PM GatiShakti
National Master Plan for Multi-Modal Connectivity

सत्यमेव जयते

DEPARTMENT FOR PROMOTION OF INDUSTRY AND INTERNAL TRADE
MINISTRY OF COMMERCE & INDUSTRY
GOVERNMENT OF INDIA

INDIA LOGISTICS

Assessment of Logistics Cost in India

Logistics Division

Department For Promotion of Industry and Internal Trade

September, 2025

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Assessment of Logistics Cost in India

September, 2025

By

National Council of Applied Economic Research (NCAER)

For

Logistics Division, Department for Promotion of Industry and Internal Trade (DPIIT)

सत्यमेव जयते

DEPARTMENT FOR PROMOTION OF INDUSTRY AND INTERNAL TRADE
MINISTRY OF COMMERCE & INDUSTRY
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पीयूष गोयल
PIYUSH GOYAL

सत्यमेव जयते

वाणिज्य एवं उद्योग मंत्री
भारत सरकार
MINISTER OF COMMERCE & INDUSTRY
GOVERNMENT OF INDIA

FOREWORD

Efficient logistics infrastructure and seamless supply chains are critical drivers of trade, economic growth and global competitiveness. Across the world, countries have implemented innovative strategies to reduce logistics costs and enhance supply chain efficiency to promote trade and business.

India's logistics sector forms the backbone of its growing economy, seamlessly connecting producers, markets and consumers. Guided by the vision of our Hon'ble Prime Minister Shri Narendra Modi ji, the Government of India has launched transformative initiatives such as the National Logistics Policy (NLP), PM Gati Shakti National Master Plan and Unified Logistics Interface Platform (ULIP). Complemented by projects like Dedicated Freight Corridors and Multi-modal Logistics Parks, these efforts aim to build an integrated, technology-driven ecosystem that reduces costs, improves efficiency and enhances both the ease and speed of doing business.

The NLP stands as a landmark reform, charting a clear vision to make India's logistics sector more efficient, competitive and future-ready. A key objective of the policy is to enable evidence-based decision-making through accurate assessment of logistics costs and their components. In this direction, the collaborative effort between the Department for Promotion of Industry and Internal Trade (DPIIT) and the National Council of Applied Economic Research (NCAER) marks the first comprehensive study in India to evaluate logistics costs, laying the foundation for data-driven policymaking.

The report presents logistics costs both as a percentage of GDP and non-service output of industries, based on a nationwide survey of more than 3,500 firms, along with the careful use of authentic secondary data from government agencies. The findings and recommendations of the report offer valuable insights for identifying infrastructure gaps, streamlining processes and improving regulatory frameworks to further reduce logistics costs and strengthen India's position as a global logistics hub. The study will also serve as a critical reference point for policymakers and industry stakeholders to design targeted interventions, track progress over time and accelerate India's journey toward a more competitive and efficient logistics ecosystem.

On this occasion, I would like to commend the Logistics Division of DPIIT and NCAER for undertaking this important study, which will serve as a cornerstone for shaping India's logistics landscape and advancing its global competitiveness.

Piyush Goyal

Ministry of Commerce & Industry, Vanijya Bhawan, Akbar Road, New Delhi-110001
Tel. No. : +91 11 23039110, 23039111, E-mail : cimoffice@nic.in

जितिन प्रसाद
JITIN PRASADA

सत्यमेव जयते

वाणिज्य एवं उद्योग तथा
इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी राज्य मंत्री
भारत सरकार
Minister of State for
Commerce & Industry
and Electronics & Information Technology
Government of India

MESSAGE

The logistics sector is a critical enabler of India's economic growth, directly impacting key sectors such as manufacturing, agriculture, retail, and exports. Efficient logistics not only reduces business costs but also enhances the competitiveness of Indian enterprises, particularly small and medium businesses, which form the backbone of our economy. Major industries including e-commerce, automotive, pharmaceuticals, and consumer goods depend heavily on a robust logistics ecosystem to ensure timely delivery, supply chain resilience, and customer satisfaction.

Recognizing the sector's importance, the Government of India has initiated transformative reforms aimed at improving infrastructure, integrating technology, and simplifying regulatory processes. Initiatives like the National Logistics Policy, PM Gati Shakti, and the Unified Logistics Interface Platform are paving the way for an efficient, transparent, and sustainable logistics environment.

One of the aims of the National Logistics Policy is to correctly assess the logistics costs. I am very happy that Logistics division of DPIIT, in collaboration with NCAER, came out with a compressive report on Logistics cost in India. This is the maiden such effort in India to assess logistics cost in such systematic and compressive manner.

This report not only offers a comprehensive assessment of logistics costs in India but also provides components of logistics cost, sector, industry and product wise logistics cost, and suggestions for policy interventions.

I am sure the report will serve as a foundation for targeted & focused policy interventions to reduce logistics costs and enhance the efficiency of supply chain across sectors, driving India's aspiration to become a global logistics hub.

(JITIN PRASADA)

Vanijya Bhawan, New Delhi-110001, Tel. : 011-23039174, 23039184, E-mail : mos-ci@gov.in
Electronics Niketan, 6, CGO Complex, Lodhi Road, New Delhi-110003, Tel. : 011-24361756, E-mail : mos-eit@gov.in

अमरदीप सिंह भाटिया, भा.प्र.से.
सचिव
Amardeep S. Bhatia, I.A.S.
SECRETARY

सत्यमेव जयते

भारत सरकार
वाणिज्य एवं उद्योग मंत्रालय
उद्योग संवर्धन और आंतरिक व्यापार विभाग
GOVERNMENT OF INDIA
MINISTRY OF COMMERCE & INDUSTRY
DEPTT. FOR PROMOTION OF INDUSTRY AND INTERNAL TRADE

FOREWORD

The logistics sector is central to India's growth story. High logistics costs have long posed challenges to trade, supply chain efficiency, and the overall competitiveness of our economy. In response, the Government of India has introduced several transformative reforms - including the National Logistics Policy (NLP) 2022, the PM Gati Shakti National Master Plan, and the Unified Logistics Interface Platform (ULIP) - to build a seamless, integrated, and technology-enabled logistics ecosystem.

A key pillar of these reforms is the need for reliable, data-driven insights into India's logistics cost structure. In this context, the Department for Promotion of Industry and Internal Trade (DPIIT), in collaboration with the National Council of Applied Economic Research (NCAER), undertook the Assessment of Logistics Cost in India. The study uses a hybrid methodology, aligned with the national framework, and draws on both demand-side and supply-side data to arrive at a robust estimate for the year 2023–24.

The report provides India's first comprehensive and disaggregated estimate of logistics costs, covering core components such as transportation, warehousing, and material handling, along with mode-wise and region-wise analyses. A key innovation in this study is the development of the Logistics Cost Dashboard, a tool designed to support ongoing monitoring and policy decision-making. The report also includes a set of detailed, actionable policy recommendations that will support targeted interventions to reduce costs and enhance overall efficiency.

These findings will be instrumental in guiding future reforms and strengthening India's position in global trade. I commend the efforts of the teams at DPIIT and NCAER for their rigorous work in producing this landmark report, which will serve as a valuable reference for policymakers, industry stakeholders, and researchers alike.

(Amardeep S. Bhatia)

Preface

In recent years, the Government of India has undertaken significant steps to reform and modernise the logistics landscape, recognising that high logistics costs have a direct bearing on trade competitiveness and overall economic growth. These initiatives include the National Logistics Policy (NLP) 2022, PM Gati Shakti, ULIP, and so on. The NLP 2022 specifically mentions the goals of reducing logistics costs and creating a data-driven support mechanism to promote an efficient logistics ecosystem.

Although policy reforms and infrastructure investments are anticipated to yield significant long-term gains, there was an immediate need for a comprehensive and robust, data-driven evaluation of India's current logistics cost. This report presents the results of a study estimating the national logistics cost for India for the year 2023-24. The study employs a hybrid methodology that combines both primary and secondary data research, and is based on the 'Framework for the Assessment of Logistics Cost in India,' a methodological report prepared by NCAER and DPIIT for this purpose.

The study provides an aggregate assessment of India's logistics cost, breaking it down into components such as transportation, warehousing, and material handling; along with their respective sub-components. To ensure international comparability and enable tracking over time, the total logistics cost has been expressed as a percentage of India's GDP and its non-services output.

This report is intended to serve as a strategic guide for policy makers in designing targeted interventions in the logistics sector. It also acts as a reference for global logistics cost estimation methodologies. It offers a more accurate tool for comparisons and more informed decision-making about the country's logistics ecosystem, including break-downs by region, mode of transport, and sector.

On behalf of the NCAER study team, I would like to extend my sincere gratitude to all the members of the Taskforce constituted to guide the DPIIT and NCAER during the course of this study. The Taskforce included representatives from the NITI Aayog, the Ministry of Railways, and the Ministry of Statistics and Programme Implementation, as well as academic experts and industry stakeholders. Their insights and support have been invaluable in making this study a valuable resource for future policy and planning.

I wish to commend the dedicated efforts of the NCAER team led by Professor Poonam Munjal and Professor Sanjib Pohit in carrying out this study. The other core team members of the study team were Dr Palash Baruah, Ms Yashika Khattar, Ms Sovini Mondal and Mr Afaq Hussain. It is hoped that this work makes a significant contribution to the government's ongoing efforts in making Indian-made goods more competitive by reducing logistics-related costs.

Anil K. Sharma

Secretary and Operations Director
National Council of Applied Economic Research
September 2025

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Abbreviations

3PLs	Third-party logistics providers
ANN	Artifical Neural Network
APL	American President Lines
B2B	Business to Business
BCAS	Bureau of Civil Aviation Security
BoP	Balance of Payment
BPM6	Balance of Payments and International Investment Position Manual, 6th Edition
CAGR	Compounded Annual Growth Rate
CCTV	Closed-Circuit Television
CDSCO	Central Drugs Standard Control Organisation
CFS	Container Freight Station
CFS	Container Freight Stations
CGST	Central Goods and Services Tax
CIA	Central Intelligence Agency
CII	Confederation of Indian Industries
CISF	Central Industrial Security Force
CKD	Complete Knocked Down
CLoCs	Centre for Logistics and Supply Chain Studies
CONCOR	Container Corporation of India
CSCMP	Council of Supply Chain Management Professionals
CSIR	Council for Scientific and Industrial Research
CSMIA	Chhatrapati Shivaji Maharaj International Airport
DCF	Discounted-Cash-Flow
DFC	Dedicated Freight Corridors
DGCA	Directorate General of Civil Aviation
DPD	Direct Port Delivery
DPE	Direct Port Entry
DPIIT	Department for Promotion of Industry and Internal Trade
EXIM	Export-Import
FMCG	Fast Moving Consumer Goods
FOIS	Freight Operations Information System
FSSAI	Food Safety and Standards Authority of India
FTL	Full Truck Load
GDP	Gross Domestic Product
GMP	Good Manufacturing Practices
GST	Goods and Services Tax
GSTN	Goods and Services Tax Network
GVA	Gross Value Added
HAWB	House Air Waybill
HS	Harmonised System
HSD	High-Speed Diesel
HVAC	Heating, Ventilation, and Air Conditioning
ICD	Inland Container Depots
ICP	Integrated Check Post
IGST	Inter-state Goods and Services Tax

IR	Indian Railways
ITB	Bandung Institute of Technology
IWT	Inland Water Transport
JNP	Jawaharlal Nehru Port
KM	Kilometer
KOTI	Korea Transport Institute
LCSs	Land Customs Stations
LEAP	Logistics Efficiency Enhancement Programme
LPAI	Land Ports Authority of India
LPI	Logistics Performance Index
LTL	Less Than Truck Load
MMLPs	Multimodal Logistics Parks
MMT	Million Metric Tonnes
MoPSW	Ministry of Ports,Shipping and Waterways
MoSPI	Ministry of Statistics and Programme Implementation
MSME	Micro, Small, and Medium Enterprises
MT	Metric Tonnes
NAS	National Accounts Statistics
NCAER	National Council of Applied Economic Research
NIT	Net Indirect Taxes
NLE	National Logistics Ecosystem
NLP	National Logistics Policy
NW	National Waterway
OD	Origin Destination
ODC	Over-Dimensional Cargo
Opex	Operating Expenditure
PGA	Partner Government Agencies
PIN	Postal Index Number
PNGRB	Petroleum and Natural Gas Regulatory Board
PPP	Purchasing Power Parity
PRCL	Pipavav Rail Corporation
PTPK	Per Tonne Per Kilometer
RBI	Reserve Bank of India
SCADA	Supervisory Control and Data Acquisition
SGST	State Goods and Services Tax
SKD	Semi-Knocked Down
SUT	Supply and Use Table
TEU	Twenty-Foot Equivalent Unit
THC	Terminal Handling Charges
TLC	Total Logistics Cost
TSP	Terminal Storage and Processing
TTM	Trade and Transport Margins
ULIP	Unified Logistics Interface Platform
UNCTAD	United Nations Conference on Trade and Development
USBLC	United States Business Logistics Cost
USD	US Dollar
WMS	Warehouse Management Systems
WPI	Wholesale Price Index

Executive Summary

Most developed and emerging economies regularly estimate their logistics costs and employ performance indicators to track the efficiency of logistics operations. For India, too, systematic measurement of logistics costs is imperative to benchmark its performance vis-à-vis competing economies, and to identify areas for improvement. The vision of Viksit Bharat—a developed India by 2047—further reinforces the urgency of building a world-class logistics ecosystem that reduces costs, enhances competitiveness, and strengthens supply chain for both internal and EXIM trade.

The National Logistics Policy (NLP) 2022 defines logistics as encompassing the transportation and handling of goods from production to consumption, along with storage, value addition, and a range of allied services, including labelling, documentation, and information exchange. Broadly, logistics costs comprise transportation, warehousing, inventory-carrying, administration, and packaging costs. At every stage of the value chain, whenever cargo changes hands, multiple factors come into play that influence the costs incurred at that particular step. As India seeks to reduce its overall logistics costs, it becomes imperative to understand the modalities of these costs, their individual components, and the factors that determine the final burden on trade and industry.

With this context, the study 'Assessment of Logistics Cost in India and Development of a Long-Term Framework' has been undertaken by the Logistics division of DPIIT in collaboration with NCAER to estimate the logistics cost in the country, while also examining its structure and key drivers. The study also aims to identify and analyse the components of the logistics costs, their interlinkages, and the implications for policy and strategy. The objective is to generate insights that support the policy decisions in designing effective measures to reduce the overall cost of logistics in the country. The present study is comprehensive in scope, covering all major modes of transport—road, rail, air, waterways, and pipelines—in addition to warehousing, inventory carrying, administrative and other cost components. Wide spectrum of stakeholders that form India's logistics ecosystem were consulted and taken on board as part of the endeavour.

This study adopts a hybrid approach, drawing on both primary and secondary data, to estimate the value of India's logistics cost, its components, and sub-components. Secondary data sources include the latest available Supply and Use Tables (SUT), the National Accounts Statistics (NAS) published by MoSPI, and the Balance of Payments (BoP) statements published by the Reserve Bank of India (RBI). Complementing this, primary data has been collected through extensive in-person surveys with both logistics service users (industries) and service providers (transporters, freight forwarders, and warehouse operators, among others). The primary survey covered a sample of over 500 service users and 3,000 service provider respondents, distributed across multiple segments—road, rail, air, waterways, and warehousing.

To present logistics costs and track their trends over time, the study proposes a composite set of metrics: (i) logistics cost as a percentage of non-services output (agriculture, mining, and manufacturing), (ii) cost per tonne per kilometre, and (iii) logistics cost as a percentage of GDP. While global practices typically rely on the share of logistics cost in GDP, such comparisons may be misleading given variations in economic structures and spatial patterns of production and consumption across countries. Hence, the non-services output measure provides a more robust estimate of cost.

Key Findings

Aggregate Logistics Cost Estimates

The aggregate logistics cost is estimated at ₹24.01 lakh crore at current prices (i.e., 2023-24 prices), derived from secondary data sources including the SUT, NAS, and RBI Balance of Payments (BoP) statements. An additional cost component of storage and warehousing costs, borne by industries in their own or rented spaces, has been derived from the industry survey and added to arrive at the total logistics cost for India.

This total logistics cost accounts for 7.97 per cent of India's GDP and 9.09 per cent of non-services output in 2023-24.

The estimates derived for the previous five years show that the pace of growth in the logistics cost is gradually slowing down compared with the pace of growth in non-services output. This may be attributed to several initiatives such as PM Gati Shakti National Master Plan; Dedicated Freight Corridors; Bharatmala Pariyojana; Sagarmala Project; Integrated Check Posts; development of the Unified Logistics Interface Platform (ULIP); Logistics Efficiency Enhancement Programme (LEAP); and so on.

Demand-Side Assessment Through the Industry Survey

- Small firms with a turnover of up to ₹5 crore incur the highest logistics cost as a percentage of their output. Their logistics cost is estimated at 16.9 per cent of their output.
- This ratio declines as the value of output goes up.
- Large firms with a turnover of above ₹250 crore incur significantly lower share of logistics costs, averaging 7.6 per cent of their output.
- This finding reflects economies of scale in logistics management, with larger firms better positioned to leverage integrated supply chains and higher levels of process efficiency.
- The survey also estimated logistics costs as a proportion of total output across commodity groups, based on the type of goods manufactured. This share is significant in the transport equipment sector at 21.4 per cent of total output, followed by textiles & apparel, agricultural products, and pharmaceuticals. The lowest share of costs is borne by chemicals and cement.

Supply-Side Estimates of Logistics Cost

On the supply side, the study conducted a sample survey of more than 3,000 logistics service providers, covering transport operators, 2PL and 3PL players, and warehouse operators. The survey captured the per tonne per km (PTPK) cost of logistics services across multiple transport modes, alongside the cost structure breakdown into various sub-components.

- The survey results highlight cost variation across transport modes (measured as ₹ per tonne per km or PTPK). These costs, for the different modes of transport, are estimated at:

Road: **₹3.78**

Rail: **₹1.96**

Air: **₹72**

Waterways (average): **₹2.30**

Coastal: **₹1.80**

Inland: **₹3.30**

Road transport

- Within road transportation, costs vary sharply by truck axle capacity.
- For light trucks (low-axle), the cost is estimated at ₹11.03 PTPK, which is the highest cost segment.
- In contrast, the cost for heavy-duty trailers (55 tonne capacity) is estimated to be far lower at ₹1.51 PTPK — the lowest cost, reaping the benefits of economies of scale.
- Additionally, the distance class-wise PTPK cost shows a significant variation, with shorter distance transportation costing more.
- A significant PTPK cost variation is seen across the origin-to-destination zone. For example, northeast-bound cargo consistently has higher costs compared to shipments moving out from the northeast, reflecting the infrastructural bottlenecks and return-load challenges in this region.

- In contrast, the western region exhibits lower transportation costs. This is due to the established industrial base in the western region of the country.
- The breakup of road transport cost into its sub-components reveals that fuel is the largest individual component, comprising 42.1 per cent of total costs, which directly affects vehicle-operating expenses and constitutes a substantial portion of total freight charges.
- 'Annual costs', which are also fixed costs and not related to trips, contribute 40.5 per cent to total cost, and include costs such as administrative expenses, permit fees, maintenance costs, insurance premiums, and operator margins.
- Toll charges account for 6.9 per cent; drivers and support staff costs contribute 4.7 per cent; and miscellaneous expenses are 4.6 per cent, all of which highlight the presence of smaller, often unpredictable costs that still impact overall road transport economics.

Rail transport

- Rail logistics emerges as a cost-efficient mode, with an average cost of ₹1.96 per tonne-km, significantly lower than road transport, in cases where the first/last mile of the consignment is not taken into consideration.
- For wagon-based cargo movement, freight charges account for 89.8 per cent of total costs, and comprises: basic freight (79.3 per cent) and surcharges (10.5 per cent). Other charges (5.8 per cent) include miscellaneous costs such as demurrage for detention beyond free time, weighment charges, terminal-handling fees, and route-specific levies.
- For parcel movement (handled largely through agents), the cost structure differs as fuel accounts for 46 per cent of total cost, and loading/unloading charges contribute 10 per cent. The remaining 44 per cent of the total cost is due to 'other charges', which include profit margins (around 15–25 per cent), administrative charges (8–12 per cent), premium/priority surcharges (3–5 per cent), packaging costs (5 per cent), and informal costs (2–4 per cent).

Air transport

- Air transportation is the most expensive, albeit the fastest, mode of freight transportation, averaging ₹72 per tonne per km, which largely limits its use to high-value, time-sensitive commodities.
- The cost breakup reveals that freight charges contribute 51.4 per cent of overall costs, making it the dominant component; other costs (30.1 per cent) are substantial, reflecting a wide range

of non-standardised add-ons; and the remaining costs are accounted for by documentation (8.2 per cent), terminal-handling (6.4 per cent), and security charges (3.8 per cent).

- For specialised cargo (such as pharmaceuticals), temperature-controlled packaging and handling add to costs, but are non-negotiable for product integrity, highlighting the premium nature of air freight.

Water transport

- Water transportation is not only a cost-effective mode of transport but also the most environmentally friendly mode.

- Broadly, domestic cargo is moved through two water channels—coastal shipping and inland waterways. Coastal shipping utilises maritime ports, both major and non-major, to transport goods along the sea route, and inland waterways depend on rivers.

- The average PTPK cost of moving cargo via waterways in India is estimated at ₹2.30, making it a cost-efficient option—just above rail, but significantly lower than road and air transportation.

- Costs vary sharply between coastal shipping and inland water transport (IWT), with coastal shipping costing ₹1.80 PTPK and inland water transport at ₹3.30 PTPK. This gap is largely driven by differences in cargo volumes and backhaul availability.

- The cost break-up, on average, shows that freight cost constitutes the majority share, accounting for 81.19 per cent of total cost. Port-handling charges, which include loading, unloading, and storage at ports, represent 7.65 per cent of the total. Documentation and administrative charges contribute a modest 1.60 per cent to the overall cost.

- The remaining 9.55 per cent is grouped under 'Other Costs', which includes insurance, vessel-idling or waiting charges, charges for pilotage and navigation aids, additional logistical services like barge coordination or local transport to or from terminals, special service costs, and operator margins.

Multi-modal transportation

Given the focus of the government on promoting multi-modal transport, especially for long-haul transport, this study also presents a comparative analysis of pure road transport costs versus multimodal transport costs, which involve rail, and identifies the distance threshold at which rail transport becomes more economical than road. The study finds that:

- For short-haul movements, pure road transport remains more economical due to high costs associated with first- and last-mile handling in multimodal setups, coupled with additional terminal-handling and trans-shipment costs.
- Rail's cost efficiency over longer hauls starts to outweigh the additional costs, an advantage which grows significantly as the distance increases.
- The break-even point between road and multimodal transport appears at around the 600 km mark, where approximately 500 km are carried by rail and 50 km each are the first-mile and last-mile distances. Beyond this distance, multimodal transport becomes the more economical option.
- With an increase in first- and last-mile distances to, say, 100 km each, the break-even point gets pushed to around 1,000 km, where 800 km is covered by rail.
- However, in a practical scenario, road transport dominates on several routes even for longer distances. This is because it provides door-to-door service, involves lesser hassles of documentation & formalities, and is more suitable for specific types of cargo.

Warehousing

- Unlike transport costs, which are typically distance- or mode-based, warehousing costs are determined by factors such as commodity type, land and infrastructure availability, location, storage duration, technology adoption, and operational efficiency.
- The average warehousing cost in India is approximately ₹30 per square foot per month.

- Temperature-controlled warehouses, commonly used for perishables, pharmaceuticals, and certain chemicals, cost approximately ₹58.5 per square foot per month, nearly double the standard rate. Similarly, facilities handling hazardous cargo attract a higher average cost of ₹56 per square foot per month due to additional safety, regulatory, and infrastructure requirements.
- The cost break-up into sub-components reveals that manpower, at 30 per cent of total cost, is the largest cost head, covering staff involved in receiving, put-away, picking, packing, inventory checks, and general warehouse operations.
- Premise rates, which include rent, lease, or ownership-related costs of the warehouse property, account for another 20 per cent of the cost; utilities are at 7 per cent; and amortised racking, mezzanine, and other storage costs at 6 per cent.
- The remaining cost components relate to value-added services, repairs & maintenance, rental of material equipment handling, insurance, technology, and security.

Pipeline Transportation

- Pipelines serve as a specialised and efficient mode of transporting specific commodities, particularly petroleum products, natural gas, and, to some extent, slurry and water.
- Its cost components can be broadly categorised under operating expenditure, which refers to recurring annual costs incurred once the pipeline is commissioned, and which include the costs of pumping, routine maintenance and pigging, heated pipelines, manpower & supervision, insurance & safety, overheads & administration, land-use, and depreciation.

Export-Import (EXIM)

- A significant portion of EXIM logistics costs is incurred at the maritime ports.
- Port-related costs are categorised into standard and variable charges. Charges, such as Terminal Handling Charges (THC) for maritime ports,

Terminal Storage and Processing (TSP) charges in the case of airports, and documentation charges, are standard, while others are variable and arise only under specific conditions, such as demurrage for exceeding the free storage period at a port or other storage facility.

- Standard charges can vary significantly depending on factors such as type of cargo (hazardous, over-dimension cargo, etc.), port location and congestion levels, choice of terminal or shipping line, mode of evacuation (rail/road/direct port delivery), specific line or consignee requirements, and value-added services (stuffing, destuffing, sampling, examination, etc.).

Concluding Remarks

This study estimates the logistics cost to be 7.97 per cent of GDP and 9.09 per cent of non-services (agriculture, mining, and manufacturing) output, the latter metric being a better measure to track logistics costs, and to make sub-national and international comparisons. The study also estimates the values of the components and sub-components of logistics costs. Transportation cost, which is the largest component of logistics cost, has been estimated for all modes of transport and expressed both in absolute values and in terms of PTPK.

Further, based on field observations and stakeholder interactions, this study presents some qualitative insights on the determinants of logistics costs, the factors that lead to fluctuations in cost, and challenges faced by logistics service providers.

Some of the challenges with regard to railways include operational bottlenecks, service availability issues, no first-mile/last-mile connectivity, limited connectivity with industry centres, and congestion; road transport suffers from uncontrolled pricing; air transport experiences inadequate cargo infrastructure in regional airports, limited routes and flight schedules; and water transport by inland waterways suffers from inadequate navigation infrastructure, frequent checks, lack of modern terminals, seasonal variations in river levels, etc.

The proposed recommendations include Dedicated Freight Corridors to reduce congestion; upgradation and modernization of railway infrastructure; technological innovation, including GPS tracking; automation for safety/security and loading/unloading of cargo; adoption of green energy or fuel-efficient vehicles; dedicated truck lanes and freight consolidation centres; multi-modal logistics parks; modern cargo-friendly airports in non-metro cities; deeper and wider navigation channels to ensure continuous, year-round navigability in the rivers; multi-modal terminals to seamlessly integrate with rail, road, and sea transport; and so on.

Besides, it is recommended that a specific set of questions be added to the questionnaires of Enterprise Surveys, conducted annually by Ministry of Statistics and Programme Implementation (MoSPI). These surveys are Annual Survey of Industries (ASI) and Annual Survey of Unincorporated Sector Enterprises. The questions may relate to the cost incurred on different components of Logistics. This will be an important data input to the annual estimation of logistics cost through the existing data collection mechanism.

1 Introduction

1.1. Background

Logistics plays a vital role in the economic development of any country by enabling the smooth and efficient movement of goods and services across geographies. In a rapidly growing economy like India, the logistics sector acts as the backbone of trade and commerce. Its performance directly influences the cost competitiveness of businesses, productivity across sectors, and the ease of doing business. An efficient logistics ecosystem is critical, not only for facilitating domestic trade but also for integrating India into global supply chains. This calls for the optimisation of expenditure on logistics.

High logistics costs can be attributed to various factors, including infrastructural bottlenecks, fragmented supply chains, regulatory hurdles, and inefficiencies in multimodal connectivity and last-mile delivery systems. Recognising the adverse impact of high logistics costs on trade competitiveness and economic growth, the Government of India has taken significant steps to reform and modernise the logistics landscape.

Among these, the proclamation of the National Logistics Policy (NLP) in September 2022 stands apart as it explicitly outlines goals with timelines.

The three broad targets of the NLP-2022 are:

- To reduce logistics cost in India to be comparable to global benchmarks by 2030;
- To be among the top 25 countries in the Logistics Performance Index ranking by 2030; and
- To create a data-driven decision-support mechanism for an efficient logistics ecosystem.

Complementing the effort laid out in NLP is the PM Gati Shakti National Master Plan, which promotes integrated infrastructure development through inter-ministerial coordination and data-driven planning. In the maritime sector, the Sagarmala programme has modernised ports, enhanced last-mile and hinterland connectivity, and promoted coastal shipping. One Nation, One Port Process by Ministry of Ports Shipping and Waterwyas to standardise and streamline port processes across the country.

At the land borders, Integrated Check Posts (ICPs) by Land Ports Authority of India (LPAI) have streamlined cross-border flows by integrating customs, immigration, and security processes, while projects under Bharatmala have strengthened corridor-based connectivity to key gateways. Airports, too, have witnessed world-class upgrades, with expanded cargo terminals, dedicated air freight stations, and modern handling facilities that have improved turnaround times and reliability. Complementing this, digitalisation efforts through port community systems, electronic data interchange (EDI), and unified logistics platforms have further advanced efficiency, transparency, and coordination across stakeholders.

While these policy reforms and infrastructure investments are expected to yield substantial long-term benefits, there remains an urgent need for a robust, data-driven assessment of India's current logistics costs. Existing estimates vary considerably due to differences in methodology, scope, and data availability.

It, therefore, becomes important to develop a full understanding of the:

- Global benchmarks available
- Methodologies applied for developing these benchmarks
- Feasibility of applying these methodologies to the Indian context
- Best possible methods to measure logistics costs in India given current data limitations, and
- Methodology to derive logistic costs if newer sources of data become available.

In this context, the Department for Promotion of Industry and Internal Trade (DPIIT) earlier constituted a taskforce, comprising members from the NITI Aayog, the Ministry of Statistics and Programme Implementation, National Council of Applied Economic Research (NCAER), international academic experts, and other stakeholders, to estimate the current logistics-cost-to-GDP ratio based on available secondary data sources. Using these sources, the NCAER's 2023 report produced an estimate of logistics cost, which was in the range of 7.8 to 8.9 per cent of GDP for 2021-22.

The present report, however, is based on a comprehensive study using both secondary data and primary survey data to not just estimate the aggregate logistics cost for 2023-24, but also estimate the values of its components and sub-components.

This study also developed a comprehensive framework for future estimates of Logistics Cost in India. This is important given the government's plans and scale of investment in developing infrastructure, to make the movement of goods smoother and faster. Hence, it is imperative to develop a mechanism to estimate logistics costs on an annual basis. It is also equally important that the mechanism is able to provide tangible policy advice on ways to reduce logistics costs.

1.2. Defining Logistics and Logistics Costs

Understanding logistics costs begins with recognising the broad range of activities that comprise the logistics process. These include order processing, inventory management, warehousing, transportation and shipping, material-handling and storage, packaging, and monitoring. The relative contribution of each of these components to total cost varies significantly across countries, industries, and firm-level operations.

Despite its strategic importance, estimating logistics costs is far from straightforward. The logistics system involves numerous and often fragmented processes, and acquiring detailed information for each—ranging from transportation and warehousing to capital depreciation—is inherently difficult (Farahani et al., 2009). Strategic and operational choices made at the firm level can further limit the availability and visibility of cost-related data (Pohlen, Klammer & Cokins, 2009).

