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A Review of Logistics and Transport Studies in Pakistan Hard or Soft Infrastructure?

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CONTENTS

List of Figure

List of Tables

ABSTRACT

The study aims to develop a systematic review on the logistics and transport sector of Pakistan aiming to identify the main themes taken up in the research and their recommendations for development of this sector. For this, systematic literature review was employed as the guideline to collect the research articles. The research articles were extracted from google scholar, jstor and SciSpace AI. The articles falling in the W, *X*, and *Y* categories of the Higher Education Commission's *HJRS* system were included in the final review. The review includes 43 articles which have been clubbed into the major themes.

1. INTRODUCTION

The logistics infrastructure plays a critical role in domestic commerce. In fact, transport infrastructure is the asset that increases the productivity of other players in the ecosystem. Pakistan was ranked 122 out of 160 countries in the Logistics Performance Index (LPI) 2018, while it disappeared from the international scenario in the LPI 2023. This calls for immediate attention to the sector that faces several challenges, which must be addressed if it is to compete in the global economy, especially in the region where other countries like India and China are performing much better. Logistical bottlenecks increase the cost of production of our goods by about 30 percent and Pakistan losses around 6 billion $ (4 to 6 present of GDP) because of these insufficiencies (SBP, 2007).

The National Freight and Logistics Policy (2021) has rightly pointed out that the logistics sector is fragmented and in dire need of modernisation. The transport related decision making involves 9 federal ministries and 22 departments directly or indirectly (Imran & Low, 2017). A lack of institutional framework has further impeded the growth of the logistics sector, and a mixture of old and new laws govern what is supposed to be a sector operating in the modern world. Currently, the logistics sector is divided among multiple federal ministries, making it extremely difficult to establish coherent regulations for the sector's growth and integration. The Ministry of Commerce handles foreign and transit trade. The shipping services are overseen by the Ministry of Ports and Shipping. The Ministry of Defense is responsible for airports and aviation. The Ministries of Communications and Railways manage rail and road infrastructure as well as freight and Customs and cargo clearance affairs fall under the jurisdiction of the Ministries of Finance and Interior.

This fragmented structure prevents the effective implementation of existing important regulations like the Trucking Modernisation Plan and the National Transport Policy, which were approved in 2007. Consequently, Pakistan has not ratified or adopted international standards and conventions concerning the transportation of goods and products, intensifying the challenges faced by the sector. Furthermore, red tape, which includes burdensome documentation requirements and furthermore, red tape, which includes burdensome documentation requirements and customs procedures, results in delays, escalates shipment costs, and reduces the ease of doing business in the country.

In its quest for growth, Pakistan followed the "investment in infrastructure" jargon in early 2000s through various programmes like Khushal Pakistan Programme in 1996 and 2007, National Trade Corridor Improvement Programme (NTCIP) in 2005, National Development Plan (NDP) over 2000–2006, National Highway Improvement Programme (NHIP) in 2007, and China Pakistan Economic Corridor (CPEC) in 2013. However, the financing requirements were massive, and resources limited. The public funds under the Medium-Term Development Framework (MTDF) could cover less than half of the required transport infrastructure investment. The remaining investment had to be secured from the private sector through a mix of policy reforms, institutional support, incentives, and financing mechanisms (SBP task force, 2007). Despite that an average project run three times longer and two times more expensive than the initially planned cost (Pasha; 2011), the politically motivated, growth less investment in infrastructure continued with donor consultations and financial assistance constituting a staggering 80.35 percent share of PSDP (Haque, et al. 2020). By 2021, Pakistan had a road density of 0.58 indicating sufficient but highly skewed road infrastructure (Table 1 and Figure 1).

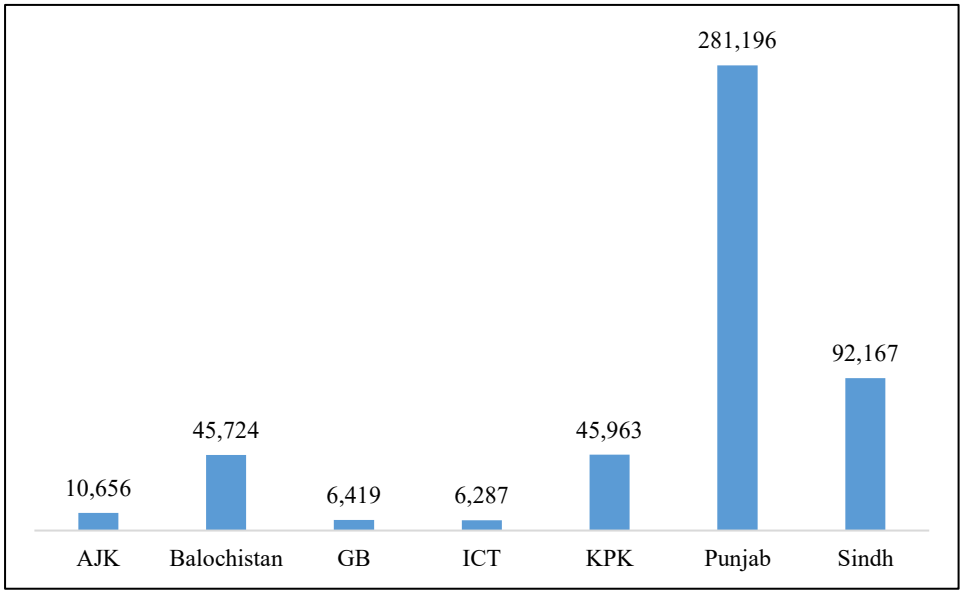
Table 1

Comparison of Road Transport Indicators: 1947 & 2021

Indicator	1947	2021
Registered Vehicles (Number)	30,577	30,968,000
Registered Trucks/Trailers (Number)	800	300,000+
Total Roads (km)	50,367	500,000
Motorways (km)	0	2500+
National Highways (km)	0	12,000
Road Density	0.06	0.58

Source: National Transport Research Centre (NTRC).

Fig. 1. Provincial Distribution of Roads (Km)



Source: National Transport Research Centre (NTRC).

While there is extensive literature on growth and transport infrastructure nexus for developed countries, the literature specific to Pakistan is limited and has never been reviewed to draw a conclusion. Similarly, the literature on logistics is scarce and fragmented focusing on individual modes of transport failing to provide a comprehensive overview. This paper aims to bridge this gap by providing a comprehensive overview. The systematic literature review aims to highlight the effect of logistics and transport infrastructure on growth, trade, tourism, locality, environment and of transport corridors on tourism and trade. It also discusses the issues pertaining to different modes of transport, their efficiency, governance and coherence to the national policies and international agreements thus presenting a comprehensive analysis of the what kind of infrastructure, hard or soft, Pakistan requires for development of its logistics and transport sector. The systematic literature review addresses the following research questions.

1.1. Research Questions

Q 1. What major themes have been explored by researchers in the logistics and transport sector of Pakistan?

Q 2. Which type of infrastructure, hard or soft, plays a more critical role in the development of logistics and transport sector of Pakistan?

The rest of the paper is structured as follows, the second sections outlines the methodology of the review, the third section discusses the themes highlighted by the included papers on the specific mode of transport and the fourth section concludes the discussion.

