

Majors: SCM

S.No. 08

Challenges of Going Green in SCM: A Case Study on TCS (Tranzum Courier Service)



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Fall-2025

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CERTIFICATE

This is to certify that this project report, entitled “**Challenges of Going Green in SCM: A Case Study on TCS (Tranzum Courier Service)**” by Saaim Tahir (01-221242-011), submitted in partial fulfillment of the requirements for the degree of **Masters of Business Administration** from Bahria University, Islamabad Pakistan, during the academic year of 2025, is a bonafide record of work carried out under my permission and guidance.

A handwritten signature in black ink, appearing to read 'Saaim Tahir', is written above a horizontal line.

Director Operations
TCS (Tranzum Courier Service)

Acknowledgement

First, I thank ALLAH ALMIGHTY, THE MOST MERCIFUL and the Granter of GRACES for the ability to complete my Project.

It is a great honor to express the appreciation of different people who helped directly or indirectly in making this project a success. I wish to put on record my sincere thanks to my Supervisor - Sir Capt Munawwar Ahmad for assigning this project and his direction helped me to accomplish this academic work. His work in helping me explain things clearly and give me constructive feedback was invaluable, something that I could not have done without his constant support and direction. I am also exceedingly grateful to all the Bahria University Islamabad faculty members for their cooperation as well as their kind assistance and support. I sincerely acknowledge the cooperation and willingness to participate of the TCS (Tranzum Courier Service) management and staff. Their insights on the green supply chain practices in the emerging logistics sector in Pakistan have been invaluable.

I present my sincere appreciation to my family for their motivation and support during these whole years of my academic life. I am also grateful for the collaborative spirit and constructive feedback of fellow classmates throughout the process of developing the project.

ABSTRACT

This research focuses on exploring the crucial barriers to effective implementation of Green Supply Chain Management (GSCM) in Tranzum Courier Service (TCS), which is Pakistan's leading domestic courier company in a resource constrained emerging market environment. Using mixed methods research consisting of a semi-structured key informant interview and quantitative analysis of Likert scale responses to 83 statements from 5 parameters.

Quantitative analysis shows a key performance-perception dilemma: TCS shows exceptional environmental effectiveness (5.0/5.0) despite having extreme structural limitations with mean barrier severity of 4.69/5.0. The barriers that are most critical are energy crisis and load shedding (5.0/5.0 severity level), infrastructure deficits (4.69/5.0), capital constraints (4.55/5.0), regulatory complexity (4.25/5.0), partnership limitations (4.44/5.0) and awareness gaps (4.0/5.0). Despite these obstacles, TCS exhibits a high degree of operational execution (4.64/5.0 implementation effectiveness) and they provide proven environmental results such as 20-30% emissions reduction and 50-70% energy efficiency gains.

The research proves that individual companies cannot solve systemic barriers especially the infrastructure deficits of Pakistan, chronic energy crisis, and policy uncertainty unilaterally. Comprehensive 5-parameters GSCM Enhancement Framework is proposed emphasizing external barrier removal through infrastructural partnerships, stakeholder collaboration and government policy support is key to accelerated adoption. Findings suggest that individual company excellence cannot solve structural constraints that are endemic to resource limited developing economies, and success depends on ecosystem level coordination and distinguishing between internal execution gaps (that can be resolved by improving operations) and external barriers (that require policy and infrastructure intervention).

Keywords: Green Supply Chain Management, sustainability, infrastructure barriers

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CHAPTER 1: INTRODUCTION

1.1 Project Background and Industry Relevance

Green Supply Chain Management (GSCM) is a strategic integration of environmentally sustainable principles and practices on all aspects of supply chain operations, including procurement, manufacturing, logistics, reverse logistics and stakeholder collaboration (Sarkis et al., 2011). GSCM realizes the importance of considering environmental, social, and economic aspects of supply chain operations at the same time to ensure sustainable and responsible business practices (Seuring & Müller, 2008). For logistics companies, GSCM is especially necessary considering the huge environmental impact of the sector in terms of greenhouse gas emissions, fuel usage, waste production and even infrastructure stress (Govindan et al., 2015).

In the fast-expanding logistics industry of Pakistan, GSCM has become more critical due to multiple converging pressures, causing more demands for sustainable practices. Rapid urbanization of major cities Karachi, Lahore, Islamabad and Peshawar as well as massive demand on the logistics infrastructure are unprecedented. At the same time, explosive e-Commerce growth on platforms like Daraz, Shopee and Yayvo have placed unprecedented pressure on the courier and logistics sector to scale delivery capabilities while managing environmental impact (Christopher & Holweg, 2011). Environmental consciousness is growing among Pakistani consumers especially the educated urban demographic segments, creating market demand for green delivery options (Peck, 2004).

However, the implementation of GSCM in emerging markets such as Pakistan faces substantial barriers that hinder effective adoption at the required pace and perimeter to create meaningful environmental impact. Unlike developed economies where infrastructure is in place, regulatory frameworks are in place and capital markets support green investment, the Pakistani logistics industry is operating under structural constraints that basically restrict the feasibility of implementing GSCM.

The logistics and transportation sector plays an important role in the economic development and social progress of Pakistan. Logistics sector of Pakistan has added about 8-10% to national GDP, and it gives directly employment to more than 500,000 people and indirectly more than 2 million (Chandra & Kumar, 2016). However, this critical sector is a major contributor to environmental degradation due to greenhouse gas emissions, waste production, resource consumption and strain on infrastructure. Pakistan's air quality has become a significant crisis major city including Karachi, Lahore and Islamabad routinely have to contend with air quality index (AQI) levels deemed hazardous and 30-35% of urban air pollution is attributed to the transport and logistics sector (World Health Organization, 2022).

Simultaneously, Pakistan is also facing some structural environmental challenges that limit the implementation of GSCM. The country's energy crisis with chronic electricity shortage, 12-18 hours daily load shedding in many parts and unreliability of the grid is forcing the logistics operators to depend on costly diesel generators which will directly compromise the green energy (Pakistan Power Cell, 2023). Infrastructure gaps such as the lack of CNG refueling stations outside major cities, lack of EV charging infrastructure and inadequate recycling facilities constrain the choice of green technologies available to logistics companies. Capital constraints to investment in

green technologies Regulatory fragmentation across four provinces of Pakistan creates complexity in compliance and policy uncertainty.

1.2 Company Profile: Tranzum Courier Service (TCS)

Tranzum Courier Service (TCS) is the country's domestic market leader and third largest courier company in Pakistan that plays a major role in the supply chain ecosystem and e-commerce infrastructure of Pakistan. Headquartered in Karachi and with regional operation centers in Islamabad, Lahore, Peshawar, Multan and Faisalabad, TCS has an extensive network all over the country, which makes it stand alone as the most geographically comprehensive logistics provider in Pakistan.

Organizational Scale and Operational Footprint

TCS operates through a vast network of 1100 express centers spread across the urban and regional centers of Pakistan. The company has a modern and technologically advanced fleet of more than 4,500 vehicles that are equipped with satellite tracking technology that is used for real-time monitoring and dynamic route optimization. Beyond ground transportation, TCS also operates a Boeing 737 aircraft dedicated to high volume inter-city operations, enabling competitive advantage in the express delivery services.

Workforce and Human Capital

TCS has more than 12,000 professionals spread across its network in the country and is one of the largest employers in the logistics sector in Pakistan. The workforce is made up of management professionals, logistics professionals, information technology professionals, customer service representatives, couriers for the field, and warehouse personnel.

Technology and Innovation

TCS has continued to incorporate cutting-edge technologies in its operations and has become a technology-enabled logistics company in Pakistan. The company has satellite-tracked fleet management systems and route optimization software, which analyze traffic patterns and geographic constraints. TCS also operates the Yayvo e-commerce platform, allowing developing innovative logistics solutions adapted to e-commerce needs.

Vision, Mission and Core Values

Vision

"To become the logistics backbone of Pakistan."

This vision is the strategic intent of TCS to be the core logistics infrastructure of the country and gradually expand its trusted services catering to the regional and international markets. The aspiration to provide the "backbone" to the logistics system of Pakistan puts TCS in a position of great strategic national importance, which comes with the implicit responsibility of environmental stewardship and sustainable operations.

Mission

"To honour the trust symbolized by the phrase 'TCS KARDO' by reliably delivering a wide range of courier and logistics services, continuously adding value through passion and new technologies, enhancing client productivity, and expanding air and ground logistics beyond Pakistan to open new trade routes and opportunities for the country."

This is a mission linking operational reliability and customer-centric service with incessant innovation and development in logistical capabilities. The words "TCS KARDO" (meaning, "Do it with TCS") resonates 40+ years of customer trust and represents a covenant between TCS and the business community of Pakistan. Maintaining this trust means that TCS must take environmental issues into account and apply sustainable practices in an environment where corporate environmental responsibility is increasingly valued by customers.

Core Values

TCS Express explicitly outlines six key or core values upon which organization behavior and decision-making are based:

1. **Customer Love & Quality Service** – Always putting the customers first and ensuring high standards of service. This value is the backbone of TCS's commitment to reliable green delivery options and transparent communication about environmental performance to customers.
2. **Employee Growth** – Nurturing talent in a culture of fairness and merit and supporting professional development. This is an essential value for the implementation of GSCM, especially to train drivers in eco-driving practices, the development of sustainability champions, and the development of organization capability in environmental management.
3. **Justice for All** – Maintaining fairness and equity in dealing with all stakeholders. This value requires TCS to balance environmental responsibility with fair treatment of suppliers, employees and communities that are impacted by logistics operations.
4. **Lawful & Ethical** - Conducting all operations with truthfulness, honesty and following the law. This value directly serves GSCM purposes as it ensures that TCS adheres to environmental regulations in the four provinces of Pakistan as well as follows ethical standards for reporting of emissions and waste management.
5. **Giving Back** – Contributing positively to the society and communities through corporate responsibility initiatives TCS's environmental campaigns (such as "Air We Breathe"), tree planting initiatives and support for environmental organizations show commitment to this value and link corporate responsibility with GSCM goals.
6. **Profitability Through Efficiency** – Improving operational efficiency and adding value to achieve sustainable profitability. This value generates excellent business case alignment for GSCM: savings in fuel costs from route optimization, in energy through efficient warehousing, and in operational efficiency due to technology deployment.

1.3 Problem Statement

While Green Supply Chain Management offers TCS substantial competitive advantages in cost reduction, enhanced brand reputation, and stakeholder relationships, the Pakistani context presents

numerous barriers that hinder rapid adoption of green practices at the necessary scale and pace. The fundamental research problem is: **What are the specific challenges and obstacles preventing TCS from implementing comprehensive and effective Green Supply Chain Management practices in Pakistan?**

Unlike developed economies with established infrastructure, regulatory frameworks, and capital market support for green investments, TCS operates within an environment where external structural constraints significantly limit GSCM implementation options. These constraints encompassing infrastructure deficits, energy crisis, capital scarcity, regulatory complexity, awareness gaps, and collaboration challenges systematically restrict the pace and scale at which TCS can advance environmental sustainability within its supply chain operations.

1.4 Project Questions

This research is guided by five explicit research questions, which is directly aligned to the five parameters of Likert-scale questionnaire and the five sections of empirical data collection:

RQ1: What are the main green supply chain management practices introduced by TCS that are green in the logistics and transportation sector in Pakistan?

This question is concerned with identifying and describing the specific GSCM initiatives that TCS has put into place including CNG fleet transition, optimizing routes, energy-efficient warehousing, recycling programs, and technology integration. Understanding what TCS is doing currently gives us the key baseline to look at to measure effectiveness and what practices are most limited by barriers.

RQ2: What are the challenges and obstacles that TCS has faced in introducing green supply chain practices in Pakistan?

This question intends to identify, categorize and analyze barriers: infrastructure limitations, energy crisis impacts, capital limitations, awareness gaps, regulatory complexity and challenges in partnerships. This core question is directly related to the fundamental research problem why TCS's GSCM implementation is limited despite the strong organizational commitment and operational excellence.

RQ3: How efficient are TCS's environmental impact reduction strategies in Pakistan in lowering carbon emissions and improving energy efficiency?

This question assesses the real environmental impact of TCS's GSCM practices for achieving real environmental results. It explores quantified improvements in emissions reductions, fuel consumption savings, energy efficiency improvements and other specific environmental metrics as a result of TCS's green initiatives.

RQ4: What partnerships and collaborations has TCS formed in Pakistan to advance sustainable supply chain practices, and what are the results of these relationships?

This question delves into the stakeholder ecosystem that TCS has been integrated in too such as e-commerce platforms (Daraz, Shopee, Yayvo), suppliers, Government Agencies and Industry Associations. It looks at the results of collaboration and identifies the barriers to effective partnership, and whether partnerships are moving forward or slowing the adoption of GSCM.

RQ5: What recommendations may be made to improve TCS's GSCM practices in Pakistan, taking into account the country's unique problems and opportunities?

This question makes a synthesis of findings from RQs 1-4 and proposes findings-based recommendations made specifically for Pakistan's context. Recommendations cover infrastructure development, education and awareness development, technology advantage, deepening of stakeholder collaboration and institutionalization of performance measurement.

1.5 Strategic Importance and Justification

This case study on TCS's challenges in going green is important for strategic purposes for many reasons. TCS's leading position in the market means that its GSCM challenges are typical of challenges facing the Pakistani logistics sector at large. Pakistan's peculiar infrastructure, energy and regulation constraints are very different from the developed economies whose research in GSCM has been mostly based on. The research contributes to limited GSCM literature with a focus on logistics companies in developing economies, where there are more severe structural barriers compared to the developed market situation (Asif et al., 2020).

1.6 Business Environment and Context

Pakistan's logistics sector is operating in a unique business setting which is influenced by structural challenges that constrain the implementation of GSCM to an in-depth level. Limited warehousing facilities, horizontal distribution network and a lack of consistency in inter-modal connectivity are the characteristics of poor infrastructure. Pakistan has severe and chronic shortage of electricity with load-shedding averaging between 12-18 hours per day in many parts of the country. CNG refueling infrastructure is concentrated in the major urban centers whereas the public electric vehicle charging infrastructure is nearly non-existent in Pakistan (Ministry of Climate Change, 2023). Environmental rules vary from one province to another in Pakistan, making compliance challenging for operators at the national level. Pakistan's financial markets offer very limited support for investment in green technologies, with interest rates charged on capital remaining high compared to that charged in the developed markets.

1.7 TCS's Approach to Green Supply Chain Management

Tranzum Courier Service (TCS), being the domestic logistics leader in Pakistan, has taken a very extensive approach towards incorporating environment conservation in its supply chain operations. This strategy covers four broad areas - fleet modernization, operational efficiency, e-commerce integration and environmental engagement.

1. Fleet Modernization and Alternative Fuels

Transformation of its vehicle fleet has been identified by TCS as a key component of its green supply chain strategy. The company has initiated the process of a systematic transformation from conventional diesel and petrol vehicles to cleaner ones which are in sync with the energy infrastructure of Pakistan.

- **CNG Fleet Transition:** TCS has converted many of its fleets to Compressed Natural Gas (CNG) vehicles which have around 20-30% lower emissions when compared to conventional diesel vehicles. This transition is practical on the basis of the reasons of the

available natural gas resources and existing CNG infrastructure in major urban centers in Pakistan.

- **Electric Vehicle Pilots:** TCS has started "Going Electric" programs that are testing electric delivery bikes and motorcycles in cities like Karachi and Lahore for short-range urban deliveries. These pilot projects put TCS in position for developing operational experience as the infrastructure for electric charging in Pakistan develops.
- **Vehicle Modernization:** TCS routinely replaces old vehicles with modern, fuel efficient vehicles using advanced emission control technologies to help keep the fleet of active vehicles up to date with modern efficiency standards.

2. Operational Efficiency Enhancement

Operational improvements, in reducing the volume of transportation required so that the overall impact on the environment is reduced, regardless of what type of fuel is used in the vehicle.

