

## Green belt construction of industrial cities in ecologically fragile regions -Take Jinchang for example

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**ABSTRACT:** The industrial development of industrial cities in ecologically fragile regions mostly relying on superior resources is rapid, while due to the restriction of geographic location and natural environment, these cities are always faced with problems including tightened resource constraints, serious environmental pollution and ecological degradation; the fundamental survival requirements of these cities not only carry the function of regional social and economic development, but also bear the important mission of regional ecological security and sustainable development, which is more urgent. Taking Jinchang as an example, this paper tries to establish the construction model of green belt on the basis of ecological civilization-orientated value, and also explore necessary measurement and developing routes to maintain the ecological security pattern of industrial cities in the ecologically fragile regions by executing the goal and core spirit of the green belt construction.

**Keywords:** ecologically fragile region; industrial city; green belt; Jinchang

### 1 INTRODUCTION

Along with deepening global desertification, particularly in many ecological fragile regions of China, ecological security has become the main problem in the development of the cities in these regions. Most of the industrial cities in Northwest China are resource-based, the selection of locations and development of these cities are resource-orientated from the very beginning in a special historical period. Under the instruction of “embedded” mode in the country, many resource-based industrial and mining cities were formed in a very short time with the large-scale development of resources; however, due to the constraints of resource distribution, these cities are always located in remote regions rich in resources with infertile soil and fragile ecology. These cities are always in gobi and desert zone with extremely rare population,

far away from the main traffic line, and vulnerable to the limited survival space, limited conditions of ecological conservation, deficient self-sufficient capability and the constraints of resource distribution.

These industrial cities not only need to carry the function of regional social and economic development, but also bear an important mission of promoting ecological security and sustainable development. Urban development is always restricted by many external forces including the capacity of land, water resource and ecology and substantial development of the industry. Therefore, the biggest threat in the urbanization comes from the serious challenge of ecology security and survival constraints under the fragile ecological conditions. Continuous industrial growth and increasing pressure of ecological environment make this kind of cities fall into a dilemma of economic development or pollution regulation, thus being blocked by the excessive damage of resource consumption and environmental destruction.

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## 2 THEORETICAL BASIS

### 2.1 *The value orientation of ecological civilization*

Since the reform and opening-up, the industrialization based on urbanization appears several problems including serious environmental pollution and ecological degradation. Under the guidance of scientific development concept, the 16<sup>th</sup> CPC National Congress puts forward the construction of ecological civilization as a major agenda. The 18<sup>th</sup> CPC National Congress first makes special discussion and report of ecological civilization, which emphasizes that the construction of ecological civilization significantly concerns the well-being of people and it is the long-term strategy of our nation in the future. It requires speeding up the system establishment of ecological civilization, perfecting national spatial development, resource conservation, and the mechanism of ecological environment protection system, and forming the new patterns of modernization which can promote the harmonious development of the human-being and nature.

Faced with the problems of tightening resource constraints, serious environmental pollution and ecological degradation, the ecological civilization concept of respecting, following and protecting the nature must be formed; it needs to attach significant importance to the construction of ecological civilization, and combine the construction of ecological civilization with the whole process of political, cultural and social construction. Ecological civilization is committed to the continuous stability of life and the environment, and it's a mode of civilization that the development of economy, society and culture is on the premises of continuous improvements of ecological environment quality<sup>[1]</sup>.

In ecological civilization, it needs to promote the advanced productive forces of industrial civilization and develop competitive life force with abandoning the outlook of separating human beings and the nature. It also requires embedding the ecological culture of material circulation, information feedback and low-carbon energy and symbiosis, regeneration and autogeny of life force in the process of human development, thus realizing the regional development as a whole and fairness in intergenerational relations<sup>[2]</sup>.

As a sustainable civilization, ecological civilization identifies with all human activities of environmental utilization and resource development in the capacity of environment and cycling time of recoverable resources; it is a kind of sustainable exploitation and utilization<sup>[3]</sup>. The core of ecological civilization is symbiosis, sustainability and equality.

