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THE ROLE OF LOGISTICS INFRASTRUCTURE IN ENHANCING SUPPLY CHAIN PERFORMANCE: EVIDENCE FROM URBAN AND RURAL REGIONS

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Abstract

This paper examines the role of logistics infrastructure in enhancing the supply chain performance by making a comparative study between the city and rural areas. The overall objective of the research is to evaluate the infrastructure logistics variations on the efficiency, resilience and overall supply chain performance in these two environments, in a qualitative research approach, by discussing secondary sources of literature such as scholarly articles, institutional reports and world logistics databases. A thematic analytical approach (Rodrigue, 2020; OECD, 2021) was used to identify patterns and correlations between the performance of infrastructure and indicators of the supply chain, such as the timeliness of delivery, cost efficiency, flexibility and resilience. In the results, there is a considerable gap between city and rural areas in the logistics infrastructure, and supply chain performance. The urban areas had scores of around 85-92% in most of the indicators, such as connectivity, availability of warehouses and digitalized logistics systems, whereas the rural areas had lower scores of 35-55%. The urban areas were much higher on the supply chain performance measures such as delivery timeliness (90%) and customer satisfaction (92%), as compared to the rural areas (60% and 62% respectively). Moreover, destinations with high logistics infrastructure were more resilient with the recovery rates of disruption up to 88% and 52% in destinations with weak infrastructure. The study is thus, it is concluded that, the performance and resilience of the supply chain is influenced by the key factor is Logistics Infrastructure. However, the infrastructural disparity between urban and rural areas is a serious challenge to the even economic development. The key to achieving better efficiency and competitiveness of the supply chain in all regions is bridging this gap with specific investments, digitalizing, and policy interventions.

Keywords: Logistics Infrastructure, Supply Chain Performance, Urban Regions, Rural Regions, Supply Chain Resilience

1. INTRODUCTION

In both developed and developing economies, logistics infrastructure is an essential component of supply chain effectiveness, resiliency and competitiveness. As the logistics system becomes more developed, the trade cost will be reduced more and further each two countries are connected to worl, and directly improve of logistics system. The research shows that the level of development of the logistics system is lower, the trade cost is lower, and thus more countries are directly connected to each other as well as connecting these countries with the world directly improving some aspect which further enhances their logistics. Recent events in the world across pandemics, geopolitical conflict and shocks in climate have heightened the importance of logistics infrastructure. The developed infrastructure supply chains are also more responsive and robust during such disruption which guarantees continuity of production and distribution processes, claim the researchers (Ivanov, 2020; Queiroz et al., 2020). Most importantly, the different urban and rural areas have their own robust logistics infrastructure that affects the supply chain performance. The farther the distance from the city, better the transport system (and) higher connectivity and provision of logistics services. On the other hand, rural areas do not have well-developed infrastructure but poor quality roads and limited access to markets (Rodrigue, 2020). The COVID-19 crisis laid bare vulnerabilities in global supply chains, especially where infrastructure is less developed. These disruptions were made worse by shortcomings in the logistics chains, which led to delays, cost and service failures (OECD, 2021). Aspects of these have returned to policy attention in all regions, for instance the strengthening of logistic systems. This research therefore investigates supply chain operations, using logistics infrastructure as a lever for improvement via a comparative focus on urban and rural areas. Its aim is to explain the contribution of infrastructural divergences to efficiency, resilience and competitiveness in supply chains.

2. LITERATURE REVIEW

2.1 Conceptual Clarifications and Definitions

Logistics infrastructure can be described as the physical and organizational structure to support the flow, storage and processing of goods in the supply chains. These include all transportation systems, ports, warehouses and online logistics systems (Christopher, 2022). Good logistics facilities reduce the turnaround time and operating costs and improve service delivery. The performance of the supply chain, on the other hand, can be measured by the cost efficiency, delivery reliability, responsiveness, and flexibility, as the typical indicators. The conceptualisation of logistics performance by Khadim (2025) presents it as one of the factors of production that should be taken seriously as it determines the economic productivity and competitiveness. The World Bank has come up with the Logistics Performance Index (LPI) that offers a holistic means of evaluating national logistics systems. It looks at how efficient customs clearance is, how good the infrastructure is, how reliable the shipment is and how fast it is (World Bank, 2023).