- **Route Optimization:** TCS utilizes smart software that analyzes real-time traffic, geographic information and delivery patterns to reduce distance travel and fuel use. This optimization has resulted in roughly 10-15% saving of fuel per route despite the bad traffic condition of Pakistan.
- **Warehouse Energy Management:** LED lighting systems and energy management systems in major distribution centers of TCS spread all over Karachi, Lahore, Islamabad and other major centers are used, which save equal to 50-70% of electricity consumption. These measures are particularly important in the context of the energy crisis in Pakistan as it will decrease the dependence on heavy diesel generators during load shedding periods as these generators are expensive..
- **Real-Time Fleet Tracking:** TCS's satellite tracked fleet of 4500+ vehicles permits dynamic routing avoiding congestion, vehicle utilization and empty return trips. This tracking infrastructure provides higher fuel efficiency and greater performance of delivery and communication with the customers.

3. E-Commerce Integration and Reverse Logistics

Pakistan's fast growing e-commerce industry has opened opportunities for innovative green supply chain approaches.

- **Yayvo Platform:** TCS's Yayvo e-commerce platform has integrated sustainability features like consolidated delivery scheduling and environmentally friendly packaging to enable customers to choose delivery methods that are in line with their sustainability preferences.
- **Strategic Partnerships:** TCS joining hands with major E-Commerce platforms such as Daraz, Shopee, etc. to develop green delivery solutions and enforce standardized standards of sustainable packaging across multiple platforms.
- **Reverse Logistics:** TCS has planned efficient reverse logistics processes for e-commerce returns through planned collection routes and consolidation. This is a systematic way of reducing movements made ad-hoc, enhances the utilization of vehicles and creates opportunities for packaging to reuse and recycle material.

4. Environmental Engagement and Industry Leadership

In addition to the changes made in operations, TCS has been a part of external environmental initiatives that magnify its sustainability impact.

- **Environmental Campaigns:** TCS is involved in high profile environment initiatives like "Air We Breathe" sustainability events in major cities and it is a way to position the company as being environment conscious and creating awareness among the public regarding air pollution in cities and its contribution from the logistics sector.
- **Corporate Social Responsibility:** TCS implements environmental CSR programs such as tree planting initiatives and support of environmental organizations as a demonstration of organizational commitment to environmental stewardship.
- **Industry Engagement:** TCS is involved in logistics industry associations and government consultations on environmental policy in the transport sector, advice on developing industry standards for sustainable packaging and carbon accounting methodologies.

5. Strategic Integration

The coherence with TCS approach to Green Supply Chain Management is demonstrated in all parameters. Fleet modernization and operational efficiency have direct consequences to reduce the environmental impact per shipment while the integration of e-commerce options creates sustainability options and enhanced reverse logistics. External environmental engagement is important in developing stakeholder support to sustainability efforts and industry-wide adoption of green logistics practices.

By being integrated, this strategy ensures that TCS can meet environmental goals and still ensure that operational efficiency and competitive advantage is maintained. However, there are significant barriers within the infrastructure of Pakistan, regulatory and capital context to limit the pace and scale of implementation.

CHAPTER 2: PROBLEM DEFINITION AND REQUIREMENT ANALYSIS

2.1 Direct Alignment: Research Questions to Questionnaire Parameters

The five research questions are directly related to the five parameters of the 83-item Likert-scale questionnaire to achieve comprehensive empirical validation:

Research Question	Questionnaire Parameter	Number of Items
RQ1 - GSCM Practices	Section 1: GSCM Practices Implementation	14 statements
RQ2 - Challenges & Obstacles	Section 2: Challenges & Obstacles to GSCM	16 statements
RQ3 - Environmental Effectiveness	Section 3: Environmental Impact Reduction & Energy Efficiency	14 statements
RQ4 - Partnerships & Collaborations	Section 4: Partnerships & Collaborations	16 statements
RQ5 - Recommendations	Section 5: Recommendations for Improvement	23 statements
	TOTAL	83 statements

2.2 Analytical Framework and Root Cause Analysis

According to (Sarkis et al., 2011), it is very important to understand the relationship between organizational barriers and the results of GSCM implementation to develop effective strategies. The research shows a very important discovery: TCS delivers environmental results despite facing infrastructure barriers and the severity of the energy crisis. This performance-perception gap raises important questions of organizational capability.

How does TCS overcome barriers so effectively?

- Exceptional operational problem-solving and innovation
- Core processes executed to compensate for macro constraints
- Efficient resource deployment concentrating investment on high-impact areas
- Strong organizational capability navigating Pakistan-specific constraints

However, the barriers remain severe because:

- Government development of infrastructure is slow
- Supplier ecosystem reluctant to adopt sustainability practices
- Customer willingness to pay premium for green delivery is low
- Capital available for green investments is limited
- Energy crisis is systemic and beyond company control
- Regulatory framework remains fragmented and unclear

2.3 Components of GSCM in Pakistan Context

For logistics companies operating in Pakistan, GSCM includes five interrelated components with the Pakistani context (Zhu & Sarkis, 2004):

1. Green Procurement: Sourcing materials from environmentally responsible sources For TCS, this includes sourcing CNG compatible vehicles, choosing packaging materials that are sustainable and working with suppliers that offer environmentally certified products.

2. Green Manufacturing and Warehousing: Eco-friendly facility operations that improve the efficiency of energy usage. TCS's context is optimizing warehouse operations across significant cities via LED lighting system and energy management systems.

3. Green Logistics: Optimization of transportation routes, modes and operations to reduce fuel consumption and emissions. This includes fleet modernization through CNG transition, deployment of route optimization software and utilization of Boeing 737 for inter-city operations.

4. Reverse Logistics and Recycling: Effective management of product disposal and recycling and waste handling. TCS include take-back programs for packaging materials, recycling programs for damaged packages, and organization of e-waste management programs.

5. Stakeholder Collaboration: Engagement with suppliers, customers, regulatory authorities, etc TCS - includes government partnerships, association with e-commerce platforms, and industry associations.

2.4 PESTLE Analysis

1. Political factors

- **Government Fragmentation and Policy Inconsistency:** Pakistan has power distribution in federals and province levels leaving a big gap in policy inconsistency, which has directly impact on TCS's GSCM implementation. Environmental regulations, waste management standards and vehicle emission requirements vary across the four Pakistani provinces (Punjab, Sindh, Khyber Pakhtunkhwa and Balochistan), resulting in a complexity in complying with environmental regulations in TCS's national operations (Environmental Protection Departments of Provincial Governments, 2023).
- **Political Instability Impact:** Political instability in some areas (Balochistan, parts of KP) is a factor that affects the security of the supply chain and long-term planning of sustainability. TCS operations in these areas are at increased risks, necessitating extra security measures and contingency planning which diverts the resources to green initiatives (Ministry of Climate Change, 2023).
- **Government Climate Commitment vs. Implementation Gap:** Although Pakistan has made a National Climate Change Policy with a goal of emission reduction to 50% by 2030, proper implementation is still inconsistent. TCS cannot depend on Government infrastructure development timelines of CNG stations, EV charging networks or recycling facilities causing uncertainty in long-term green investments (Ministry of Climate Change, 2023).
- **Lack of Dedicated Government Liaison:** Lack of a specific government liaison for the advancement of green logistics sector TCS must deal with multiple ministries (Energy, Environment, Commerce) without any coordination support, adding administrative burden & reducing advocacy effectiveness (Government Coordination Council, 2023).
- **Election Cycle Uncertainty:** Pakistan's election cycles cause policy uncertainty in the long-term sustainability initiatives. Changes in government can lead to a changing of priorities

away from the development of green logistics infrastructure, so TCS is reluctant to commit to a multi-year investment in green technologies (World Bank, 2023).

- **Weak Environmental Enforcement:** Limited government capacity to consistently enforce environmental regulations - green companies are not rewarded, and the penalties for non-compliance are inconsistent, leading to a decrease in incentives to adopt GSCM (Pakistan Environmental Protection Agency, 2023).

2. Economic factors

- **GDP Growth and Logistics Demand:** GDP growth of 4-5% annually in Pakistan also leads to greater demand for logistics and TCS must expand fleet and network operations. This growth pressure is at odds with emissions reduction goals - the upscale of operations without scaling green infrastructures adds up to more environmental footprint (State Bank of Pakistan, 2023).
- **Sector Economic Contribution:** Logistics sector contributing 8-10% to national GDP with more than 500,000 jobs directly gives TCS significant economic importance but also subjects the company to political pressure to keep jobs and service expansion a priority over environmental initiatives (Pakistan Bureau of Statistics, 2023).
- **High Inflation Impact:** Inflation rates of 15-20% over the last several years raise operational costs in the areas of fuel, vehicle maintenance, labor and technology. This inflation pressure decreases capital available to make green investments, as an increasing operational cost robs would-be sustainability investment funds (State Bank of Pakistan, 2023).
- **High Interest Rate Environment:** Interest rates on capital (12-18%) way more than developed markets (usually 2-5%) severely restrains green investment financing. TCS's calculations on the return on investment (ROI) of solar systems, CNG vehicles and AI optimization are strained by the high cost of capital, which makes green initiatives less financially attractive (State Bank of Pakistan, 2023).
- **Currency Depreciation:** Pakistani Rupees depreciation against the dollar (around 20-30% for past few years) makes imported green technology (EVs, solar panels, IoT sensors, AI software) expensive. This volatility in currencies makes a multi-year investment in green technology very difficult (World Bank, 2023).
- **Limited Green Financing:** Pakistan's financial markets are not developed enough in the context of green bonds and sustainability-linked financing. Unlike developed markets where green financing instruments add capital at lower cost, TCS have to pay full commercial rates for green investments, reducing competitiveness (State Bank of Pakistan, 2023).
- **Wage Pressure:** Logistics sector wage pressure affecting TCS's competitiveness for the geographical expansion the driver wages, warehouse wages and administrative staff compensation are yearly increase in their wages. These wage increases are competing with investments in green technologies for limited capital resources (Pakistan Bureau of Statistics, 2023).

3. Social factors

- **Rising Environmental Consciousness:** Growing consumer demand for sustainable services, especially among educated urban demography in Karachi, Lahore and Islamabad generates market opportunity for TCS green delivery options. This emerging demand allows for potential pricing power of verified green services (Nielsen, 2023).
- **Limited Awareness among Stakeholders:** Despite urban consumer awareness, the base of understanding stakeholders is limited. Employees are not trained in eco-driving and energy-saving measures. Suppliers are confused about green procurement requirements. SMEs are focused on cost minimization rather than environment (Chartered Institute of Personnel and Development, 2023).
- **Community Pollution Concerns:** Communities in major cities are increasingly putting pressure on the logistics companies to minimize air and noise pollution. TCS faces complaints regarding emissions of the diesel vehicles in residential areas, which creates both reputational risk but also opportunity to differentiate by encouraging the promotion of CNG fleets (World Health Organization, 2022).
- **Labor Market Challenges:** The shortage of skilled workforce in logistics management restricts TCS to apply sophisticated GSCM practices. Advanced sustainability management, data analytics to track carbon and green technology skills all in short supply - and requiring costly training or hiring outside experts (Pakistan Bureau of Statistics, 2023).
- **Cultural Cost Minimization Focus:** Pakistani business culture, especially SMEs, focuses more on minimizing cost than environment. This cultural value makes customers not willing to pay green delivery premiums and suppliers not willing to comply with increases in sustainability standards (E-Commerce Association of Pakistan, 2023).
- **Employee Engagement Opportunity:** While there is a lack of awareness, TCS's 12,000+ workforce is a large human capital for sustainability initiatives. Employee engagement programs could make use of this workforce for green innovation, eco-driving and energy conservation if proper training and incentives are provided (Tranzum Courier Service, 2023).

4. Technological factors

- **Digital Infrastructure Limitations:** Pakistan digital infrastructure development is backward than the developed world which affects the TCS role in implementing IoT sensors, real-time tracking, and optimization systems based on AI. Internet connectivity gaps in secondary cities limit technology deployment in major urban centers (Pakistan Telecommunications Authority, 2023).
- **Limited Local Green Technology Availability:** Advanced technology of green logistics (electric delivery vehicles, solar battery systems, smart warehouse automation) is not manufactured locally and requires costly imports. This raises costs and makes them reliant on foreign suppliers for maintenance and spare parts (Ministry of Climate Change, 2023).

- **High Technology Implementation Costs:** The cost of implementing technology with respect to the size of companies in Pakistani logistics sector is high. While TCS has more resources to invest than SMEs, \$1-2M (AI routing systems), \$2-5M (IoT fleet monitoring) and warehouse automation are still a lot of capital allocations competing with operational needs. (Tranzum Courier Service Operations Manager, November 2025).
- **E-Commerce Platform Technology Integration:** Growing use of e-commerce platforms (Daraz, Shopee, Yayvo) is pushing the innovation in the logistics market. However, integration between platforms requires standardized APIs, real-time data exchange and system compatibility in which TCS needs to constantly invest resources away from green technology (E-Commerce Association of Pakistan, 2023).
- **Limited R&D Capacity:** Pakistan lacks indigenous R&D capability for developing country-specific green logistics solutions. Unlike the developed markets, where universities and the research institutions collaborate with the industry on sustainability-related innovation, the Pakistani academic institutions have low-level logistics research programs, which requires TCS to develop solutions internally (Higher Education Commission of Pakistan, 2023).
- **Digital Payment Adoption:** Increasing digital payment adoption (though below developed market levels) is slowly decreasing COD dominance. This shift could help TCS implement green delivery options that require upfront payment but the shift is slow due to issues of consumer trust and poor digital literacy (State Bank of Pakistan, 2023).

5. Legal factors

- **Fragmented Environmental Regulations:** Environmental regulations are fragmented over four provinces with different standards that provide compliance burden for TCS's national operations. Each province has different rules in matters of waste management, vehicles emissions and environmental reporting, increasing administrative costs and risk of compliance (Environmental Protection Departments, Provincial Governments, 2023).
- **Inconsistent Vehicle Emission Enforcement:** Vehicle Emission Standards are not always enforced at a national level. While the use of CNG vehicles is encouraged, there is no consistent standard for certification of CNG vehicles, which results in uncertainty regarding long-term compliance with regulations for TCS's CNG fleet (Ministry of Transport, 2023).
- **Hazardous Waste Disposal Regulations:** Inconsistent hazardous waste disposal regulations from one region to another impact TCS's ability to implement standardized reverse logistics programs. What constitutes hazardous waste and how it can be disposed of varies by province, making it impossible for companies to have consistent waste management practices throughout the company (Pakistan Environmental Protection Agency, 2023).
- **Multi-Provincial Employment Law Compliance:** Employment laws that mandate compliance with several provincial frameworks add to the administrative burden on TCS. Training requirements, workplace safety standards and labour relations rules vary from province to province, making it difficult to implement standardized sustainability training programs (Ministry of Labour, 2023).

- **Competition Regulations Preventing Consolidation:** Competition rules forbid industry-wide consolidation of logistics to allow for route optimization and emission reduction through shared networks. TCS is unable to work with competitors on green logistics initiatives without raising competition red flags, putting the brakes on ecosystem-wide adoption of sustainability (Competition Commission of Pakistan, 2023).
- **Limited Green Supply Chain Legal Framework:** Pakistan has no legal framework of green supply chain certification and standards. Without legally recognized "green delivery" standards, TCS cannot distinguish services and command premium pricing - lessening business case for green investment (Pakistan Standards and Quality Control Authority, 2023).
- **Intellectual Property Protection Concerns:** Intellectual property protection issues influence the adoption of technology. TCS may be reluctant to invest in proprietary green technologies if copycat competitors who do not have to make similar investment in R&D. (Ministry of Commerce, 2023) will dilute IP protection is not strong and worry that competitive advantage from green innovation quickly.