### 2.2 *The development and application of Green Belt Policy*

Public policy is the selection, integration, distribution and execution of public interests and it is a manage-

ment tool of government. As this kind of management is always realized by authoritative distribution of the social value, it requires the public policy must have a good value basis<sup>[4]</sup>. From the perspective of urban living environment, the appearance of Green Belt Policy is due to a series deterioration problems of urban ecology resulted from the vicious expansion of cities led by the industrial revolution in western countries. The green belt in London is the most typical example. W.Petty explicitly put forward the concept of urban green belt in the 17th century for the first time, and until 1826, J.Loudon compiled the London Planning, and first proposed the ring mode of city development and put forward the assumption of integrating the city development with the protection of farmland and forest. And the idea turned the assumption of city green belt into reality. However, the real construction began in the late 1920s and early 1930s; Greater London Regional Planning Committee (1927-1936) was the leading organization to conduct the green belt construction, and the technical consultant R.Unwin suggested a green belt only with 2km in width and 200km<sup>2</sup> in area. Later after Greater London Plan(1944) compiled by Abercrombie, the Urban and Rural Planning Law (1947), in 1968, by conducting a two-level system of structural planning and local planning, the Urban Planning Law was implemented, which turned the plans into reality. Later the practice extended from London to other cities, and also helped the Green Belt Policy obtain support from laws and has been maintained in reality.

Green Belt Policy plays a very significant role in the urban and rural planning system of British in a history of more than 60 years. The government implemented corresponding laws to set legal foundations for the construction of green belt. The policy has been in fairly stable execution and widely regarded as one of the cornerstones of British urban and rural planning<sup>[5]</sup>. Also it has worldwide influence, modern urban planning history occupies an important position in the world and it has become the model in the world, which has been imitate by many cities. Simultaneously, several improvements from different levels have been made in the imitation.

## 3 GENERAL SITUATION OF JINCHANG

Jinchang is located in northwestern of Gansu Province, and it's in the middle of the Hexi corridor, being sandwiched by Qilian Mountain in the south and Alashan Platform in the north. The whole city is mostly composed of mountains and plain, and it is covered with Gobi desert and oasis alternately. The city is on the edge of Gobi, where Dragon Mountain stretches intermittently from northwest to southeast and vanishes in the Gobi gradually and the Tengger desert half cycled the territory in the northwest (Figure 1).



Figure 1. The administrative division and satellite imagery of Jinchang city  
Source: According to Google's satellite map

As a typical industrial city with fragile ecology, Jinchang has been developed in large scale since the discovery of extra-large copper sulfide nickel ore in 1958. By 1981, the setup of prefecture-level city was approved by the State Council. During this period, it always focused on the construction of nickel base; the development mode is obviously embedded with the characteristics of resource-based cities. And now it has been built the largest production base of nickel and cobalt, refining center of platinum group metals, the largest production base of copper in North China, and major fertilizer production base and high-efficiency agriculture base in Gansu Province. Since 2000, Jinchang achieved rapid growth in social economy with an average increase of 19.38%, 19.1% of GDP and per capita GDP respectively, which is far ahead of other cities in Gansu Province<sup>[6]</sup>.

Jinchang is located in the inland arid desert in China, and it is obviously featured with the continental climate with annual precipitation less than 200mm while with annual evaporation being about 10 times of annual precipitation. Under the constraints of the climate and being the transitional zone of oasis, Gobi and desert and especially by the influences of Tengger desert, the city is always in a grave shortage of water resources and low in forest coverage. And also Jinchang is always suffering from the sandy and windy weather, and it is in the core region of one of the four biggest sandstorm source areas in north China. Land desertification is a serious threat to the ecological environment and sustainable development of the city and the surrounding areas.