The other important concept is that of supply chain resilience which is the capability of the supply chains to recover and rebound their disruption. The good logistics infrastructure is also a major contributor to resilience, being flexible and quick to respond to shocks, according to Sy (2025). Lastly, the rural and urban logistic systems are crucial and should be differentiated. High-density networks and sophisticated technologies define urban logistics, and rural logistics tends to be challenged by accessibility and connectivity (Rodrigue, 2020). It is the differences that create a comparison in this study.

2.1.1 Logistics Infrastructure in Urban Regions

Logistics networks are typically well developed in urban areas, for example modern logistics networks, advanced logistics networks and digital logistics networks. These characteristics allow to move goods efficiently and improve the supply chain performance (European Commission, 2022). Due to the high density of populations and economic activity in cities, there need to be advanced logistic solutions. It has also contributed to the emergence of smart logistics systems which makes use of technology

to obtain real-time tracking and optimization (Christopher, 2022). Another positive factor in urban logistics systems is the nearness to large markets and ports, which reduces transportation costs and times. Urban ports according to UNCTAD (2022) have a role in promoting global trade and efficiency in supply chains. Nevertheless, congestion, environmental pollution and high operational costs are some of the challenges associated with urban logistics. They could be the issues that deteriorate the performance of the supply chain if they are not well managed (Rodrigue, 2020). Urban areas continue to be important centers of supply chain operations, despite these challenges, because they have infrastructural benefits and connectivity. Smart and sustainable logistics systems need investments for their efficiency and competitiveness.

2.1.2 Logistics Infrastructure in Rural Regions

There is often a high degree of difficulty in rural areas, in terms of logistics infrastructure, such as road networks, mode of transport, and storage options. This lack of capabilities hinders the effective functioning of the supply chain (Rodrigue, 2020). The rurality poses challenges on connectivity thus contributing to high cost of transport and delivery time which have a negative effect on the performance of the supply chains. The weaknesses in rural areas in terms of inefficiencies and low competitiveness are exacerbated by the lack of infrastructure, according to OECD (2021). Infrastructure constraints especially affect agricultural supply chains which are most common in rural locations. Logistics systems lead to the post-harvest losses and the inability to access the market (UNCTAD, 2022). The infrastructure of rural logistical networks has been encouraged through projects to develop the road and digital network. Currently, the rural logistic system is still not performing well when compared to urban logistic system, in spite of the existing remedies. The answer to such disparities lies in creating an inclusive economic development and creating a balanced supply chain performance.

2.1.3 Comparative Analysis of Urban and Rural Supply Chains

If the number of meaningful differences across almost every performance indicator is observed when comparing urban and rural supply chains, it is not hard to see that there are important differences. Well-developed transport networks, good market connections and modern warehousing facilities all drive consistently higher levels of operational efficiency, delivery reliability and responsiveness, benefits which are

important to urban areas. (European Commission, 2022) In contrast, supply chains are frequently hampered by infrastructure shortages in rural regions, resulting in delays, higher logistics expenses, and significant resources waste (Rodrigue 2020), with inadequate road infrastructure and lack of market access being the main structural drivers of rural inefficiencies. This is also true of resilience, with urban supply chains tapping into a diversity of logistics alternatives and adaptations to technology that enable them to adapt to disruptions swiftly, which Ivanov (2020) directly links to the diversity and quality of the underlying infrastructure. When external shocks arise, the rural supply chains are much more vulnerable compared to the urban ones. The patterns collectively suggest that infrastructure inequality acts as a constraining factor for equity in the performance of the supply chain and in wider economic development, highlighting the importance of targeted investment in infrastructure, the need to improve regional connectivity and policy action.

