

Enhancing Supply Chain Resilience with Diversified Strategies



Foreword

It is my pleasure to introduce this Knowledge Paper at the Food Forward Summit held in the Kingdom of Saudi Arabia from 30 April to 1 May 2024. The focus of our panel discussion, “Opportunities, Vulnerabilities, and Risks in the Supply Chain: Is Diversification the Way Forward?” is both timely and significant. Amidst global upheavals and regional developments, the imperative to evaluate and fortify our supply chains has become increasingly apparent.

The global food supply chain, a complex network valued at more than USD 8 trillion and responsible for around 10% of global GDP, plays a crucial role in feeding the world’s population. Yet, it is fraught with vulnerabilities — from the effects of climate change impacting a significant portion of prime agricultural lands, as noted by the FAO, to political instabilities that can disrupt operations without warning.

Particularly in the GCC region, where the dependency on imported food exceeds 85%, the fragility of supply chains was highlighted during the pandemic, showcasing the potential for rapid and severe disruptions. Therefore, initiatives such as Saudi Vision 2030 have prioritised food security and supply chain resilience as critical components of regional economic strategy.

This paper provides a comprehensive analysis of the global food supply chains by drawing upon both global insights and regional contexts to chart a course for diversification. It highlights robust strategies for enhancing supply chain resilience, including post-tsunami recovery in Japan and strategic food reserves in the European Union. The paper analyses the transformative role of advanced technologies such as IoT, AI, and blockchain, with practical insights from major corporations and food processing firms. It also discusses sustainable logistics initiatives such as the GoGreen programme and the adoption of circular economy principles. Additionally, it examines risk management in sourcing, featuring best practices and the geopolitical strategies of ASEAN countries. The concept of friendshoring, nearshoring, reshoring as well as multi-sourcing strategies such as strategic diversification approaches are explored within the regional context, supported by examples from international agreements. The importance of cross-industry collaborations and public-private partnerships is elaborated through examples.

As we unfold these insights and strategies, our objective is to spark a global dialogue that deeply resonates within local markets, regional and cross-regional. Here, the shift towards diversified and robust food supply chains can potentially serve as a model for the entire region.

Key recommendations for supply chains include increasing visibility through technology, enhancing flexibility via dual sourcing and nearshoring, and integrating sustainable practices to meet regulatory and consumer expectations. These strategies are essential for navigating the changing landscape of global supply chains and ensuring their long-term sustainability and resilience. Conclusively, the paper calls for a unified approach among stakeholders to forge a resilient and sustainable supply chain future.

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I am privileged to participate in this crucial discourse and am keen to explore, together with this Summit’s esteemed delegates, how the strategies discussed here can foster a more stable and flourishing future for the global food supply chain.

Chirag Jain

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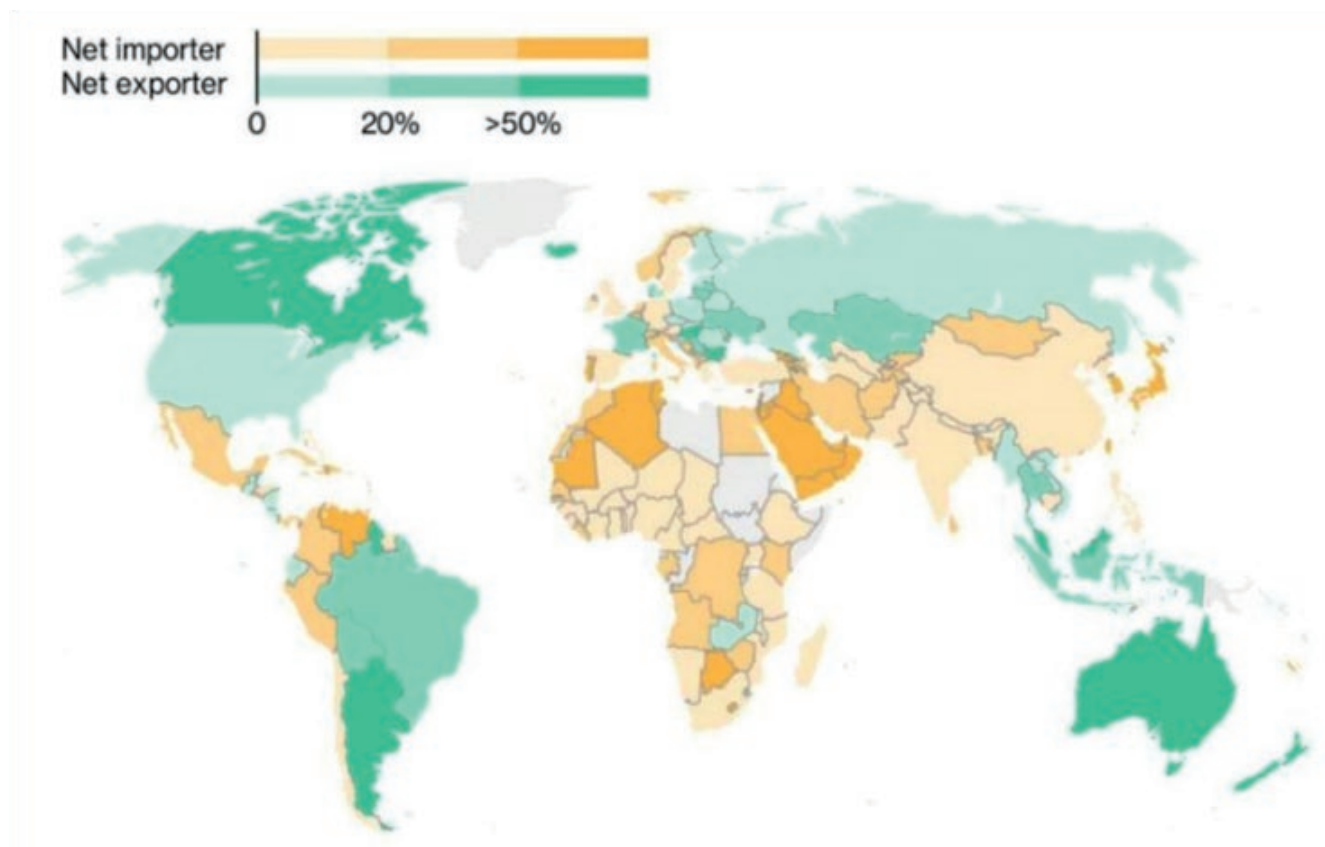
Chapter 1: Introduction