#### 4 CONSTRUCTION RESEARCH OF GREEN BELT

##### 4.1 *The goal of the construction of green belt – integration of fairness and efficiency*

From the perspective of public policy, maintaining public security is the focus of urban planning and

development, whereas the potential harm of the urban living environment with ecological imbalance, frequent natural disaster like geological disasters is far more than the potential economic value. The basic requirement of public policy is to concern the public interest in the process of urban spatial growth, and balance the acute and urgent contradiction between urban development and the ecological environment.

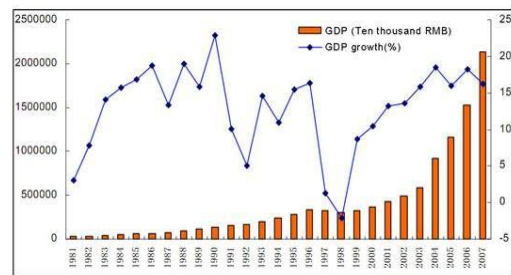


Figure 2. Change of economic growth since the reform and opening up (Jinchang)

Source: Jinchang Municipal Government & Beijing Tsinghua Urban Planning Design and Research Institute. Specifications of Urban and Rural Overall Planning (2008-2020) of Jinchang City (2009)

On the one hand, as a typical industrial city, the industry of Jinchang develops rapidly relying on the resource advantages. Especially with insisting long-term implementation of the strategy that is to construct a powerful city through industrial development makes the promoting influences of the industry on the economic development more prominent (Figure 2). Currently, Jinchang is in the intermediate stage of industrialization and is transforming from primary processing of raw material to deep processing. The proportion of industrial value in GDP is increasing year by year and the economy is more dependent on the industry. The city with resource-based is the most significant type of planned economic system and extensive economic growth in China. Facing up with the intensified resource shortage and deteriorating ecology,

it brings new challenges as well as opportunities to the survival and development of market economy<sup>[7]</sup>.

on the other hand, in addition to the pollution of soil, water, air and noise brought by the industrial production, in the process of mining, it will strip the topsoil, which can bring damage to native vegetation, and the restoration of vegetation covering soil, soil detachment and piled waste rock can cause desertification, and the instability of waste rock, tailings deposit will also incur geological disasters like landslide and debris flow. Moreover, a surplus of waste rock and piled tailings need to occupy the land, thus bringing ecological safety conflicts of desertification and geological disasters.

High industrial efficiency is always the evolution and development principle of industrial cities. But Jinchang is located in ecologically fragile region; the living base is in the fragile ecosystem with large-scale Gobi and desert. High-speed growth of urban development is always on the basis of sacrificing public security and public interests. It will bring tremendous burden to the fragile ecological environment and lead to the deterioration of ecological conditions that when the resources are exploited excessively and improperly. The core solution of developing urban space of Jinchang city is to maintain the ecological balance, reduce the destruction of ecological environment, find the solutions of balancing the protection of ecology and urban construction, and realize the harmonious development of economy and environment.

The construction of green belt can effectively inhibit the spread of urban expansion and promote the ecological environment protection. It's an important means to realize the sustainable development of cities. Currently in China, the main difference of the construction of green belt in cities is the differentiation in its concept. It is mostly believed that the construction of green belt is in the megalopolis and big cities and the purpose is to prevent rapid spread of cities. This convergence of the value of the construction of green belt results from the perspective of efficiency. In fact, by setting up the concept of integrating fairness and efficiency, and forming a perspective from public security and public interests to construct green belt, it's of more necessity and feasibility to balance the economy development and ecological security in Jinchang.

