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Abstract

The Belt and Road region crosses different geographic areas and ecological zones. Ecologic problems and hazards risks are complicated in these zones and they threat seriously the green development and economic corridors security along the Belt and Road region. Based on multiple data sources platform installation and experiment-demonstration researches and observations, the regional ecologic-environmental regulations of the Belt and Road region are well and scientifically recognized, key areas/zones and the ecologic-environmental security and risk response programmes of major projects are systematically integrated. The findings of the key advanced research project on the environment change and construction of the Green Silk Road of the Pan-Third Pole provide scientific and technical supports to the further promotion of the Green Belt and Road development, and they also serve the world successful cases for global environmental governance.

Keywords

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Ecologic Problems and Hazards Risks: Challenges and Countermeasure for Promoting Green Belt and Road

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Abstract: The Belt and Road region crosses different geographic areas and ecological zones. Ecologic problems and hazard risks are complicated in these zones and they seriously threat the green development and economic corridors security along the Belt and Road. Based on multiple data sources platform installation and experiment-demonstration research and observation, the ecologic-environmental regulations of the Belt and Road region are scientifically recognized, and the key areas/zones and the ecologic-environmental security and risk response programs of major projects are systematically integrated. The findings of the key advanced research project on the environment change and construction of the Green Silk Road of the Pan-Third Pole provide scientific and technical supports to the green Belt and Road development, and they also serve the world successful cases for global environmental governance. **DOI:** 10.16418/j.issn.1000-3045.20210129002-en

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The Belt and Road (B&R) initiative originated in China, but it has delivered benefits well beyond its borders. Promoting the green B&R construction and sharing the principle of ecological civilization and green development is an important practice of China to participate in global environmental governance as well as to serve and build a community with a shared future for humanity^[1–3]. The B&R runs through the continents of Asia, Europe, and Africa and connects the East Asia economic circle and the European economic circle, covering a wide area. The China-Mongolia-Russia, New Eurasian Continental Bridge, China-Central Asia-West Asia, China-Indochina Peninsula, China-Pakistan, and Bangladesh-China-India-Myanmar economic corridors constitute the strategic pillar and the main frame of the Belt and Road construction. The climate change and human activities increase the uncertainty of ecologic-environmental problems and the risks of natural disasters in the six economic corridors, which pose serious harm or threat to the ecologic-environmental safety and the engineering projects^[1,3,4]. The research on regional desertification, extreme weather events, frozen soil, landslides, and debris flow will facilitate our understanding toward the ecologic-environmental problems in the key areas, the identification of disaster risks in the key channels, nodes, and projects, and thus the integration of ecologic-environmental security and risk response programs of major projects. This will provide scientific and technical support to the green B&R construction and even serve demonstration cases for global environmental governance.

1 Desertification in the B&R region

As desertification is one of the most serious ecologic-environmental problems in the world, the prevention and control of desertification is a core content for the construction of the green B&R^[5]. The National Forestry Administration (now the National Forestry and Grassland Administration) of China and the Secretariat of the United Nations Convention to Combat Desertification jointly released The “Belt and Road” Joint Action Initiative for Combating Desertification and The Belt and Road Cooperative Mechanism to Combat Desertification, aiming to promote practical cooperation, improve the ability to combat desertification, and contain the trend of desertification and land degradation through information sharing, technical training, and project demonstration. These measures will contribute to the realization of zero growth in global land degradation and the United Nations Sustainable Development Goals by 2030.

The six economic corridors cover the areas with concentrated desertification lands, including the Arabian Peninsula, Iranian Plateau, Central Asia, Northwest China, and Mongolian Plateau, which forms a desertification belt running through the Eurasian continent. Among the six economic corridors, the China-Mongolia-Russia, New Eurasian Continental Bridge, China-Central Asia-West Asia, and China-Pakistan economic corridors have desertification, involving over 60 countries suffering from desertification and drought.

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Particularly, Central Asia, which is the key area of the joint construction of B&R, features the severest desertification, with the severely and extremely severely deserted lands ranging from the central coast of the Caspian Sea to the east of the Aral Sea and the southern Turkmenistan.

