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MULTI-DIMENSIONAL FREIGHT AND TRADE CAPACITY ANALYSIS – A CASE STUDY ON BURHAN-KHUNJERAB ROUTE IN CHINA-PAKISTAN ECONOMIC CORRIDOR (CPEC)

Summary. Trade corridors are critical for fostering global economic growth, reducing transportation costs, and enhancing regional connectivity, yet increasing trade volumes have imposed significant demands on these infrastructures. This study focuses on the Burhan-Khunjerab route, a pivotal section of the China-Pakistan Economic Corridor (CPEC), which connects China to global markets through Pakistan. Despite its strategic importance, the route faces challenges including mountainous terrain and limited capacity, raising concerns about its ability to accommodate future freight demands. The study employs a combination of capacity analysis and statistical modeling to estimate the freight-handling capacity of the Burhan-Khunjerab route under the CPEC scenario, specifically for the horizon year 2035. Using Level of Service (LOS) 'C' as the performance benchmark, the analysis identifies the Thakot-Raikot section as the critical

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bottleneck, capable of handling 9,519 additional trucks per day. Statistical models further reveal that an annual increase of 1 million US dollars in Pakistan's trade corresponds to a 1.3-million-ton-km annual increase in road freight, while a 1-million-ton rise in trade volume results in a 1,684-million-ton-km increase. By 2035, the route is estimated to handle 7.93% of China's total trade in monetary terms and 6.39% in tonnage. The findings emphasize the importance of targeted infrastructure improvements and multimodal integration to optimize freight capacity. Policymakers are urged to address critical bottlenecks and invest in capacity management strategies. Globally, this study highlights the transformative potential of trade corridors like CPEC in driving regional integration and global economic growth while offering a replicable framework for analyzing similar emerging trade routes.

Keywords: China Pakistan Economic Corridor (CPEC), Burhan-Khunjerab route, freight capacity modeling, trade corridor analysis, Level of Service (LOS)

1. INTRODUCTION

Trade routes have been a cornerstone of global economic growth, connecting regions and facilitating the efficient movement of goods. From the ancient Silk Road, which connected China to Europe, to modern maritime corridors such as the Trans-Pacific Ocean Trade Route and Asia-Europe Route, trade corridors have transformed economies by reducing transportation costs and boosting connectivity [1-3]. These routes not only enhance trade efficiency but also drive regional integration and GDP growth. However, as global trade volumes continue to rise, the demands on these corridors intensify, necessitating advanced freight and trade capacity analyses to optimize their performance and meet future demands [1, 4, 5].

China's Belt and Road Initiative (BRI), one of the largest infrastructure projects globally, aims to create a network of trade corridors spanning over 60 countries [6-9]. A flagship project under the BRI, the China-Pakistan Economic Corridor (CPEC), connects Gwadar Port in southern Pakistan to Kashgar in China's Xinjiang province, offering the shortest trade route for Chinese goods to reach the Middle East, Africa, and Europe [10-13]. By reducing shipment times and distances, CPEC holds immense potential to transform regional trade dynamics. Among its alignments, the Burhan-Khunjerab route, which includes the Karakoram Highway (KKH) and Hazara Motorway, is critical as it serves as the sole trade link between China and Pakistan [14, 15]. This section is shared by all three major CPEC routes – western, central, and eastern – underscoring its strategic importance.

Despite its significance, the Burhan-Khunjerab route faces several challenges. Its mountainous terrain and infrastructural limitations create a bottleneck that restricts its ability to handle increasing freight volumes projected under the CPEC scenario [16, 17]. While existing research extensively focuses on CPEC's socio-economic impacts, studies addressing the freight and trade capacity of this crucial section remain limited. With this background, this study conducts a multidimensional freight and trade capacity analysis of the Burhan-Khunjerab route to evaluate the quantum of China's trade that can be efficiently handled under the CPEC scenario. Using statistical modeling techniques, the analysis estimates the route's freight-handling capacity while ensuring compliance with Level of Service (LOS) 'C' standards. The findings address critical logistical challenges and provide actionable insights for optimizing freight capacity, contributing to the broader understanding of trade corridor performance in emerging economies.

2. LITERATURE REVIEW

The analysis of multidimensional freight and trade capacity is critical in understanding and optimizing global trade networks. Trade corridors form the backbone of global trade infrastructure, enabling seamless freight movement, reducing transit times, and fostering economic growth. Existing research has predominantly focused on enhancing logistics efficiency, modeling trade flow patterns, and understanding the economic impact of infrastructure on freight movement. This study builds on global and regional perspectives to address specific gaps in the existing literature on freight and trade capacity analysis, utilizing the Burhan-Khunjerab section of the China-Pakistan Economic Corridor (CPEC) as a case study.

2.1. Trade corridors and economic growth: Global perspective

Trade corridors are key enablers of economic development, directly contributing to GDP growth and regional trade connectivity. [18] examined trade volume redistribution across multimodal transport networks in the United States, highlighting the critical role of efficient freight networks in addressing bottlenecks and supporting economic growth. Similarly, the Lagos-Kano corridor in Nigeria emphasized the importance of balancing road and rail infrastructure, revealing that road transport often dominates time-sensitive freight operations [19]. These findings demonstrate the necessity of integrated transport strategies to optimize freight flows. The Central Asian Trans-Caspian route underscores the economic importance of robust cross-border trade corridors. Studies by [20] highlighted logistical challenges such as transit bottlenecks, which are particularly relevant for emerging corridors like CPEC. The Pantura Highway in Indonesia exemplifies the use of clustering analysis to manage highway saturation caused by growing freight demand [21]. These examples illustrate the economic benefits of addressing logistical inefficiencies in trade corridors but also reveal gaps in modeling freight capacity specific to developing regions.