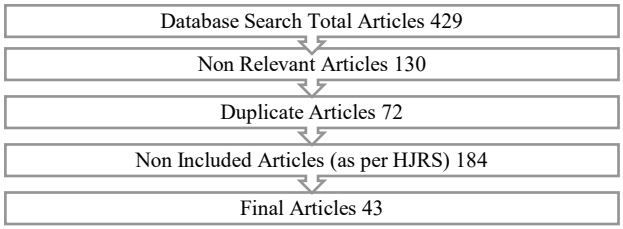
2. MATERIAL AND METHODS

The systematic literature review was conducted as per the protocols defined. In the first stage, the google scholar, jstor and SciSpace AI was used with key words such as "infrastructure and growth", "impact of", "investment", "railways", "aviation", "airline". "airport", "post office", "courier services", "ports", "dry ports", "transport corridors", "blue economy", "maritime" with "in Pakistan". The use of multiple databases helped to prevent the potential omission of relevant studies. Initially, 429 documents were retrieved from these data bases. The exploration was limited to the available on line journal articles from 2000 to date.

2.1. Inclusion Criteria

The available articles in the second phase were checked through the Higher Education Commission's HJRS. HJRS is a system to evaluate and rank academic journals. The HJRS categorises journals into three tiers: *W*, *X*, and *Y*, based on their quality and impact. The articles falling in these three categories were included in the review. Avoiding duplication, 43 articles were reviewed.

Fig. 2. Search and Retrieval Process



2.2. Study Flow

The data base identified 429 documents on the basis of title and key words. Out of these articles, upon reviewing the abstract 130 were dropped as they were non relevant to the discussion. Searching from different databases also resulted in 72 duplicates. These were then dropped. The final screening was done through HJRS. A total of 184 articles could not meet the inclusion criteria of HJRS. The remaining 43 articles were finally included for the review and were added in the database for analysis. These articles were then grouped with respect to the specific mode of transport. There are 3 articles on logistics, 18 articles on road transport, 6 articles on transport corridor, 9 articles were on railways, 3 articles were on air transport and 6 articles on the water transport. Further, within each mode, upon thorough review, the specific themes were identified, which are discussed below.

3. THEMATIC REVIEW

3.1. Logistics and Growth

The analysis of the impact of logistics on growth requires an indicator that tracks over all development of logistics and has a long time horison. Following logistics index of world bank Zunaira, et al. (2021) used the available indicators to construct a logistics index for Pakistan via principal component analysis. The variables included were gross domestic product factor cost at constant prices, number of employed persons, financial development proxied by M2 to gdp ratio and energy consumption. By utilising time series data from 1972 to 2018, the study found that logistics developments have a significant positive impact on economic growth in both the long run and the short run. The long run elasticity of growth was estimated to be 0.4 percent. The results suggest that collaborative efforts between China and Pakistan for logistics developments, such as those under CPEC, will strongly benefit economic growth in Pakistan. Long term CPEC plan has projects for investments in roads, railways, energy and information technology. However, the four ministries, ministry of port and shipping, ministry of communications, ministry of Pakistan railways and ministry of aviation that govern the logistics sector need to cooperate and coordinate to reap the benefits of CPEC investments. It is an opportunity for Pakistan railways to modernise its infrastructure and services and enhance its share in the transport for a sustainable development. The regional disparities observed in the road infrastructure can be overcome and less developed provinces will be able to improve their infrastructure also.

In another study by (Alam, et al. 2020) the road infrastructure (total road in km) had a positive impact (0.45 percent) on per capita GDP in the long run. Railway infrastructure (length of track km) also played a crucial role (2.233 percent) in per capita GDP. However, the air transport (number of flights take off) negatively correlated with the growth which may be due to substantial improvement in road infrastructure, which has reduced the cost of travel. Unidirectional causality was observed from transport infrastructure to economic development, emphasising on immediate expansion and upgradation of the transport infrastructure to enhance connectivity and an appropriate transport policy should be designed to enhance economic development of the country.

3.1.2 Investment in Logistics

Though the modern logistics industry comprises of transportation, warehousing, storage, planning, packaging, inventory handling etc, however based on the availability of data Hanif, et al. (2020) took transport, storage and postal services as the indicators of logistics. The investment in these indicators thereby represented the investment in modern logistics. The results indicate a unidirectional causality exists from economic growth to investment in logistics. The government need to formulate a policy to develop the modern logistics sector. The hard infrastructure interventions are needed in dry ports, cold chains, warehouses, and inland waterways. A comprehensive overhaul of the soft infrastructure and integration of technology is a must (Sumbal, et al.). This includes reforming the tax structure of logistics firm, a public information platform containing all the information of the logistics for different cities can help in reducing the costs. The logistics companies should adopt latest technology like GIS, RFID technology and bar codes to improve the efficiency of their operations. The on job trainings and relevant diplomas and degrees in the educational institutes can also assist in the modernising of the sector which can leverage its potential due to strategic location.

Table 2

Logistics Growth Nexus

Authors	Variable	Inference	Elasticity	Years
Zunaira, et al. 2021	LPI constructed from available data	Positive and significant relationship	LR 0.4 percent	1972 – 2019
Hanif, et al. 2020	Investment in logistics	One-sided causal relationship from economic growth to logistics industry development.		1990 – 2018
Alam, et al. 2020	Individual infrastructure	Road, rail positively affect GDP per capita. Air transport has a negative effect.	Road 0.45 percent Rail 2.33 percent	1971 –2017

3.2. Road Transport

In Pakistan, the transport modal shares are highly skewed towards roads. Roads are the predominant source of transportation in Pakistan accounting for more than 92 percent of passengers and 96 percent of freight. This imbalance has increased the cost of transportation through congestion, pollution, and expenditure on the maintenance of roads. The transport sector contributes around 10.7 percent to the GDP of Pakistan and employs more than 5.8 percent of the labour force.

3.2.1. Transport Policy

In Pakistan, despite having a wide railway network at the time of independence, there has always been a fixation on building roads at the expense of other modes of transport and logistics. In the Second Five-Year Plan (1960–65), the allocation of financial resources prioritised roads over railways, and the larger cities witnessed an immense expansion of road networks. This was the initial critical juncture that set the path for the future transport policy (Imran & Low, 2007). Resultantly, the emphasis of the policymakers remained on the hardware of the country, especially on roads. The road investment policy did not originate from any industrial development policy, but the heavy investment in roads left no money for the public transport system (Imran & Low, 2007).

The detailed path dependency analysis of the transport policy further revealed that transport decision-making in Pakistan remains highly centralised with nine federal ministries and twenty-two departments directly or indirectly involved it (Imran & Low, 2007). In addition, the policy making has been influenced heavily by international financial institutions. This has led to a dependence on Western development models, which are unsustainable on a global scale. To promote sustainable transport, international bodies and the federal government need to commit to diverse development paths and capacity-building. Pakistan's transport planning is locked into outdated methods of forecasting such as "grow, guess and gain" by the government. The idea of anticipated growth led to the complementary requirement of road infrastructure and ultimately resulted in growth in roads without any economic growth. The "decide and provide," was from the international donors which made the sector technically rigid. The long-term stability of Pakistan's road development paradigm is reinforced by economic and environmental narratives of infrastructure and growth, infrastructure and poverty

eradication and motorisation and economic development that emphasise the necessity of extensive road infrastructure for economic growth and sustainability.

3.2.2. Road Infrastructure and Growth

The relationship between infrastructure investments and economic growth varies across countries and sectors, with infrastructure development creating an investment-conducive environment for private investors. These differences can also be attributed to the differences in the dependent variable, statistical technique and time of analysis. However, these dynamics need to be understood for effective policy making and sustainable planning in the country. The subject was taken up by the researchers for further analysis with substantial investments by the government in projects like Khushal Pakistan Programme" in 1996 and 2007, "National Trade Corridor Improvement Programme"(NTCIP) in 2005, "National Development Plan" (NDP) over 2000–2006 "National Highway Improvement Programme" (NHIP) in 2007, and "China Pakistan Economic Corridor" (CPEC) in 2013 onwards although the subject was under scrutiny post-World War II, with governments investing to create a conducive environment for the private sector.