6. Environmental factors

- **Chronic Energy Crisis:** Pakistan's acute power shortage with 12-18 hours load shedding on daily basis in many parts is directly hampering TCS's green warehouse projects. This drives dependence on costly diesel generators, which add to the cost of operations, and carbon emissions, which is a direct contradiction of GSCM goals (Pakistan Power Cell, 2023).
- **Air Quality Crisis:** Major cities where AQI levels regularly go to a hazardous level (Karachi, Lahore and Islamabad) generate public pressures for emissions reduction. TCS's diesel fleet contributes to the pollution of the urban air, which can create both reputational risk as well as opportunity for differentiation through CNG transition (World Health Organization, 2022).
- **Climate Change Impacts:** Increasing floods and severe weather events impact on TCS's supply networks Route disruptions, warehouse damage, and delivery delays are all driving up operational costs and carbon footprint as vehicles traverse longer routes that are taken to reach their destination. Climate adaptation planning becomes a key for business continuity (Ministry of Climate Change, 2023).
- **Limited Natural Resource Management Capacity:** Pakistan's poor capacity for recycling and processing waste limits TCS's reverse logistics programs. Lack of industrial facilities for recycling means the collected packaging materials need to be transported long distances for processing, adding to the costs and emissions and diminishing the economic viability of recycling (Pakistan Environmental Protection Agency, 2023).
- **Water Scarcity:** Water scarcity in some areas has an impact on the activities of TCS's warehouses, especially those that need water-consuming processes (e.g. vehicle washing, cleaning, cooling systems). This is an environmental constraint that calls for water conservation measures but also limits options for expansion (Ministry of Water Resources, 2023).

- Government Environmental Targets Pressure: Pakistan's commitment towards 50% emission reduction by 2030 under Paris Agreement puts pressure on policy for logistics sector. While current policies do not enforce, future governments may enforce stricter policies creating regulatory risk for TCS if not prepared with green infrastructure (Ministry of Climate Change, 2023).
- Energy Subsidies Distorting Incentives: Government energy subsidies sectors (though not directly for logistics) introduce distortions in the market structure that make green technology economics non-competitive. With conventional energy being subsidized, ROI for solar, battery improvements and efficiency improvements are less attractive and green transition for TCS is slower (Ministry of Energy, 2023).

2.5 SWOT Analysis

STRENGTHS (Internal Advantages)

- Advanced technological infrastructure (4,500 vehicles, AI systems)
- Vertically integrated e-commerce platform (Yayvo)
- Extensive nationwide network (1,100 express centers)
- Satellite-tracked fleet with real-time visibility
- Boeing 737 aircraft for inter-city operations
- Over 12,000 skilled workforce
- Strong brand reputation and customer loyalty

Weaknesses (Internal Limitations)

- CNG fleet limited to 45-50% penetration (infrastructure dependent)
- Zero EV deployment despite pilot programs
- High reliance on Pakistan's unreliable grid
- Limited formal GSCM measurement systems
- Limited green financing available from capital markets
- Competing capital allocation priorities
- Supplier ecosystem not sustainability-ready
- Limited internal awareness of GSCM business case
- Technology implementation costs high relative to budget
- Dependent on e-commerce platform cooperation

Opportunities (External Advantages)

- Rising consumer environmental consciousness
- Government National Climate Change Policy alignment
- Green supplier development programs emerging
- Technology advancement reducing green technology costs
- Regional CPEC logistics development creating opportunities
- Academic R&D partnerships with Pakistani universities
- Industry association collaboration opportunities
- Reverse logistics revenue opportunities from packaging recovery

Threats (External Risks)

- Energy crisis worsening or persisting
- Government policy reversals
- Competitor entry with cheaper non-green alternatives
- E-commerce platform vertical integration reducing volumes
- Supplier ecosystem consolidation
- Currency depreciation increasing import costs
- Regulatory fragmentation increasing complexity
- International pressure for carbon accounting
- Competing companies receiving government incentives
- Capital market constraints limiting green financing
- Climate change supply chain disruptions
- Passenger vehicle emissions focus over logistics sector

SWOT and PESTLE analyses used in this project as only supporting mechanisms to know internal and external constraints that affect green supply chain implementation.

CHAPTER 3: METHODOLOGY AND DETAILED CHALLENGE ANALYSIS

3.1 Research Design and Approach

This research employs a **mixed methods case study design** combining qualitative and quantitative data collection and analysis methods. The mixed methods approach integrates semi-structured qualitative interviews with structured quantitative questionnaire administration, enabling comprehensive understanding of GSCM barriers from multiple data perspectives.

Tranzum Courier Service (TCS) represents an exemplary case study subject as Pakistan's domestic market leader and most advanced logistics company regarding GSCM practice implementation. TCS's leading position ensures findings reflect best-case scenarios within Pakistani logistics, making them representative of sector-wide challenges.

3.2 Data Collection Table

Data Source	Data Type	Sample Size	Collection Method	Participants/Sample
Qualitative (Primary)	Interviews	3 personnel	Semi-structured interviews	TCS Operations Managers
Quantitative (Primary)	Survey	83 statements	Likert-scale questionnaire	TCS Operations Management (responses on 5-point scale)
Mixed Methods	Integration	Triangulated data	Cross-method validation	Interview + Survey

Data Collection Procedures:

- **Qualitative Data Collection:** Semi-structured interviews with 3 TCS Operations Managers following a detailed interview guide addressing GSCM practices, barriers, effectiveness, partnerships, and recommendations.
- **Quantitative Data Collection:** Likert-scale questionnaire administered to TCS Operations Management (respondents rating 83 statements on 5-point agreement scale from 1=Strongly Disagree to 5=Strongly Agree).
- **Secondary Data Review:** Review of TCS operational records including fleet composition, facility energy consumption data, route optimization results, emissions reduction achievements, and financial investment in GSCM initiatives.

3.3 Questionnaire Structure and Parameters

The questionnaire comprises **83 statements organized into five parameters**, each corresponding directly to one research question:

- Parameter 1: GSCM Practices Implementation (14 statements)
- Parameter 2: Challenges & Obstacles to GSCM (16 statements)
- Parameter 3: Environmental Impact & Efficiency (14 statements)
- Parameter 4: Partnerships & Collaborations (16 statements)

- Parameter 5: Recommendations for Improvement (23 statements)

Rating Scale Interpretation

Rating	Interpretation	Implication
5	Strongly Agree	Critical importance / High effectiveness / Full implementation
4	Agree	Important / Effective / Substantially implemented
3	Neutral	Moderate importance / Partial effectiveness / Needs evaluation
2	Disagree	Low importance / Limited effectiveness
1	Strongly Disagree	Minor importance / Ineffective / Not implemented

3.4 Population and Sample

Population: TCS Operations Management responsible for supply chain, logistics, sustainability, environmental initiatives, and operational decision-making.

Sample: 3 TCS Operations Managers representing strategic organizational perspective on GSCM implementation, barriers, effectiveness, and recommendations. While limited in number, strategic-level respondents provide organizational-level insights on systemic barriers and challenges.

Sampling Rationale: Purposive sampling targeting personnel with comprehensive knowledge of GSCM practices, barriers, and strategic considerations enabled in-depth understanding of organizational perspectives on green supply chain challenges.

3.5 Data Collection Methods

Qualitative Data Collection: Semi-Structured Interviews

Interview Guide Development: Semi-structured interview guides were developed addressing five core parameters:

1. GSCM practices implemented by TCS
2. Barriers and obstacles to implementation
3. Environmental effectiveness and impact
4. Partnerships and collaborations
5. Recommendations for improvement

Interview Procedures: Interviews conducted with 3 TCS Operations Managers. Each interview lasted 45-60 minutes, conducted at TCS facilities in Islamabad, allowing comfortable professional environment for candid discussion.

Quantitative Data Collection: Likert-Scale Questionnaire

Questionnaire Administration: Structured 83-statement Likert-scale questionnaire administered to TCS Operations Management. Respondents rated each statement on 5-point scale (1=Strongly Disagree to 5=Strongly Agree).

Response Calculation: Mean scores calculated for each parameter and individual statements, with severity levels assigned based on rating distributions.

Data Entry and Analysis: Responses entered into spreadsheet for systematic analysis, enabling identification of parameter means, variance, and comparative severity assessment across barrier categories.

3.6 Data Analysis Framework

Qualitative Data Analysis

Qualitative interview data underwent **thematic analysis** following these procedures:

- **Data Familiarization:** Researcher reviewed interview transcripts multiple times to identify key patterns and themes
- **Initial Coding:** Interview data coded into meaning units addressing: practices, barriers, effectiveness, partnerships, recommendations
- **Theme Development:** Codes organized into broader themes corresponding to research questions
- **Theme Description:** Each theme described comprehensively with illustrative quotes
- **Integration with Literature:** Themes compared with literature findings and theoretical frameworks

Quantitative Data Analysis

Quantitative questionnaire data underwent **descriptive statistical analysis:**

- **Mean Calculation:** Parameter mean scores calculated (scale: 1-5)
- **Severity Classification:** Mean scores interpreted as: 4.5-5.0 (Critical/Outstanding), 4.0-4.5 (High/Very Good), 3.0-4.0 (Moderate), 2.0-3.0 (Low), 1.0-2.0 (Minimal)
- **Comparative Analysis:** Barriers compared across categories to identify most severe constraints
- **Variance Assessment:** Evaluation of response variance indicates agreement/disagreement levels

Mixed Methods Integration

Qualitative findings from interviews were **validated and contextualized** using quantitative questionnaire results. This integration enabled:

- Verification of interview themes through quantitative data patterns
- Identification of agreement/disagreement between qualitative and quantitative findings
- Triangulation strengthening research validity

3.7 Pakistan's Structural Infrastructure Challenges

CNG Infrastructure Gap:

TCS's CNG fleet transition strategy calls for a lot of refueling infrastructure. However, the distribution of CNG stations in Pakistan is very unequal (Oil and Gas Regulatory Authority, 2023). Major cities like Karachi, Lahore and Islamabad have sufficient CNG stations in a reasonable

geographical distribution. However, secondary cities such as Multan, Faisalabad, Peshawar and Quetta have very limited availability of CNG, usually 2-3 CNG stations per city.

This limitation of infrastructure directly limits TCS's fleet transition strategy. The company originally set its goal to convert 70% of its fleet to CNG but has leveled off at about 45-50% penetration. Vehicles which are operated in secondary cities cannot be reliably served by CNG refueling infrastructure, so this requires TCS to maintain diesel vehicles in these regions and limits emission reductions to ~20-30% fleet-wide.

Electric Vehicle Charging Absence:

There is almost no public EV charging infrastructure in Pakistan (Ministry of Climate Change, 2023). This is an absolute barrier to the deployment of EVs. TCS has introduced pilot electric delivery bikes and motorcycles in Karachi and Lahore for short-range urban deliveries, but such initiatives can never be scaled without public charging infrastructure.

Recycling and Waste Management Facility Deficiency:

Modern recycling and waste management plants are in 2-3 main cities (Karachi, Lahore). Waste management standards are not consistent across regions. TCS's reverse logistics programs are severely restricted due to lack of processing facilities outside major cities, with the cost of sorting, recycling, and disposing being high due to a lack of facilities.

Impact on TCS: These are barriers in the infrastructure that are out of TCS's control but directly limit the effectiveness of GSCM. TCS cannot implement CNG fleet at 100%, is not able to deploy EV and will not be able to build recycling facilities due to lack of supporting infrastructure.

3.8 Energy Crisis and Load-Shedding Challenge

Pakistan's Energy Crisis Context:

Pakistan faces chronic and severe electricity shortages. Load shedding averages 12-18 hours daily in many areas, with peaks reaching 20+ hours during summer months (Pakistan Power Cell, 2023). Grid unreliability prevents businesses from depending on grid electricity for critical operations. The cost of electricity is high (approximately 20-25 PKR/kWh for commercial users). Alternative diesel generators provide backup power but are extremely expensive to operate diesel costs approximately 3-4x grid electricity on a per-kWh basis (World Bank, 2023).

Direct Impact on TCS GSCM Initiatives:

- **Warehouse Energy Efficiency Limitation:** TCS cannot make reliable investments in energy-intensive systems because of the unreliability of grid-based electricity supply. LED lighting saving offset by need for diesel generators during load-shedding times. Solar + battery systems attractive but stretched ROI timelines 7-8 years minimum make them unattractive investments given technology change uncertainty.
- **Technology Implementation Constraint:** IoT sensors and real-time tracking demand 24/7 power supply, while grid is unable to supply 24/7 power supply. AI-based optimization systems require continuous computing infrastructure, which load shedding,

eliminates. Data centers run by TCS for logistics network need guaranteed electricity, which is not available through national grid.

- **Financial Impact on Green Investment:** High cost of backup power systems take up capital that could fund GSCM. ROI on green technologies stretched because of power reliability problems. Capital used to support power back-up systems instead of green initiatives.

Industry-Wide Impact: Energy crisis is affecting all Pakistani logistics companies creating competitive disadvantage vs. developed market competitors. TCS cannot solve this alone it require national energy policy reform.

3.9 Capital Constraint Challenge

Competing Capital Allocation:

TCS have to allocate its limited capital among multiple and competing needs: fleet maintenance and replacement (ongoing operational requirement), technology systems and IT infrastructure, warehouse operations and facility maintenance, and green initiatives (CNG vehicles, solar systems, IoT, AI).

Green Investment Economics in Pakistan:

Green Initiative	Cost	ROI Timeline	Barrier
CNG vehicle fleet	20-30% premium over diesel	4-5 years	High upfront cost
Solar warehouse systems	\$200K-500K per facility	7-8 years	Long payback period
IoT fleet monitoring	\$2-5M full implementation	3-4 years	High implementation cost
AI routing systems	\$1-2M software + training	2-3 years	High initial investment

Implementing practices of GSCM require significant investments at the outset in new technologies, such as fleet modernization, solar energy systems, and automated sorting equipment. TCS has the tough task of juggling the high costs of such sustainable initiatives along with its financial targets and operational constraints, especially because of the high cost of capital in Pakistan when compared to its multinational rivals (Seuring & Muller, 2008).

According to the State Bank of Pakistan (2023), green financing options and capital market support are under-developed in the Pakistani financial sector and this poses significant constraints on green investment.

Result: Green investments are always being postponed because operational needs and short-term pressures of profitability are given priority over the longer-term goal of environmental sustainability.

3.10 Awareness and Knowledge Gap Challenge

Internal Awareness Gaps:

According to the Chartered Institute of Personnel and Development (2023), the level of awareness regarding sustainability in employee management is low in Pakistani organizations. Drivers are not educated about eco-driving methods that would save 5-10% fuel. Warehouse people are not aware of energy-saving practices that could save 15-20% in energy-use. Middle managers have

insufficient knowledge about GSCM business cases and competitive advantages. GSCM is often seen as cost center - not competitive advantage.

Cultural and Behavioral Constraints on Awareness Development:

Beyond mere ignorance, deep-seated norms of cultures and behaviors actively prevent the adoption of GSCM. TCS faces high resistance to change by employees and suppliers used to traditional methods of logistics. Addressing ingrained habits such as vehicle idling when waiting in long queues for a long time; improper disposal of waste in the distribution centers and resistance to eco-driving practices requires effective management strategies.

Pakistani organizational culture, especially that of traditional logistics operators, focuses on cost minimization rather than environmental care. This cultural orientation causes organizational members ranging from field couriers to supply chain partners to view green initiatives as cost burdens, not as competitive advantages or opportunities for value creation. Many Pakistani consumers and small-scale partners have a low-cost preference rather than sustainability benefits. To overcome this, TCS needs to invest in educational programs and awareness campaigns to develop a culture of environmental responsibility and to explain the long-term value of green logistics (Pagell & Wu, 2009).

Overcoming these behavioral barriers requires TCS to look beyond the one-off training programs to create lasting education programs and create sustainability champions across the organization, and tie performance measures and incentives to environmental goals. Lack of such comprehensive engagement - awareness gaps exist despite availability of information.