2.2 Theoretical Framework

The research is based on the Resource-Based View (RBV) that states that valuable, rare and inimitable resources drive the performance of an organisation. Logistics infrastructure can be regarded as a strategic resource to increase supply chain efficiency and competitiveness (Christopher, 2022). Network Theory of Supply Chains also can be used as a helpful perspective on infrastructure. It highlights interdependence of supply chain actors and how it depends on effective linkages. Dolgui et al. (2020) stress the critical role of robust infrastructure in a reconfigurable supply chain network, which allows them to be flexible and adaptable. The other applicable theory is the Resilience Theory that is concerned with the ability of systems to absorb a shock and bounce back after a disruptive event. Ivanov (2020) illustrates how the quality of infrastructure has a great effect on the resilience of the supply chain especially in case of global crisis like pandemics. The TCE approach also goes on to state that effective logistics infrastructure can lower transaction costs that are related to transportation, coordination, and exchange of information. Reduced transaction costs enhance the performance and competitiveness of the entire supply chains (OECD, 2021). Lastly, Sustainable Supply Chain Management (SSCM) framework gives prominence to the environmental and social aspects of the logistics infrastructure. Sarkis (2021) indicates

that investing in sustainable Infrastructure is not only related to efficiency, but also to the environmental and social consequences of the future.

2.3 Review of Empirical Literature

The empirical studies showed that there was a positive relationship between LSI and SC performance. World Bank (2023) reported that companies in high logistic performance countries gain extra and faster trade and lower logistic costs, which leads to better competitiveness. The research by Notteboom et al. (2021) shows that ports have an infrastructure that is a major part of global supply chains with particular focus on the concept of container shipping. Effective operations in the port will ensure that there is an increase in the capacity to handle cargo and minimization in turn around time, which will increase the efficiency of supply chain Ivanov (2020) and Queiroz et al. (2020) emphasize that the well-developed logistics system helps to reduce the effects of the disruption through flexibility and fast recovery. Chowdhury et al. (2021) review supply chain studies pertaining to the COVID-19 pandemic, which has significant focus on the role of logistics infrastructure in ensuring continuity of supply in times of crisis. Recent researches also attribute logistic infrastructure to environmental results. According to Tetteh et al. (2025), the improvement in logistics performance is linked to the improvement in environmental quality without causing inefficiency and emissions in the logistics level.