The challenge is compounded by the growing trend in outsourcing. According to Langley (2008), approximately 81 per cent of international transportation and warehousing activities are outsourced. While outsourcing can improve efficiency, it also complicates cost estimation—particularly when logistics services are bundled with other offerings. Disaggregating the specific costs of logistic functions from broader service contracts becomes a difficult task (Rantasila, 2013).

An additional layer of complexity arises from the absence of a common definition or framework for supply chain management. Without standardisation, firms often adopt different approaches to cost estimation, leading to inconsistency across sectors and countries (Pohlen et al., 2009). Moreover, the lack of sufficient, reliable data remains a persistent barrier in developing a consistent macro-level understanding of logistics costs.

Literature on logistics costs has explored different frameworks for cost categorisation. One influential perspective comes from Lambert, Grant, Stock, and Ellram (2006), who emphasise a 'total cost' approach. They argue that focusing on optimising one logistics function in isolation may inadvertently increase costs in another area, thereby driving up overall logistics cost. Their classification includes components such as customer service (including costs related to lost sales and product returns), transportation (which varies based on product characteristics and market conditions), warehousing (covering storage and facility setup), and inventory-carrying costs (including capital costs and risk-related costs). They also include costs related to procurement and production, which are affected by order size and frequency, as well as expenses tied to order-processing and information systems.

Other scholars offer simplified categorisations. Sopple (2007) narrows the cost structure to transportation, storage, and inventory, while Rushton, Croucher, and Baker (2006) include administrative costs alongside transportation, inventory-carrying, and warehousing. Ayers (2006) adds another dimension by identifying purchased materials and associated labour as a separate cost group.

A widely recognised definition from the Council of Supply Chain Management Professionals defines logistics as "that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption to meet customers' requirements." This emphasises not only the physical movement of goods but also the management of information and services along the supply chain.

Despite the varied approaches and definitions, no globally accepted nomenclature exists for logistics cost components. Addressing this gap, the National Logistics Policy (NLP) 2022 defines logistics to include the transportation and handling of goods from the point of production to the point of consumption, along with storage, value addition, and allied services. These allied services may include a wide range of supporting activities, such as labeling, packaging, documentation, and information exchange.

The role of logistics infrastructure is also crucial in cost determination. This infrastructure includes nodes such as ports, railway stations, warehouses, and multimodal logistics parks (MMLPs), interconnected through a variety of transport modes—roads, railways, inland waterways, coastal shipping, air routes, and pipelines. The effective operation of this network depends on a skilled workforce and the integration of appropriate technologies and systems.

In practical terms, logistics costs refer to all expenditures incurred in moving a specific volume of cargo from one point to another. These include the costs of transportation, order processing, inventory management, warehousing, material handling, packaging, customs clearance (particularly in cross-border trade), and information management. Each component plays a significant role in shaping the total logistics expenditure.

Recognising the importance of these costs, governments and industries around the world are increasingly investing in strategies to reduce logistics costs. Improvements in infrastructure, digital integration, and policy reforms are being pursued to enhance efficiency, promote trade competitiveness, and strengthen the economic performance of nations in the global marketplace.

On the macroeconomic scale, logistics costs are an important factor in the competitiveness of a nation. Given the acceleration in logistic activities over the last few decades due to the agglomeration of inter-firm activities and increasing competition among nations, the importance of a unified and reliable way to measure logistics costs is crucial. Most of the developed countries compute logistic costs on a regular basis and use performance indicators for logistic activities to measure their efficiency levels. For India too, measuring national logistics costs is essential to know where it stands vis-à-vis its competitor countries. Equally important is to identify the factors where there is scope to optimise costs.

1.3. Components of Logistics Costs

At the outset, it is important to understand the elements that determine logistics costs. The most commonly identified functions of the logistics process are:

- Transportation and shipping – information that directs inventory movement; making sure that the required transportation equipment is available, and that the required transactions documentation is in place.
- Order-processing – checking the orders for any change in negotiated terms including prices, payment terms, and delivery schedules; inquiring about the availability of stocks; and production and material planning.

- Inventory management – maintaining sufficient inventories to meet the demand in time while also keeping carrying cost to a minimum.
- Warehousing – storage of finished items until they are delivered. Efficient warehousing ensures that goods are delivered to customers when demand is high, or production is low.
- Material handling and administration – refers to the process of moving goods around the warehouse so that orders are fulfilled quickly and accurately.
- Packaging - includes all the activities and operations implemented to prepare goods for handling and transportation to customers. It has to be compliant with safety and other regulations.
- Monitoring – this involves checking the movement of goods, inventory levels, delivery status, etc. Sophisticated monitoring tools may be deployed for this.

Cost is associated with each of these functions. At a broad level, the most common logistics cost components are: transportation costs, warehousing costs, inventory carrying costs, administration costs, and packaging costs. These can be categorised into direct costs and indirect costs, each further classified into function-related costs and overheads.

Direct Function-related Costs

Direct function-related costs are usually the kind of costs caused by tangible logistics functions that are easily identified and traced back to a specific activity. The costs belonging to this group include transportation and warehousing costs that are commonly perceived as logistics costs. These are directly linked to a certain activity like transporting goods from the factory to a wholesaler.

Direct Overhead Costs

These expenses arise from operations that are compulsory for a company in order to offer its products to customers. These costs can be directly linked to logistics functions, like inventory-carrying costs or other related operations, but still cannot be allocated to a sole logistics activity (e.g., a single truckload). It is important to note the difference between warehousing costs, which are direct and function-related costs, and inventory-carrying costs that occur when capital is tied to the inventory itself.

Indirect Function-related Costs

Indirect function-related costs are expenditures that are not directly linked to a sole logistics function but rather to an activity. It is impossible, for example, to allocate the cost of packaging material or a new forklift to a specific transported product. However, these supporting functions are essential for smooth logistics activity.

Indirect Overhead Costs

Indirect overhead costs are costs that arise when logistics activities are not working as planned. The costs in this group are only incurred in the case of a failure in logistics functions, like delayed deliveries, lost sales, or unsellable goods. Even when such problems are avoided, taking preventive measures—such as maintaining a buffer stock or investing in risk management—can still lead to additional costs.

Logistics costs should attempt to estimate all of these components of costs from published official or private sources, primary surveys using structured questionnaires, or stakeholder interactions. In reality, most logistics cost estimates do not incorporate the value of time or other items listed under indirect overhead costs in Table 1.1.

Table 1.1. : Cost Components by Functionality

Function-related costs	Overhead costs	
Direct function-related costs	**Direct overhead costs**	Direct logistics costs
Transportation Cargo handling Warehousing Custom clearance logistics Documentation IT hardware, software Maintenance costs Other direct activities	Inventory carrying cost Other related operations	
Indirect function-related costs	**Indirect overhead costs**	Indirect Logistics Costs
Packaging material Packaging Logistics equipment cost Other fixed capital cost Administration Other supporting functions	Lost sales Employing customer service agents Nonmarketable goods Other logistics related trade-offs	

Source: Pohit et al. (2019) 'Survey of Literature on Measuring Logistics Cost: A Developing Country's Perspective.' Journal of Asian Economic Integration, 1 (2): 260–82.

1.4. Objectives of the Study

The broad objective of the study is to estimate logistics costs for India, and to determine its ratio to GDP and to other key data metrics, like industrial and agricultural output.

Box 1.1. : Scope of the Study

1. Calculation of logistics costs:
   - At an aggregate level
   - Per tonne per km (product-wise-OD – mode-wise matrix)
   - As per cent age of the value of produce
2. Identify the components of total logistics cost like transportation, cost of carrying inventory, handling, warehousing, etc., and calculate their percentage share to total logistics cost.
3. Unbundle the component costs, and break them down into sub-components; for example, transportation cost will be separated into fuel charges, labour cost, material handling cost, etc.
4. Identify dynamic contributors to the components of logistics costs which will aid in pinpointing strategy and policy reforms. The effect of these determinants on overall costs can then be visualised.
5. Develop a roadmap for the policy establishment in the form of strategic recommendations that can be categorised, based on transportation modes, commodity levels, stakeholders, and/or time span needed for implementing the recommendations.
6. Create a data-driven decision support mechanism/framework that can aid the policy makers in carrying out logistics cost analysis (periodically) to measure any change for an efficient logistics ecosystem.

1.5. Structure of the Report

This report is structured as follows. This chapter provides the context of the study; defines logistics and logistics costs; discusses the broad components of logistics costs; and lays out the objectives and scope of the current study. Chapter 2 presents a review of the literature to discuss various methodologies for the estimation of logistics costs. It also presents the specific methodologies adopted by several countries to derive their logistics costs. Chapter 3 details the methodology adopted for this study, outlining the different sources used to obtain the relevant data, including primary and secondary data. The findings of the study are presented in Chapter 4, which is further divided into sections, each presenting insights from a specific mode of transport. Finally, the last chapter presents the way forward

2 Global Practices And Cost Estimates

Many studies have estimated logistics costs for single or multiple countries. Research shows that the methods used to measure logistics costs for individual companies (micro-level) are not suitable for estimating costs at the national level (macro-level). Instead, researchers adapt methods based on data availability and reliability. Rantasila (2013)[1] suggests three alternative approaches for studying logistics costs at the macro level.

1. **Survey-based studies:** Such studies rely on information collated through structured/semi-structured questionnaires, which provides estimates of logistics cost from the perspective of key stakeholders in the industries. Typically, the questionnaires are canvassed to key persons (such as chief operating officers) in industries, with a view to soliciting the logistics cost of their respective industries. Their responses are aggregated by a suitable weighing scheme to arrive at the logistics costs for a country.
2. **Statistical studies:** These studies use statistical models and secondary data, like national accounting statistics, to derive the level of logistics cost in a country.
3. **Case studies:** Case studies typically address the issue at a micro level or for a specific industry. The information in this method is obtained through in-depth interaction with the relevant and knowledgeable persons of that industry.

The earliest attempt to measure logistics costs at the macro level was made by Heskett, Glaskowsky, and Nicholas in 1973.[2] They classified the logistic cost as the sum of four activities: transportation, inventory, warehousing, and order-processing. They adopted a modelling approach for estimation purposes, which has undergone several refinements.

Bowersox (1992)[3] modified Heskett et al.'s (1973) method to assess global logistics requirements. He presented an estimation of global logistics costs based on four components:

- Gross Domestic Product (GDP)
- Government Sector Product
- Industrial Sector Product
- Total Trade Ratio

Total Gross Domestic Product and Total Trade Ratio were included to size individual economies. And both government sector product and industrial sector product were included to capture expenditures related to the logistics activities of transportation, inventory, and warehousing.

In 1998, Bowersox[4] improved the earlier model by introducing an Artificial Neural Network (ANN) approach to assess logistics costs. This methodology expanded the scope of the previous approach by including infrastructure variables related to cost and information systems. The model is based on a biological emulation of the nervous system and uses five input variables:

1 Rantasila, K. (2013). Measuring Logistics Costs, Turku School of Economics.

2 Heskett, James L., Nicholas Glaskowsky, Jr., & Robert M. Ivie. (1973). Business Logistics, Physical Distribution and Materials Management. New York: Ronald Press Co.

3 Bowersox, Donald J., & M. Bixby Cooper. (1992). Strategic Marketing Channel Management, McGraw-Hill.

4 Bowersox, Donald, & Roger J. Calantone. (1998). 'Executive Insights: Global Logistics,' Journal of International Marketing, Vol. 6, No. 4, pp.83-93.

geographic region variables, economic variables, income-level variables, transportation variables, and country-size variables. These input variables are entered into the ANN model to give output as the national-level logistics cost.

Later, Bowersox et al (2005)[5] presented logistics costs as a percentage of GDP for 24 selected countries. Even though the study does not provide individual cost components of logistics costs, it still made an important contribution to estimating global-level logistic costs.

Rodrigues et al. (2005) improved Bowersox's ANN method by introducing new input variables. One of the challenges to any country-level-based research is the availability and reliability of data. To minimise these problems, and to be able to use the same type of data across countries, available economic and infrastructure information was used to capture the relationship between country characteristics and national logistics costs. The main source of data was the *World Development Indicators*, published by The World Bank (2002). This edition largely contains information for the year 2000. All the variables were obtained from this source, except for information on coastlines and maritime freight, which came from the *CIA World Fact Book* (Central Intelligence Agency 2000), and UNCTAD (2001).

The input variables were selected from previous studies, such as Bowersox and Calantone (1998) and Delaney and Wilson (2003). In addition, an attempt was made to control not only for country size, but also for geographic region and income level. Finally, transportation variables related to volume were included in the current estimation.

The economy-related variables included GDP (PPP, in USD); imports (USD); exports (USD); trade openness (imports+exports as a per cent of GDP); and gross value added of the three broad sectors of the economy – agriculture, industry, services (all as a per cent to GDP). The transportation variables included maritime freight (million tonne); road freight (million ton-km); rail freight (million ton-km); and air freight (million ton-km).

To ensure that this group of variables would be a representative predictor of logistics expenditures, the correlation matrix between this group of variables and the 1996 logistics national cost estimated in Bowersox and Calantone (1998) was analysed. All the variables had a significant statistical correlation with the estimates.

A variation of this model has been widely used by Armstrong and Associates (2017) to estimate logistics costs for major and emerging economies around the world (Box 2.1.). The ANN approach uses input variables like geographic region, economic indicators, income levels, transportation, and country size to estimate logistics costs at a national level. Their methodology is most applicable to countries with robust, reliable data—typically developed economies.

5 Bowersox, D., A. Rodrigues, & R. Calantone. (2005).'Estimation of Global and National Logistics Expenditures: 2002 Data Update.' Journal of Business Logistics, Vol. 26 (2), 1–16.

Box 2.I. : Model Used by Armstrong & Associates Inc.

In this statistical approach, the logistics cost of a country—as a percentage of its GDP—is estimated by incorporating observed data related to economic and infrastructure variables into the model. These variables act as the independent inputs and are usually available from sources like the World Bank database. For developed countries, logistics cost estimates are often available through alternative methods. These countries are used as 'control' countries to train the neural network model. Once the model is developed using data from these control countries, it is then used to estimate logistics costs for other countries by feeding in their respective input variables.

This method highlights that supply chain management capabilities vary from country to country, mainly for two reasons: 1 flow of information and control systems, and 2 physical limitations such as infrastructure for roads, railways, waterways, and airways.

Typically, estimates of logistics costs as a percentage of GDP in developed countries are also available from alternative methods. So, one estimates a neural model for the control countries, which are basically developed economies. Once the ANN model is estimated for the control countries, the input variables for any country can be entered into the model to estimate its logistics costs as a percentage of its GDP.

While this is a commendable effort, applying a model trained on data from developed economies to developing countries may not provide accurate results. This is because for a developing country like India, where transaction costs are fairly high in terms of both expenditure and time, and the quality of physical infrastructure is inefficient, the application of the ANN model estimated from developed economy data may provide misleading results. Besides, the share of manufacturing output in GDP in a developed economy is lower than in a developing economy. The volume of movement of manufacturing goods, which is the determining factor for logistics cost is consequently expected to be lower in a developed economy. So, the model's estimation based on control country data may provide an incorrect estimate of the model parameters.

When the availability of data for deploying statistical methods is a limitation, survey methods are used, where information is collected through direct interviews with the companies that provide logistics services. The data collected through sample surveys are usually self-reported data but, in some cases, can also be obtained from the companies' financial statements.

The survey-based data are usually supplemented with available secondary data. According to the logistics literature, there are two main approaches to estimating logistics costs using survey-based methodology: top-down and bottom-up.

The top-down approach breaks down data from national accounts to estimate the costs of transport, storage, and other components of logistics. On the other hand, the bottom-up approach calculates logistics costs by compiling detailed data on transportation and warehousing, and linking it to specific products. Most developed countries adopt the bottom-up approach to estimate logistics cost. This approach is more data-intensive. However, as the logistic sector is more organised in developed countries, respective industries collate these data for their own use and the governments of the respective countries also maintain such databases. Example USA used secondary data, including BEA input-output accounts, industry data, S&P Global transresearch and public company financial statements in estimating the cost.

In contrast, developing countries usually rely on the top-down approach due to limited data availability. However, this method needs to be supported with surveys for the following reasons:

- Compiling of national accounts statistics at a disaggregated level depends on various parametric estimates from survey data, which are not up-to-date. For this reason, surveys are recommended to obtain up-to-date estimates of these parametric elements of logistics cost.
- Some elements of logistics may not be directly available in the National Accounts Statistics; thus, one may need to undertake a survey.

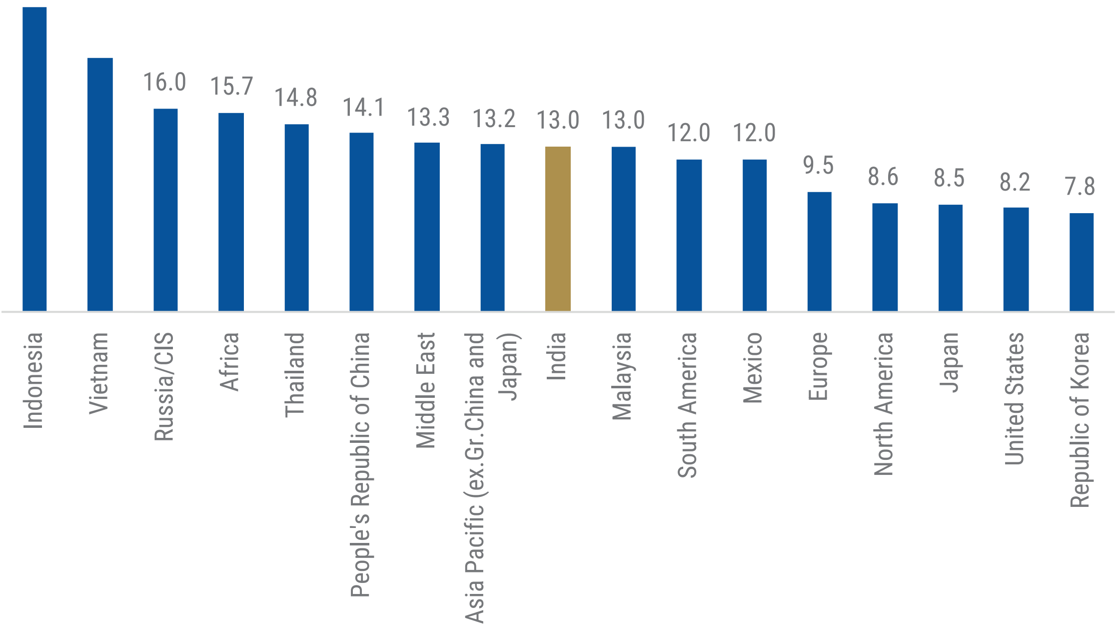
Some countries adopt a hybrid approach (a combination of the top-down and bottom-up approaches) which has the following advantages over other commonly applied methods:

- Aggregated and disaggregated approaches are entirely independent in their methods of analysis and sources of data. This not only allows for logical checks, but also for an assessment of the propensity to outsource logistics tasks.
- The aggregated approach builds up logistics costs from the most detailed input elements. This is in contrast to methods commonly used to extrapolate cost data based on sample surveys. The validity of the data can be verified at the primary source before any aggregation takes place.
- The aggregate approach can be undertaken on a MS Excel spreadsheet platform. So, one can undertake sensitivity analyses by varying the parameters of the model (such as mode of transport, cost per ton km, packaging cost, etc.)
- The model focuses research on the refinement of individual input elements. It would even be possible to add more layers for the analysis of a particular industry in more detail.

2.1. Logistics Cost Estimates Across Countries

Using an ANN model, Armstrong and Associates provided cross-country comparisons and found that, in 2016, logistics costs in developing countries generally ranged between 11 per cent and 15 per cent of GDP. However, there were notable differences among major Asian countries. For example, logistics costs in Indonesia were relatively high at 24 per cent of GDP, while in South Korea they were much lower at around 8 per cent (Figure 2.1).

Figure 2.1.: Logistics Costs for Key Regions and Countries (as per cent to GDP, 2016)



Source: Armstrong and Associates report (2017)

The US Business Logistics Cost (USBLC) is published annually in the *State of Logistics Report*, produced by the Council of Supply Chain Management Professionals (CSCMP). Logistics cost is estimated using secondary data which includes Input-Output Table Accounts, S&P Global US Freight Transport database 'Transearch', US Bureau of Transportation Reports, and other government sources. The USBLC is estimated as the summation of its three components – transportation cost, inventory carrying cost, and other cost.

Inventory carrying costs should ideally include capital cost for holding inventory; inventory service cost consisting of taxes and insurance; cost of storage in public/private warehouses and in own/rented spaces; and inventory risk cost, which includes charges for damages, obsolescence, and relocation. However, it is not clear whether all of these components are included in the international studies which are discussed below.

According to the 2025 *State of Logistics Report* by CSCMP, the USBLC stood at USD 2.58 trillion in 2025, which is 5.3 per cent higher than the previous year, when the cost was recorded as USD 2.45 trillion. Despite the growth, its share in the respective year's nominal GDP remained unchanged at 8.8 per cent in 2025. Transportation cost remains the largest component, accounting for about 63 per cent of the total cost. Inventory carrying costs contribute another 30 per cent and the remaining 7 per cent is on account of other costs—including support and administrative services.

Thailand estimates its national logistics cost using an ANN model, utilising 21 input variables drawn from the EPIC Supply Chain Risk Assessment framework and other sources such as the Logistics Performance Index (LPI). The EPIC framework incorporates secondary country-specific data across four key dimensions—economy, politics, infrastructure, and competence to arrive at the logistics cost as a per cent of GDP. Also, it validates calculation assumptions with an empirical survey of 6,000 firms.

Based on this methodology, Thailand's total logistics cost in 2023 is estimated at 2,527.4-billion-baht, accounting for 14.1 per cent of GDP, marking a 3.7 per cent increase from the previous year. Transportation costs constituted 1,195.1 billion baht (47.3 per cent of total cost), while inventory holding costs, including warehousing, totalled 1,144.2 billion baht (45.3 per cent of total cost). Administrative costs accounted for the remaining 7.4 per cent, at 188.1 billion baht.

The components of logistics cost in Korea comprise of transportation, inventory holding, packing, stevedoring, information, and administrative costs, classified into public and private segments. Most data are sourced from official ministries, industry chambers, and annual reports.

Public road transport costs are derived from revenue data across freight and delivery services. Due to the absence of official data for private road transport, the Korea Transport Institute (KOTI) developed an independent methodology incorporating material (fuel, oil, tires), labour, insurance, maintenance, depreciation, tolls, and indirect costs, calculated by vehicle type, tonnage, and usage. Historically, total logistics costs ranged between 14.8 per cent to 16.3 per cent of nominal GDP (1991–99). In 2023, it declined to 13.6 per cent of nominal GDP.

Indonesia's logistics cost model, developed by the Centre for Logistics and Supply Chain Studies (CLoCs) at the Bandung Institute of Technology (ITB), combines methodologies from the US, South Africa, and South Korea. It also estimated logistics costs as a percentage of GDP, covering transportation, inventory handling, and administration. Transportation costs are estimated using models from the US (CASS system) and South Korea (KOTI), while inventory costs follow the KOTI model. Administrative costs are based on the US and South Africa's approach, computed as a proportion of transportation and inventory costs.

As the estimates highlight, in Indonesia, the logistics administration fee is set at 4 per cent of the inventory handling and transportation costs. However, the cost has been estimated using bottom-up approaches encompassing companies in four business sectors—transportation, manufacturing, agriculture (including livestock, forestry, and fisheries), and mining (to calculate inventory costs).

The classification of these business sectors follows South Africa's Council for Scientific and Industrial Research's (CSIR) measurement model of logistics costs, since South Africa and Indonesia have similar economic structures and natural resources. Notably, Indonesia's logistics costs amounted to 23.5 per cent of GDP in 2021, decreasing to 14.3 per cent of GDP in 2023. The Indonesian government aims to reduce this figure to 8 per cent of GDP by 2045. This improvement is driven by various initiatives, including the National Logistics Ecosystem *(NLE) project, which has significantly reduced processing times and costs.*

In 2023, China estimated its logistics costs as 14.4 per cent of its GDP. This represents a decrease from the 18 per cent share in 2012, indicating a downward trend in overall social logistics costs. China's approach to estimating these costs likely involves a combination of statistical data, surveys, and analysis of various logistics activities like transportation, warehousing, and inventory management.

There is significant room to improve logistics efficiency in China, and the country has rolled out a plan to cut the ratio of social logistics costs-to-GDP to approximately 13.5 per cent by 2027, through high-quality development of modern logistics by adjusting structures, deepening reforms, and optimising logistics resource allocation.

2.2. Historical Logistics Cost Estimates for India

There are a few studies by private organisations, academic institutions, and research think tanks which have calculated logistics costs for India, often highlighting the fact that India has high logistics costs.

The most widely cited of these is by Armstrong & Associates, which using the Artificial Neural Network Model estimated logistics costs to be 13 per cent of GDP for 2016. The weaknesses of this model have been discussed earlier. Besides, information on the comprehensiveness of the data and its sources is not available in the public domain.

Another study by AVALON Consulting, done for the Confederation of Indian Industries (CII), estimated the cost to be 10.9 per cent of the gross value added (GVA) in 2015. This study used the questionnaire-based approach to estimate logistics costs, where stakeholders in major industries were asked to report their assessment of logistics cost as a per cent of the gross value added. These were then weighed to arrive at an estimate of the logistics costs for India, taking into account the sectoral contribution to the economy.

In a 2019 study, the NCAER adopted a hybrid approach and estimated India's logistics costs using primary survey data of 1,120 logistics players, as well as secondary data from India's Supply and Use Tables (SUT). The study asserts that any estimate of logistics costs derived from the SUT is consistent with GDP estimates, as SUT portrays the circular flows of goods and services in the economy. The study estimated the logistics cost to be 8.1 per cent of GDP in 2017-18, and also derived the values of its components.

In 2023, NCAER conducted a quick assessment study and derived tentative estimates of logistics cost and its components using SUT data only. The study estimated this cost to lie in the range of 7.8-8.9 per cent of GDP for 2021-22. It recommended that a comprehensive study be undertaken to arrive at more plausible estimates of logistics cost, and also provide disaggregated information on logistic costs associated with various product groups and supply chains, and across different locations within India.

The present study is an outcome of this recommendation, as it adopts the hybrid approach by considering data from a primary survey conducted on both users and providers of logistics services, as well as data from SUTs and NAS to assess the logistics sector ecosystem in a more holistic way.

3 Methodology

As mentioned earlier, the methodology adopted in this study is based on the hybrid approach, which involves combining primary data collection through surveys with secondary data analysis using statistical methods, to provide a comprehensive picture of logistics costs. The secondary data used for the study are Supply and Use Tables (SUTs, for domestic transportation cost, other than railways); National Accounts Statistics (for railway transportation cost, and storage and warehousing cost); balance of payment statements (for international transportation cost borne by Indian companies); and GSTN E-way bill data (for the development of a sampling plan for a primary survey). Each of these are discussed in detail below. This is followed by the description of the primary survey, including its sampling plan and methodology.

3.1. Secondary Data Research

3.1.1. Supply and Use Table (SUT)

The most relevant secondary data, which provides the government estimate of aggregate freight transport cost, is the Supply and Use Tables (SUT), prepared and published by the Ministry of Statistics and Programme Implementation (MoSPI).

The SUT, which comprises two tables, is a comprehensive representation of all economic transactions between all sectors of an economy, that result in income generation during a particular reference period. The Supply Table describes how goods and services become available in an economy during a certain period of time. Products are either produced by domestic industry or imported. The Use Table shows how goods and services are used in the economy during a certain period of time. These conform to the internationally standardised data compilation and collation framework.

Both the Supply Table and the Use Table are matrices of products and industries, where products are shown in rows and industries in columns. The Supply Table is prepared in basic prices, whereas the Use Table is in purchaser's price.

Basic price is the amount receivable by the producer from the purchaser for a unit of a good or service. These basic price is calculated by deducting any tax payable and by adding any subsidy receivable, as a result of production or sale of the unit. Purchaser's price is the amount paid by the purchaser. This includes any taxes payable (less any subsidies receivable) on production and imports, any transport charges paid separately by the purchaser to take delivery, and the retailers' margin.

Due to different valuations in the Supply Tables versus the Use Tables, additional columns are included in the Supply Table to complete the valuation gap between total use and total supply of products. These additional columns for valuation adjustments are Trade and Transport Margins (TTM) and Net Indirect Taxes (NIT).

Table 3.1. : Additional Columns in the Supply and Use Tables

	Additional Columns
Supply Table	Imports showing values of imports of products Trade and transport margins (TTM) Indirect taxes less subsidies on products (NIT)
Use Table	Private final consumption expenditure Government final consumption expenditure Gross capital formation Exports

The 'Trade and Transport Margin' column covers trade margins and the transport cost of goods, or freight costs, from the place of the seller (factory) to that of the purchaser (factory or store).

- For all agriculture and manufactured products, TTM values are a combination of trade and transport margins.
- For services, the TTM value is zero as it involves neither trade nor transport margins.
- The entire Trade margin is provided against Trade row and entire Transport Margin is provided against rows of Transport Services, both in negative entries. These values against Transport Services depict the total Freight cost.

The transport services for which these freight costs are available in the Supply Table are:

- Railway transport
- Road transport
- Water transport
- Air transport
- Supporting and auxiliary transport activities

The values of TTM for the above items include the values of freight cost for each type of transport, as well as the cost of supporting and auxiliary services for each of the transport services. The support services include services such as switching and shunting (for railways), parking charges (in land transport), fire-fighting services (for air transport), cargo handling in all types of transport services, and the service charges of travel agents. Most commonly, support services can be referred to as Material Handling services. Therefore, the SUT can provide the official estimates of freight transportation by all modes of transport.

However, SUTs are available with a lag of about 2-3 years. There are other limitations due to which SUTs cannot be used for a comprehensive assessment of logistics costs. These are given in Box 3.1 The latest available SUT is for 2021-22. But the reference period of this study is 2023-24. To project the transport cost for this year, another important secondary source is the NAS (also published by MoSPI). It should be noted that the freight transport cost for railways is directly available in the NAS, while the cost of other modes of transport is extrapolated using NAS statements.

Box 3.1. : Limitations of using Secondary Data

The SUTs provide a reliable estimate of freight transport costs as TTM. However, TTMs are derived numbers and may not reflect the actual estimate of transport costs. Further, the use of SUTs does not encompass all the components of logistics costs. Most importantly, it does not provide the value of the inventory carrying cost borne by industries on the goods which are kept in their factories/godowns, etc. These components are, therefore, obtained through the survey with the industries.

Moreover, SUTs do not provide the following disaggregated information that is critical for policymakers:

- Freight transport costs by mode of transport for all the transportable commodities given in the SUTs;
- Route-wise logistics costs to determine which are efficient and inefficient routes;
- Routes exhibiting the fastest growth of freight traffic and where investments are required; and
- Congestion points of freight traffic where policy action is required.

3.1.2. National Accounts Statistics

The National Accounts Statistics (NAS), published by MoSPI, presents detailed statements on the sectoral values of output and gross value added (GVA). The data on output and GVA are provided for all major economic sectors, including those which are required to estimate logistics costs—that is, transport, storage, and warehousing. Transport output is available by all modes of transport, but not disaggregated into passenger and freight (except for railways). Using the data and past trends in the ratio of freight transport cost-to-total transport output, the values of freight transport cost (or TTM) were derived for the reference year 2023-24.

The NAS also provides the value of output for the storage and warehousing sector. This covers all storage and warehousing output, comprising both public and private components.

3.1.3. Balance of Payment, RBI

Freight transportation costs obtained from the SUT represents the cost of movement of freight through domestic transport service providers. However, in addition, there are international transport service providers. The value of transport services provided by these international providers encompasses the movement of passengers and freight, along with other related transportation services, between residents of different economies. The values of these services are available in India's Balance of Payments (BoP) statement (as per BPM6), published by the Reserve Bank of India (RBI) on a quarterly basis.