2.2. Freight capacity modeling approaches

Freight capacity modeling has been a cornerstone of transportation planning, particularly in developed economies. Researchers have used diverse methodologies to estimate freight load and forecast demand. [22] developed an input-output model to analyze transportation value, correlating freight traffic with economic growth. [23] introduced stepwise regression models to examine relationships between freight volume and economic indicators like industrial structure and consumption coefficients. These approaches provide robust frameworks for understanding the interplay between economic activities and freight demands. Advancements in predictive modeling have introduced hybrid approaches that integrate traditional statistical methods with machine learning. [24] compared prediction methods, demonstrating the superiority of hybrid models in forecasting freight demand with high accuracy. [25] used hierarchical modeling to couple truck traffic data with socio-economic variables, enabling precise freeway-level freight demand predictions. Similarly, models from the Netherlands evaluate congestion impacts and suggest traffic management strategies to maintain service levels [26]. These methodologies form the foundation for this study's statistical modeling approach, which incorporates GDP, trade volume, and truck traffic as key predictors.

2.3. Gaps in freight studies for emerging economies

While global studies provide valuable insights, their applicability to emerging economies is often limited due to contextual differences. Most existing models overlook factors unique to developing regions, such as policy instability, inadequate infrastructure, and fluctuating economic growth rates. Studies like those on Indonesia's Pantura Highway and the Central Asian transport corridor reveal challenges in adapting advanced models to regions with resource constraints [27]. These gaps underscore the need for region-specific models tailored to the dynamic conditions of emerging trade corridors like CPEC.

2.4. Insights from past CPEC studies

Research on CPEC has extensively focused on socio-economic impacts, emphasizing job creation, industrial growth, and energy security. [28] examined the strategic importance of CPEC for enhancing bilateral trade between China and Pakistan. [29] explored the positive correlation between Pakistan's export growth and China's GDP, while [30] analyzed trade facilitation bottlenecks in cross-border trade. However, most studies overlook the logistical and freight capacity challenges of the northern alignment, particularly the Burhan-Khunjerab route. Studies have highlighted potential benefits, such as reductions in shipping costs and transit times, with CPEC projected to decrease shipping costs by up to 68% for Oman and 36% for European ports [31]. [32] highlighted how CPEC investments improve connectivity and economic integration in key cities but warns of growing development inequalities between regions. [33] quantified bilateral economic impacts, projecting GDP and welfare gains for both Pakistan and China, but did not address logistical constraints on freight capacity. While these findings validate CPEC's economic feasibility, they fail to address its capacity to handle increasing freight loads, particularly under the constraints of Level of Service (LOS) standards.

2.5. Bridging the research gaps

This study addresses the critical gaps identified in the existing literature by focusing on the freight and trade capacity of the Burhan-Khunjerab route within the CPEC scenario. Unlike previous research, which primarily assesses socio-economic benefits, this study employs statistical modeling to estimate freight load capacity using economic indicators as independent variables, including GDP, trade volume, and truck traffic. The models are further applied to evaluate the corridor's ability to accommodate China's trade while maintaining LOS 'C' standards. By integrating global best practices with region-specific insights, this research provides a novel framework for assessing trade corridor performance in underdeveloped regions. The findings not only enhance understanding of CPEC's logistical potential, but also offer a replicable approach for optimizing freight capacity in similar emerging trade corridors worldwide.

3. METHODOLOGY

3.1. Data description

Miscellaneous data for the study have been collected from various government departments of Pakistan (e.g., Planning Commission, Finance Division, National Highway Authority (NHA)) and the National University of Sciences and Technology (NUST), Pakistan (e.g., Chinese Studies Centre (CSC), School of Social Sciences and Humanities (S3H)). Historic traffic data from NHA were used as input in capacity analysis. Study-related time series economic data (from the year 2000 to 2022) were extracted from web sources to perform the statistical modeling. This data included road freight in million-ton km, number of registered trucks, number of trucks on the road, trade (import/ export) in million US dollars and million tons, population, GDP, and length of roads.

3.2. Conceptual framework

The conceptual structure of the study is presented in Fig. 1. For analysis purposes, the Burhan-Khunjerab route has been divided into five sections [34] and capacity analysis of each section was carried out with respect to the level of service (LOS) using the HCM (Highway Capacity Manual) method [35]. LOS is a measure of road functional performance with respect to its traffic capacity and congestion. LOS is based on categories from A to F. LOS ‘A’ represents the best road functional condition, while LOS ‘F’ indicates extremely congested traffic conditions (i.e., traffic jams). In this study, the year 2035 has been considered as the ‘horizon year,’ considering that CPEC would be considerably completed and fully operational by this year.

Considering that trucks would primarily constitute the CPEC-induced traffic, maximum traffic (capacity) has been estimated in terms of the number of additional trucks per day that could be accommodated on the road in addition to the projected traffic for a particular year. Capacity analyses have been carried out for the years 2025, 2030, and 2035, keeping the traffic within the threshold, which is the maximum limit of LOS ‘C.’ Statistical models have been developed in this study to estimate the freight traffic/load and percentage of China’s trade that could be accommodated by the Burhan-Khunjerab route in the CPEC scenario. Finally, vital conclusions and recommendations have been proffered.