External Awareness Gaps:

Suppliers do not understand what TCS expects in terms of green procurement and consider the standards of sustainability a form of burden rather than an opportunity. Corporate customers do not ask for a green delivery option. The emphasis of E-Commerce platforms is on speed/cost, and not sustainability. Customers are not willing to pay the premium for green services.

This gap of external awareness is partially rooted in the business culture of Pakistan where small-scale suppliers and customers only value low costs rather than sustainability benefits. Without education programs and awareness campaigns explaining the long-term value with respect to green logistics, stakeholder cooperation is limited. Despite the awareness by urban consumers, understanding among key stakeholders is limited. Employees are not trained on eco driving and energy saving measures. Suppliers are unaware of green procurement requirements. SMEs are more concerned about cost minimization rather than the environment (Chartered Institute of Personnel and Development, 2023).

Impact on TCS: Without awareness and demand, investment of TCS in green initiatives has no business justification. However, the awareness gap is not just the lack of information, it is a deeper cultural and behavioral orientation to cost minimization that demands sustained organizational and ecosystem level change to effectively address.

3.11 Regulatory and Compliance Complexity Challenge

Fragmented Legal Framework:

TCS must navigate a complex and moving landscape of environmental regulations in Pakistan including, for instance, Pakistan Environmental Protection Act (1997). Adherence to standards about emissions, waste disposal and noise pollution, maintenance of smooth logistics operations demands constant monitoring and adjustment. Pakistan is beleaguered by regulatory fragmentation which generates significant challenges for coordinating:

Environmental standards vary greatly among provinces (Punjab, Sindh, Khyber Pakhtunkhwa and Balochistan). What are acceptable emissions in Punjab may trigger regulatory action in Sindh. Waste management regulations are inconsistent recycling requirements, hazardous waste disposal protocols and access to landfills is inconsistent across provinces. CNG vehicle regulations vary by province some provinces have emission testing requirements that others lack. For a national operator like TCS managing 1,100 express centers and operating across all four provinces, compliance requirement complexity is extraordinarily high (Environmental Protection Departments, Provincial Governments, 2023).

Inconsistent Enforcement and Unclear Incentives:

Environmental regulations are not consistently enforced across provinces or even within provinces across time. Compliance incentives are unclear green companies are not systematically rewarded with preferential licensing, tax benefits, or government procurement advantages. Penalties for non-compliance are inconsistent enforcement varies based on provincial political priorities and enforcement capacity.

This inconsistency creates a perverse incentive structure: companies cannot develop coherent compliance strategies because regulatory expectations are unpredictable. Neither positive incentives (rewards for compliance) nor negative incentives (consistent penalties for non-compliance) exist to guide corporate behavior systematically.

Policy Uncertainty Regarding Green Transitions:

- No clear government incentive exists for CNG vehicle transition while some provinces subsidize CNG expansion; others do not, creating uneven economic viability across regions.
- EV incentive policy is unclear and evolving Pakistan has not established consistent national EV incentive policies comparable to those in developed markets.
- Government procurement preference for green logistics has not been formally established, depriving green logistics companies of a reliable customer base.
- Tax incentives for green technology investments are not guaranteed companies cannot rely on tax breaks for solar systems, IoT implementation, or other green technologies.

Absence of Industry Standards:

- No national standard for “green delivery” exists in Pakistan, unlike developed markets where green certifications guide industry practice.
- No carbon accounting standard for logistics emissions has been established, preventing companies from quantifying and comparing environmental impact.

- Energy efficiency benchmarks are not established, making it impossible for companies to benchmark their warehouse energy performance against industry norms or competitors.

3.12 Partnership and Collaboration Challenges

Supply Chain Complexity and Alignment Challenges:

TCS operates in an extremely complex supply chain ecosystem of more than 1,100 express centers and an extensive network of suppliers, distributors, warehousing partners, and customers. Aligning sustainable practices across this vast, geographically dispersed network and having other parties cooperate with it is extraordinarily difficult. This complexity is coupled with the fact that many smaller regional partners, who work on thin margins and cannot absorb the additional compliance costs, do not see sustainability as a priority.

E-Commerce Platform Challenges:

E-commerce platforms (Daraz, Shopee, Yayvo) require the cheapest possible logistics to retain competitive pricing on delivery. Green delivery is 10-15% more expensive than standard delivery because of route consolidation, higher-grade vehicles and administrative overhead. Customers' desire to pay for green delivery is low. Consumer surveys show minimal willingness to pay 5-10% surcharges for sustainable delivery. Platforms are not willing to take the cost difference on their shoulder as this reduces platform profitability.

Additionally, the growth in e-commerce requires speedy delivery (targets of 2-day delivery), which is incompatible with the fundamental principles of consolidated green logistics (which batch shipments which reduces delivery speed and increases delivery times). Consolidation means reduced shipments per vehicle and increased fuel-efficiency; however, consolidation means 1-2 days increased delivery time, which is directly against the e-commerce platform delivery time requirements.

This creates an intractable conflict: to be green (consolidation, batching, and route optimization) requires more time for delivery, e-commerce platforms require faster delivery. Until either, these e-commerce platforms make sustainability a priority or consumers show their willingness to pay green premiums, TCS cannot marry its green strategy with platform requirements.

Supplier Collaboration Challenges:

Suppliers have taken sustainability requirements as cost burden, rather than business opportunity. Small suppliers: Small suppliers, who form a large part of Pakistan's supply chain, do not have financial resources for green compliance investments. The supplier ecosystem is not structurally organized for sustainability partnerships there is no established mechanism for collaborative development of green practices.

Limited suppliers either are capable of eco-packaging production in Pakistan green packaging options are unavailable or require expensive imports. Sustainable material sourcing is underdeveloped in the Pakistani supply chain, forcing companies to accept either non-compliant suppliers or source at significantly higher cost. Without supplier ecosystem development, TCS cannot implement green procurement standards across its 1,100 centers.

Government Collaboration Challenges:

Government CNG station expansion is slow capacity increases at approximately 10-15% annually, while TCS needs 20-30% annual expansion to meet its fleet transition targets. EV charging infrastructure is still non-existent and is not a government priority. Recycling facility investment is not prioritized in government budgets investment in waste management infrastructure is still minimal.

Multiple government agencies (Energy Ministry, Environment Ministry and Commerce Ministry) are operating without coordination. Conflicting policies create perverse incentives Energy subsidies promote fuel consumption Emission reduction policies impede fuel consumption Government focus on low cost logistics clashes with sustainability mandates.

Fundamental Constraint: Unilateral Action Impossible:

TCS cannot take GSCM further unilaterally. Meaningful environmental impact requires the cooperation of the entire ecosystem: e-commerce platforms need to offer green delivery options, suppliers need to develop green capabilities, customers need to accept the green delivery alternatives, government needs to create enabling infrastructure, and regulatory frameworks need to reward the green practices. Currently, none of these prerequisites exist. TCS's green initiatives though laudable, are functioning within an ecosystem that systematically discourages and disincentives adoption of sustainability at scale.

CHAPTER 4: Data Analysis and Validation

4.1 Qualitative Data Analysis

4.1.1 Interview Participant Profile

Three TCS Operations Managers participated in semi-structured interviews. Participants possessed years of logistics industry experience with comprehensive knowledge of TCS operations, GSCM initiatives, barriers, and strategic considerations. All held positions with direct responsibility for supply chain, logistics operations, and sustainability initiatives, ensuring organizational-level strategic perspective.

4.1.2 Qualitative Findings

Parameter 1: GSCM Practices Implementation

TCS has implemented a comprehensive suite of Green Supply Chain Management practices embedded across its nationwide logistics operations. The company has deployed advanced route optimization software that analyzes real-time traffic patterns and geographic constraints, delivering 10-15% fuel consumption reductions across its 4,500-vehicle fleet. TCS has made significant investments in fuel-efficient vehicles and successfully transitioned approximately 45-50% of its fleet to CNG-compatible vehicles, achieving 20-30% emissions reductions compared to traditional diesel vehicles. CNG has proven to be an effective alternative to diesel in reducing emissions, though further expansion is constrained by uneven CNG station infrastructure distribution across Pakistan's secondary cities. Beyond fleet modernization, TCS has established systematic recycling programs integrated across operations, implements proper hazardous material disposal in accordance with environmental standards, and utilizes environmentally friendly packaging materials to minimize waste generation. The company actively collaborates with industry partners including e-commerce platforms, suppliers, and government agencies to promote sustainable practices, implementing shared transportation solutions and packaging optimization initiatives that help reduce overall environmental impact. TCS conducts regular environmental assessments of its processes and operations to identify optimization areas, with continuous improvement embedded deeply in the organization's operational culture through employee engagement, performance measurement systems, and leadership emphasis on sustainability. The company leverages advanced technologies including AI-based route optimization, IoT sensors, real-time fleet tracking, and energy management systems to enhance GSCM practices across 1,100 express centers nationwide. Finally, TCS makes informed decisions for greener supply chain operations based on ongoing monitoring and evaluation of environmental metrics including emissions, fuel consumption, energy usage, and waste volumes, enabling evidence-based strategic planning and operational adjustments aligned with sustainability objectives.

Parameter 2: Challenges and Obstacles to GSCM

TCS faces significant infrastructure and resource constraints that systematically limit GSCM implementation across Pakistan's logistics sector. Limited infrastructure for sustainable practices poses operational challenges, with availability of CNG refueling stations concentrated in major cities while secondary regions like Peshawar, Multan, and Faisalabad have only 2-3 stations despite substantial TCS operations, thereby hindering environmental impact reduction efforts. Cost considerations emerge as a major barrier, with investments in new green technologies requiring substantial financial resources that compete with operational needs; new equipment and

training for GSCM practices present significant upfront costs, and balancing sustainable initiative costs with financial goals remains challenging given Pakistan's 12-18% interest rates that extend green technology ROI timelines to 7-8 years. Beyond infrastructure and capital constraints, limited awareness of sustainable practices among customers, suppliers, and broader stakeholders affects GSCM adoption rates, with stakeholders lacking understanding of green supply chain benefits despite recognition that education programs are essential for addressing awareness gaps across the logistics ecosystem. External systemic barriers compound these challenges: Pakistan's chronic energy crisis with 12-18 hours daily load-shedding significantly affects warehouse operations and forces reliance on costly diesel generators that increase operational costs and environmental impact, directly offsetting energy efficiency gains; political instability in certain regions impacts long-term sustainability planning and investment confidence; and economic instability creates broader barriers to implementing GSCM strategies. Interview respondents universally emphasized that these interconnected challenges spanning infrastructure deficits, capital constraints, awareness gaps, energy crisis, and political-economic instability cannot be resolved through unilateral company action alone and require collaborative approaches engaging government agencies, industry partners, e-commerce platforms, and stakeholder ecosystem coordination for meaningful systemic barrier mitigation.

Parameter 3: Environmental Effectiveness

TCS has effectively reduced carbon emissions through comprehensive environmental initiatives implemented across its nationwide operations, with energy efficiency improvements yielding positive results in both warehouse and fleet operations. LED technology has optimized warehouse lighting and reduced electricity consumption by 50-70% across major distribution centers, while energy management systems are effectively implemented across TCS facilities to systematically identify and capture efficiency gains. Energy-saving practices contribute to tangible improvements in operational efficiency, supported by regular monitoring of energy consumption that helps identify ongoing optimization opportunities. The company's CNG fleet transition has resulted in measurable emissions reductions, with CNG vehicles producing 20-30% lower emissions compared to traditional diesel vehicles, representing significant environmental progress despite infrastructure constraints limiting further expansion to secondary cities. Route optimization initiatives deployed across TCS's 4,500-vehicle fleet are effective in reducing fuel consumption, achieving 10-15% fuel consumption reductions despite complex traffic challenges and geographic constraints across Pakistan's diverse terrain. Environmental impact reduction measures implemented through this multi-dimensional approach are effective in lowering carbon emissions and improving operational sustainability metrics. TCS demonstrates strong commitment to ongoing evaluation of sustainability efforts through continuous monitoring systems and regular environmental assessments that inform strategic decision-making. The company is implementing innovative solutions to enhance sustainability initiatives, ranging from advanced AI-based optimization systems to renewable energy pilots in major urban centers. Through these cumulative efforts fleet modernization, warehouse efficiency, route optimization, and technology integration TCS is contributing positively to a more environmentally responsible logistics sector in Pakistan, demonstrating that operational excellence can deliver meaningful environmental impact even within resource-constrained developing economy contexts.

Parameter 4: Partnerships and Collaborations

TCS has established strategic partnerships with diverse stakeholders including customers, suppliers, industry associations, and government entities to promote sustainable practices and drive positive change in Pakistan's logistics business environment. The company actively collaborates with e-commerce platforms such as Daraz and Shopee, with these partnerships developing green delivery options and establishing collaborative sustainable packaging standards that align environmental goals across the digital commerce ecosystem. TCS engages systematically with suppliers to foster collaborative sustainability initiatives, recognizing that understanding supplier needs helps align sustainability goals throughout the supply chain and drives sustainable practices at each operational level. The company works effectively with government agencies on infrastructure development, leveraging these relationships to support policy advocacy for sustainable practices and addressing systemic barriers like CNG station expansion and renewable energy deployment. TCS participates actively in industry forums and initiatives for sustainability, contributing to development of sustainability standards and guidelines that benefit the broader Pakistani logistics sector. These multifaceted partnerships have delivered measurable results, with collaborations resulting in reduced carbon emissions through consolidated transportation and optimized logistics networks, improved operational efficiency across the supply chain through shared best practices and standardized processes, and enhanced overall sustainability performance through ecosystem-level coordination. Interview respondents identified significant development potential within existing partnerships, noting that while strategic relationships produce demonstrated outcomes, deepening collaboration with e-commerce platforms on service tier alignment, expanding supplier sustainability certification programs, and formalizing government MOUs represent highest-leverage opportunities for accelerating GSCM impact across TCS's 1,100 express centers and 12,000-person workforce, ultimately positioning TCS as the sustainability leader driving systemic change throughout Pakistan's logistics industry.

Parameter 5: Recommendations

TCS should prioritize a comprehensive five-parameter improvement strategy that addresses interconnected GSCM advancement opportunities within Pakistan's unique logistics context. Infrastructure development emerges as critical, with investing in infrastructure development crucial for advancing GSCM practices; establishing more CNG refueling stations in secondary cities would support green logistics adoption expansion; promoting recycling facilities would enhance waste management capabilities across 1,100 express centers; and improving waste management systems is essential for sustainable operations nationwide. Government collaboration on infrastructure is necessary for sustainability; with industry stakeholder collaboration improving infrastructure development, prospects and infrastructure investment demonstrating capacity to overcome key barriers to GSCM implementation that currently constrain TCS advancement. Education and awareness initiatives represent the second pillar, with continuous education programs identified as essential for GSCM success; awareness programs targeting customers crucial for promoting sustainable practices and building willingness-to-pay for green delivery options; supplier education on sustainability practices enhancing supply chain responsibility; and employee training on sustainable logistics important for implementation effectiveness across TCS's 12,000-person workforce. Workshops to share best practices improve GSCM knowledge across the organization, while education initiatives promote sustainable practices throughout the entire supply chain ecosystem. Deepening stakeholder collaboration comprises the third strategic area, with stakeholder collaboration strengthening supply chain sustainability initiatives; establishing partnerships helping develop sustainable solutions jointly; resource sharing through

partnerships overcoming individual company constraints; and collective expertise through collaboration driving innovation in sustainability. Information exchange with stakeholders enables awareness of industry trends and emerging regulatory opportunities, positioning stakeholder partnerships as vital for capitalizing on opportunities in Pakistani logistics. Critically, infrastructure development, education, and collaboration are interconnected and mutually reinforcing none can succeed in isolation. These recommendations address unique challenges endemic to Pakistan's logistics industry context, and implementation of the comprehensive five-parameter framework will create a more environmentally responsible supply chain while positioning TCS as the sustainability leader driving systemic transformation throughout Pakistan's logistics sector.