The BOP statement in the BPM6 (*Balance of Payments and International Investment Position Manual,* 6th Edition) is a comprehensive statistical statement that summarises economic transactions between residents and non-residents for a specific period. It provides credit and debit values for each type of transaction. In the case of transport services:

- credit values represent the value of exports of transport services, that is, the earnings of resident carriers (e.g., airlines and shipping companies) when they provide transport services to non-residents. For example, an Indian shipping company transporting goods for a foreign firm is counted as a credit (export of service).
- debit values represent the value of imports of transport services, that is, payments made by residents to non-resident carriers for transport services provided to them. For example, an Indian importer paying a foreign shipping company to deliver goods to India is counted as a debit (import of service).

Therefore, the debit values against transport services refer to the transportation cost borne by Indian residents on international transport services. Transport services comprise the carriage of people and goods from one location to another by air, sea, rail, road, or pipeline, as well as related supporting and auxiliary services. Within each mode of transport, transport services include:

- international freight, which refers to the carriage of goods, including associated services like insurance and warehousing;
- passenger transportation or transportation of individuals (tourists or other travellers); and
- auxiliary services such as cargo-handling, storage, port and airport services, charges for the use of transport infrastructure, and rental of transport equipment (without crew).

To derive the logistics costs on international transport services, freight and auxiliary services are taken into consideration. These values are available separately in the BoP statement. The combination of domestic freight transportation cost (as obtained from the SUT) and international freight transportation cost (from the BoP 2023-24) presents the complete coverage of transportation cost, under logistics costs.

3.1.4. E-way Bill Data

E-way bill is an electronic document required for the movement of goods in the country. This document must be generated on the e-way bill portal when transporting goods worth more than Rs 50,000. Therefore, this data is supposed to cover almost all freight movements. The data is maintained by Goods and Services Tax Network (GSTN).

There are two parts in an E-way Bill – Part A and Part B. The parameters for which information are collected in these are as follows:

PART A:

1. Supply Type – whether Outward or Inward
2. Sub-Type – whether domestic supply; or Export; or Job work; or Semi-Knocked Down (SKD) or Complete Knocked Down (CKD) Lots; or for own use; or for Recipient not known; or for Exhibition; or for Line sales; or others
3. Document Number
4. Document Date
5. Transaction Type – Regular, Bill to-ship to, Bill from-dispatch from
6. Bill From (details of sender firm):
    a. Name of firm
    b. GSTIN
    c. State
7. Dispatch From:
    a. Address
    b. Place
    c. PIN Code
8. Bill To (details of recipient firm):
    a. Name of firm
    b. GSTIN
    c. State
9. Ship To:
    a. Address
    b. Place
    c. PIN Code
10. Item Details:
    a. Product Name
    b. Description
    c. HSN Code
    d. Quantity
    e. Unit of quantity
    f. Value of product
    g. Central Goods and Services Tax (CGST) and State Goods and Services Tax (SGST) Rate
    h. Inter-state Goods and Services Tax (IGST) Rate
    i. Cess Rate
    j. Total Value
11. Transportation Details
    a. Transporter ID
    b. Transporter Name
    c. Approximate Distance – (auto-calculated using PIN to PIN)

PART B

12. Mode – Road/Rail/Air/Ship
13. Vehicle type – Regular/Over dimensional Cargo
14. Vehicle No.
15. Transporter Document Number and Date

Given the colossal amount of data, a few selected parameters were obtained from GSTN. These included eight parameters, namely, month and year of the transaction, HS-code of the product which is transported, source state, destination state, source pin-code, destination pin–code, sub-supply type and value of commodity moved by each Origin-Destination (O-D) and HS code wise. The data provided was aggregated on value of products moved between 2 pin-codes during a month.

In order to capture the distance travelled between origin and destination, the latitudes and longitudes of the source and destination pin codes were mapped, using the *All India Pin Code Directory*. Distance groups were then created which divided all the movements into the following nine categories:

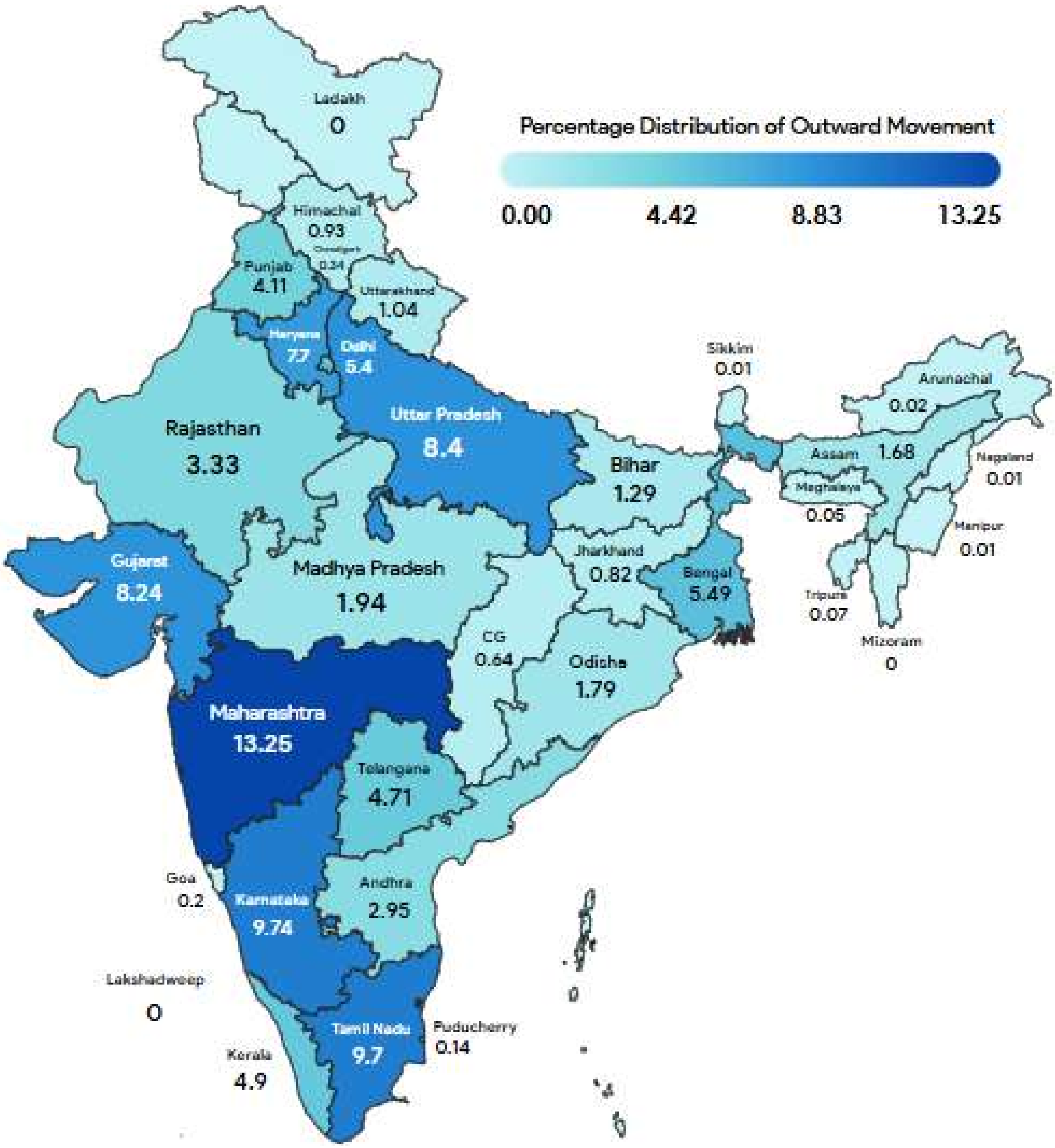
- Within the same pin code
- Up to 50 km
- 50-100 km
- 100-200 km
- 200-500 km
- 500-1,000 km
- 1,000-1500 km
- 1,500-2,500 km
- More than 2,500 km

Moreover, in order to capture regional variations, a zone was defined based on the source state of the movement, and the movements were categorised into north, south, east, west, and north-east.

For this study, the GSTN e-way bill data has been used for sample allocation for the supply-side primary survey of the study. Based on the unique O-D pairs from the e-way bill data, a sample was allocated for each of the five zones and for each of the nine categories of distance.

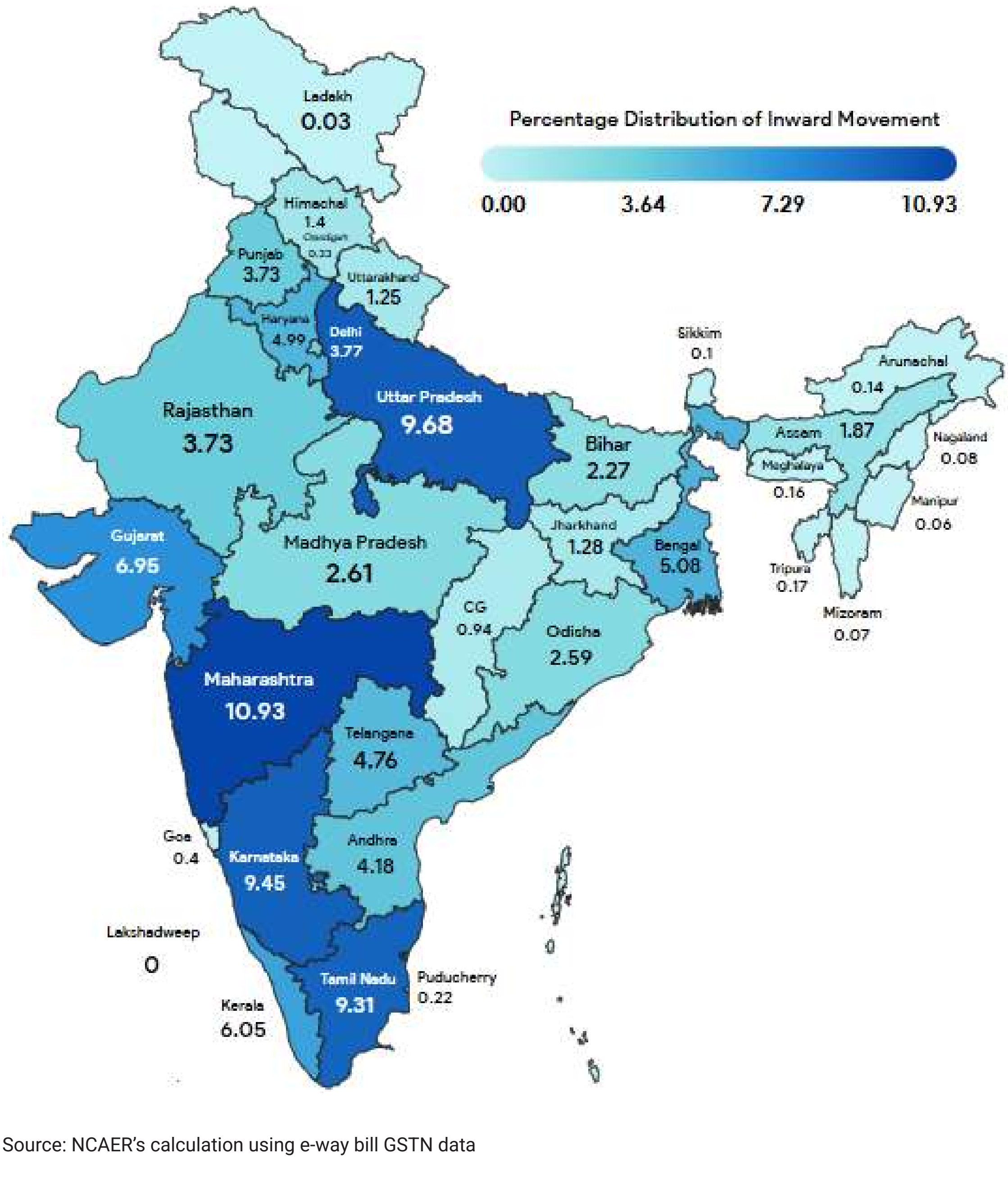
The data provided some key insights on the movement of goods. It showed that Maharashtra was the top origin state, followed by Karnataka, Tamil Nadu, and Uttar Pradesh (Figure 3.1 (a & b). At the HS 2-digit level, the commodity with the most transactions was HS-85 (electrical machinery and equipment), followed by HS-84 (majorly covering heavy machineries), and HS-30 (pharmaceutical products).

Figure 3.1.a. : Percentage Distribution of Outward Freight Movement Across States.



Source: NCAER's calculation using e-way bill GSTN data

Figure 3.1.b. : Percentage Distribution of Inward Freight Movement Across States.



Source: NCAER's calculation using e-way bill GSTN data

We also used this data to derive the estimated value of road freight transport costs across different routes in the country, by multiplying the per-trip cost for a route (obtained from the primary survey) by the total number of trips in that route. However, due to certain limitations (see Box 3.2), this purpose could not be served.

Box 3.2.: Limitations of E-Way Bill Data

The e-way bill data are a rich and reliable source of data on freight transport costs, the prime component of logistics costs. It helps estimate the volume and value of all the freight transport across the country, as with every freight movement, an e-way bill has to be generated. The prime purpose of generating e-way bills is to ensure GST compliance, as the GST numbers of both the sender and the recipient have to be inserted in the bill.

However, while analysing the data, we realised that the data does not ensure full coverage of the freight movement.

For example, an e-way bill is not generated when the value of goods is less than Rs 50,000; further, goods like fruits, vegetables, meat, cereals, and precious or semi-precious stones are exempt from the need to generate an e-way bill. Therefore, these bills do not capture the universe of freight movements.

E-way bills are predominantly issued for road transportation, while compliance across other modes remains weak. Although the legal provision requires their issuance for all modes, in practice this is seldom followed beyond road transport.

Given these limitations, e-way bill data could not be used to estimate aggregate logistics costs, but the data has been used for sample allocation for the primary survey of the study. Based on the unique O-D pairs from the e-way bill data, a sample has been allocated for each of the five zones and for each of the nine categories of distance.

3.2. Primary Data Research

The primary survey is a critical component of the hybrid approach, designed to collect data directly from stakeholders in the logistics ecosystem. The survey targeted both providers and users of logistics services, capturing the supply and demand sides, respectively, and ensuring a comprehensive view of cost structures and operational realities.

Demand Side: On the demand side, the survey targeted manufacturing industries with significant transportation needs. The focus was on collecting detailed data on logistics costs as a proportion of total production or sales costs, as well as identifying key factors influencing these costs, such as modal choices and logistics service efficiency. This helped in understanding the impact of logistics on the overall operational efficiency and cost structure of these industries.

For the primary survey for the demand side, the country was divided into five regions based on

geographical distribution:

North | East | West | South | North-east

From each of these five regions, approximately 100 manufacturing industries were surveyed to gather information, which included firms' details (such as, value of the turnover, name of the major products, share of exports, etc.); value of input cost and its constituents; and challenges related to logistics.

Among input costs, the cost incurred on different components of logistics were collected. The industries, therefore, provided data on the proportion of logistics costs in their total production costs, including:

- Transportation costs (in-house or outsourced to logistics providers) and its break-up by different modes of transport
- Storage costs
- Material-handling costs

- IT and IT-related innovation costs

Supply Side: The survey engaged a diverse range of logistics service providers across multiple transportation modes, including road, rail, air, and waterways, as well as specialised services like warehousing and cold chain operations. The primary goal was to gather comprehensive insights into cost structures, operational dynamics, and challenges encountered by these service providers.

The target respondents included the following:

- **Logistics service providers:** They provided information on all components of logistics costs borne by them, primarily on transportation-related costs such as transfer fees (for changing transport modes), pickup and delivery costs, material handling costs during transportation, and others.
- **Warehousing service providers:** The survey collected insights into storing specific commodities in warehouses and the factors contributing to logistics inefficiencies. The costs associated with storing these commodities contribute to overall logistics costs.

As in the demand side, the primary survey for the supply side also divided the country into five regions based on the following geographical distribution:

North | East | West | South | North-east

The study encompassed all major modes of transport: road, air, water, and rail, including movement by pipelines.

The sample size was determined based on the relative importance and volume of goods transported through each mode. This in turn was determined by calculating the proportion of freight costs by each mode of transport, as obtained from the SUTs.

For road transport, e-way bill data from the GSTN was utilised to identify key trade routes within each of the five regions, categorised by distance. The e-way bill data provides details of the movement of goods across different routes, which are identified by pin-codes. The classification of routes by distance-classes ensured the selection of routes by their length, across all five regions of the country.

The following distance categories were used:

- Up to 50 km
- 51-100 km
- 101-200 km
- 201-500 km
- 501-1,000 km
- 1,001-1,500 km
- 1,501-2,500 km
- More than 2,500 km

A survey of more than 2,000 road transporters and related stakeholders were interviewed. The respondents were allocated across each distance group and region in proportion to the total number of unique routes.

Table 3.2.: Region-wise Sample Coverage for Road Transporter Surve

Distance Classes	East	North	North-east	South	West	Total
Up to 50 km	37	54	5	76	39	211
51-100 km	25	28	7	58	25	143
101-200 km	38	64	6	91	44	243
201-500 km	46	129	17	225	118	535
501-1,000 km	23	101	14	177	180	495
1,001-1,500 km	20	92	14	79	142	347
1,501-2,500 km	21	54	24	52	64	215
More than 2,500 km	0	11	7	10	6	34
Total	**210**	**533**	**94**	**768**	**618**	**2,223**

For shipping and inland waterways targeted respondents, including cargo handlers, warehouse operators, freight carriers, port authorities were allocated across five regions based on the extent of movement of cargo through the inland waterways and availability of ports/jetties in each region, with a minimum allocation of 10 respondents per region, where applicable.

For rail transport, the bulk cargo movement through wagons is facilitated directly by the Ministry of Railways, which provides comprehensive and publicly available data on freight rates per tonne for each commodity, route, and wagon type. The Indian Railways also offers parcel cargo service for transporting goods, parcels, and other commodities using specialised vans and trains. There are railway parcel booking agents who act as intermediaries, streamlining the parcel movement process through the Railways. The survey was conducted on these agents, and information related to the structure of costs associated with railway freight transport was collected. The survey covered approximately 350 railway cargo/parcel agents, allocated across five regions in proportion to the total number of railway stations and junctions in each region with a minimum of 25 respondents per region, where applicable.

For air transport, approximately 225 relevant stakeholders, including cargo handlers, and freight carriers were interviewed. These respondents were also allocated across five regions in proportion to the total number of airports in each region, with a minimum allocation of 15 respondents per region, where applicable.

For the warehouse survey, approximately 83 stakeholders were covered across the five regions.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4 Logistics Cost Estimates

While logistics costs are often represented as a single average value—such as cost per tonne per km or as a percentage of the GDP or industry output—these figures oversimplify the reality. In practice, logistics costs are the outcome of a multi-layered operational process, where variations at each stage significantly alter the final cost. Factors like shipment size, frequency of movement, cargo type, route conditions, handling methods, and stakeholder arrangements directly influence the cost structure. Each shipment is not merely a standardised movement of goods but a unique operational event shaped by market dynamics, infrastructural bottlenecks, and transactional complexities. As a result, logistics cost across modes cannot be viewed as a static or uniform metric; rather, it reflects a dynamic and fluid process where any shift in variables leads to corresponding changes in the cost value.

This chapter provides a detailed overview of total logistics cost in absolute terms and as a percentage of GDP; and as a percentage of the value of the output of non-service industries.

4.1. Aggregate Logistics Costs for India

As mentioned in the methodology section, the hybrid approach has been used to derive the aggregate value of logistics costs. The data from secondary official source such as, the SUT has been used to obtain the domestic freight transportation cost by all modes of transport.

However, for railways, passenger earnings and freight earnings are separately available in the NAS, therefore, railway freight transport costs are sourced from the NAS. The NAS has also been used to obtain the value of output for the storage and warehousing industry, which indicates the cost of storing goods in public and private warehouses.

Transportation costs for international transport services has been obtained from RBI's *Balance of Payment Statement*. These are available for air, water and supporting transport services separately.

Besides, the cost of storage borne by industries in their own or rented premises has been estimated using data from the primary survey of industries. Industries were asked to provide the values of their output or turnover, and for their inputs, including raw materials, transportation (either their own or through a transporter), packaging and labelling of finished products, storage in their own or rented space, handling and packaging,[6] utility expenses, and other costs.[7] The ratio of storage cost to the value of output is used to supplement the value of the storage and warehousing industry obtained from the NAS. However, it is important to note that the NAS covers only registered warehouses. As a result, the costs reflected in the NAS are relatively lower compared to the higher expenses incurred by industries when storing goods in their own or rented premises, which are not classified as warehouses.

Total logistics cost (TLC), therefore, works out at INR 24 lakh crore for 2023-24. The largest

6 Handling and packaging costs includes all the expenses related to administration costs, such as order-processing, monitoring orders, IT-related services, and maintaining transaction documents.

7 'Other Cost' includes rent on fixed assets, repair and maintenance of fixed assets, expenses on R&D, etc.

component is road freight transport, with a value of INR 10.01 lakh crore, translating to a share of 41.7 per cent in the TLC. (It should be noted that transportation through pipelines is also included in this estimate.) This is followed by storage and warehousing cost, at INR 5.95 lakh crore, accounting for 24.8 per cent of TLC.

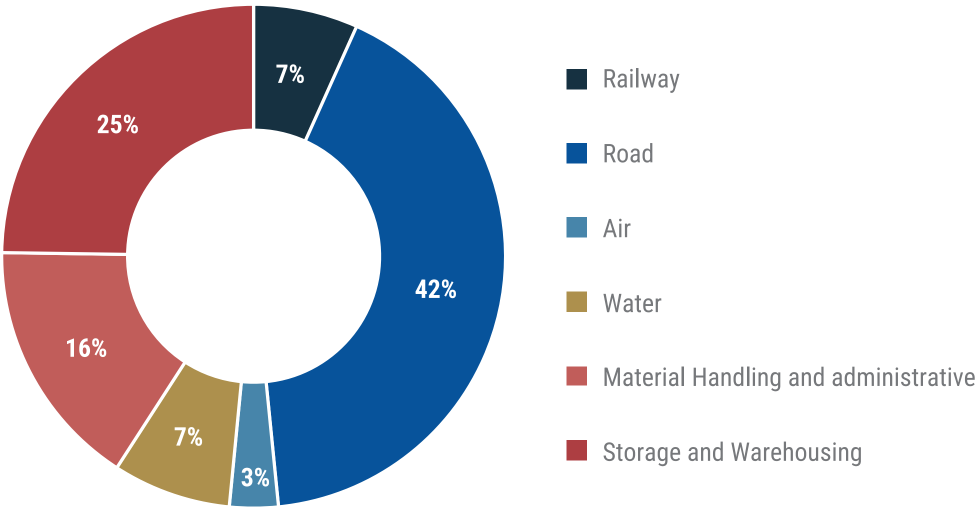
It may be noted that theoretically, inventory carrying costs include capital cost for holding inventory; inventory service cost consisting of taxes and insurance; cost of storage in public/private warehouses and in own/rented spaces; and inventory risk cost, which includes charges for damages, obsolescence, and relocation. It is not clear whether all of these components are included in the international studies, but this study attempts to include all the operations-related inventory carrying cost.

The values of each component of TLC, along with data sources, are provided in Table 4.1, which also gives the per cent contribution of each component in the total. Figure 4.1 presents the percent share of each component in total cost. Box 4.1 presents the international comparison of the breakup of logistics cost.

Table 4.1. : Components of Total Logistics Costs

	Logistics Components	Data Sources	Value (INR lakh crore)
Domestic Transport Services	Railway transport	NAS	1.61
	Road transport	SUT	10.01
	Air transport	SUT	0.20
	Water transport	SUT	0.48
	Material handling	SUT	3.84
Imported Transport Services	Air transport	RBI BOP	0.55
	Water transport	RBI BOP	1.34
	Material handling	RBI BOP	0.03
Storage and warehousing		NAS and primary survey	5.95
Total logistics cost (TLC)			**24.01**

Figure 4.1. : Share of Components in TLC (per cent), 2023-24



Box 4.1. : Logistics Cost Breakup – International Comparison

The breakup of Total Logistics Cost by its components varies significantly among various countries. While the reference years are different across the countries, but the estimates provide some useful insights. Transportation accounts for 59.1 per cent of Logistics Cost in India, whereas its share is as low as 36.7 per cent for Sweden and as high as 70.4 per cent for South Korea. In case of USA and China, transportation accounts for 63.0 and 53.5 per cent of Logistics Cost respectively.

Another significant component i.e. Storage & Warehousing and Inventory Carrying Cost together account for around 45 per cent of Logistics Cost for both Thailand and Sweden which is much higher than that for India. Both China and USA also report a higher share for these components as compared to India.

Material handling and Administrative cost accounts for 16.1 per cent of total Logistics cost in India, this is close to Thailand where material handling contributes 14.9 per cent to the total logistics cost. The corresponding figures for USA, China and Sweden are 7.5, 12.7 and 17.5 per cent respectively.

	Transportation	Material Handling & administrative	Storage & Warehousing
India 2023-24	59.1	16.1	24.8
Thailand 2023	39.8	14.9	45.3
US 2023	63.0	7.5	29.5
South Africa - 2009	47.8	17.6	34.6
China - 2010	53.5	12.7	33.8
S. Korea - 2008	70.4	7.2	22.4
Sweden 2005	36.7	17.5	45.8

Source: https://www.itf-oecd.org/sites/default/files/docs/dp201204.pdf

The breakup of transportation cost by modes of transportation reveals that Road transport has the highest share when the breakup of transportation cost is considered for India, Thailand and USA. The share of water transport is significantly higher at 12.4 per cent for Thailand compared to India at 7.6 per cent and USA at 3.5 per cent. On the other hand, Thailand has the lowest share for air and railway transport compared to USA and India.

4.2. Metric to Present Logistics Costs

It must be noted that the metrics to assess logistics costs in the literature differs across studies. By and large, there are three main metrics to assess logistics costs:

- As a percentage of gross domestic product (GDP);
- As a percentage of sales or value of output; and
- As the absolute cost and cost per tonne per km in (INR).

Internationally, measuring logistics costs as a percentage of GDP has been a common practice so that the results for different countries are more comparable. However, this is not the best measure to make logical international comparisons or to track changes in logistics costs over time. This is because the magnitude of the logistics cost of a country varies significantly based on its economic structure and the spatial distribution of production and consumption centres. Economies dominated by services naturally have lower logistics costs, while those driven by agriculture and manufacturing face higher logistics costs. Additionally, cost calculations as a percentage of GDP will not help businesses in decision-making. Therefore, comparing logistics costs as a per cent of GDP across economies can be misleading.

Additionally, GDP growth and its magnitude have multiple determinants, some of which may not be relevant for logistics, yet show up while computing logistics costs as a percentage of GDP. Developed countries have a higher GDP and a higher share of the service sector, which may translate into a lower percentage of logistics costs in their GDP. Developing/under-developed economies have lower GDP concomitant with a larger share of agriculture and manufacturing, which may result in logistics cost that are a higher percentage of GDP. Hence, the calculation of logistics cost as a percentage of GDP may not adequately capture logistics efficiently.

Furthermore, expressing logistics cost as a percentage of GDP does not capture region-wide variations in logistics costs. For a large and diverse country like India, with varying levels of development across states, it is important to understand the zone-wise or region-wise differences in logistics costs for effective policy intervention.

There are also sectoral and product-wise variations in the logistics cost. Some commodities like coal are predominantly transported by railways, while electronics and pharma commodities are mostly transported by air. There are also variations between containerised and non-containerised goods, temperature-sensitive and non-temperature-sensitive commodities, dangerous goods, etc. This results in a significant variation in logistics costs across sectors and commodities. Measuring logistics cost as a percentage of GDP cannot capture these variations.

Thus, there are significant gaps in estimating logistics cost as a percentage of GDP. An alternative metric can be to measure logistics costs as a percentage of the value of produce or in terms of per tonne per km. This metric can better incorporate the above-mentioned variations, and thus capture logistics costs holistically. The various metrics to calculate logistics costs are discussed in Box 4.2.

BOX 4.2. : Different Metrics for Logistics Cost

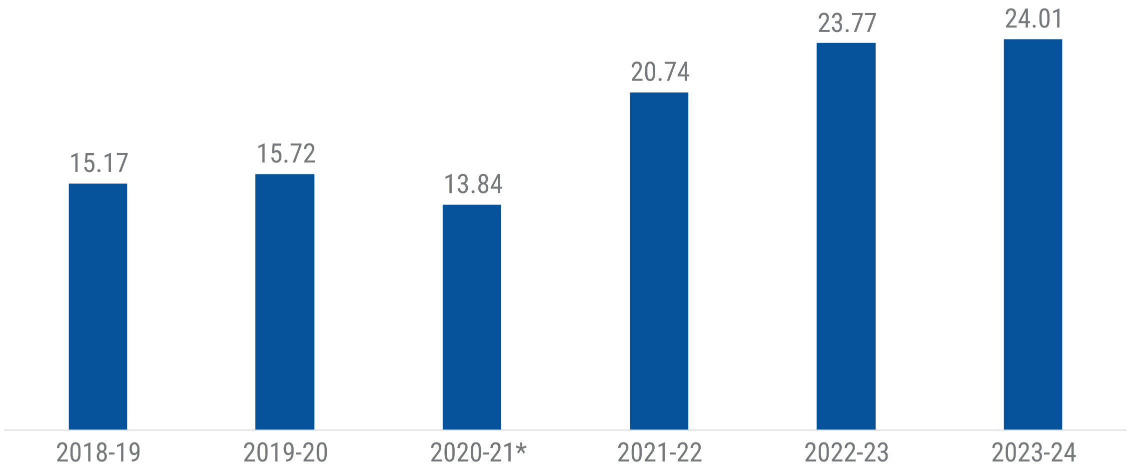
Logistics cost as per cent of GDP	**Pros** • Enables international comparability • Enables tracking over time
	Cons • Does not capture variation among countries based on economic structure and spatial distribution of production and consumption centres. • Often misinterprets how much logistics contributes to GDP; it is only an indication of the relative sizes of logistics costs and GDP, not of how much one depends on the other. • Does not help businesses in making decisions on costs • Does not say anything about logistics efficiency • Does not capture regional, sectoral and product-wide variations in logistics costs
Logistics cost as per cent of value of output	**Pros** • A determinant of logistics efficiency • Can be derived at the industry or industry-group levels • Can capture regional, sectoral and product-wide variations in logistics costs • Can be tracked over time
	Cons • Does not allow international comparability
Absolute cost	**Pros – Absolute cost** • Absolute cost is a transparent measure of total cost borne by business users on logistics. • It gives clear cost visibility on how much is spent on each logistics component. • It enables better planning for fluctuations due to cost elements like fuel prices or demand shocks. • It helps in establishing fair product pricing. • Pros – Per tonne per km cost • Costs per tonne per km enable regional comparisons of all components of logistics cost. • Enables comparison across different modes of transportation.
	Cons • Significant variations in per tonne per km costs across different modes of transportation can lead to inaccurate measures at the macro level. • Does not allow international comparability.

In this report, TLC has been expressed as a percentage of GDP in line with global practice, but more importantly as it expresses it as a percentage of the value of the produce of non-services industries and in per tonne per km. The non-services industries, which are agriculture, mining, and manufacturing, produce transportable goods and, therefore, are bound to incur logistics costs. The values of their outputs are also obtained from the NAS.

In order to track TLC in absolute terms and as a percentage of GDP as well as a percentage of the output of non-services, the TLC has been estimated for the past five years (excluding the covid year, 2020-21), that is, 2018-19 to 2023-24. Most of the components of TLC are sourced from the SUT and NAS and, therefore, its series can also be extended back for years prior to 2018-19. However, since the ratio to estimate storage costs has been derived from the primary survey, conducted for the present study, it can be reasonably assumed that this ratio remained the same for the previous five years only, and not before that.

