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# RESEARCH ON ECO-ECONOMIC REGIONALIZATION OF THE CHINA – MONGOLIA – RUSSIA ECONOMIC CORRIDOR

***Dong Suocheng[1,2], Yang Yang[1*], Boldanov T.[1,2]***
*[1]Institute of Geographic Sciences and Natural Resources Research, CAS, Beijing, China*
*[2]University of Chinese Academy of Sciences, Beijing, China*
*dongsc@igsnrr.ac.cn; [*]corresponding author: feiyang199012@163.com; tamir2002@mail.ru*

# ИССЛЕДОВАНИЕ ЭКОЛОГИЧЕСКОЙ И ЭКОНОМИЧЕСКОЙ РЕГИОНАЛИЗАЦИИ ЭКОНОМИЧЕСКОГО КОРИДОРА КИТАЙ – МОНГОЛИЯ – РОССИЯ

***Дун Суочен[1,2], Ян Ян[1], Болданов Т.[1,2]***
*[1]Института географии и природных ресурсов Китайской академии наук, Пекин, КНР,*
*[2]Университет Китайской академии наук, Пекин, КНР*

In this paper, we establish a two-level eco-economic regionalization program, and explore the eco-economic regionalization of the China-Mongolia-Russia economic corridor for the first time. Based on the spatial distribution pattern of physical geographical factors such as landforms, precipitation, temperature and human economic factors such as the intensity of human activities, we firstly divide the 48 regions of the China-Mongolia-Russia economic corridor into six types of eco-economic zones. Then, by introducing in specific eco-environment and socio-economic factors such as land use type, environmental pollutant emissions, industrial structure, urbanization rate, and GDP per capita, etc., we divide these six eco-economic zones are further divided into 19 sub eco-economic zones. Afterwards, we comparatively analyze the characteristics and the regularity of regional differentiation of the eco-environment and socio-economic development of these 19 sub eco-economic zones, and summarize them into the optimized development zone, the key development zone, and the conservation and development zone. At last, we put forward green development suggestions for each of these three zones.

**Keywords:** the China-Mongolia-Russia economic corridor; eco-economic regionalization; regularity of regional differentiation; green development suggestions

В данной работе представлена двухуровневая программа эколого-экономической регионализации и впервые исследована эколого-экономическая регионализация экономического коридора Китай-Монголия-Россия. На основе пространственной структуры распределения физико-географических факторов, таких как рельеф, осадки, температура, и антропогенных экономических факторов, таких как интенсивность человеческой деятельности, мы сначала разделили 48 регионов экономического коридора Китай-Монголия-Россия на шесть типов эколого-экономических зон. Затем, введя конкретные экологические и социально-экономические факторы, такие как тип землепользования, выбросы загрязняющих веществ в окружающую среду, структура промышленности, уровень урбанизации, ВВП на душу населения и т.д., мы разделили эти шесть эколого-экономических зон на 19 эколого-экономических субзон. Затем мы провели сравнительный анализ характеристик и закономерностей региональной дифференциации экологической среды и социально-экономического развития этих 19 эколого-экономических субзон, и объединили их в зону оптимального развития, зону ключевого развития и зону сохранения и развития. В заключение мы сформулировали предложения по экологическому развитию для каждой из этих трех зон.

**Ключевые слова**: экономический коридор Китай-Монголия-Россия; эколого-экономическая регионализация; закономерность региональной дифференциации; предложения по экологическому развитию

## 1. Introduction

China-Mongolia-Russia economic corridor is the key regions in Northeast Asian countries. These three countries are not only geographical adjacent, but also have an affinity connection and a long-standing relationship in history, culture, and socio-economy [1]. However, the China-Mongolia-Russia economic corridor

contains multi-regions of the three countries. There are great differences in the economic development level and eco-environment background [2]. In order to promote the green and sustainable development of the China-Mongolia-Russia economic corridor, it is necessary to scientifically evaluate and regionalize the eco-economic development level of the China-Mongolia-Russia economic corridor.