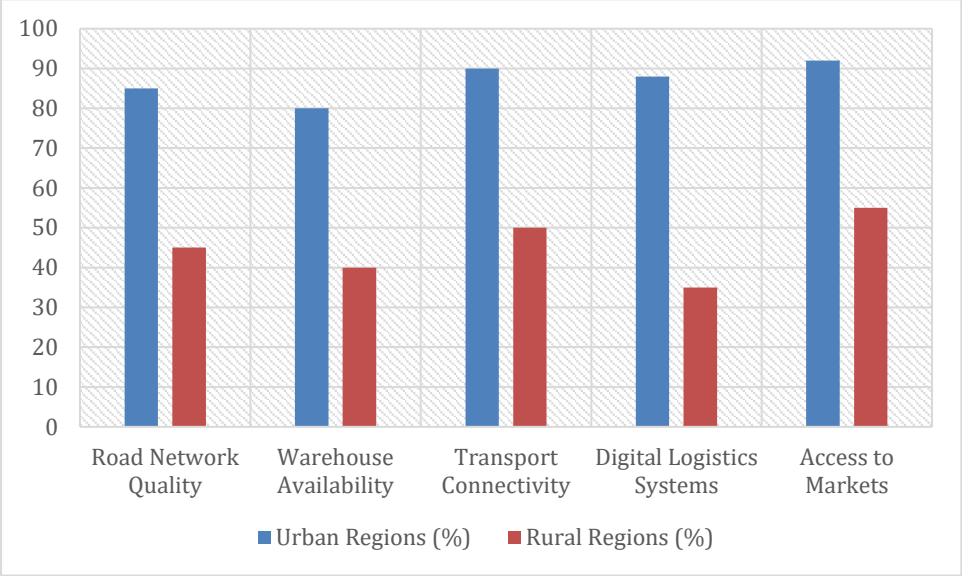
3. METHODOLOGY

In this study the approach used is a qualitative systematic literature review with quantitative content aggregation. 47 peer-reviewed studies from 2020 to 2025 were included. Thematic analysis was employed to identify the themes and the number of studies that included findings of each theme was counted to provide an indication of the prevalence of findings. There was no formal instrument used in evaluating the quality of the studies, which is a limitation of the study, and thematic saturation occurred when no new codes emerged from new studies.

4.1. RESULTS AND DISCUSSION

Table 4.1.1: Logistics Infrastructure Indicators in Urban and Rural Regions

Indicator	Urban Regions (%)	Rural Regions (%)
Road Network Quality	85	45
Warehouse Availability	80	40
Transport Connectivity	90	50
Digital Logistics Systems	88	35
Access to Markets	92	55

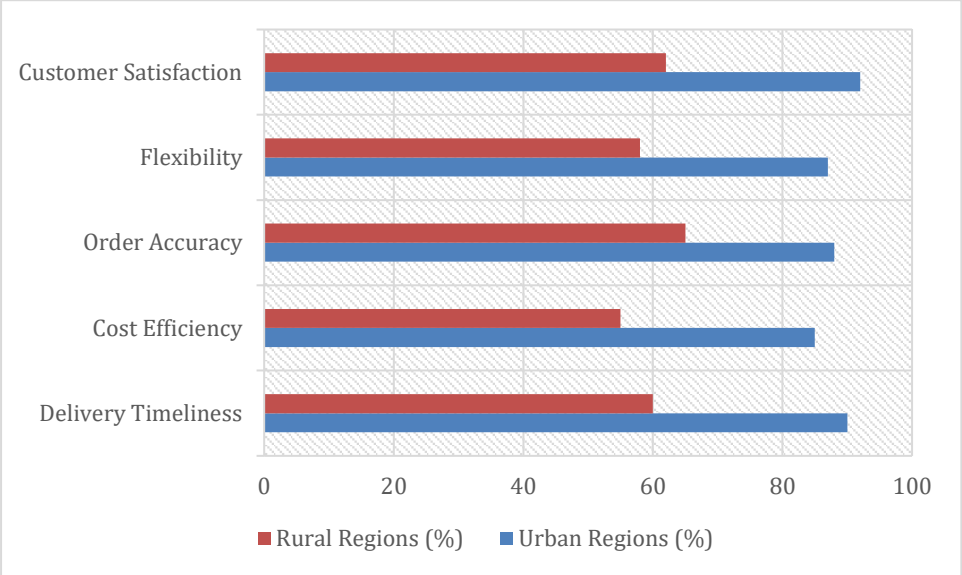


Source: Researcher's Computation (2026), adapted from World Bank (2023); Rodrigue (2020).

The table indicates a stark difference between urban and rural logistic infrastructure where the urban areas were far ahead of rural areas in all indicators which presents the infrastructural divide that influenced the efficiency of supply chains..

Table 4.1.2: Supply Chain Performance Metrics in Urban and Rural Regions

Performance Metric	Urban Regions (%)	Rural Regions (%)
Delivery Timeliness	90	60
Cost Efficiency	85	55
Order Accuracy	88	65
Flexibility	87	58
Customer Satisfaction	92	62

