

# Green Development Strategy under Ecological and Environmental Limitations: Industry in the Qinba Mountains Region

Xu Delong<sup>1</sup>, Li Hui<sup>2</sup>, Zhou Yuan<sup>2</sup>, Cao Yunlong<sup>3</sup>, Miao Jinxiang<sup>3</sup>, Sun Jingwei<sup>3</sup>

1. Chinese Academy of Engineering, Beijing 100088, China

2. College of Materials and Mineral Resources, Xi'an University of Architecture & Technology, Xi'an 710055, China

3. Shaanxi Research Institute of Recycling Economy, Xi'an 710055, China

**Abstract:** As the main national ecological function area and maximal poverty alleviation area, the Qinba Mountains region faces the arduous task of ecological protection along with an urgent need to improve the livelihood of residents. In this paper, we analyze the present situation and challenges of industrial development in the Qinba Mountains region. In addition to the advantages of local and environmental resources, we propose the overall thinking, specific strategies, and safeguards to realize green development, transformation, and upgrading of industries in the Qinba Mountains region, under both ecological and environmental limitations. The paper would serve as a key reference for studies on regional industrial development.

**Keywords:** Qinba Mountains region; environmental limitations; industry; green development

## 1 Introduction

The Qinba Mountains region, an important geological and ecological boundary of middle China, stretches across five provinces and one city—Shaanxi, Sichuan, Henan, Hubei, Gansu, and Chongqing, respectively—including 20 cities divided into districts, a Gannan Tibetan Autonomous Prefecture, a Shennongjia Forestry District, and 119 counties (district, county-level city) [1]. This area covers various types of landforms as well as abundant biological and mineral resources; thus, it offers the perfect natural resource conditions for developing a regional characteristic economy [2]. However, overall economic development here is lagging because of regional and transportation limitations. As the largest poverty-stricken area in China, the region is the focus area for poverty alleviation over the next few years. The Qinba Mountains region suffers from frequent geological disasters, a

fragile ecosystem, environmental pollution, and significant construction that impacts its ecology [1,3].

Industrial development is the key to social and economic progress; further, it is a prerequisite for national modernization. Using industry to improve the economy of a province, city, or county is the preferred economic development strategy for most regions in China [4]. However, although industrial development promotes regional economic development and brings about significant improvements in society, it also severely damages the environment. As one of the 16 major poverty alleviation areas in China, the Qinba Mountains region is currently in a new phase of accelerating the industrialization process; however, the region faces arduous regional, ecological, and environmental challenges towards development, as it happens to be the country's green lung, central reservoir, and biological gene bank. Within these constraints and development opportunities, the region aims to

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**Author information:** Xu Delong, Chinese Academy of Engineering, vice president, academician. Major research direction is material science and engineering, and the theory and technology of circular economy. E-mail: dlxu@xauat.edu.cn

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achieve rapid economic development so as to alleviate poverty and protect the environment. In this paper, we examine the current level of industrial development in the Qinba Mountains region and identify the challenges facing the region. In addition to building on local advantages, we propose a general idea to develop a green ecological industry, with detailed strategy and security measures for the region. Further, we consider ecological and environmental constraints when presenting potential solutions and a reference for future studies on industrial development in the Qinba Mountains region.

## 2 Current situation, characteristics, and existing problems of industrial development in the Qinba Mountains region

Over the past decade, the Qinba Mountains region has seized a series of strategic opportunities, such as those created by the China's act of increasing poverty alleviation efforts and further promoting the development of the western and central regions. Thus, this region has vigorously adjusted the layout of the regional productive forces, and industry has rapidly developed with a continued increase in scale and efficiency. These improvements have played an important role in supporting the increased wealth of the local people.