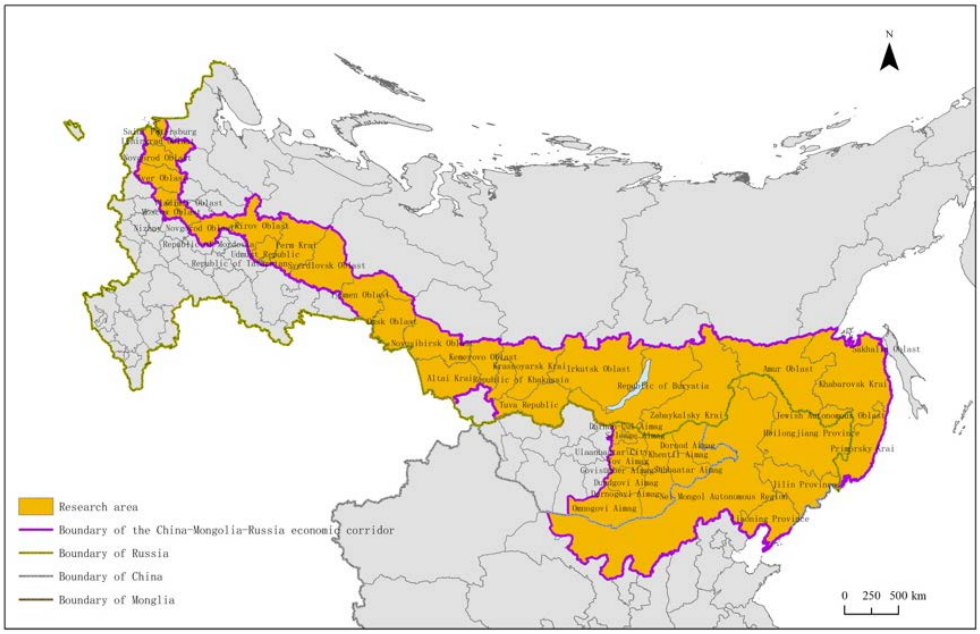


Fig. 1. Research area

**2. The two-level eco-economic regionalization program**

According to the principle of eco economic regionalization, this study adopts a two-level classification scheme, which gradually includes the indicators of physical and geographical elements, eco-environmental elements and economic and social elements from high to low, and divides the study area into two levels: eco economic region and eco economic sub region.

Landform and temperature data are taken from Worldclim website [3], and precipitation data are taken from global precipitation data set [4]. The data of socio-economic and eco-environment indicators are obtained from statistical yearbook of these three countries. The proportion of forest land, grassland, wetland and cultivated land in the jurisdiction is obtained by interpreting MODIS product mcd12q1 [5].

Table 1

Regionalization index system of eco-economic zone for the China-Mongolia-Russia economic corridor

| Regionalization object | First-level indicators | Second-level indicators | Classification standard | | | |
|---|---|---|---|---|---|---|
| Eco-economic zones | Landforms | landforms | Plain (altitude < 200m) | Hills (200-500m) | Mountainous area (500-1000m) | Plateau (altitude > 1000m) |
| | climate | precipitation | Drought (0-200 mm / year) | Semi-arid (200-400 mm / year) | Semi humid (400-800 mm / year) | Wet (> 800mm / year) |
| | | temperature | Very low (-14-0 ℃) | Low (0-4 ℃) | Higher (4-8 ℃) | High (8-12 ℃) |
| | landforms | GDP per $m^2$ | extensive intensity development zone (1000-111418USD/$m^2$) | Moderate development zone (200-1000USD/$m^2$) | Underdeveloped zone (0-200 USD/$m^2$) | |

The method of hierarchical cluster analysis is applied to regionalize the 48 regions into 6 eco-economic zones. The method of entropy is applied to evaluate the degree of eco-environment quality and socio-economic development.