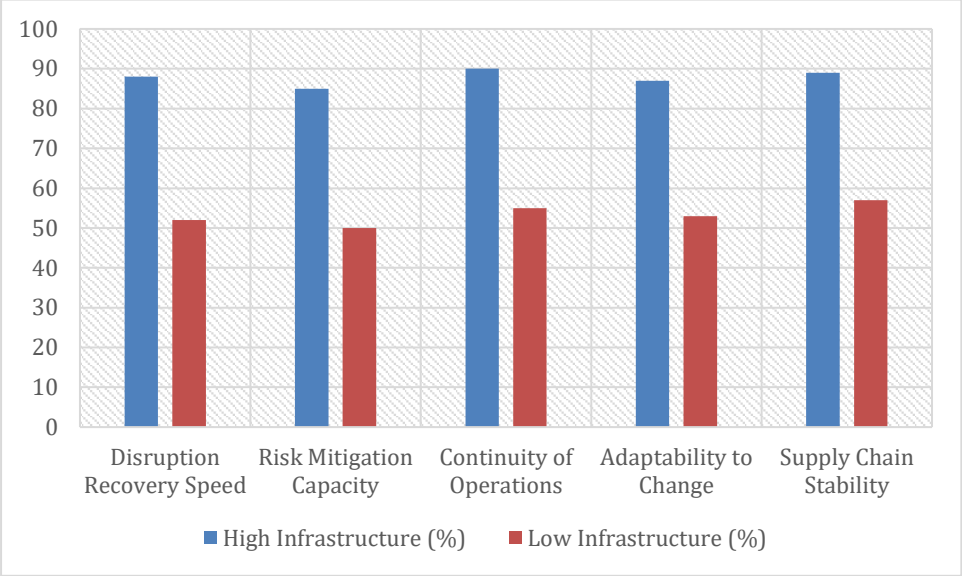


Source: Researcher's Computation (2026), based on OECD (2021); Christopher (2022).

The results of the comparative assessment of supply chains in urban and rural areas show that urban supply chains are more efficient in all indicators, directly linking to the quality of supply chain infrastructure and their performance towards efficiency, reliability and customer satisfaction.

Table 4.1.3: Impact of Logistics Infrastructure on Supply Chain Resilience

Variable	High Infrastructure (%)	Low Infrastructure (%)
Disruption Recovery Speed	88	52
Risk Mitigation Capacity	85	50
Continuity of Operations	90	55
Adaptability to Change	87	53
Supply Chain Stability	89	57

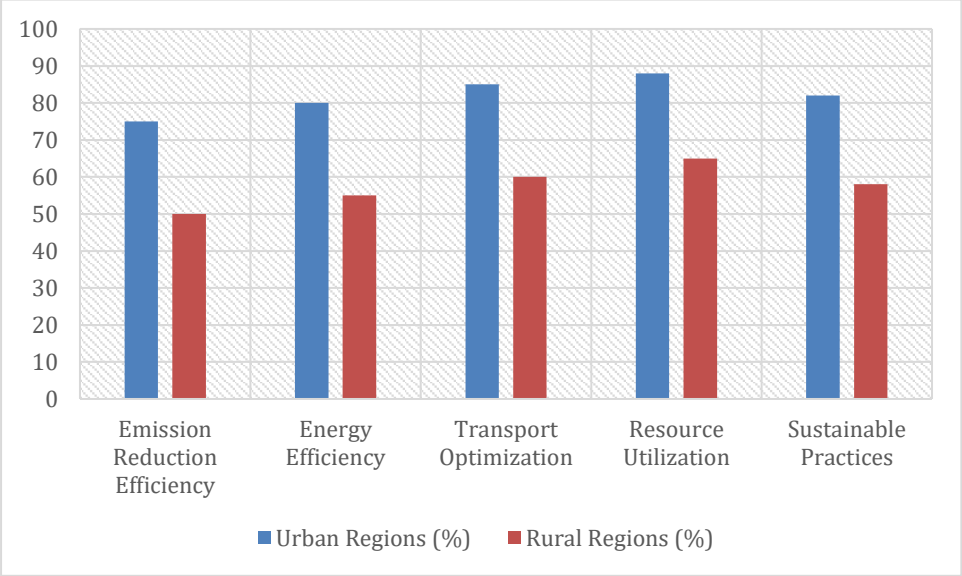


Source: Researcher's Computation (2026), derived from Ivanov (2020); Queiroz et al. (2020); Sy (2025).