#### 4.2 *The combination of core-single mode and diversity mode in the construction of green belt*

Traditional construction of green belt is only to control the expansion of urban city and realize the division of urban and rural areas, and it's far from leading and integrating. It can be seen from the development of the construction of green belt in London that the concept of "green belt" was proposed for three reasons. The first one is to prevent further expansion of the city; the second one is to protect agriculture of

suburbs; and the third one is to provide a place for leisure to the citizens<sup>[8]</sup>. The construction of green belt is to constrain the city expansion and divide the urban and rural areas. However, for Jinchang, a city with harsh natural conditions and extremely fragile ecology, the ecologically sensitive areas are widely distributed in the entire district, which accounts for more than half of the city (Figure 3). Moreover, the suburbs are different in ecological environment which is not only farmland and villages.

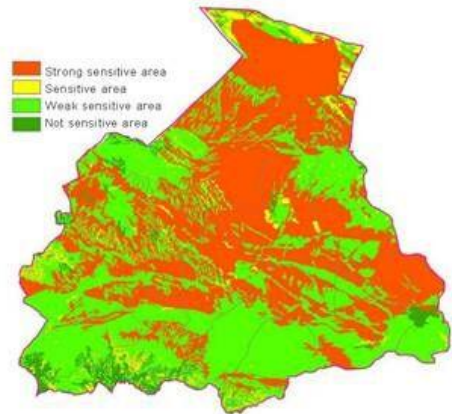


Figure 3. The distribution of ecologically sensitive area in Jinchang

Source: Jinchang Municipal Government & Beijing Tsinghua Urban Planning Design and Research Institute. Specifications of Urban and Rural Overall Planning (2008-2020) of Jinchang City (2009)

Gobi and desert are distributed in the north of the city, and the long-term soil erosion by the wind destroyed the structure of the soil, thus it strengthened the desertification. The construction of green belt should establish the ecological barrier on the basis of the existing ecological shelter belt with 500-1000m wide. It needs to select native shrub and trees for afforestation and sand fixation, expand the area of psammophytes, and form a barrier with the function of windbreak, thus realizing the purpose of preventing the desert moving towards the south area.

The mining area in Dragon Mountain is in the west of the city. Large-scale mining leads to stripping of the soil and piled waste rocks, which also brings desertification. The construction of green belt should be combined with the reclamation of forest, and conduct restoration of soil detachment area and realize the purpose of ecological restoration of the mountain and optimization of the construction of green belt.

The Jinshui River, piled wasted rocks and the sand are in the south of the city, and this always leads to geological disasters like soil erosion. In addition, the constraints like railways, the tailing dam and the sand impeded the development towards the southern areas. In this situation, the construction of green belt should be combined with the development of waterfront. It

needs to establish and conserve an ecological corridor along with the riverside as an important measurement to safeguard the ecologic security and realize the purpose that integrates the urban development and the balance of the ecology of the river.

The oasis farmland, pastures and villages are in the east of the city. In this situation, it needs to establish farmland shelter-belt, conduct ecological isolation and form the ecological boundaries. Also, to realize the purpose of limiting city expansion and protecting peripheral ecological areas of the city, it needs to strengthen the protection of arable land, especially the protection of basic farmland, thus avoiding the conflict between urban construction and farmland protection. It needs to show the characteristics of the construction of green belt which is to control the expansion boundaries.

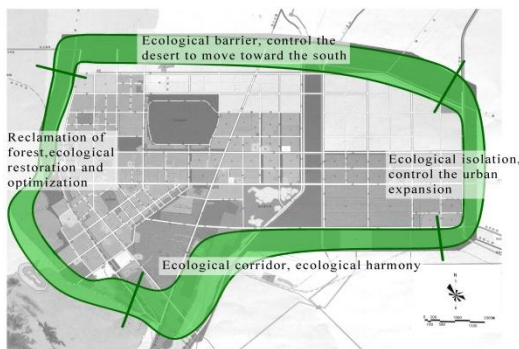


Figure 4. The divisional construction of green belt of Jinchang city

Source: The author

The construction of green belt in Jinchang city must be combined with the specific circumstances. Purely defensive actions need to be transferred to the coordination of multiple actions. In other words, based on the idea of integrating the singular actions and the multiple actions, it needs to conduct divisional construction of green belt (Figure 4). Simultaneously, combined with the external traffic corridor of the city and set boundaries of the green belt in different orientations, it can establish an ecological green belt with multi-functions and reserve sufficient space for the further development. This will make the green belt become the base line of the ecological security in the process of development and form a good ecological structure in the periphery of the city.