Table 2

Regionalization index system of sub eco-economic zone for the China-Mongolia-Russia economic corridor

| Regionalization object | First-level indicators | Second-level indicators | Second-level indicators |
|---|---|---|---|
| Sub Eco-economic zones | Eco-environment | Eco-environment | Proportion of forest land |
| | | | proportion of Grassland |
| | | | Proportion of cultivated land |
| | | | Proportion of wetlands |
| | | | Production of Solid waste per capita |
| | Socio-economic | Economic quality | Proportion of agriculture |
| | | | Proportion of industry |
| | | | Proportion of service industry |
| | | | GDP per capita |
| | | | Urbanization rate |
| | | | Unemployment rate |
| | | Development potential | Fixed capital investment per capita |
| | | | Population density |
| | | | Growth rate of population |
| | | | Growth rate of GDP |
| | | | Number of doctors per 10000 people |

## 3. Regionalization results

### *3.1 Eco-economic zones*

The research regions are classified into six eco-economic zones (fig. 2).

I. *The Eastern European plain eco-economic zone* is dominated by plains, with a semi humid climate. The temperature is relatively high, with an average annual temperature higher than 0 ℃. The average annual temperature in some western regions can reach more than 8 ℃. The economic development intensity in Moscow, St. Petersburg and surrounding areas is high, while that in other areas is low.

II. *The West Siberian plain eco-economic zone* is also dominated by plains, with low annual temperature between 0-4 ℃ and low economic development intensity.

III. *The Central Siberian plateau eco-economic zone* is dominated by the plateau, with a semi humid climate and extremely low temperature. The average annual temperature in most areas is below -10 ℃, and the intensity of economic development is low.

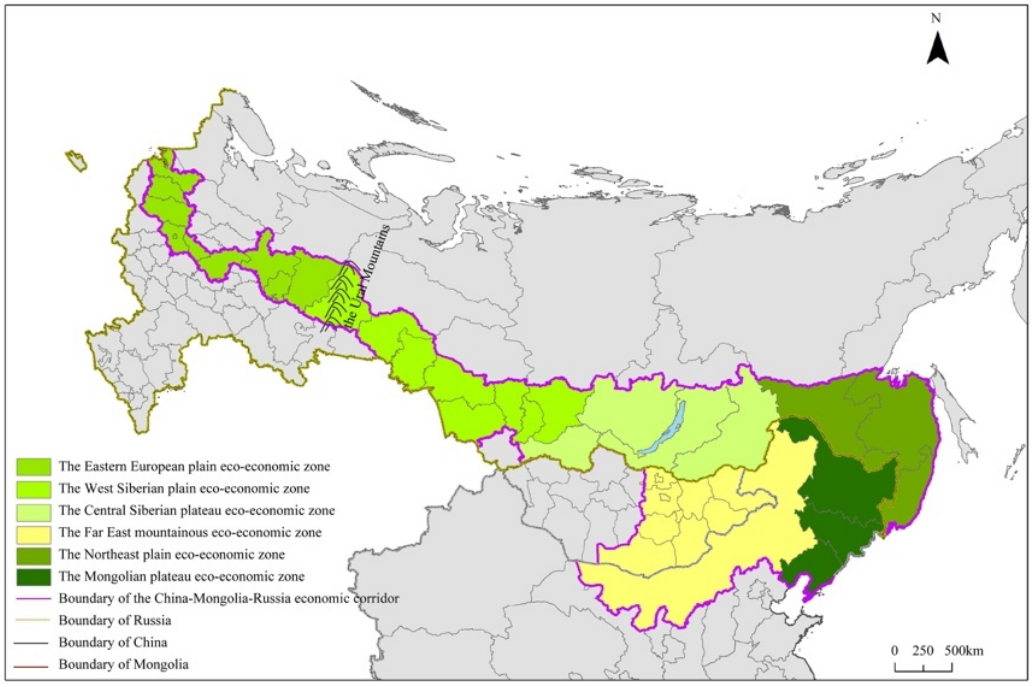


Fig. 2. Eco-economic zones of the China-Mongolia-Russia economic corridor

IV. *The Far East mountainous eco-economic zone* is dominated by mountainous areas with semi humid climate, while a few coastal areas are humid, the zone is with extremely low temperature and low economic development intensity.

