DOI.https://doi.org/10.3126/ljbe.v13i2.84763

Vol. 13, No. 2 Journal homepage: www.nepjol.info/index.php/ljbe **December, 2025**

ISSN: 2091-1467 (Print) **EISSN: 3102-0240**

The Lumbini Journal of

Business and Economics

Peer Reviewed

Rewiring Economic Interdependence: A Mixed-Methods Analysis of India–Nepal Cross-Border Trade, 2010–2024

Udayan Samajpati[1]

Article Info

Received:

24 September 2025

Revised:

01 November 2025

Accepted:

24 November 2025

Abstract

Purpose: *Every truck crossing the Birgunj-Raxaul checkpoint carries more than goods. It carries the weight of India–Nepal interdependence. Despite long-standing treaties, the corridor still mirrors South Asia's paradox: deep proximity, shallow coordination. This study examines how bilateral trade has evolved since 2010, what infrastructural and institutional bottlenecks persist, and how digital initiatives are reshaping this interdependence.*

Methods: *Using a mixed-methods approach, the study combines quantitative analysis of official trade data (DGFT, NRB) with twenty semi-structured interviews involving traders, customs officials, and logistics experts to link numbers with lived realities.*

Results: *Trade rose from USD 4.2 billion in 2010 to about USD 11 billion in 2023, yet remains uneven. Digital reforms under BBIN and customs automation improved processing times but failed to eliminate manual checks, power outages, and fragmented coordination.*

Conclusion: *Transforming geographic closeness into genuine connectivity demands synchronized digital platforms, harmonized procedures, and trust-based institutional cooperation – turning border crossings from choke points into channels of shared prosperity.*

Keywords: Non-tariff barriers, Bilateral trade, Trade logistics, Digital era, South Asia.

JEL Classification: F14, F15, O53

I. Introduction

Each dawn, hundreds of trucks queue at Birgunj, their engines humming against the chill morning air as they await customs clearance into India. From textiles and herbs to petroleum and steel, this daily movement of goods captures the living pulse of South Asian interdependence. Yet, the same border that connects markets also exposes a regional paradox – deep geographic proximity but shallow economic coordination (Kathuria, 2018; De & Iyengar, 2016). For decades, India and Nepal have shared an open border, common cultural threads, and complementary economic needs, but their trade relationship still wrestles with

[1]*Mr. Samajpati, PhD, is an Assistant Professor at P.G. Department of Commerce, Jai Prakash University, Chapra, Bihar- 841302, India. He can be reached at udayansamajpati@gmail.com, https://orcid.org/0009-0001-6819-461X*

inefficiency, asymmetry, and procedural friction (Bhattarai & Mishra, 2020; Rai & Jha, 2020).

Historically, India has served as primary trading partner of Nepal and transit lifeline. The Ministry of Finance of Nepal (2023) estimated that India accounts for nearly 64 percent of Nepal's total trade and more than 90 percent of its oil imports, underlining a structural reliance that extends far beyond commodities. Bhattarai (2017) characterizes this relationship as a hybrid of partnership and dependency, shaped by geography, energy flows, and diplomatic rhythms. While India benefits from access to hydropower, herbs, and tourism linkages, Nepal depends on Indian ports, electricity, and manufacturing supplies (Pant, 2019; Government of Nepal, 2023). Over time, bilateral relations have evolved from aid and transit arrangements to a trade-driven economic partnership grounded in multiple agreements, including the Treaty of Trade and Transit revised in 2009 (Mukherjee & Chaturvedi, 2019). Despite these institutional frameworks, outcomes remain uneven and under-optimized (ADB, 2022; ESCAP, 2022).

Persistent challenges constrain the potential of this relationship. Border infrastructure remains outdated at several checkpoints, and non-tariff barriers such as sanitary and phytosanitary requirements, inconsistent documentation, and complex customs procedures raise transaction costs (Rajbhandari, 2021; Aslam & Karim, 2021). Informal trade flourishes along porous frontiers, creating parallel channels that distort official data and fiscal revenues (Sapkota, 2022; Bohara & Gautam, 2021). Even where modernization efforts have been initiated, progress has been asymmetric. India's digital customs interface, ICEGATE, and Nepal's ASYCUDA system operate with limited interoperability, forcing traders to rely on duplicate paperwork and manual verification (Rashid & Alam, 2021; Joshi & Shrestha, 2023). These friction points reveal how physical connectivity has outpaced institutional and digital coordination (De & Wagle, 2019; OECD, 2022).

