

# The Belt and Road Initiative's Railway Network: Balancing Economic Growth and Environmental Preservation

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**Abstract.** China established the Belt and Road Initiative (BRI) in 2013, which aims to stimulate trade and investment in the Eurasian region through infrastructure development. While railway construction under the BRI framework is important for economic integration and growth, it also raises significant environmental challenges, including habitat loss, greenhouse gas emissions, and water pollution. The purpose of this study is to discuss how to achieve a balance between economic growth and environmental protection in the construction of the BRI railroad projects. Through qualitative research methods, evaluates current strategies for mitigating environmental impacts and analyzes the role of international cooperation in improving environmental protection. The findings of the study show that while some countries have adopted environmental assessment and green building techniques, differences in environmental standards between countries still affect the effectiveness of the treatment. In particular, many developing countries face economic instability and technological limitations in the implementation of environmental policies. The findings imply that strengthened international cooperation and the establishment of uniform environmental standards are essential to the sustainable development of the BRI railroad project.

**Keywords:** The Belt and Road initiative; railway infrastructure construction; environment; sustainable development.

## 1. Introduction

The BRI is a global development strategy proposed by China in 2013 to promote trade and investment flows by strengthening infrastructure development and economic cooperation in the Euro-Asian region and its neighboring countries. The initiative which includes the “Silk Road Economic Belt” and the “21st Century Maritime Silk Road” aims to promote regional economic integration and create a framework for regional financial collaboration for the benefit of all countries by enhancing connectivity in transportation, trade, and investment [1]. Under the BRI framework, railway construction plays a key role as one of the essential transportation infrastructure projects. By extending the railroad network, participating countries can improve their integration into the global economic system, increase logistics efficiency, and reduce trade costs to accelerate economic growth.

However, railway infrastructure projects have a potentially long-lasting environmental impact, including greenhouse gas emissions and other air pollution, soil and water erosion, habitat loss, and resource overexploitation [1]. Railroad infrastructure projects are widely distributed and there is significant overlap with areas considered environmentally fragile, such as marine biodiversity hotspots, wilderness areas, and key protected regions [1,2]. The environmental impacts of railroad construction are particularly significant in ecologically sensitive areas [1,2]. Therefore, it is important to implement effective management strategies to minimize these negative impacts.

This paper aims to explore how to make a balance between economic benefits and environmental protection in the BRI railroad projects, and to discuss how to achieve sustainable development in the railway projects. This paper uses a qualitative research approach to evaluate the efficiency of current strategies for reducing environmental impacts. The paper will analyze the role of international cooperation in environmental protection improvement and provide recommendations for the sustainable development of the BRI railway project, to achieve a win-win outcome for economic growth and environmental protection.

## **2. Background of Railway Projects in BRI Countries**

### **2.1. Economic and Trade Growth**

Railway projects play a significant role in BRI, connecting economic regions with Asia, Africa, and Europe and promoting economic development and connectivity. These projects improve the local countries' logistics capacity and promote trade and investment growth. BRI countries seek to promote further regional economic integration by expanding and improving their rail systems. Wang et al. used the Spatial Durbin Model (SDM) to analyze the impact of railway infrastructure on economic growth in 42 Belt and Road Initiative (BRI) countries [3]. Countries with well-developed railroad transportation infrastructure have higher levels of economic development, and transportation infrastructure has a significant positive contribution to economic growth in the BRI countries [3]. The China-Europe Railway Express (CRE) is an important part of the BRI, which promotes trade between China and Europe by providing a faster and more reliable transportation solution, significantly increasing the volume of goods transported [4]. CRE has become the primary way of international transportation, helping backward countries to achieve global economic integration and providing opportunities to promote mutually beneficial cooperation [5]. The establishment of the CRE has significantly increased the volume of goods transported between China and Europe and promoted trade growth. According to the data, CRE has accumulated more than 40,000 train trips, opened 73 routes, reached more than 160 cities in 23 European countries, and transported more than 50,000 kinds of goods, which effectively protects the stability and smoothness of the international industrial chain and supply chain, and promotes inter-regional co-development [6]. China's cooperation has been expanding with countries and regions along the border. According to incomplete statistics, China has invested and participated in the construction of a total of 86 BRI railway projects [6]. Although BRI railway projects promote economic and trade growth, they still have an impact on the ecological environment.