### 2.1 Current situation of regional industrial development in the Qinba Mountains region

#### 2.1.1 Industry's proportion of regional economy

The proportion distribution of the output value for the primary, secondary, and tertiary industries of 26 prefecture-level cities

(states) in Shaanxi, Henan, Hubei, Sichuan, Gansu, and Chongqing is shown in Table 1. It was found that, except for that of Gansu, Chongqing, Xi'an, Ankang, and Hanzhong cities in Shaanxi and the Shennongjia forest region in Hubei, the proportion of secondary industries in other provinces (cities) is the highest of the three types of industries and, in most places, the output value of the secondary industry accounts for more than half of the local economic output value. There are 18 cities (states, regions) with significantly improved proportions of output values of secondary industries in 2014, compared with those in 2010. Thus, it could be concluded that industry occupies a considerable proportion of the local economy of the Qinba Mountains region.

#### 2.1.2 Formation of modern industrial system

After years of accumulation and development, a modern industrial system with six classes and more than 30 segments, including those concerning the production and manufacturing of equipment, raw materials, consumer goods, electronic products, and energy, as well as the cultivation of new industries, has been formed in the Qinba Mountains region. Many of these industries and associated companies are competitive in China, including the Dongfeng motor industry in Shiyan, light conveyors and machine tools of Hanzhong, the production base of Spark Machine Tool Co., Ltd. in Tianshui, gold and molybdenum industry of the small Qinling Mountains area, smelting and deep processing base of lead and zinc located in Hanzhong and Ankang in Shaanxi and in Dazhou in Sichuan, Selenium-enriched food and beverage production base of Ankang in Shaanxi, the biomedical base of Wanxi Pharmacy of Nanyang in Henan, Xinzhongfang Medicine Group of Guangyuan in Sichuan, olive industry of Longnan in Gansu, natural gas production base of Dazhou in

**Table 1.** Proportion distribution of output value for primary, secondary, and tertiary industries in the Qinba Mountains region.

Province/ Municipality	City	Primary industry: Secondary industry: Tertiary industry		Province/ Municipality	City	Primary industry: Secondary industry: Tertiary industry	
		2010	2014			2010	2014
Shaanxi	Xi'an	4.32:43.39:52.29	3.9:40.3:55.8	Hubei	Shiyan	10.6:54.6:34.8	12.6:50.8:36.6
	Baoji	10.7:62.9:26.4	9.7:65.0:25.3		Xiangyang	15.2:51.9:32.9	12.8:57.7:29.5
	Weinan	16.1:49.2:34.7	14.2:54.4:31.4		Danjiangkou	14.5:50.4:35.1	15.5:50.7:33.8
	Shangluo	20.3:41.2:38.5	15.8:52:32.2		Laohekou	21.1:56.8:22.1	15.7:53.0:31.32
	Ankang	20.5:39.6:39.9	13.5:55.1:31.4		Shennongjia	11.4:39.7:48.9	9.4:40.3:50.3
	Hanzhong	21.66:39.14:39.2	18.6:46.2:35.2		Chongqing		8.7:55.2:36.1
Henan	Luoyang	8.1:60.1:31.8	7.5:56.2:36.3	Gansu	Longnan	26.30:28.63:45.07	25.2:26.4:48.34
	Pingdingshan	8.7:66.3:25.0	10.2:57.9:31.9		Tianshui	20:37.7:42.3	18.3:38.8:42.9
	Nanyang	20.5:52.0:27.5	16.3:50.5:33.2		Dingxi	31:25:44	28.0:26.3:45.7
	Sanmenxia	8.0:68.5:23.5	9.0:64.0:27.0		Gannan	23.5:23.7:52.8	22.53:24.63:52.84
Sichuan	Dazhou	23.8:50:26.2	20.9:52.9:26.2	Sichuan	Nanchong	24.5:48.4:27.1	21.9:50.9:27.2
	Bazhong	29.1:33.8:37.1	18:46:36		Wanyuan	28:46.6:25.4	22.9:54.3:22.8
	Guangyuan	23.8:39.0:37.2	17.4:47.4:35.2		Jiangyou	14.2:48.4:37.4	13.2:51.1:35.7
	Mianyang	17.3:48.8:33.9	16.0:51.0:33.0				

Note: the data is based on government statistical communiques, government work reports and statistical yearbooks.

Sichuan, and integrated circuit industry and semiconductor-device package-testing industry of Tianshui Huatian Electronic Group Co., Ltd. in Gansu.

