

Ecological environment risks and green development modes of China-Mongolia-Russia economic corridor

S Dong^{1,2}, Y Li^{1,2}, Z Li^{1,2}, F Li^{1*}, H Cheng¹, Y Yang^{1,2}, A Bilgaev^{1,2}, J Zheng^{1,2},
T Bazarzhapov^{1,2}

¹Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

²University of Chinese Academy of Sciences, Beijing, China

E-mail: lifujia2003@163.com

Abstract. China-Mongolia-Russia Economic Corridor is a key strategic area that China, Mongolia, and Russia are all dedicated to developing. However, China-Mongolia-Russia Economic Corridor cover three countries, and passes through multiple geographical units, and there are huge differences in economic, social, and ecological development within the regions. The construction of China-Mongolia-Russia Economic Corridor has many potential risks. Therefore, this paper studied the current socio-economic and environmental situation of main regions along the China-Mongolia-Russia Economic Corridor, including Primorski Krai, Khabarovsk Krai, Amur oblast of Far East Region, Irkutsk oblast, Zabaykalsky Krai and Republic of Buryatia of Baikal region and Novosibirsk region, Mongolia, and Liaoning, Jilin and Heilongjiang of Northeast China. Then we revealed the main ecological environment risks, and put forward green development mode to achieve sustainable socio-ecological-economic development of the corridor, which includes the ecological civilization mode, four hierarchies of Chinese circular economy mode, green service industry and low carbon tourism, establishing green and low carbon eco-tourism mode and establishing eco-city. Then prior action to achieve sustainable development of the China-Mongolia-Russia Economic Corridor was proposed. Including establish green, low-carbon, circular economic system, establish low carbon eco-tourism pilot area and cultivate green development and ecological civilization.

1. Introduction

As one of the six core corridors planned in “the Belt and Road (B&R) Initiative”, China-Mongolia-Russia Economic Corridor fits within the “Eurasian Economic Union” proposed by Russia and the “Prairie Road Program” proposed by Mongolia. This corridor is a key strategic area that China, Mongolia, and Russia are all dedicated to developing. However, China-Mongolia-Russia Economic Corridor cover three countries, and passes through multiple geographical units, including the North China Plain, Northeast China Plain, Mongolian Plateau, and Eastern Siberian Plateau. The overall ecological environment is characterized by transitivity, diversity, complexity, vulnerability, and sensitivity [1]. At the same time, there are large differences in economic, social, and ecological development within these regions [2]. Therefore, the construction of China-Mongolia-Russia Economic Corridor has many potential risks, which needs to be studied carefully. So, this paper studied the current socio-economic and environmental situation of main regions along the China-



Mongolia-Russia Economic Corridor, revealed the main ecological environment risks, and put forward further steps towards a sustainable socio-ecological-economic development of the corridor.

2. Socio-economic situation of the China-Mongolia-Russia Economic Corridor

2.1. Socio-economic situation for Russia

2.1.1. Social-economic of Lake Baikal Region and Far Eastern regions. The permanent population of Burytia has an increasing trend from 2005 to 2016, and the entire population in 2016 is 983 200. Also, we observe a 4.4% increase in the urban population during the period under review from 2008 to 2016 [3]. This is the largest growth among the regions under consideration.

The occupation level showed an increasing trend from 2005 to 2016 in regarding to whole Russia, in some regions it slightly decreased in 2016 (table 1). The population with incomes below the subsistence minimum is decreasing during recent years (table 2). Despite the increase of occupation level, we see an increase in the number of people with incomes below the subsistence minimum.

