. 2), which plays an important role in safeguarding homeland ecological security. In terms of the overall region, the vital and important zones are ecological protection zones, and these are the bottom line for the ecological development of the region; other regions can be seen as potential development spaces. Approximately 80% of the area is in need of protection, whereas the remaining 20% can be used as a coordinated development area (Table 3).

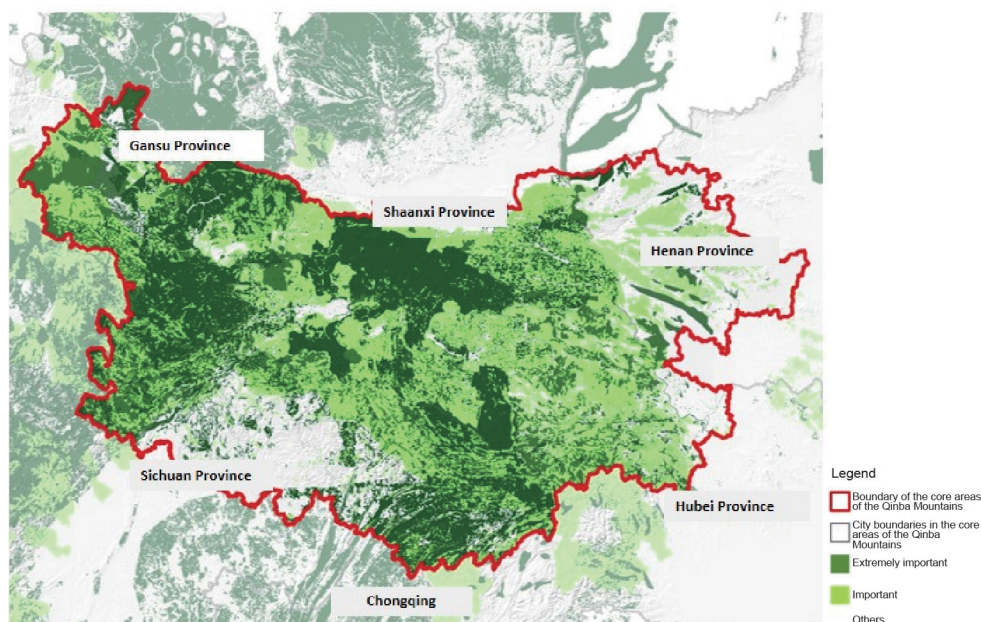
#### 4.2 Evacuating population space

The current population of the Qinba Mountains region is

61.64 million. Most regions are uninhabitable, and a gradual lack of available land for city construction is occurring. According to the carrying capacity of the population stabilization zone and the population accumulation zone of the Hanjiang River Valley, the Dan River Valley, the Huicheng Basin, and the southern base of Bashan Mountains in the Qinba Mountains region, as well as the experience of similar areas in the world, urbanization in the region should be maintained at the moderate level of about 55%. According to an estimate made with respect to the land-carrying capacity, an ecological footprint method, and a rational regional population density suitable for development, the total population gathered in urban and rural areas should be around 15 million. This presents a method for combining remote urbanization and local urbanization; the declining population of remote urban areas is between 3 million and 5 million, and the local urbanization transformed population is between 10 million and 15 mil-

**Table 2.** Types and amount of the Qinba Mountains' core reserves.

Level	Type	China	Qinba Mountains region
		Amount	Amount
World-class	Global biosphere reserves	32	4
	World natural and mixed heritage and cultural landscapes	17	1
	World geoparks	31	1
National level	National nature reserves	335	40
	National parks (pilot)	8	1
	National scenic spot	225	7
	National forest parks	779	61
	National geoparks	240	12
	National wetland parks (pilot)	251	11
	National water conservancy reserves	658	5



**Fig. 2.** Patterns of comprehensive ecological security in the core areas of the Qinba Mountains

lion. In accordance with ecological carrying capacity, the Qinba Mountains region can be divided into four major zones: the population restricted zone, the population evacuation zone, the population stabilization zone, and the population accumulation zone (Fig. 3).

