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Greening the Belt and Road: Environmental and Sustainable Development in the China-Pakistan Corridor

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Abstract

The *CPEC*, a flagship element of China's Belt and Road Initiative (BRI) has been creating great economic prospects for both countries. However, it faces significant challenges in the ecological realm. This study critically examines the connection of environmental and sustainable development within the context of CPEC. It explores, through a qualitative method mostly based on policy analysis and secondary sources, that how China and Pakistan have addressed the environmental concerns accompanying rapid infrastructural development. The green policy initiatives, co-environmental frameworks, and the evolving narrative on sustainable development continue along the corridor. Findings of the paper suggest that while the drive toward greening CPEC exists, evidenced by initiatives like renewable energy projects and afforestation, gaps remain in enforcement, environmental impact assessments (EIA) and inclusive governance. Therefore, it is necessary to make long term strategic polices to avoid environmental degradation. The potential of CPEC to serve as a model for environmentally acceptable development through transnational infrastructure programs is also emphasized. It is recommended that strengthening institutional capacities, enforcing environmental safeguards, and fostering the engagement of local communities will ensure that CPEC development is both economically and environmentally sound.

Keywords: China, Pakistan, Environment, Sustainable Development

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INTRODUCTION

Industrialization and financial progress have greatly contributed to human well-being, but these developments have also harmed ecological quality, becoming key providers to global warming. In the long run, climate change has become a serious danger to environmental limits such as climate stability (Steffen, 2015). This phenomenon is mainly fueled by greenhouse gas (GHG) releases and the overconsumption of natural resources. In response, 195 countries adopted the Paris Agreement, aiming to limit the universal temperature rise to below 2C° above pre-industrial levels and achieve net-zero discharges through maintainable progress initiatives. The World Bank identifies CO_2 emissions from diverse economic activities as the predominant contributor to environmental pollution among GHGs (Data Bank, 2021). Accordingly, reducing CO_2 emissions is essential for shifting developing countries from business-as-usual pathways toward sustainable growth. Emerging states, despite their abundant natural sources, face significant ecological pollution contests (Liu, 2023).

To realize ecological sustainability, these countries essential focus on factors that regulate GHG releases and support a transition to a greener economy. This shift requires financial resources, advanced technologies, and capacity building, mainly within emerging contexts. The Paris Agreement talks these requirements through specific provisions: Article 9 (finance), Article 10 (technology development and transfer), and Article 11 (capacity building) (Paris Agreement, Issue. U. N. C. Change, 2015). Recent research has identified additional determinants critical for climate sustainability, comprising globalization, urbanization, financial development, trade openness, and renewable energy adoption (Bekun, 2022).

Additionally, the BRI is a strategic expansion plan propelled by China, aimed at improving connectivity and fostering collaboration between China and multiple regions worldwide through both the historic overland Silk Road and the newly established marine routes. Introduced by President Xi Jinping in 2013, the initiative seeks to strengthen fiscal and broader social linkages between Sino and areas as well as South Asia, Southeast Asia, the Middle East, Europe, Oceania, and Africa (Swaine, 2015). The BRI targets the promotion of shared prosperity among over 65 countries along its routes. China ranks among the world's largest financial prudence, with a GDP exceeding $11.2 trillion as of 2017 (China: Country Data, 2017), and is expected to become the largest economy of the globe by 2050, reaching a GDP of $58.5 trillion, up from $5.7 trillion in 2010 (The World in 2050 – Summary report. (2017a)).

The BRI has been considered as strategic response of China to the changing era of globalization, with the respect of its economic, cultural, and political influence while responding to the development aspirations of nations along the traditional Silk Road. Most probably the leaders of China emphasize the principles of connectivity, inclusiveness, and mutual benefit when discussing the BRI (Lingliang's, 2016). The initiative offers opportunities for cooperation and interaction alongside other regional integration frameworks. Nonetheless, the participating countries exhibit considerable diversity in their capacity for transformative progress because of differences in their monetary, socio-cultural, and political contexts. The program focuses on regional integration and connectivity to build a common economic zone through cultural exchange, increased trade, and infrastructural development.

But, according to a World Bank report, large-scale transportation projects such as those under the BRI expose nations and local societies to significant ecological and societal risks.