Table 1. Occupation level (%) [3]

Regions	2005	2010	2011	2012	2013	2014	2015	2016
Russian Federation	61.3	62.7	63.9	64.9	64.8	65.3	65.3	65.7
Siberian Federal District	59.8	61	61.5	61.9	62	62.6	62.5	62.5
Republic of Buryatia	53.2	58.2	58	58.9	58.6	58.4	58.6	57.7
Irkutsk oblast	60.2	60.4	61.8	62.4	62.9	62.1	64.2	63.7
Zabaykalsky Krai	60	55.8	57.1	57.6	58	59	59.4	59.6
Far Eastern Federal District	61.3	62.6	64.4	65	65.2	65.6	65.8	66.3
Primorsky Krai	60.2	61.2	62.4	63.6	63.9	64.2	64.9	65.9
Khabarovsk Krai	62.7	62.4	65.2	65.4	66	66.3	65.9	67.4
Amur oblast	54.5	60.9	65.4	63.7	61.9	63.6	62.9	63.6

Table 2. Population with income below the subsistence minimum
(% of total population of the region) [3]

Regions	2005	2010	2011	2012	2013	2014	2015	2016
Russian Federation	17.8	12.5	12.7	10.7	10.8	11.2	13.3	13.4
Republic of Buryatia	32.6	19.2	20.1	17.7	15.9	16.9	17.7	18.3
Irkutsk oblast	21.3	18.1	19.2	16.8	17	18.6	20.1	20.6
Zabaykalsky Krai	26.1	19	18.9	17.6	16.2	18	20.4	21.4
Primorsky Krai	27.4	16.3	15.7	14.2	15.9	14.7	15.3	15.7
Khabarovsk Krai	20.7	15.9	15.8	14.3	12.5	13.2	13.7	12.7
Amur oblast	30.1	23.7	20.4	16	15.1	14	14.2	16.1

2.1.2. Socio-economic situation of the Novosibirsk region. Novosibirsk region locates in the central part of the West Siberian Plain, it is one of the largest regions, the most industrially developed, the largest scientific center and the largest municipal unit in Russia. The permanent population has an increasing trend from 2012 to 2018, and the entire population in 2018 is 2 788 849. The proportion of urban population increased from 77.5% to 79.1% in 2012–2018, while the proportion of the rural population decreased from 22.5% to 20.9%.

2.2. Social-economic situation for Mongolia

Population gathered in Ulaanbaatar contributed 46.2% and that along the China-Mongolia-Russia railway is 58.45% of Mongolia total population in 2016 [4]. The population of Ulaanbaatar exceeded the carrying capacity of the city, and had severe impacts on the environment. GDP is 49.9% of Mongolian total in the areas along China-Mongolia-Russia railway

The level of employment fluctuated acutely during 2005-2014 in the Mongolian part, except Ulaanbaatar, because the resource development labor demand fluctuated with the resource market price.

2.3. Social-economic situation of Northeast China

In 2015, population in Liaoning, Jilin and Heilongjiang were 43.82 million, 27.53 million and 38.12 million respectively, the total population of the northeast China was 109.47 million [5]. In 2005-2015, the population of the northeast China change little.

Urbanization rate grew rapidly in the past decade. Urbanization rate of Liaoning, Jilin and Heilongjiang increased from 58.7%, 52.5%, 53.1% to 67.4%, 55.3% and 58.8% respectively, which grew rapidly.

GDP is huge and increased rapidly. In 2005-2015, GDP of Liaoning, Jilin and Heilongjiang grew rapidly, which increased from 800.9, 362.03 and 551.15 billion RMB to 2866.9, 1406.31 and 1508.37 billion RMB, the annual growth rate in 2005-2015 were all above 9%.

3. Environmental situation of the China-Mongolia-Russia Economic Corridor

3.1. Environmental situation for Russia

3.1.1. Environmental situation of Lake Baikal Region and Far Eastern regions. Emissions (mln. t): Irkutsk oblast (642) > Primorskii Krai (186) > Amur oblast (135) > Zabaykalskii Krai (122) > Khabarovsk Krai (114) > Republic of Buryatia (94) ; Waste Water (mln. m3): Irkutsk oblast (514) > Primorskii Krai (276) > Khabarovsk Krai (172) > Amur oblast (74) > Republic of Buryatia (38) > Zabaykalskii Krai (34) .