Existing scholarship and policy reports have illuminated important aspects of the India–Nepal trade landscape, yet several gaps remain. Most prior studies examine tariff patterns or aggregate volumes but rarely combine quantitative evidence with ground-level experiences of traders and customs officials (Karmacharya & Pant, 2015; Gautam, 2021). Few have analysed post-COVID transformations in logistics and digital facilitation, even though the pandemic accelerated paperless trade adoption worldwide (UNCTAD, 2021; ESCAP, 2024). Moreover, earlier works treat institutional and technological factors separately, leaving limited understanding of how coordination or its absence affects trade outcomes (Saha & De, 2022; Baral & Sharma, 2023). Addressing these blind spots requires an integrated, mixed-methods perspective that situates trade data within the lived realities of cross-border actors (Creswell & Clark, 2018).

Accordingly, the present study pursues three interrelated objectives: to analyse long-term trade trends and asymmetries between India and Nepal during 2010–2024; to identify institutional, infrastructural, and logistical bottlenecks affecting cross-border efficiency; and to evaluate the role of digital facilitation and regional initiatives such as the Bangladesh–Bhutan–India–Nepal (BBIN) and Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) frameworks in reshaping bilateral interdependence (Haque & Yusuf, 2023; BIMSTEC Secretariat, 2022).

Building on these aims, the analysis tests three directional hypotheses: H_1: Greater digital facilitation is positively associated with higher bilateral trade intensity. H_2: Non-tariff and procedural barriers are negatively associated with Nepal's export diversification. H_3: Stronger institutional coordination enhances the efficiency of infrastructure investments along trade corridors (Anderson & Wincoop, 2003; Keohane & Nye, 1977).

The study focuses on key land corridors: Raxaul–Birgunj, Sunauli–Bhairahawa, and Jogbani–Biratnagar, that handle the majority of bilateral freight traffic (ADB, 2021; World Bank, 2023a). The temporal scope extends from 2010 to 2024, encompassing critical inflection points such as the 2015–16 border blockades, the COVID-19 pandemic, and the rollout of digital customs systems after 2020 (OECD, 2023; World Bank, 2024).

II. Reviews

Trade liberalization in South Asia has long been considered an unfinished agenda. Despite shared borders, cultural linkages, and historical trade routes, intra-regional trade accounts for less than 5 percent of total trade among South Asian countries (De & Iyengar, 2016; Kathuria, 2018). This paradox, proximity without productivity, reflects deep-seated structural barriers such as fragmented transport networks, high transaction costs, and overlapping regulatory regimes. South Asian economies, including India and Nepal, have struggled to translate geographical advantages into competitive regional integration. As a result, trade corridors remain congested and underperforming, even when formal treaties promote openness. Within this context, the India – Nepal economic relationship serves as a microcosm of the broader regional pattern, where connectivity initiatives coexist with logistical frictions and policy asymmetry.

The Gravity Model of Trade, introduced by Tinbergen (1962), provides a foundational lens for understanding such bilateral patterns. The model posits that trade between two countries is directly proportional to their economic mass, typically measured by GDP and inversely proportional to the geographic distance between them. Building on this, Anderson and Wincoop (2003) introduced the concept of "multilateral resistance," highlighting that trade is also influenced by barriers relative to other trading partners. Under normal conditions, India and Nepal, as contiguous neighbours with high economic complementarity, should exhibit strong trade intensity. However, the empirical reality diverges from theoretical expectations. Despite zero tariffs under the 2009 Trade Treaty, non-tariff barriers (NTBs), including lengthy phytosanitary inspections, manual documentation, and infrastructure bottlenecks, dampen the predicted trade flows. The deviation underscores that geographical closeness alone does not guarantee trade efficiency when institutional and digital frictions persist across borders.

To complement the economic explanation of trade flows, Interdependence Theory offers a political-economic perspective that captures the nuances of vulnerability and asymmetry. Keohane and Nye (1977) conceptualized interdependence as a condition of reciprocal effects among nations, wherein transactions become both mutually beneficial and mutually constraining. In such relationships, power asymmetries determine who bears the cost when disruptions occur. Bhattarai (2017) applies this lens to the India-Nepal context, arguing that Nepal's dependence on Indian ports, energy, and consumer goods creates a form of "bounded interdependence." The 2015-16 border blockade exposed this imbalance, as logistical disruptions reverberated across Nepal's economy. Yet, the same interdependence also fosters incentives for cooperation: hydropower exports and cross-border tourism of Nepal contribute to India's regional connectivity ambitions. Thus, interdependence between the two nations is simultaneously a source of resilience and fragility, reinforcing the need for institutional trust and policy synchronization.