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For instance, BRI routes passing through Cambodia, Kyrgyzstan, and Laos have contributed to a 7 percent increase in total CO_2 emissions (Majid Ali, 2022). Given the ongoing expansion of the BRI, concerns regarding its environmental impact continue to grow among researchers, governmental bodies, and NGOs. For South Asian partner countries, particularly Pakistan balancing economic growth with environmental protection is a significant challenge. This requires the introduction of policies that support initiatives like China's "Green Belt and Road" and the idea of "Ecological Civilization" to promote sustainable progress (Johanna Coenen, 2020).

CONCEPTUAL FRAMEWORK

Among all the theories of IR, the most appropriate theory to this topic is Neo-Gramscian perspective. Neo-Gramscian concept is particularly related with hegemony and world order in international relations. Robert Cox played a pivotal role in advancing the Gramscian concept of hegemony, serving as a pioneer in introducing neo-Gramscian perspectives to the analysis of international relations and the global order (Özçelik, n.d.). Antonio Gramsci (1891-1937), an Italian Marxist intellectual, developed much of his theoretical work during his incarceration under Mussolini's fascist regime. His ideas significantly influenced the evolution of critical theories in international relations, particularly giving rise to the neo-Gramscian school in the 1980s. Central to Gramsci's thought is the concept of hegemony, which he defined as the process through which the dominant social group secures the voluntary consent of the subordinate classes to its leadership and worldview (Arias, 2017). This form of consent is not coerced but appears "spontaneous" as it becomes embedded within the norms and institutions of society. Building on Gramsci's framework, Robert Cox emerged as a leading figure in the neo-Gramscian tradition. He conceptualized hegemony in the context of global order, defining it as leadership sustained through a historical bloc composed of a particular alignment of material capabilities, ideational constructs, and institutional arrangements (Persaud, 2016). According to Cox, a hegemonic order remains stable only when there is a harmonious relationship among these three elements. Conversely, when this equilibrium is disrupted, the existing hegemony begins to erode (Burnham, n.d.).

According to neo-Gramscian theory, environmental sustainability is not merely a technical or ecological concern, but a contested political space shaped by the interests of dominant social forces or states. In the case of BRI, and (CPEC), the neo-Gramscian approach situates environmental policies within broader hegemonic projects. In which, China, as an emerging global power, promotes a vision of sustainable development that aligns with its economic and geopolitical ambitions. This perspective helps to accentuate how environmental discourses are used to legitimize infrastructural expansion and regional influence. As China has been striving to maintain her dominancy in South Asia and beyond. The main focus of neo-is to analyze the concept of the historical bloc, an alliance of social, political, and economic forces that sustain a particular world order. As China has been making transnational alliances to counter the hegemonic designs of existing power. In the context of CPEC, the formation of a green development narrative can be observed as part of a new historical bloc comprising the Chinese state, Pakistani elites, multinational corporations, and development agencies. These actors collectively promote a model of environmental modernization that emphasizes clean energy, green finance, and eco-industrial zones. Such sustainable and environmental development helps China to accomplish her vested interests in different regions particularly in South Asia. The core assumption of the neo-Gramscian perspective is its focus on resistance and counter-

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hegemonic movements. Within the CPEC framework, environmental sustainability has become a site of contestation, where local populations, civil society groups, and transnational environmental organizations challenge the dominant development discourse. Different Issues such as land dispossession, ecological degradation, and exclusion from decision-making processes have resulted in critical responses that question the legitimacy of the state-corporate environmental agenda.

BRI AND CHINA'S GLOBAL IMPRESSION

Given its significant role in the universal economy, China is increasingly under analysis to ensure that its infrastructure investments abroad, particularly in developing countries in Central Asia, align with its global summit commitments and national green policies. The BRI, China's flagship strategy, aims to foster monetary progress and inter-regional connectivity across more than 115 nations. Initially, this expansive infrastructure project alongside mergers and acquisitions in various countries was perceived as a strategic move to offset domestic economic slowdown and, to some extent, sustain declining polluting industries. The BRI encompasses investments in transport, energy, and telecommunications setup, as well as industrial capability and technical capacity-building. The BRI has garnered global attention not only for its foreign and security policy implications nevertheless likewise for its potential large-scale environmental effects. A quarter of entirely coal plants under construction outside of China, with a combined capacity of 102 GW, have committed or projected funding from Sino economic institutions and businesses, according to Climate Action Tracker (2019). Sino investment around the world will meaningfully impact future global GHGs releases according to the Climate Action Tracker as the state lingers to fund and build both fossil fuel and renewable energy infrastructure around the globe in different regions.