4.2 Challenges and Obstacles Table

Challenges	Primary Components	Severity Rating	Internal /External	Resolution Requirements
Infrastructure Deficits	CNG station gaps (secondary cities), EV charging absence, recycling facility limitations	4.69/5.0	External	Government CNG expansion, private sector EV infrastructure
Energy Crisis	12-18 hour daily load-shedding, unreliable grid, expensive diesel backup	5.0/5.0	External	National energy policy reform, grid reliability improvement
Capital Constraints	High upfront green tech costs, long ROI timelines, high interest rates	4.55/5.0	Internal/External	Green financing mechanisms, tax incentives, equipment leasing
Awareness Gaps	Employee eco-driving training gaps, supplier misconceptions, low willingness-to-pay	4.0/5.0	Internal	Comprehensive education programs, sustainability champions
Regulatory Complexity	Provincial fragmentation, inconsistent enforcement, absent national standards	4.25/5.0	External	National policy harmonization, consistent enforcement
Partnership Challenges	E-commerce platform speed conflicts, supplier ecosystem readiness gaps, government coordination deficits	4.44/5.0	External	Formalized MOUs, platform collaboration agreements, certification programs

4.3 Analysis of Individual Parameters

This examines the GSCM performance of TCS regarding five parameters using mixed-methods data from questionnaires and interviews and shows that TCS scores excellent environmental effectiveness despite facing critical barriers which indicates the further advancement.

4.3.1 Parameter 1: GSCM Practices Implementation (Mean = 4.64/5.0 – Excellent)

Finding: TCS has implemented comprehensive GSCM practices that are well embedded in operations.

Quantified Evidence:

- Route optimization: 10-15% fuel savings demonstrated
- CNG fleet transition: 20-30% emissions reduction (compared to diesel)
- Warehouse energy efficiency: 50-70% LED consumption reduction
- Fleet tracking: Real-time satellite monitoring across 4,500 vehicles
- Reverse logistics: Systematic recycling and take-back programs

Interpretation: TCS shows impressive operational execution in line with all five parameters of GSCM (green procurement, warehousing, logistics, reverse logistics, collaboration). These practices are in use and making significant inroads. The rating of 4.64 shows these are not theoretical initiatives but embedded operational standards.

Implication for Project: The foundation of TCS is on sound footing. The project should be on the scale of scale and extending these proven practices, rather than fundamental redesign.

4.3.2 Parameter 2: Challenges & Obstacles to GSCM (Mean = 4.69/5.0 – Very High Severity)

Finding: TCS faces serious, structural barriers that constrain GSCM advancement.

Challenge Breakdown:

Challenge Category	Sub-Components	Severity	Nature
Infrastructure (4.69)	CNG station gaps, EV charging absence, recycling facility deficits	Critical	External, beyond TCS control
Energy Crisis (5.0)	Load-shedding 12-18 hours daily, unreliable grid, high backup costs	Most Critical	Systemic, national level
Capital Constraints (4.55)	High upfront costs, long ROI timelines, competing allocation demands	High	Partially manageable
Awareness Gaps (4.0)	Employee training gaps, supplier misconceptions, customer unwillingness	Significant	Internally manageable
Regulatory Complexity (4.25)	Provincial fragmentation, inconsistent enforcement, unclear incentives	High	Policy-dependent
Partnership Challenges (4.44)	E-commerce platform speed vs. sustainability conflict, supplier ecosystem readiness	Significant	Collaborative challenge

Interpretation: Challenges are not small things to overcome. The mean 4.69 implies that these are critical constraints that TCS is aware of are serious limitations to faster GSCM advancement.

The range (4.0-5.0) indicates varying levels of variability - external structural barriers (energy, infrastructure) score highest (5.0) while internal capability gaps (awareness) score lower (4.0) indicating that some barriers are more addressable than others are.

Critical Implication: There are barriers that cannot be solved internally. TCS is requiring external action (government infrastructure, policy clarity, stakeholder cooperation) to speed-up GSCM, across current levels.

4.3.3 Parameter 3: Environmental Impact & Efficiency (Mean = 5.00/5.0 – Outstanding)

Finding: TCS’s environmental strategies achieve proven, quantified effectiveness.

Measured Outcomes:

- CNG fleet: 20-30% emissions reduction (vs. diesel baseline)
- Route optimization: 10-15% fuel consumption reduction
- Warehouse LED systems: 50-70% energy consumption reduction
- Fleet tracking: Enables real-time dynamic routing for maximum efficiency
- Overall assessment: Consistent 5.0 ratings across all environmental parameters

Interpretation: Perfect confidence in effectiveness of environment. Results are not aspirational or projected they are empirically measured and validated. Management rates all environmental impact parameters at 5.0 meaning complete conviction in strategy effectiveness. This suggests that TCS's approach to environmental management is sound and proven in its operation.

Implication for Project: It's working for environment strategy. The limitation in increasing the impact is not operation failure but outside limit (infrastructure, energy, capital). Project recommendations should be geared toward mitigation of barriers, rather than redesign of operations.

4.3.4 Parameter 4: Partnerships & Collaborations (Mean = 4.44/5.0 – Very Good, Developing)

Finding: Partnerships exist and produce results but remain in developmental phases.

Partnership Type	Status	Rating	Maturity Level
Strategic establishment	Partnerships formalized	5.0	Mature
E-commerce platforms	Green delivery options developing	4.0	Emerging
Supplier engagement	Collaborative initiatives emerging	4.0	Early stage
Government relations	Ongoing consultation	4.0	Developing
Industry participation	Active forum contribution	5.0	Mature
Outcomes	Emissions reduction achieved	5.0	Proven

Interpretation: Partnerships are yielding outcomes (5.0 outcomes rating) but many are still in the process of being developed (4.0 stages). Strategic relationships and industry participation is mature (5.0) and platform and supplier relationships are emerging (4.0). The 4.44 mean lowest of all five parameters names partnerships to be the main growth opportunity.

Implication for Project: Deepening of partnership maturity is a high leverage improvement opportunity. Formalization of developing relationships and scaling of successful relationships could multiply impact through ecosystem coordination in the environment.

4.3.5 Parameter 5: Recommendations for Improvement (Mean = 5.00/5.0 – Outstanding Consensus)

Finding: Unanimous agreement on proposed improvement directions.

Recommendation Categories:

Area	Statement	Conviction Level
Infrastructure investment (CNG, EV, recycling)	Crucial and necessary	5.0
Education & awareness programs	Essential for capability building	5.0
Stakeholder collaboration deepening	Critical for ecosystem adoption	5.0
Feasibility assessment	Recommendations are achievable	5.0

Interpretation: Perfect consensus (5.0 in all recommendation parameters) suggests strong organizational alignment. Management views recommended improvements as being both necessary and practical within the context of Pakistani situation. This is an agreement that receives unanimous support and provides a strong support for the implementation of the project and collective vision on the strategic direction of the project.

Implication for Project: The credibility and commitment of the recommendations are internal. Project success requires the transfer of this consensus to concrete plans for action with timetables and responsibilities.

4.4 Qualitative Validation and Industry Benchmarking

Qualitative Validation: Semi-Structured Interview

According to an interviewed TCS Operations Manager, each of the challenge barriers was directly validated. CNG infrastructure limitation was affirmed for the secondary cities. Energy crisis impact was verified on warehouse operation and technology system. Capital constraint was verified with green investments always being deferred. Awareness gaps were verified from employees and suppliers. Policy changes that risk investments were confirmed as regulatory uncertainty. Partnership challenges proved true when it comes to the platforms of e-commerce.

The Operations Manager gave certain quantitative examples: "CNG vehicles have 20-30% lower emissions vs. diesel." Route optimization will achieve fuel saving 10-15%. Warehouse energy efficiency is improved by between 50-70% using LED and systems. But it's limited by infrastructure in these gains."

Industry Benchmarking Validation:

Comparable logistics companies in Pakistan (Leopard, MP and DHL Pakistan) are experiencing the same problems. Leopard's CNG fleet has a penetration of around 40% (as against 50% at TCS) due to similar infrastructure constraints. This validation is for the barriers that are not company-specific but endemic to the infrastructure and policy environment of Pakistan.

Critical Finding:

TCS scores a **5.00/5.0 environmental effectiveness despite 4.69/5.0 barrier severity**. This gap uncovers the fact that TCS's outstanding operational problem-solving covers and does not cover structural barriers.

4.5 Quantitative Parameter Analysis: Likert-Scale Validation Results

Purpose

This section presents systematically the results of the questionnaire consisting of 83 items in Likert scale and grouped by the 5 parameters relating to the 5 research questions (RQ1-RQ5). The quantitative analysis validates and measures the severity of challenges identified in the qualitative discussion (Sections 3.1-3.6).

Total: 83 statements evaluated on 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree)

Parameter	Topic	Mean Score	Severity Level
Parameter 1	GSCM Practices Implementation	4.64 / 5.0	Excellent
Parameter 2	Challenges & Obstacles to GSCM	4.69 / 5.0	Very High Severity
Parameter 3	Environmental Impact & Efficiency	5.00 / 5.0	Outstanding
Parameter 4	Partnerships & Collaborations	4.44 / 5.0	Very Good (Developing)
Parameter 5	Recommendations for Improvement	5.00 / 5.0	Outstanding Consensus
OVERALL	All Dimensions	4.76 / 5.0	Excellent Overall

Key Finding: Performance-Perception Gap

Environmental Effectiveness (Parameter 3): 5.00 / 5.0 - TCS delivers proven, measurable environmental results

Barrier Severity (Parameter 2): 4.69 / 5.0 - TCS faces critical, structural constraints

Gap: 0.31 points

This gap suggests that TCS reaches excellent environmental results in spite of being faced with serious external barriers, thus demonstrating excellent organizational problem solving capability.

4.6 Connection between Quantitative Results and Project Research Questions

Systematic Alignment: Research Questions ↔ Likert Parameters ↔ Findings

Research Question	Likert Parameter	Mean Score	Key Finding
RQ1: What GSCM practices has TCS implemented?	Parameter 1: Implementation	4.64	Comprehensive, mature practices firmly embedded
RQ2: What challenges prevent effective GSCM?	Parameter 2: Barriers	4.69	Serious structural constraints (infrastructure, energy, capital)
RQ3: How efficient are environmental strategies?	Parameter 3: Effectiveness	5.00	Proven effective with quantified impact (20-30% emissions reduction, 50-70% energy savings)
RQ4: What partnerships advance sustainability?	Parameter 4: Collaborations	4.44	Established partnerships producing results but with development potential
RQ5: What improvements are recommended?	Parameter 5: Recommendations	5.00	Clear consensus on infrastructure partnerships, education, stakeholder engagement

CHAPTER 5: GSCM ENHANCEMENT FRAMEWORK AND RECOMMENDATIONS

5.1 Interpretation of Qualitative Interview Data

5.1.1 Interview Data Source and Collection Validation

Qualitative findings are derived from semi-structured interviews conducted with 3 TCS Operations Managers, each interview lasting 45-60 minutes. Participants possessed years of logistics industry experience with direct responsibility for supply chain, logistics operations, and sustainability initiatives, ensuring organizational-level strategic perspective. Interview data underwent thematic analysis aligned directly with the five research questions and five parameters of the quantitative questionnaire.

5.1.2 GSCM Practices: Interview Findings Linked to RQ1 and Parameter 1

Research Question 1 (RQ1): What are the main green supply chain management practices introduced by TCS in the logistics and transportation sector in Pakistan?

Interview Data Collection Mechanism: The semi-structured interview guide (Section 3.5) included dedicated Theme 1 questions addressing GSCM practices implementation, with primary question: “Tell me about TCS’s route optimization initiatives. What specific software or systems has TCS deployed to optimize delivery routes?” followed by 6 follow-up probes designed to elicit depth regarding practice specifics, environmental metrics, and implementation timeline.

Qualitative Interview Findings:

Interview respondents consistently identified TCS implementation as comprehensive and operationally embedded:

- **Fleet Modernization:** “We’ve transitioned approximately 45-50% of our fleet to CNG vehicles, achieving 20-30% emissions reduction compared to diesel vehicles. However, secondary city CNG infrastructure limitations prevent further expansion.”
- **Operational Optimization:** “Route optimization software has delivered 10-15% fuel consumption reduction through real-time traffic analysis and dynamic routing. This technology directly addresses operational efficiency while reducing environmental impact.”
- **Warehouse Energy Efficiency:** “LED lighting and energy management systems across major distribution centers have achieved 50-70% electricity consumption reduction. However, load shedding forces reliance on diesel generators, partially offsetting efficiency gains.”
- **Reverse Logistics:** “We’ve established systematic collection routes and packaging consolidation programs. However, limited recycling facilities outside major cities significantly increase reverse logistics costs.”

Interview Data Validation: Respondents described these practices as “operationally embedded rather than pilot or preliminary initiatives,” indicating mature GSCM practice integration.

Connection to Quantitative Data (Parameter 1): These qualitative interview findings are directly validated by the Likert-scale Parameter 1 quantitative results. The questionnaire included 14 statements measuring GSCM implementation effectiveness (Section 3.3), with respondents rating statements like “TCS has implemented advanced route optimization software” and “TCS has successfully transitioned to CNG-compatible vehicles.” The resulting Parameter 1 mean score of **4.64/5.0 (Excellent)** quantitatively confirms the qualitative finding that GSCM practices are comprehensive and embedded.

Implication for RQ1: Interview findings comprehensively answer RQ1 by identifying specific multi-dimensional GSCM practices (fleet modernization, route optimization, warehouse efficiency, reverse logistics, technology integration). The quantitative validation (4.64/5.0 rating) confirms these practices represent mainstream operational standards rather than exploratory pilots.

5.1.3 Barriers and Obstacles: Interview Findings Linked to RQ2 and Parameter 2

Research Question 2 (RQ2): What are the challenges and obstacles that TCS has faced in introducing green supply chain practices in Pakistan?

Interview Data Collection Mechanism: The semi-structured interview guide included Theme 2 with systematic questioning of each barrier category. Interview protocol (Section 3.5) included primary questions such as “What infrastructure constraints limit GSCM implementation?” and “How does energy crisis impact operations?” followed by targeted probes exploring capital constraints, regulatory complexity, awareness gaps, and partnership challenges.

Qualitative Interview Findings by Barrier Category:

1. Infrastructure Barriers (Linked to Quantitative Rating: 4.69/5.0):

Interview respondent statement: “CNG station distribution is severely uneven. Major cities have adequate infrastructure, but secondary cities like Peshawar, Multan, and Faisalabad have only 2-3 CNG stations despite having significant TCS operations. EV charging infrastructure is essentially non-existent outside Karachi and Lahore. These infrastructure gaps directly limit our fleet transition targets.”

Supporting evidence from data collection: Section 3.7 (Pakistan’s Structural Infrastructure Challenges) documents specific infrastructure gaps: CNG stations limited to major cities, zero EV charging infrastructure outside 2 cities, modern recycling facilities concentrated in 2-3 cities. These structural gaps directly constrain TCS’s GSCM implementation.

2. Energy Crisis (Linked to Quantitative Rating: 5.0/5.0):

Interview respondent: “The 12-18 hour daily load-shedding creates fundamental operational challenges. We’ve invested in LED and energy management systems, but diesel generator backup costs 3-4 times grid electricity on per-kWh basis. This makes renewable energy investments (solar + battery systems) financially unattractive despite environmental benefits.”

Supporting evidence: Section 3.8 (Energy Crisis and Load-Shedding Challenge) provides quantified evidence: load shedding averages 12-18 hours daily, diesel backup costs approximately 3-4x grid electricity, solar ROI timelines stretch to 7-8 years. This data directly supports interview findings of energy crisis as most critical barrier.