Empirical studies reinforce these theoretical insights while revealing persistent gaps. Karmacharya and Pant (2015) showed that export basket of Nepal remains narrow, dominated by low-value commodities such as jute, carpets, and spices, whereas India's exports are diversified across industrial and consumer goods. This asymmetry contributes to a chronic trade deficit. Rai and Jha (2020) examined elasticity patterns and found that Nepal's imports from India are largely price-inelastic, suggesting structural dependence rather than market responsiveness. Their analysis also emphasized that infrastructure and procedural reforms have stronger effects on trade than tariff adjustments alone. De and Wagle (2019), assessing the South Asia Subregional Economic Cooperation (SASEC) framework, demonstrated that logistics modernization such as the creation of integrated check posts (ICPs) and electronic data interchange has improved trade flow efficiency, but coordination gaps between border agencies limit these gains. On the other hand, Sapkota (2022) highlighted the role of informal trade networks that flourish under weak enforcement and procedural rigidity, estimating that unrecorded trade between India and Nepal could reach USD 1 billion annually. Collectively, these studies highlight five clear gaps:

Limited integration of quantitative data with qualitative stakeholder insights;

Neglect of digital transformation and its trade facilitation potential;

Insufficient focus on post-pandemic logistics evolution;

Underestimation of informal trade's scale and policy implications; and

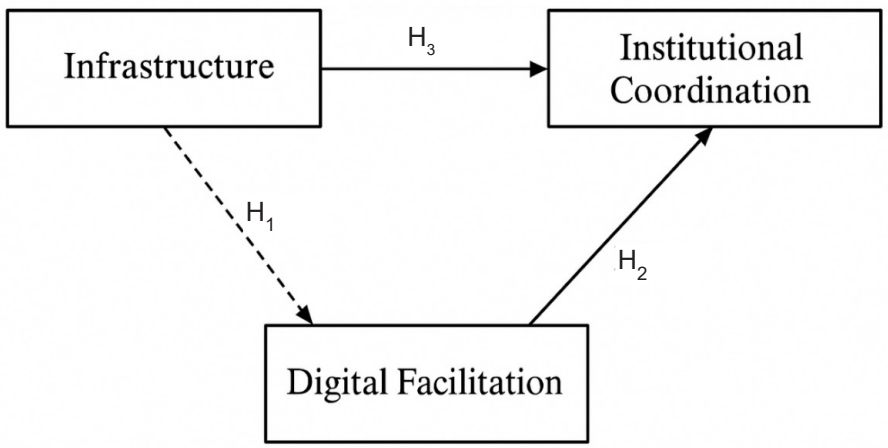
Lack of an integrated view connecting infrastructure, institutions, and technology.

To address these research gaps, the present study develops a conceptual framework that synthesizes insights from both the Gravity Model and Interdependence Theory. It assumes that trade efficiency is not solely a function of geography or policy but an outcome of infrastructure capacity, institutional coordination, and digital integration. Efficient road, rail, and dry-port infrastructure (e.g., the Birgunj ICD and Bhairahawa SEZ) provide the physical foundation for trade, yet these assets yield optimal outcomes only when coupled with harmonized customs regulations and interoperable digital systems. Institutional coordination, through bilateral trade councils, cross-border committees, and standardized documentation, is pivotal in transforming physical connectivity into operational efficiency. Finally, digitalization acts as the catalyst, linking real-time data flows, automated clearance, and paperless transactions to reduce costs and delays. Together, these dimensions form a dynamic feedback loop in which infrastructure enables, institutions align, and digital systems accelerate the deepening of economic interdependence.

To consolidate these theoretical linkages, Figure 1 presents the conceptual framework developed for this study, illustrating how infrastructure, institutional coordination, and digital facilitation jointly influence bilateral trade efficiency between India and Nepal.

Figure 1

Conceptual Framework Linking Infrastructure, Institutional Coordination, and Digital Facilitation to Bilateral Trade Efficiency (2010–2024)



Note. Author's elaboration based on Gravity Model (Tinbergen 1962; Anderson & Wincoop, 2003) and Interdependence Theory (Keohane & Nye 1977; Bhattarai 2017).

Figure 1 visualizes the central logic of the study: that trade performance arises not merely from geographical proximity but from the interaction of physical, institutional, and digital systems. Robust infrastructure improves logistics capacity, yet without harmonized institutional procedures its benefits remain partial. Institutional coordination converts physical assets into efficient flows, while digital facilitation acts as the accelerator linking agencies, reducing

transaction costs, and enhancing transparency. The three hypothesized pathways (H_1 – H_3) thus capture a cyclical process in which digital modernization strengthens the infrastructure; institution interface, generating more resilient and equitable economic interdependence between India and Nepal.