The population restricted zone is unsuitable for human life and habitation. Population immigration should be prohibited, and emigration should be organized in an orderly fashion, taking into consideration the current population in nature reserves, national forest parks, and national geological parks. The population evacuation zone comprises critical or general suitable regions in the Qinba Mountains, where the environmental carrying capacity is critically overloaded. Migration and agglomeration development should be encouraged. The population stabilization zone comprises suitable areas for living environments. However, because the environmental carrying capacity is critically overloaded, maintenance of basic population stability is recommended, along with optimization of the regional industrial structure and improvement of public service facilities. The population accumulation zone, mainly the plains areas, is relatively or highly suitable for living environments. The better conditions pertaining to cities with construction land are recommended for promoting

industrial agglomeration and enhancing population carrying capacity.

**4.3 Evacuating industrial space**

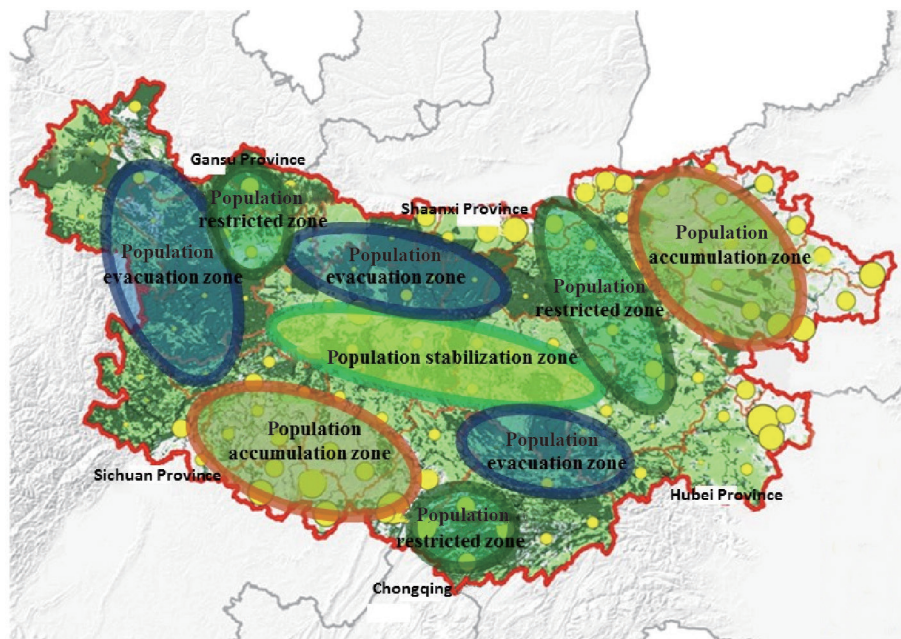
To protect the ecological environment of the Qinba Mountains region, the ecological strategy of “protecting the green heart, developing outside the mountain” is presented. According to the planning idea of “inner evacuation and outer extension, coming out of the mountain for development,” this research systematically analyses the Qinba Mountains’ industries, and adopts a concentric spatial pattern, with a green heart zone and a peripheral ring. The internal green heart focuses on the development of cultural tourism, health science and technology, ecological agriculture, forestry, and other industries, while in the peripheral ring, the development of mining, manufacturing, and other industries is undertaken. The industrial space is divided into seven sections (Table 4). The mining and manufacturing industries integrate and migrate outward, especially heavy chemical industries and other pollution-producing enterprises that should be relocated from the core area; new types of international green recycling industrial pilot zones and mountainous leisure areas should be built.