For Buryatia, the air pollution showed increasing trend from 2010 to 2014, in 2016 we can see its decrease in Republic of Buryatia. The sector of the production and distribution of electricity, gas and water accounts for the core factor in air pollution of the Republic of Buryatia. It is obvious that the increase of the production rate inevitably leads to increase of the load on the environment. However, a sufficient volume of investments aimed at its protection, proportional to their distribution among all groups of activities, and timely conduct of environmental work, will allow to prevent critical deterioration of the environmental situation in the region.

3.1.2. Environmental situation of Novosibirsk region. Atmospheric air. The growth of cities, the development of industry, the increase in the number of road transport, combined with the lag in the development of appropriate modern road transport infrastructure cause an intensive increase in the mass of emissions of pollutants into the air.

Groundwater. New sources of ground water pollution are detected every year. The main reason for the receipt of pollutants in groundwater is the failure to comply with sanitary standards in the operation of wells (figure 1).

Floods. Negative of channel siltation of river beds, riverbed over growing trees and shrubs.

Waste material. Waste disposal of territories, including water protection zones, forests; loss of secondary material raw materials; pollution of the environment with particularly hazardous waste generated by the population (figure 2).

Preservation of flora and fauna. Violation by citizens and legal entities of the rules of hunting; non-compliance with the regime of specially protected natural areas of regional significance; insufficient destruction of animals harmful to hunting.

3.2. Environmental situation of Mongolia

The China-Russia-Mongolia railway goes through the Central Plateau and Southern Gobi in Mongolia, and hilly area in Zabaykalskii Krai in Russia. The climate of the study area is multiplicity. The climate type of Mongolian part area is continental temperate grassland climate, and the Russian part is extreme continental climate. The Mongolian part area along the China-Russia-Mongolia railway belongs to arid and semi-arid regions, with average annual precipitation below 400 mm or 200 mm [4].

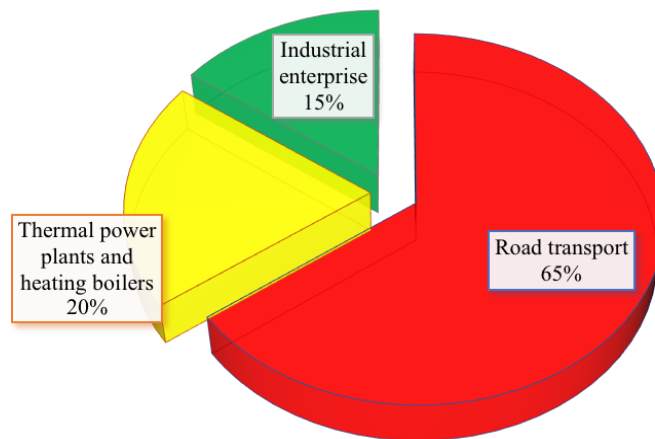


Figure 1. The structure of air pollution

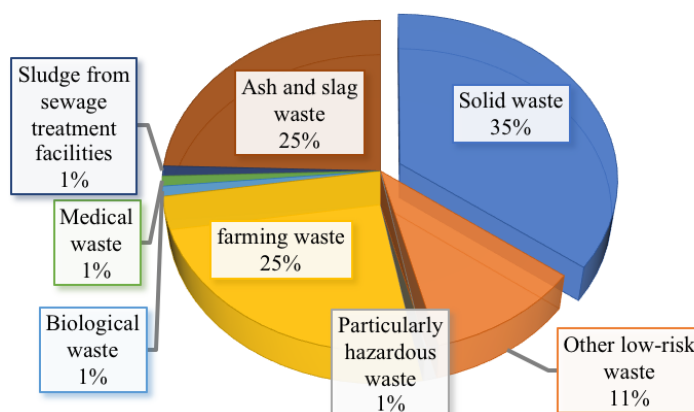


Figure 2. The structure of waste

3.3. Environmental situation of Northeast China

3.3.1. Shortage of resource. The rapid growth of urbanization and GDP in northeast China has consumed large quantity of resources and leads to shortage of resource. The total amount of water resource reduced from 249 billion m³ to 132 billion m³. Water resource is short and shows a declining trend.