BRI: IMPLICATIONS FOR CLIMATE CHANGE

There are abundant studies on the BRI, particularly with respect to its opportunities and challenges regarding environmental sustainability. A systematic literature review of the BRI, and its impact on climate change issues, delivers a wide-ranging impression of the situation. Zhang et al. (2023) stress the critical nature of foreign direct investment (FDI) out of Sino and the building of renewable energy infrastructures in regard to promoting ecological sustainability in BRI partner economies. Chen et al. (2022), meanwhile, speak to the environmental hazards of mining activities in BRI territories, thus providing insights regarding the scope and challenges of ecological reclamation. A plethora of literature still speaks to the great need for integrating sustainability issues into action and policy concerning the BRI-from environmental rehabilitation and energy efficiency down to the counter impact of trade and logistics.

Yet a lot of studies have investigated the relationship between environmental issues and economic expansion, with various policy mechanisms relating to initiatives, such as the BRI. Such statements are true when Wang & Xin (2020) examined the influences of trading BRI nations on the general energy efficiency of China's logistics sector; it noted that this influence varies but is mainly positive. Li et al. (2022) present an Inverted-U relationship between economic growth and environmental degradation within the BRI economies, indicating that FDI offers a beneficial role to be played in environmental quality improvement. According to Wen et al. (2023), urgent structural trade policy reforms are required, given that PM2.5 pollution has dual ramifications: health hazards and economic benefits. Offering a more critical perspective, Mahadevan and Sun (2020) discussed the contribution of FDI to carbon emissions in China and other BRI states and

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therefore recommended a policy mix guiding FDI toward low-carbon development trajectories. On a larger global platform, Huang and Zhu (2023,) critically analyze the international consequence of China's climate approaches and add that economic and emissions-reduction outcomes vary greatly across regions and sectors. Then, Luo and Zhang (2022) analyze how research and development investments contribute to low-carbon energy transition within BRI economies while emphasizing that national policy support is essential in realizing that objective. Perhaps because of that, the available literature has an extensive and multi-dimensional understanding of environmental implications mainly within the BRI context.

BRI: GREEN ENERGY AND CARBON EMISSION REDUCTION

On the promotion of a green economy and ecological sustainability BRI exerts a multifaceted influence as they are critical pillars of sustainable development. Liu et al. (2023) discover how substantial green investments under the BRI have the potential to strategically redesign the fiscal scene. Their study climaxes the BRI's sustenance for green technology progress and the expansion of ecologically sustainable fiscal models, whereas likewise representing a proactive commitment to environmental conservation. Further, the input of external FDI to endorsing industries' green transformation in BRI partaking low and middle-income states examined by Zhang and Sun (2023). They found that, strategic speculation flows are presented as drivers of greener industrial behavior. Li and his co-authors (2022) assess the BRI's role to Green Total Factor Productivity in 121 nations and climax its capability to endorse green growth though at the same time declining financial susceptibilities. Moreover, in sources management area, Wang et al. (2021) highpoint the necessity for cooperative water resource administration, particularly in addressing risks of water scarcity because of trade within the framework of the BRI.

From an infrastructure-oriented viewpoint, a structural model developed by Soyres et al. (2020) to evaluate the worldwide impacts of BRI-related transport infrastructure plans. Whereas their conclusions recommend potential surges in GDP. They likewise attention against possible adverse welfare outcomes in certain areas because of the high fiscal costs related with such extensive infrastructure investments. Adding this, a systematic analysis of conservational and ecological challenges alongside the BRI routes provided by Zhang et al. (2021), underlining the significance of risk mitigation policies to ensure longstanding ecological sustainability. In addition, a inclusive assessment of energy sustainability in the BRI framework contributed by Bompard et al. (2022), observing the role of carbon pricing as a mechanism to address climate-related distresses. Together, these studies employ quantitative methodologies that underline the significance of assessing sustainability through an integrated lens encompassing communal, financial, energy, and ecological dimensions. Numerous authors situate these instruments as inevitable tools for accomplishing sustainable development objectives for carbon-pricing instruments, Horn et al. (2021) provide a detail analysis of China's foreign lending practices, with specific importance on their implications for emerging nations. The study discloses a considerable volume of unreported or "hidden" debt, rising important apprehensions about debt transparency and longstanding financial sustainability, especially given China's position as the world's leading official creditor. Supplementing this discourse, regional analyses more enrich the understanding of sustainability challenges within the BRI. For example, Qian et al. (2022) determine the Water-Energy-Food link in the BRI context, identifying notable inefficiencies in the allocation and utilization of these interdependent sources. Their