**4.4 Integrating urban and rural space**

The authors present several measures to integrate urban and rural space, as follows: rational guidance of the population flow and industry concentration based on protection of the ecological security pattern; promotion of the coordinated development of the Qinba region, focusing on construction south of the Bashan

**Table 3.** Area ratio of various zones in the comprehensive ecological security pattern.

Classification	Area (km <sup>2</sup> )	Percentage (%)
Vital zone	124 110	44
Important zone	101 081	36
Coordination zone	54 987	20
Total	280 178	100



**Fig. 3.** The scattered population zones in the Qinba Mountains region.

**Table 4.** Integration of industrial spaces.

	Division	Function
Green heart zone	Valley plate	Modern materials, modern medicine, green food, cultural tourism
	Mountains region plate	Cultural tourism, special plants and animals, healthcare, carbon sinks
Peripheral ring	Southeast of Gansu plate	Green food, green building materials, medicine and chemistry, modern husbandry
	Northeast of Sichuan plate	Mechanical manufacturing, energy and chemistry, smart logistics, food and medicine
	Northwest of Hubei plate	Automobile and parts, food and medicine, energy and chemistry, intensive processing of agricultural products
	Southwest of Henan plate	Energy and chemistry, equipment manufacturing, green raw materials, intensive processing of agricultural products
	Northern foot of Qinling Mountains plate	Cultural tourism, food and medicine, green raw materials

Mountains and east of the Qinling Mountains region; promotion of the Hanjiang River's point-axis type urban and rural development; and building an integrated urban-rural spatial structure of "one chain, one axis, one heart, and multi-point" to form a coordinated development pattern of resource elements optimizing allocation, thereby realizing a closely linked regional space.

A "chain" refers to the primary gathering area of urban and rural populations and the green recycling industry located the southern foot of Bashan Mountains and the east of the Qinling Mountains region, which focuses on ecological protection. The southern foot of Bashan Mountains and the Qinling Mountains region is recommended for development as a key zone relying on military technology, mineral resources, and land resources, the fostering of new energies, the precision processing of mineral products, new materials, electronic information, textiles, and food processing. "One axis" focuses on protection of water resources and utilization of ecotourism resources. A green recycling industry should be encouraged to be concentrated in the key cities and towns along the Han River, supported by the transportation backbone of the national expressways such as Shiyuan–Tianshui (G701) expressway and the Xiangyu Railway; development should focus on the automobile manufacturing industry, bio-industry, eco-tourism, and so on, thus building a recycling economic development axis along the Han River. "One heart" refers to the ecological green heart that primarily protects agricultural, forestry, and ecological land located in the hinterland junction of the Qinling Mountains and Bashan Mountains. "Multi-point" refers to using small and medium cities as nodes, combining the construction of industrial parks and the cultivation of special industries to improve industry and population accumulation capacity, thereby optimizing the urban system and industrial layout.

## 5 Constructing a green-oriented living environment pattern

### 5.1 Urban and rural layout pattern

So-called living environment science primarily studies the

habitats of all humankind, including villages, towns, and cities. The core of living environment science is identifying interrelations between various factors based on a holistic concept [5]. On this basis, by combining the ecological foundation and industrial conditions and directing the concept of green development, the paper presents four living environment patterns: whole green, dark green, medium green, and light green (Table 5).

#### 5.1.1 All green—village microcirculation

This model is suitable for most villages in the Qinba Mountains, as well as nature reserves, water sources, and national parks. Such settlements are generally smaller in scale, dispersed towns that have experienced a large ecological disturbance. Such areas should control population size and construction scale, and encourage migration from the relatively more dispersed villages to villages with better development conditions, or to large and medium cities in peripheral coordinated areas when migrating from extremely eco-sensitive regions and areas with frequent natural disasters. Farmland from the evacuated villages or towns should be returned to forestry. Development of industry and mining is prohibited in such areas. Farmers can conduct the green production of agriculture, forestry, livestock husbandry, and traditional Chinese medicine in designated areas, and proper development of rural tourism can increase farmers' wealth.