The continuous expansion of construction land. While the urbanization rate in Liaoning, Jilin and Heilongjiang has increased rapidly, their land for construction has increased from 1.40, 1.07 and 1.49 million hectares in 2008 to 1.62, 1.08 and 1.62 million hectares [6]. The continuous expansion of urban space and construction land has increased resources consumption and pollutant emissions, and increased the ecological environment load.

Black soil degradation and loss. The black soil layer of cultivated land in the Northeast Plain has fallen, while the forming 1 cm will take about three hundred or four hundred years. The rate of loss is hundreds of times more than that of forming.

3.3.2. The emissions of pollutants mainly show increasing trend. Environmental Pollution is huge in Northeast China. Discharge of waste water in Liaoning and Jilin shows an increasing trend, the industrial waste gas emission of Liaoning and Jilin shows an increasing but that of Heilongjiang started to decline in 2014. In 2005-2015, industrial solid waste generated of Liaoning, Jilin and Heilongjiang shows an increasing trend, that of Liaoning increased especially rapid [6]

4. Green Development Modes

To implement UN SDGs along the China-Russia-Mongolia economic corridor, the best way is to explore typical modes which are suitable for the basic regional conditions, for their circumstances based on distribution patterns of its resources, environment, ecology, society and economy.

4.1. Ecological civilization mode

Human-beings created agricultural civilization and industrial civilization, in which man and nature were conflict and contradict. Human is marching towards Eco-Civilization, which establishes harmonious relationship between human and nature. The core ideology is to respect, obey, and protect nature, which is priority to Green “One Road One Belt” and its sustainable development [7]. China is implementing Eco-Civilization Building Strategy.

Passing through agricultural civilization and industrial civilization, human society is marching towards Ecological civilization which advocates coexistence harmonious between human and nature. And the core ideology is to respect nature, to follow nature, and to protect nature, and to drive human sustainable development.

The general mode of Ecological civilization is: the basic premise is protecting the spatial ecology, the crucial support is good ecological environment, the drive force is flourishing ecological economy, the leading ideology is advanced ecological culture, the important guarantee is thorough ecological regime, the direct behavior is high quality living environment. Finally, Silk road ecological civilization system of six in one will be set Ecological civilization is sublimation of traditional industrial civilization, the core ideology is respecting, obeying, and protecting nature, which is priority for Green Lake Baikal and its sustainable development (figure 3).

4.2. Four hierarchies of Chinese circular economy Mode

It is vital for the Countries, like China, to develop four sorts of circular economy, which are enterprise circular economy, industries circular economy, regional circular economy and social circular economy, formulating grade circular economic system through whole process of production, circulation and consumption, promoting green, circular and low-carbon development, at principle of Reduce, Reuse, Re-cycling.

Following is the four-layer circular system which integrated the four-layer circular economy system, it's consists of enterprise circular economy, industries circular economy, regional circular economy and social circular economy [8], formulating grade circular economic system through whole process of production, circulation and consumption with the principle of 3R [9] (figure 4).

4.2.1. Enterprise circulation. From 2005 until now, carrying out more than 300 cleaner production projects. Main industry: metallurgy industry, chemical industry, building new material industry. Main continent: implementing compulsory clean production audit for Enterprises that discharge pollutants in hierarchies exceeding standards. Encouraging enterprises to employ submerged arc furnace for ferroalloy industry and calcium carbide industry in order to recycle CO and waste heat in the burner gas. Promoting comprehensive utilization of dry coke quenching and technology using gas to generate electricity.