The risk of desertification in Central Asia has significant spatial heterogeneity on different scales. On the scale of Central Asia, high-risk areas are mainly distributed in the Aral Sea basin, Balkhash Lake basin and other areas, of which the Amu Darya basin features an extremely high risk^[6]. The Amu Darya basin presents improving ecologic environment in the upper reaches while high desertification risks in the middle and lower reaches. Although a wide range of areas in the basin have potential desertification risks, the high-risk area accounts for less than 5% and is concentrated in the Amu Darya delta and the Aral Sea basin. The desertification risk of the area (especially the east area) around the Aral Sea is high, and the risk of desertification has been increasing from 2000 to 2008^[6].

The sandstorm full of salt from the shrinking of the Aral Sea has become the most serious desertification event and the most shocking environmental disaster in the world. The area where salt dust is released in the Aral Sea basin and its surrounding regions has been expanding year by year, and the total amount of release of salt dust every year can reach ten million tons. The salt dust not only causes serious harm to local human health, crop production, atmospheric environment and ecosystems, but also spreads to the European continent, endangering a wider area. The United Nations Environment Programme (UNEP) once commented that except the Chernobyl catastrophe, there is probably no more area like the Aral Sea basin with such a wide coverage of ecologic disasters and so many people involved.

2 Disaster risks along the B&R

The six economic corridors span different geographic environments and climate types, where the key nodes, projects, and bases are facing a series of disaster risks^[3]. The disaster risks along the B&R have obvious regional heterogeneity, which is manifested by the frozen soil disasters at the middle and high latitudes, sandstorm disasters in the Asia-Europe desert zone, landslides and debris flows in plateau mountainous areas, and extreme weather in coastal areas.

(1) Frozen soil. Frozen soil disaster is the main risk to the infrastructure security of the China-Mongolia-Russia economic corridor. Central-eastern Russia, northern Mongolia, and northeastern China are the middle- and high-latitude areas with frozen soil. There are continuous permafrost, vast-area continuous permafrost, island-shaped permafrost, sparse island-shaped permafrost, and seasonal frozen soil distributed intermittently from the north to the south. The

accelerating frozen soil degradation resulted from climate warming causes the increase in the depth and range of frozen soil melting as well as the melting of underground ice. The rising risks of permafrost disasters such as frost heaving, thaw collapse, and stagnant water seriously threaten the infrastructure security of the China-Mongolia-Russia economic corridor. The northern Mongolia, the Republic of Buryatia, the Transbaikalian Territory and Amur Oblast are exposed to high risks of permafrost disasters and are the key sections for the prevention and control of permafrost disasters of the China-Mongolia-Russia cross-border railway and highway as well as China-Russia crude oil pipeline.

(2) Sandstorm. Sandstorm disasters mainly endanger the energy bases, resource channels, and transportation facilities in Central Asia and West Asia. Arabian Peninsula, Iranian Plateau, Aral Sea Basin, and Mongolian Plateau are the extensive development areas of desert groups such as the Rub'al Khali Desert, Kumtag Desert, and Taklimakan Desert, with drift potential and high dune movement index. Besides, the strong wind brings about shifting sand intrusion and soil wind erosion, posing high risks of sandstorm disasters.

(3) Landslide and debris flow. Landslide and debris flow are widely developing and distributed in most areas of the six economic corridors, which seriously threaten the safety of transportation facilities. The high-risk areas are mainly in China's southeast hills-Yunnan-Guizhou Plateau-Himalayas Mountains-Pamirs and Iranian Plateau-Alps. The China-Pakistan economic corridor has extremely high risks of landslide and debris flow, and the areas with high risks are mainly concentrated in the corridor's northern areas such as Chitral and Gilgit.

(4) Extreme weather. The extreme weather and climate events such as storm surge, heatwave, extreme precipitation, and extreme drought caused by climate change have increased, posing rising risks of disasters. Storm surge risks are regional, with high-risk areas concentrated along the Bay of Bengal, which have a tendency to expand outwards along high-value clustering points. The high-risk areas of heatwave are mainly in South Asia, Southeast Asia, and parts of the Arabian Peninsula, with a trend of expanding toward the north and the inland. Extreme drought risks manifest regional differences, with the high-risk areas in central and western Asia, the Mediterranean coast, and the Indus River basin. The northern Asia is mainly affected by temperature while the southern and eastern Asia are greatly impacted by precipitation. The areas with high risk of extreme precipitation are mainly concentrated in the Ganges River basin, eastern China, and central Europe. The precipitation in the Jakarta-Bandung high-speed Railway, Maldives, Hambantota Port and other typical node areas of B&R shows a rising trend, posing an increasing risk.