#### 5.1.2 Dark green—township small circulation

The model is adapted for standard towns or villages with relatively low demand for ecological protection, and a location far from an extremely ecologically sensitive area. Current township population and land scale must be maintained. Towns with small populations or inconvenient traffic conditions should carry out population reduction or township merging procedures. Polluting industries are prohibited in retained townships, and building space should be consolidated, with planning pursued in favor of ecological agriculture and forestry product processing. Settlements should make full use of the topography, and reduce the disturbance caused by urban and rural construction to the ecological environment as much as possible [6]. Secondary and tertiary industries with greater amounts of pollution are banned,

**Table 5.** Living environment patterns.

Green recycling cell	Recycling model	Main linking industry	Main function	Public center	Present town system or administrative cell	Construction model	Measures of recycling and control
All green residential areas	Microcirculation	Primary and tertiary industry	Habitations, agriculture, forestry, and hunting and medicine production	Rural community center	Village	Ecological immigration, green production	Control scale and combine ecologically sensitive zones and places experiencing frequent disasters, thus providing raw materials for the production of Medium and Light Green residential areas
Dark green residential areas	Small circulation	Primary, secondary and tertiary industry	Habitations, tourism, agriculture, forestry, hunting and medicine production, and green processing	Primary and middle school, health center, activity center	County	Scale control, ban on pollution	Control scale and ban polluting industries, connecting the All Green residential zone and the Medium Green residential zone, and building the important nodes of the recycling chain
Medium green residential areas	Medium circulation	Primary, secondary and tertiary industry	Habitations, tourism, green processing, innovative industry	Comprehensive service center, primary and middle school, stadium, central hospital	County center city	Networking facility, complete industry chain	Build a green transition line, complete radial pattern of transport and city infrastructure toward All Green and Dark Green residential zones, and establish an inner and outer recycling transitional station
Light green residential areas	Large circulation	Recycling for local economy, society, ecology, and cultural system	Habitations, tourism, green processing, advanced manufacturing	Large business center, commercial center, tourism service center, large hospital, primary and middle school	Medium city	Comprehensive, large-scale recycling model for all systems	Accelerate urbanization and establish inner circulation of the primary, secondary, and tertiary industries plus a large recycling industrial model, thus providing carriers for circulation of ecology, production, and livelihood

and conditional towns should be guided in properly developing green processing industry and rural tourism. Integration of rural tourism and urban and rural green construction should be accelerated, thus constructing an all-green recycling industry chain blending primary, secondary, and tertiary industries.

5.1.3 Medium green—county medium circulation

This model is suitable for counties and small cities with relatively flat terrain and already developed traffic conditions and industries. These cities are located along river valleys, generally in banding or collective arrangements. It is necessary to control the increase in population and land scale and define the urban growth boundary. Construction is encouraged to occur in specific areas separated by urban ecological green spaces, thereby making full use of the terrain. Within each group, building density should be enhanced appropriately, and the construction of urban

traffic should give full consideration to urban form in order to increase traffic efficiency in banding-pattern cities. Industry activities should be coordinated at the regional level, and recycling industrial parks, circular agriculture parks, and loop logistics parks should be constructed according to the park and clustering approach decided at the city level.

5.1.4 Light green—city large circulation

This model is suitable for central cities with relatively large populations and scale, with greater interaction with the ecological environment of the Qinba Mountains. Guilds should adopt a strategy for utilizing rainwater resources, with the goal of ensuring urban drainage and flood safety controls. A dynamic coordinating system for urban rainfall should be established that combines aspects of “discard, filtration, storage, usage, and drainage,” integrating local use and storage, reducing urban

runoff pollution, cutting runoff peak flow, and protecting water safety, thus achieving effective rainwater recycling.