4. RESULTS

4.1. Capacity analysis of Burhan-Khunjerab route

Burhan-Khunjerab route has been divided into five sections for capacity analysis, as explained in Tab. 1 and Fig. 2. The additional number of trucks per day that could be accommodated by each section under the threshold condition (i.e., maximum limit of LOS 'C') was calculated using HCM-based Highway Capacity Software (HCS). The procedure adopted to determine the additional number of trucks was to add the number of trucks to the projected trucks for a particular year of analysis, keeping the base non-truck traffic constant until the LOS 'C' changed to the next lower LOS i.e., LOS 'D'. The number of additional trucks, beyond which the LOS changed from 'C' to 'D', was designated as the threshold/ maximum limit of LOS 'C'. These calculations were performed for the years 2025, 2030 and the horizon year 2035 using a growth factor of 3% [36]. Although LOS ‘D’ is expected to yield higher capacity for all sections under consideration, LOS 'D' is considered practically inappropriate, exhibiting considerably congested traffic conditions. Therefore, LOS 'C' was considered as the threshold condition for this study.

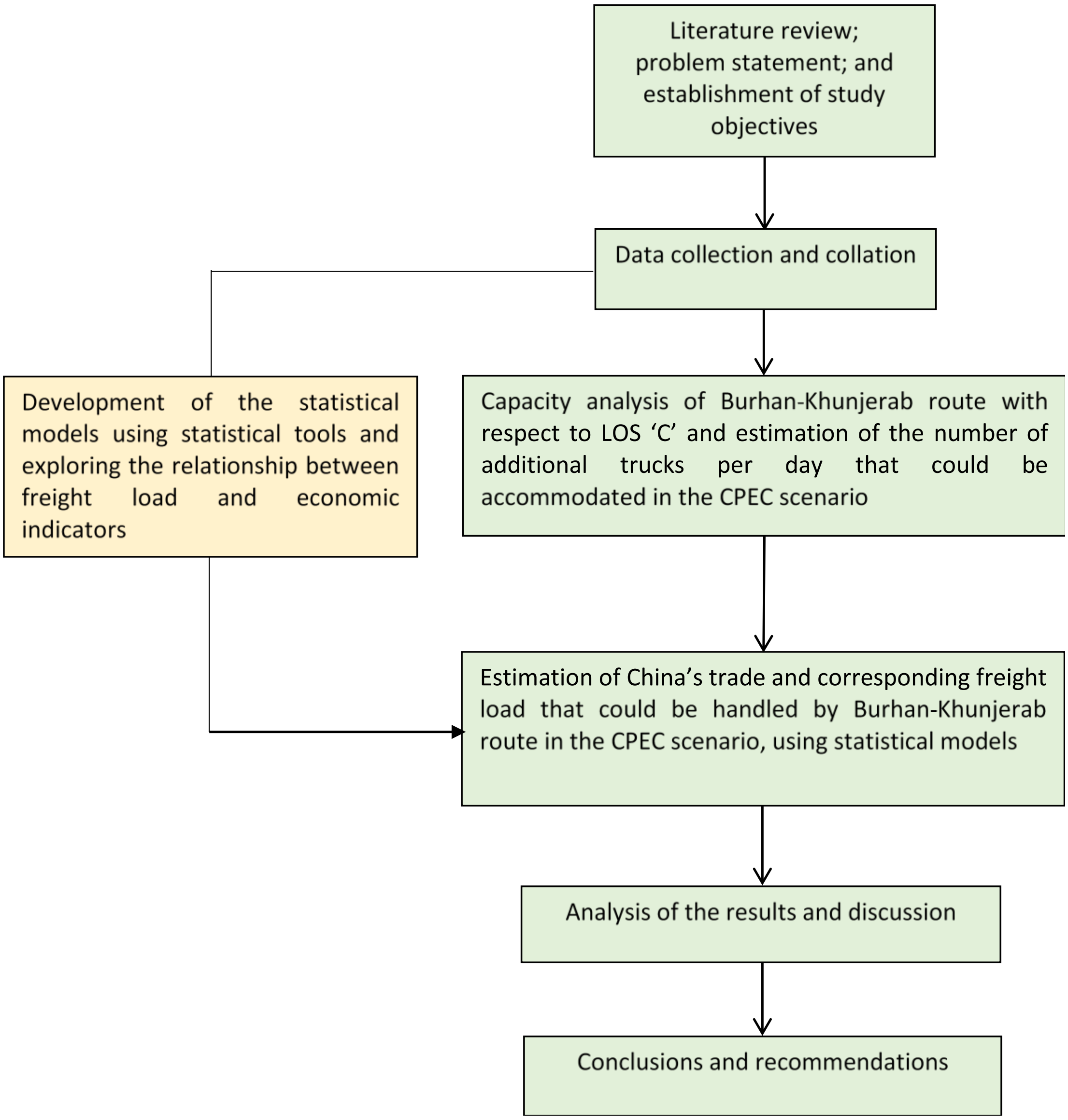


Fig. 1. Conceptual framework of the study

Tab. 1

Sections of Burhan-Khunjerab route

Section	Description of Section	Distance (Km)	Number of Lanes
Hazara Motorway (M-15)			
1.	Burhan to Havelian (BH)	60	6
2.	Havelian to Mansehra (HM)	39	4

3.	Mansehra to Thakot (MT)	80	2
National Highway N-35			
4.	Thakot to Raikot (TR)	270	2
5.	Raikot to Khunjerab (RK)	336	2
Total		785	-
Note: Letters in parentheses show the abbreviation used to indicate a particular section of the route.			