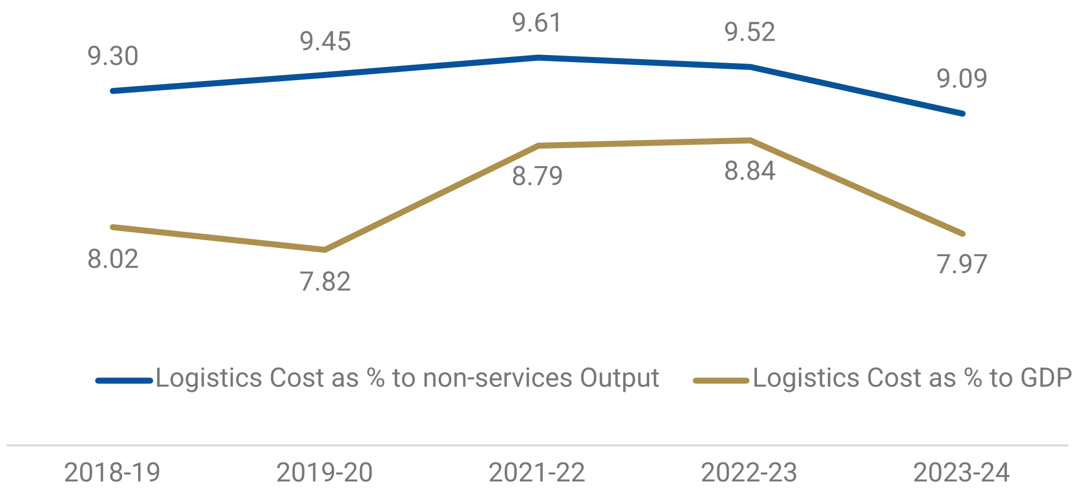
Figure 4.2.(a & b) presents the Logistics Cost of India in Rs Lakh Crore from 2018-19 to 2023-24 and presents the Logistics Cost as percentage to GDP and non-services output. The Logistics Cost increased from 23.77 lakh crore in 2022-23 to 24.01 lakh crore in 2023-24. There was a significant drop in the absolute value of Logistics Cost in the year 2020-21 due to COVID-19 pandemic. For 2023-24, the logistics cost as a per cent of non-service output is estimated to be 9.09 per cent and as a per cent of GDP is 7.97 per cent.

Figure 4.2.a. : Time Series of TLC as an Absolute Value in Lakh Crores



* COVID Year
- Logistics Cost Components: Transportation by all modes, Warehouse & Storage, Material Handling by all modes
- Data Source: Supply and Use Tables, National Accounts Statistics, MoSPI; NCAER Industry Survey

Figure 4.2.b. : Time Series of TLC Metrics



There are some interesting inferences that can be drawn from the time series of the logistics cost metric. These are:

- TLC, as a per cent of non-services output, follows a declining trend since 2021-22, whereas as a per cent to GDP increases in 2022-23 but falls sharply in 2023-24. For the reasons outlined above, TLC as a percentage of GDP exhibits a misleading pattern, as in India, the services sector (which does not incur any logistics costs) accounts for around 65 per cent of overall GDP. Therefore, a growth in GDP than is higher than the growth in logistics costs, even if GDP growth is led by the services sector, translates to a fall in the metric.
- On the other hand, a growth in TLC is expected to be in sync with the growth in non-services output. The data reveals that between 2018-19 and 2023-24, TLC experienced a CAGR (compounded annual growth rate) of 9.62 per cent, which is lower than the CAGR of non-services output in the corresponding period (10.13 per cent). Furthermore, the CAGR between 2021-22 and 2023-24 for TLC works out to be even lower at 7.58 per cent, compared with 10.61 per cent for the non-services output.

> **This means that the pace of growth in the logistics cost is gradually slowing down compared with the pace of growth in non-services output.**

> **Additionally, the slow pace of growth in TLC is despite the fact that fuel prices shot up by more than 15 per cent of CAGR in the aforementioned periods. Fuel price, in this case, refers to the price of high-speed diesel (HSD), as reflected in its wholesale price index (WPI). The WPI for HSD increased from 97.1 in 2018-19 to 128.2 in 2021-22 and further up to 171.9 in 2023-24. Fuel cost is the biggest cost component in logistics costs, hence an increase in fuel cost adds further pressure to logistics costs.**

> **If, despite the surge in fuel prices, the pace of growth in TLC exhibits a declining trend, then it can be reasonably inferred that India is already witnessing an optimisation of logistics cost as is evident from the reduction in TLC as a percentage of non-services output.**

This can be attributed to several initiatives being undertaken towards the reduction in logistics cost, which aim to improve efficiency and competitiveness. Key initiatives include the framing of the National Logistics Policy, 2022, which aims to integrate digital technologies, improve infrastructure, and streamline processes; PM Gati Shakti, the national master plan for multimodal connectivity which aims to reduce logistics costs by integrating various transportation modes like roads, railways, waterways, and airways; dedicated freight corridors (DFC), which have the objective of reducing transit times and costs by providing dedicated railway lines for freight movement; Bharatmala Pariyojana, an initiative to develop a comprehensive road network across the country; the Sagarmala Project, an initiative to promote port-led development, enhance port infrastructure, and improve connectivity to ports; development of the Unified Logistics Interface Platform (ULIP), which integrates various logistics-related systems, providing a single window for users and enabling real-time information exchange; and the Logistics Efficiency Enhancement Programme (LEAP), which focuses on improving freight transport efficiency through infrastructure and process interventions. Besides, in order to provide access to cheaper finance to the logistics sector, it has been granted an infrastructure status. This enables industry players to invest in infrastructure development and technology upgrades.

4.3. Logistics Cost Metric by Industries

As mentioned earlier, logistics services are used by industries which produce goods, and incur expenditure on transportation and handling of goods from the point of production to the point of consumption, along with storage, value addition, and allied services. These industries include producers of agricultural, mining, and manufacturing products. The demand-side survey was conducted on a sample of 500 manufacturing industries, representing different product groups. The survey data has been used only to highlight variations across firm sizes and product types.

The sample manufacturing industries provided data on the values of all the inputs and on the value of their outputs. Of the total inputs, logistics costs are given separately, along with its components. The industries have been categorised by parameters such as firm size and the major product they produce. The logistics cost as a percentage of output for each of these categories provides useful insights on the variation of this metric by these categories within each parameter.

Logistics Costs by Firm-size

Industries have been classified into categories based on firm-size or value of turnover. The categories are as follows:

a. Firms with less than INR 5 crore turnover

b. Firms with a turnover between INR 5 and 50 crore

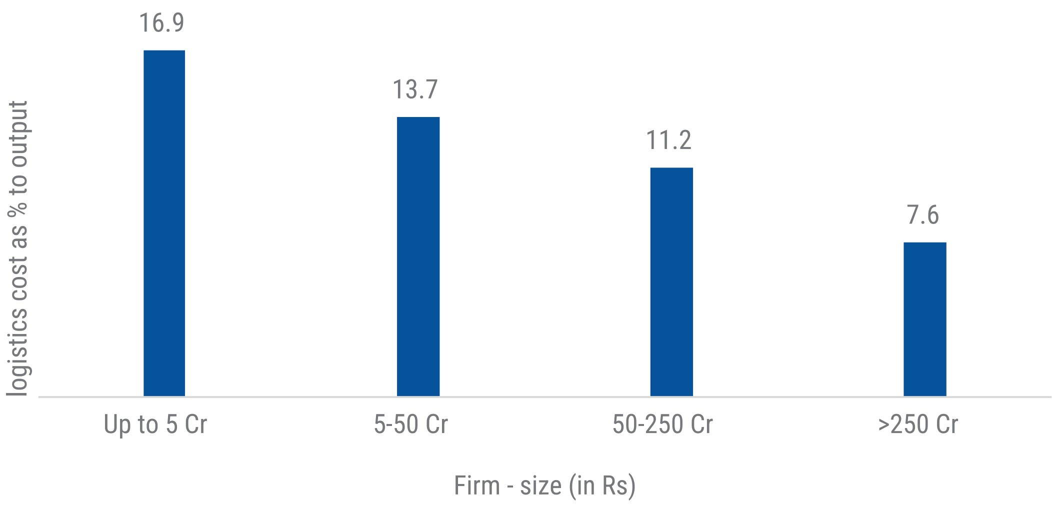
c. Firms with a turnover between INR 50 and 250 crore

d. Firms with a turnover over INR 250 crore

These categories respectively align with the classification of enterprises into micro, small, medium, and large based on their turnover, although the definitions of these also take into account their investment in plant and machinery.

Logistics cost as a percentage of output across these four categories is presented in Figure 4.3. It shows that logistics costs as a percentage of output is highest for units with the lowest value of turnover, and this ratio declines as the value of turnover goes up. The ratios for the smallest firm-size category are as high as 16.9 per cent and as low as 7.6 per cent for the large firm-size.

Figure 4.3. : Logistics Cost (as per cent of output) by Firm-size



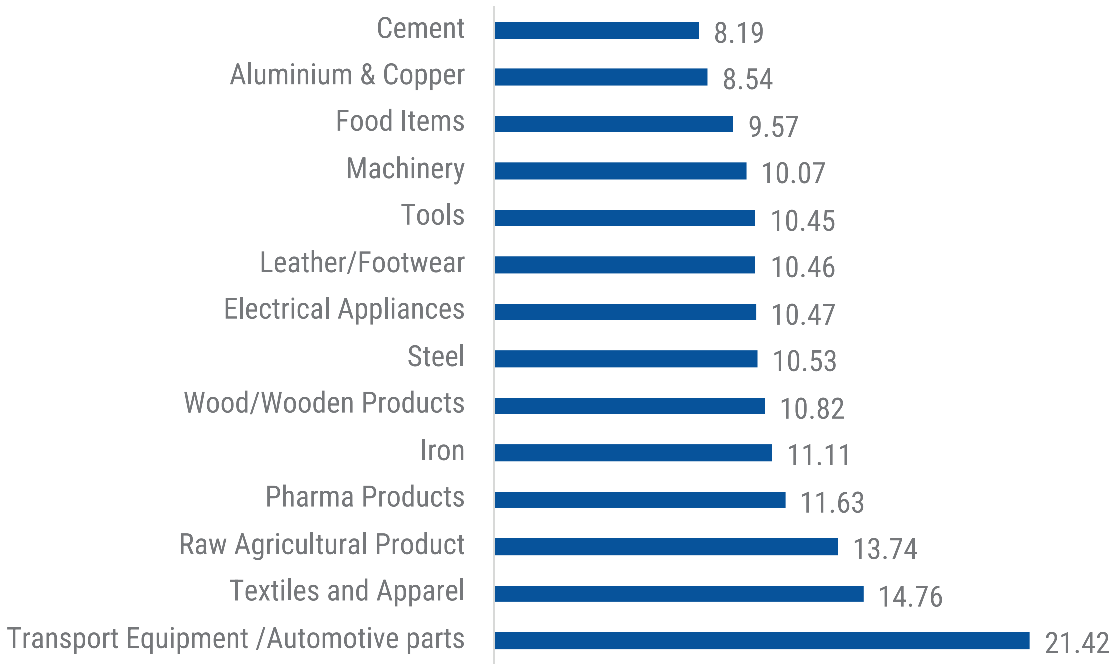
Logistics Cost by Product Type

The industries were asked about the major products they produce. The cost of logistics, especially transportation, can vary by products that are transported, based on whether they are bulky, fragile, perishable, voluminous, need specific handling requirements, and so on. Therefore, the logistics cost has been derived for the different product types produced by the sample industries, and has been expressed as a percentage of the respective industries' output.

Figure 4.4. shows that the highest logistics cost (as a per cent of output) is for transport equipment (automobile and equipment parts), as these are heavy items and, generally, cost more to transport because of their high fuel consumption, need for larger trucks, and also the low truck capacity utilisation while transporting them. The cost as a per cent of output for a transport-equipment-producing industry works out at 21.4 per cent.

Textiles and apparel also tend to have high logistics cost as a per cent to the rather modest value of output, due to high packaging and handling costs. The logistics cost for raw agricultural items, such as rice and flour, is high because of the high handling and storage costs. On the other hand, cement is transported largely by railways, resulting in a low logistics cost as a per cent of output.

Figure 4.4. : Logistics Cost (as per cent of output) by Product Type



Section 4.4. highlights some of the factors that determine logistics costs for a logistics service provider. The rest of this chapter presents key insights for each component of logistics cost, as obtained from the supply-side survey.

4.4. Factors Impacting Logistics Costs in India

Logistics costs in India are shaped by the interplay of operational, structural, and market-driven factors. Even within the same route and commodity type, freight rates can vary significantly. Factors such as whether the shipment is full truck load (FTL) or less than truck load (LTL), availability of backhaul cargo, and the bargaining power of the parties involved can substantially influence the final cost. A transporter securing return cargo and dealing directly with shippers may quote far lower rates compared to brokered or fragmented shipments. Similarly, cargo consolidation, volume of cargo, and frequency of orders affect pricing, with MSMEs or smaller players typically paying higher rates due to LTL shipments and limited negotiating leverage.

> **Multiple rates exist for the same route and the same commodity. A transporter with backhaul cargo and a direct booking may quote INR 85,000 for the Delhi-Guwahati route in an 18-tonne truck. Whereas, a brokered shipment without a return load may incur a cost of up to INR 1,10,000 for the same route. An MSME sending goods via LTL consolidation may pay INR 1.4–1.5 lakh (per truck equivalent).**

Further, in many cases, logistics costs may be represented as the summation of charges levied by the service providers; these costs may be taken from the tariff cards of the service providers. This method would also lead to a value which may not be a correct representation of the costs, because the involvement of multiple intermediaries—brokers, consolidators, and clearing agents—adds additional cost layers. Therefore, the end-user would be paying a much higher cost than the one mentioned in the tariff cards. For instance, terminal handling charges paid by traders to shipping lines often exceed the tariffs charged by the terminals themselves, reflecting intermediary margins. Operational inefficiencies, such as congestion at ports, Inland Container Depots (ICDs), Container Freight Stations (CFSs), and state borders, result in hidden costs through delays and excess fuel consumption, which are not always captured in conventional 'per tonne-kilometre' cost metrics.

The nature of cargo-handling, whether factory-stuffed or warehouse-stuffed, also influences logistics costs due to variations in documentation, handling, and first-mile/last-mile operations. Additionally, the prevalence of informal transporters operating outside the GST network complicates cost tracking and leads to non-standardised pricing across stakeholders.

Finally, the method by which costs are calculated and reported varies across participants in the supply chain. Shippers, third-party logistics providers (3PLs), transporters, and intermediaries often use different accounting methods and cost structures, making direct comparisons difficult. Collectively, these factors result in a highly fragmented cost landscape where national averages or standard rates fail to capture the actual cost realities faced by businesses.

Against this backdrop, the following sections seek to present logistics costs separately for each mode of transportation, while also dissecting their underlying cost components. By doing so, the analysis aims to highlight how different operational variables and structural factors interact to shape the overall cost structure across modes.

4.5. Railways Transportation

4.5.1. Overview

India's railway network, one of the largest and densest in the world, plays a vital role in moving cargo across the length and breadth of the country. With over 69,000 route km, the Indian Railways moves around 1.5 million tonnes of freight annually,[8] connecting ports, industrial clusters, and consumption centres. The major commodities carried by them are coal, iron ore, food grains, iron & steel, cement, petroleum products, fertiliser, and containerised traffic. Despite its vast reach and relatively lower cost per tonne-km compared to road transport, the railways still account for just about one-fourth of India's total freight movement in terms of volume.

For many businesses, especially those operating in the hinterlands or dealing in bulk commodities,

8 Freight Operations Information System (FOIS), Ministry of Railways

rail offers a critical link to global and domestic markets. However, the cost of rail transportation is not just a function of distance. It is shaped by a mix of fixed tariffs, handling charges at terminals and ICDs, haulage rates charged by the Indian Railways, and a variety of ancillary costs. These are further influenced by operational bottlenecks, service availability, first-mile/last-mile connectivity, and the presence of private container train operators.

This section unpacks the components that make up the cost of moving EXIM cargo by rail in India. It looks beyond base tariffs to understand how different stakeholders—rail operators, port terminals, ICDs, and freight forwarders—contribute to the overall cost burden. Through this lens, not just the economics of rail movement has been explored, but also the live experiences of manufacturers, logistics providers, and small exporters who rely on this mode to stay competitive in the market.

4.5.2. Railways Transportation Segments

Cargo movement in the Indian Railways (IR) falls into two broad categories:

1. *Bulk cargo movement:* Within the bulk cargo category, there are block rake express trains and specialised freight trains.

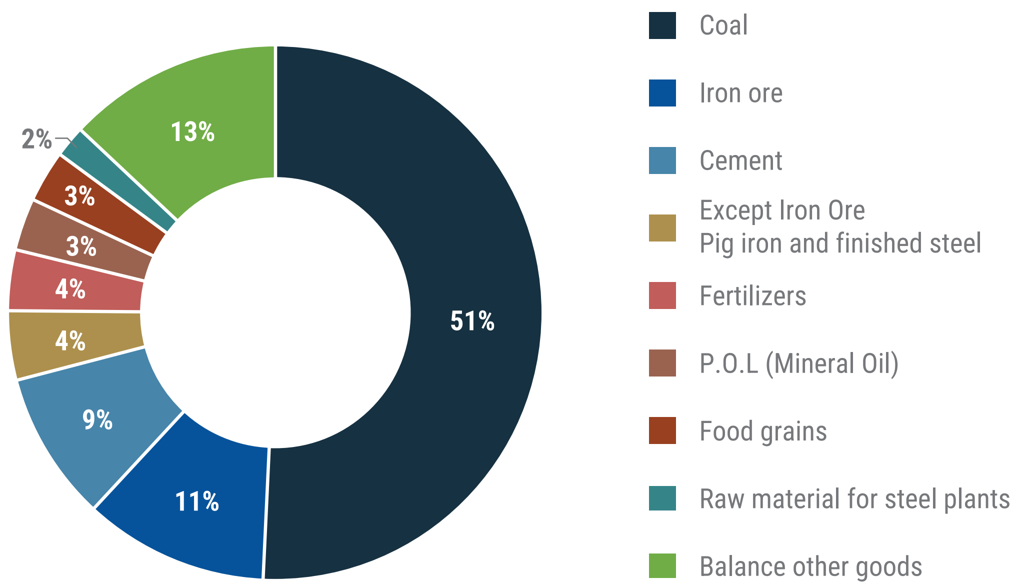
a. A block rake refers to a full train load consisting of wagons moving directly, from the origin to the destination, without being split or shunted enroute. Hence, these are end-to-end goods trains for single destinations, operating on fixed schedules with guaranteed transit times.

These are used for bulk freight and primarily serve large industrial users, such as power plants, steel producers, cement manufacturers, and petroleum companies. The block rake model enhances operational efficiency and ensures better asset utilisation.

b. Specialised freight trains based on cargo type: These include covered wagons, closed containers for goods needing protection from weather, open wagons for bulk commodities, tankers for liquids, and containers for containerised traffic. Containerised traffic includes EXIM goods moving to or from ports and, therefore, container trains support intermodal transport, linking ports and ICDs, improving cargo security, minimising transit time, and allowing easy transfer between road and rail. It is a significant segment, handled largely by CONCOR (Container Corporation of India), a public sector enterprise using the Indian Railway network. Since 2006, multiple private operators have been licensed to run container services along select routes, increasing private participation.

In 2024, the IR transported 1,617.38 million tonnes of goods, up from 1,590.68 million tonnes in 2023[9]. The main products transported included coal (51per cent), iron ore (11 per cent), and cement (9 per cent), underscoring the reliance on large-volume, long-distance cargo linked to industrial sectors – the IR's primary freight clientele. The dominance of bulk freight is evident in Figure 4.5.

Figure 4.5. : Major Commodities Transported Through the Railways January - December 2023



Source: Indian Railways Annual Report & Account 2023–24

9 Source: https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=2117417

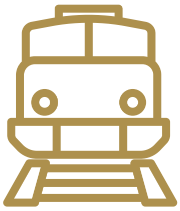
2. *Parcel movement:* This form of transport is less prominent in terms of volume but vital for smaller businesses. It refers to the transportation of smaller consignments, parcels, mail, and other small cargo often attached to passenger trains. It caters primarily to micro, small, and medium enterprises (MSMEs) that lack the cargo volume to fill a full rake or even a single wagon. Parcel cargo booking and handling are generally managed by vendors and agents located near railway stations. These vendors facilitate the end-to-end process, including the aggregation of small consignments, arrangements for loading and unloading, and providing receipts to cargo owners. Parcels largely involve an informal system with no centralised documentation, scanning, or shipment tracking.

Bulk cargo and parcel movements by the Indian Railways follow distinct procedural and logistical frameworks. Some of the key distinctions have been summarised in Table IV.2.

Table 4.2. : Key Characteristics of Bulk Cargo and Parcel Movements

Details	Bulk Cargo Movement	Parcel Movement
Registration	Only registered companies	Open to all individuals or entities
Booking	Typically done via the Freight Operations Information System (FOIS) or manually at the nearest freight terminal	Bookings are made through the Parcel Services website or manually at designated parcel booking stations.
Movement	An empty rake (train) is allotted by the Indian Railways for loading .	Parcels are delivered to the godown at the originating station, where they are loaded into parcel vans. **Involvement of vendors** Some vendors lease parcel wagons from the Indian Railways and, in turn, offer space to multiple parties—particularly MSMEs—when full load capacity is not met. Additionally, due to the prioritisation of agricultural and perishable goods, general cargo often gets lower preference in standard parcel movement. As a result, MSMEs dealing in general cargo frequently opt for leased parcel wagons, which offer more predictable and dedicated services.
Weighment	The entire rake is weighed by the railways at the nearest weighbridge.	Parcels are weighed individually, and freight charges are calculated based on actual weight. **For parcels moved via leased wagons**, individual parcel weighment may not always occur; the wagon is typically weighed as a whole, and vendors manage internal cost apportioning.

4.5.3. Railways: Average Cost Per Tonne Per Km



INR 1.96

Per Tonne

Per KM

The average cost of transporting cargo by rail in India is approximately INR 1.96 per tonne per km. However, despite this relatively low per-unit cost, the volume of cargo moved by rail remains much lower than that carried by road. This is largely due to the inherent limitations of rail transport in terms of first- and last-mile connectivity, which restricts its utility to stakeholders with access to rail-linked facilities. Moreover, rail transport is operationally suited for bulk cargo and large shipment volumes, making it economically viable primarily for businesses capable of aggregating large consignments.

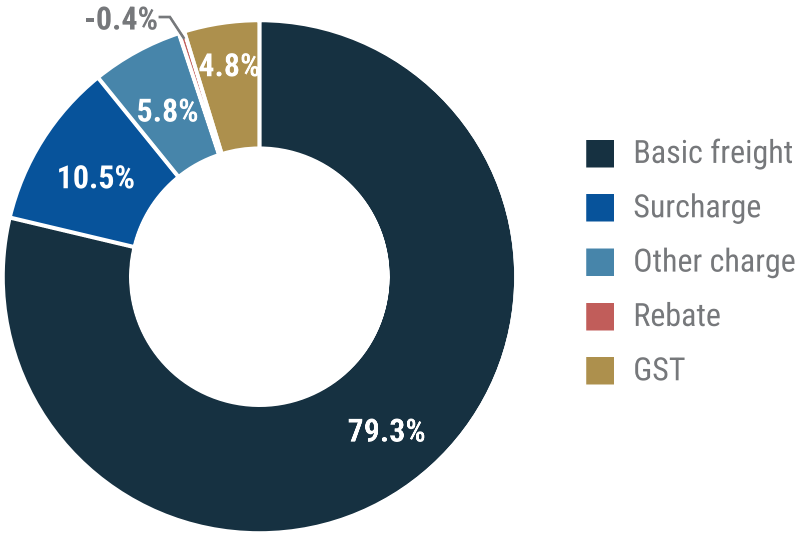
It is important to note that the INR 1.96 per tonne per km figure reflects only the terminal-to-terminal (railhead-to-railhead) cost. The actual door-to-door logistics cost becomes significantly higher once the first- and last-mile transport, handling, warehousing, and trans-shipment expenses are factored in, especially for businesses not located near rail terminals. Thus, while the static average cost offers a useful benchmark for comparing rail with other modes of transport, real-world logistics costs are highly variable, influenced by factors such as volume of cargo, origin-destination (OD) pairs, frequency of shipments, and operational arrangements. Consequently, the effective cost advantage of rail transport is often limited to large-volume, long-haul movements where consolidation offsets additional first- and last-mile handling expenses.

4.5.4. Railways: Cost Break-up

Bulk Cargo

A major share of rail transport cost is basic freight (79.3 per cent) followed by surcharge (10.5 per cent), GST (4.8 per cent), and other charges (5.8 per cent). The basic freight charge reflects the core pricing structure set by the Indian Railways based on commodity-type, distance, and weight. This base rate is often high due to the need to maintain extensive infrastructure, including dedicated tracks, terminals, dedicated freight corridors, etc., as well as supporting infrastructure such as yards, sidings, signal systems, bridges, and tunnels. Additionally, there can be various surcharges – such as terminal-handling charges and development fees – which add to the cost, often making rail less competitive for certain commodities and for shorter routes.

Figure 4.6. : Breakup of Railway Transport Cost, per cent (Bulk Cargo)



Other charges include miscellaneous costs, such as demurrage charges (for detention of rolling stock beyond the free time), weighment charges, handling at terminals, and route-specific levies. Although relatively small, compared to basic freight, these charges can accumulate, especially for operationally inefficient consignments. Surcharges and ancillary charges together account for about 16 per cent of the total cost, indicating that operational inefficiencies, congestion, and network constraints impose a tangible financial burden on users.

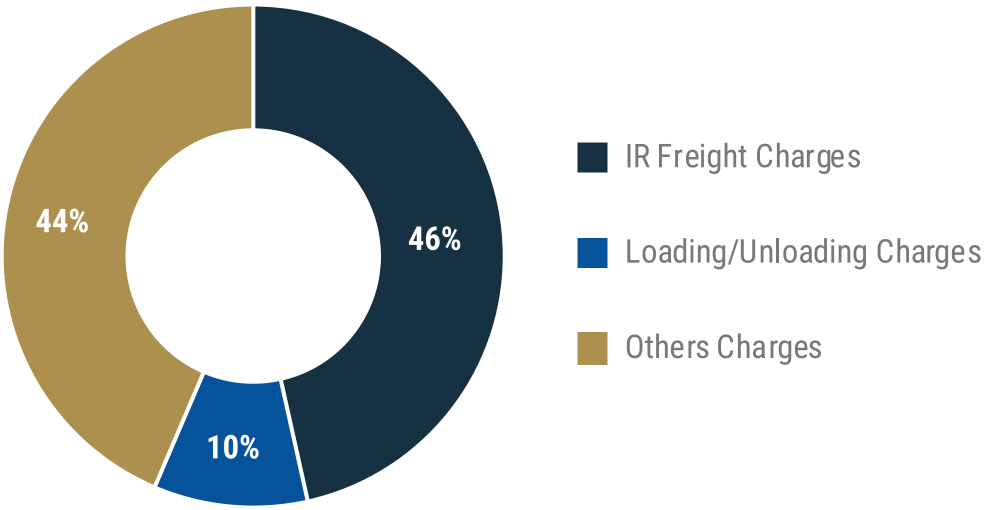
Parcel Cargo

Parcel cargo movement constitutes a very small proportion of total freight movement by railways. However, the average cost per tonne per km is far higher than that of bulk cargo.

The sample data indicates that the average cost of parcel movement per tonne per km is INR 12.40.

Of this total, 46 per cent accounts for Indian Railways' base freight rate, 10 per cent covers loading and unloading charges, and the remaining 44 per cent comprises vendor charges. These vendor charges include costs for ancillary services, such as administrative overheads, profit margins, and informal payments (e.g., 'compassion money' to loading/unloading staff). It is important to note that vendors operate through leased wagons and pay a premium over the standard lease cost. As a result, while the vendor charges may appear high, actual profit margins are relatively modest.

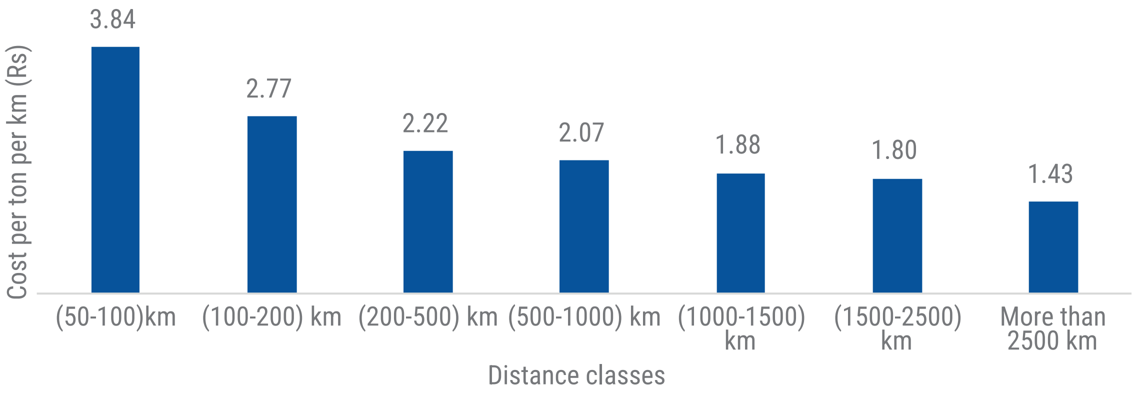
Figure 4.7. : Breakup of Railway Transport Cost (Parcel Cargo)



4.5.5. Railways: Cost by Distance Class

This section presents the analysis of railway transport costs for bulk and parcel cargo, segmented across various distance brackets, to understand how distance influences per-unit transport costs. Unlike road transport, railways exhibit clear economies of scale, where unit costs reduce progressively with increasing distance. Understanding this distance-wise cost variation is critical for identifying rail's comparative advantage over other modes, especially for large-volume, long-distance cargo movements. The insights help highlight why rail remains a strategic mode of transport for certain commodities despite its limited reach in first- and last-mile connectivity.

Figure 4.8. : Railway Costs per Ton per Km for Bulk Cargo by Distance Class (INR)



An assessment of rail transportation costs for bulk cargo by distance class reveals that the average cost per ton per km displays a declining trend with an increase in distance for cargo transported by rail. For short distances (50–100 km), the average transport cost is INR 3.8 per ton per km, the highest among all the distance categories. This is largely due to:

- Fixed terminal handling and loading/unloading costs getting distributed over fewer kms and
- Operational inefficiencies in short hauls, such as time spent in shunting, handling, and administrative procedures.

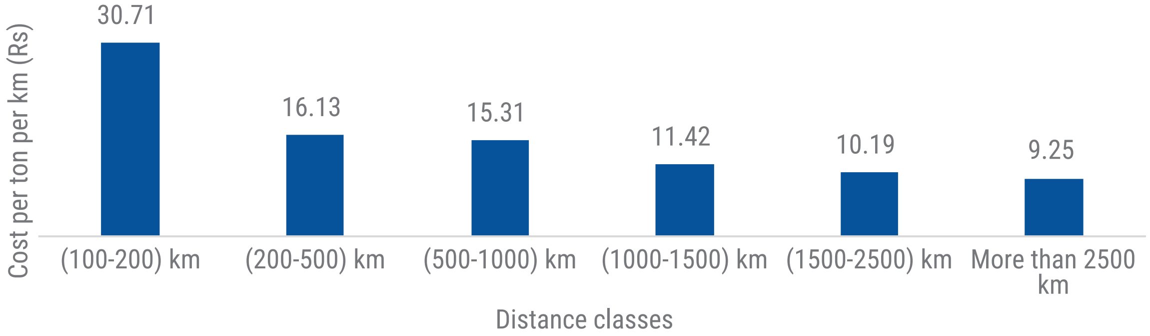
The metric dips consistently from INR 3.8 for a distance class of 50-100 km to less than half, i.e., INR 1.4 for a distance of more than 2,500 km. This is due to various factors, such as economies of distance and scale, inherent energy efficiency (vis-à-vis other modes such as road) for the movement of goods such as bulk cargo over long distances, dedicated freight corridors for long-distance travel, fewer stoppages and direct connectivity, etc. Extended hauls entail operational efficiencies that lower fuel consumption, minimise idle time, and optimise asset utilisation, thereby ensuring lower costs over longer distances.