## 5.2 Transportation support system

Oriented by the strategy of the national ecological main functional zone, this paper discusses the transportation zones of the peripheral development zone and the internal core zone differently. The peripheral development zone involves primarily rapid distribution transportation, while the inner core zone involves slow, leisurely transportation. An integrated transportation system should thus be built with the objectives of “periphery rapid, inner leisure, internal and external accessibility, and integrated speed,” led by fast transportation methods, combining aviation, high-speed rail, and highways with general highways and railways as the main transportation body, and supplemented by special tourism routes, slow green ways, and waterway transport systems. Green transportation can be developed by coordinating the surrounding area and sharing the Qinba Mountains region’s resources [7].

The Qinba development zone has formed a “one ring, three horizontal, and five vertical” main transport corridor pattern. The main transport corridor is formed with the Qinba Mountains’ core area as the center. It crosses the Guanzhong-Tianshui economic zone, the economic zone in the plains area, and the Wuhan agglomerations, and extends to the rivers and the sea. “One ring” refers to the outer ring formed by high-speed rail and highways connecting the six major cities in the development zone: the Longhai new line, the Chengdu–Lanzhou High-speed Railway, the Chengdu–Chongqing–Wuhan High-speed Railway, the Zhengzhou–Wuhan High-speed Railway, and highways in the periphery. The “three horizontal” refers to the Xi’an–Shangluo–Nanyang corridor, the Xiangyang–Shiyan–Ankang–Hanzhong–Jiuzhaigou corridor, and the Wanzhou–Bazhong–Guangyuan corridor. The “five vertical” refers to

the Luoyang–Nanzhao–Xiangyang corridor, the Xi’an–Shiyan corridor, the Xi’an–Ankang–Dazhou corridor, the Xi’an–Hanzhong–Bazhong corridor, and the Baoji–Guangyuan–Mianyang corridor.

## 5.3 Special landscape system

The Qinba Mountains region comprises mountains, basins, hills, and many other geomorphologic types. The natural landscape pattern is known as “two mountains, three waters, and five basins” (Fig. 4). The authors explored the functional connections of and differences in the terrain features between the internal organizational structure and elements of the urban and rural landscape. They divided the Qinba Mountains region into six types based on their analysis of the cultural, economic, and social factors influencing the terrain within the region and the ecological patterns of the mountains and rivers, including mixed scenery areas, the Qinlong scenic area, the Chuanshu scenic area, the Bayu scenic area, the Jingchu scenic area, and the central plains scenic area (Fig. 5). Important terrain axes and nodes in these six regions are illustrated.

The terrain axes are divided into the mountain landscape vista, the water landscape vista, and the transportation landscape vista. The mountain landscape vista highlights the two big mountain ecological security patterns. Relying on the five major river systems of the Yellow River, the Weihe River, the Hanjiang River, the Jialing River, and the Dan River, the waterfront landscape vista should be construed as forming six distinctive areas and regional identities. The transportation corridor is an important regional traffic route across the Qinba Mountains and should display images of the region through the different styles of landscape. Each terrain section takes first-tier city landscapes as its core, second-tier city landscapes as a supporting point, and third-tier municipalities’ terrain as featured nodes to build six regions of different grades and levels.