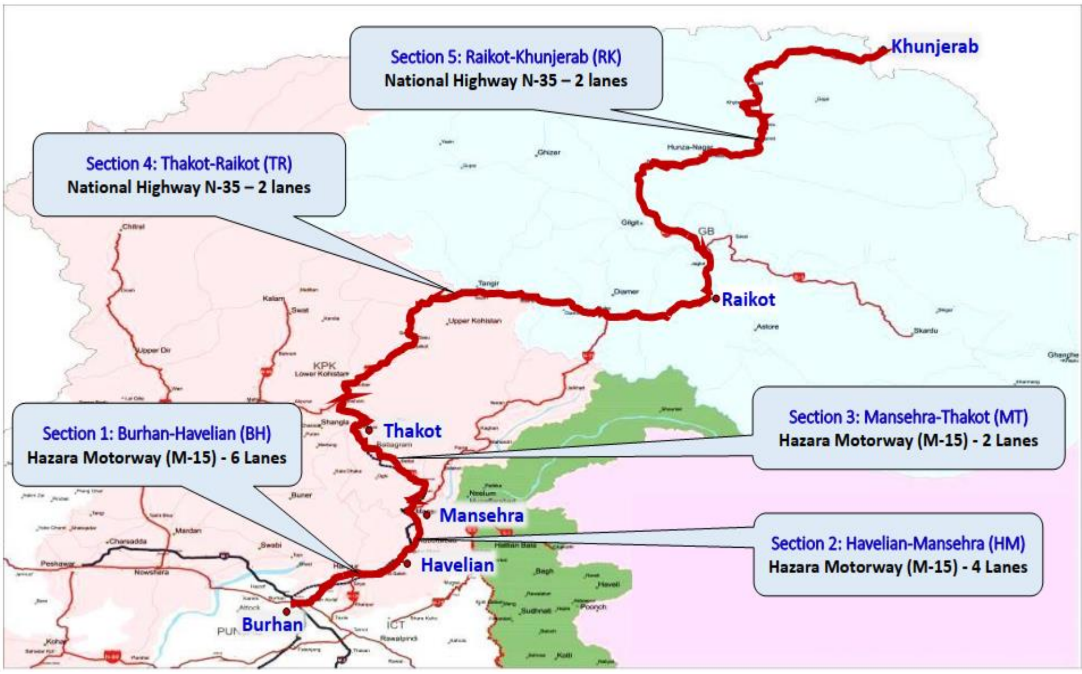


Fig. 2. Burhan-Khunjerab Alignment-Hazara Motorway (M-15) and National Highway N-35

Results of the capacity analysis are presented in Tab. 2. Numbers in the table represent the maximum number of additional trucks per day that could be accommodated by each section of M-15 and N-35 under the threshold condition of LOS 'C'. Since the section accommodating the lowest number of additional trucks would dominate the capacity of the whole alignment, therefore such a section has been designated as 'critical section'. Based on the capacity analysis (Tab. 2), 'Thakot-Raikot (TR)' section has been found to be the most critical section of Burhan-Khunjerab route in the CPEC scenario with critical capacity of 9,519 trucks per day in addition to the projected base traffic volume in the year 2035 under the threshold condition of LOS 'C'. It is important to highlight that the Thakot-Khunjerab (TK) section (which is 77% of the Burhan-Khunjerab route), especially the Thakot-Raikot (TR) section of N-35, is located on extremely mountainous terrain which is the most difficult section with respect to road construction and expansion (lanes addition).

Tab. 2

Additional number of trucks per day under the threshold condition of LOS 'C'

Ser.	Year	Burhan-Havelian (BH) (No.)	Havelian-Mansehra (HM) (No.)	Mansehra-Thakot (MT) (No.)	Thakot-Raikot (TR) (No.)	Raikot-Khunjerab (RK) (No.)	Lowest Trucks/ Day (No.)	Critical Section
1.	2025	54,045	32,508	21,574	10,366	10,584	10,366	TR
2.	2030	52,708	30,732	21,303	9,974	10,022	9,974	TR
3.	2035	51,156	28,673	20,991	9,519	9,671	9,519	TR

4.2. Statistical modeling for estimation of freight traffic capacity of Burhan-Khunjerab route in CPEC scenario

CPEC is expected to considerably increase the trade and freight load on the existing road infrastructure along CPEC routes. Therefore, a detailed analysis is required to estimate the percentage of China's trade that is expected to be routed through the Burhan-Khunjerab section of CPEC based on its freight handling capacity. Since the capacity of the Burhan-Khunjerab route is the most vital element affecting the capacity of the whole corridor, therefore, the trade handling capacity of this section is essential for analyzing the capacity of the complete corridor. With this perspective, statistical modeling has been carried out in this research to estimate freight traffic and load in the CPEC scenario. Details pertaining to time series data of various economic indicators, from 2000 to 2022, used in the regression modeling, are mentioned in Tab. 3. The methodology adopted in this study for statistical modeling to predict the freight capacity of the Burhan-Khunjerab route in CPEC scenario is elaborated in Fig. 3. Three regression models were developed, which were further employed to estimate China's freight that could be accommodated by the Burhan-Khunjerab route in the CPEC scenario.