### **2.2. Environmental Impacts**

While rail infrastructure development promotes trade growth, it also has an impact on the local environment. Railway projects under the BRI cause unavoidable impacts on local ecosystems during construction, including soil erosion, water pollution, habitat loss, and global warming. According to research, the BRI economic corridor overlaps with 265 endangered species, 46 biodiversity hotspots, and 1,739 Important Bird and Biodiversity Areas [1]. Railway construction in Kenya is still a challenge in terms of how to protect the environment while promoting economic development. The China Road and Bridge Corporation (CRBC) is constructing railways in Kenya with more than 100 kilometers of railroad line crossing the Nairobi National Park [7]. This resulted in protests in Nairobi and an appeal to the National Environmental Tribunal [7]. Furthermore, the use of some of the raw materials necessary for the construction of transportation infrastructure has led to the release of large quantities of chemical pollutants, with the use of lime soils having the most impact on global warming [2]. Between 2008 and 2017, the construction of overseas railway projects invested in by China under the BRI resulted in a total of 2.0952 billion tons of carbon dioxide emissions [2]. How sustainability can be applied to railroad projects should be considered.

## **3. Evaluation Strategies for Mitigating Environmental Impact**

BRI countries have developed a variety of environmental protection strategies to address the ecological challenges of railway infrastructure projects. BRI countries have included environmental assessments in their project planning processes to minimize potential damage. Due to Indonesia's participation in the Belt and Road Initiative, think tanks, academics, and government officials in Indonesia are now concerned about environmental problems [7]. Indonesia's government uses Environmental Impact Assessment (EIA) to predict the environmental impacts and potential risks caused by railway projects and to minimize these risks. However, the value and comparability of

EIAs are limited because they frequently lack consistency across local or national political boundaries [7]. The Indonesian government has also developed Analisis Mengenai Dampak Lingkungan (AMDAL) to standardize the conditions of facilities and operations and to establish procedures and regulations [7]. Although the Ministry of Environment and Forestry has made great efforts to reduce environmental impacts, the actual results have not met expectations, and the railroad projects continue to affect the local ecosystem. Many international organizations, such as The United Nations Environment Program (UNEP) and The International Union for Conservation of Nature (IUCN), have also provided sustainable development frameworks for BRI's railway projects. The framework includes environmental impact monitoring, assessment, and implemented measures to ensure that the project meets international environmental standards. In addition, IUCN has developed guidelines for biodiversity conservation, which are often applied to areas along the BRI railway projects. The IUCN's guidelines recommended creating ecological corridors around rail projects to allow wildlife to migrate safely and reduce habitat destruction. The Chinese government follows the Paris Agreement and the United Nations (UN) Sustainable Development Goals for 2030 to reduce ecological impacts and to qualify carbon emissions standards [8].

To reduce the environmental impacts of railway projects, there have been some policies and technological measures adopted. The BRI International Green Development Coalition (BRIGC) requires advanced technologies and equipment, including the use of clean energy such as natural gas in blending asphalt mixtures, and the increase of dust treatment equipment to reduce the emission of pollution such as smoke, sulfur dioxide, etc. [6]. It also includes a sewage treatment and recycling work, avoiding the direct sewage emissions. Green engineering construction has also strictly regulated the construction and improved the construction workers' awareness of ecological and environmental protection [6]. The eco-compensation mechanism is another significant financial strategy for protecting and sustainably using ecosystem services. It aims to create a justifiable benefit-sharing system that distributes the benefits of ecological preservation fairly, promoting sustainable development. This strategy provides a win-win situation for ecological preservation and economic development by balancing infrastructural development with the protection of biodiversity.