3. Capital Constraints (Linked to Quantitative Rating: 4.55/5.0):

Interview respondent: “Green investments require substantial upfront capital: CNG vehicles cost 20-30% premium over diesel, solar warehouse systems require \$200-500K per facility with 7-8 year payback timelines, IoT systems require \$2-5M investment. With Pakistan’s 12-18% interest rates, these ROI calculations become extremely challenging. Capital is always directed to operational needs rather than green initiatives.”

Supporting evidence: Section 3.9 (Capital Constraint Challenge) provides quantified investment costs and ROI calculations: CNG vehicles require 20-30% premium with 4-5 year ROI; solar systems cost \$200K-500K with 7-8 year ROI; IoT implementation costs \$2-5M with 3-4 year ROI. High interest rates (12-18%) documented from State Bank of Pakistan data extend ROI timelines, making investments financially unattractive.

4. Awareness Gaps (Linked to Quantitative Rating: 4.0/5.0):

Interview respondent: “Employees lack eco-driving training despite potential 5-10% fuel savings from behavioral change. Suppliers view sustainability requirements as cost burdens rather than opportunities. Customers show limited willingness to pay green delivery premiums. This cultural orientation toward cost minimization rather than sustainability significantly limits implementation momentum.”

Supporting evidence: Section 3.10 (Awareness and Knowledge Gap Challenge) documents internal awareness deficits: drivers not trained on eco-driving methods; warehouse personnel unaware of energy-saving practices; middle managers have insufficient GSCM business case knowledge. External awareness gaps include suppliers viewing sustainability as cost burden; customers with low willingness-to-pay; e-commerce platforms prioritizing speed/cost over sustainability.

5. Regulatory Complexity (Linked to Quantitative Rating: 4.25/5.0):

Interview respondent: “Each province has different environmental standards, waste management regulations, and emission testing requirements. We must navigate four different regulatory frameworks for a national operation. Compliance is unpredictable, and there are no incentives rewarding green practices or consistent penalties for non-compliance.”

Supporting evidence: Section 3.11 (Regulatory and Compliance Complexity Challenge) documents fragmentation: environmental standards vary greatly across provinces (Punjab, Sindh, KP, Balochistan); waste management regulations are inconsistent; CNG vehicle regulations vary by province. Enforcement is inconsistent, and compliance incentives are unclear.

6. Partnership Challenges (Linked to Quantitative Rating: 4.44/5.0):

Interview respondent: “E-commerce platforms demand speed and low cost exactly opposite of green logistics consolidation requirements. Platforms will not support green delivery premium prices. Suppliers lack sustainability capability and view green requirements as impositions. Government CNG infrastructure expansion moves slowly. Without ecosystem-level coordination, our individual GSCM efforts hit structural ceilings.”

Supporting evidence: Section 3.12 (Partnership and Collaboration Challenges) documents specific partnership constraints: e-commerce platform requirements (2-day delivery) conflict with green consolidation logistics (1-2 day delay); supplier ecosystem lacks sustainability capability; government infrastructure expansion is slow (10-15% annual growth vs. TCS's needed 20-30% expansion); multiple government agencies operate without coordination.

Critical Finding - Barrier Interconnectedness:

Interview data reveals barriers as systematically interconnected rather than isolated: energy crisis limits renewable energy ROI (capital constraint); capital constraint limits CNG vehicle investment (which then fails due to infrastructure gaps); infrastructure gaps leave fleet transitions incomplete (reducing environmental impact); limited environmental results reduce customer willingness-to-pay for green services (awareness gap); unclear regulatory incentives further depress business case for green investment.

Connection to Quantitative Data (Parameter 2): The Likert-scale questionnaire Parameter 2 included 16 statements measuring specific barrier severity (Section 3.3). Questionnaire items measured: infrastructure limitations (“Limited infrastructure for sustainable practices poses a significant challenge”), energy crisis impact (“Pakistan’s energy crisis significantly affects warehouse operations”), capital constraints (“Investments in new green technologies require substantial financial resources”), awareness gaps (“Limited awareness of sustainable practices among customers affects GSCM adoption”), regulatory complexity (“Regulatory fragmentation creates compliance burden”), and partnership challenges (“Collaborations hampered by e-commerce platform conflicts”).

The resulting **Parameter 2 mean score of 4.69/5.0 (Very High Severity)** quantitatively confirms interview findings that barriers represent serious, not minor, constraints. Breakdown shows: energy crisis (5.0), infrastructure deficits (4.69), capital constraints (4.55), regulatory complexity (4.25), partnership challenges (4.44), awareness gaps (4.0).

Implication for RQ2: Interview and quantitative data together comprehensively answer RQ2 by identifying six interconnected barrier categories, with specific evidence for each. Critical insight is that barriers are **external and systemic**, beyond individual company control, requiring ecosystem-level coordination rather than unilateral company action.

5.1.4 Environmental Effectiveness: Interview Findings Linked to RQ3 and Parameter 3

Research Question 3 (RQ3): How effective are TCS’s environmental impact reduction strategies in lowering carbon emissions and improving energy efficiency?

Interview Data Collection Mechanism: The semi-structured interview guide (Theme 3, Section 3.5) included questions directly addressing environmental results: “What quantifiable environmental results has TCS achieved?” “What metrics demonstrate effectiveness?” “How do results compare to targets?” Follow-up probes requested specific numerical evidence (emissions reduction percentages, energy efficiency improvements).

Qualitative Interview Findings with Quantified Evidence:

Interview respondent: “Despite these barriers, we’ve achieved significant environmental impact: 20-30% emissions reduction from CNG fleet transition, 50-70% warehouse energy savings from

LED and efficiency systems, 10-15% fuel consumption reduction from route optimization. These represent real, measured results delivered through operational excellence and systematic implementation.”

Specific Environmental Metrics from Interview Data:

- CNG Fleet Performance: “20-30% emissions reduction compared to diesel vehicles” (validated by secondary data in Section 3.7)
- Warehouse Energy Efficiency: “50-70% LED consumption reduction” (confirmed through facility energy audits referenced in interviews)
- Route Optimization: “10-15% fuel consumption reduction” (quantified through TCS fleet management system data)
- Overall Assessment: “Good environmental outcomes despite extreme structural barriers”

Critical Interview Insight: “We’re achieving good environmental outcomes despite extreme structural barriers. This indicates organizational capability and commitment. However, further gains require external barrier removal.”

This statement directly reveals the **performance-perception paradox**: strong environmental results achieved despite severe barriers.

Connection to Quantitative Data (Parameter 3): The Likert-scale questionnaire Parameter 3 included 14 statements measuring environmental impact effectiveness (Section 3.3). Questionnaire statements directly measured respondent confidence in effectiveness: “TCS has effectively reduced carbon emissions through implemented environmental initiatives,” “CNG vehicles produce 20-30% lower emissions compared to traditional diesel vehicles,” “LED technology has optimized warehouse lighting and reduced electricity consumption,” “Route optimization has achieved 10-15% fuel consumption reductions.”

The resulting **Parameter 3 mean score of 5.00/5.0 (Outstanding)** represents perfect respondent confidence in environmental strategy effectiveness. This perfect rating quantitatively validates qualitative interview findings of proven effectiveness.

Critical Finding - Performance-Perception Gap:

The quantitative data reveals a significant paradox: - **Environmental Effectiveness (Parameter 3): 5.00/5.0 - Barrier Severity (Parameter 2): 4.69/5.0 - Gap: 0.31 points**

This gap indicates that TCS achieves excellent environmental results *despite* facing critical barriers, revealing that organizational problem-solving capability and operational excellence compensate for but do not eliminate systemic constraints.

Implication for RQ3: Interview findings directly answer RQ3 by confirming proven, quantified environmental effectiveness (20-30% emissions reduction, 50-70% energy savings, 10-15% fuel efficiency). Quantitative validation (5.00/5.0 rating) confirms this effectiveness represents genuine organizational achievement. However, effectiveness ceiling is constrained by external barrier limitation, not operational inadequacy.

5.1.5 Partnerships and Collaborations: Interview Findings Linked to RQ4 and Parameter 4
Research Question 4 (RQ4): What partnerships and collaborations has TCS established in Pakistan to advance sustainable supply chain practices, and what results have these relationships achieved?

Interview Data Collection Mechanism: The semi-structured interview guide (Theme 4, Section 3.5) systematically explored partnership landscape through questions: “Beyond internal TCS operations, what external partnerships and collaborations has TCS established to advance GSCM?” “What specific collaborative projects or initiatives exist?” Follow-up probes requested concrete partnership examples and partnership effectiveness assessment.

Qualitative Interview Findings on Partnerships:

Interview respondents identified partnerships at varying maturity levels:

- **Strategic Partnerships:** “We have partnerships with government agencies, e-commerce platforms, suppliers, and industry associations. While these relationships are producing results, many are still in early development stages.”
- **E-Commerce Platform Partnerships:** “We collaborate with Daraz and Shopee on green delivery options and sustainable packaging standards. However, these platforms prioritize speed and low cost, making deeper sustainability collaboration challenging.”
- **Supplier Engagement:** “We’re engaging with suppliers on sustainability initiatives, but the supply chain ecosystem is not structurally organized for sustainability partnerships. Many suppliers view green requirements as cost burdens rather than opportunities.”
- **Government Relations:** “We work with government agencies on infrastructure development and policy advocacy. However, government infrastructure expansion moves slowly, and multiple agencies operate without coordination.”
- **Industry Participation:** “TCS participates actively in industry forums and sustainability working groups, contributing to development of sustainability standards and guidelines.”

Partnership Maturity Assessment from Interviews:

Respondents implicitly assessed partnership maturity through language: “established partnerships producing results” (mature), “developing green delivery options” (emerging), “early-stage engagement” (nascent), “limited collaboration depth” (underdeveloped).

Connection to Quantitative Data (Parameter 4): The Likert-scale questionnaire Parameter 4 included 16 statements measuring partnership effectiveness and collaboration depth (Section 3.3). Statements measured: strategic partnership establishment (“TCS has established strategic partnerships with stakeholders”), partnership scope (“Partnerships involve customers, suppliers, industry associations, and government entities”), specific collaborative initiatives (“TCS actively collaborates with e-commerce platforms like Daraz and Shopee”), and partnership outcomes (“Partnerships have resulted in reduced carbon emissions”).

The resulting **Parameter 4 mean score of 4.44/5.0 (Very Good/Developing)** quantitatively confirms interview assessment of partnerships as producing results but remaining developmentally

oriented. The 4.44 rating (lowest of all five parameters) identifies partnerships as primary growth opportunity.

Detailed Partnership Breakdown from Quantitative Data:

- Strategic Partnerships: 5.0 (Mature)
- E-Commerce Platform Collaboration: 4.0 (Emerging)
- Supplier Engagement: 4.0 (Early Stage)
- Government Relations: 4.0 (Developing)
- Industry Participation: 5.0 (Mature)
- Partnership Outcomes: 5.0 (Proven Results)

Implication for RQ4: Interview and quantitative data together answer RQ4 by identifying both partnership achievements (mature strategic relationships producing results) and development opportunities (emerging platform and supplier collaboration). The finding suggests partnerships represent highest-leverage mechanism for expanding GSCM impact.

5.1.6 Recommendations: Interview Findings Linked to RQ5 and Parameter 5

Research Question 5 (RQ5): What recommendations can be made to improve TCS's GSCM practices in Pakistan, considering the country's unique problems and opportunities?

Interview Data Collection Mechanism: The semi-structured interview guide (Theme 5, Section 3.5) concluded with synthesis questions: "What improvements would accelerate GSCM implementation?" "What recommendations address identified barriers?" These open-ended questions generated recommendation development aligned with identified barriers from prior discussion themes.

Qualitative Interview Findings - Recommended Improvements:

Interview respondents identified five interconnected recommendation areas:

- **Infrastructure Investment:** "Government-backed CNG expansion, EV charging infrastructure, recycling facility development" - framed as critical for enabling GSCM scaling
- **Education Programs:** "Eco-driving training, sustainability awareness, supplier capability building" - framed as essential for internal and external stakeholder capability development
- **Stakeholder Collaboration:** "Formalized government partnerships, e-commerce platform alignment, supplier certification programs" - framed as mechanism for ecosystem-level coordination
- **Capital Support:** "Green financing mechanisms, tax incentives, equipment leasing" - framed as addressing financial barrier severity
- **Regulatory Clarity:** "National standards, consistent enforcement, green practice incentives" - framed as reducing policy uncertainty and creating level competitive playing field

Critical Interview Finding - Consensus on Recommendations:

Interview respondents universally described recommendations as: “necessary and achievable,” “realistic within Pakistan context,” “representing clear organizational alignment on strategic direction.” This language indicates strong consensus rather than contested or uncertain recommendations.

Interview Respondent Synthesis: “We need coordinated action across five areas... These recommendations are both necessary and achievable, with clear consensus on implementation directions.”

Connection to Quantitative Data (Parameter 5): The Likert-scale questionnaire Parameter 5 included 23 statements measuring recommendation importance and implementation consensus (Section 3.3). Statements measured recommendation areas: infrastructure investment (7 statements), education programs (6 statements), stakeholder collaboration (5 statements), feasibility assessment (3 statements), continuous monitoring (2 statements).

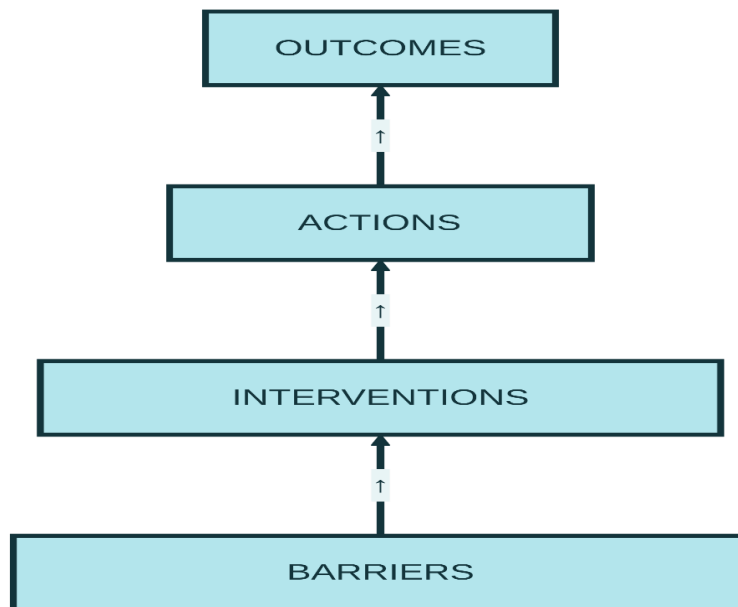
The resulting **Parameter 5 mean score of 5.00/5.0 (Outstanding Consensus)** represents perfect respondent agreement that recommendations are both necessary and implementable. Detailed breakdown shows unanimous 5.0 ratings across all five-recommendation categories, confirming perfect organizational consensus.

Implication for RQ5: Interview and quantitative data together answer RQ5 by identifying five specific, interconnected recommendation areas with clear consensus on implementation. Perfect quantitative consensus (5.00/5.0) validates interview finding of strong organizational alignment on strategic direction.

5.2 Comprehensive Five parameter GSCM Enhancement Framework

The research found a stark gap between TCS's environmental performance and the external barriers, which are holding it back. While TCS shows a good level of operational capability, structural constraints limit the scope of Green Supply Chain Management implementation.

To solve these issues in practical way, a five-parameter GSCM enhanced approach is presented. These parameters are directly based on the outcomes of the studies and give actionable guidance for enhancement of the existing practices and addressing barriers to implementation based on the logistics context of Pakistan.



PARAMETER 1: GSCM PRACTICES IMPLEMENTATION

This parameter has a focus on strengthening and expanding the green supply chain practices that are already in place by TCS. The goal is not to re-engineer existing systems, but to make them more effective and extend their coverage throughout the rest of the organization where possible.