Figure 3. Ecological civilization mode

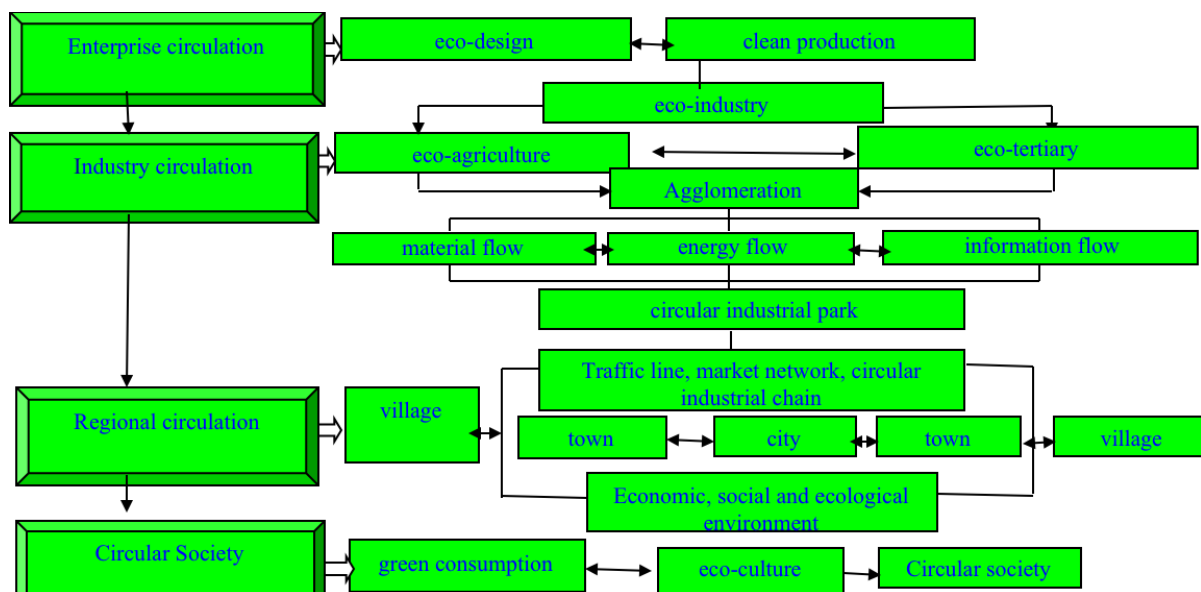


Figure 4. Four hierarchies of Chinese circular economy Mode

4.2.2. Industry circulation. Since 2005, combined with present situation of Shizuishan City's industry, government identified some circular economy projects in fields of city's comprehensive utilization of resources, energy-saving and cost-reducing, cleaner production etc.

4.2.3. Region circulation. In a certain region such as a county, a prefecture, a province, a country, a natural geographical area which includes parts of several administrative region, an ecological region or

economical region, and even region which includes parts of several countries and so on, circular economy is carried out by connecting raw materials, production and wastes of the enterprises together within this region. On the basis of benefit sharing, virtuous cycles of cash flow, information flow, people and goods flow are promoted through connection of industrial chains, market network, financial network, information network, resources and ecological environment according to labor division and cooperation in various regions.

4.2.4. Society circulation. Forming macroscopic recycling of resources consumption-environment-resources in whole society from the level of social consumption through establishing a sense of resource saving, mobilizing whole people to participate green consumption and garbage recycling use.

4.3. Green service industry including low carbon tourism

Green service industry refers to supplement or replace traditional services by using green, ecological ideas, to reduce resource consumption and pollution emissions, to improve the comprehensive utilization of resources and services for the ecological value of the service industry. It includes green financial system, green logistical industry, green environmental protection services and green eco-tourism.

To develop of green service industry, Lake Baikal region should comprehensively utilize laws and regulations and other coercive means and economic incentive measures to stimulate producer behavior and consumer behavior of services enterprises, to improve the comprehensive utilization level of services industries, to reduce production of living and producing waste and pollution emission levels, strengthen green management and management services, building green service industry[10].

4.4. Establishing green and low carbon eco-tourism mode

Eco-tourism characterized by its unique ecological environment, refers to the tourism mode of regarding sustainable development as goal, protecting environment as premise, realizing harmonious development of human and nature as principle, based on the beautiful natural eco-environment and unique cultural ecological system, adopting eco-friendly way to carry out the ecological experience, ecological education, cognitive and psychosomatic pleasant.