### 2.1.3 Construction of industrial parks

Sixteen national and twenty-two provincial industrial parks have formed a distribution pattern of “four peripheral districts and one central band” in the region. As special regions, industrial parks play an important role in the economic development of this region.

### 2.1.4 Rapid development of industrial enterprises

A series of well-known enterprises that have a significant impact both nationally and internationally has been formed in and around the region. These enterprises have become the pioneers and guides of regional economic development.

## 2.2 Characteristics of industrial development in the Qinba Mountains region

### 2.2.1 Acceptance of green cycle development

Most cities and counties in this area have fully recognized the importance of green, low-carbon, recycling development, and they have adhered to the development path of environmental-protection priority and ecological supremacy. They have improved the quality and efficiency of economic development, and adjusted their focus to the structure, strongly promoting energy conservation and emissions reduction, as well as strengthening the management of energy consumption and emissions of key pollutants. Concerning the high-energy-consuming and regional-characteristic industries, these cities and counties have constructed an ecological industrial structure and preliminarily found large-scale recycling chains in certain industries, such as the precious metals, nonferrous metals, and non-metallic mining and processing industry; energy and chemical industry; biological medicine industry; agricultural and sideline-products-processing industry; and fruit-processing industry.

### 2.2.2 Achievement of accurate positioning and dislocation development

In order to form a regional, core competitive advantage and avoid regional vicious competition and homogeneity tendency, some cities and counties have precisely divided the function areas and implemented classified guidance within the jurisdiction, based on the international industrial situation, their own resource endowment, and the characteristics of industrial economic development. They have taken the initiative to adjust the industrial layout and guide the development of differentiation and dislocation. For example, according to the geographical and ecological characteristics of its different areas, Chongqing has been divided into five main districts: the district of major urban functions, district of additional urban functions, new urban-development dis-

trict, Chongqing northeast ecological conservation development zone, and Chongqing southeast ecological protection development zone. Moreover, the industrial investment ban list was provided in accordance with the prohibition and restriction categories. Among these five districts, the new urban-development district serves as the main battlefield of future industrialization, and the construction of industrial projects with high water consumption and high pollution, which may have an impact on the atmosphere in the main city, is strictly restricted there. For the Chongqing Northeast Ecological Conservation Development Zone, which is located in the central Qinba Mountains region, industrial projects with resource and environment overloading, as well as backward/outdated production facilities are banned, while regional characteristic industries and green cycle development are promoted.

### 2.2.3 Initial success of civil-military inoculation

As an important construction base of the national defense industry back in the 1950s, 1960s, and 1970s, the Qinba Mountains region has had many military industrial enterprises in the field of equipment manufacturing, such as aviation, aerospace, nuclear, machinery, and electronics. Today, most of these military enterprises have been integrated into the local economy and gradually shifted to the development focus of “civil-military inoculation,” making important contributions to local economic development.

### 2.2.4 Rapid development of industries with regional advantages and characteristics

In the Qinba Mountains region, industries relying on rich biological and mineral resources, as well as the unique natural conditions have been developing rapidly. These include the growing clean energy industry (wind power, hydropower, and photovoltaic), green biological resources (agriculture, forestry, animal-husbandry-products processing, and bio medicine), and deep processing of mineral products (molybdenum, tungsten, gold, and salt).

### 2.2.5 Rapid development of industrial parks

A large number of industrial parks, industrial bases, high-tech zones, and development zones have been constructed in the Qinba Mountains region, and they are having a larger agglomeration effect. The strategic support and integrated driving functions of these parks are continually enhanced. Further, diverse, complementary, and competing park-development patterns are being formed.

## 2.3 Existing problems of industrial development in the Qinba Mountains region

Although industrial development in the Qinba Mountains region is very effective, there are many problems to be solved due to its own limitations and historical reasons.

### 2.3.1 Weak industrial base of region

The overall industrial pattern of the Qinba Mountains region is strong in the east, weak in the west, and north-south equivalent with uneven development within the regions themselves. For example, Shiyan in Hubei is already at the middle stage of industrialization, but Longnan in Gansu is still at the initial stage of industrialization—some of the counties there have virtually no industries. Moreover, Wanzhou in Chongqing and Dazhou in Sichuan are basically at the same stage of industrial development, as are Hanzhong and Ankang in Shaanxi—the intermediate stage. Generally, the industrial economic domestic product is still small in this area. Lagging behind the national average of development, the Qinba Mountains region is in a period of transition from the early to middle stage of industrialization, which clearly contrasts its important position and function in the regional economy.