This declining cost trend is important for policy makers and large shippers, as it underscores why strategic shifts to rail for long-distance cargo can drive significant cost savings and modal shift benefits.

> **The graph 4.8 also indirectly highlights the operational limitation of railways in serving fragmented, small-volume, short-haul cargo demand, which is better served by road transport due to its flexibility and door-to-door delivery. A similar trend is observed for parcels as well, with the average cost per ton per km decreasing considerably from INR 30.7 for a distance class of 100-200 km to INR 9.3 for hauls of more than 2,500 km.**

Apart from the reasons noted above, rail parcels travelling longer distances also often benefit from bulk consolidation, wherein multiple small consignments are grouped into full parcel vans, thereby improving space utilisation and reducing cost per unit.

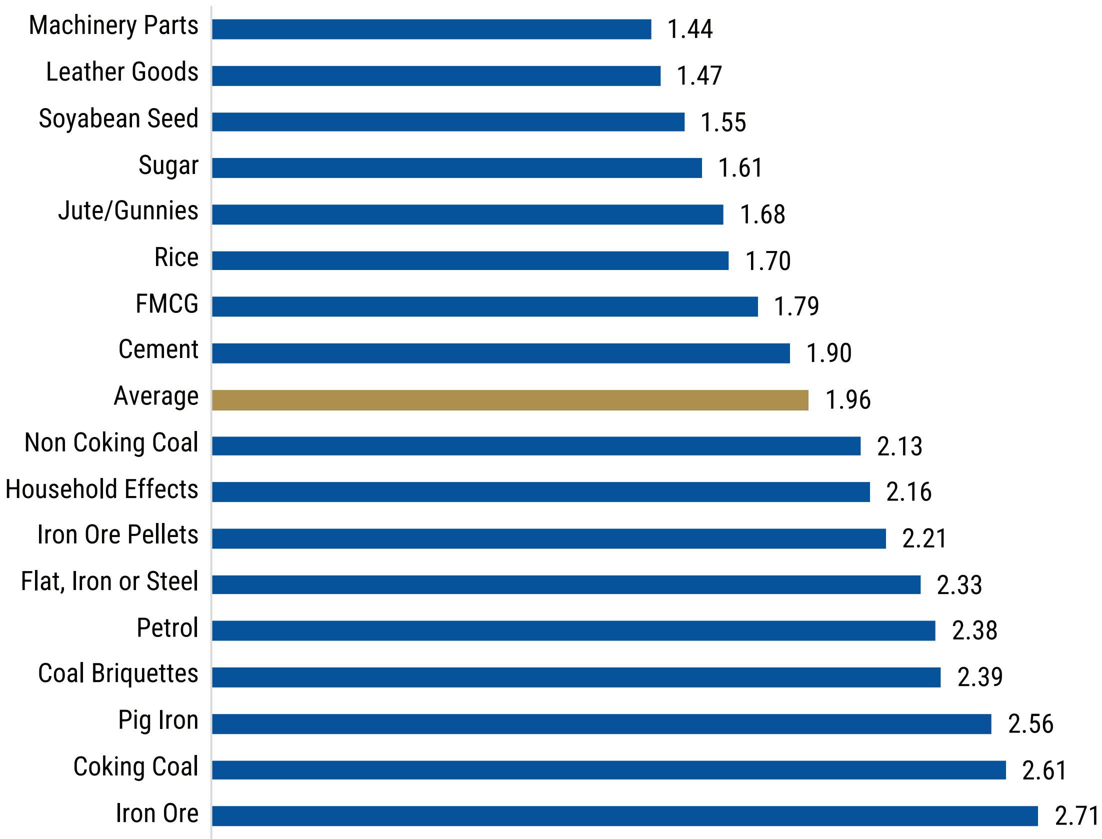
Figure 4.9. : Railway Costs per Ton per Km for Parcel Cargo by Distance Class (INR)



4.5.6. Railways: Cost by Product Types

This section presents the railway transportation costs segmented by product categories, providing insights into how different commodity types influence the overall cost structure of rail freight. Since railways primarily handle bulk and heavy cargo, understanding cost variations across product types, such as coal, cement, minerals, fertilisers, and containerised goods, is critical for assessing rail's commercial competitiveness. This breakdown helps identify which commodities benefit most from rail transport's inherent economies of scale, and which may be less suited to this mode due to handling complexities or volume constraints. Such an analysis is particularly relevant for logistics planning, modal shift strategies, and policy interventions aimed at optimising cargo movement through rail.

Figure 4.10. : Railway Costs per Ton per Km for Bulk Cargo by Product (INR)



An assessment of average cost per ton per km of cargo transported by rail reveals that product categories such as iron ore, coking coal, pig iron, coal briquettes, petrol, flat iron & steel, iron ore pellets, and non-coking coal entail higher costs than the overall average of INR 1.96. This can be primarily attributed to the fact that these are heavy, high-volume commodities that are often characterised by specialised wagons, bulk- handling infrastructure, longer handling time, safety protocols and related infrastructure/operations (for sensitive cargo such as petrol), among others. Conversely, costs are lower for commodities such as cement, FMCGs, rice, jute, sugar, leather goods, and machinery parts, due to their relatively high-volume movement, standardised handling, lower infrastructural strain, better supply chain integration, and shorter average lead distances. For instance, cement is usually produced near consumption hubs, reducing transport distance. Rice, sugar, and jute are staple commodities with standardised logistics practices and high domestic demand, allowing scale efficiencies in transport. Further, leather goods and machinery parts entail the lowest rail transportation costs, which may be due to streamlined route planning and multimodal options, especially for export-oriented shipments.

> **The national average of INR 1.96 per tonne per km serves as a benchmark for assessing rail competitiveness across commodities. Heavy industrial goods cost more to move but suit rail transport because of large volumes. while low cost goods are usually lighter or packaged and need simpler handling, as a result the logistics cost is on a lower side. This cost differentiation emphasises the need for product-specific logistics planning, especially for manufacturers and bulk traders aiming to optimise modal choice and route-planning based on cargo characteristics.**

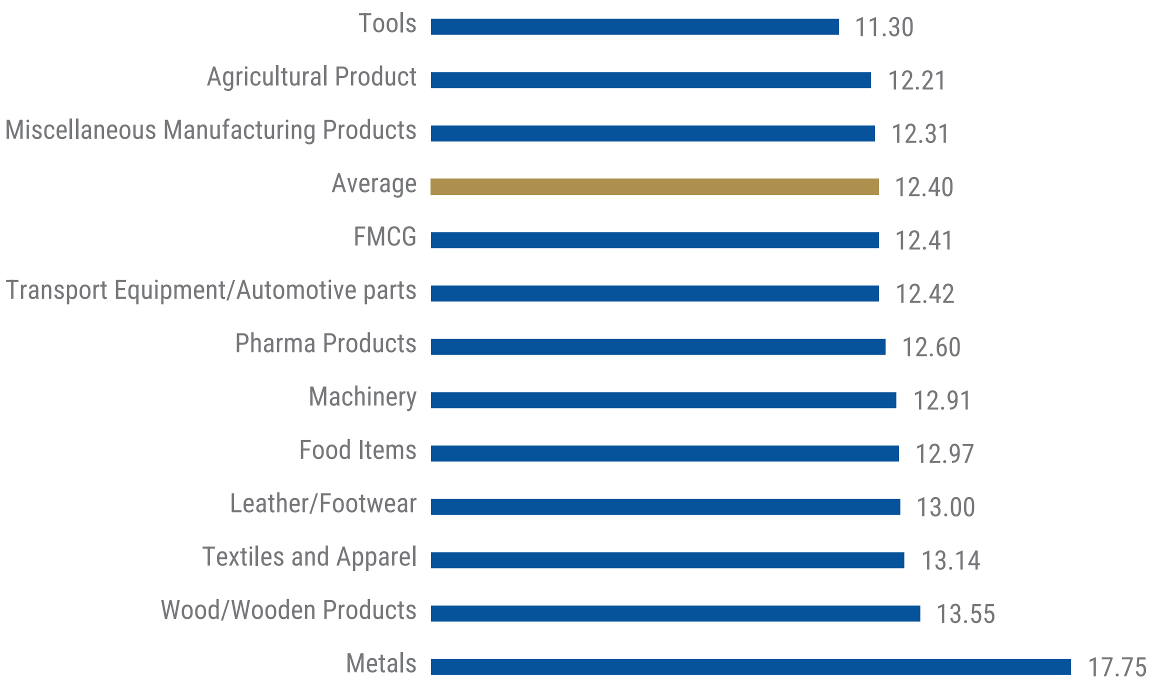
With respect to parcels transported by rail, the survey found that most of the product categories display a higher cost per ton per km compared to the overall average. Metals, when moved in parcel form, entail the highest cost (INR 17.8 per ton per km), owing to dispatches in small quantities, leading to poor space utilisation and higher unit costs. The costs for products such as wood (which require protective packaging and careful handling), textiles, apparel, and leather goods (which are volume-intensive requiring frequent handling), food items (which include perishables requiring temperature control), machinery (which may require customised packaging to avoid damages), and pharmaceuticals (which entail specialised handling and time-sensitive delivery)

are found to be higher. Conversely, parcels related to agricultural products display costs that are lower than the overall average, which may be due to their standardised packaging, high demand across regions, and suitability for consolidated bulk movement. Tools are also more economical to handle in small consignments, as is evident from the survey result

Box 4.2. : Pricing of Parcel Cargo

Due to the informal nature of operations, the pricing mechanism for parcel cargo varies significantly. While the Indian Railway provides a base tariff based on weight and distance, vendors often charge higher rates to cover additional services such as labour, handling, and commissions. For example, for a 1,000 kg consignment from Delhi to Mumbai, the official railway rate under the premier category is around INR 7,000, but vendors may charge INR 13,000 to INR 15,000 depending on service bundles. A key reason for the premium is the assurance of timely loading and faster delivery. When booked directly with Indian Railways, there is often uncertainty regarding when the cargo will actually be accommodated on a train, potentially causing delays. In contrast, vendors provide greater predictability and speed, which is critical for MSMEs and perishable goods, justifying the higher cost. This highlights the informal and demand-driven pricing structure of the parcel segment, where flexibility, convenience, and reliability often come at a premium.

Figure 4.11. : Railway Costs per Ton per Km for Parcel Cargo by Products (INR)



4.5.7. Railways: Challenges and Recommendations

Based on the field observations and stakeholder interactions, this study highlights qualitative insights on the challenges faced by the logistics service providers and proposes few recommendations.

Railway transport, while being a cheaper and faster mode of transport compared with road, suffers from some limitations, such as, operational bottlenecks, service availability issues, no first-mile/ last-mile connectivity, documentation processes, limited connectivity with industry centres, congestion, and the presence of private containers in operators. Besides, human intervention in cargo-handling, security, and paperwork delays the process. All of these add to costs and make rail transportation less desirable. The following recommendations to make rail transportation more efficient emerge:

- Promotion of private railway sidings to provide total logistics services, including first-mile and last-mile connectivity and warehousing
- Dedicated Freight Corridors to reduce congestion
- Upgradation and modernisation of railway infrastructure
- Technological innovation, including GPS tracking, real-time updates on pricing, and availability of rakes
- Automation for safety/security and loading/unloading of cargo
- Skill training programmes for railway staff and cargo operators

4.6. Road Transportation

4.6.1. Overview

₹3.78

Per Tonne Per KM

India's road logistics landscape forms the backbone of the country's freight ecosystem. It accounts for nearly 71 per cent of India's overall freight transport.[10] This predominance is driven by an interplay of India's geographical terrain and infrastructural development. India boasts the second-largest road network in the world, spanning approximately 6.5 million km – an expansive system that enables seamless connectivity across diverse terrains and makes access to remote and underserved regions significantly easier.

This vast network not only underpins the country's logistical flexibility but also serves as a crucial lifeline for first- and last-mile delivery, especially in areas where rail and waterway infrastructure remain limited. Its strategic role is particularly evident in regions like the northeast, rural areas, border districts, and tribal hinterlands, where road transport often becomes the only reliable mode of connectivity. In this section, the cost of moving cargo by road in India, as obtained from the primary survey of road transport service providers, is presented dissecting the cost components and analysing the factors that lead to these costs being high or low.

4.6.2. Roads - Average Cost Per Tonne Per Km

The survey results reveal that the national average cost of moving cargo by road in India is INR 3.78 per tonne per km.

This figure represents a consolidated estimate derived from a diverse set of data collated across various geographies, stakeholders, and cargo types. While it may appear to be a definitive number, this value is best understood as a benchmark, providing a general sense of the typical cost associated with road freight movement in the country.

It is important to note that this average cost masks significant variations. In practice, road transport costs fluctuate depending on several factors, including distance of the haul, volume of cargo moved, geographic terrain, regional infrastructure availability, and the nature of operational arrangements. For instance, longer hauls may benefit from economies of scale and lower per-unit costs, while smaller consignments or movements through congested or hilly terrains could incur higher costs.

Despite these variations, the national average of INR 3.78 per tonne per km serves as a critical

10 Fast Tracking Freight in India: NITI Aayog

reference point. It helps benchmark the cost of road transport against other modes such as rail and waterways, which are generally perceived as more cost-efficient alternatives. Furthermore, this average enables comparisons with international logistics costs, offering policymakers and industry stakeholders a broader perspective on India's competitiveness in terms of freight efficiency and transport economics. In the subsequent sections, the analysis delves deeper into how this average cost changes across distance bands, cargo volumes, and regional corridors, providing a more granular understanding of the complexities underpinning road transport costs in India.

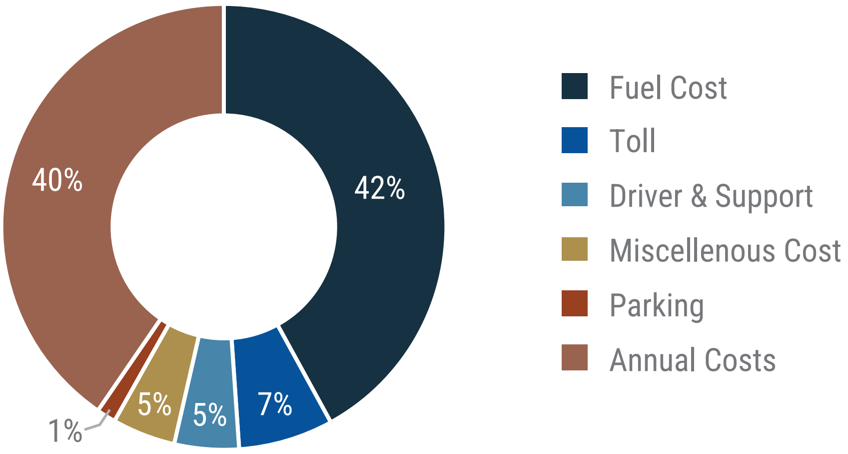
> **Despite its higher cost, road transport continues to be the dominant mode of freight movement in India. This is primarily due to its ability to offer end-to-end connectivity, enabling direct door-to-door delivery without requiring modal shifts or trans-shipment, which are often necessary in rail or waterways. This flexibility and accessibility make road transport the preferred choice for industries and traders, even at a relatively higher per-unit cost. In essence, while cost-efficiency favours rail and waterways, the operational convenience and network reach of road transport position it as the backbone of India's logistics ecosystem.**

4.6.3. Roads – Cost Break-up

Although the average per tonne per km value helps in understanding the inter-modal cost efficiency, it is important to delve deeper to understand the components of the cost. Figure 4.12 presents the break-up of road transport costs in India across key sub-components.

There are two major sets of costs that comprise the total logistics cost: the per-trip costs and the fixed annual costs. The per-trip costs are variable trip-related costs; they can be calculated on a trip basis and include fuel, tolls, parking, etc. Annual costs, on the other hand, include components that are not related to a trip and are paid annually, such as permits, vehicle insurance, maintenance, administrative costs, etc. A key caveat is that many of these components are not attributable to individual trips—they represent overheads and fixed costs that are spread across multiple trips or operations. Hence, they have been clubbed together for analytical purposes.

Figure 4.12. : Break-up of Road Transport Costs



The distribution depicted in Figure 4.12 highlights that fuel is the largest individual component, comprising 42.1 per cent of total costs, which directly affects vehicle operating expenses and constitutes a substantial portion of total freight charges. This can be attributed to the heavy dependence on fossil fuels – especially diesel – for truck movements and the limited adoption of fuel-efficient or alternative fuel vehicles in the freight sector. Further, this impact is intensified by frequent fuel price fluctuations and high taxes on diesel. Moreover, India's road freight sector faces issues like traffic congestion, poor road conditions, and low average vehicle speeds, which lead to reduced fuel efficiency. Additional impediments, such as empty return trips and long idle times at toll booths, further escalate fuel usage.

The 'annual costs' category, contributing 40.5 per cent, includes costs such as administrative expenses, permit fees, maintenance costs, insurance premiums, and operator margins.

Toll charges account for 6.9 per cent, reflecting costs related to highway usage. Driver and support staff costs (wages and allowances) contribute 4.7 per cent. Informal payments (2.4 per cent) and miscellaneous expenses (4.6 per cent) highlight the presence of smaller, often unpredictable costs that still impact overall road transport economics.

4.6.4. Roads – Cost by Distance Class

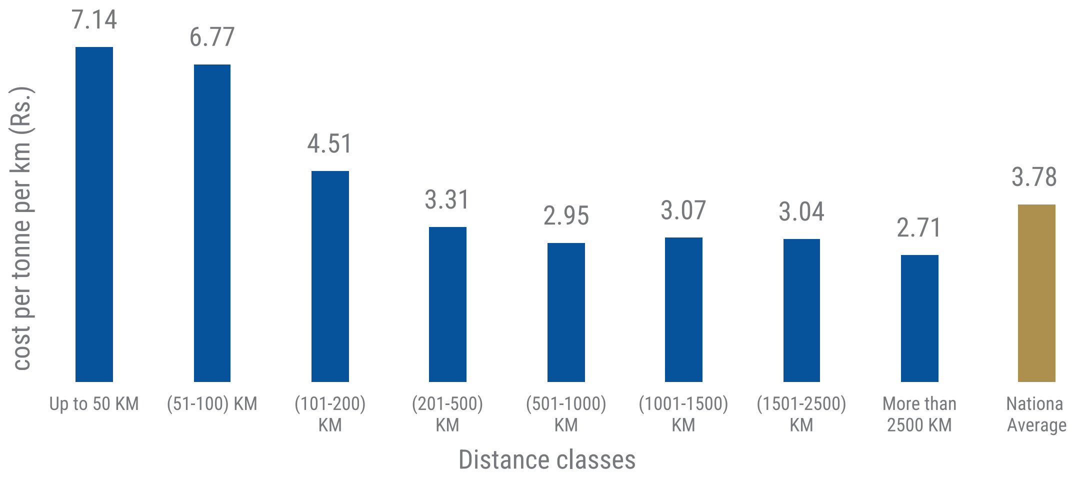
To better understand the structure and dynamics of road transport costs in India, it is important to break down logistics costs across different distance categories. Aggregated national averages do not depict the significant variations across short-, medium-, and long-distance hauls. By analysing per tonne per km costs within specific distance brackets, this section provides clearer insights into how operational variables—such as congestion, toll charges, and route efficiencies—impact the overall cost structure.

Short-distance movements are disproportionately expensive on a per-unit basis, primarily due to urban operational challenges and fixed costs. Conversely, long-haul freight benefits from scale efficiencies and operational streamlining.

Figure 4.13. presents these differentiated cost patterns across distance categories, highlighting the correlation between trip length and freight costs. The graph depicts a clear inverse relationship between distance and per-unit transport costs. Costs progressively decline as distance increases. Some observations that can be made from the graph include:

- **Short hauls, particularly those under 100 km, exhibit disproportionately higher per-unit costs, largely due to:**
  - Urban traffic congestion, causing idling and higher fuel consumption relative to the distance covered;
  - Toll charges, which become a significant percentage of total costs for short trips;
  - Loading, unloading, and waiting times in congested urban areas which inflate operating costs; and
  - The limited scope for cargo consolidation and optimisation in shorter hauls.
- **As trip distances increase, per-unit costs reduce due to:**
  - Economies of scale, where fixed costs (such as tolls and loading times) are spread over longer distances;
  - The reduced proportion of urban driving, leading to better fuel efficiency and less stop-start movement;
  - Higher vehicle utilisation rates and better route planning over long hauls; and
  - For trips exceeding 500 km, costs stabilise at around INR 2.7 to INR 3.1 per tonne per km, reflecting an operational efficiency plateau.
- Operational plateaus beyond 500 km: Beyond 500 km, the reduction in costs becomes less steep, indicating that most economies of scale have been realised by this point. Marginal improvements beyond this distance are minimal due to factors like driver limitations, regulatory stops leading to delays, and return load uncertainties.
- Additionally, long-distance cargo delivery is often characterised by factors like continuous movement, fuel economy, better route planning, and backhaul opportunities (resulting in reduced empty miles), which collectively bring down average costs.

Figure 4.13. : Road Costs per Ton per Km by Distance Class (INR)



4.6.5. Roads: Costs by Different Routes Across Zones

To gather specific insights on regional dynamics concerning road transport, an assessment was done on select origin-destination (OD) pairs across five regions, i.e., east, west, north, south, and north-east.

PTPK cost varies significantly across routes, even within the same distance bracket, underscoring how corridor-specific operational realities influence transport expenses. Table 4.3 presents route-specific road transport costs across some of the major freight corridors in India, offering a more granular view beyond national or distance-based averages.

The data shows that while the average PTPK cost for the 1,000–1,500 km distance category is approximately INR 3.06, major routes within this bracket display notable variations. The Kolkata–Delhi corridor records a relatively low INR 1.92 per tonne per km, benefiting from higher cargo volumes and better infrastructure. In contrast, the Guwahati–Lucknow route reports a higher INR 3.26 per tonne per km, reflecting the logistical challenges associated with moving cargo from the northeast, such as lower return loads, rugged terrain, and longer transit times.

Similarly, within the 1,500–2,500 km bracket, against a national average cost of INR 3.04 per tonne per km, the Howrah–Mumbai route reports an exceptionally low cost of INR 1.15 per tonne per km, due to favourable cargo density, operational efficiencies, and backhaul availability. Meanwhile, the Guwahati–Chennai route, which is the same distance, is at the higher end at INR 3.75 per tonne per km, driven by limited backhaul options and complex routing from the northeast region.

Interestingly, short- to medium-haul routes like Pune–Bengaluru (500–1,000 km) also reflect higher costs (INR 3.77 per tonne per km) despite the relatively moderate distance. This can be attributed to dense urban stretches, high toll incidence, and potential underutilisation of vehicle capacity on this corridor.

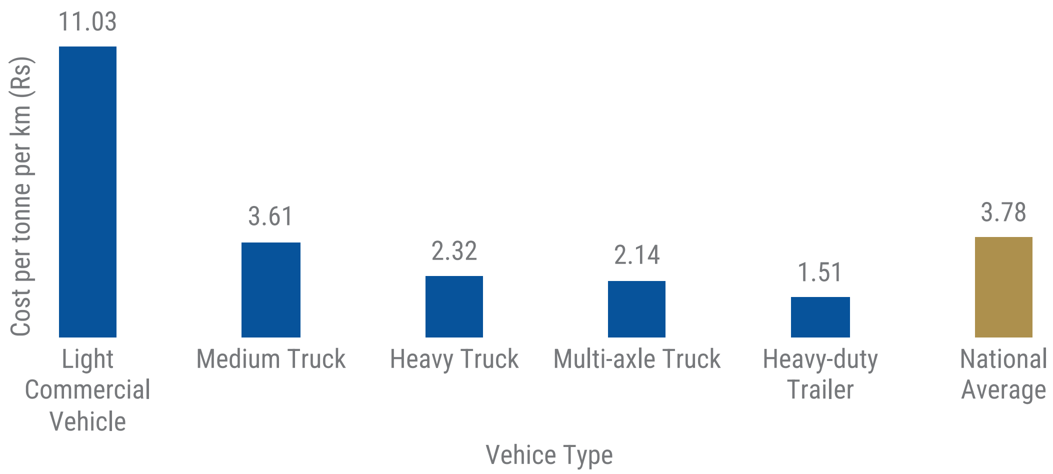
Table 4.3. : Road Transportation Cost by Specific O-D Pairs

Zone	O-D Pair	Average Cost PTPK (O-D Pair) INR	Average Cost PTPK (Distance Group) INR	Average Cost (O-D Pair) INR	Distance Group (kms.)
East	Kolkata-Delhi	1.92	3.06	97,750	1,000-1,500
East	Howrah-Mumbai	1.15	3.04	89,000	1,500-2,500
Northeast	Delhi-Bengaluru	2.25	3.04	1,12,000	1,500-2,500
Northeast	Delhi-Madurai	2.00	3.04	1,22,500	1,500-2,500
Northeast	Guwahati-Lucknow	3.26	3.06	1,04,250	1,000-1,500
Northeast	Guwahati-Chennai	3.75	3.04	1,95,000	1,500-2,500
South	Bengaluru-Ahmedabad	1.75	3.06	79,000	1,000-1,500
South	Bengaluru-Lucknow	2.05	3.04	60,000	1,500-2,500
West	Pune-Bengaluru	3.77	2.95	57,200	500-1,000
West	Pune-Kolkata	3.74	3.04	1,26,500	1,500-2,500

4.6.6. Roads: Costs by Vehicle Type

An assessment of road transportation cost with respect to vehicle type reveals that the average cost per ton per km reduces progressively with an increase in vehicle size, the metric being INR 11.03 for a 6-ton vehicle and as low as INR 1.51 for a 55-ton vehicle (refer in figure 4.14). This is primarily due to economies of scale in freight movement, as larger vehicles carry significantly more goods per trip, spreading fixed costs such as driver wages, tolls, fuel, and maintenance over larger cargo volumes. Additionally, bigger trucks often operate on long-haul routes, which entail fewer stops and greater fuel efficiency compared to smaller vehicles, which are frequently used for short distances. The use of heavier vehicles is contingent on infrastructure support and route suitability but, where feasible, higher tonnage vehicles consistently deliver lower average transportation costs. Further, with larger payloads, companies can also minimise the number of trips required, thereby lowering overall operating and administrative expenses.

Figure 4.14. : Road Costs per Ton per Km by vehicle type (INR)



4.6.7. Roads: Costs by Regional Zones

In order to understand road logistics costs as a function of inter-regional transport costs in India, we have divided average costs across regional zones in the form of a matrix. The matrix offers a structured view of how PTPK costs vary between different origin-destination region/zone pairs. Rather than looking at logistics costs as a national average, this matrix disaggregates the costs to reveal corridor-level nuances across India's major zones—North, South, East, West, and Northeast. This breakdown is important because logistics costs are not uniform across regions; they are shaped by factors like infrastructure quality, terrain, availability of return loads, toll density, congestion, and trade flow imbalances. By analysing directional cost differences and inter-regional movements, this matrix helps in understanding how geographic, operational, and infrastructural realities influence transport costs between specific zones. Such insights are critical for benchmarking, route planning, and identifying high-cost corridors that require targeted interventions.

The distance dependence of logistics costs is also evident from the matrix in Table 4.4. In each OD pair, the short-distance (within-region) costs are the highest. The matrix also shows that logistics costs vary based on the direction of cargo movement, not just the distance.

For example, northeast-bound cargo consistently shows higher costs compared to shipments moving out of the northeast, reflecting infrastructural bottlenecks and return load challenges in this region. Terrain, bad roads, and poor logistics services are some of the reasons that lead to delays and additional fuel consumption, which in turn result in higher operational costs. Also, drivers driving on the hilly roads of the northeast need to be highly trained, resulting in higher per-trip costs. The paucity of backhaul cargo in the northeast is another critical factor leading to higher costs.

In contrast, it can be seen from the matrix (Table 4.4) that the western region exhibits lower transportation costs, due to its established industrial base. The GSTN e-way bill data also supports this analysis, as most of the inward or outward movement of GSTN e-way bills takes place into and out of Maharashtra. This tells us that vehicles moving westward have a higher probability of backhaul cargo, which leads to lower costs – as depicted in the matrix.

Table 4.4. : Road Transportation Cost Per Ton Per Km Between Regional Zones (INR)

Origin zone	Destination Zone					
	East	North	North-east	South	West	National Average
East	4.25	2.78	3.44	2.32	2.52	3.81
North	2.92	4.5	3.25	2.39	2.58	3.87
North-east	3.09	3.19	5.01	2.82	2.93	3.81
South	3.49	3.38	3.87	4.38	3.43	4.07
West	3.09	2.9	3.03	3.22	3.5	3.31
National Average	3.74	3.91	4.24	4.12	3.28	3.78

4.6.8. Road Transport: Qualitative Insights

Interactions and observations on the ground reveal that the factors defining road transportation in India are not merely operational and financial, they are also regulatory, relational, and strategic. These factors range from route deviations driven by state-level policy towards the economics of empty hauls and the opacity of financial reporting, the road freight ecosystem is a product of both formal structures and informal workarounds. Understanding these realities is crucial for designing interventions that are not only efficient but also grounded in how the sector actually operates on the ground. Some of the key determinants of operational efficiency in the road transportation segment, as compiled from the field interactions and observations, have been summarised below:

1. **High variability in road conditions:** Road conditions across India vary considerably, from smooth expressways to broken rural link roads. Poor roads slow down truck movement, increase fuel consumption, and damage cargo. A typical logistics company, operating on a route where there are bad roads, experiences a fuel efficiency drop of around 20 per cent due to pothole-ridden roads, increasing the cost per trip. Many ODs also involve hilly terrains,

which present a unique set of challenges, such as difficulties in navigation and vehicle manoeuvring, unpredictable weather conditions, landslides, driving fatigue, etc., which may cause delays and increased costs.

> **Guwahati to Itanagar and Guwahati to Silchar are almost the same distance (around 300-310 km); however, the time taken to complete these distances varies between 5.5 hours from Guwahati to Itanagar to 9 hours from Guwahati to Silchar, owing to bad roads. This leads to a significant variance in the costs.**

2. **Issues in movement through designated routes:** The total distance covered by road is often longer than the straight-line distance between two points due to routing issues, detours, and regulatory road closures. Such inefficiencies often lead to higher costs.

. Further, as per stakeholder feedback, shorter distances do not always translate to faster trips. Many transporters intentionally opt for longer routes – not out of inefficiency, but to avoid toll roads, bypass checkpoints, or circumvent states, wherein certain goods face restrictions. For example, trucks carrying regulated commodities or items prone to state-specific levies may take alternate, longer routes to avoid seizures, fines, and harassment.

> **While these detours may add distance, the decision is rooted in cost-benefit calculations – a longer route with fewer regulatory hurdles often proves more predictable and, ultimately, more profitable. Yet, this workaround increases fuel costs, driver fatigue, and delivery time, reinforcing how regulatory fragmentation contributes to logistical inefficiency.**

3. **Incidence of local levies:** Despite the implementation of GST, some interstate borders still experience checks (permits, local levies, etc.). Apart from the outlays, the time lost in queues adds to the overall turnaround time. Further, taxation regimes differ between states. While some states collect quarterly motor vehicle tax, others require annual payments. These inconsistencies lead to strategic vehicle registration decisions (such as registering in low-tax states), route-planning variations, as well as administrative overheads and delays during cross-border movements.