(Javed, 2019) estimated a significant impact of investment in infrastructure on growth, however, the impact of aggregate infrastructure investment on the aggregate and sub-sectors of the economy shows very different estimates in terms of magnitude. When the total investment in infrastructure is disaggregated into the public, and private sector, positive and statistically significant effects are obtained in the case of public sector infrastructure investment for the aggregate, as well as for sub-sectors of the economy. In the case of private infrastructure investment, statistically significant and positive estimates are obtained for industrial and agricultural sectors. Both public and private infrastructure investments contribute to economic growth in Pakistan. However, public infrastructure investment seems to play a much more important role in the industrial sector, while the private infrastructure investment role is more significant in the agriculture sector. The elasticity of roads and telecommunications investment is higher in the industry (0.22) than in agriculture (0.14), and in the service sector is (0.03). The sectoral analysis reveals that investment in roads, and telecommunication networks is highly crucial for the industrial sector in Pakistan. Similar results were obtained by Sharif (2021), any increment in the length of the road leads to substantial growth of 1.45 and 2.56 in case of johansen cointegartion and Dynamic Ordinary Least Square respectively. (Danish and Baloch, 2017) estimated the long run road infrastructure growth elasticity to be around 24.4 percent.

Developing countries face challenges sustaining infrastructure investment due to rising costs, leading to project closures, especially in energy and water sectors. Governments are exploring alternative financing methods like public-private partnerships and build-operate-own models, but legal and regulatory frameworks for such transactions are lacking in many developing nations. Vaqar (2013) analysed planning commission framework for growth that envisaged the increase in public sector infrastructure investment to GDP ratio by 4 percent. The increase in investment could either be financed by international borrowing or production tax. The computable general equilibrium model revealed that public infrastructure investments, whether funded by taxation or international borrowing, have similar impacts on growth. In the long run real GDP grows by 1.01 percent and 1.29 percent under tax and international financing, respectively. In the short run, the tax financing reduces the industrial output straining growth, while exports decline in international financing creating a dutch disease like impact. In contrast

Siddiqui (2005) using a CGE framework reported an increase of 0.05 percent in the output in case of tax financed increase in public transport investment in the short run. In the long run the cost of intermediate inputs would decline as the price of transport decreases, leading to a decline in industrial output by 0.04 percent as compare to the business as usual scenario.

On the other hand, Sabir & Shamshir (2020) indicated that the overinvestment in roads has resulted in the negative impact of the length of highways on per capita GDP (0.231). The substantial maintenance of the highways could be another factor hindering the growth. Moreover, the transport index consisting of length of road, freight carried by railways and freight carried by air ways, was found to have no impact on per capita GDP indicating that there is a need to improve other sectors of economic infrastructure i.e. communication and energy along with roads to boost short run and long run growth. A further disintegrated national and provincial analysis also revealed no causality between economic growth and length of the roads in the short run (Mohmand, et al. 2017). The infrastructure projects are usually long run and may not have any immediate impact. In the long run for the growth to be sustainable, increase in the length of the roads is required to complement increasing economic activities as observed by a unidirectional causality from growth to road infrastructure at the national level. At provincial level, a bidirectional causality was observed in Punjab and Sindh, and a unidirectional causality from growth to infrastructure development was observed in KPK. The less developed province thus need targeted policies to stimulate economic growth and boost infrastructural development. No causality was observed in case of Baluchistan. Neither economic growth has any effect on length of the roads and neither road infrastructure effect the growth of the province. If the effect of highways on the growth is insignificant, there has to be targeted approach to investment in infrastructure to maximise economic benefits. Imran & Niazi (2011) found the investment in electricity generation, agricultural water availability, and telecommunications to be more growth inducing. A composite economic infrastructure index comprising of energy, telecommunications and transport variables was found to have profound impact (1.14 percent) on economic growth in long run. Thus, the public sector development programme allocation to highways need to be diverted to communications with a caution that the specific infrastructure requirement of the communication sector needs to be unbundled through research.

3.2.3. Quality of Infrastructure

The debate on the road infrastructure and growth remains inconclusive. Probably the question is not the amount of investment spent on transport infrastructure, it's how efficiently it is used or the quality of infrastructure. In Pakistan almost 60 percent of the road infrastructure is in dire need of repair because of over loading, shifting of freight and passengers form rail to road. The inadequacy of infrastructure is a major bottleneck to the growth of businesses and economic development. Saleem, et al. (2022) constructed an index of infrastructure quality using four variables paved roads, non-diesel locomotives, the energy produced from alternative energy resources and transmission and distribution losses. Infrastructure quality had a favorable and considerable impact on GDP growth. Its coefficient shows that a 1 percent increase in infrastructure quality boosts GDP growth by 0.15 percent, ceteris paribus. This calls for focus on the quality of existing road infrastructure rather than initiating new economically unviable projects for political gains. Road investments are primarily funded through the annual budget allocation, which has historically proven insufficient for timely and necessary road capacity expansion. Many new projects are launched for political gain, and roads are often left deliberately weak and

prone to rapid deterioration to facilitate repeated contract awards. Additionally, there appears to be a lack of accountability in infrastructure expenditure. To address these issues, a significant overhaul of the bureaucratic processes is needed to ensure better use of the allocated budget for enhancing infrastructure quality in Pakistan.

Table 3

Road Transport and Growth Nexus

Authors	Variable	Inference	Elasticity	Years
Saleem, et al. 2022	Infrastructure Index	Positive and significant impact on GDP growth.	(0.15)	(1975–2018)
Javid, 2019	Investment in roads and telecom	Investment in roads, and telecommunication networks is highly crucial for the industrial sector in Pakistan	Whole economy (0.12) Industry 0.22 Agriculture 0.14 Services 0.03	(1972–2015)
Sharif & Tauqir, 2021	Road length km	Positive and significant	(1.45)	(1972–2017)
Sabir & Shamshir 2020	Road length km	Negative impact in long run	− 0.231	(1971–2014)
Tariq, et al. 2017	Road length km	Economic growth causes infrastructure development at national level and for KPK. For Punjab and Sindh, the bidirectional causality between the two variables exists	National 0.91 KPK 0.86 Punjab 1.2, 0.72 Sindh 0.22, 0.31	(1982–2010)
Imran & Niazi , 2011	Growth rate of length of roads	Insignificant relationship		(1072-2008)
Vaqar, et al. 2013	Public infrastructure investment-to-GDP ratio.	Real GDP grows by 1.01 percent and 1.29 percent under tax and international financing		(2007-08)
Farooq, et al 2022	Density of roads	Insignificant relationship		(1985-2018)
Rizwana & Siddiui, 2005	Tax financed investment in transport infrastructure		BAU output increases by 9 percent ii) SR (one year) 0.04 LR 9,2 percent	

3.2.4. Industrial Output

The transport infrastructure plays a vital role in industrial development as it brings efficiencies in the industrial sector particularly in the early phases on industrialisation. Land and water transport played a significant role in growth of China, while other Asian countries consider investment in transport infrastructure crucial to achieve efficiency in production and distribution channels or supply chains. The efficient upstream and downstream supply chain saves time and reduces the prices paid by the consumers. Ahmed, et al. (2021) analysed the role of all modes of transport in Pakistan in industrial

output. The results demonstrate that infrastructure development related to roads and ports has a positive and statistically significant effect on the industrial value added in Pakistan. Specifically, long-run elasticities indicate that a 1 percent increase in port and road infrastructure leads to a 0.36 percent and 0.28 percent increase in industrial value added, respectively. Conversely, railways exert a negative and statistically significant impact on industrial value added. Additionally, airways do not constitute a significant factor for industrial value added. The short-run analysis reveals that the impact of ports and roads, while modest, remains statistically significant. Thus the investment in roads and ports infrastructure is indispensable for export competitiveness and economic growth. The forecasts for 2027 indicate that 37.1 percent of the value addition will be attributed to the improvement in railways. The airways constitute a small portion in the entire transport logistics, thus its impact is negligible. However, improving the travel time for passenger and cargo both on domestic and international routes and open sky policies will improve the share of this sector. Overall, a reform of regulatory regimes aimed at enhancing efficiency and productivity is a must for sustainable industrial development in Pakistan. Siddiqui (2005) also reported an increase of 0.02 percent in the value addition in the long run as a result of tax financed public investment in transport infrastructure.