These theoretical and empirical insights together underscore that the India–Nepal trade relationship is shaped not merely by proximity but by the interaction of systems, policies, and technology. As regional frameworks like BBIN and BIMSTEC expand, understanding how infrastructure, institutions, and digitalization jointly influence cross-border performance becomes increasingly vital. These insights frame the dual exploration that follows quantitative patterns that describe the magnitude of trade flows and qualitative experiences that explain the mechanisms behind them.

III. Methodology

This study adopts a mixed-methods research design, integrating quantitative trend analysis with qualitative stakeholder insights to capture both the magnitude and meaning of India–Nepal trade dynamics. As Creswell and Clark (2018) emphasize, mixed methods enable researchers to combine "numbers that show what is happening with voices that explain why it is happening." Given the multidimensional nature of cross-border trade, where infrastructure, policy, and behaviour intersect neither statistical patterns nor narratives alone are sufficient. The design thus follows an explanatory sequential approach, where quantitative analysis identifies macro-level trends, and qualitative exploration deepens interpretation by contextualizing the observed patterns within institutional and operational realities.

The quantitative component relies on secondary data drawn from official and internationally recognized sources. Primary datasets include the Directorate General of Foreign Trade (DGFT, India), Nepal Rastra Bank (NRB) trade statistics, and the International Monetary Fund's Direction of Trade Statistics (IMF DOTS). These datasets cover the period 2010 to 2024, a timeframe chosen to encompass the pre-blockade period (2010–2014), blockade disruption (2015–2016), pandemic shock (2020–2021), and digital recovery (2022–2024). The analysis employs standard trade indicators such as the Compound Annual Growth Rate (CAGR) and Trade Concentration Index (TCI) to assess growth and diversification patterns. Additional descriptive statistics capture shifts in export-import composition, partner intensity, and trade imbalance ratios. Data cleaning and trend computations were conducted using Microsoft Excel 2021, while graphical representations and correlation matrices were generated through SPSS v26. These procedures ensure internal consistency and comparability across years and data sources.

To complement numerical findings, a qualitative inquiry was undertaken through twenty semi-structured interviews conducted between January and April 2025. Respondents included a purposive mix of stakeholders, ten cross-border traders, four customs and logistics officials, three policymakers from commerce ministries, and three representatives from trade facilitation NGOs. Interviews averaged forty minutes and were carried out in both Hindi and Nepali with translation validation for accuracy. Questions explored experiences with customs clearance, digital documentation, infrastructure adequacy, and institutional coordination. Data were transcribed verbatim and analysed using NVivo 12 Plus, applying an inductive thematic coding approach. Emerging themes were categorized under four headings; formalization frictions, coordination deficits, digital divide, and infrastructure readiness, mirroring constructs in the conceptual framework. Representative quotations were paraphrased for confidentiality while retaining contextual meaning.

Methodological rigor was ensured through triangulation and cross-validation between quantitative indicators and qualitative narratives. For instance, trade-volume dips detected in DGFT and NRB data were cross-checked against interview accounts describing procedural delays or system failures during those periods. This iterative integration allowed the researchers to test hypotheses not merely statistically but also experientially. Reliability was reinforced through data-source triangulation (domestic vs. international records) and inter-

coder agreement during qualitative analysis. To minimize bias, quantitative computations followed transparent formulas, while qualitative codes were verified by two independent reviewers. The resulting synthesis connects macro-level trade trends with micro-level institutional dynamics, thus aligning empirical observation with theoretical propositions under the Gravity and Interdependence frameworks.

Table 1

Summary of Data Sources and Methods

Data Component	Source / Tool	Coverage Period	Purpose / Indicator	Output / Analysis
Quantitative Trade Data	DGFT (India); NRB (Nepal); IMF DOTS	2010–2024	CAGR, TCI, Trade Balance, Export Share	Trend and comparative statistics via Excel & SPSS
Policy and Institutional Documents	India MoC Reports; Nepal MoICS; ADB SASEC Updates	2015–2024	Infrastructure and Digitalization Review	Content analysis linked to framework variables
Qualitative Interviews	Traders, Officials, Policy Experts (20)	Jan–Apr 2025	Perceptions of barriers and facilitators	NVivo thematic coding (4 core themes)
Integration Process	Cross-validation between data types	—	Triangulate quantitative and qualitative findings	Joint interpretive summary linked to hypotheses

Table 1 summarizes the mixed-methods design, illustrating how diverse data sources converge to provide a multidimensional understanding of India–Nepal trade. The integration of numeric indicators with field narratives strengthens internal validity and ensures that subsequent results reflect both statistical patterns and human-institutional realities.