While there has been significant progress in reducing the environmental impacts of railway projects, there are still challenges and room for improvement. A significant challenge is the differences in environmental standards among the BRI countries [1]. Different environmental standards may lead to the transfer of polluting industries between countries, thus countries with relatively low environmental standards into seriously polluted regions [1]. Other challenges include the BRI developing countries facing energy shortages and economic challenges [8]. These developing countries also need to build on their economic stability to effectively implement environmental policies for sustainable development. Policies related to the BRI depend on corporate and voluntary self-regulatory mechanisms instead of being strictly enforced [9]. Overall, while there are some promising strategies for mitigating the environmental impacts of the BRI railway projects, ongoing challenges prove that these strategies still need to be continually improved. Achieving a balance between economic interests and environmental protection in railway projects demands not only funding and investment in environmental protection technologies but also strengthened cooperation among countries at the policy level.

## **4. International Cooperation and Environmental Protection**

### **4.1. Current State and Challenges of International Cooperation**

International cooperation mechanisms play a key role in the BRI railway project to promote environmental protection and sustainable development. These cooperation mechanisms include bilateral and multilateral agreements, regional cooperation platforms, and the participation of international organizations. The Chinese Minister of Ecology and Environment claims that under the guidance of the BRI, China strengthened a variety of bilateral and multilateral structures for environmental cooperation, which include China-ASEAN, the Euro-Asia Economic Forum, the

Shanghai Cooperation Organization, and the Lancang-Mekong Cooperation [9]. It not only promotes the coordination of infrastructure construction but also the sharing of environmental protection technology and experiences. Through these cooperation mechanisms, BRI countries can solve environmental problems in the implementation of railroad projects together and improve environmental effectiveness. Despite the establishment of international cooperation mechanisms, the challenges of transboundary environmental management exist and remain. China has made efforts to improve and develop the BRIGC framework, but efficient environmental administration in the BRI countries is still needed [9]. Some low-income countries might reduce environmental regulations to attract foreign direct investment, prioritizing national economic development over the protection of the environment.

#### **4.2. Strategies for Enhancing Environmental Protection**

Policy coordination and information sharing between countries improve the effectiveness of environmental protection. The Peljesac Bridge project, a major infrastructure project under the BRI, is a case study of China's success in international cooperation to strengthen environmental protection with the EU. China created a Safety and Environmental Protection Department, developed noise-canceling technology to protect the marine ecosystem, and collaborated with local businesses to meet the EU's stringent ecological standards [9]. The Chinese government and the BRI countries could co-establish an environmental protection agency, which could oversee the implementation of railway projects in countries that follow consistent environmental protection standards [8]. Moreover, developing countries may strengthen cooperation with developed countries to achieve global sustainable development. Under the BRI railway projects, developing countries can reduce the environmental effects and achieve global sustainable development by outsourcing production to countries that have adopted low-carbon technologies [2].

### **5. Conclusion**

The study emphasizes while railway infrastructure expansion can stimulate commerce and improve regional connections, its establishment in ecologically diverse regions causes significant risks to local ecosystems. The evaluation of existing strategies indicates that BRI countries have already implemented environmental assessments and green technologies to minimize these impacts. Nevertheless, there are still gaps in the effectiveness and implementation of these strategies, as the inconsistencies in environmental standards among participating countries may lead to the relocation of polluting industries and increase ecological degradation in low-regulation regions. Additionally, developing countries often face economic instability and energy shortages that limit their ability to implement stringent environmental policies. To address these challenges, policymakers and international organizations need to strengthen cooperation in establishing uniform environmental standards and providing technical support to developing countries. Ecological compensation methods could provide a fair distribution of benefits and also ensure that economic growth does not come at the cost of the environment. By balancing economic growth with environmental protection, the BRI can contribute to sustainable development for all participant countries. The limitation of this study is the complexity of transnational cooperation in the Belt and Road project. The environmental impact assessment and the effectiveness of implementation strategies also need long-term attention. Overall, achieving a balance between economic growth and environmental protection would require a combination of a rigorous regulatory framework and collaborative efforts among all countries.

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