3.2.5. Trade

Exports increase in the short run as well as in the long run by 0.11 and 0.06 percent over their respective business as usual values if infrastructure is financed by taxes. A rise in export of all commodities can be observed except food and textile, which decline marginally. The demand for investment goods; cement, wood, and other manufacturing rises in the long run by 2.7, 11.4, and 1,1 percent respectively. Imports of mining commodities (a major input in petroleum sector) and petroleum (major input in transport services) increases significantly in the long run (Siddique, 2005).

3.2.6. Land Development, Prices

The impact of road infrastructure on property values has been the subject of intense debate for over a century. Numerous studies have explored the relationship between transport infrastructure and property values, with a significant portion of the empirical research originating from developed countries. However, in rapidly growing cities of developing countries, as Tian (2006) notes, there is a consistently high demand for road infrastructure investment, which often results in increased land prices but remains unmet.

Regarding the impact of the M-9 motorway construction on land development in Bahria Town, Karachi (BTK), the findings of this study highlight several key points. Firstly, it is evident that the construction of the M-9 Motorway significantly influences the pace of land development in BTK, with 58 percent of respondents acknowledging this connection. Additionally, a substantial majority (78 percent) attribute the accelerated pace of development to the motorway's construction, while a smaller proportion (20 percent) believe that the motorway has bolstered investor confidence, leading to increased investment and subsequent land development. In terms of correlation, a weak positive relationship is observed between the pace of land development and the construction of the M-9 Motorway ($r = .259$), as well as between the motorway construction and investor confidence in BTK ($r = .077$). These outcomes collectively suggest that while the M-9 Motorway construction has contributed to a high pace of land development, it has not led to a significant difference in the overall land development. Moreover, there is no significant difference in the pace of development in BTK before and after the construction of the M-9 Motorway.

In the case study of bahria town Karachi and M 9, the majority of individuals (72 percent) reported observing changes in residential prices and rents due to the construction of the M-9 Motorway. Among the surveyed participants, 46 percent indicated that prices were higher prior to the M-9 Motorway construction, while 60 percent stated that prices had increased following the construction. The results indicate a weak positive correlation between the marketing of BTK and house prices and rents after the completion of the M-9 Motorway construction.

3.2.7. Transport Strike

In developing countries, public transport strikes can cause severe disruptions due to the high demand for public transport, lack of alternatives, and inadequate law enforcement. These strikes can impact various sectors of the economy due to their interconnected nature. The financial sector is the most effected by the transport strike (Ali, et al. 2020). Financial intermediation includes institutions like the State Bank of Pakistan, commercial banks (such as United Bank Limited, Habib Bank Limited, National Bank Limited), money market funds, insurance businesses, and pension funds. Then comes the food and beverages sector which also shows high inoperability values, primarily due to the reliance on edible oil, a major component of Pakistani cuisine. Transport strikes disrupting the supply of edible oil significantly impact this sector. The petroleum, chemical, and non-metallic mineral products sector is the third most affected, as petroleum products are mainly transported via road. The strike, involving over 25,000 oil tankers, severely disrupted the supply of these products. In 2012, 65 percent of Pakistan's electricity was generated using furnace oil and diesel, both transported by road. The strike influenced the supply of these fuels, thereby affecting electricity generation. This is reflected in the electricity and machinery sector being among the top 10 most affected sectors. Public administration, education, health, and related services also faced significant disruptions due to the strike, which led to law and order issues, commute disruptions, and even violence. The negative impacts on wholesale and related trade sectors were also observed as the edible oil producers suspended production due to overstocking. This also reduced the demand for agricultural inputs.

3.2.8. Environment

The infrastructure development, particularly of road length, positively impacts economic growth, while carbon emissions, mainly from transportation, electricity and manufacturing have a negative effect on economic growth in Pakistan (Sharif, 2021). The coefficient size of CO2 emissions from the transportation sector is small, indicating that a 1 percent increase in these emissions results in a 0.004 percent decrease in Economic growth. Overall, investing in road infrastructure is essential for Pakistan's economic growth, but sustainable practices must be considered to mitigate environmental consequences. The expansion of road infrastructure has a substantial effect on CO_2 emissions from the transport sector over time in Pakistan (Rasool, et al 2019). As the road infrastructure expands, the energy consumption in transport sector rises due to increase in the vehicles on road. Since the transport sector consumes half of the imported fossil fuel, it creates heavy financial burden on the economy. (Danish & Baloch, 2017) also observed that expansion in road infrastructure increases SO_2 emissions, thus road infrastructure has a significant impact on emissions. It is a good opportunity to have a clean transport policy by prioritising the use of electric vehicles and efficient public transport. In contrast (Siddiqui, 2005) reported a decline in the air pollution due to decline in the transport

demand and transport capital in the long run by 2.05 percent as the public investment in transport infrastructure increases.

The road freight transportation is the most polluting mode (Shaoukat & Xiaoqiang, 2023). If equal distances are traveled by each mode, road, rail, and sea transportation account for 62 percent, 23 percent, and 15 percent of emissions, respectively. Considering intermodal freight transportation, road and sea freight contribute 33 percent and 67 percent of emissions. When distances are equal, road freight accounts for 81 percent and sea freight 19 percent (Shaoukat & Xiaoqiang, 2023). Transport systems should use more environment friendly modes of transport.

3.2.9. Tourism

Transport infrastructure is a crucial element of tourism development. Enhanced road and transport infrastructure not only reduces travel time and costs (Kanwal, et al 2019) but also positively impacts tourism activities. This study explored the impact of road and transportation infrastructure on community support for tourism along the CPEC route in Pakistan. Results from a survey of 350 people show a positive relationship between perceived positive impact of CPEC infrastructure and community support for tourism. The community satisfaction played a mediating role because of the positive media reports. The community support can be leveraged in KPK and GB to support tourism for wider benefits.