#### 4.3 *The combination of implementation-action mode with passive mode in the construction of green belt*

The essence of green belt in the city is a compulsory management mode of the city space, and it mainly used to control the disordered expansion of the city and improve the ecological environment of the city.

The construction planning of the city has not proposed specific policies of the green belt in China. It was literally translated from English, and it has not reached a consensus and explicit definition of green belt yet. In the research and discussion, the scholar always grants it some modifications and restrictions including the appearance of green barrier and ring green belt. The construction of green belt always cannot be enforced due to the lack of laws and regulations. So corresponding laws must be formulated to smooth the implementation of the construction of green belt, and it seems particularly urgent in the industrial cities with fragile ecology.

In the process of the development of Jinchang city, there has always been a progressive extension, and salutatory extension also existed in specific stages and certain conditions. The city always starts from a mining base and when it becomes a comprehensive industrial production base in the progressive extension, a new growth driving force- a administrative center away from the original center appears and it promotes the new beginning of the transformation of urban structure; The third growth driving force appears in facing with the need of urban transformation and diversified industrial development. It will avoid the old city and start the construction of new city with the characteristics of High-tech zones<sup>[9]</sup>. The capacity of urban spatial growth is always the starting point and positive driving force of the construction of the city. Conversely, the reverse succession of the ecosystem in Jinchang including desertification, sandstorm, grassland degradation, land desertification and land degradation speeds up with a deteriorating trend, and the collapsing ecosystem and losing capacity of the ecology will lead to passive maintenance of structure of the ecological security.

The construction of green belt in Jinchang city must break the traditional mode of single government behavior. With the bi-way driving force of construction and protection, it should be based on the coordination of "upper-lower" perspectives; the upper perspective refers to the planning and policy of green belt implemented by the government with concerning the development of the whole city; the lower perspective refers to full consideration should be taken into the interests balance of the land users inside and outside of the green belt<sup>[10]</sup>. The construction of green belt with 500m-1000m width is a huge ecological project, so it must be based on the principle of benefiting public interests. From the perspective of government, the construction of green belt should be equally conducted like other projects and supported by the laws and regulations. Simultaneously, from the perspective of the public, it needs to promote the understanding, concern and participation of green belt, and facilitate the concept of the construction of green belt by the entire community, thus providing powerful support to the construction of green belt from the public. It also helps the public have a deep understanding of the

urgency and significance of green belt in the sustainable development of urban spatial and ecology and set up the concept of whole involvement of the construction of green belt from the perspective of public interests and public security.

## 5 CONCLUSION

The industrial cities located in ecologically fragile regions like Jinchang are always trapped in the serious problems including tightening constraints of resources, environment pollution and degradation of ecosystem in the development. Under this circumstance, it first needs to set up the value of ecology security and sustainable ecological civilization, and in the guidance of this value of scientific development, the construction of green belt can be set as the measurement which is particularly suitable for maintaining the structure of ecological security. As the spatial guarantee of the industrial cities in ecologically fragile regions, the construction of green belt should set the integration of fairness and efficiency as the objective; combine the singular and multiple constructions; conduct the positive and passive construction; form a complete barrier of urban ecological security under the different characteristics of ecologically fragile regions and recover the urban ecosystem. Simultaneously, it also needs to strengthen the regulations on overgrazing and excessive deforestation, improve the efficiency of intensive utilization of resources on the premises of protection the ecosystem and also set up a concept of ecological security structure and environment friendly in the urban development, thus promoting the construction of ecological civilization in ecologically fragile regions.

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