IV. Results and Discussion

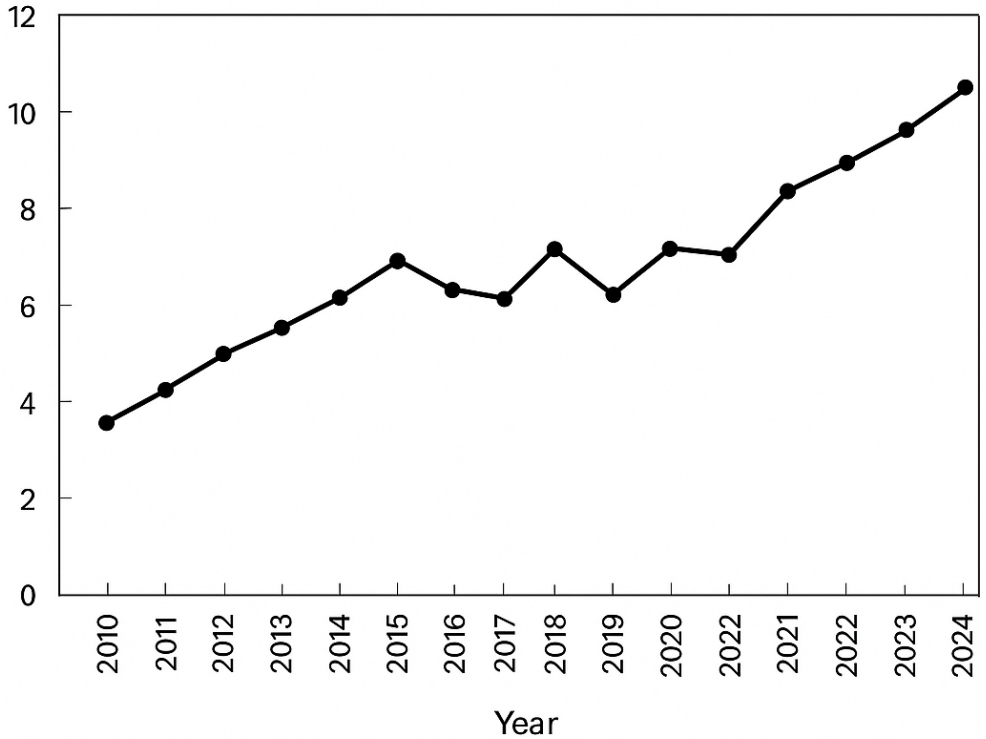
A. Quantitative Findings

Bilateral trade between India and Nepal has demonstrated a steady upward trajectory over the past decade, rising from USD 4.2 billion in 2010 to USD 11 billion in 2023, reflecting an average Compound Annual Growth Rate (CAGR) of 6.9 percent. This growth, however, has not been linear. The data reveal distinct inflection points corresponding to major political and logistical disruptions. The 2015–2016 border blockade caused a temporary collapse in trade volumes, followed by a gradual recovery from 2017 onward. The COVID-19 pandemic (2020–2021) produced another contraction as supply chains were disrupted and transport restrictions intensified. Post-2021, the introduction of digital customs systems, integrated check posts (ICPs), and renewed cross-border cooperation under the BBIN initiative facilitated recovery and stabilization. The steady rebound since 2022 underscores the adaptive resilience of both economies despite structural vulnerabilities.

Figure 2 visualizes the temporal evolution of bilateral trade volumes, highlighting the shocks and recoveries across the 14-year period.

Figure 2

India–Nepal Bilateral Trade Trend (2010–2024)



Note. Author's calculation using DGFT (India, 2024), NRB (2023), and IMF DOTS (2024).

Trade volumes expanded threefold during 2010–2024, yet cyclical disruptions illustrate the sensitivity of interdependence to institutional and infrastructural bottlenecks.

An examination of trade composition reveals persistent asymmetry between India's industrial exports and Nepal's agro-artisanal exports. According to DGFT (2024) and NRB (2023) data, India primarily exports petroleum products, industrial chemicals, iron and steel, electrical machinery, and pharmaceuticals, while Nepal's exports remain concentrated in cardamom, jute products, handicrafts, textiles, and lentils. The structure of exchange thus reflects both production complementarities and dependency hierarchies, India as the supplier of high-value intermediate and capital goods, and Nepal as the provider of low-value, resource-based commodities. Although Nepal has diversified marginally into processed foods and hydropower components, these sectors remain small relative to total export value.