> **Trucks carrying goods into the north-eastern states often face hold-ups at multiple spots, impacting delivery reliability and increasing demurrage risks. These local levies are a common practice across the region, and increase the cost per trip.**

4. **Inconsistencies in fuel prices:** Fuel continues to be the largest expense for transport operators, accounting for a significant portion of overall trip costs. Diesel makes up 35-45 per cent of the total trip cost on average. Frequent changes in diesel prices across various geographic areas, which are not regulated under a uniform national price, create volatility. With diesel

prices fluctuating regionally and nationally, operators have to carefully manage routes, load schedules, and refuelling patterns. As per responses to the survey, some of the prevalent cost-saving measures adopted to offset these fluctuations and the resultant cost inflations are: shutting off engines during long idle periods, strategically selecting fuel stations known for quality and competitive pricing – even if this means detouring, – and carrying spare fuel in regions where reliable outlets are scarce.

> **Access to clean, dependable fuelling stations remains inconsistent, especially in remote, hilly or low-density areas, often requiring additional unproductive kilometres to reach a trusted outlet.**
>
> **A INR 5 per litre hike in diesel can increase cargo transport cost by INR 500–700 for a 500-km run.**

5. **Seasonal variations in operations and demand characteristics:** Seasonal variations often lead to unique circumstances which need to be factored in to optimise logistics operations. For instance, during the monsoons, heavy rainfall increases average trip durations by 25–40 per cent depending on the region, leading to waterlogging, landslides, reduced visibility, and disruptions in loading and unloading. Hot summers often result in frequent vehicular issues, like overheated engines, radiator failures, and tyre blowouts, which could lead to spikes in maintenance.

. Further, during peak agricultural seasons or festival times, trucks are in high demand. For instance, March to June marks the busiest period due to perishable produce (mangoes, watermelon, vegetables, etc.), leading to a considerable spike in truck demand. As a result, spot freight rates rise sharply during these months.

> **During Diwali, transporters from Ludhiana to Ahmedabad see rates surge by 30–40 per cent due to a spike in textile and e-commerce demand. To cite another example, the Christmas–New Year period sees freight costs rise by up to 200 per cent.**

6. **Driver shortages and associated costs:** Trucking in India faces chronic driver shortages, especially for long-haul routes. Labour costs rise, and idle time increases if alternate drivers are not available. In the southern states, truck trips to the northeast often require two drivers for rotation, and an inability to secure this delays cargo movement. Challenges related to drivers get amplified in some regions, such as the north-eastern states, where certain areas only allow drivers from a particular tribe. Also, not everyone can drive through the difficult terrain in the north or north-eastern states, which amplifies the cost incurred for driver salaries.

Khasi drivers are preferred to drive trucks into Meghalaya, with the exception of long-haul drivers who are allowed in certain cases. In certain cases, the situation gets to a point where only Khasi drivers are allowed to drive in the region, which increases the cost per trip.

7. **Delays in cargo handling:** Delays at loading/unloading points are often due to poor infrastructure and coordination. This adds to waiting times and reduces fleet utilisation. Drivers often face multi-hour or overnight waits due to labour unavailability, poor coordination at the yards, weather interruptions, yard congestion, and so on. Further, owing to the lack of real-time updates, drivers have to rely on verbal communication or personal scouting.

In Bihar and the northeast, unloading yards are highly congested and have minimal infrastructure.

A manufacturer from Mumbai reports an average truck turnaround time of 2.5 days for a specific OD instead of the expected 1.5 days, mainly due to yard congestion.

8. **Specific treatment of specialised cargo:** Hazardous, perishable, or high-value cargo require special handling, insurance, and permits. According to responses to the survey, perishables suffer the most due to the lack of cold storage and their time sensitivity. Therefore, specialised allocations for the aforementioned categories increases costs, because of the need for refrigeration, safety escorts, or documentation, which affect overall outlay.

Transporting frozen seafood from Visakhapatnam to Kolkata costs 25 per cent more than dry cargo, due to the need for refrigeration units and the tight delivery window.

9. **Regional restrictions:** Entry restrictions in city zones (such as time bans, axle limits) require re-routing, night driving, or trans-shipment to smaller vehicles.

In the Delhi NCR, large trucks can only enter at night; this results in higher costs due to idle daytime hours and offloading to LCVs.

10. **Backhaul availability:** The economics of road transport is strongly shaped by whether a truck returns loaded or empty. Indian trucking witnesses empty running rates as high as 40 per cent,[11] adversely affecting costs as well as emissions. Backhaul availability, or the lack thereof, can significantly influence the cost-efficiency of a route. When trucks carry goods in both directions, the effective cost per km drops significantly, making the trip financially viable. In contrast, an empty return leg becomes a liability – wherein fuel is consumed, time

11 Fast Tracking Freight in India, A Roadmap for Clean and Cost-Effective Goods Transport, NITI Aayog, RMI, RMI India, 2021

and resources are lost, and the additional wear-and-tear has to be accounted for, without the adequate or predictable revenue to offset it.

. Moreover, several transporters noted that even when return cargo is available, it is often priced 30–40 per cent lower than the outward trip. This discount reflects both urgency and scheduling pressures – trucks are often needed back at the origin to pick up their next consignment and are thus willing to accept a lower-paying load to avoid returning empty. This dynamic speaks to the broader imbalances in India's regional trade flows, which disproportionately favour industrialised regions and urban centres.

> **This pattern is especially pronounced in routes from industrial hubs to non-industrial regions, such as Tier 2 and Tier 3 cities.**
>
> **Transporting goods from a non-industrial city to an industrial hub often costs less, as there is a higher probability of securing cargo for the return journey. However, moving in the opposite direction costs more, since trucks are unlikely to find return freight for smaller markets. In such cases, the transporter often absorbs the cost of the empty leg, which is often factored into the overall transportation cost and passed on to the consumer.**

11. **Variations on freight rates:** Another notable insight relates to freight rate discrepancies for identical goods on the same routes. Prices often vary not because of inefficiency, but because of commercial relationships, volume-based negotiations, and contractual arrangements. Moreover, market intelligence and timing play a critical role. Some forwarders adjust prices dynamically based on cargo availability, fuel prices, or even anticipated return load opportunities. In this way, freight pricing is less about distance and more about network leverage, market timing, and relationship management.

> **Freight forwarders with higher shipment volumes tend to negotiate better rates with carriers, allowing them to offer lower prices to customers. Conversely, smaller firms without bulk agreements face higher base rates, which are passed on to the end user.**

. Further, difficult terrains and regions with below par road infrastructure also impact costs. In the case of mountainous terrains as well as roadways in rural and interior regions – involving unpaved or potholed roads, single-lane highways, toll booths which are not operational, etc. – operators are faced with impediments such as delays in movement, and vehicle damages, congestion, which contribute to increased transit times, fuel wastage, and vehicle-servicing costs.

> **Mountainous and hilly regions – such as in Himachal Pradesh, Uttarakhand, and much of the northeast – command premium freight rates due to (a) increased fuel burn on slopes and hairpin routes, (b) accelerated wear and tear on engines, brakes, and tyres, (c) specialised driver skillsets required for narrow, steep, or slippery roads, and (d) greater accident and breakdown risks, especially during rain or fog.**

12. **Adoption of digitised processes:** The extent of digitisation is a key factor determining overall road transportation cost. Access to technology remains a challenge especially for smaller operators – for whom such upgrades often remain unaffordable – leading to delays and cost inflations. The lack of digital tools leads to poor route planning, inefficient load matching, inaccurate pricing, idle fleets, and low transparency, among others. Further, the dearth of modern digital platforms leads to the absence of real-time tracking, traffic/toll data monitoring, adequate price benchmarking, and so on, thereby affecting operations, especially of small operators.

4.6.9. Road Transport: Challenges and Recommendations

The field observations indicate that road transport is by far the most popular mode of freight transportation, as it provides easy accessibility, door-to-door connectivity, time-flexibility, a good tracking system, and so on. However, the main challenge in this form of transport is uncontrolled pricing, which depends on several factors, including distance of the haul, volume of cargo moved, geographic terrain, regional infrastructure availability, and the nature of operational arrangements. Recommendations to tackle these issues include:

- Adoption of green energy or fuel-efficient vehicles
- Decongestion and maintenance of road infrastructure
- Dedicated truck lanes and freight consolidation centres
- Multi-modal logistics parks
- Better remuneration and working conditions for drivers to avert their shortage
- Adoption of technology and digital systems for route optimisation

4.7. Multi-Modal Transportation: Roads-Railways

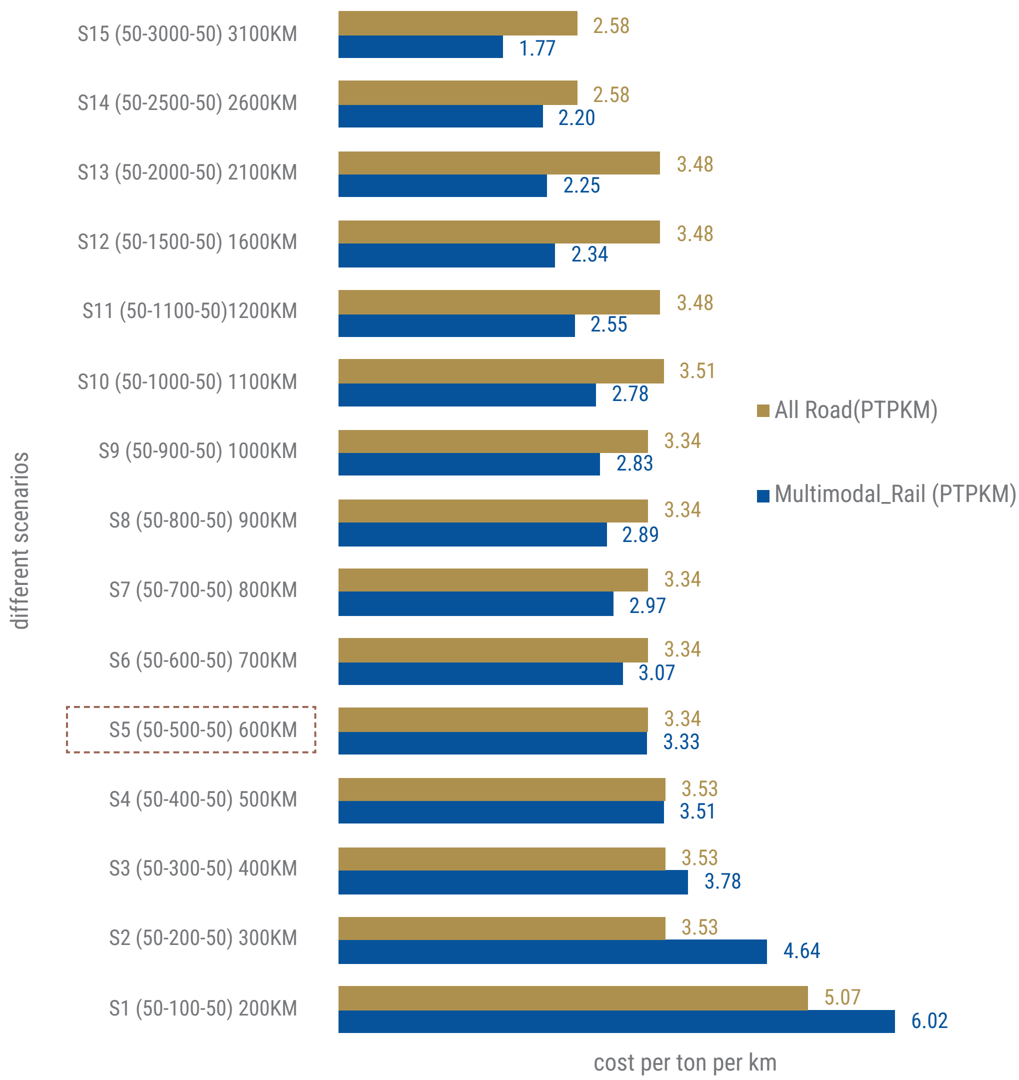
In this section, we present a comparative analysis of pure road transport costs versus multimodal transport costs involving rail. The objective is to identify the distance threshold at which rail transport becomes more economical than road. This analysis offers valuable insights for both logistics operators and policymakers, enabling a clearer understanding of rail freight economics and supporting more informed decisions in optimising cargo movement strategies and infrastructure development.

Multiple scenarios across different distance classes have been considered and presented in Figure 4.15. The labels on the x-axis of the graph depict distances, including 'first-mile/long-haul/last-mile' parts of the total route. Therefore, (50-100-50) for 'all road' means that the total distance covered by road is 200 km; and for 'multi-modal' means that the total distance covered is 200 km, where 50 km each are first-mile and last-mile parts of the route covered by road, and 100 km of the route is covered by rail. Similarly, (50-3000-50) for 'all-road' refers to 3,100 km of distance covered by road; and for 'multi-modal' refers to 50 km each covered by road and 3,000 km covered by rail.

The graph illustrates a comparative analysis between pure road transport costs and multimodal transport costs. It can be observed that for short-haul movements, pure road transport remains more economical. The high fixed costs associated with the first- and last-mile handling in multimodal setups, coupled with additional terminal handling and trans-shipment costs, make rail less viable for shorter movements. Road transport benefits from direct point-to-point connectivity, avoiding modal shift complexities.

Rail's cost efficiency over longer hauls starts to outweigh the additional costs of first/last-mile road handling and terminal operations. This advantage grows significantly as the distance increases. Beyond 2,500 km, multimodal transport emerges as the most cost-effective solution. The longer the middle rail segment, the larger are the cumulative savings, due to rail's lower per-km bulk transport costs.

Figure 4.15. : Road Vs Multi-modal Transportation Costs (INR)



As per the graph, ***the break-even point between road and multimodal transport appears at around the 600 km mark, where approximately 500 km are carried by rail. At this stage, the average transport costs for both modes roughly equalise***. This suggests that, beyond this distance, multimodal transport should theoretically become the more economical option.

> **However, in practical and real-world scenarios, this shift does not fully materialise. For instance, on key long-haul routes like Delhi-Mumbai, which span around 1,400 km, and is one of India's busiest freight corridors, road transport continues to dominate, despite rail being ostensibly cheaper over such distances. The reasons are structural: rail freight primarily benefits operators with large, consolidated volumes of cargo and those dealing in specific commodities suited to rail movement, such as bulk materials.**

Moreover, nearly half of the rail freight volume in India is coal, which inherently follows fixed origin-destination (OD) pairs linked to mining sites and power plants. This means that such movements are largely locked into rail, independent of the distance-based economic considerations highlighted in the graph. Therefore, while the graph provides useful theoretical insights, its applicability is restricted mainly to operators handling high-volume shipments of suitable cargo types, leaving a substantial share of general cargo reliant on road transport even for longer hauls.

In Figure 4.16, we continue the scenario analysis of comparative transportation costs between all-road and multimodal (road-rail-road) movement, but with a variation: the first and last mile legs by road have been doubled to 100 km each, while the rail segment remains dynamic based on total distance. The graph clearly shows that with longer first- and last-mile road legs, the cost advantage of using rail in a multimodal setup gets pushed further out beyond 800 km.

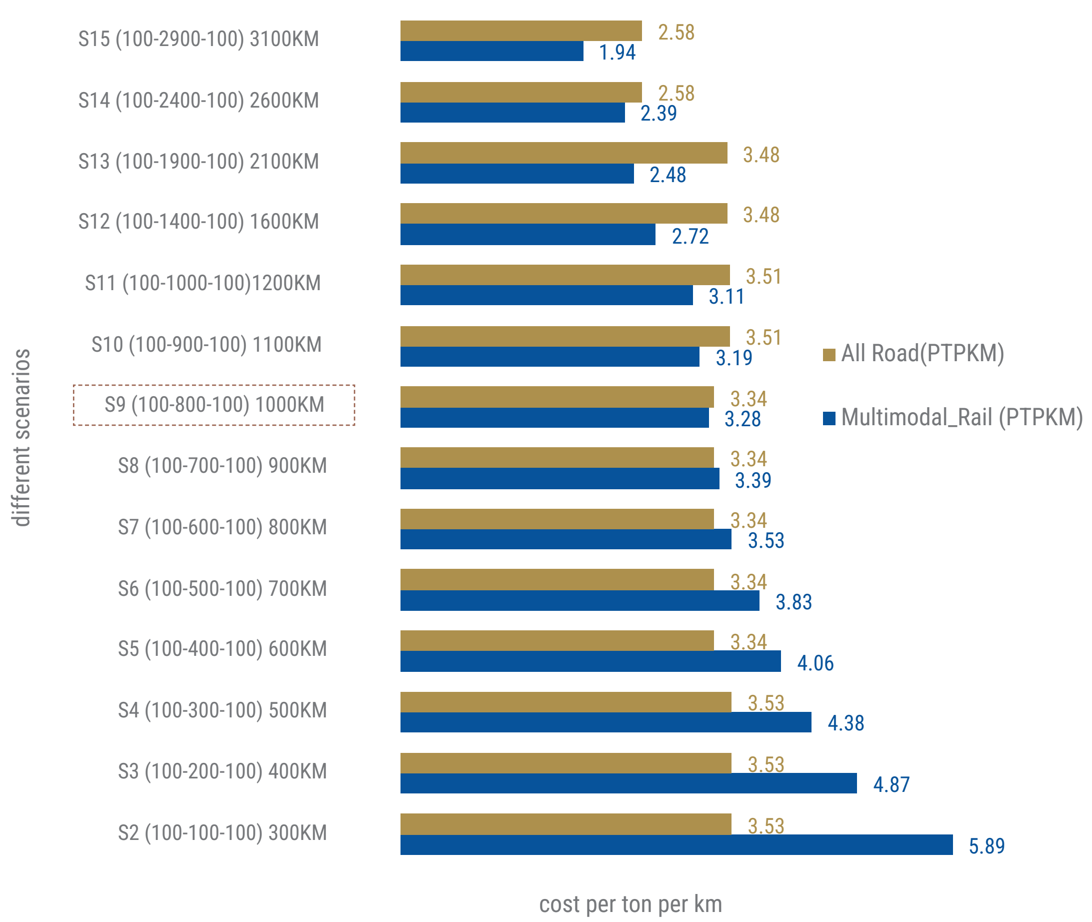
In practical terms, the breakeven point where rail becomes competitive shifts towards longer distances. Unlike the previous scenario (with 50 km road legs), where the cost parity between road and rail was reached around the 600 km range, in this case, rail starts to become more economical only beyond approximately the 1,000 km range. This highlights the significant impact of first- and last-mile connectivity on the overall economics of multimodal transport.

Moreover, the graph underlines why, in real-world scenarios, routes like Delhi-Mumbai (around 1,400 km) continue to witness high road dependency despite theoretically favouring rail for cost and time efficiency.

> **This is because high first- and last-mile costs, combined with handling and trans-shipment complexities (which also increase time), dilute the rail advantage—especially for operators handling fragmented or smaller cargo volumes.**

Thus, the graph emphasises that while rail offers a cost advantage for long hauls, this benefit is contingent on efficient, low-cost first- and last-mile connectivity—a challenge that needs to be addressed for multimodal transport to become more competitive and widely adopted.

Figure 4.16. : Road Vs Multi-modal Transportation Cost (INR)

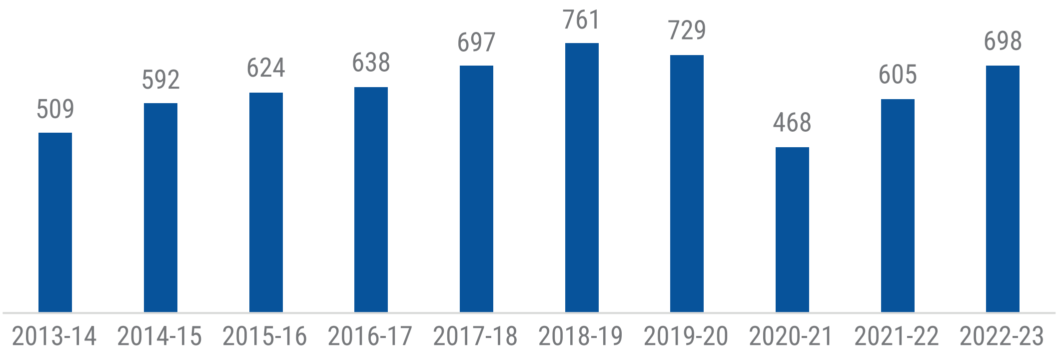


4.8. Air Transportation

4.8.1. Overview

Air cargo plays a relatively small but critical role in India's domestic logistics ecosystem. Its share in terms of volume of cargo carried may be very small, but its share by value is significantly higher due to its use in transporting time-sensitive, high-value, and perishable goods. Air freight is particularly important for industries such as pharmaceuticals, electronics, automotive components, high-end textiles, and express logistics—sectors that require rapid and reliable delivery across long distances or between key metro hubs.

Figure 4.17. : Domestic Air Cargo Carried in India (in '000 metric tonnes)



Source: Navigating the Skies: PHD Chamber of Commerce & Industry

Despite its small share in volume, domestic air cargo has shown consistent growth over the past decade, supported by rising demand for express delivery and faster e-commerce fulfilment. The volume of domestic air freight increased from approximately 509,000 MT in FY2013–14 to 698,000 MT in FY2022–23, with a sharp dip in FY2020–21 due to COVID-19 disruptions and a subsequent rebound.

This section focusses on logistics costs associated with domestic cargo movement by air in India, specifically on terminal-to-terminal costs, that is, the cost incurred from one airport terminal to another, excluding first- and last-mile connectivity. It is important to note that the actual end-to-end cost of moving cargo by air is typically higher, and additional costs are incurred in transporting goods from the origin to the airport and from the destination airport to the final consignee.

This section also provides a foundation for understanding air freight costs in India, which is further explored through cost breakups, distance-based cost comparisons, key commodity flows, major domestic routes, and qualitative insights on industry practices and operational dynamics.

4.8.2. Air Transport: Average Cost Per Tonne Per Km

INR 72

Avg. Cost Per Tonne Per Km

The average logistics cost for moving domestic cargo by air in India is approximately INR 72 per tonne per km, making it the most expensive mode of freight transport in the country.

This figure is significantly higher than road or rail, but what air freight offers is speed and reliability that other modes cannot match—particularly over long distances or when time-critical delivery is involved. While air freight is commonly associated with specific high-value sectors like pharmaceuticals, electronics, and perishables, its use is not limited to any single industry or product category. Often, the urgency of the situation dictates the mode of transport—for instance, critical automotive or industrial spare parts may be shipped by air to avoid costly production downtimes.

In India's domestic aviation logistics, cargo is transported via two primary modes: dedicated freighter aircraft and the belly space of passenger aircraft.[12] The latter accounts for a significant portion of domestic air freight movement due to the widespread connectivity of commercial passenger routes and relatively lower marginal costs for cargo handling. Around 80-85 per cent of domestic air cargo is moved in the belly hold of passenger flights, while the remaining 15-20 per cent is carried in dedicated freighter aircraft. This dual structure enables the air cargo segment to be both flexible and responsive to varied demands across industries and regions.

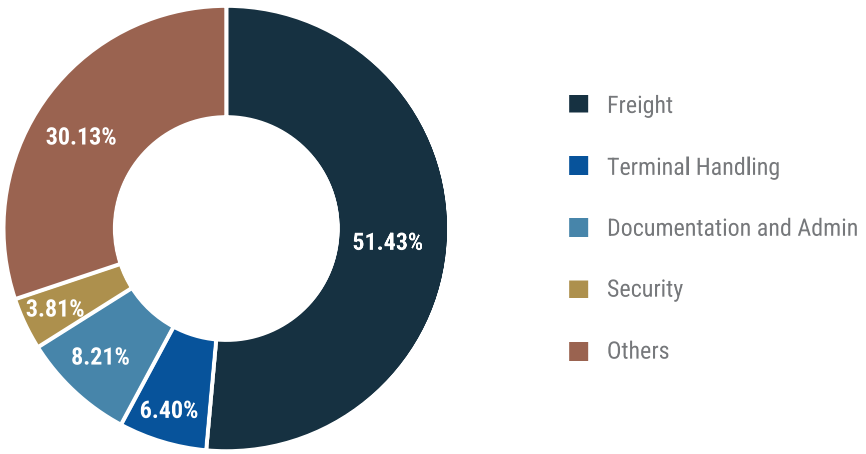
4.8.3. Air Transport: Cost Break-up

Figure 4.18 presents the cost breakup of domestic air cargo logistics in India, focusing on

12 Navigating the Skies: PHD Chamber of Commerce & Industry

terminal-to-terminal movement. Breaking down the total cost into its constituent components—such as freight, handling, documentation, and security—offers deeper operational insight into where inefficiencies lie and which levers can be adjusted to improve competitiveness. For a high-cost mode like air freight, this granularity is essential to understand the true nature of cost build-up and to identify targeted areas for policy or operational intervention.

Figure 4.18. : Break-up of Air Transport Costs



The pie chart shows that freight is the major component of cost, contributing 51.4 per cent of overall costs. This refers to the core air transport cost, i.e., the charge for physically flying cargo from one airport terminal to another. Since air transport is expensive due to fuel costs, aircraft maintenance, slot charges, and limited cargo capacity (especially for belly-hold cargo), it dominates the overall cost structure. For example, if a Delhi-based textile company wants to ship cargo urgently to Bengaluru, the freight cost alone could be over INR 19,000 for just 200 kg of cargo.

Documentation and administration costs comprise 8.2 per cent of the overall costs. These costs cover airway bill issuance, cargo booking, invoice reconciliation, and internal administration. Even in domestic operations, air cargo logistics is documentation-heavy, especially for B2B and insured cargo movements.

Terminal handling cost is another major component, contributing 6.4 per cent to overall costs. These costs include charges for offloading, loading, cargo-stacking, space allocation, weighing, screening, and short-term warehousing at air cargo terminals. It varies depending on the airport's infrastructure and operator. For example, a fragile textile consignment at Delhi's air cargo complex might require customised/special loading and storage, increasing this share of the cost.

Security contributes 3.8 per cent to overall costs. These costs reflect charges for mandatory X-ray screening, sniffer dog checks, sealed movement zones, and Central Industrial Security Force (CISF) security at cargo terminals. Since security is non-negotiable under the Directorate

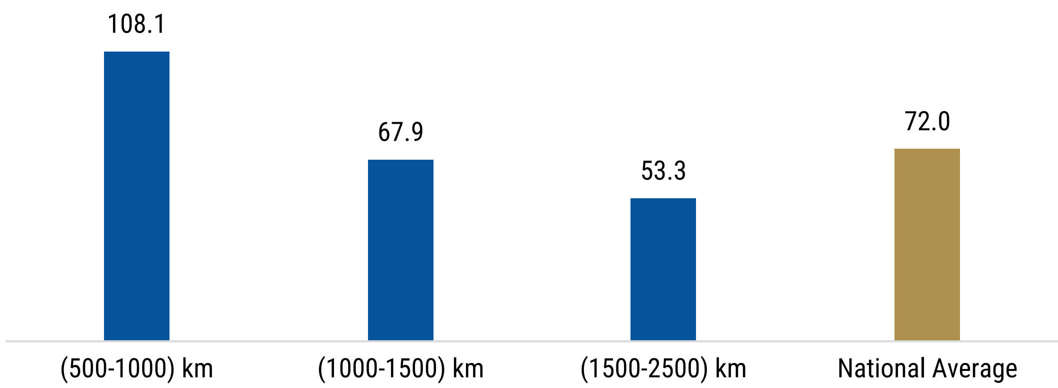
General of Civil Aviation (DGCA) and the Bureau of Civil Aviation Security (BCAS) regulations, even low-value cargo must bear this cost. For example, some courier firms must pay these charges regardless of the nature of the package they are transporting, which is then passed on to customers.

Another significant proportion of costs is 'others' at 30.1 per cent. This category includes insurance premiums, handling equipment rentals, palletisation, packaging, surcharge, congestion fees, special request charges, airline-specific charges, and profit margins. It reflects the fragmented and varied non-standardised add-ons across airlines and airports. For example, high-value pharma shipments often require temperature-controlled packaging, which adds to cost but is critical to product integrity.

4.8.4. Air Transport: Cost by Distance Class

This section presents the cost PTPK for air freight in India, segmented by distance class, along with the national average. There is a clear inverse relation between distance and costs, as is evident from Figure 4.19. The data shows that air freight is most expensive in the short-distance segment, averaging INR 108.1 PTPK.

Figure 4.19. – Air Transport Cost Per Tonne per Km by Distance Class (INR)



Short-haul routes face high fixed costs spread over shorter distances, resulting in higher unit costs. For example, a Bengaluru–Hyderabad shipment (~575 km) would fall into this band. Despite being a short haul, airport charges, security, and handling fees are fixed, making it costlier per km.

As we move to the next bracket, covering 1,000 to 1,500 km, the cost drops substantially to INR 67.9 per ton per km. This reduction indicates that some efficiencies begin to take hold over medium-range routes. Aircrafts are more likely to operate closer to full payload capacity, and the fixed operational costs begin to spread over a larger distance, thus improving cost efficiency.

Costs decline further in the group 1,500 to 2,500 km, where it is INR 53.3 per ton per km. This is

the lowest cost segment in the figure, and it exemplifies how longer-distance operations yield better economies of scale. The combination of full-capacity utilisation, streamlined long-haul operations, and reduced cost-per-km of airborne operations contributes to this efficiency. In such cases, aircrafts often fly point-to-point between major airports, avoiding multiple stops and delays that are more common in shorter domestic hauls.

Another observation that can be drawn from the graph is that the national average cost (INR 72/ton/km) is closer to the longer distance rates. This suggests that a greater share of cargo in the country is being transported on longer routes, or that longer-distance freight is more cost-efficient, pulling down the average.

Some examples of cost variation across distance classes with a mix of product categories are presented in Table 4.5 to contextualise the changes in the per tonne per km. The table presents a mix of product types with varying weights across different ODs with varying distance slabs.

Table 4.5. : Air Freight Cost Variation Across Distance Classes and Product Types

Product	Weight (kg)	Origin	Destination	Total Cost	Cost per kg (INR)
Machinery and Parts	2,150	Chennai	Ahmedabad	1,71,550	79.79
Agricultural Products	210	Chennai	Delhi	16,000	76.19
Agricultural Products	190	Patna	Amritsar	16,000	84.21
Machinery & Parts	3,180	Patna	Mumbai	1,94,000	61.00
Pharma Products	1,020	Delhi	Guwahati	1,01,000	99.01
Textiles	220	Delhi	Bengaluru	19,000	86.36
Organic Products	2,356	Guwahati	Hyderabad	1,81,000	76.82
Fruits and Vegetables	2,504	Guwahati	Delhi	2,05,000	81.86
Electrical Appliances	180	Mumbai	Dehradun	12,640	70.22
Leather Products	185	Mumbai	Kochi	12,000	64.86

4.8.5. Air Transport – Qualitative Insights

Air cargo logistics in India forms the backbone of time-critical and high-value trade, supporting industries such as pharmaceuticals, electronics, gems & jewelry, and perishables. **The cost of moving cargo by air is influenced by a range of factors that extend beyond base freight rates. These include the frequency and availability of flights, volume commitments, nature of the cargo, warehousing policies, and regulatory procedures.** Some of these factors include:

1. **Volume-based Pricing and Contractual Leverage:** Airlines and freight forwarders offer discounted rates for higher cargo volumes. For example, an exporter regularly shipping 10–15 tonnes of garments weekly from Tirupur to a specific destination or through a specific airline may secure a better rate compared to a one-off shipper. Consolidation hubs, such as Delhi and Mumbai, also enable forwarders to aggregate shipments, offering economies of

scale to clients. Smaller shipments, often moved on a per-kilo basis, face significantly higher unit costs due to lack of scale.