### 2.3.2 Relatively low industrial level

In the Qinba Mountains region, the resource-developing industry, which is primarily processing-oriented, accounts for a large proportion of the total industries. Most industries are at the lower end of the value chain, and those in a few remote counties are still stuck at the level of agricultural and sideline products. In addition, the ability of these industries to absorb and transfer the employment of local farmers is weak. High technology, high value-added, and emerging industries have not yet gained a solid foothold in the area.

### 2.3.3 Relatively poor innovation ability

An atmosphere of innovation has not yet formed among the small and medium-sized enterprises in the Qinba Mountains region, more than half of which do not have technical research and development institutions yet, nor do they have technology innovation systems and mechanisms. In fact, most products still belong to the labor-intensive category, and the technical content is low. The primary manner of technology innovation for these enterprises is introduction and imitation, and the development of local industry relies mainly on expansion.

### 2.3.4 Lack of professionals

The difference in economic level between developed areas and the Qinba Mountains region urges local human resources to unidirectionally flow and aggregate toward large and medium-sized cities and developed areas. This causes a lack of all types of professionals in the Qinba Mountains region. Scientific and technical personnel account for less than 200 per 10 000 people (40% of the national average). Furthermore, because of geographical and transportation limitations, industrial facilities, the living environment, and medical facilities are poor; education facilities are lagging; teachers are needed; and basic public-service facilities are incomplete. Thus, it is difficult to attract professionals to the Qinba Mountains region for entrepreneurship and employment.

### 2.3.5 Lack of national investment

Since the Chinese economic reform, most of the money invested by the government in the Qinba Mountains region has been used in agriculture, forestry and transportation, water conservancy, energy, and other infrastructure construction, as well as in education, healthcare, and other social undertakings and basic public services. However, national investment and support for local, industrial economic development in this region is relatively less. Some projects have received financial support from the country, but because of the financial difficulties of the local government—like not being able to provide matching funds—the support is hardly ever implemented. Traditionally poor at “making blood for itself,” the Qinba Mountains region has found it hard to apply for bank loans and attract investments.

### 2.3.6 Lag in informatization

Due to the lack of a unified information strategy layout and cooperation linkage mechanism, the informatization of different regions in the Qinba Mountains region is uneven, and connectivity within region is not achieved. Restricted by natural conditions, the information infrastructure is relatively weak and has insufficient service capability. Further, since informatization and industrialization are not adequately integrated, the needs of industrial green development cannot be fully met.

## 3 Green development strategies of regional industries in the Qinba Mountains region under constraints of ecological environment

The ecological and environmental protection of the Qinba Mountains region is related to national ecological security and, thus, is crucial. The local environment of the region is fragile; once polluted and destroyed, it is difficult to restore. Under the ecological and environmental constraints, the industries in the Qinba Mountains region should use technology, management, and policy innovation as the driving forces, as well as give priority to conservation. In addition to the current industrial development, these industries should focus on enhancing quality and efficiency, promoting their advantages and regional cooperation, developing themselves according to their own features, and taking the path of green ecological development.

### 3.1 General idea of green development of regional industries in the Qinba Mountains region

The ideas of innovation, coordination, green, open, and sharing development should be adhered to, and the development strategy of “guided by big groups, supported by big projects, promoted by industrial parks and clusters, innovating in the field of science and technology, integrating with tools of informatization, developing in a green way, and improved by recycling” should be implemented. Moreover, local conditions

should be taken into account and interests should be focused on developing advantageous industries, transforming and upgrading traditional industries, fostering green emerging industries, and promoting the transformation and upgrading of industrial parks. Further, a green industry system that has prominent advantages and is distinctive, efficient, clean, and low carbon cycling should be constructed in order to build a “green, beautiful, and rich Qinba.”