3.2.10. Employment

Road Infrastructure generates employment both directly and indirectly. In fact, this infrastructure contributes to three types of employment. Direct jobs: these are created by public spending on the projects, indirect jobs: these are created by the suppliers of the material needed for the infrastructure and induced jobs: which are generated by the spending of the income generated by the multiplier effect of the public spending. Nawaz, et al. (2021) analysed the road–employment nexus integrating the institutional quality through an index in the nexus using a district level panel data. The results indicate that road infrastructure has a positive and significant impact on employment, suggesting that the development of road networks directly boosts employment in the 111 respective districts. Thus, districts with better road infrastructure tend to generate higher employment. Further analysis reveals that when road infrastructure is coupled with high-quality institutions, the impact on employment is both positive and significant. Similarly, the interaction between road infrastructure and RCI (access to the metallic road within one km range) also shows a positive and significant effect on employment, indicating that complementary factors are crucial in maximising the benefits of road infrastructure. Using spatial analysis, Nawaz, et al. (2021) reported that the direct and indirect elasticities of road infrastructure. The direct elasticity (0.39) and the indirect elasticity of infrastructure (0.04) is both positive and statistically significant. Additionally, road infrastructure exhibits a positive and significant spillover effect. A 10 percent increase in road infrastructure in neighboring districts would lead to a 0.4 percent increase in employment in a particular district. While the RCI has a positive and significant direct effect on employment, its indirect effect is not significant, indicating that rural connectivity plays a more pivotal role within the district itself rather than in neighboring districts. Furthermore, the interaction terms reveal that IQI and RCI enhance both the direct and indirect impacts of road infrastructure on employment, confirming the importance of complementary factors in shaping the effects of economic corridors. In addition to expanding main highways and motorways, the government should prioritise improving

local roads, particularly those connecting rural areas to central hubs. Enhancing rural connectivity is crucial for linking local labour with services, such as hospitality along highways and motorways. Furthermore, developing local roads is vital for connecting rural industries, especially agriculture, with major industries in megacities (Nawaz, et al 2021).

3.2.11. Transport Corridors and Growth

Key projects in CPEC include railway networks, roads, airports, energy units, and high-speed trains. Economically, CPEC is expected to boost GDP growth, improve GNP, and increase foreign direct investment, with free economic zones and industrial parks aimed at alleviating poverty and promoting technological growth and innovation. The OBOR initiative includes investments of $34 billion in the energy sector and $12 billion for transportation and infrastructure, aiming to produce 21,000 MGW of electric power and create 2,000,000 jobs. However, the awareness about CPEC was limited in the initial years (Menhas, et al. 2019). A survey of 500 respondents revealed that 14.0 percent of respondents knew CPEC as an economic project, 22.2 percent as an energy project, and 26.2 percent as an infrastructure development project. Majority of respondents received information about CPEC from electronic media, discussions, and political parties. Another Survey of 384 respondents yielded positive effect of CPEC on economic security, energy security, regional trade and integration (Javed & Ismail, 2021). Pakistan's economic growth is expected to accelerate, with Baluchistan being a key beneficiary (Khetran & Saeed, 2017).

There are wider economic benefits of transport corridors on macro-economic variables. (Melecky, et al 2018) conducted an appraisal of the CPEC using completed Gloden Quadilateral highway in India as the benchmark. The impact of the China-Pakistan Economic Corridor (CPEC) on household expenditure depends on land market conditions, output market conditions, and access to banking. Districts with more cropland may see a smaller benefit due to difficulties in reallocating land for industrial and service uses. In contrast, districts with more privately owned firms are likely to experience a greater positive impact due to increased market competition. The impact on poverty reduction was most significant in areas with a high proportion of agro-processing firms. This is likely because these regions already employed many low-skilled workers in the agro-processing industry, which stands to gain from improved market access. These workers can benefit from better job opportunities within the same sector without needing new skills or changing jobs, and even agricultural workers may see benefits from the local agro-industry's growth. The impacts of labour market changes due to CPEC varies across districts. Districts with more cropland, like Thatta and Attock, are expected to see less change in female non-farm employment, likely due to land constraints limiting women's access to new market opportunities. In contrast, districts with higher education levels, such as Rawalpindi, are predicted to experience a greater increase in female non-farm employment, as education correlates with better opportunities in non-farm sectors. CPEC is generally expected to increase air pollution, but the impact varies by district. Districts with higher education levels might experience a smaller rise in pollution, as educated populations are more likely to adopt cleaner, though more expensive, vehicles. Additionally, districts with higher secondary school completion rates may shift towards non-farm jobs, reducing pollution from activities like straw burning on farms, a significant source of pollution in South Asia.

CPEC is seen as a transformative project for the region, benefiting not only Pakistan and China but also the Middle East, Europe, and landlocked Central Asian

countries such as Tajikistan, Turkmenistan, Kazakhstan, Kyrgyzstan, and Afghanistan by providing them with the shortest seaway access to the Gwadar port (Alam, et al. 2019). The CPEC route will save China approximately $71 billion in shipping costs for imports and exports from Europe and the Middle East. Specifically, China will save about $1,450 per container traded with the Middle East and $1,350 per container from Europe. Additionally, travel time will be reduced by about 21 days for trade with Europe and by 21 to 24 days for trade with the Middle East. The total distance from Kashgar (Western China) to these destinations will be shortened by about 11,000 to 13,000 kilometers (Alam, et al. 2019). The completion of CPEC is expected to decrease the travel distance by 50 - 85 percent for the 33 percent of China current container traffic directed towards Europe, middle east and Africa (Masood, et al. 2016). The expected potential is of 70,000 to 10,000 containers annually.

Despite this potential, the transport sector is facing multiple challenges like old truck fleet, the speed is half of that in Europe, the freight takes 3-4 days longer than international standards. The railways productivity is 1/8 of Chinese, and 1/3 of Indian railways and ½ of Thai railways. Port charges are still above the international standard and are not competitive. The container dwell time is still 5 -6 days which is higher than the international average of 3-5 days.

3.3. Railways

Up until the 1960s, rail transport was expanding and there was considerable focus on developing the rail infrastructure in the country. Several policies and plans were initiated to this effect. After the second five-year plan, investment in rail infrastructure declined in favor of road infrastructure, which had an overall negative impact on the rail network as well as Pakistan Railways. At present, Pakistan Railways is the sole entity responsible for freight and passenger traffic through the rail network and has 650 stations, 461 locomotives and a route length of 7,791 km (2023). Freight and passenger revenues have been declining for PR, which has had an impact on the gross earnings of the entity.

3.3.1. Efficiency

Extensive research on efficiency of railways is conducted in the developed countries, however, for there is dearth of literature for developing countries. (Alam, et al. 2020) analysed the overall technical, pure technical, and scale efficiencies of Pakistan's railway industry from 1950 to 2016. The average technical efficiency of Pakistan Railways is 86.8 percent, implying that inputs could be decreased by a 13.2 percent if railways was efficient. Interestingly, only five years i.e. 1975-80, 1985-90, 2006-07, 2007-08, 2008-09 were technically efficient with a score of 1. The year 1975-80 was super-efficient. For 17 years it was locally efficient, the inappropriate scale size caused local inefficient. The slack analysis revealed the necessary adjustment in the input and output required to achieve overall technical efficiency. For example, in 1960-65 an increase in output (Passenger-kilometers) by 7,562 and reduction in inputs (locomotives owned, freight wagons, and coaching vehicles) by 120, 526, and 263, respectively was required. The observed technical inefficiency in Pakistan Railways stems from both managerial inefficiency (poor input utilisation) and a failure to operate at the most productive scale (scale inefficiency). Thus, the Pakistan railway is more successful in choosing optimal levels of output than adopting best practice technology (Alam, et al 2020). These are internal factors through which efficiency could be achieved, the GDP, highway and trade are the external factors that affect efficiency of railways. The increase in GDP and trade increases while the increase in highways decrease efficiency as they are

substitute to railways. Labour, being one of the largest inputs, must be reconsidered. As the Pakistan Railways is overstaffed now, downsising and rightsising will also help improve its efficiency (Alam, et al. 2020).