Lake Baikal as the world's natural heritage, its superior ecological environment is its most valuable asset. In recent years, with the rise of Lake Baikal tourism, tourism economy has become an important component of Lake Baikal economy. In this case, Lake Baikal tourism must take ecological tourism, so as to protect the ecological environment of Lake Baikal, scientifically assess tourism carrying capacity of Lake Baikal, exploring tourism resources properly and moderately, so as to protect the world natural heritage.

4.4.1. Green consumption. Green consumption contains green consumption and Green lifestyle. Green consumption refers to the consumption behavior which is characterized by conserving resources and protecting the environment as a goal, mainly for advocating thrift, reducing loss and waste, choosing efficient, environmentally friendly products and services, and reducing the consumption of resources in the process of consumption and pollution emissions. Green lifestyle refers to by advocating the use of green products, advocating people to establish green development values, sharing ideas, to promote green travel, green living, green life, people nature, environmental protection, frugal and healthy life style.

4.4.2. Green culture. As a kind of cultural phenomenon, green culture is associated with the awareness of environmental protection, ecological consciousness, life consciousness and other green ideology, it's the sum reflection of living mode, code of practice, thinking ways and values of harmony between mankind and nature, co-prosperity and common development, Green culture is the soul of green development.

4.5. Establishing eco-city

Eco-city contains six layers: safe city, convenient city, circular city, green city, innovation city and harmony city (figure 5). The safe city is the basic requirements, the core of the city's social order is good, perfect infrastructure, comprehensive disaster prevention level. The convenient city is the core. It is the three-dimensional traffic oriented urban layout led by public transport. The circular city is the eco-industrial chain as the core, modern ecological agriculture and ecological service industry as the auxiliary system of circular economy. The green city is the core of city - ecological landscape and beautiful environment of the living environment, suitable for living and business. The innovation city is high level of eco city requirements, science and technology and high concentration of talent, the development of high-tech industries, and the construction of innovative cities. The harmony city is the highest level of requirements, the core is a high level of ecological and cultural and social civilization [9, 11].