V. *The Northeast plain eco-economic zone* is mainly plain, and the climate is mainly semi humid. A few coastal areas are humid, and the temperature is relatively high. The average annual temperature in the southern coastal areas is higher than 10 ℃, and the intensity of economic development is high.

VI. *The Mongolian plateau eco-economic zone* is mainly plateau with little precipitation. It is an arid and semi-arid area with relatively high temperature. Except for the moderate development in Inner Mongolia Autonomous Region, other areas are low degree development.

### *3.2. Sub eco-economic zones*

According to the regional differentiation law of eco-environment quality and socio-economic development level of the China-Mongolia-Russia economic corridor, the six types of eco-economic zones are further divided into 19 types of sub eco-economic zones. The details are shown in Tab. 3 and the spatial distribution is shown in Fig. 3.

Table 3

The sub eco-economic zones the China-Mongolia-Russia economic corridor

| Eco-economic zones | Sub eco-economic zones |
|---|---|
| I. The Eastern European plain eco-economic zone | I(1) zones with excellent ecology and developed economy; I(2)zones with excellent ecology and developing economy; I(3)zones with good ecology and developing economy; I(4) zones with excellent ecology and underdeveloped economy; I(5)zones with good ecology and underdeveloped economy; I(6) zones with fragile ecology and underdeveloped economy; |
| II. The West Siberian plain eco-economic zone | II(1) zones with excellent ecology and developing economy; II(2) zones with good ecology and developing economy; II(3) zones with excellent ecology and underdeveloped economy; II(4) zones with good ecology and underdeveloped economy; |
| III. The Middle Siberian Plateau eco-economic zone | III(1) zones with excellent ecology and underdeveloped economy; III(1) zones with fragile ecology and underdeveloped economy; |
| IV. The Far East mountainous eco-economic zone | IV(1) zones with fragile ecology and developing economy; IV(2) zones with excellent ecology and underdeveloped economy |
| V. The Northeast plain eco-economic zone | V(1) zones with good ecology and developing economy; VI(2) zones with good ecology and underdeveloped economy; |
| VI. The Mongolian plateau eco-economic zone | VI(1) zones with good ecology and developing economy; VI(2) zones with good ecology and underdeveloped economy; VI(3) zones with fragile ecology and underdeveloped economy |

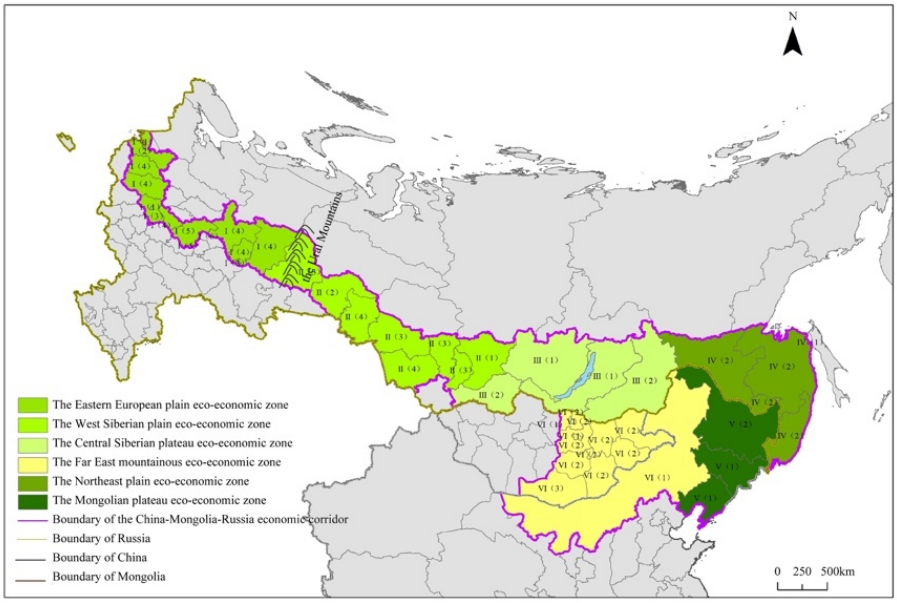


Fig. 3. Eco-economic zones and sub eco-economic zones of the China-Mongolia-Russia economic corridor