A similar result was obtained by the (Tayeh, et al. 2023) which indicated that to achieve overall technical efficiency, Pakistan Railway must reduce the number of employed persons by 4,600 under constant returns to scale (CRS) decrease by 3,670 under variable returns to scale. Under CPEC, as the major upgradation of aging railways will take place, the railways should focus on the improvement in the freight ton-kilometers (257, 188) and substantially reduce the passenger transport vehicles (3293, 3378) to achieve efficiency. There railways were inefficient under the entire period of analysis (1977–2018). The overall technical efficiency (89.8 percent) was slightly better than (Alam, et al. 2020) implying a reduction in the employees and passenger transport vehicles by inputs by 10.1 percent. The policy recommendation is to leverage the potential of freight via CPEC and reduce the politically motivated running of loss-making passenger transport vehicles.

(Tahir, 2013) had indicated a reduction of 12 percent in employees, 10 percent of routes, 29 percent of fixed assets, 13 percent of locomotives and 15 percent of passenger and 21 percent of freight coaches to achieve efficiency after a similar analysis. The efficiency was estimated in terms of financial, operational and earning efficiency. The1994-95 was the sole overall efficient year. PR has been financially inefficient since 2004-05. It was product efficient in only 5 out of 17 years, specifically in 1998-99, 2006-07, 2007-08, 2008-09, and 2009-10. Pakistan railways is the most operationally inefficient when compared with India and China with lowest production and financial efficiency. The significant political interference and hiring has diminished autonomy and reduced the technical capacity resulting in “never on time dirty trains” image. The elite capture has struck this sector also, where perks and privileges are for the upper ranks only. Governance reforms is the need of the hour to ensure productive efficiency and operational autonomy so freight potential can be leveraged with public private partnership.

3.3.2. Passenger Demand

A comprehensive analysis of rail travel demand dynamics, influencing factors, and the impact of market shocks is crucial for any policymaking in the transportation sector. This information can assist in strategic decisions related to fare pricing, modal shift strategies, and resilience planning in the face of market uncertainties. Khan & Khan (2021) identified that GDP per capita, fare, route density and fuel prices are the main influencing factors for two models of rail travel demand: rail passengers and rail passenger-kilometers. Notably, the long-run fare elasticities of passenger (0.474) and passenger-kilometer (0.278) demand is inelastic. There is a clear margin for increased passenger revenue for Pakistan railways without any decrease in rail demand. The authorities can also maximise passenger revues by increasing the traffic first and then increasing the fares. Also, higher road transport costs (estimated through fuel price) could shift demand in favor of rail as the cross-price elasticity of rail travel demand relative to road passenger travel costs is positive. Through this mechanism, PR can regain its modal share. The increase in railways route density decreases the average operating cost making it more efficient as compared to roads, thus further investment in railways infrastructure is advised based on the highly elastic rail demand. The impact of various market shocks, such as terrorist attacks and shortages of fuel and rolling stock reduced rail travel demand

by 16 percent for passengers and 12 percent for rail passenger-kilometers between 2010 and 2014.

Railways is expected to become the best alternative post-CPEC investment due to significant improvements in travel speed and time on the ML-1 line, making rail travel more competitive with buses and airlines. The best route identified for the ML-1 upgrade is Route 3, which connects Karachi to Peshawar via Hyderabad, Nawab Shah, Sukkur, Rahim Yar Khan, Khanpur, Bahawalpur, Multan, DI Khan, Mianwali, Jand, Basal, Taxila, Attock, Nowshehra, and Peshawar. This route is preferred because it is safer, shorter, reduces repair and maintenance costs, and covers about 38 million people, making it the most attractive option for Pakistan Railways (Ali & Sabir, 2022).

3.3.3. Freight Demand

Empirically derived elasticity estimates are valuable for policymakers, transport planners, public agencies, and transport operators, helping them assess policy options for future rail freight transport growth, modal shifts, or emissions reductions. An accurate empirical rail freight transport demand model is crucial for policy decisions regarding price regulations, subsidies, and taxes. (Khan & Khan, 2020) examined the relationship between aggregate rail freight demand in Pakistan and economic activity, freight rates, international trade, and fuel prices, using time series data from 1972 to 2017. The freight rate demand elasticities are inelastic (-0.28, -0.39), indicating possibility of increase in freight revenue collection to offset the deficits or to buy freight wagons and locomotives. The increasing road fuel taxes, especially on high-speed diesel, could promote a modal shift in favor of rail freight as the long run cross price elasticity is positive. These suggestions can help achieve the vision 2025 for railways that calls for the modal share to be 20 percent in 2025.

3.3.4. Environment

Transportation is the second-largest energy-consuming sector in Pakistan, with 97 percent of its energy derived from fossil fuels, and nearly 28 percent of this energy is used by transportation. From 1991 to 2014, CO2 emissions from energy consumption in Pakistan increased from 68,242 kilotons to 166,298 kilotons. Currently, carbon emissions are growing at a rate of 6 percent per year and are projected to reach 400 megatons of CO2 equivalent annually by 2030 if the current trends continue (Sohail, et al 2023). Railways is considered the most environment friendly mode of transport yet (Sohail, et al. 2021) found that a 1 percent increase in air passengers carried (railway passengers carried) raises environmental pollution by 0.21 percent (0.32 percent) in the long run. Furthermore, while a positive shock in railway passengers carried increases environmental pollution, a negative shock in railway passengers carried decreases environmental pollution in the short run. The government hence need to introduce green transport systems, raise awareness about green logistics, green supply chains, green transportation, adopt pollution free engines, adopt efficient fuel substitution policy and digital economy for sustainable environment. In 2018–2019, truck-based freight transportation emitted an estimated 4.38 million tonnes of CO2. If 50 percent of freight transport to railways over the next 10 years, this shift could reduce CO2 emissions by about 3 million tonnes (43 percent) by 2028-2029 (Ahmed, et al. 2022).

Another viable option could be to shift the transport sector from fossil to renewable resources like solar energy. Pakistan benefits from an average annual solar insolation of 200-250 W/m², higher than the global average of 184 W/m². While grid electricity for charging an electric bike in Pakistan appears more economical (Rs 0.91/km), it faces

significant issues due to frequent power outages. In contrast, solar charging, despite the initial setup costs, offers a sustainable and cost-effective solution in the long run, with a zero running cost per kilometer after installation (Jaffery, et al. 2017). However, the bikes don't have sufficient area for onboard charging and the rolling resistance of pneumatic tires decrease the overall efficiency of the electric bikes. However, these limitations are nonexistent in railways. Thus solar powered railway vehicles, in the urban centers of major cities seems more viable to address congestion. The specially designed tracks for solar trains, optimised carriage designs for larger surface areas and reduced drag, fixed charging units at stations, and dedicated tracks for regenerative braking and low energy use makes it workable to have solar powered railways.

3.4. Air Transport

Pakistan has a total of 46 airports for conducting commercial operations. Out of these airports, 42, including 10 international, are owned and operated by the Pakistan Civil Aviation Authority (CAA) (2018). At present, out of these 42 airports, 13 are being used for both international and domestic operations, whereas 11 are only for domestic operations, and the remaining 22 are either scaled down or closed for operations due to various reasons (2018). Air transport is another avenue where Pakistan faces challenges, especially when it comes to its airports. Pakistan has consistently failed to perform well against its regional competitors in terms of airport usage and volume of passengers and freight catered to by the airports (Batool, et al. 2018).