Table 2

Major Export–Import Composition of India–Nepal Trade (2023)

India's Major Exports to Nepal	Share (%)	Nepal's Major Exports to India	Share (%)
Petroleum products	22.4	Cardamom	2.1
Iron & Steel	8.9	Jute goods	1.8
Electrical machinery	6.3	Lentils & pulses	1.6
Industrial chemicals	4.8	Handicrafts & carpets	1.4
Pharmaceuticals	3.2	Processed foods	1.2

Note. DGFT (India, 2024); Nepal Rastra Bank (2023).

India's top exports (petroleum, steel, machinery) account for nearly 45% of total trade value, while Nepal's top five exports collectively contribute less than 10%, reflecting persistent structural asymmetry.

Despite overall growth, Nepal's share in India's total exports remains below 1 percent, underscoring a sharp asymmetry in economic interdependence. Nepal depends heavily on India not only for finished goods but also for raw materials, industrial inputs, and access to seaports via Kolkata. Fuel and energy imports constitute nearly 25 percent of Nepal's import bill, creating a structural current account vulnerability. Conversely, India's trade exposure to Nepal is minimal, reducing its sensitivity to bilateral disruptions. Such asymmetry aligns with Interdependence Theory's notion of vulnerability interdependence, where one party bears disproportionate adjustment costs (Keohane & Nye, 1977). Even when tariff barriers are minimal, procedural inefficiencies, differing standards, and inconsistent documentation practices sustain the imbalance.

Quantitative results offer partial support for the study's hypotheses. H_1 – that digital facilitation enhances trade intensity is partially confirmed, as the post-2020 digitalization push corresponded with accelerated recovery in trade flows. H_2 – that non-tariff barriers constrain export diversification is strongly supported, given persistent concentration of Nepal's exports in few product categories. H_3 – that institutional coordination improves infrastructure efficiency finds moderate support, as the benefits of physical upgrades like ICPs were unevenly realized due to procedural fragmentation. Collectively, the results suggest that while digital and infrastructural improvements contribute to resilience, sustainable efficiency depends on parallel institutional harmonization.

B. Qualitative Insights

Interviews with traders and customs agents highlighted that, despite policy reforms, ground-level practices remain cumbersome. Respondents frequently cited manual verification, brokerage dependency, and informal fee structures as recurring challenges. A small-scale exporter from Birgunj summarized: *"Every shipment still needs multiple stamps digital approval comes later, but paper must move first."* These accounts suggest that while procedural automation has begun, entrenched bureaucratic habits and rent-seeking behaviour continue to delay clearance times and erode the credibility of digital reforms.

Stakeholders identified fragmented institutional mandates and lack of synchronized operational hours between Indian and Nepali customs as major bottlenecks. Policy ambiguity over product classification and temporary rule changes often create uncertainty. For instance, traders described situations where consignments were cleared in Nepal but held in India pending new circulars. The absence of a joint grievance redressal mechanism forces traders to rely on intermediaries, adding cost and time. These experiences reflect the limited effectiveness of bilateral coordination bodies, which meet infrequently and focus more on protocol than problem-solving.

While integrated check posts have improved logistics, the uneven functionality of digital systems across corridors remains evident. Participants from Bhairahawa and Biratnagar reported frequent server outages, limited technical staff, and inadequate cold chain storage. Conversely, the Birgunj–Raxaul corridor supported by an inland dry port and private container operations showed relatively smoother processing. This disparity indicates that physical infrastructure upgrades yield diminishing returns when not matched by technological reliability and personnel training.

Collectively, these narratives illustrate that digital modernization alone does not ensure efficiency unless mirrored by institutional synchronization and behavioural adaptation. The persistence of manual dependencies, inconsistent coordination, and uneven technological capacity points to an implementation gap between policy intent and practice. Traders view reform measures as incremental rather than transformative, reinforcing the argument that successful facilitation requires a comprehensive, multi-agency approach rather than isolated digital fixes.

Table 3

Summary of Major Qualitative Themes from Stakeholder Interviews (2025)

Theme	Representative Issue	Illustrative Quotation	Interpretive Note
Formalization Frictions	Manual checks and informal fees	"The system is online, but clearance is still offline."	Reflects persistence of hybrid (paper-digital) procedures
Coordination Deficit	Lack of harmonized customs hours	"Trucks clear in Nepal but wait in India overnight."	Reveals need for synchronized operating schedules
Infrastructure & Tech Divide	System outages, cold-chain gaps	"If servers go down, everything stops, drivers wait days."	Demonstrates dependence on technical capacity and contingency plans

Note. Author's fieldwork (Jan–Apr 2025).