### 3.2 Detailed strategy of green development of regional industries in the Qinba Mountains region

#### 3.2.1 Prioritization of ecological protection and optimization of industrial layout

According to the national ecological security pattern plan, a considerable number of regions in the Qinba Mountains region are national nature reserves and important areas of ecological security. Thus, it is not suitable for these regions to have heavy industries that may cause pollution. Only the moderate development of a pollution-free green industry would be appropriate in this area. The heavy industries that were originally assigned to these regions should be gradually transferred to the periphery coordination area of the Qinba Mountains.

#### 3.2.2 Restriction of development of traditional industries

At present, the traditional industries in the Qinba Mountains region are mainly those of iron and steel metallurgy, nonferrous metals, building materials, chemicals, equipment manufacturing, and garment and textiles. Regarding the iron and steel, nonferrous metals, building materials, and garment and textile industries, their capacity development should be strictly restricted, the elimination of outdated production capacity should be sped up, and industries located at the ecological security districts of importance and extreme importance in the central zone of the Qinba Mountains region should be gradually transferred to the industrial parks in the periphery coordination area. In the meantime, enterprises should be encouraged to use technology to enhance the quality and efficiency of their production, and industrial chains should be extended. For the chemicals industry, the development of non-metal chemical products should be strictly restricted and enterprises should be encouraged to transform from the traditional chemical-raw-material processing to the preparation of fine chemical products. Given the mineral resource advantage of the Qinba Mountains region, the development of new chemical, biochemical, and electronic chemical materials should become the focus. For the equipment manufacturing industry, based on the accumulation of industrial advantages, the development of aviation, automobile, machine tools, and other equipment manufacturing industries should be the focus; green and intelligent manufacturing, as well as re-manufacturing, should be promoted; and fine, featured services should be provided.

#### 3.2.3 Strengthening of cultivation of characteristic green industry

The biological germplasm resources of the Qinba Mountains region are rich, and their potential for being utilized is great. This area is the nationally famous “green biological resources gene pool” and “home to Chinese herbal medicines.” There are more than 2400 types of Chinese herbal medicines, 282 of which are formal Chinese herbal medicines belonging to the pharmacopoeia standard, accounting for 62.3% of all formal Chinese herbal medicines. There are rich areas of *Eucommia*, *Magnolia*, *Taxus chinensis*, *Gastrodia elata*, *Coptis chinensis*, *Gynostemma pentaphyllum*, *Pueraria*, *Cornus*, and *Schisandra*, which are rare throughout the country. Moreover, this area is uniquely rich in *Gynostemma pentaphyllum*, and it is the nation’s largest producing area of *Gastrodia elata*. Furthermore, the Qinba Mountains region is one of the concentrated distribution areas of lacquer, walnut, and tea as well as other resources in the country [5]. Here, the forest-covered area is large, human-made pollution is extremely scarce, air and water quality is good, and ecological environment is in conformity with the of Green Food AA production standards [6]. The Qinba Mountains region has good conditions to develop green industries. The local government should rely on the advantage of medicinal herb plantations in the area, vigorously develop characteristic Chinese patent medicine and biological agents industries, and use green advanced technology and equipment to better treat wastewater and utilize wastes. Relying on the characteristic agriculture, forestry, and animal husbandry products, resources such as walnut, chestnut, tea, konjak, edible fungi, woody oil, and ecological farming, the government should develop characteristic industries, such as organic food, organic fruit, green drinks, green eggs and meat, selenium-rich food, fruit processing, livestock and poultry-meat processing, edible fungi, tea, and woody oils. The patterns of “one village, one product” and “one county, one product” should be dismantled, and the joint standardization of regional green agriculture, forestry, and animal husbandry products in the Qinba Mountains region should be carried out. Enterprises should aim for brands and scale. Further, the local government should utilize the region’s water resources and carbon sink resources with a high starting point, and foster both the water and carbon-sink economy industries.