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results highlight the requirement of integrated source management strategies to sustenance sustainable progress through these interconnected sectors.

ENVIRONMENTAL INITIATIVES OF CPEC

Different initiatives have been taken by Pakistan and China in response to climate challenges. The main aim of these efforts is to secure long-term benefits from this strategic scheme by enhancing the socio-economic conditions of the area and its population. Green CPEC initiatives is one of the foremost in which both nations took their initiative in the year 2022 for making a green decarbonized CPEC. CPEC is going to provide many avenues through significant development projects that will enhance the socio-economic betterment of Pakistan's populace by establishing a better system for green and sustainable development. Along with this green infrastructure initiative promoting the integration of green and ecologically sound practices in construction and infrastructure development, sustainable practices in the transportation system, and the creation of green spaces along the CPEC corridor are expected to ameliorate air quality and alleviate the environmental degradation (Liaqat, 2024).

Similarly, under CPEC green corridor initiative China is assisting Pakistan in the modernization of its agricultural sector by promoting development along corporate lines. Key areas of collaboration include agricultural research, advanced farming techniques, modern irrigation technologies, improved export infrastructure, and enhanced access to regional markets. These efforts are expected to not only strengthen the economic well-being of farmers but also contribute positively to environmental sustainability. Furthermore, Green CPEC Alliance platform is important for exchange of dialogue and concerted action for ensuring the long-term viability of the CPEC.

In addition to this, Gwadar Environment Plan makes Gwadar the "Shining Pearl" of the CPEC. Scientist of both states trying to produce such plant species which help in producing best air quality under regional conditions. As a joint venture to endorse a flourishing Gwadar Port with better financial and ecological circumstances, with participation from the regional community the Pak-China Friendship Green Park is designed. To promote a sustainable environment by engaging proper ecological laws and regulations is the major aim of the park. Likewise, both state plan to set up a green financing system with corporate and bank sustenance to encourage the development of low-carbon Special Economic Zones. Moreover, since 2020, the two nations have pledged bilateral collaboration on developing green and sustainable energy projects under CPEC. The Karote Hydropower Scheme is a shining instance, with a biodiversity management plan to reserve aquatic and wildlife species. Additionally, stringent measures have been implemented to safeguard the water quality of the river surrounding the project site. A Water Preservation Plan has also been established to prevent and control river pollution, with the Suki Kinari Hydropower Project exemplifying such environmental management efforts. Additionally, China aims to position CPEC as a green and sustainable project within its Global Development Initiatives 2030, aligned with the UN 2030 SDGs. The objective is to promote balanced and comprehensive progress (Javid, 2023). Stakeholders from both China and Pakistan have collaborated on Green CPEC initiatives to ensure the project's environmentally sustainable progress. Pakistan's adherence to environmental laws and protocols is particularly important in this context. Therefore, the emphasis must remain on achieving environmental sustainability to secure long-term economic benefits.

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ASSESSMENT OF ENVIRONMENTAL IMPACT IN CHINA AND PAKISTAN

Environmental Impact Assessment is a compulsory legal prerequisite in both China and Pakistan, as outlined in their respective national environmental regulations (Khwaja, 2018). Additionally, both countries have endorsed the UN Declaration on Environment and Development, thereby committing to the implementation of EIA processes. The EIA framework involves a comprehensive evaluation of proposed projects to determine their potential environmental and ecological effects. Approval is granted only when appropriate mitigation strategies are incorporated into project planning. In Pakistan, the EIA process is governed by the Pakistan Environmental Protection Act of 1997. Specifically, Section 12 of the Act mandates the submission of a detailed EIA report prior to the initiation of any project. Non-compliance with this requirement may result in legal penalties and other regulatory actions. Likewise, China demands an EIA conformity certificate for every construction-related project (Khan, 2018). Certification is not just a prerequisite before embarking on a project but also for any expansions, extensions, or renovations. Inability to comply with EIA can result in the rejection of the assessment and ultimately bring project progress to a halt. With these legal frameworks in place, all CPEC projects ought to have conducted thorough environmental impact assessments to analyze their effects on the natural environment, displacement of people, and local socio-economic conditions before their implementation (Ruilian Zhanga, 2018).