2. **Flight Frequency on Origin-Destination Pairs:** The frequency of flights on a particular OD pair directly impacts cargo rates. Sectors with multiple daily flights — such as Delhi–Mumbai, Mumbai–Chennai – generally have lower freight rates due to greater cargo space availability and carrier competition. In contrast, routes with limited frequency, like Ahmedabad–Guwahati, often command higher rates due to capacity constraints and fewer routing options.
3. **Type of Cargo and Special Handling Requirements:** Cargo that is high in value or requires special conditions incurs additional costs. For instance, the transport of diamonds and gold from Mumbai necessitates secure vault storage, armed escorts, and high-insurance coverage—all of which add to logistics costs. Similarly, pharmaceutical shipments from Hyderabad or Pune often require temperature-controlled packaging and cold-chain infrastructure at the airport, significantly raising handling costs.
4. **Warehousing and Airport Dwell-Time Charges:** Most airports offer a free storage period of 24–48 hours. Beyond that, storage charges escalate steeply, sometimes charged per kg per hour. For example, at Delhi and Bengaluru airports, cargo stuck due to delayed clearance or incomplete documentation can incur substantial demurrage. This is especially critical during weekends or holidays when staffing levels are low and cargo clearance gets delayed.
5. **Packaging and Cargo Configuration Needs:** Perishable goods (such as seafood from Kochi or flowers from Bengaluru) require specialised packaging and often have a limited shelf life, necessitating priority handling and faster clearance — all of which command premium charges. Inadequately packaged cargo also risks being rejected or repackaged, further adding to costs.
6. **Airport Infrastructure, Congestion, and Time Windows:** Congestion at cargo terminals, especially during peak seasons (like Diwali or Christmas), can delay cargo movement and increase dwell times. For example, Mumbai and Delhi airports often face cargo congestion due to capacity constraints, limited dock availability, or truck queuing delays, leading to additional costs in terms of waiting charges and missed flight connections.
7. **Regulatory Procedures and Delays:** Processing times for air cargo can vary based on cargo type and documentation. For instance, the carriage of live animals or hazardous chemicals through some airports may require additional inspections, quarantine approvals, or chemical board clearances. Such regulatory holds result in longer warehousing and handling times, escalating logistics costs.
8. **First- and Last-Mile Connectivity and Intermodal Transfers:** Air cargo typically involves multimodal movement for first- and last-mile connectivity, with road transport connecting manufacturing hubs to airports. The availability and ease of cargo transfers from one hub to another is not standard across airports. Poor warehousing and access to transport, traffic congestion near airports, or the lack of dedicated cargo corridors can increase costs.

By factoring in these granular elements, one can better understand the cost structures of air cargo movement. This also allows directing policy interventions and strategies at a granular level to streamline the overall process.

4.8.6. Air Transport – Challenges and Recommendations

Air transport is the fastest but most expensive mode of transportation. It is ideal for the transport of specific types of commodities, such as pharmaceuticals, electronics, automotive components, high-end textiles, and express logistics. The challenges in this mode include inadequate cargo infrastructure in regional airports, no first/last mile connectivity, limited routes and flight schedules, a shortage of skilled personnel, and regulatory inefficiencies. Based on these, the key recommendations are:

- Improve infrastructure and develop modern cargo-friendly airports in non-metro cities
- Single-window clearances
- Adoption of green aviation practices
- Digital systems for real-time exchange of information between customs, airlines, and freight forwarders
- Reduce human intervention by introducing Artificial Intelligence and automation in cargo-handling and ensuring safety and security
- Expand cold-chain infrastructure to meet the growing demand.

4.9. Water Transportation Coastal and Inland

4.9.1. Overview

Domestic cargo movement through waterways is globally recognised as the most cost-effective mode of transportation, offering not only economic benefits but also significant environmental advantages. This is why many economies are actively promoting a modal shift from traditional modes like road and rail to waterborne transport.

In India, the conversation around this shift has also gained prominence, but progress on the ground has been relatively slow. Broadly, domestic cargo is moved through two channels—coastal shipping and inland waterways. While coastal shipping primarily utilises maritime ports, both major and non-major, to transport goods along the sea route, inland waterways depend on rivers such as the Ganga and the Brahmaputra to facilitate cargo movement within the hinterland. This section examines the role of these two modes in domestic logistics, and highlights the challenges that hinder a smoother transition from conventional modes to these more sustainable alternatives.

Coastal Shipping

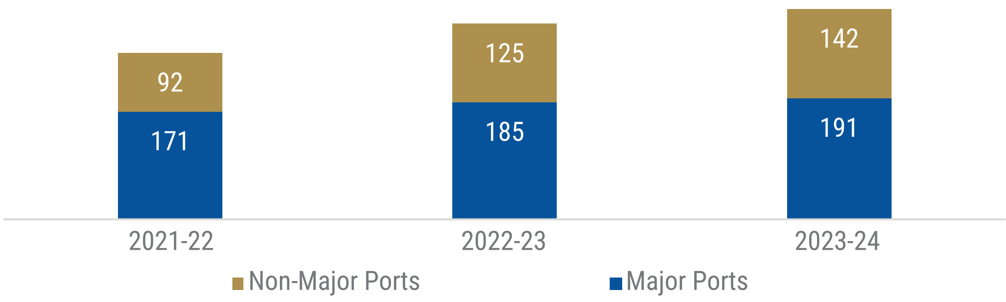
Coastal shipping in India is still at a nascent stage but has begun to show promising growth. Over the last three years, traffic through coastal shipping has seen a 26 per cent increase from approximately 264 million tonnes in 2021-22 to 333 million tonnes in 2023-24.[13]

Coastal traffic has shown a significant growth of 54 per cent at non-major ports compared to a 11 per cent growth at major ports in the same period. While this growth is encouraging, it represents only the initial steps of a much larger journey, as the government has set an ambitious target of scaling coastal cargo volumes to 1,300 million tonnes by 2047 under the Maritime Amrit Kaal Vision.

India's natural advantage lies in its extensive 11098 km coastline and the presence of more than 200 ports, which together create significant potential for coastal trade. In addition, recent policy initiatives and infrastructure developments, such as the establishment of dedicated coastal berths at key ports, are further enabling the movement of cargo along coastal routes, signaling a gradual shift towards more sustainable and efficient domestic logistics.

The key commodities transported via coastal shipping include Petroleum, Oil and Lubricants, coal, cotton, tiles, soda, ash, wheat and containerised cargo, specifically on west coast. The more push from Government and Private sector have huge potential to increase coastal cargo share towards sustainable as well economical way of transport. However issues such as handling capacity and suitable vessel availability are critical factors for coastal shipping.

Figure 4.20. : Coastal Shipping Traffic at Indian Ports (MT)



Inland Water Transport

On the other hand, traffic movement through inland waterways is lower than through coastal shipping. Nonetheless, this segment has seen a steady and significant growth in cargo movement over the past five years, reinforcing its emergence as a promising mode of domestic freight. From 18.1 million metric tonnes (MMT) in 2013-14, cargo volumes have increased more than eight

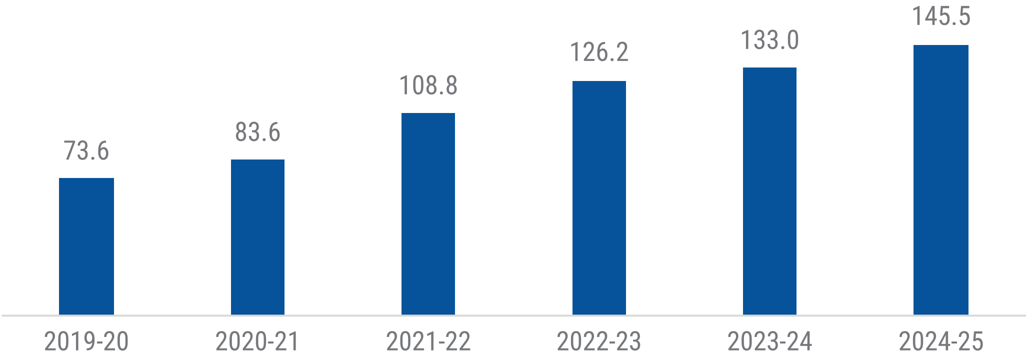
13 Basic Port Statistics: MoPSW

times to 145.5 MMT in 2024–25. The number of national waterways has increased from 5 to 111 and the operational length has grown from 2,716 km to 4,894 km during the same period.

This upward trajectory signals growing confidence in inland water transport (IWT) as a viable and efficient logistics alternative, especially for bulk cargo. The key commodities carried using this mode include coal, iron ore, fly ash, boulders, and other loose cargo. The consistent rise in cargo volumes, despite infrastructural and operational limitations, highlights the untapped potential of waterways and underscores the importance of continued investment and policy support to scale up this low-cost, environment-friendly transport mode within India's multimodal logistics ecosystem.

Although freight movement through waterways is growing, this mode of transport remains underutilised for domestic cargo transportation. Given India's extensive riverine and coastal geography, this mode offers a significant opportunity for cost-effective logistics, particularly for bulk commodities. Water-based transport is considerably cheaper per tonne-km compared to road or rail; however, it comes with trade-offs in terms of speed and reliability. For instance, cargo movement between Kolkata and Guwahati—a distance of about 1,000 km—can take 20 to 25 days by barge, against being just 2–3 days by road. These delays stem from multiple operational challenges, including the inability of vessels to operate continuously, frequent checks and protocols (as the route traverses through Bangladeshi territory), and river navigation constraints.

Figure 4.21. : Cargo Movement Through IWT (million MT)



Despite these limitations, waterways remain attractive for high-volume, low-value, and non-time-sensitive goods due to the large carrying capacity of barges. However, their utility is limited to a narrow segment of users and commodities that can benefit from bulk movement and can accommodate longer transit times. Currently, the share of waterways in India's total domestic multimodal cargo movement remains marginal, with operations being restricted to a few routes—and even these are not fully functional. In several cases, connectivity exists only in one direction between an origin and destination pair, undermining the viability of return loads.

It is also important to distinguish between the two sub-categories of waterborne freight. Coastal shipping, which takes place along the Indian coastline, primarily supports movement between ports, while inland waterway transport operates on rivers and canals such as the Ganga-Bhagirathi-Hooghly system. In this section, both segments—coastal and inland—are discussed in greater detail, highlighting their current scope, challenges, and potential role in enhancing multimodal connectivity in India.

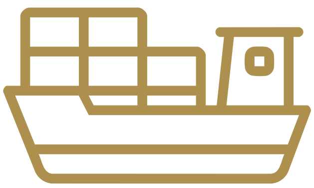
Box 4.3. : Key Waterways

NW-1 (Ganga – Haldia to Allahabad): Most cargo movement on NW-1 is driven by lighterage operations — about 90 per cent of the traffic involves transferring cargo from larger vessels onto smaller ones within Kolkata, then moving it to Haldia via the outer reaches (such as Sagar Island) of the port. Moreover, actual long-haul cargo movement towards Allahabad, Varanasi, and other upstream stretches is minimal due to draft restrictions and limited infrastructure.

NW-2 (Brahmaputra – Dhubri to Sadiya): Cargo movement is limited mainly due to insufficient depth in the northern stretches beyond Narayanganj. In these areas, vessels often run aground, leading to significant losses. Navigation is considered safe up to Chandpur, but beyond that, operators do not have reliable information on the least available depth. Because of these risks — which can cause vessel damage and extended travel times — most shippers and operators avoid using NW-2 for long-haul cargo.

NW-3 (West Coast Canal – Kerala) NW-3 is a shorter, predominantly horizontal route running along Kerala's backwaters. It is primarily suited for local transport due to its limited length. Furthermore, since Kerala's well-developed road network and capacity are static, NW-3 has remained a niche, localised option rather than a major cargo corridor.

4.9.2. Water Transport: Average Cost Per Tonne Per Km



INR 2.3

Per Tonne Per KM

The per tonne per km cost of moving cargo via waterways in India is INR 2.3, making it a cost-efficient option—just above rail, but significantly lower than road and air freight.

While this figure reflects the potential of waterways as a competitive transport mode, the actual share of domestic cargo moved through this mode remains minimal. It is also important to note that the INR 2.3 cost represents only terminal-to-terminal movement, excluding first- and last-mile logistics, which typically depends on road connectivity and often increases total cost substantially. Furthermore, the nature of waterways transport—geared primarily toward high-volume, bulk cargo—necessitates cargo consolidation before shipment, and inventory-holding at both origin and destination points, further adding to storage and handling costs that are not captured in the base per-km rate.

A closer look at cargo movement costs through waterways reveals a stark contrast between coastal shipping and inland waterways. Coastal shipping averages just INR 1.80 per tonne-km, whereas inland water transport costs nearly three times more at INR 3.30 per tonne-km. This gap is largely driven by differences in cargo volumes and backhaul availability. Coastal routes handle larger volumes and enjoy more predictable return loads, while inland waterways remain constrained by limited navigable routes, a shortage of vessels, and scarce backhaul cargo.

Box 4.4. : Coastal Shipping: Key Challenges

Coastal cargo movement, as an alternative to road and rail-dependent cargo transportation, has been one of the major initiatives aimed at improving logistics efficiency and bringing down overall costs. However, the numbers suggest that coastal shipping cargo volume in the country has been almost stagnant from 258 million tonnes in 2018-19 to 260 million tonnes in 2021-22. Some of the issues are:

Lack of Dedicated Berths: The situation on the ground is that the lack of dedicated berths for coastal cargo at ports further exacerbates the bottlenecks in the ecosystem. In the absence of dedicated berths currently, coastal vessels have to compete with vessels with overseas cargo for berthing space at ports. Based on volume of cargo and the economics associated with overseas cargo, berths are most often allocated to vessels with overseas cargo.

Connectivity and Institutional Gaps: These include poor last-mile connectivity between the hinterland and ports/jetties; limited integration between mainline and feeder services which affect scheduling efficiency; the absence of uniform tariff structures; and opportunistic pricing by some operators.

Cost and Regulatory Issues: These include: high bunker fuel duties and taxes, with no concessionary rates for domestic coastal shipping; mandated IMO 2020 low-sulphur fuel, which raises operational costs; higher manning scale requirements for coastal vessels versus international norms; high repositioning costs for empty containers and empty backhauls eroding profitability; detention charges by coastal main lines and lack of extended free-days; and the lack of incentives/subsidies compared to rail and road.

Additionally, while various secondary literature sources may report even lower per tonne per km costs for waterway transport, many of these figures are based on ideal or best-case operational scenarios, which do not reflect the ground reality. As discussed earlier, India's inland waterway network is still in a nascent stage, with only a handful of routes operational—and even those not fully functional in both directions. For instance, cargo movement from Haldia to Pandu (Guwahati) is currently viable only in one direction, that is, Haldia to Pandu. Once the vessel reaches Pandu, it must often travel empty to Dhubri to pick up cargo that can be shipped onward to terminals in Bangladesh, resulting in empty backhauls that add significantly to the total logistics cost.

Further, vessel availability is also a bottleneck for this mode. An ideal situation would be that vessels are be available as per traders' and manufacturers' requirements. However, that is not the case currently. Users have to wait till vessels become available, which adds to delays and inventory costs.

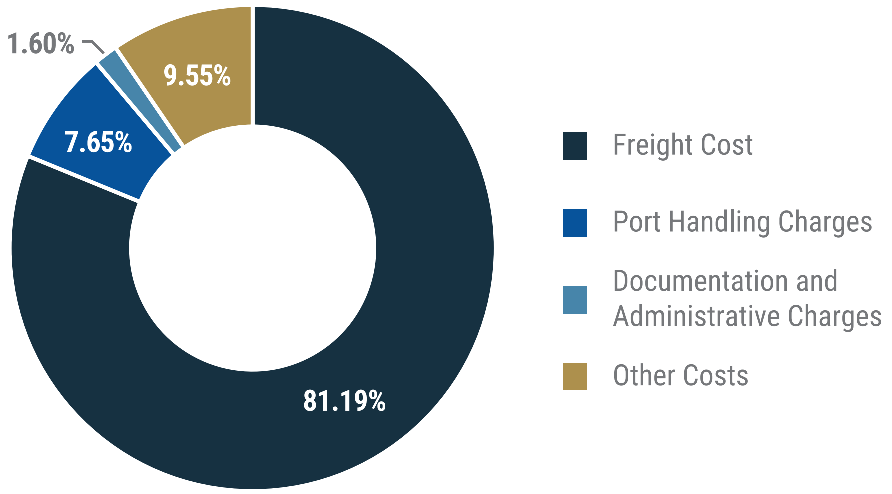
These operational inefficiencies—combined with infrastructure gaps and limited route reliability—mean that the per tonne per km cost, though useful as a benchmark, does not fully capture the real-world cost implications of using waterways in their current form.

4.9.3. Water Transport: Cost Break-up

This section presents a more granular analysis of waterway costs to provide better insights. Figure 4.22 presents a detailed view of the various cost components involved in water-based cargo movement. It shows that the freight cost constitutes the majority share, accounting for 81.19 per cent of total cost, highlighting the core role of the actual movement of goods across water in determining overall logistics expenses.

Port-handling charges, which include loading, unloading, and storage at ports, account for 7.65 per cent of the total. These are relatively standardised costs, but can vary depending on the type of cargo, port infrastructure, and efficiency. For instance, handling bulk cargo like coal or cement may incur lower per-tonne handling rates due to economies of scale, while containerised goods may be more expensive due to equipment and space requirements.

Figure 4.22. : Water Transport: Cost Break-up, per cent



Documentation and administrative charges contribute a modest 1.60 per cent to overall cost. While small in share, delays or inefficiencies in this component can result in disproportionate delays, especially in cross-border inland waterway routes such as those passing through Bangladesh.

The remaining 9.55 per cent is grouped under ‘Other Costs’, which include insurance, vessel-idling or waiting charges, charges for pilotage and navigation aids, additional logistical services like barge coordination or local transport to and from terminals, special service costs, and operator margins. For example, in the Haldia–Guwahati corridor, vessels often face delays due to tidal windows, lock operations, or clearance delays at border points. These waiting times increase vessel charter duration, indirectly adding to this ‘other’ cost category.

Box 4.5. : Waterways, the Cheapest Mode of Transport – A Reality Check

Waterways are widely regarded as the most cost-effective and environmentally sustainable mode of transport. Global and domestic policy discourse has rightly emphasised the need to shift more cargo movement from road and rail to inland and coastal shipping. However, while the strategic case for expanding water-based logistics is strong, on-ground realities present several operational and cost-related constraints that must be acknowledged before advocating large-scale modal shifts.

Limited Network Coverage: Despite efforts under initiatives like the Jal Marg Vikas Project, only a few waterway routes are currently operational at scale. This severely restricts viable OD pairs for cargo movement, limiting the commercial attractiveness of this mode.

Cargo Consolidation Requirements: For vessels to be economically viable, cargo loads typically need to be consolidated up to 300–400 tonnes or more. This requires extensive warehousing and holding infrastructure near terminals, which adds to costs and demands significant coordination among shippers and transporters.

First- and Last-Mile Dependencies: Waterways are not a door-to-door solution. Cargo must be trucked to the loading terminals and again from the unloading point to the final destination. This intermodal dependency dilutes cost advantages, especially where road infrastructure is weak or distances are long.

Limited Vessel Availability and Low Frequency: A shortage of suitable vessels on inland and coastal routes constrains service frequency and routing flexibility. As a result, scheduling becomes uncertain, and freight costs can increase due to the need for chartering or waiting for vessel availability.

Slower Transit Times: Compared to road or even rail, cargo movement via waterways tends to take longer, especially on routes with multiple locks, tidal dependencies, or seasonal water level variations. This higher transit time affects supply chain reliability, particularly for time-sensitive cargo.

In light of these constraints, while the vision for expanded use of waterways is sound, any shift strategy must be grounded in a pragmatic assessment of infrastructure readiness, service frequency, cargo suitability, and total landed cost, including intermodal handling.

Water transport through coastal shipping is the cheapest and most environmentally friendly mode of transportation. Water transport through inland waterways is being strongly promoted to reap the benefits of India's extensive riverine and coastal geography, and also to decongest road and railway traffic. But it too has various limitations, including inadequate navigation infrastructure, frequent checks, international protocols (as the route traverses through Bangladeshi territory), lack of modern terminals, seasonal variations in river levels, shortage of skilled labour, and poor connectivity with the hinterland. In several cases, connectivity exists only in one direction between an origin and destination pair, undermining the viability of return loads. Some of the recommendations include:

- Deeper and wider navigation channels to ensure continuous, year-round navigability
- Multi-modal terminals to seamlessly integrate with rail, road, and sea transport
- Encourage and incentivise private players to manufacture more vessels to avert their shortage
- Use of green vessels to improve efficiency
- Locate economic zones along waterways to increase their use
- Skill training for personnel

4.10. Warehousing

4.10.1. Overview

Warehousing forms a crucial non-transportation component of overall logistics cost in India. While much of the discourse around logistics focuses on transportation across various modes—road, rail, air, and waterways—warehousing remains an equally vital cog in the supply chain machinery. It plays a central role in inventory management, order-fulfilment, and buffering demand-supply mismatches. Unlike transport costs, which are typically distance- or mode-based, warehousing costs are shaped by factors such as commodity type, land and infrastructure availability, location, storage duration, technology adoption, and operational efficiency. As India's logistics sector evolves, understanding warehousing dynamics is essential to building a holistic picture of logistics costs and designing strategies that enhance efficiency across the supply chain.

4.10.2. Warehousing - Factors Impacting Cost

Warehousing costs in India are influenced by a wide range of variables that extend well beyond the basic expense of storing goods. For end users—whether manufacturers, exporters, e-commerce platforms, or retailers—warehousing is not just about storing goods but about ensuring timely availability, inventory control, and fulfilment efficiency. The cost of warehousing forms a substantial portion of overall logistics expenditure and directly impacts margins, service levels, and competitiveness. However, these costs are shaped by a wide range of factors, many of which are outside the direct control of the user but which significantly influence final pricing and performance. Unlike transportation costs, which are primarily driven by distance and mode, warehousing involves a complex interplay of operational, spatial, and commodity-specific factors. Understanding these cost drivers is critical for any effort aimed at optimising logistics efficiency and competitiveness across sectors.

Understanding these drivers is essential for users to make informed choices while selecting warehousing solutions, negotiating contracts, or planning logistics budgets.

1. **Type of Commodity Stored:** Different types of commodities require different storage conditions, which significantly affect cost. Generic dry goods may only need basic warehousing infrastructure, whereas perishable goods like fruits, dairy, or pharmaceuticals demand temperature-controlled or cold chain facilities, which are far more capital- and energy-intensive. Similarly, hazardous materials require specialised handling, ventilation, and compliance with safety norms. For example, a cold storage facility for vaccines will have 2–3 times higher operating costs than a regular warehouse storing packaged grains.
2. **Open vs. Closed Warehousing:** Open yards or godowns are often used for low-value, weather-resistant goods like construction materials, leading to lower costs. Closed warehouses, on the other hand, provide secure, enclosed spaces and often include racking systems, lighting, and climate control—resulting in higher setup and operational costs. For example, steel coils may be stored in an open yard, while electronics would require a secured, closed warehouse.

3. **Urban vs. Rural Location:** Warehousing near consumption centres or ports (urban or peri-urban zones) offers faster access to markets and shorter delivery times but comes with high land and rental costs. In contrast, rural or remote locations offer cheaper rates but may lead to longer transit times and reduced flexibility. For example, a brand looking for last-mile delivery efficiency in Delhi NCR will pay a premium for a warehouse in Ghaziabad or Bhiwandi compared to one in rural UP.
4. **Warehouse Grading (Grade A vs. Grade B/C):** Higher-grade warehouses offer better layout, higher racking capacity, safety features, and automation—often translating to greater operational efficiency and fewer losses for the user. While Grade A facilities are more expensive, they are preferred by users seeking scalability and service consistency. Grade B or C warehouses offer lower costs but may increase risks such as damage, shrinkage, or slower turnaround times. For example, an electronics company may opt for a Grade A facility with strong security and clean interiors, while a grain trader may use a simpler structure at lower cost.
5. **Technology Adoption (Smart vs. Non-Smart Warehouses):** Smart warehouses that integrate Warehouse Management Systems (WMS), barcoding, real-time inventory tracking, and automation offer better inventory visibility and order accuracy, which are valuable to users. However, such features come at a higher service fee. Traditional warehouses, while cheaper, may lack efficiency and transparency—often leading to higher hidden costs such as stock mismatches or order delays. For example, an e-commerce seller may opt for a WMS-enabled facility to meet rapid fulfilment needs, even at higher costs.
6. **Infrastructure and Accessibility:** End users are affected by the warehouse's connectivity to highways, ports, and transport hubs. Facilities with poor access roads, frequent power outages, or flooding risks often lead to higher dwell times, cargo damage, and indirect costs like penalties or missed delivery windows. For example, a logistics-dependent exporter may avoid warehouses in industrial clusters with poor last-mile road connectivity, even if rents are low.
7. **Labour Efficiency and Availability:** For users relying on high-volume operations—like distribution centres or e-commerce fulfilment—labour availability for tasks like picking, packing, and inventory-handling becomes a key factor. Warehouses in regions with skilled and cost-effective labour are often more attractive. Shortage or high-wage costs in certain zones can result in delays or increased service fees. For example, a footwear retailer operating out of Tamil Nadu may find better labour economics than one using a warehouse in suburban Bengaluru.
8. **Compliance and Certifications:** Users storing food, pharmaceuticals, or regulated goods must ensure the warehouse meets all the necessary safety and quality norms. Facilities with FSSAI, GMP, or other certifications often charge more but reduce user risk, especially for exporters facing strict destination market regulations. For example, an organic food exporter will prefer a certified, hygienic warehouse even at a higher cost, to ensure compliance and avoid rejections.

9. **Contract Structure: Lease vs. Pay-per-Use:** End users often choose between long-term leasing (build-to-suit or dedicated space) and pay-per-use (shared or multi-user facility). While leasing provides cost predictability and control, it requires larger commitments. Pay-per-use models are more flexible but may come with variable pricing and limited control over layout or processes. For example, a seasonal exporter may prefer a shared, pay-per-use warehouse to avoid year-round fixed costs.

Ultimately, warehousing costs for end-users are not just a function of square footage, but a result of strategic choices related to commodity needs, delivery expectations, and operational priorities.

4.10.3. Warehousing: Average Cost per Sq. Ft

INR 30

Per Sq. Ft.

Per Month

The average warehousing cost in India is approximately INR 30 per sq ft per month. This figure has been derived through an analysis of data encompassing a wide range of warehouse types and commodities. While this standardised value provides a useful reference point for understanding basic warehousing expenses and serves as a benchmark for users across sectors, it is important to note that actual costs can vary significantly depending on factors such as location, warehouse type, commodity handled, and service level. For instance, temperature-controlled warehouses—commonly used for pharmaceuticals, perishables, and certain chemicals—cost approximately INR 58.5 per square foot per month, nearly double the standard rate. Similarly, facilities handling hazardous cargo attract a higher average cost of INR 56 per square foot per month due to additional safety, regulatory, and infrastructure requirements. These are just a few examples—there are multiple other cargo categories and influencing factors that drive warehousing costs, which have been discussed in detail in this chapter. Therefore, while this average offers a helpful starting point, a more detailed analysis—particularly at the sub-component level and with commodity-specific insights—is essential for an accurate cost assessment and informed decision-making.

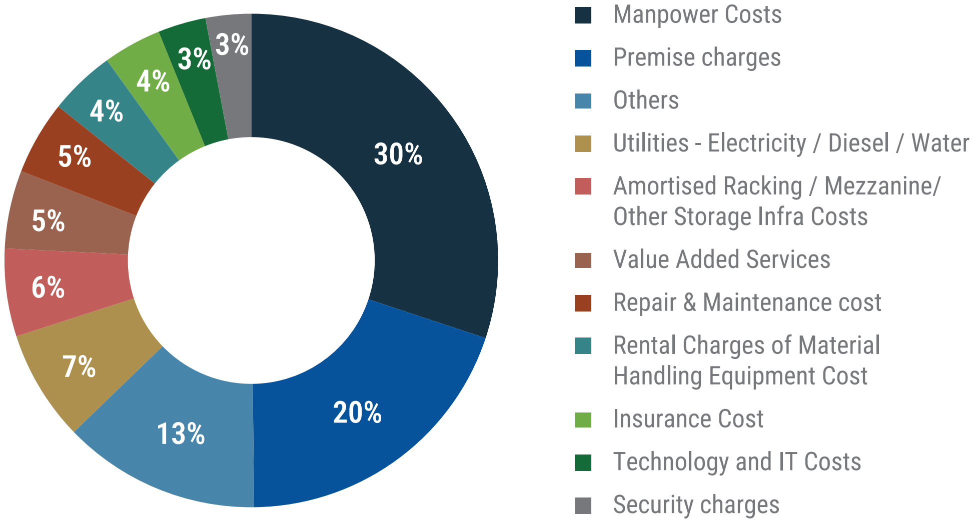
4.10.4. Warehousing - Cost Components

In warehousing cost analysis, we often focus primarily on per square foot rental rates or overall lease costs. While these figures are useful for budgeting, they offer only a partial view of the true cost of warehousing. A more accurate and actionable understanding emerges when we look at granular cost components that contribute to the total expense. Each sub-component—ranging from manpower and utilities to insurance and value-added services—can vary depending on the type of goods stored, warehouse grade, location, and technology adoption. This breakdown is crucial for end-users to assess service efficiency, compare vendors, and identify potential areas for optimisation.

Box 4.6. : Warehouse Service Model

In contrast to conventional models where warehouse operators lease land and build infrastructure, a distinct contract structure has emerged in which a dedicated developer acts as the infrastructure provider. These developers acquire large parcels of land, build core and site infrastructure—such as internal roads, essential utilities, security systems, and basic or customised warehouse shells—and lease built-up spaces to multiple warehouse operators on a monthly billing basis. This model offers significant adaptability to meet client-specific needs. Pricing typically follows a tiered service structure, varying according to the level of customisation. Large clients often opt to implement their own operational modifications, such as refrigeration, automated sorting, material handling, and segregation systems. At the same time, for clients seeking a turnkey solution, developers offer optional value-added services including automated racking systems, material-handling equipment (e.g., forklifts, pallet jacks, conveyor systems), and specialised storage infrastructure (for temperature-sensitive or hazardous goods). This flexible, modular model enables warehouse operators to scale and customise operations efficiently while benefitting from pre-built infrastructure and a developer-managed environment.

Figure 4.23. Break-up of Warehouse Operators Costs



The figure 4.23 represents represents the average cost distribution across key warehouse sub-components, providing a useful snapshot of how expenses are typically allocated in an Indian warehousing facility. Manpower (30 per cent) is the largest cost head, covering staff involved in receiving, put-away, picking, packing, inventory checks, and general warehouse operations. Labour-intensive processes in traditional warehouses make this a major contributor. For users, this affects service charges, especially in facilities with high throughput. For example, e-commerce fulfilment centres will have higher manpower costs due to intensive order processing.

The next big segment is the premise rates (20 per cent). This includes rent, lease, or ownership-related costs of the warehouse property. It varies significantly based on location (urban vs. rural), warehouse grade (A vs. B/C), and availability of land or built-up space. For example, warehouses near port cities like Mumbai or Chennai may have significantly higher premise costs compared to warehouses in hinterland areas.

Utilities constitute 7 per cent of the overall costs. This covers electricity, water, lighting, ventilation, and climate control systems. These costs rise with larger facilities or those handling perishable and temperature-sensitive goods. For example, cold chain warehouses storing vaccines or dairy require constant cooling, raising utility bills.