3 Countermeasures in response to ecologic problems and disaster risks in the B&R region

The serious ecologic-environmental problems represented by desertification aggravate the risks of freezing and thawing, sandstorm, landslide, debris flow, and extreme weather. The “Environmental Issues and Disaster Risk Prevention and Control in Key Areas and Important Projects,” Project 3 of Strategic Priority Research Program of CAS “Pan-Third Pole Environment Study for a Green Silk Road aims to improve the environmental governance and sustainable development of the six economic corridors. It carries out multi-scale full-chain research on different ecologic-environmental problems and disasters in key areas and important projects of B&R, and then formulates reasonable countermeasures in the following three aspects.

(1) Construction of multi-source data integration and information sharing platform. The green construction of B&R not only includes different regions and countries but also involves resources, environment, society, economy and other fields. Powerful databases, supporting systems, shared service platforms and related products are important premises for the prevention and control of ecologic problems and disaster risks in the B&R region. The risk prevention and control project focuses on the diagnosis of ecologic issues and the assessment of disaster risks in the B&R region, which collects remote sensing data and products with different resolutions, thematic maps with different natural elements, social economy and engineer project documents of different regions, the data of field surveys and experimental demonstration areas, and results of related studies. These data constitute a dataset of desertification in the Central Asia-West Asia region, a dataset of frozen soil disasters along Sino-Russian crude oil pipeline, a basic dataset of ecologic risks along the China-Russia crude oil pipeline, a dataset of landslide and debris flow disasters along the six economic corridors, a dataset of extreme climate risks across the B&R region, and an observation dataset of typical node areas of B&R. An atlas of desertification risk assessment in Central Asia-West Asia region, an atlas of ecologic risk assessment of transportation and pipelines in China, Mongolia, and Russia, an atlas of risk assessment of landslide and debris flow in the B&R region, and an atlas of regional fine-scale risk evaluation in key nodes of B&R have been compiled. Furthermore, a database system for desertification information sharing in Central Asia-West Asia region, a collaborative innovation information platform for the prevention and control of ecologic risks in transportation and pipelines in China, Mongolia, and Russia, and a disaster risk assessment information platform for the six economic corridors and key nodes of B&R have been developed.

(2) Test and demonstration of environmental governance technology. In view of the vegetation degradation in key

areas as well as the permafrost and sandstorms of important projects of B&R, it is necessary to restore the vegetation on desertified land, test and demonstrate the technology for the control of frozen soil and sandstorm disasters, and develop technology integration models to serve successful cases for the construction of green B&R. (1) Vegetation restoration. The technologies for the optimization of plant community structure and vegetation restoration on desertified land as well as for the salinized land remediation with salt-tolerant plants have been developed. An experimental demonstration base for vegetation restoration of deserted land in the lower reaches of the Amu Darya basin, and a demonstration base for vegetation restoration of salinized land in the Aral Sea have been established. (2) Control of sandstorm. The sand-fixing material for oil and gas fields in the Sakar Desert of Turkmenistan and the plant species for the ecologic barrier of the capital circle of Kazakhstan have been screened out. A prevention and control model adaptive to desert oil and gas fields has been built. An afforestation model for low-temperature strong-wind environment has been integrated and a demonstration base of seedling breeding for ecologic barrier construction in Nur Sudan has been established. (3) Prevention and control of frozen soil. The prevention and control technology of frozen soil disasters along China-Russia crude oil pipeline has been developed and a demonstration field of this technology has been built.

(3) Countermeasures for risk prevention and control. Considering the local resources, environment, and economic and social conditions, we put forward three countermeasures for the mitigation of the ecologic problems and disaster risks in the B&R region. (1) Ecologic risk prevention and control. The collaborative innovation information platform for the ecologic risk prevention and control of China-Mongolia-Russia economic corridor has been built, and the recovery measures for the high-risk sections of transportation and oil pipelines have been formulated. (2) Response to extreme weather risks. Based on the principle of forecasting danger and reducing exposure and vulnerability, the capability of risk defense at typical nodes of B&R route has been systematically evaluated, and a comprehensive climate disaster defense system that combines “hard defense” with “soft defense” has been established. (3) Response to landslide and debris flow risks. The disaster monitoring and warning system for the key landslide bodies and debris flow basins of the China-Pakistan economic corridor has been established; the emergency measures for personnel within the disaster range and the emergency protection measures for important facilities have been proposed; the schemes of the mobilization and allocation of rescuers, personnel placement, as well as resource delivery have been formulated.

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