Framework Convention on Climate Change SDGs to which Pakistan is a party. But due to non-prioritization of environmental assessment in lieu of monetary and infrastructural welfares, the ecological consequence of CPEC investments is unclear. However, due to a lack of prioritization of environmental assessments in favor of fiscal and infrastructural gains, the environmental impact of CPEC investments remains uncertain. Furthermore, the absence of transparency and the vague terms of investment agreements have cast doubt on the credibility of EIA procedures in these projects. While Sino claims to promote sustainable development under the BRI through increased use of renewable energy and reduced carbon emissions, the establishment of coal-fired power plants under CPEC contradicts this commitment. The adverse environmental consequences of these plants could compel the Pakistani government to reconsider or even discontinue such projects (Reynolds, 2018). Nonetheless, it is not too late to conduct proper EIAs and adopt corrective measures to mitigate the environmental impacts of ongoing and future initiatives.

ECOLOGICAL CHALLENGES OF THE BRI

Like other foremost infrastructure projects, the BRI is inherently associated with ecological challenges. Many BRI participant nations are emerging nations characterized by diverse environments and climates, facing significant ecological issues. In some cases, economic development has been prioritized over environmental protection. The application of the BRI risks exacerbating these problems. Infrastructure development and energy exploitation may lead to increased pollutant emissions and resource consumption, as well as the withdrawal of raw materials and the misuse of oil and gas reserves at rates exceeding natural renewal. Additionally, biodiversity may be adversely affected through habitat fragmentation, increased wildlife mortality, pollution, and the spread of aggressive species, as indicated by initial spatial examination conducted by the World Wildlife Fund (WWF,2017).

Additionally, many BRI routes pass through geo-dynamically active regions that are susceptible to flooding, soil erosion, landslides, and river sedimentation. Notable instances

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include the Russia-China Amur Bridge transport corridor, which intersects two nature reserves with pristine forests (Tracy, 2017), and the Karakoram Highway, which crosses one of the most geo-dynamically active areas on Earth, exposing it to risks such as earthquakes, landslides, and flooding. Beyond these direct environmental impacts on various Earth system components such as the atmosphere, hydrosphere, geosphere, and biosphere scene fragmentation and changes in land use may result in indirect impacts. For example, the building of roads and railways reduces transportation costs, thereby altering markets and population distribution, which can contribute to illegal stealing, logging, and other adverse fiscal and ecological consequences. Furthermore, these environmental impacts may threaten the livelihoods of communities heavily dependent on local natural resources, with negative repercussions for fisheries, farming, and agriculture (Lechner, 2018). The Sambor hydroelectric dam, supported by China Southern Power Grid Company, reportedly obstructed fish migration, devastated fisheries downstream, and blocked sediment flow essential for fertilizing the Mekong Delta rice fields. Dams constructed in Sino section of the Mekong River have also been implicated in worsening drought conditions in Southeast Asia (Study Says China-Backed Dam in Cambodia Would Destroy Mekong, 2018).

Ultimately, environmental risks associated with BRI projects may provoke strong local opposition and complaints, particularly from activists and environmental groups, potentially stigmatizing the BRI and hindering its development. For example, the building of a hydroelectric dam on Sumatra Island, Indonesia, in 2018 faced significant resistance due to concerns over habitat fragmentation, threats to local livelihoods, and earthquake risks (Jong, 2018). Another critical concern related to the BRI is its potential to increase greenhouse gas emissions, thereby challenging the achievement of the Paris Agreement goals. While Sino has substantial potential and has significantly expanded BRI investments in renewable energy technologies, a considerable proportion of BRI projects remain focused on oil, gas, and coal. According to the report, between 2014 and 2017, loans from Chinese state policy banks for coal, nuclear, and hydropower projects in the energy sector were nearly seven times greater than those for solar and wind projects (Zhou, 2018).