Another segment is amortised racking, mezzanine, and other storage costs which contribute 6 per cent to the average cost. This includes the depreciated cost of storage infrastructure such as pallet racking, shelving, mezzanine floors, and mobile racks. It is a capital expenditure that is amortised over time but passed on to users via storage or handling fees. For example, an FMCG firm storing in high-rack Grade A facilities will share a portion of these costs in their contract.

Warehousing is not only about storing goods; it also provides value added services which contribute 4 per cent to overall costs. These are customised services provided beyond basic storage—such as kitting, labelling, assembly, bundling, quality inspection, and reverse logistics. For example, a fashion retailer may request ironing, tagging, or combo pack creation before dispatching items to stores.

Repairs and maintenance (5 per cent) includes routine upkeep of infrastructure and equipment such as racks, doors, HVAC systems, and material handling tools. For end users, this influences operational reliability and safety standards. For example, poor maintenance can lead to damages and claims, indirectly affecting users.

Rental charges of material equipment handling constitute 5 per cent of warehousing costs. Rental costs cover the cost of leasing forklifts, pallet jacks, conveyors, and other mechanical tools. It is a pass-through cost, borne by users based on the volume and frequency of movement.

Insurance costs contribute 4 per cent. Insurance premiums cover stock held, facility, fire, theft, and liability, which are especially important for high-value or risk-prone goods. For example, an electronics distributor may have higher insurance-linked storage costs than one dealing in paper goods.

Technology, which has become a critical feature for some industries contributes 3 per cent to overall costs. These costs include the use of Warehouse Management Systems (WMSs), barcode scanners, IoT sensors, and ERP integrations. While small in share, it adds value in terms of transparency, accuracy, and efficiency.

Security, another critical feature contributes 3 per cent. Security expenses cover personnel and systems—such as guards, CCTV, access control, and alarm systems—to ensure cargo safety. For example, high-value cargo like luxury goods or pharmaceuticals will warrant enhanced security protocols.

All other costs covered under the aforementioned heads have been categorised under 'other costs,' which contribute 13 per cent to overall costs. They include the cost of administration, compliance, documentation, licensing, and unforeseen expenses. They may also include seasonal surcharges or costs like pest control, fumigation, etc.

4.11. Pipeline Costs

4.11.1. Overview

Pipelines in India serve as a specialised and efficient mode of transporting specific commodities, particularly petroleum products, natural gas and, to some extent, slurry and water. While their use is limited to such bulk, homogeneous goods, pipelines offer significant advantages in terms of operational efficiency, safety, and cost-effectiveness over long distances. Being a continuous and automated mode, they eliminate the need for manual handling, reduce transit losses, and ensure a steady, uninterrupted flow. Understanding the operational dynamics and cost structure of pipelines is essential, especially as India seeks to enhance its multimodal logistics mix with more economical and environmentally sound options.

The transportation of oil and gas via pipelines is central to India's energy infrastructure, offering a reliable and cost-efficient alternative to road and rail movements. Pipelines traverse diverse terrains, from coastal plains to mountainous regions, and operate under constant pressure, which prevents empty 'dead hauls,' or trips without product onboard that waste energy and time, and use significantly less energy per tonne-km than trucks or trains, while also reducing carbon dioxide emissions. These systems are governed by stringent safety and technical standards set by the Petroleum and Natural Gas Regulatory Board (PNGRB), which mandate robust leak detection, high-quality materials, and comprehensive emergency-response procedures.

4.11.2. Pipelines – Cost Break-up

The operational and financial sustainability of pipeline networks depends on a broad range of cost inputs, many of which are influenced by geography, pipeline length and diameter, product type (crude oil, refined products, or natural gas), and throughput volumes. These cost components can be broadly categorised under operating expenditure (Opex), which refers to recurring annual costs incurred once the pipeline is commissioned. The figure 4.24 represents key components of the pipeline costs The key elements of Opex include:

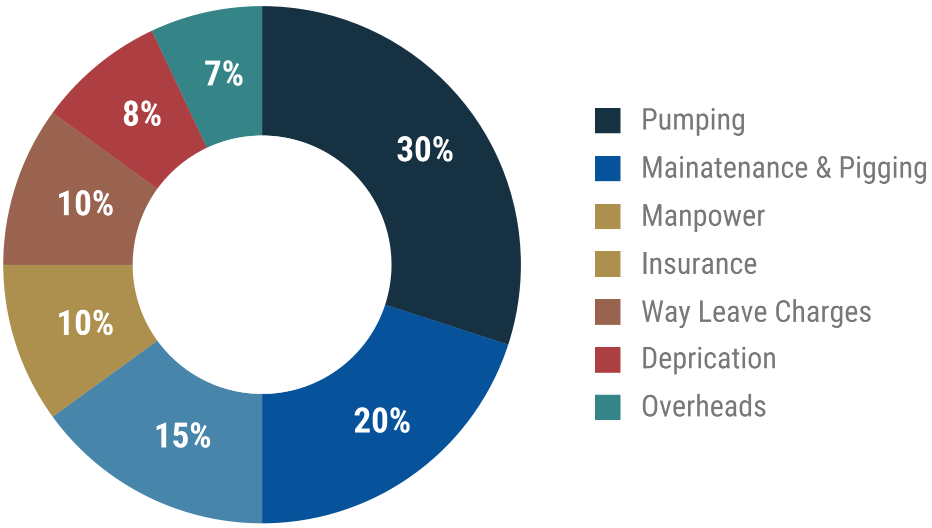
- **Pumping (Energy) Costs:** Among the most significant contributors to Opex, energy costs arise from the continuous operation of pump and compressor stations. These maintain the necessary pressure and flow velocity throughout the pipeline's length and elevation profile. Costs are directly affected by throughput volume, fluid viscosity, pipe diameter, terrain complexity, and booster station requirements. Energy consumption, whether from fuel or grid electricity, typically constitutes 20-30 per cent of total Opex.

- **Routine Maintenance and Pigging:** Routine maintenance encompasses corrosion control, valve inspections, leak detection, and overall pipeline integrity assessments. Pigging is critical for cleaning and inspecting the pipeline's internal surfaces, ensuring uninterrupted operations and compliance with regulatory norms. This category also covers unplanned repairs when faults are detected. Maintenance and pigging activities, such as valve replacements, inspection of corrosion protection systems, and scheduled cleaning, can account for 10-20 per cent of Opex. Pigging intervals vary depending on the product and operational standards.
- **Heated Pipelines:** For the transportation of waxy or heavy crude oil, trace heating or the use of insulated pipeline sections is required to maintain fluid temperature and prevent wax deposition and flow blockages. These systems contribute to increased energy use and necessitate specialised maintenance, thereby raising operating costs.
- **Manpower and Supervision:** Skilled technical and operational staff are essential for the end-to-end functioning of pipeline infrastructure. This includes control room engineers monitoring SCADA systems, on-ground technicians conducting safety drills, and supervisors ensuring regulatory compliance. Manpower costs include wages, benefits, and training for personnel involved in shift operations, emergency responses, and routine monitoring. These can contribute 10-20 per cent of Opex.

- **Insurance and Safety:** Pipelines are insured against a range of risks such as accidental damage, third-party liability, and environmental hazards. Safety expenditures cover gas detectors, fire protection systems, and regular safety audits in accordance with national and international standards. These also include costs associated with emergency preparedness, office operations, documentation systems, and compliance reporting. Together, insurance, safety, and overheads typically represent 10-20 per cent of Opex.
- **Project Overheads and Administration:** This includes costs related to project management, legal services, procurement, regulatory compliance, IT support, and coordination with central and state authorities for permits and inspections. These are essential to ensure smooth and lawful pipeline operations.
- **Way-Leave (Land-Use) Charges:** Way-leave charges refer to recurring payments made to private landowners, public authorities, or forest departments for the right-of-way along the pipeline corridor. These charges may escalate over time due to tenure agreements or inflation-based revisions. Annual or periodic, they typically constitute 5-10 per cent of Opex and include rental payments, renewals, and inflation-linked adjustments.
- **Depreciation:** As capital-intensive infrastructure, pipelines incur annual depreciation costs to reflect the gradual loss of asset value over time. Though non-cash, depreciation has a significant impact on tariff setting and tax calculations. It is generally estimated at 10-15 per cent of Opex.

The key components of operating expenditure and their percentage shares may vary across different pipeline networks.

Figure 4.24. Pipeline Cost Break-up



4.11.3. Pipelines: Tariff-Setting and User Charges

The determination of tariffs and user charges for petroleum and natural gas pipelines in India is governed by guidelines issued by the PNGRB, which balances cost recovery with efficient pricing for users.

Under India's regulatory framework, natural-gas and petroleum-product pipelines each follow their own PNGRB tariff regulations:

- Natural gas pipelines: Tariffs are determined under the PNGRB (Determination of Natural Gas Pipeline Tariff) Regulations, 2008, which employ a discounted-cash-flow (DCF) model targeting a 12 per cent post-tax return on capital and, since April 2023, apply a 'unified distance-based tariff' with two zones (≤300 km and >300 km) for all grid pipelines. Under the PNGRB Regulations, 2008, all tariffs for natural-gas pipelines must be set via DCF methodology targeting a 12 per cent post-tax return on invested capital, levelised over the pipeline's economic life.

Box 4.7. : Pipeline Cost Projectionis: 2023-49

In 22 March 2023, PNGRB adopted GAIL's projections (of 30 December 2022) which spanned the period from 1 April 2023 to 31 March 2049. These projections were:

- Capital expenditure (capex): INR 40,961.64 crore
- Operating expenditure (opex): INR 1.72 crore
- Transmission losses: INR 2,784.64 crore
- Line pack value: INR 536.67 crore
- NFA (residual): INR 4,811.15 crore
- Working capital (closing): INR 1,024.03 crore
- Terminal value (residual): INR 6,371.86 crore
- Return on capital: 12 per cent post-tax

These cash-flows are discounted and levelised into a single unit tariff of INR 58.61 per MMBtu (GCV basis)

- Petroleum-product pipelines: These are governed by the PNGRB (Determination of Petroleum and Petroleum Products Pipeline Tariff) Regulations, 2010 (as amended in 2024). Under this:
  - Legacy pipelines (pre-Dec 2010) are charged at 75 per cent of the equivalent rail freight (100 per cent for LPG) with capped annual escalations.
  - New pipelines (post-Dec 2010) and bid-out projects adopt the DCF approach (12 per cent return), with bid-out tariffs locked in for 10 years before reverting to DCF.

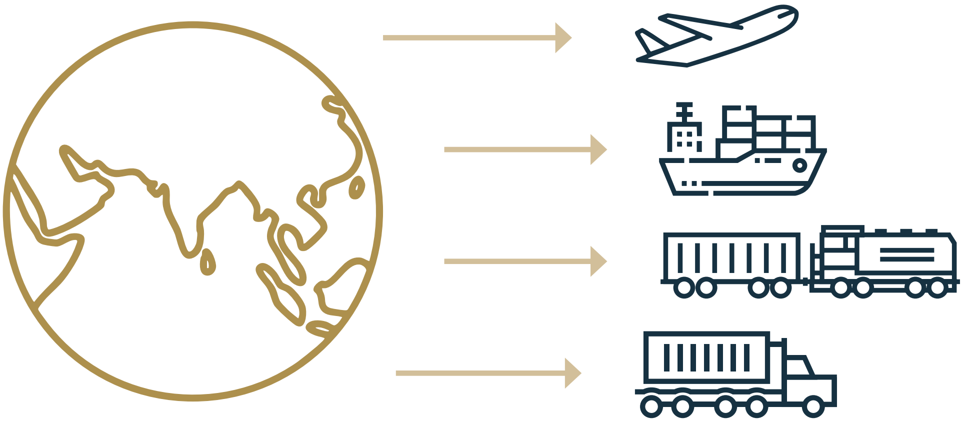
Table 4.6. : Tariff Determination for Mudra-Delhi Pipeline (petroleum and petroleum products)

Entry Point	Tap-off Points (TOPs)	Equivalent Rail Distance (km)	Tariff for SKO Class 165 (INR/MT)	Tariff for HSD & Others Class 180A (INR/MT)
Mundra	Palanpur	397.76	530.18	531.90
Mundra	Awa	621.10	834.83	837.38
Mundra	Ajmer	724.90	955.65	958.65
Mundra	Jaipur	919.95	1,193.33	1,197.08

4.12. Export and Import (EXIM) Costs

4.12.1. Overview

The cost of moving goods across borders is a critical determinant of trade efficiency and export competitiveness. In India, almost 95 per cent of the EXIM cargo (by volume) is transported through maritime ports, while the remaining 5 per cent is handled at airports and land ports. Therefore, a significant portion of EXIM (export-import) logistics costs is incurred at maritime ports, where cargo interfaces with multiple stakeholders, including port authorities, terminal operators, customs, shipping lines, and inland transport service providers. Similarly, at airports and land ports, various stakeholders come together to move the cargo across the Indian borders. Some of the key stakeholders include airlines, terminal operators, airport authorities at airports, and Integrated Check Post (ICP) staff at land ports. In addition to these, a few other common sets of stakeholders, operating across port categories, include customs, traders/agents, transporters, and financial institutions. Port-related charges typically cover services such as cargo-handling, container movement, documentation, scanning, storage, and other ancillary operations. While some charges are standard, and levied across all shipments (e.g., terminal handling charges), others are situational, such as demurrage for a delayed clearance or additional shifting charges.



The entire chain of the EXIM process has three major categories: cargo movement across the hinterland to or from the port, cargo handling at the ports, and cargo movement away from the ports (going away or coming in). In this section, only the middle process is discussed, that is, cargo handling at the ports. It provides a detailed overview of the cost structure for EXIM cargo across port types. It also identifies the key cost components, explains how they vary across different cargo movement pathways, and highlights systemic and operational factors that influence these costs. Understanding this cost framework is essential for diagnosing inefficiencies in the logistics chain and designing more competitive trade facilitation strategies. To accurately assess these costs, it is essential to understand the processes involved in cargo movement and the types of charges levied.

- **Cargo types:** The type of cargo significantly influences port-handling costs, primarily due to differences in how goods are loaded, stored, and moved. General cargo across port categories incurs lower costs compared to perishable, oversized, special, or hazardous cargo, which involves specialised and multiple handling. At maritime ports, bulk cargo generally incurs lower handling costs than containerised cargo, because it is moved in large volumes using mechanised systems like conveyors and grabs, requiring minimal packaging and labour. In contrast, container cargo involves multiple handling stages—loading, unloading, stacking, inspection—which demand specialised equipment and higher operational effort, driving up the costs.
- **Modes of cargo movement:** At maritime ports, EXIM cargo moves through different pathways, each impacting the cost structure. For imports, cargo may be cleared directly from the port under direct port delivery (DPD), attracting only terminal-level charges. If the cargo is routed through a container freight station (CFS), additional handling and service charges apply. Rail-bound cargo is moved to an Inland Container Depot, incurring a separate set of charges. Similarly, export cargo reaches the port either via direct port entry (DPE), through a CFS, or from an ICD by rail. Similarly, at the airports, import cargo may be cleared directly from the airport cargo terminal, attracting only standard terminal-level charges. If the cargo is routed through a freight forwarder or consolidation facility before or after arriving at the airport, additional handling and service charges may apply. Further, export cargo reaches the airport either directly from

the shipper, through a consolidation centre, or via an inland transport hub. Understanding the cargo's movement path is critical to determining the applicable cost components.

- **Standard vs. Variable Costs:** Port-related costs can be broadly categorised into standard and variable (case-specific) charges. Certain charges—such as terminal handling charges (THC), in the case of maritime ports and terminal storage and processing (TSP) charges for airports, and documentation charges—are universally applicable, while others arise only under specific conditions, such as demurrage for exceeding the free storage period at a port or at other storage facilities like CFS. Distinguishing between recurring and situational costs is essential before presenting a comprehensive cost estimate.

Figure 4.25. : Categorisation of Port-related Costs

Standard Costs

- Terminal handling cost - THC
- Documentation
- Container maintainence
- Equipment surcharge
- Import container faciltation charge
- Delivery order charge
- CFS/ICD charge

Variable Costs

- Scanning/examination charge
- Demurrage
- Detention charge
- Shifting charge
- Weighting charge
- Sampling
- Special service charge

- **Additional steps in the Clearance Process:** Certain commodities entail specific processes to be carried out at the port. This includes commodities where certification from various partner government agencies (PGAs), like Food Safety and Standards Authority of India (FSSAI), Central Drugs Standard Control Organisation (CDSCO), etc., are required. Such cargo requires additional processes involving sample collection and examination which add to delays, thereby adding to costs. Similarly, there are other generic commodities where the process gets delayed owing to some additional processes like examination and penalties due to delays by the owner/ trader. These additional costs also amplify overall costs.

- **Cost Components and Stakeholders:** Port charges are further organised based on the stakeholders levying them. At maritime port terminals, for example, the THC includes costs for moving containers from the vessel to the yard and onto a truck or train; these costs are charged by terminals depending on the tariff. However, in practice, it is the shipping line that pays these dues and later bills it to the customer. The important point here is that, whilst the terminal may charge the shipping line as per the tariff, the shipping line, in practice, does not pass the exact amount on to the customer: it always charges a higher rate, which changes overall costs paid by the customer. Therefore, if we were to calculate port-level costs based on tariffs from various stakeholders, we would arrive at a figure that is less than the actual costs paid by users. Additional shifting within the terminal may attract separate charges, although these are often bundled with the THC. Similarly, container maintenance and cleaning charges are typically paid to shipping lines and are often grouped with THC, which is also levied by them. These bundled cost heads provide a more streamlined structure for presenting port-related expenses.

In the following section, we provide an estimate of the standard port-related costs incurred by EXIM cargo across different movement scenarios. Before that, it is important to understand the movement of cargo through the ports.

Box 4.8. : Movement of EXIM Cargo at Maritime Ports

Imports

- Road -> Cargo arrives at the port and leaves by truck either to the destination or CFS.
- Rail -> Cargo arrives at the port and leaves by rail to the designated ICD, from where the cargo is taken to the destination in a truck.

Exports

- Road -> Cargo arrives at the port either directly or via CFS.
- Rail -> Cargo arrives at the ICD by truck, and from there is taken to the port by rail.

4.12.2. Port-Related Costs

Maritime ports:

Table 4.7 outlines the standard cost components typically incurred for handling containerised EXIM (export-import) cargo at Indian maritime ports. These are often considered baseline or indicative charges levied by various service providers involved in the port logistics ecosystem – such as terminal operators, shipping lines, freight forwarders, CFS, and ICDs. These costs reflect the bare minimum expenses that cargo owners or logistics operators must typically bear to process a container through a port. They help provide an initial understanding of the range of services availed during port operations, including cargo handling, documentation, container upkeep, and administrative clearances. However, the on-ground reality is often far more complex. These standard charges can vary significantly depending on factors such as:

- type of cargo (hazardous, ODC, etc.)
- port location and congestion levels
- choice of terminal or shipping line

- mode of evacuation (rail/road/direct port delivery)
- specific line or consignee requirements
- value-added services (e.g., stuffing, destuffing, sampling, examination, etc.)

In practice, actual costs are often higher due to surcharges, informal facilitation fees, delays, or bundled services not captured in the standard rate card. Still, presenting these cost heads is important, as it helps stakeholders understand the process of cargo clearance and movement at ports. Such a breakdown also becomes useful for cost benchmarking, operational planning, or identifying areas for regulatory and policy intervention.

Table 4.7: Port-related Cost Break-up

Cost Component	Cost (INR)
Terminal Handling Charge per TEU*	8,000 – 10,000
Documentation per Shipping Bill/Bill of Entry	3,000 – 5,000
Container Maintenance per TEU	3,000
Equipment Surcharge per TEU	1,000
Import Container Facilitation & Admin	3,000
Toll Charge	1,000
CFS Charges	4,000– 6,000
Delivery Order (D/O) per Bill of Lading (B/L)	2,500 – 5,000

*TEU-Twenty-Foot Equivalent Unit is a standard unit of measurement used in the international shipping industry to express the cargo-carrying capacity of ships and container terminals

To place these costs in perspective, we present in Figure 4.26 a contextual representation of the cost components associated with moving a container between Jawaharlal Nehru Port (JNP) and Delhi. In the earlier sections, we discussed the various standard or generic charges typically levied at ports for EXIM cargo. However, to make those cost heads more relatable and practical, this illustration uses a real-world example to show how these charges manifest when moving cargo along a specific origin-destination (OD) pair.

Figure 4.26. : Exim Cost per TEU From JNPT to Delhi

Imports

Transportation - INR 70,000
Port Costs - INR 30,000

Exports

Transportation - INR 65,000
Port Costs - INR 24,000

In this example, the movement of both import and export cargo is assumed to take place entirely via road-based transportation, and the costs are broken down into two broad categories: transportation cost, which captures the expense of moving the container from the port to its inland destination (or vice versa); and port-level cost, which has been presented as a consolidated figure that includes various charges such as terminal handling, documentation, customs facilitation, and other related services that occur within the port ecosystem.

For import cargo arriving at JNP and destined for Delhi, transportation cost is estimated at INR 70,000, while cumulative port-related costs are estimated at INR 30,000. This brings the total cost of import container movement to INR1,00,000 per TEU. On the export side, where cargo originates from Delhi and moves out through JNP, transportation cost is slightly lower, at INR 65,000, and port-related costs are also comparatively lower, at INR 24,000. Thus, the total export cost comes to INR 89,000 per TEU.

It is important to emphasise that these figures reflect standard charges or the bare minimum levels typically encountered in such movements. In practice, the actual costs are often higher due to additional services, logistical complexities, or process-related inefficiencies. For instance, if a container requires warehousing, time-bound customs clearance, or intermodal transfers, the overall cost would increase significantly. Moreover, the use of rail-based transportation is not considered in this example.

This illustration should also be viewed within the context of benchmarking rather than as an absolute representation of cost. Charges will naturally vary from port to port, and across different OD pairs, depending on the nature of infrastructure, service availability, and market conditions. What is presented here is a simplified, standardised example to help readers understand how port and inland transport costs combine in shaping overall EXIM logistics expenditure.

Ultimately, this example reaffirms the broader theme discussed in this chapter—that while cost per tonne per km offers a macro-level view, a detailed breakup of costs is essential for meaningful analysis, targeted interventions, and operational efficiency improvements in the EXIM logistics ecosystem.

Airports: As at maritime ports, the actual costs at airports are often higher than the published standard tariffs due to surcharges, informal facilitation fees, delays, or bundled services not explicitly captured in the standard rate card. Nevertheless, presenting these cost components is important, as it helps stakeholders understand the processes involved in cargo clearance and movement at airports.

Just to put these costs into perspective, we have presented a contextual representation of the cost components associated with moving an air cargo consignment between Chhatrapati Shivaji Maharaj International Airport (CSMIA) and Pune. In the earlier sections we discussed the various standard or generic charges typically levied at airports for EXIM cargo. However, to make those cost heads more relatable and practical, this illustration uses a real-world example to show how these charges manifest when transporting cargo along a specific origin-destination (OD) pair.

In this example, the movement of both import and export air cargo is assumed to take place entirely via road-based transportation, and the costs are broken down into two broad categories: transportation cost, which is the expense of moving cargo to or from the airport and its inland destination (or origin); and the airport-level cost, which is presented as a consolidated figure that includes various charges such as terminal storage and processing, documentation, customs facilitation, and other related services that occur within the airport cargo terminal ecosystem.

To contextualise airport-related cargo movement costs, we present an example of transporting general electronics cargo weighing 3 tonnes between CSMIA Mumbai and Pune.

Imports

For import cargo arriving at Mumbai Airport and destined for Pune, road transportation costs are estimated at INR 6,500. The cumulative airport-related charges applicable to this general cargo shipment amount to approximately INR 47,800. This total includes terminal storage, facilitation and processing charges calculated per kg, as well as fixed fees for delivery order issuance, house air waybill (HAWB) issuance, de-consolidation services, and documentation charges, which are standard components of the import cargo handling process at the airport. Therefore, the total cost of moving this import cargo port-to-destination is approximately INR 54,300.

Table 4.8. : Imports: Break-up of Airport-Related Charges

Charge Description	Amount (INR)
Terminal, Storage, Facilitation & Processing Charges	32,000
Delivery Order Fees	7,800
HAWB Issuance Charge	5,000
De-Consolidation Fee - HAWB Delivery Charge	1,000
Documentation Charges	2,000
Total Import Charges	47,800

Exports

On the export side, where cargo originates from Pune and moves out through Mumbai Airport, the road transportation cost is INR 4,800, and airport-related charges for this 3-tonne general cargo shipment are INR 7,900. This figure includes terminal storage and processing fees calculated per kg and fixed export administration charges. Optional charges such as packing, express handling, and back-to-town fees were not applied in this example. Consequently, the total export movement cost from Pune to Mumbai is approximately INR 12,700.

Table 4.9. : Exports: Break-up of Airport-Related Charges

Charge Description	Amount (INR)
Terminal, Storage, Facilitation & Processing Charges (TSP)	6,200
Export Administration Charges	200
Clearance Charges	~1,500
Total Export Charges	~7,900

It is important to emphasise that these figures reflect standard airport handling charges or the bare minimum levels typically encountered in such air cargo movements. In practice, actual costs are often higher due to additional services, logistical complexities, or process-related inefficiencies. For example, if air cargo requires warehousing, expedited customs clearance, or trans-shipment through multiple modes of transport, overall cost would increase significantly. Moreover, this illustration assumes road-based transportation and does not consider rail or other modal options.

This example should be viewed within the context of benchmarking rather than as an absolute representation of cost. Charges will naturally vary from airport to airport, and across different origin-destination pairs, depending on infrastructure quality, the range of services offered, and market conditions. What is presented here is a simplified, standardised illustration to help readers understand how airport handling fees and inland transportation costs combine to shape the overall air cargo logistics expenditure.

Ultimately, this case reaffirms the broader theme discussed in this chapter—that while aggregate cost metrics such as cost per tonne per km are useful at a macro level, detailed cost breakups anchored on real-world data are essential for targeted policy action, operational improvements, and efficient logistics management in the EXIM air cargo ecosystem.

Land Ports: There are two main types of land ports through which EXIM cargo movement takes place in India: integrated check posts (ICPs) and land customs stations (LCSs). Technically, there is little difference between the two categories, as both serve the same regulatory purpose. However, on the ground, the difference in infrastructure is quite visible, and this often adds an additional layer of cost when trading through ICPs.

The cost of moving cargo through land ports depends on multiple factors, including the volume of cargo, its type, vehicles used, and the kind of land border in question. Since infrastructure across land ports is not standardised, it is difficult to establish a uniform costing model. As a result,

costs for moving the same volume of the same commodity can vary significantly across different land ports.

For instance, at Petrapole, there is abundant parking and storage space. Cargo can be unloaded and reloaded onto other trucks, but this also attracts additional handling costs. In contrast, at the Sonauli border between India and Nepal, there are no parking or storage facilities. Trucks from both sides are permitted to move directly into the hinterland, which means no handling costs are incurred at the border.

The origin of trucks also plays a critical role in determining costs. At the Bhutan–India border, trucks are allowed to move into each other's hinterland without additional charges—Indian trucks can travel into Bhutan, and Bhutanese trucks can enter India (albeit up to a specified distance). However, this facility is not available at all borders. In some cases, trucks from across the border are subject to additional charges. These may be formally prescribed under regulations, or in other cases, collected as informal payments, further escalating costs.

Another important aspect is that at ICPs managed by the Land Ports Authority of India (LPAI), there is a specific cost head for imports known as the LPAI cost. This is essentially an administrative or service charge levied on inbound cargo.

It is therefore clear that EXIM costs across land ports cannot be standardised. They vary widely depending on infrastructure availability, border regulations, and operational practices. To illustrate this, we will use an example of EXIM movement through the Petrapole border. The cargo in this case is assumed to be moving from New Delhi for exports, and likewise destined for New Delhi in the case of imports.

It should also be noted that all costs at land ports are calculated on a per-truck basis and vary depending on the size and type of truck used. For our example, we consider an 18-tonne truck carrying general cargo.

Import Costs

- Clearance costs or documentation costs = INR 10,000
- LPAI costs = INR 5,000
- Transportation costs (Petrapole to New Delhi) = INR 60,000
- Informal costs = INR 3000-4,000
- Total costs = INR 79,000

Export Costs

- Transportation costs (New Delhi to Petrapole) = INR 65,000
- Clearance cost = INR 5,000
- Slot booking charges = INR 10,000
- Total costs = INR 80,000

It must be noted that the costs mentioned above represent the most standard and indicative charges. In reality, costs may escalate as additional services are availed, or depending on factors such as the type of cargo, time taken for clearance, penalties, and other operational variances. The example provided here is meant to simplify understanding of the key cost components and illustrate how and when they may vary across land ports.

5 Way Forward

The assessment of logistics cost in India represents a significant milestone in addressing a long-standing gap in the country's economic analysis. For decades, the absence of a uniform definition and robust methodology led to wide variations in estimates, so this report tries to establish a credible, evidence-based framework for logistics cost estimation, placing India at par with global best practices. By developing an indigenous framework, India joins this global discourse, ensuring that its logistics sector can be measured, compared, and aligned with international standards which would also facilitate in identifying bottlenecks, encourage multi-modal integration, and optimize supply chains.

The present assessment places India's logistics cost at 7.97 per cent of GDP, with detailed insights across modes, product categories, and firm sizes. The report goes beyond a headline figure by quantifying freight cost per tonne-kilometre for road, rail, air, and waterways, and by underlining the critical role of multi-modality in optimising costs and improving efficiency. This assessment will play a pivotal role in shaping the logistics reforms and infrastructure development.

The findings will inform key initiatives under the PM GatiShakti National Master Plan (NMP) by aligning infrastructure planning with real logistics needs. In particular, the framework will aid in the development of Multi-Modal Logistics Parks (MMLPs) and other integrated projects, enabling a more efficient modal mix and reducing bottlenecks. By providing evidence-based guidance, the study strengthens India's efforts to enhance competitiveness and supports the broader vision of positioning the country as a global logistics hub.

Looking ahead, the future prospects of logistics cost assessment lie in institutionalizing this exercise through a Logistics Cost Index (LCI) for annual monitoring. By incorporating real-time data sources such as e-way bills, GSTN, and technology-enabled tracking, India can progressively enhance the accuracy of cost estimates. Greater use of digital tools, automation in warehousing, and a shift towards greener and more sustainable transport modes will further contribute to reducing costs and improving competitiveness.

This report is therefore not an end in itself, but a foundation for sustained policy reform. By providing reliable benchmarks and actionable insights, it equips policymakers, industry, and stakeholders with the tools to make informed decisions, strengthen supply chain resilience, and advance India's ambition of becoming a global leader in efficient, competitive, and sustainable logistics.

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Study Team
National Council of Applied Economic Research (NCAER)

Study Team

Project Leaders

Poonam Munjal, Sanjib Pohit

Research Team

Palash Baruah, Yashika Khattar, Sovini Mondal

Consultant

Afaq Hussain

Survey Planning and Coordination

K A Siddiqui, Prabir Ghosh, Jyoti Thakur, Nijara Deka

Asrar Alam, Mukta Kaushik, Chanchal Negi, Dhruv Pratap Singh, Sameeha Jameel, Ravi Gupta

DPIIT's Core Team

Sagar R. Kadu, Yagya Kumari Lodhi, Aman

Editor

Anuradha Bhasin

Administrative Support

Tara Joshi, Sadhna Singh

For any suggestions/feedback, please write to:

Logistics Division

Department for Promotion of Industry and Internal Trade (DPIIT),

Ministry of Commerce and Industry, Government of India, New Delhi - 110011

Contact Number: 011-23062821

logistics-div@gov.in

And

National Council of Applied Economic Research

NCAER India Centre, 11 Indraprastha Estate, New Delhi - 110002

Contact Number: 011-61202698

Email: info@ncaer.org