Introduction

Food supply chains represent a profoundly impactful yet often underappreciated realm of investment and business opportunity. As an industry integral to every individual worldwide, it stands on the brink of substantial transformation and is primed for innovative disruptions. This sector's universal relevance underscores its potential to reshape global economic landscapes.

In the foreseeable future, food supply chains will involve assembling a network of suppliers capable of delivering robust year-round harvests, sourcing inputs from global locations. Looking further ahead, the prospects are even more promising. Touchless agriculture stands out as a transformative technology, poised to bring significant disruptions in the years ahead. By leveraging thorough data analysis, it assists farmers in selecting superior seeds without the need for actual planting.

The global food supply chain manages the transportation, processing, and distribution of food on a global scale. The increasing interconnectedness of economies due to globalisation has facilitated this process, making it more viable in today's economic landscape. These global food chains play a crucial role in delivering substantial quantities of high-quality food from various corners of the globe, catering to approximately one-ninth of the global population. However, understanding globalisation goes beyond its economic dimensions; it necessitates consideration of its social and environmental implications as well.



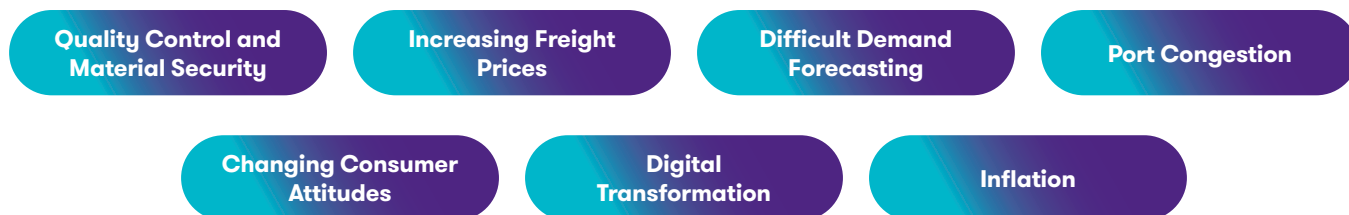
Disclaimer: Maps are for graphical purposes only. They do not represent a legal survey

Source: Bloomberg based on FAO Global perspectives

Supply Chain Challenges in 2023

Globalisation offers numerous advantages to those involved in the food supply chain, enhancing access to high-quality food and fostering advancements in agricultural practices and transportation worldwide. However, alongside its benefits, globalisation poses sustainability challenges within the global food supply chain. These chains have far-reaching impacts, not only on the environment but also on culture and biodiversity.

Globalisation has led to job displacement in certain areas of the global food supply chain, attributed to practices like “job outsourcing” and significant shifts in transportation modalities. While globalisation has contributed to enhancing “food security” by increasing access to food, it has also raised concerns regarding “food safety.”