Tab. 3

Economic indicators and model variables

Ser.	Economic Indicators/ Model Variables	Abbreviations	Units	Model Variable Type
1.	Annual Pakistan road freight	RF	Million Ton Kms	Continuous
2.	Annual number of trucks on the road in Pakistan	TOR	Numbers	Discrete
3.	Annual Pakistan trade in million US dollars	PT (USD)	Million US dollars	Continuous

4.	Annual Pakistan trade in million tons	PT (Tons)	Million Tons	Continuous

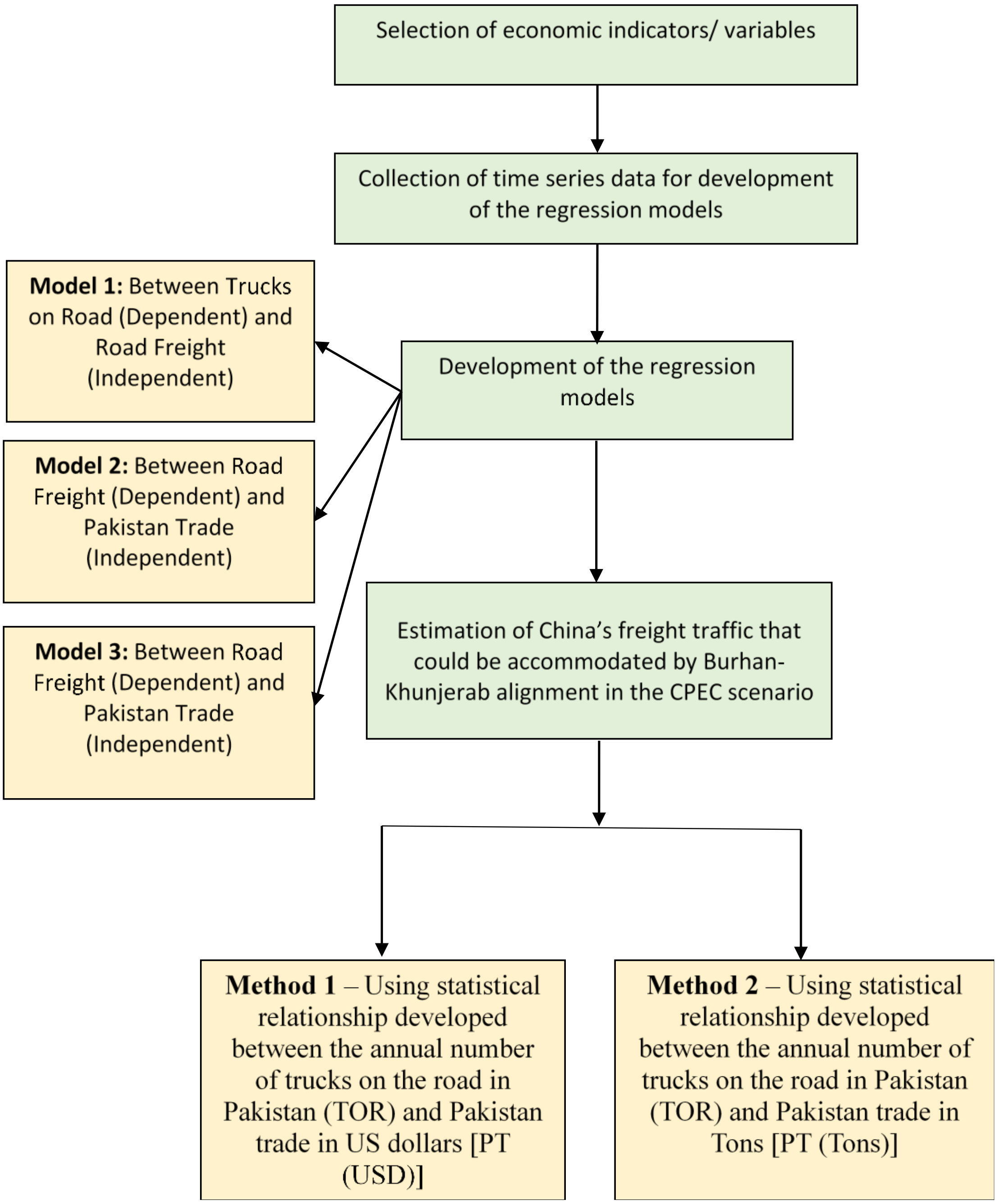


Fig. 3. Methodology for statistical modeling to predict and estimate the freight traffic.

4.2.1. Statistical modeling for the development of relationships between freight load and economic indicators

To explore the relationships between freight load and various economic indicators/ variables, three regression models were developed using statistical software, i.e., Statistical

Package for Social Sciences (SPSS). Details of three regression models, with model statistics exhibiting aptness of these models, are presented in Tab. 4. 74% of the data was used for model development, while 26% of the data was used for model validation based on the Mean Absolute Percentage Error (MAPE) method as shown in Tab. 4. MAPE values for the developed models, being less than 30%, exhibit appropriate predictability of the developed models [37, 38]. Moreover, observed versus predicted plots for the response variables of three regression models: (a) Regression Model 1 – Annual Number of Trucks on Road in Pakistan (TOR), (b) Regression Model 2 – Annual Pakistan Road Freight (RF), and (c) Regression Model 3 – Annual Pakistan Road Freight (RF), as presented in Fig. 4, also exhibit their very good predictability and statistical goodness of fit [39-41].

Tab. 4

Regression models with R-squared and MAPE values

Regression Model	Regression Models Equation	R-Squared (%)	MSE	MSPE	MAPE (%)
Model 1	TOR = -16476.32 + 1.45 x RF	0.98	34080119.69	24602182.16	27.81
Model 2	RF = 75852.15 + 1.3 x [PT (USD)]	0.90	65001361.21	61679798.04	5.11
Model 3	RF = 42609.2 + 1683.97 x [PT (Tons)]	0.94	39288998.00	46756398.74	19.01