Thematic evidence confirms that policy-level digitalization and infrastructure reforms remain constrained by institutional fragmentation and procedural inertia.

The integrated analysis underscores a recurring theme across both data strands: infrastructure development and digital facilitation deliver partial gains when institutional alignment lags behind. The post-2020 rebound supports ADB's (2022) conclusion that digital reforms shorten clearance times, but only where governance structures are responsive. Similarly, De and Wagle (2019) observed that infrastructure investments alone do not guarantee seamless trade flow without procedural harmonization. The findings of this study extend Interdependence Theory by showing that asymmetry in capability not merely in trade volume shapes vulnerability. While India–Nepal trade embodies mutual benefit, the dependency gradient remains steep. In essence, trade is no longer a story of distance but of coordination; a process where digital technology, institutional cooperation, and policy coherence must converge to sustain interdependence that is equitable as well as efficient.

V. Conclusion and Implications

The evolution of India–Nepal trade between 2010 and 2024 reveals a narrative of steady growth amid structural constraints. Bilateral trade expanded from USD 4.2 billion to more than USD 11 billion, driven by geographic proximity, economic complementarity, and gradual policy liberalization. Yet this growth has unfolded within a fragile architecture marked by procedural delays, digital fragmentation, and institutional asymmetry. The same borders that connect two economies also expose their dependency gap: Nepal's logistical and infrastructural reliance on India's systems continues to shape the rhythm and resilience of trade flows.

The empirical evidence integrates quantitative and qualitative strands to construct a multi-layered picture of bilateral interdependence. Statistical analysis confirms long-term upward trends in trade volume and partial recovery following the blockade and pandemic, validating the positive but uneven impact of digital customs reforms. However, export diversification remains limited, and trade imbalance persists, supporting the hypothesis that non-tariff barriers and coordination deficits remain critical constraints. The qualitative findings enrich this understanding by illuminating everyday challenges manual documentation, inconsistent customs hours, and unreliable technology that blunt the effectiveness of policy reforms. Together, these insights reveal that India–Nepal trade efficiency is shaped less by distance and tariffs, and more by governance quality, institutional harmony, and digital readiness.

Sustaining and equalizing cross-border efficiency requires interventions that blend infrastructure, institutional coordination, and technological integration. The policy recommendations below translate the study's empirical findings into actionable measures aligned with the BBIN and BIMSTEC regional connectivity frameworks.

Action	Lead Agency	KPI / Expected Outcome
Integrate ICEGATE–ASYCUDA platforms to enable real-time electronic data exchange between India and Nepal.	Ministry of Commerce (India) & Nepal Rastra Bank	↓ 30 % in average customs clearance time within one year of implementation.
Establish a Joint Trade Grievance Cell at the bilateral level to handle operational disputes, documentation mismatches, and digital bottlenecks.	India–Nepal Bilateral Trade Council	≥ 90 % of complaints resolved within 15 days; enhanced trader trust and transparency.
Develop Shared Logistics Parks and SEZ-linked Corridors at Birgunj, Bhairahawa, and Biratnagar for multimodal integration and cold-chain support.	BBIN Secretariat & ADB SASEC Program	20 % reduction in demurrage and idle-truck time; improved export competitiveness.

Implementing these measures would require institutionalized policy dialogue supported by data-driven monitoring. A unified digital platform could automatically synchronize documentation, minimizing redundant verification. The grievance cell would operationalize accountability and mitigate informal brokerage dependency, while shared logistics infrastructure would expand spatial inclusivity and reduce regional disparity in corridor performance. Collectively, these steps could transform border management from a compliance-driven process to a facilitation-oriented ecosystem, aligning national reforms with South Asia's broader digital trade agenda.

The study extends the Gravity Model of Trade by introducing digital facilitation as a moderating variable that enhances trade intensity beyond geographic proximity and economic mass. It demonstrates that proximity without interoperability yields partial efficiency, reaffirming Anderson and van Wincoop's (2003) assertion that relative barriers shape outcomes as much as distance. Similarly, within Interdependence Theory, the findings emphasize mutual vulnerability: while India's logistical dominance grants leverage, it also imposes responsibility for maintaining smooth flows. The research thus reframes interdependence as a two-way vulnerability, mediated by technology, trust, and institutional coherence.