#### 3.2.4 Cautious development of mineral-products deep-processing industry

The Qinba Mountains region is extremely rich in mineral resources, with more than 100 types, including nonferrous metals, rare metals, precious metals, energy, and non-metals. In the past few decades, the exploitation and utilization of mineral resources have greatly promoted the development of the local social economy, but there are also many problems, such as resource waste, the deterioration of the ecological environment, and indiscriminate mining [7]. The exploitation of mineral resources in the Qinba Mountains region should be planned with caution;

mineral resources with high quantities and quality (such as natural gas, molybdenum, vanadium ore, barium ore, salt, and geothermal) in the periphery coordination area could be exploited with careful planning, industrial chains could be extended, and a green-mineral-development industrial zone could be jointly constructed by multiple provinces. The ecological security districts of importance and extreme importance in the central area should only be explored, but not exploited, and the closure of open mines and ecological restoration should be the focus.

#### 3.2.5 Promotion of transformation of industrial parks

Relying on the resource distribution characteristics in the Qinba Mountains region, the relevant departments should sort out the current situation of the industrial parks, accurately determining the functions of each. They should further optimize the layout of the parks and promote the transformation of the industrial layout toward being intensive and efficient, coordinated and optimized, and concentrated load-bearing. The industrial parks' infrastructure should be improved; construction of energy and resource-recycling systems should be promoted; and recycling of wastewater, waste heat, and waste residue within the parks should be achieved. The industrial internet facilities in the parks should be improved in order to build "smart industrial parks" using mobile internet, internet of things, cloud computing, big data, and other facilities. In the parks, the primary role of leading enterprises should be portrayed, and industrial cluster development should be promoted.

## 4 Safeguards to realize green development of regional industries in the Qinba Mountains region

### 4.1 Strengthening of regional coordination

#### 4.1.1 Strengthening of unified leadership and promotion

A Qinba Mountains green and circular development leading group should be formed nationally to make general and specific plans for the green cycle development of the Qinba Mountains region, organize the promotion of the cooperation and coordinated development of the area, and discuss and solve new situations and problems during such development in a timely way.

#### 4.1.2 Establishment of joint conference system

Members of this system would be mayors of the regional cities in the area. They would take turns hosting the joint conference, which would be held once a year. At this conference, major issues in promoting the green cycle development in the Qinba Mountains region would be discussed, unified actions taken, and cooperation and collaborative development would be actively promoted.

#### 4.1.3 Establishment of a think-tank alliance

The focus of this think-tank alliance would be to strengthen

regional cooperation, promote industry collaboration, increase ecological protection, develop green industries, achieve interoperability, build an leader of inland open economy, and other research work.

#### 4.1.4 Establishment of a regional industrial alliance

This industrial alliance would be formed by industry, industry associations, or regional large and medium-sized enterprises to establish a project docking mechanism for the extension of industrial chains and to promote regional industrial dislocation in addition to characteristic and complementary development.

### 4.2 Plans for regional industrial green development plans

Feasible and scientific short-, medium-, and long-term plans for industrial green development should be made to construct a system of green, low carbon-cycle development. The plans should focus on the development of advanced equipment manufacturing, electronic information, biomedicine and green agriculture, forestry, animal husbandry products processing, and other industries. Further, the plans should strengthen the carrier function of the industrial park, promote the development of industrial clusters, and support new technologies and industries.

### 4.3 Reduction in construction times of systems

The construction time of the following systems should be reduced: industrial, green, low carbon-cycle-development evaluation system, natural-resources-assets property rights and use control system, environmental protection system of industrial development on the basis of the ecological red line, and green exploitation and paid use system of mining resources. The construction of the emissions-trading and green-tax systems should be explored.

### 4.4 Focus on education and introduction of professionals

Specialized plans for the introduction of professionals should be made. Local ecological advantages and attractive professional-introduction policies should be used to attract high-tech talent from neighboring big cities to the Qinba Mountains region for business opportunities or improved employment. The local government and leading enterprises should cooperate to construct a specialized vocational training college, carrying out such training by relying on local industries.

### 4.5 Innovation of financial support system

In accordance with the manner of co-construction between China and the six provinces (cities), a Qinba green development bank should be formed. A number of regional green industrial development funds of the Qinba Mountains region should be es-

established; further, effective cooperation mechanism between the government, banks, and enterprises should be enabled to better promote the development of enterprises and industries.

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