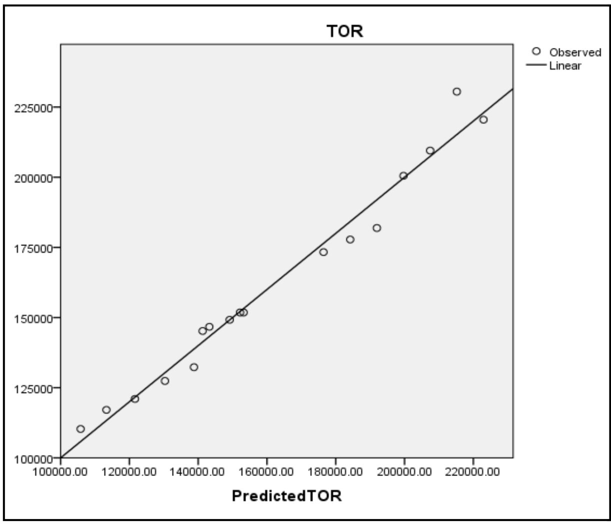
Explanation of abbreviations:
RF = Annual Pakistan Road Freight (Million Ton Kms);
TOR = Annual Number of Trucks on Road in Pakistan (Numbers);
PT (USD) = Annual Pakistan Trade in million US Dollars (Million USD);
PT (Tons) = Annual Pakistan Trade in Million Tons (Million Tons)

4.2.2. Percentage of trucks on Burhan-Khunjerab route

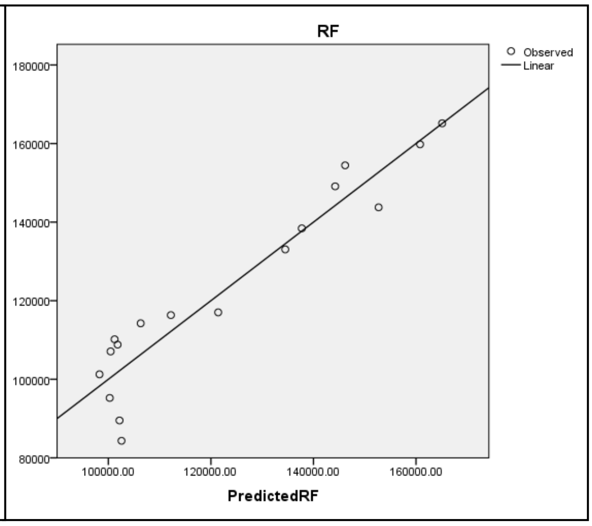
To predict the freight load in the CPEC scenario, the annual average daily number of trucks on the Burhan-Khunjerab route (i.e., 1,842 trucks) is compared to the total annual number of trucks on the roads in Pakistan (i.e., 305,371 trucks) in the year 2022 [42]. It was revealed that the annual average daily number of trucks on the Burhan-Khunjerab route is 0.603% of the total annual number of trucks on the road in Pakistan in the year 2022.

4.3. Estimation of China’s freight to be accommodated by the Burhan-Khunjerab route in CPEC scenario in the year 2035

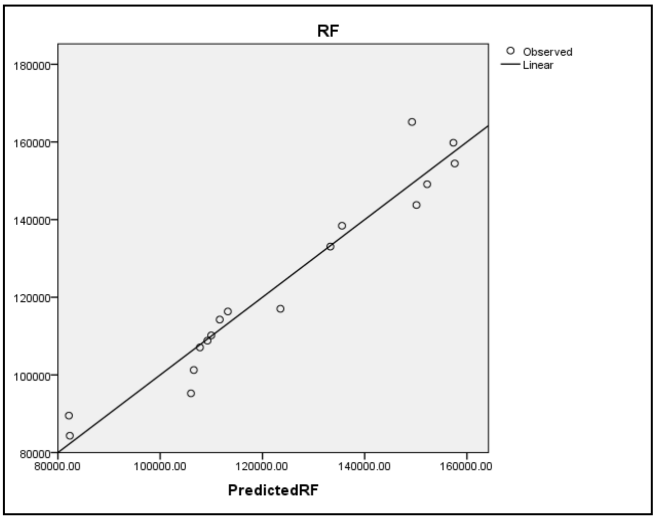
To estimate China's freight load to be accommodated by the Burhan-Khunjerab route in the CPEC scenario, two methods were adopted as shown in Fig. 3 and as explained in ensuing sections.



(a)



(b)



(c)

Fig. 4. Observed versus predicted plots of regression models

4.3.1. Method 1 – Using Model-1 and Model-2

The annual number of trucks on road in Pakistan (TOR) (i.e., CPEC induced additional trucks) in the year 2035 has been estimated to be 1,578,084 trucks by considering the following two parameters:

a. Estimated percentage of trucks on the Burhan-Khunjerab route compared to the annual number of trucks on road in Pakistan (i.e., 0.603 %; as already explained in Section 6.2) and
b. Estimated CPEC induced additional trucks per day on this route under the threshold condition of LOS 'C' in the year 2035 (i.e., 9,519 trucks per day).

Trade capacity of the Burhan-Khunjerab route in CPEC scenario (under the threshold condition of LOS ‘C’) in the year 2035, in terms of Pakistan trade [PT (USD)], was estimated to be 786,362.76 million US Dollars by following two steps:

Step-1: Using the CPEC-induced annual number of trucks on road in Pakistan (TOR) (in year 2035) in Model-1, Pakistan road freight (RF) in year 2035 was estimated to be 1,099,696.46 million ton-kms.

Step-2: Pakistan trade [PT (USD)] in year 2035 was estimated to be 786,362.76 million US Dollars by employing estimated Pakistan road freight (RF) in year 2035 in Model-2.

China's total trade for the year 2035 was estimated to be 9,920,173 million US Dollars, employing trend analysis based on the time series data from the year 2000 to 2022 [36, 43], as shown in Fig. 5. Comparing the estimated trade capacity of the Burhan-Khunjerab route (i.e. 786,362.76 million US Dollars) and projected China's total trade (i.e. 9,920,173 million US Dollars), it was revealed that 7.93% of China's trade (in million US Dollars) could be accommodated by the Burhan-Khunjerab route in CPEC scenario in the year 2035.