## 4. Discussion

According to the characteristics and regional division rules of the eco-environment quality, socio-economic development, the sub eco-economic zones are further summarized into three categories: the optimized development zone, the key development zone, and the conservation development zone (Fig. 4). The optimized development zone has excellent eco-environment and high level of socio-economic development. We should continue to optimize the industrial structure and development mode, actively develop green, low-carbon and circular economy, protect the ecological environment while maintaining sustainable economic development, and realize the sustainable and coordinated development of human and nature; The optimized development zone includes Moscow and St. Petersburg. The key development zone has relatively backward socio-economic development level, but good eco-environment and rich resources. Developing economy is its main function. We should focus on the development of economy on the premise of actively protecting the eco- environment. The key development zone includes 33 areas such as Leningrad oblast, Primorsky Krai, Irkutsk oblast. The conservation and development zone has fragile eco-environment, its main function is ecological conservation, and has backward economic development. We should strengthen ecological conservation and restoration, give priority to the development of green industry and ecological industry with less ecological disturbance or damage, and moderately develop economy in the process of ecological environment conservation. It includes 13 regions such as the Zabaykalsky Krai and the Republic of Mari El. This study will provide theoretical guidance and scientific support for the green, sustainable and high-quality development of China Mongolia Russia economic corridor.

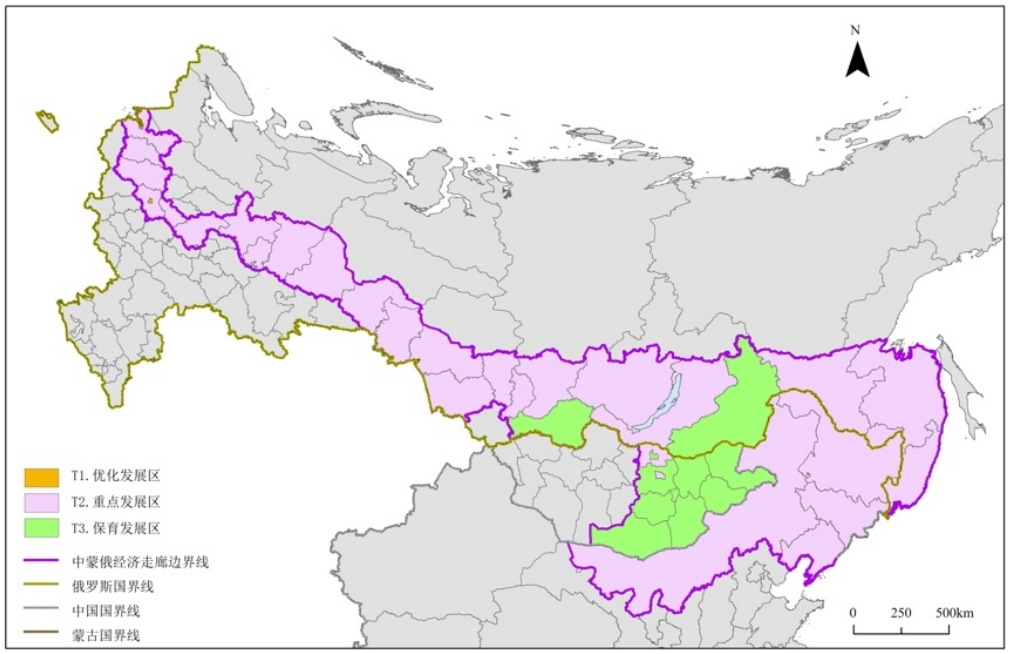


Fig. 4. Spatial distribution of green development of eco-economic zones in China-Mongolia-Russia economic corridor

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