PROMOTING ECO-FRIENDLY PRACTICES IN THE BRI

By mega-infrastructure initiative BRI, there is new and serious environmental dangers to the fiscal corridors and beyond, but there also is an opportunity if it is managed well and responsible: BRI will keep the environmental risks under control and without giving up a huge potential for economic growth.

BASELINE PROTECTION UNDER THE ECOLOGICAL REGULATIONS AND LAWS OF HOST NATIONS

First, host administrations' policies govern the implementation of the green BRI scheme. The host state regulations and laws can provide at least some degree of baseline protection against environmental hazards associated with BRI projects. It was on 29 January 2019 that the China Commerce Ministry formally issued the Guidelines for Country-by-Country (Region-by-Region) Foreign Investment and Cooperation (Guidelines for Country-by-Country, 2020). The guidelines introduce the political, fiscal, cultural, and topographical circumstances of 172 states, including all BRI contributing states. They also emphasize the formulation of a green BRI and incorporate the eco-friendly laws and regulations of BRI host countries. Sino has pledged to abide by host states' legislation and regulations for all BRI projects. In practice, these principles can serve as the first line of protection contrary to environmental consequences of the BRI, as long as they are imposed with utmost regard to site selection, consultation, social effect, dislocation, and long-term effects.

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GREEN BRI AND THE UN 2030 AGENDA: A SHARED PATH TO SUSTAINABILITY

Adherence to the ecological laws and regulations of host states safeguards that BRI schemes align with local ecological standards. Simultaneously, China's green BRI strategies, which are connected to the UN 2030 SDGs (Dong, 2018), facilitate compliance with the highest international environmental benchmarks. China has declared its commitment to a green BRI and has introduced comprehensive strategies to support this objective. As early as 2015, Sino introduced a domestic "Ecological Civilization" reform agenda, supported by a series of new eco-friendly plans, comprising a reinforced Environmental Protection Law, aimed at addressing its ecological crisis. Following the Paris Agreement, China adjusted its energy policy to place greater emphasis on green development, technological innovation, and the promotion of renewable energy sources (Heggelund, 2021). In October 2017, during the 19th National Congress of the CPC, President Xi Jinping reiterated the need to "accelerate the reform of the ecological civilization system and build a beautiful China (Full Text of Xi Jinping's Report at 19th CPC National Congress, 2017).

To align the principles of ecological civilization with the BRI, China introduced the concept of a "green BRI" and has made efforts toward its realization. In addition to current guidelines that highlight the environmental roles of Chinese businesses in foreign investment and cooperation, the 2015 Vision and Actions on Jointly Building the Belt and Road specifically emphasized environmental civilization in BRI investment and trade and encouraged greater cooperation in environmental protection, protection of biodiversity, and climate change mitigation. The 2017 Guidance to Promote Green Belt and Road was another major development in championing a green BRI. It provides that the BRI ought to "follow the principle of being resource efficient and environment friendly," incorporating the green concept into policy organization, infrastructure connectivity, unhindered trade, fiscal integration, and people-to-people exchanges, as well as integrating ecological protection into entirely phases and aspects of BRI development.

In the inaugural BRI Forum in May 2017, the Sino administration pledged that the BRI would be underpinning the Paris Agreement and UN SDGs, describing it as a "vision of green progress and a way of life and work that is green, low-carbon, circular, and sustainable". Being a formal product of the inaugural BRI forum, The Belt and Road Ecological and Environmental Cooperation Plan emphasized the role of ecological cooperation in promoting a green BRI, facilitating the ecological upgrading of corridor economies, and delivering the UN 2030 SDGs. The strategy laid out general necessities for environmental cooperation under the BRI and specified particular projects regarding policy coordination, green infrastructure, green trade, green finance, people-to-people exchange, and capacity building. In April 2019, at the 2nd BRI forum, 27 fiscal institutions globally, as well as entirely foremost Chinese banks engaged in the BRI, signed the Green Investment Principles, with further participation anticipated. These principles promote the integration of sustainability into corporate governance, awareness of ecological, social, and governance risks, environmental information disclosure, stakeholder engagement, the use of green fiscal instruments, green supply chain management, and capacity building through collective efforts. Their objective is to ensure that new BRI investment projects incorporate environmental sustainability, climate resilience, and social inclusiveness (Green Belt and Road Principles Receive Industry Backing, 2019)