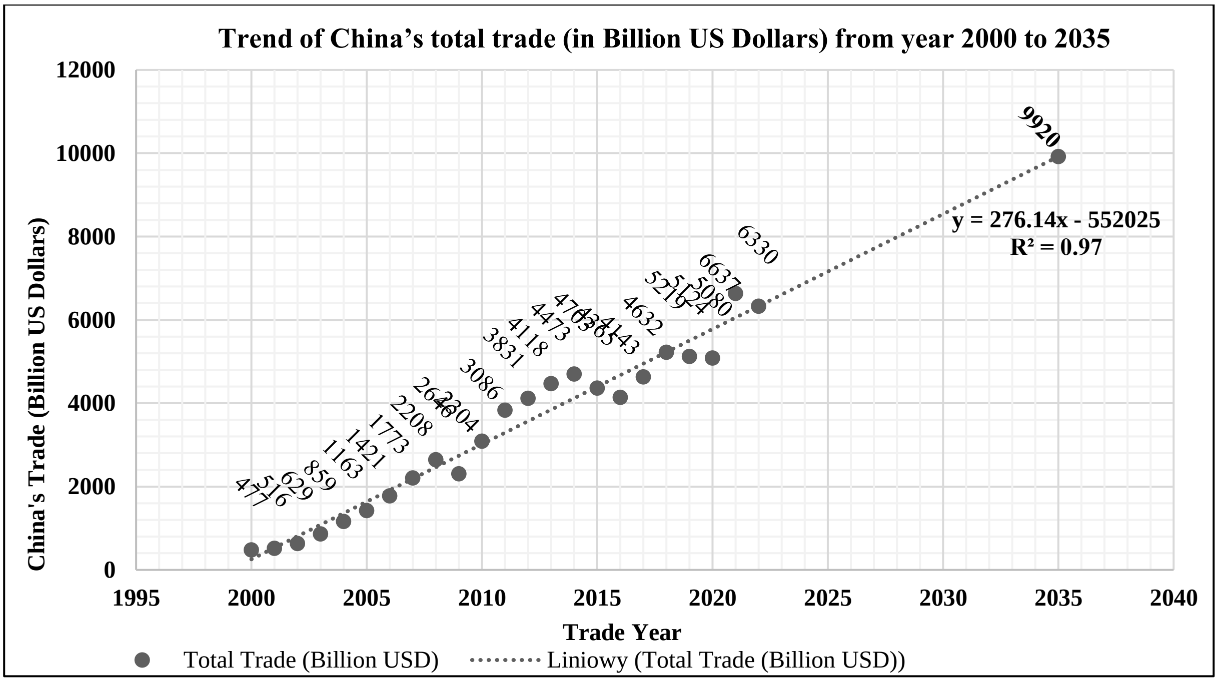


Fig. 5. Trend of China's total trade (million tons) from the year 2000 to 2035

4.3.2. Method 2 – Using Model-1 and Model-3

Trade capacity of the Burhan-Khunjerab route in CPEC scenario (under the threshold condition of LOS 'C') in the year 2035, in terms of Pakistan trade [PT (Tons)], was estimated to be 627.73 million tons by following two steps:

Step-1: Pakistan road freight (RF) in year 2035 was estimated to be 1,099,696.46 million ton-kms by using CPEC-induced annual number of trucks on road in Pakistan (TOR) in year 2035 (i.e., 1,578,084 trucks) in Model-1.

Step-2: The estimated Pakistan road freight (RF) in year 2035 (i.e. 1,099,696.46 million ton-kms) was used in Model-3 to determine Pakistan trade [PT (Tons)] in year 2035 (i.e., 627.73 million tons).

China's total trade for the year 2035 was estimated to be 9,828 million tons, employing trend analysis based on the time series data from the year 2000 to 2022 [36, 43, 44], as shown in Fig. 6. Comparing the estimated trade capacity of the Burhan-Khunjerab route (i.e., 627.73 million tons) and projected China's total trade (i.e., 9,828 million tons), it was revealed that 6.39 % of China's trade (in million tons) could be accommodated by the Burhan-Khunjerab route in CPEC scenario in the year 2035.