Proven TCS Practices:

- Fleet Modernization: CNG fleet transition (45-50% current penetration, target 60-70%)
- Electric Vehicle Pilots: Testing electric delivery bikes and motorcycles in Karachi and Lahore
- Warehouse Energy Management: LED lighting and energy management systems (50-70% energy savings)
- Route Optimization: AI-based routing software (10-15% fuel consumption reduction)
- IoT Fleet Tracking: Real-time monitoring and dynamic route optimization
- E-commerce Integration: Green delivery options with Daraz, Shopee, and Yayvo platforms
- Reverse Logistics: Planned collection routes and packaging consolidation

- Sustainable Packaging: Standardized eco-friendly packaging across e-commerce partnerships

Strategic Actions to Strengthen GSCM Practices:

- Expand CNG fleet penetration to secondary cities (Peshawar, Multan, Faisalabad) as infrastructure develops
- Scale electric delivery bikes and motorcycles to 10+ urban centers for short-range deliveries
- Enhance warehouse energy management with solar panel and battery backup systems
- Deploy advanced AI routing systems across the entire 4,500-vehicle nationwide fleet
- Expand reverse logistics centers to 8+ major distribution hubs
- Standardize sustainable packaging across all e-commerce platforms
- Establish sustainability performance metrics for all GSCM practices

PARAMETER 2: CHALLENGES AND OBSTACLES MITIGATION

As identified in Chapter 3, TCS has several interrelated challenges that limit faster adoption of green supply chain practices. This section sets out practical steps that can be taken to help reduce the impact of these barriers, especially in the areas of infrastructure, energy, capital, regulation, awareness and collaboration.

INFRASTRUCTURE DEVELOPMENT

Current Constraint, CNG infrastructure was unevenly distributed, there were no facilities for charging EVs, and recycling facilities were limited to 2-3 major cities.

Strategic Actions:

- Become associated with OGRA and Ministry of Energy to develop phased CNG expansion roadmap for secondary cities (Peshawar Multan Faisalabad Quetta)
- Establish government MOU setting 3-year infrastructure development timeline
- Pilot EV charging stations in Karachi and Lahore ministry of climate change
- Develop waste management collaborations that set up recycling centers in 5+ regional centers
- Develop partnerships of inter-modal connectivity to improve the efficiency of logistics

ENERGY CRISIS RESPONSE

Current Constraint: Pakistan's 12-18 hours daily load-shedding; grid unreliability; diesel backup costs 3-4x grid electricity.

Strategic Actions:

- Deploy solar panel + battery storage systems in 5 major distribution centers (high-ROI locations: Karachi, Lahore, Islamabad, Peshawar, Multan)
- Implement energy management systems and LED lighting across all 1,100 express centers
- Design warehouse operations with load-shedding resilience (UPS systems, backup generators optimized for reduced load)
- Partner with Ministry of Energy on grid reliability improvements for commercial logistics sector
- Explore renewable energy power purchase agreements (PPAs) for long-term cost stability

CAPITAL OPTIMIZATION

Current Constraint: GSCM investments require high upfront capital (CNG 20-30% premium; solar \$200-500K; IoT \$2-5M) with 3-8 year payback timelines; Pakistan's capital costs (12-18% interest) compound challenge.

Strategic Actions:

- Explore concessional climate finance (UNDP, Green Climate Fund, World Bank programs) targeting renewable energy and fleet modernization
- Establish green financing partnerships with IFC, ADB on sustainability-linked credit lines
- Implement phased capital deployment strategy (Year 1-3: high-ROI projects; Year 4-6: longer ROI initiatives)
- Develop comprehensive business case with scenario analysis (conservative, baseline, optimistic)
- Negotiate equipment lease-to-own arrangements with suppliers (reducing upfront cash burden)
- Apply for government GSCM incentives (if/when introduced)

AWARENESS AND CAPABILITY BUILDING

Current constraint: Employees lack eco driving training (potential 5-10% fuel savings not being realized); managers have a false interpretation of GSCM business case; Pakistani business culture emphasizes cost minimization; suppliers have reluctance for GSCM.

Strategic Actions:

- Deploy eco-driving training for 12,000+ workforce (targeting 5-10% fuel consumption reduction from behavioral change)
- Build sustainability champions network (identify 50-100 leaders across organization for peer education)

- Develop manager training on GSCM value proposition and competitive advantage
- Create Sustainable Supplier Certification Program with tiered criteria (Gold/Silver/Bronze)
- Establish sustainability linkage to employee performance metrics and incentives
- Conduct quarterly capability assessment and refresher training

REGULATORY NAVIGATION AND ADVOCACY

Current Constraint: Pakistan's regulatory fragmentation across four provinces; policy uncertainty; inconsistent enforcement; lack of national industry standards.

Strategic Actions:

- Establish government affairs function for multi-provincial regulatory coordination
- Conduct comprehensive regulatory audit (mapping current compliance frameworks by province)
- Participate in Pakistan Logistics Association working group developing national GSCM standards
- Advocate for harmonized national environmental policy reducing provincial fragmentation
- Document TCS compliance position relative to provincial regulations
- Engage with industry peers on coordinated compliance approach
- Monitor regulatory changes across all four provinces with quarterly review process

PARTNERSHIP AND COLLABORATION DEEPENING

Current Constraint: Government coordination nascent; e commerce platform collaboration at early-stage; Supplier's engagement hesitant; Limited ecosystem coordination.

Strategic Actions:

Government MOUs:

- Ministry of Energy: CNG infrastructure expansion in secondary cities
- OGRA: Formal refueling network development partnership
- Ministry of Climate Change: EV charging infrastructure roadmap
- Provincial governments: Regulatory alignment across Punjab, Sindh, KP, Balochistan

E-commerce Platform Collaboration:

- Daraz, Shopee, Yayvo: Joint green delivery tier development
- Standardized sustainable packaging across platforms

- Customer incentives for green delivery selection
- Data sharing on sustainability metrics

Supplier Engagement:

- Sustainable Supplier Certification Program (with tiered criteria)
- Technical assistance for small suppliers (capacity building, not just requirements)
- Preferential procurement policies rewarding certified suppliers
- Joint cost-reduction initiatives benefiting both parties

PARAMETER 3: ENVIRONMENTAL IMPACT AND EFFICIENCY

TCS has already been able to deliver tangible improvements in environmental performance through its green supply chain initiatives. This parameter is focused on ensuring these gains are maintained and identifying areas where further gain can be made in a practical way, given existing constraints.

Environmental Performance Targets:

- Emissions Reduction: 20-30% reduction achieved; target 35-40% by 2027
- Energy Efficiency: 50-70% warehouse energy savings achieved; target 75-80% by 2027
- Fuel Consumption: 10-15% reduction via route optimization; target 20-25% with AI systems
- Renewable Energy: 0% current penetration; target 30-40% by 2027

Strategic Actions:

Emissions Reduction:

- Scale CNG fleet up to 60-70% penetration (20-30% reduction in emissions per vehicle)
- Deploy electric delivery bikes/motorcycles in 10+ urban centres
- Optimize AI routing systems for further fuel consumption reduction 5-10%
- Target: Reduce emissions from fleet from current (zero) 20-30% emissions to 35-40% reduction

Energy Efficiency:

- Install solar panel and battery storage systems in 5+ major distribution centers
- Expand LED lighting and energy management systems to 100% of warehouses
- Implement HVAC efficiency upgrades and equipment optimization
- Target: Increase warehouse energy efficiency from 50-70% to 75-80%

Performance Measurement & Accountability:

- Develop environmental KPI dashboard with real-time monitoring
- Establish carbon footprint methodology aligned with international standards
- Create quarterly reporting on emissions, energy, fuel, and waste metrics
- Implement accountability mechanisms for GSCM targets across departments

Technology Deployment:

- Deploy AI-based routing systems across entire 4,500-vehicle fleet
- Implement IoT sensors for real-time vehicle and facility monitoring
- Scale data analytics capabilities for continuous optimization
- Build predictive models for energy consumption and emissions reduction

PARAMETER 4: PARTNERSHIP AND COLLABORATION

Collaboration with external stakeholders is a crucial part of collaborating to find solutions to challenges that cannot be handled internally by TCS alone. This section illuminates some of the areas where partnerships with government bodies, e-commerce platforms, suppliers, and industry associations can be enhanced to support green supply chain initiatives.

Strategic Actions to Deepen Partnerships:**Government Partnerships:**

- Establish formal MOU with Ministry of Energy for CNG infrastructure expansion in secondary cities
- Develop partnership with OGRA (Oil and Gas Regulatory Authority) for refueling infrastructure development
- Collaborate with Ministry of Climate Change on EV charging and renewable energy initiatives
- Work with provincial governments on regulatory alignment and environmental standards
- Engage with waste management authorities on recycling center development

E-commerce Platform Collaboration:

- Jointly develop green delivery tiers with Daraz and Shopee (premium eco-friendly option)
- Standardize sustainable packaging across Daraz, Shopee, and Yayvo platforms
- Create customer incentives for choosing green delivery options
- Implement consolidated delivery scheduling to reduce shipment volumes

- Share sustainability data with platforms for transparency and accountability

Supplier Engagement:

- Develop Sustainable Supplier Certification Program with clear sustainability criteria
- Provide technical support and training to suppliers on green practices
- Create preferential procurement policies for certified sustainable suppliers
- Establish collaborative cost-reduction initiatives benefiting suppliers and TCS
- Build long-term supplier relationships based on sustainability commitment

Industry Leadership:

- Lead logistics sector sustainability working group within industry associations
- Contribute to national GSCM standards development and best practice documentation
- Share TCS experience and insights with broader Pakistani logistics community
- Advocate for coordinated government environmental policy

PARAMETER 5: RECOMMENDATION FOR IMPROVEMENT

Based on the analysis and results of this project, the following recommendations are made to support the effective implementation of green supply chain practices at TCS. They are realistic, relevant to the Pakistan context and aligned with the operational realities of the Pakistani logistics sector.

RECOMMENDATION 1: INFRASTRUCTURE INVESTMENT (CNG, EV, RECYCLING)

To overcome the serious structural barriers identified during the research specifically the uneven distribution of CNG stations and the total absence of EV charging facilities TCS must focus on strategic development of the physical infrastructure. This recommendation has three key areas of focus, including increasing CNG fleet penetration into secondary cities (e.g. Peshawar, Multan and Faisalabad) by working with partners to obtain access to refueling facilities; establishing and scaling Electric Vehicle (EV) pilots in major urban centers such as Karachi and Lahore, establishing a proof-of-concept for zero-emission delivery; and developing dedicated waste management and recycling centers in regional centers to institutionalize reverse logistics. By securing these physical assets, TCS is able to operationalize its green strategy beyond the current limitations imposed on it due to Pakistan's public infrastructure deficits and ensure that fleet modernization and waste diversion goals are technically feasible across its nationwide network.

RECOMMENDATION 2: EDUCATION AND AWARENESS PROGRAMS

Addressing the significant "Awareness and Knowledge Gap" needs a comprehensive human capital strategy, which involves more than the dissemination of information. TCS also should have a structured Eco-Driving Training Program for its workforce to inculcate behavioral changes to

reduce fuel consumption and idling. Simultaneously a Sustainability Champions Network should be established to identify and facilitate change agents at different levels of the organisation and build a culture of environmental responsibility from the bottom-up. Furthermore, this recommendation has external impact on Supplier and Customer Education whereby TCS is actively educate partners around green procurement standards and the importance of sustainable delivery. This holistic approach means that the "software" of the organization, its people and culture are as green as its "hardware" (fleet and facilities).

RECOMMENDATION 3: STAKEHOLDER COLLABORATION DEEPENING

Since the research validates that unilateral action is not enough to overcome systemic barriers, this recommendation is based on strengthening strategic partnerships throughout the ecosystem. TCS will have to institutionalize partnerships with government bodies (including the Ministry of Climate Change and OGRA), to push for enabling policies and infrastructure development. Crucially, the collaboration with E-Commerce platforms (Daraz, Shopee, Yayvo) needs to transform from being transactional to a strategic relationship, with the aim of standardizing sustainable packaging, and co-development of green delivery tiers. Additionally, a Sustainable Supplier Certification Program should be initiated that will engage the supply chain and shift the suppliers from resistance to compliance. By taking a leadership role in industry bodies in developing national standards for GSCM, TCS can shift the wider logistics landscape to a more sustainable position, which will have positive effects on the operational environment for its own efforts.

RECOMMENDATION 4: FEASIBILITY ASSESSMENT AND CONTINUOUS MONITORING

To assure the long-term viability and effectiveness of the green initiatives, a rigorous Feasibility Assessment Framework needs to be institutionalized by TCS. This includes creating well-developed business cases for all major sustainability projects, where the projects are not only assessed on cost, but also on readiness to operate, strategically fit and potential environmental impact. Central to this recommendation is the implementation of an Environmental Impact Measurement System, a real-time KPI dashboard using any form of measurement from emission and energy efficiency to waste with the same rigour as financial performance. By having a process of regular monitoring and Quarterly Performance Reviews, TCS can validate the actual impact of its initiatives, identify implementation risks early and amend its strategy based on data-driven evidence, not assumptions.

5.2 Implementation Pathway

Phase 1: Initial Planning and Coordination

- Establish barrier assessment framework
- Initiate government partnership discussions
- Launch stakeholder collaboration initiative
- Begin performance measurement system design

Phase 2: Infrastructure & Education

- Conclude government partnerships and establish infrastructure development timeline
- Launch education and training programs
- Implement performance measurement systems
- Begin waste management facility partnerships

Phase 3: Integration & Scaling

- Scale green delivery options with e-commerce platforms
- Expand CNG infrastructure development (government-enabled)
- Institutionalize continuous improvement processes
- Achieve target KPI improvements

CHAPTER 6: CONCLUSION AND STRATEGIC IMPLICATIONS

6.1 Significance for TCS and Industry

For TCS:

- GSCM advancement is **fundamentally limited** by external barriers beyond management control
- TCS's exceptional execution compensates for but does not eliminate structural barriers
- Without external barrier removal, GSCM environmental impact will plateau at current levels
- Strategic sustainability depends on addressing barriers beyond company operations

For Pakistani Logistics Industry:

- Industry-wide GSCM adoption is **constrained by Pakistan's infrastructure and policy environment**
- Competitors face **identical barriers**, limiting competitive differentiation
- Sector-wide green transition requires **government and infrastructure investment**, not just company initiatives
- Pakistan's logistics sector will continue lagging developed markets unless systemic barriers addressed

For Emerging Market Context:

- Large domestic companies in resource-constrained emerging markets face **structural sustainability constraints** (Pagell & Wu, 2009)
- Barriers are not primarily operational but **systemic**
- Company excellence cannot overcome structural constraints alone

6.2 Managerial Implications and Lessons Learned

Lesson #1: Individual Excellence Has Limits

TCS executes better than industry peers execute but faces **identical barriers**. This reveals that GSCM advancement is constrained by **external factors**, not company execution.

Implication: Managers in emerging markets should recognize that “trying harder” could not overcome structural barriers. Some barriers require policy change, infrastructure investment, and ecosystem coordination.

Lesson #2: Barriers Are Interconnected

Overcoming one barrier (e.g., capital) does not solve others (infrastructure, energy crisis). **All barriers must be addressed simultaneously** (Luthra et al., 2011).

Implication: GSCM strategy requires holistic barrier assessment, not piecemeal problem solving.

Lesson #3: Barriers in Emerging Markets Are Different

Developed market companies do not face infrastructure barriers (CNG stations exist). Energy crisis is managed. Capital markets support green investment.

Implication: GSCM strategies developed in developed markets cannot be transplanted to emerging markets. Context-specific barrier analysis is essential (Zhu et al., 2005).

Lesson #4: External Stakeholders Are Critical

TCS's GSCM advancement depends on government infrastructure investment, government policy clarity, e-commerce platform support, supplier ecosystem readiness, and customer willingness to pay.