PROJECTED CLIMATE IMPACTS OF CPEC

In Pakistan climate change is already evident, with a significant rise in the frequency and intensity of natural disasters over the past two decades (Hussain, 2020). Infrastructural

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developments such as the construction of coal-fired power plants, deforestation for road and railway networks, and augmented fossil fuel consumption are expected to leave a lasting impact on the country's climate trajectory. According to IUCN, more than 54,000 trees were felled for road building under CPEC projects in Khyber Pakhtunkhwa alone (Khan & Chang, 2021). This scale of deforestation poses a serious threat to both the regional climate and the agriculture sector. Additionally, traffic on the Karakoram Highway is projected to rise by 7,000 trucks per day, resulting in the emission of 36.5 million tons of CO_2 annually (Kouser, 2020).

Among the 21 energy projects under CPEC, the early harvest phase (2015–2019) added 10,000 MW of electricity to the national grid, primarily through conventional sources. Notably, the Quaid-e-Azam Solar Park is the only significant renewable energy project, contributing 1,000 MW. In contrast, coal-fired power plants are set to supply 8,800 MW to the grid (Ali, 2018), raising legitimate apprehensions about increased carbon emissions. However, proponents argue that these new coal plants will replace older fossil-fuel-based facilities, resulting in no net increase in emissions. The timing of these environmental changes is critical, as Pakistan is already facing climate vulnerability. Shifts in weather patterns have led to seasonal variability, with rising temperatures accelerating glacial melt posing serious risks to Pakistan's agroecological systems (Nabi, 2018). These disruptions threaten water and food security, and declining agricultural yields are expected as a result of increased seasonal irregularity. One notable positive initiative is the Billion Tree Plantation program in KPK, which aims to mitigate the adverse impacts of climate change.

DISCUSSION AND ANALYSIS

The CPEC is widely regarded as a transformative initiative for both China and Pakistan in their pursuit of sustainable economic growth. Between the two states history CPEC offers a widespread network of infrastructure and road connectivity. The project lacks obvious requirements addressing ecological protection within these foundational agreements, primarily governed under the Bilateral Investment Treaty (1989) and the Free Trade Agreement (2006). Furthermore, to mitigate or regulate ecological degradation there is a manifest absence of vigorous institutional mechanisms resulting from bilateral trade and progress activities. Pakistan has progressively shifted its effort toward green energy and ecologically friendly technologies to identify the serious need for sustainable practices. Between both state, this strategic redirection has led to improved environmental collaboration. In 2019, Alternative and Renewable Energy Policy is introduced by Pakistan, while Sino demonstrated a alike shift by withdrawing its sustenance for overseas coal power plants in its 14th Five-Year Plan (2020–2025). For integrating green infrastructure within CPEC projects, these parallel developments have opened opportunities mainly in the domains of urban planning and construction. In the region for sustainable progress practices these struggles are gradually laying the groundwork. By provincial administrations, in spite of the adoption of numerous environmental frameworks, the implementation of green policies within CPEC remains limited. However, as China pursues to expand CPEC's reach into the Central Asian and Middle East nations, it has gestured a commitment to more ecologically responsible policies. This comprises falling investments in fossil fuel-based projects and redirecting capital toward green and sustainable endeavors. Such shifts are instrumental in positioning CPEC as a model for sustainable regional development.

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CONCLUSION

The CPEC sits at a pivotal crossroad of economic aspiration and ecologic stewardship. CPEC lies at the heart of the BRI and can transform the development dynamics of the region in particularly Pakistan. Regardless, the strategic cooperation and economic partnership integration must include sustainability if it is to be successful in the long term. Moreover, some steps have been taken to green CEC through renewable energy initiatives, environmental policies, and collaborative ecological programs, significant gaps still exist in local and collaborative implementation, oversight, and participation. Models of sustainable development such as CPEC will require stronger institutional frameworks, robust impact assessments for the environment, rigorous assessments, and genuine participation from all stakeholder groups. China and Pakistan must go beyond mere symbolic commitments to the environment and adopt a more holistic, enforced, and more deeply integrated policy to multi-level environmental governance. Only in this way can CPEC meet its potential to foster not only connectivity and economic growth, but also ecological resilience and sustainable peace in the region.

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