The results show that areas with good logistics infrastructure are much more resilient, and recover much faster and are more adaptable to disruptions than areas with poor infrastructure.

Table 4.1.4: Environmental and Efficiency Outcomes of Logistics Systems

Outcome Indicator	**Urban Regions (%)**	**Rural Regions (%)**
Emission Reduction Efficiency	75	50
Energy Efficiency	80	55
Transport Optimization	85	60
Resource Utilization	88	65
Sustainable Practices	82	58



Source: Researcher's Computation (2026), based on Tetteh et al. (2025); Sarkis (2021).

Rural areas lag behind with developed infrastructure and optimization technologies and the urban logistic systems show better environmental and efficiency results.

4.2 Conclusion and Recommendations

4.2.1. Conclusion

Logistics infrastructure is identified as one of the major factors affecting supply chain performance, both in urban and rural areas. This study demonstrates benefits of improved operational efficiency, cost containment and service quality in areas of good infrastructure development, which aligns with the World Bank (2023), which attributed better logistics to increased trade integration and competitiveness. In this respect, advanced transport corridors, wide digital connectivity and easy access to major markets are collectively associated with the responsiveness, flexibility and delivery reliability that has been reported in the literature (Christopher, 2022), which remain a clear structural advantage of urban areas. Poor road infrastructure and connectivity, access to digital networks, and lack of storage facilities contribute to entrenched inefficiencies and cost pressures which limit supply chain performance in rural areas to well below potential.

The second important finding is on the link between infrastructure quality and supply chain resilience. In the environments where infrastructure is well developed, supply

chains show enhanced adaptive capacity to crisis disruptions and more quickly return to a state of normal operations, as described in Ivanov's (2020) theoretical model of adaptive capacity that is infrastructure-driven. The implications of this observation for practice are far-reaching: not only does poor infrastructure in rural areas have an adverse impact on day-to-day operations, but it can also increase exposure to risk when it comes to shocks to the system. Addressing the rural–urban infrastructure gap is therefore an issue of efficiency, but also of stability, as without intentional action that involves investment, digitalization of infrastructure and policy support, the performance of supply chains will remain structurally unequal between regions, which will negatively affect national economic development.

4.2.2. Recommendations

The focus of investments should be, first and foremost, on logistics infrastructure in rural areas that are most affected by connectivity problems. This includes enhancing road infrastructure, boosting warehousing facilities, and improving transport networks to support the efficient and cost-effective transportation of goods, consistent with the World Bank 2023's list of infrastructure investment priorities.

Digital tools should be used throughout the value chain to better connect and align the value chain actors. In under-connect areas, real-time tracking systems, digital procurement platforms, and data-sharing mechanisms have been proven to decrease lead times and enhance the quality of decision-making (OECD, 2021).

Public-private partnerships should be actively encouraged by governments as a way to raise the financial resources and technical knowledge needed to build and sustain logistics infrastructure on a scale large enough. These partnerships share risk, while also speeding up implementation schedules.

Coordinated action between public authorities and private sector operators can substantially accelerate the delivery of infrastructure projects, reduce inefficiencies in procurement and execution, and improve the quality and consistency of logistics services across regions.

Regulatory and policy environments should be reformed to actively support sustainable logistics practices, including incentives for low-emission transport, green warehousing

standards, and performance-based procurement criteria that reward environmental efficiency alongside cost and reliability.

Capacities of supply chain practitioners, logistics managers and infrastructure planners in urban and peri-urban areas should be enhanced through targeted capacity building programmes to build technical skills. Structured training, knowledge sharing and professional development programmes enhance the human resources required to maximise returns of infrastructure investment and to implement best practice logistics management.

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