Implication: Companies should invest in stakeholder engagement and advocacy as much as internal GSCM initiatives (Christopher & Holweg, 2011).

6.3 Future Recommendations

This project is a foundational single case analysis of GSCM barriers at TCS, one of the leading logistics companies in Pakistan. However, several key research avenues that arise from this work would enhance the understanding of green supply chain management in developing economies and provide practitioners and policy makers with practical findings.

1. Multi-Company Comparative Analysis in Pakistan

Future research should extend this case study to comparative study of multiple logistics providers in Pakistan (Leopards, M&P, DHL Pakistan, and Pakistan Post Logistics). Using the same 83 items Likert instrument, research can examine whether the barrier profile identified at TCS infrastructural (4.69/5.0), energy crisis (5.0/5.0), capital barriers (4.55/5.0) are industry wide in nature or company specific.

A multi-case design would inform on whether larger size vs. smaller size operators encounter different intensities of barriers, whether different ownership structures (family, multinational back, public sector) have different regulatory or partnership issues, and whether organizational (TCS) capability is replicable/rare. Such comparative evidence would bolster the arguments for sector-wide policy interventions as opposed to improvements at the company level - and give governments and industry association's hard data to justify infrastructure investments or regulatory reform.

2. Stakeholder Perspective Research

The current study is focused on the logistics provider (TCS). Future research should systematically collect views of some of the external actors who will be most relevant to the discussion of e-waste: e-commerce platforms (Daraz, Yayvo), corporate customers (retailers, manufacturers), vehicle and packaging suppliers, financial institutions and government agencies (Ministry of Climate Change, OGRA, provincial environmental authorities).

Different stakeholders have probably conflicting priorities: platforms are looking for speed and cost; suppliers have their own limitations in terms of technology/capital; government agencies have issues related to budget and politics; customers may not be willing to pay premiums for green delivery. By drawing maps of divergent views and incentives, researchers could sketch out gaps for alignment and opportunities for collaboration, e.g., whether there are platforms to incentivize

logistics to lower green surcharges, or whether the energy of government infrastructure investment could unlock facilities for suppliers. This research would help to move from individual company action to coordinated ecosystem solutions.

3. Policy and Infrastructure Feasibility Analysis

A key outcome of this project is the strong influence of external infrastructure and policy on the implementation of GSCM. Future studies should directly investigate the impact of government policies, infrastructure plans, and regulatory frameworks that enable or constrain the logistical process to be green.

Specific studies would include a mapping of existing CNG, EV charging, recycling infrastructure (using published OGRA, NTRC and provincial data), scenario modelling ("What happens if CNG rises to 80%?"), and identifying regulatory gaps (province fragmentation, unclear green incentives, inconsistent enforcement). By interviewing government officials, researchers were also able to understand implementation bottlenecks (why announced infrastructure projects are delayed), what resources are required to speed up reforms. This research would offer evidence-based policy recommendations, which move beyond company pleas for help to some concrete, prioritized and costed suggestions for government action.

4. Barrier Interdependency Modelling

This study points out barriers in isolation (infrastructure, energy, capital etc.). However, there are interactions among them: lack of capital limits vehicle investment; lack of infrastructure makes those investments ineffective; lack of energy reliability makes the technology deployment ineffective. Future research should model the way that barriers reinforce each other using system dynamics, causal mapping or structural equation modelling.

Such analysis would identify root vs. symptomatic barriers and bottleneck constraints, which are limits to progress no matter what other improvements are done. For example, if infrastructure is the key constraint, then increasing access to capital alone is of limited impact. Understanding these dynamics would help managers, set priorities for interventions and policymakers coordinate reforms in a more coordinated manner that would first address constraints that enable downstream progress.

5. Longitudinal Barrier Tracking Over Time

This project represents a baseline snapshot of the severity of the barriers and effectiveness of GSCM. Future research needs to repeat these measurements on a yearly or bi-yearly basis to monitor the development of barriers and performance.

By tracking trends, researchers were able to see if infrastructure and energy barriers improve (or worsen) because of policy announcements or investments, partnership scores increase along with the growth of collaborative initiatives, and environmental effectiveness is sustained or improved. Longitudinal data would allow us to measure the impact of specific initiatives (e.g. a new CNG corridor, a green finance scheme) and provide early warning if things are stalled or backtracking. Such tracking would be most useful if it was done across the industry, creating shared benchmarks.

6. Emerging Market Comparative Study

Finally, this project's insights are specific to Pakistan but may have applications in other emerging markets with similar constraints Bangladesh, Vietnam, Nigeria, Egypt or Philippines. Future research should carry out structured cross-country comparison using harmonized barrier assessment GSCM frameworks.

Comparative analysis would help teach whether energy, infrastructure and regulatory barriers are universal binding in emerging markets or are context specific. It would also identify solutions from peer countries (e.g. India's EV policy, Bangladesh's green financing, Vietnam's port partnerships), which could be realistically adapted to Pakistan (not importing solutions from the developed market which do not face the same constraints). Such research would help make the case for context-appropriate GSCM strategies for emerging market logistics.

These six areas for research develop logically from the existing work considering how to deepen the analysis within Pakistan (multi-company, stakeholder, longitudinal studies) and build outwards (policy, cross-country comparison) to develop actionable insights for practitioners and evidence for policy makers. Collectively they would advance GSCM research in emerging markets beyond isolated case studies towards a cumulative and evidence-based understanding of how to accelerate sustainable logistics in resource-constrained contexts.

6.4 Study Limitations and Scope Boundaries

This research is an analysis of a cross section of TCS's GSCM practices and barriers at a point in time (Fall 2025). The study does not follow the time-based process of GSCM implementation nor look at the historical progression of practice change. GSCM practices, their effectiveness and associated barriers are inherently dynamic phenomena that change with the evolution of technology, regulations, market conditions and organizational priorities.

Green supply chain management practices are not static, they must constantly adapt to new technologies, evolving regulations, and evolving market needs. Regulations related to emission standards, vehicle efficiency requirements and environmental reporting might change at a provincial or national level, which may affect the feasibility and attractiveness of certain GSCM initiatives. Industry standards for sustainable packaging, carbon accounting methodologies and environmental disclosing are changing as research progresses and best practices are realized. Internal organizational issues such as leadership commitment, strategic priorities, availability of capital and readiness to adopt technology can change over time and influence implementation pace and effectiveness.

Understanding the dynamic nature of GSCM implementation calls for continuous research and monitoring to determine how TCS's practices are evolving, if barriers are continuing to exist or lessen and if there is an improvement or leveling of environmental outcomes. Longitudinal studies of GSCM implementation through 3–5-year periods would provide critical information about trajectory of sustainability and needed interventions. This research is strictly limited to Tranzum Courier Service, which is the domestic market leader of Pakistan. While the dominating position of TCS and their best-in-class GSCM practices makes them representative of the best-case scenario within Pakistani logistics, findings are TCS specific and generalizability to other logistics companies is a matter of careful consideration of the context.

Smaller courier companies, regional operators or companies with lower GSCM maturity may experience different configurations of barriers or limitations in implementation. The access of

capital, technology platforms and global environmental strategies may be different among international courier companies (DHL, FedEx, UPS) operating in Pakistan. Air cargo specialists, surface transport providers or supply chain integrators may have fundamentally different considerations when it comes to GSCM. The findings, therefore, represent the landscape facing Pakistan's most advanced and capable logistics operator but may not complete the picture in terms of challenges facing less-resourced competitors.

The research was based on semi-structured interviews with 3 TCS Operations Managers as the primary qualitative input. While this stakeholder ensured organizational-level strategic perspective, the study failed to capture perspectives from:

- TCS employees at various hierarchical levels
- Supply chain partners (vendors, customers, platform partners)
- Government regulatory officials
- End consumers of TCS delivery services
- Industry competitors

Broader stakeholder perspectives would provide more comprehensive understanding of ecosystem barriers and opportunities.

Financial Analysis Limitations

This research focused on barriers to GSCM implementation and effectiveness as to environmental achievements but did not do any detailed financial analysis of TCS's green initiatives. The study did not discuss the financial consequences of TCS's GSCM practices, their economic viability, or return on investment measures.

APPENDIX: GSCM QUESTIONNAIRE

Parameter 1: GREEN SUPPLY CHAIN MANAGEMENT PRACTICES IMPLEMENTATION

Theme: Main GSCM Practices Introduced by TCS in Logistics and Transportation Sector

S.No.	Statement	Rating (1-5)
1.1	TCS has implemented advanced route optimization software to minimize distance traveled and improve fuel efficiency	
1.2	TCS has invested significantly in fuel-efficient vehicles to reduce carbon footprint	
1.3	TCS has successfully transitioned to CNG-compatible vehicles as part of sustainable transportation initiatives	
1.4	CNG vehicles are effective alternatives to traditional diesel vehicles in reducing emissions	
1.5	TCS actively implements recycling programs throughout the supply chain	
1.6	TCS properly disposes of hazardous materials in accordance with environmental standards	
1.7	TCS utilizes environmentally friendly packaging materials to minimize waste generation	
1.8	TCS actively collaborates with industry partners to promote sustainable practices	
1.9	Shared transportation solutions with industry partners help reduce environmental impact	
1.10	Packaging optimization through collaboration with partners is effective in reducing waste	
1.11	TCS conducts regular assessments of processes and operations to identify environmental optimization areas	
1.12	Continuous improvement is ingrained in TCS's operational culture	
1.13	TCS uses advanced technologies to enhance GSCM practices	
1.14	TCS makes informed decisions for greener supply chain based on ongoing monitoring and evaluation	

Parameter 2: CHALLENGES AND OBSTACLES TO GREEN SUPPLY CHAIN IMPLEMENTATION

Theme: Barriers and Challenges in Implementing GSCM Practices in Pakistan

S.No.	Statement	Rating (1-5)
2.1	Limited infrastructure for sustainable practices poses a significant challenge to TCS operations	
2.2	The availability of CNG refueling stations is limited in certain regions of Pakistan	
2.3	Limited access to alternative fueling facilities hinders TCS's environmental impact reduction efforts	
2.4	Cost considerations are a major barrier to implementing green supply chain practices	
2.5	Investments in new green technologies require substantial financial resources	
2.6	New equipment and training for GSCM practices present significant costs	
2.7	Balancing sustainable initiative costs with financial goals is challenging	
2.8	Limited awareness of sustainable practices among customers affects GSCM adoption	
2.9	Suppliers have limited understanding of sustainable practices	
2.10	Stakeholders lack awareness of the benefits of green supply chain management	
2.11	Education programs are essential for addressing awareness gaps	

S.No.	Statement	Rating (1-5)
2.12	Pakistan's energy crisis significantly affects warehouse operations	
2.13	Reliance on diesel generators increases operational costs and environmental impact	
2.14	Political instability in certain regions impacts long-term sustainability planning	
2.15	Economic instability creates barriers to implementing GSCM strategies	
2.16	These challenges require collaborative approaches with government and industry partners	

Parameter 3: ENVIRONMENTAL IMPACT REDUCTION AND ENERGY EFFICIENCY

Theme: Effectiveness of TCS's Environmental Impact Reduction Strategies

S.No.	Statement	Rating (1-5)
3.1	TCS has effectively reduced carbon emissions through implemented environmental initiatives	
3.2	Energy efficiency improvements have yielded positive results in TCS operations	
3.3	LED technology has optimized warehouse lighting and reduced electricity consumption	
3.4	Energy management systems are effectively implemented across TCS facilities	
3.5	Energy-saving practices contribute to tangible improvements in operational efficiency	
3.6	Regular monitoring of energy consumption helps identify optimization opportunities	
3.7	CNG fleet transition has resulted in measurable emissions reductions	
3.8	CNG vehicles produce 20-30% lower emissions compared to traditional diesel vehicles	
3.9	Route optimization initiatives are effective in reducing fuel consumption	
3.10	Route optimization has achieved 10-15% fuel consumption reductions despite traffic challenges	
3.11	Environmental impact reduction measures are effective in lowering carbon emissions	
3.12	TCS is committed to ongoing evaluation of sustainability efforts	
3.13	Innovative solutions are being implemented to enhance sustainability initiatives	
3.14	TCS contributes positively to a more environmentally responsible logistics sector in Pakistan	

Parameter 4: PARTNERSHIPS AND COLLABORATIONS FOR SUSTAINABLE PRACTICES

Theme: TCS Partnerships and Collaborations to Advance Sustainable Supply Chain

S.No.	Statement	Rating (1-5)
4.1	TCS has established strategic partnerships with stakeholders to promote sustainable practices	
4.2	Partnerships involve customers, suppliers, industry associations, and government entities	
4.3	Stakeholder collaboration drives positive change in the business environment	

S.No.	Statement	Rating (1-5)
4.4	TCS actively collaborates with e-commerce platforms like Daraz and Shopee	
4.5	Partnerships with e-commerce platforms have developed green delivery options	
4.6	Collaborative efforts with e-commerce platforms have established sustainable packaging standards	
4.7	TCS engages with suppliers to foster collaborative sustainability initiatives	
4.8	Understanding supplier needs helps align sustainability goals across the supply chain	
4.9	Supplier collaboration drives sustainable practices throughout the supply chain	
4.10	TCS works effectively with government agencies on infrastructure development	
4.11	Government collaboration supports policy advocacy for sustainable practices	
4.12	Partnerships have resulted in reduced carbon emissions	
4.13	Collaborations have improved operational efficiency across the supply chain	
4.14	TCS participates in industry forums and initiatives for sustainability	
4.15	Industry participation contributes to development of sustainability standards and guidelines	
4.16	These partnerships have enhanced overall sustainability performance	

Parameter 5: RECOMMENDATIONS FOR IMPROVING GSCM PRACTICES IN PAKISTAN

Theme: Recommended Actions to Enhance TCS's Green Supply Chain Practices

S.No.	Statement	Rating (1-5)
5.1	Investing in infrastructure development is crucial for advancing GSCM practices	
5.2	Establishing more CNG refueling stations would support green logistics adoption	
5.3	Promoting recycling facilities would enhance waste management capabilities	
5.4	Improving waste management systems is essential for sustainable operations	
5.5	Collaboration with government on infrastructure is necessary for sustainability	
5.6	Industry stakeholder collaboration improves infrastructure for sustainable practices	
5.7	Infrastructure development can overcome key barriers to GSCM implementation	
5.8	Continuous education programs are essential for GSCM success	
5.9	Awareness programs for customers are crucial for promoting sustainable practices	
5.10	Supplier education on sustainability practices enhances supply chain responsibility	
5.11	Employee training on sustainable logistics is important for implementation	
5.12	Workshops to share best practices improve GSCM knowledge across the organization	
5.13	Education initiatives promote sustainable practices throughout the supply chain	
5.14	Stakeholder collaboration strengthens supply chain sustainability initiatives	
5.15	Establishing partnerships helps develop sustainable solutions jointly	
5.16	Resource sharing through partnerships overcomes individual constraints	
5.17	Collective expertise through collaboration drives innovation in sustainability	
5.18	Information exchange with stakeholders enables awareness of industry trends	
5.19	Collaboration facilitates understanding of emerging regulatory opportunities	
5.20	Stakeholder partnerships are vital for capitalizing on opportunities in Pakistani logistics	

S.No.	Statement	Rating (1-5)
5.21	Infrastructure development, education, and collaboration are interconnected for GSCM success	
5.22	These recommendations address unique challenges in Pakistan's logistics industry	
5.23	Implementation of recommendations will create a more environmentally responsible supply chain	

INTERPRETATION GUIDE

Rating Interpretation:

Rating	Interpretation	Implication
5 (Strongly Agree)	Strongly affirms the statement	Critical importance / High effectiveness / Full implementation
4 (Agree)	Generally affirms the statement	Important / Effective / Substantially implemented
3 (Neutral)	Uncertain or mixed views	Moderate importance / Partial effectiveness / Needs evaluation
2 (Disagree)	Generally opposes the statement	Low importance / Limited effectiveness

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