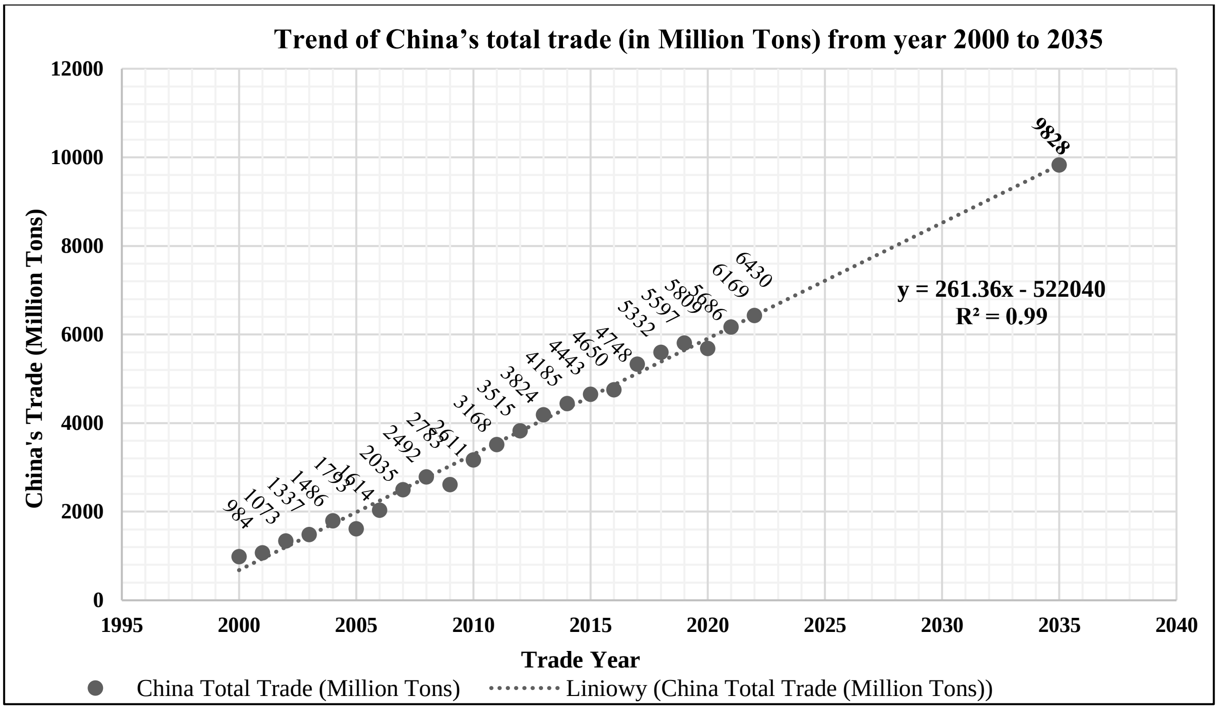


Fig. 6. Trend of China's total trade (million tons) from the year 2000 to 2035

5. DISCUSSION

The study highlights significant findings regarding the freight and trade capacity of the Burhan-Khunjerab route in the CPEC scenario, addressing critical gaps in understanding and optimizing global trade corridors. The analysis identifies the Thakot-Raikot section as the most critical bottleneck due to its mountainous terrain and limited potential for expansion. This section's capacity of 9,519 trucks/day under LOS 'C' by 2035 emphasizes the physical constraints on infrastructure development and its impact on overall route performance. The regression models developed in this study establish strong relationships between economic indicators and freight loads, demonstrating that an annual increase of 1 million US dollars in trade contributes an additional 1.3-million-ton kilometers to Pakistan's road freight, while a 1-million-ton increase in trade volume adds 1,684-million-ton kilometers. These results affirm the direct link between economic growth and freight demands, highlighting the importance of aligning infrastructure development with projected trade expansions.

Under the projected 2035 trade volumes, the Burhan-Khunjerab route is estimated to handle 7.93% of China's trade by value and 6.39% by volume. These findings underscore the strategic importance of this route in facilitating trade and promoting regional connectivity. However, the data also point to the limitations of relying solely on this corridor for China's growing trade needs, suggesting that supplementary infrastructure investments are necessary to mitigate capacity constraints. Globally, the study's findings contribute to the broader understanding of trade corridor performance, particularly in emerging economies. The statistical modeling approach employed provides a replicable framework for analyzing freight capacity in constrained terrains, offering valuable insights for policymakers worldwide.

6. CONCLUSIONS

This study focused on analyzing the freight and trade capacity of the Burhan-Khunjerab route under the CPEC scenario, a crucial trade corridor with significant regional and global importance. By examining its capacity to handle increasing trade volumes, the research provides critical insights into optimizing freight flow and addressing logistical challenges along this strategic alignment. A review of the literature revealed limited analyzes on the capacity and logistical challenges of CPEC's northern alignment, particularly in the context of projected freight volumes and infrastructural constraints. Employing statistical modeling and a robust methodological framework, this study assessed the capacity limitations and trade-handling potential of the Burhan-Khunjerab route, focusing on its ability to maintain Level of Service (LOS) 'C' standards.

The findings underscore the criticality of the Thakot-Raikot section, which presents the lowest capacity along the route due to its challenging mountainous terrain and limited scope for expansion. By the horizon year 2035, based on the most critical section, the route is estimated to accommodate an additional 9,519 trucks per day, beyond the projected 5,047 daily vehicles, resulting in a total traffic volume of 14,566 vehicles per day (including all types of traffic). Statistical models further revealed significant correlations between economic indicators and freight capacity. The findings suggest that an annual increase of 1 million US dollars in Pakistan's trade would result in a corresponding annual increase of 1.3-million-ton-kms in road freight per year. Similarly, a rise of 1 million tons in Pakistan's trade volume annually would enhance the country's road freight capacity by 1,684 million ton-kms per year. These projections underscore the profound impact of trade growth on freight infrastructure, emphasizing the need for targeted planning to accommodate escalating demands. The Burhan-Khunjerab route holds significant strategic importance within the CPEC framework, with its freight capacity estimated to accommodate 7.93% of China's total trade in monetary terms (million US Dollars) and 6.39% in trade tonnage (million tons) by 2035. These figures underscore the route's pivotal role in facilitating regional and global trade. To fully utilize this potential, targeted investments in infrastructure development and capacity enhancement along this corridor are required.

From a global perspective, this study contributes to the understanding of the role of economic corridors in facilitating trade and optimizing freight flows. The methodological approach and findings offer valuable insights for policymakers and planners involved in the development and management of emerging trade corridors worldwide. The emphasis on maintaining service-level standards while accommodating growing freight volumes provides a replicable framework for addressing logistical challenges in similar contexts. Policymakers are encouraged to prioritize both infrastructural enhancements and strategic capacity management, alongside multimodal integration, to improve the resilience and operational efficiency of trade corridors. This study highlights the transformative impact of economic corridors like CPEC in fostering regional connectivity and advancing global economic growth while effectively addressing key logistical challenges.

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