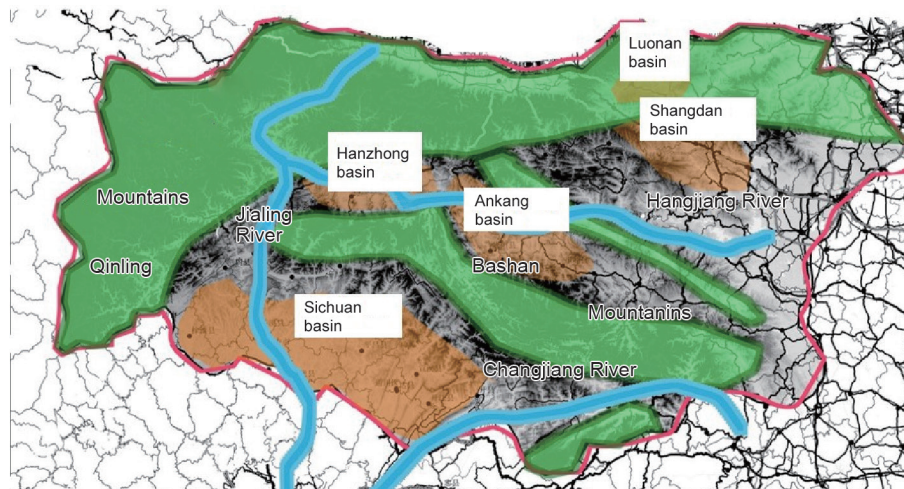


Fig. 4. Natural territory pattern.



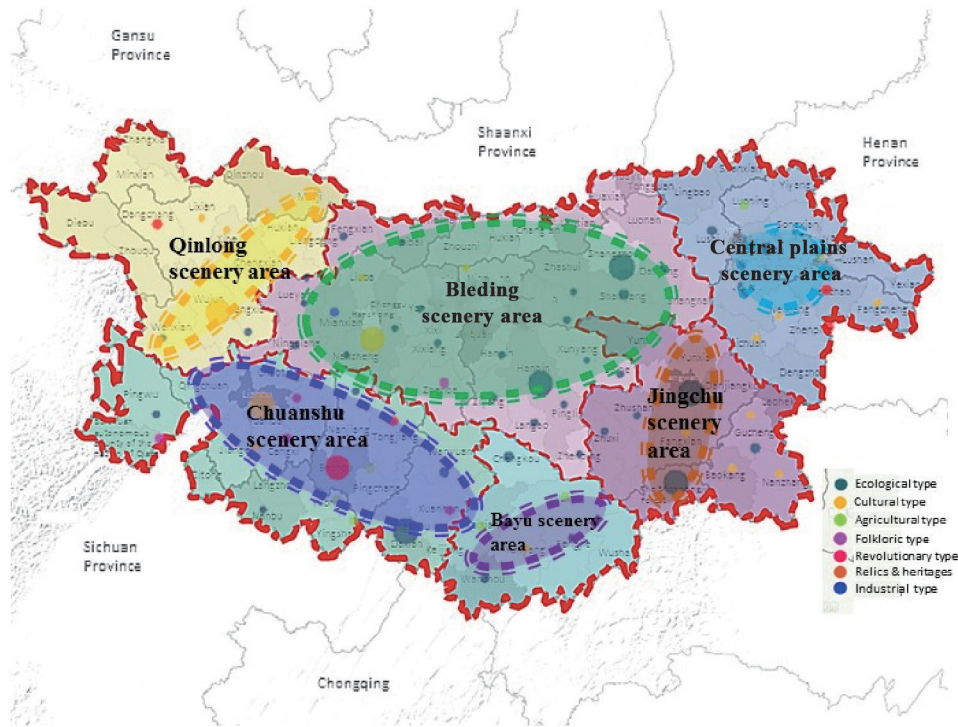


Fig. 5. Natural territory distribution.

## 6 Conclusion

This paper analyzes two core problems faced by the Qinba Mountains region: the conflict between ecological protection and urban-rural development interests in spatial planning, and the separation of green development from urban and rural development. These problems are approached from the perspective of environment protection, and an “ecology pilot, green-oriented” development strategy is proposed. First, holistic recognition of the ecological security pattern in the Qinba Mountains region is achieved through an ecology pilot living environment space integration; second, a green-oriented urban and rural planning model is constructed to realize the development of green living environments supported by transport systems and special terrain systems. Finally, an overall prediction is made to achieve a win-win scenario of regional ecological security and poverty alleviation in the region. The green development of the Qinba Mountains’ urban and rural living environment is a large, systematic project and also offers opportunities for exchange and research among different disciplines. The perspectives of this article are not the end of this research. With the advancement of this research, future in-depth study could be carried out from multiple levels

and using different perspectives on relevant issues in the Qinba Mountains region.

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