3.4.1. Air Transport and Growth

In South Asia, given the low income and large populations, changes in the relatively small aviation sector do not significantly impact the large GDPs of these countries. (Habib & Merkert, 2006) found a causal relationship where economic growth leads to increases in both air passenger traffic and air freight volumes. Specifically, GDP growth affects air passenger traffic and air freight volumes with time lags of three and four years, respectively. When national income rises, the demand for air transport services also increases in Asian countries. This results in more goods and services being exported and imported, which further boosts the country's national income. Increased individual income would encourage people to use air-trans-port for travel within and out of the country. In technical terms, this bi-causality may be termed as "air-transport accelerator effect" (Mehmood, et al. 2015).

3.4.2. Airports Efficiency

(Ennen & Batool, 2018) analysed the cost efficiency of the 12 airports of Pakistan. All airports with a single runway and no parallel taxiway are cost-efficient, essential for managing airplane traffic effectively. However, the runway systems at Faisalabad and Sukkur are cost-inefficient, suggesting their taxiways are not fully needed at current traffic levels. Lahore's inefficiency is partly due to having a large runway system similar to Karachi's but serving 40 percent fewer aircraft movements. Economies of scale in runway operations are evident at all airports except Karachi. Karachi, the largest airport with 6 million passengers in 2011-12, is scale-efficient. Lahore, with 3.7 million passengers, operates close to scale efficiency with a score of 0.85. Smaller airports like Faisalabad, Rahim Yar Khan, & Turbat show pronounced scale inefficiencies due to low runway utilisation. Economies of scale are observed at airports handling up to 350,000 passengers annually. Bahawalpur, Rahim Yar Khan, and Turbat, each with fewer than 100,000 passengers per year, show the largest scale inefficiencies. This is partly because

smaller airports need larger peak hour terminal capacity due to airlines' preference for operating larger aircraft, causing demand fluctuations throughout the day. Consequently, at the smallest airports, terminal capacity is only utilised a few times daily, leading to low average utilisation. The staff model results show that cost efficiency is determined by technical efficiency. Faisalabad, Peshawar, Rahim Yar Khan, and especially Quetta airports exhibit high technical inefficiencies, primarily due to overstaffing relative to their traffic levels. In contrast, Sialkot (private) and Karachi, Multan, and Turbat (public) airports have efficient staffing levels. Economies of scale in employee activities are limited, with only very small airports (fewer than 150,000 passengers per year) showing increasing economies of scale.

3.5. Maritime / Blue Economy

Pakistan has a 1050 km long coastline along which 8 seaports are operating. Among these, more than 95 percent of maritime trade is carried out by the ports at Karachi, Qasim and Gwadar (Alam, 2020. It plays a vital role in Pakistan's economic growth but faces challenges such as lack of institutional capacity, poor governance, and insufficient investment as discussed below.

3.5.1. Blue Economy

Pakistan can transform its huge maritime area into the region's hub for the blue economy. It can link the West and Central Asia, the West and the Muslim world, and the USA and China. (Jehan, Kasi, & Qadir, 2019).

According to the United Nations Convention on Trade and Development (UNCTAD), Pakistan's annual goods bill ranges between US$4 to US$5 billion, which exacerbates the country's balance of payments issues. To reduce these costs, Pakistan should increase the number of Pakistan-flagged vessels. Expanding the fleet would not only boost the shipping sector and maritime trade but also create more jobs for seafarers, thereby accelerating the growth of the blue economy. Currently, Pakistan operates a fleet of 13 ships-five cargo ships and eight oil tankers. However, older cargo ships are restricted from European waters, limiting their routes to the west coasts of South America and Africa. The oil tankers handle around 35 percent of Pakistan's oil imports. The Maritime experts emphasise the importance of every nation having its fleet, yet Pakistan remains heavily dependent on foreign shipping companies, paying billions annually for overseas cargo transport, which only covers about 10 percent of its shipping needs. Bangladesh has doubled its fleet from 40 to 80 ships, and India owns 1,000 flag carriers (Alam & Azam, 2023). (Aslam, et al. 2023) found the overall quantitative coherence index score of 2.1 indicates poor governance in the shipping sector. MARPOL and UNCLOS scored 3.74 and 3.26, respectively, while national and provincial governance frameworks scored between 1.24 and 2.63, reflecting weak coherence. The MMP 2019 and its amendments focus solely on shipping management within Pakistan, and the Merchant Shipping Ordinance (MSO) 2001, which guides government handling of shipping issues, received a low score of 2.08, highlighting its limited effectiveness.

Pakistan is one of the leading nations in shipbreaking, a labour-intensive industry that thrives due to the country's favorable environmental conditions. The industry, centered at Gadani, once the world's second-largest shipbreaking site, provides raw materials, especially steel, for various sectors and directly employs around 20,000 people. However, the industry has declined significantly due to financial instability, inconsistent tax policies, and failure to adhere to international conventions like the Hong Kong Convention (HKC) and Basel Convention, which India and Bangladesh are already

recognising, giving them an edge over Pakistan (Alam & Azam, 2023). The inadequate policies for local entrepreneurship and economic diversification were reflected in the lowest coherence score of 1.24 for socio-economic well-being (Aslam, et al. 2023). Despite its challenges, the shipbreaking industry is crucial for Pakistan's blue economy, supplying raw materials to about 70 sub-industries, including construction and manufacturing. The steel produced at Gadani is vital for construction and the cottage industries in cities like Gujranwala and Sialkot, contributing significantly to the country's foreign exchange.

The fishing industry, valued at $1.2 billion, employs around 1.8 million people and significantly contributes to exports. The demand for seafood is rising, with industry growth expected to increase by 50 percent in the next 15 years. However, poor management has led to an 80 percent decline in fish populations. Pakistan, earning $450 million annually from fish exports, faces periodic EU bans due to outdated and unhygienic practices. Overfishing is evident with 28,000 fishing boats, far exceeding the sustainable limit of 7,000-8,000. There is potential to double fish exports to $1 billion, but this requires expert collabouration and addressing issues like using juvenile fish for chicken feed, which disrupts reproduction cycles (Alam & Azam, 2023).

The Indus delta in Sindh once boasted the world's 5th largest delta with around 200,000 acres of mangroves. However, this has drastically declined to 47,600 mangroves as of 2010, with some NGOs increasing this number to around 75,000. Despite these efforts, Pakistan's mangrove coverage remains significantly lower than its historical levels. These mangroves are essential as fish hatcheries but have lost eight types over time (Alam & Azam, 2023). This decline threatens the habitats of fish, shrimp, and oysters, disrupting the ecosystem. In areas like Thatta, Badin, and along the Makran coast, the lack of mangroves worsens the effects of natural disasters such as cyclones and floods, resulting in substantial losses.

In 2017, coastal tourism accounted for just 1 percent of the total revenue from marine tourism in Pakistan. However, marine tourism holds significant potential for the country, with attractions such as Hingol National Park, Mud Volcanoes, Beach Lagoons, Beach Sports, and Cruise Ships offering considerable economic opportunities. Identifying key stakeholders is essential for fostering public-private partnerships and other initiatives to capitalise on this industry's potential (Alam & Azam, 2023).

Maritime governance in Pakistan is fragmented across legal, policy, strategic, and international dimensions. A proper policy framework is crucial as Pakistan struggles with execution due to overlapping responsibilities between the central and provincial governments. Maritime governance in Pakistan is fragmented across legal, policy, strategic, and international dimensions The Maritime Merchant Policy (MMP) of 2001 was amended in 2019 but lacks alignment with today's needs, and the Merchant Shipping Ordinance (MSO) of 2001 hasn't been updated since replacing the 1923 Act. The 2022 National Hazardous Waste Management Policy (NHWMP) also needs integration with provincial rules in Sindh and Balochistan. Enforcement of international conventions is another challenge (Aslam, et al. 2023). The 18th amendment has helped somewhat, but maritime authority is still unclear, creating confusion, particularly in the fishing industry. Fishing is regulated by both provincial and central governments, causing issues for fishermen who often need to fish beyond the 10 nautical miles limit. The weak governance and infrastructure severely limits the potential of blue economy. The absence of more roads and railway lines slows down the logistics chain across the country (Alam & Azam, 2023).