Future studies should quantify informal trade channels that remain outside official records, employing mirror-trade or nighttime-flow analyses to estimate their macroeconomic relevance. Investigating the impact of digital financial connectivity, particularly UPI-QR linkages and e-payment interoperability across the border, could reveal how fintech deepens trade formalization. Further, incorporating gender-disaggregated analysis of cross-border labour and micro-enterprise participation would enhance understanding of inclusive trade facilitation. Longitudinal surveys comparing pre- and post-digital-reform phases would help

evaluate whether observed improvements reflect systemic transformation or short-term adaptation.

The evidence from this study underscores that the future of South Asian trade integration will hinge not merely on corridors and checkpoints but on coordination and code – the policies, institutions, and digital systems that bind them. The India–Nepal corridor, once symbolic of dependency, can become a blueprint for digitally integrated, regionally resilient trade; an interdependence not of vulnerability, but of shared capability and trust.

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Appendix A. Time-Series Bilateral Trade between India and Nepal, 2010–2024

Year	India's Exports to Nepal (USD Billion)	Nepal's Exports to India (USD Billion)	Total Trade (USD Billion)	Trade Balance (India–Nepal)
2010	3.75	0.45	4.20	3.30
2011	4.05	0.48	4.53	3.57
2012	4.60	0.52	5.12	4.08
2013	5.05	0.55	5.60	4.50
2014	5.40	0.58	5.98	4.82
2015	4.10	0.42	4.52	3.68
2016	4.25	0.40	4.65	3.85
2017	5.25	0.50	5.75	4.75
2018	6.20	0.55	6.75	5.65
2019	7.30	0.65	7.95	6.65
2020	6.10	0.60	6.70	5.50
2021	8.25	0.75	9.00	7.50
2022	9.90	0.85	10.75	9.05
2023	10.30	0.70	11.00	9.60
2024*	10.60	0.75	11.35	9.85

**2024 figures are provisional estimates based on Q1–Q3 data.*
Source: Compiled by author from DGFT (India, 2024), Nepal Rastra Bank (2023), and IMF Direction of Trade Statistics (2024).

Trade between India and Nepal more than doubled from 2010 to 2024, driven by increased exports of petroleum, industrial inputs, and consumer goods from India. The CAGR of 6.9 percent underscores steady integration, though Nepal's export contribution remains below 10 percent of total trade. Temporary contractions during 2015–16 (blockade) and 2020

(pandemic) visibly interrupted the trend but were followed by strong recovery with post-2021 digital customs reforms.

Appendix B. Interview Themes and Analytical Matrix (Jan–Apr 2025)

Theme	Stakeholder Group	Indicative Issue / Observation	Supporting Evidence	Policy Relevance
Formalization Frictions	Small Traders; Customs Brokers	Persistent manual verification despite online systems; extra brokerage fees; delays in documentation.	14 of 20 respondents identified "hybrid clearance", digital entry but physical verification.	Indicates need to strengthen digital trust and reduce parallel paper procedures.
Coordination Deficit	Customs Officials; Transporters	Mismatched working hours between Indian and Nepali checkpoints; unclear HS code classification updates.	Reported at Raxaul–Birgunj and Bhairahawa–Sunauli ICPs; repeated in 6 interviews.	Supports creation of joint trade grievance and coordination cell.
Infrastructure and Tech Divide	Exporters; Logistic Operators	Frequent power cuts and limited technical staff at smaller ICPs; slow bandwidth affecting ASYCUDA.	Mentioned in 8 interviews, particularly at Jogbani, Biratnagar.	Highlights need for system redundancy and technician training.
Informal Dependence Channels	Local Traders; NGO Observers	Informal payments expedite cargo movement; system inefficiencies incentivize bypasses.	Observed by 5 respondents; informal trade approximated to 10–15% of official flows.	Aligns with literature on vulnerability interdependence and governance gaps.
Digital Transition Barriers	Policy Experts; Chambers of Commerce	Fragmented data systems and lack of mutual recognition of digital signatures.	4 respondents; corroborated by MoC and NRB digitalization reports.	Justifies need for ICEGATE, ASYCUDA integration and legal interoperability.

Methodological Note: Themes derived through inductive coding in NVivo 12 Plus, following open–axial–selective procedure (Creswell & Plano Clark, 2018). Codes were validated through peer debriefing and inter-coder agreement (>85%).

The qualitative evidence underscores that policy-led digitalization has yet to penetrate daily logistics practices. Institutional misalignment and digital trust deficits remain critical barriers, confirming the need for *coordinated system integration and human-capacity investments*.