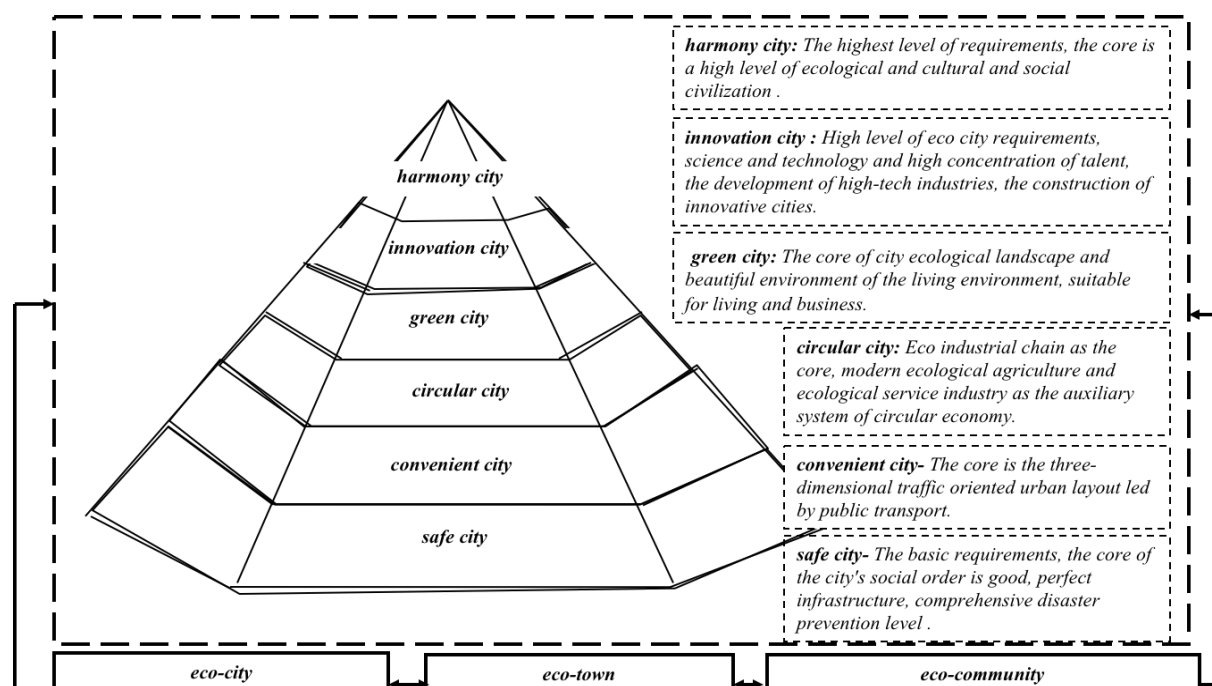


Figure 5. Six-layer eco-city

5. Prior Action Suggestions to achieve sustainable development of Lake Baikal

5.1. Establish green, low-carbon, circular economic system demonstration area

Establish Circular Economy Park, introduce in advanced technology and equipment, speed up clean and green renovation of equipment, set strict emission standards, to achieve the low resource consumption of production, less environmental pollution, good economic benefits.

5.2. Establish low carbon eco-tourism pilot area

Develop low carbon ecological tourism mode, protecting the natural resources of Lake Baikal as the premise, reasonable planning and developing tourism resources of Lake Baikal. Strengthen the construction infrastructure, in particularly the construction of garbage recycling stations, sewage treatment plants, public toilet, etc., to build a international pilot area of low carbon ecological tourism in Lake Baikal.

5.3. Cultivating green development and ecological civilization

Strengthen propaganda and education of concept of green development and ecological civilization to promote formation of value of green production, green consumption and green culture, promoting merging of green ideology into production, life, ecological construction.

Acknowledgements

The research was funded by National Social Science Fund of China (No.17VDL016); Key international cooperation projects of the Chinese academy of sciences (No. 131A11KYSB20160091)

References

- [1] Dong S C, Li Z H, Li F J and Li Y 2017 The green development mode of the “B&R” *China Econ. Times* 05-11
- [2] Dong S C, Yang Y, Li F J, Cheng H, Li J N, Bilgaev A, Li Z H and Li Y 2018 An evaluation of the economic, social, and ecological risks of China-Mongolia-Russia high-speed railway construction and policy suggestions. *J. Geogr. Sci* **28**(7) 900-18
- [3] Russian Statistical Yearbook <http://www.gks.ru>
- [4] Mongolia Statistic Yearbook <http://www.en.nso.mn/index.php>
- [5] Liaoning Statistical Yearbook <http://www.ln.stats.gov.cn/tjsj/sjcx/ndsj/otherpages/2016/indexch.htm>
- Jilin Statistical Yearbook <http://tjj.jl.gov.cn>
- Heilongjiang Statistical Yearbook. <http://www.hlj.stats.gov.cn>
- [6] China Environmental Statistic Yearbook. http://www.stats.gov.cn/tjsj/tjcbw/201706/t20170621_1505831.html
- [7] Li Z H, Wang J L, Zhao Z P, Dong S C, Li Y, Zhu Y Q and Cheng H 2014 Eco-environment patterns and ecological civilization modes in the Silk Road Economic Zone *Resour. Sci.* **12** 2476-82
- [8] Li Z H, Dong S C and Tang S Y 2008 Constructing a circular economy with Chinese characteristics *Theor. Explor.* **1** 88-90
- [9] Li Y, Dong S C, Wang F, Wang Z and Zhang L J 2012 Study on development pattern and path of eco-city based on circular economy *Urban Stud.* **11** 146-8
- [10] Dong S C, Zhao M Y, Guo P, Shi G Y, Li Y, Li Z H, Wang J N and Zhu S Q 2016 Development mode and countermeasures for international ecotourism zone along the Belt and Road *Bull. Chin. Acad. Sci.* **6** 647-55
- [11] Zhang X J, Dong S C, Yin W H and Wang L L 2009 The transform of the resource city in china: A case study of Shizuishan eco city in Ningxia Hui Autonomous Region. *J. Arid Land Resour. Environ.* **4** 6-11