Marine pollution severely undermines Pakistan's blue economy potential. The primary contributors to sea pollution are industrial and municipal solid waste. The problem is worsened by inadequate sewage treatment facilities and dysfunctional disposal systems. In areas near Qasim Port, rapid industrialisation, particularly in oil refining, chemical production, and leather tanning, releases pollutants such as heavy metals, fertilizers, and hydrocarbons. Despite being a signatory to the London Convention to prevent ocean waste, Pakistan continues to discharge significant amounts of litter into the sea, including plastic bags, bottles, and infectious hospital waste. The coherence score of 1.74 for environment highlights the need for robust regional, international, and local strategies to address the sustainability of the shipping industry (Aslam, et al. 2023). Pakistan not ratifying the Ballast Water Convention, the Pakistan National Shipping Corporation (PNSC) must implement ballast water management systems on all vessels to avoid disrupting maritime trade. Additionally, new IMO regulations require vessels over 5,000 DWT to report their annual efficiency ratio (AER) and achieve a 2 percent improvement annually, or face removal from service for non-compliance (Aslam, et al. 2023).

3.5.2. Ports

Karachi port has three terminals and port qasim has one terminal. There is strong competition between the four terminals for market power. (Saeed & Larsen, 2009) analysed potential coalition combinations among container terminals at a single port. The game is structured in two stages. In the first stage, the three terminals at Karachi Port must decide whether to act independently or form a coalition. In the second stage, those who chose to join a coalition play a non-cooperative game against those who did not. Four possible coalition combinations are explored, each evaluated numerically using the Bertrand model to determine the net effect on all players' profits. In coalitions A, B, C, and E, despite high prices and a resulting low market share, the combined profit of the coalition terminals is higher compared to acting alone (Case A). Conversely, the main competitor at a different port (QICT) benefits significantly, as it maintains low prices and gains a larger market share, resulting in higher profits. This situation makes QICT an orthogonal free-rider, benefiting from the coalition dynamics at Karachi Port. The only stable coalition is the grand coalition, where all terminals at Karachi Port cooperate. While this coalition yields the highest benefits for the terminals, it is the least favorable for the users (Saeed & Larsen, 2009).

The shipping lines prioritise factors such as service quality, loading and discharging rates, and handling charges when choosing a terminal (Saeed, 2019). Terminal operators should therefore focus on improving these aspects to meet customer expectations. Moreover, shipping lines do not consider whether a terminal is privately operated or government-controlled, nor do they factor in personal contacts or the length of their relationship with terminal authorities when selecting terminals (Saeed, 2019). Although KICT, PICT, and QICT offer similar services, respondents' evaluations of the four terminals regarding handling rates, vessel stay duration, cargo loss and damage, equipment availability, handling of large cargo, asset specificity, personal contacts, and container search vary significantly. Terminal operators need to address these areas to remain competitive.

4. CONCLUSION

The available literature on various subsectors of the logistics and transport sector analyses the potential and challenges of each mode. Over all the logistics sector is growth

enhancing and relies heavily on both hard and soft infrastructures. However, determining which type of infrastructure is more effective was challenging owing to the non-availability and challenges in quantifying the of data on procedures, processes, policies etc. Thus the majority of the literature centered around hard infrastructure. Still, interestingly, the majority of recommendations in each sub sector have focused on the software like improvement in coordination, efficiency, adoption of green policies for sustainable development, reduction of red tapism and corruption preferably through coordination, transparency and digitalisation. For logistics, comprehensive overhaul of the software and integration of technology is a must. This includes reforming the tax structure of logistics firm, a public information platform containing all the information of the logistics for different cities, adoption of latest technology like GIS, RFID and bar codes, on job trainings and relevant diplomas and degrees in the educational institutes can also assist in the modernising of the sector which can leverage its potential due to strategic location.

Roads, railways and ports are identified as the major growth inducing sub sectors. Road investments in Pakistan are primarily funded through annual budget allocations, but this funding has historically been insufficient for timely road capacity expansion. Many projects are launched for political reasons, resulting in poorly constructed roads that deteriorate quickly, leading to repeated contract awards. There is also a lack of accountability in infrastructure spending. To improve infrastructure quality, a significant overhaul of bureaucratic processes and regulatory reforms is essential to enhance efficiency and support sustainable industrial development in the country. Although the emphasis on road development has resulted in a decent average road density of 0.5, and the impact of road length was found to have negative impact on growth in some cases because of over investment and carbon emissions, it was observed that rural connectivity plays a more pivotal role in terms of employment generation. It is a good opportunity to have a clean transport policy by prioritising the use of electric vehicles and efficient public transport. The cooperation and coordination within the four ministries, ministry of port and shipping, ministry of communications, ministry of Pakistan railways and ministry of aviation can make CPEC address regional disparities.

Similarly, in railways, governance reforms are the need of the hour to ensure productive efficiency and operational autonomy so freight potential can be leveraged with public private partnership and reduce the politically motivated running of loss making passenger transport vehicles and overstaffing of employees. This reform of software can be achieved through the lens of green transportation. In addition, solar powered railway vehicles, in the urban centers of major cities seems more viable to address congestion.

The blue economy is also in dire need of reforms and modernisation of soft infrastructure through a proper policy framework. The shipping industry, plagued by poor governance and financial instability, needs policy coherence and adherence to international conventions to remain competitive. Additionally, the fishing industry faces overexploitation, requiring expert collaboration to double fish exports and address sustainability issues. The major challenges of the ship breaking industry are financial instability, inconsistent tax policies, and failure to adhere to international conventions. In short, the processes need to be identified through which the implementing mechanisms could be reinforced.

There was no literature on other sectors of logistics and transport like post offices, dry ports, inland water transport, pipeline transport and freight forwarders.

The modern growth theories are driven by software of the economy including productivity, management, policy, innovations and strong institutions. This is in contrast

to the current development approach of Pakistan which still carries inertia from the Haq/HAG model of the first five-year plan. The approach primary aimed at building the scarce hardware without any consideration to its adequate usage and sustainability. While roads, railways and ports provide physical foundation, it is the soft infrastructure comprising of regulation, policy, coordination mechanism and technology that ensures that these assets are utilised effectively. Singapore's world class logistics sector owes much of its success to robust software. The strategic use of digital platforms like TradeNet significantly streamlines the trade documents and custom processes, significantly reducing the clearance time and reducing the overall efficiency. Sweden and Denmark's integration of smart, green and innovative technologies in logistics and transport systems came through digitalisation. Thus it is the right time to bring about fundamental shift in the growth policy by prioritising soft infrastructure over hard. These examples highlight how soft infrastructure—such as technology, policy, and coordination—amplifies the impact of physical investments. In this context, the second component of the fourth 'E' in Uraan Pakistan rightly focuses on comprehensive infrastructure development through modern transport networks. This entails the strategic expansion and modernization of Pakistan's highways, railways, and urban transit systems to facilitate smoother and faster movement of people and goods. Together, these efforts aim to establish a reliable, inclusive, and future-ready transport infrastructure that drives economic growth and regional integration.

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