Source - <https://www.extensiv.com/blog/supply-chain-management/challenges>

Globalisation is a permanent fixture in our world, and global food chains are an integral part of this reality. It is imperative for global food chains to prioritise measures that guarantee their long-term sustainability, ensuring the well-being of future generations.

Import and Export Data of World Trade (2)

 **230**
Countries

 **26,593,299**
Exporters

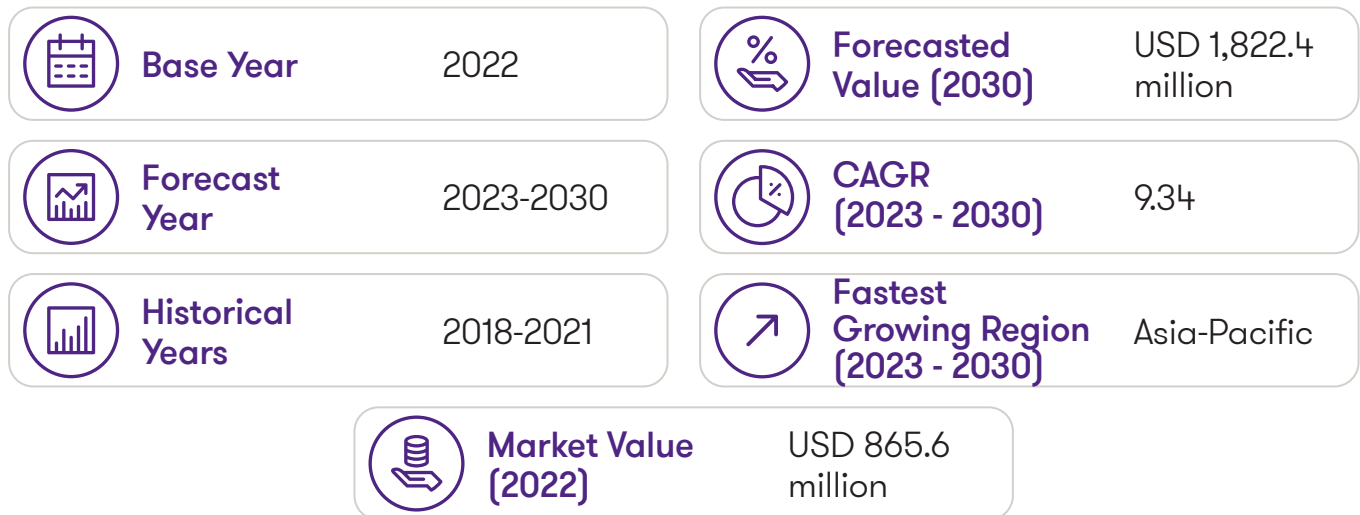
 **30,259,374**
Importers

The economic prosperity of each country heavily relies on its companies, which are increasingly expanding both locally and globally. When companies go global, their supply chains transcend local boundaries, sourcing from and selling to diverse organisations and individuals across the world. This globalisation introduces complexity to supply chains, and mismanagement of this complexity can lead to disruptions and increased costs.

Local businesses may encounter challenges related to domestic regulations, societal dynamics, economic conditions, and political factors. However, these issues are often familiar to local businesses, allowing them to anticipate and navigate them more effectively. In contrast, global businesses face challenges beyond national borders, potentially limiting their operations and causing losses for less influential players who may struggle to compete.

Agricultural Supply Chain Service Market

Global Industry Analysis and Forecast 2023-2030



To compete effectively in the global market, businesses must have a thorough understanding of each country's policies and regulations. This enables them to operate on an equal footing with competitors and navigate the complexities of international business environments.

The food supply chain



Source - <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8936386>

Current state of global food supply chain

The global food supply chain forms the base of the world economy. This logistical marvel connects farmers, distributors, retailers, and consumers in a complex, never-ending production, processing, and distribution cycle to keep supermarkets stocked and kitchens brimming with fresh foods.

However, the vulnerabilities inherent to this system have come under the spotlight, due to recent global events. Once considered a strength, global connectivity has become the supply chain's biggest hurdle. Disruption in one region caused a domino effect that rippled across world markets, impacting

future operations.. Therefore, we need to analyse what are the major causes of food supply chain issues. Although many major supply chain problems related to COVID-19 have eased, the repercussions linger.

In 2022, consumers had to deal with a fresh slate of issues — including labour and driver shortages, regional droughts, rising fuel costs, and the ongoing war in Ukraine — which only added to the mounting problem of food scarcity and price inflation. While eggs and baby formula made the headlines, they were just the tip of the iceberg.

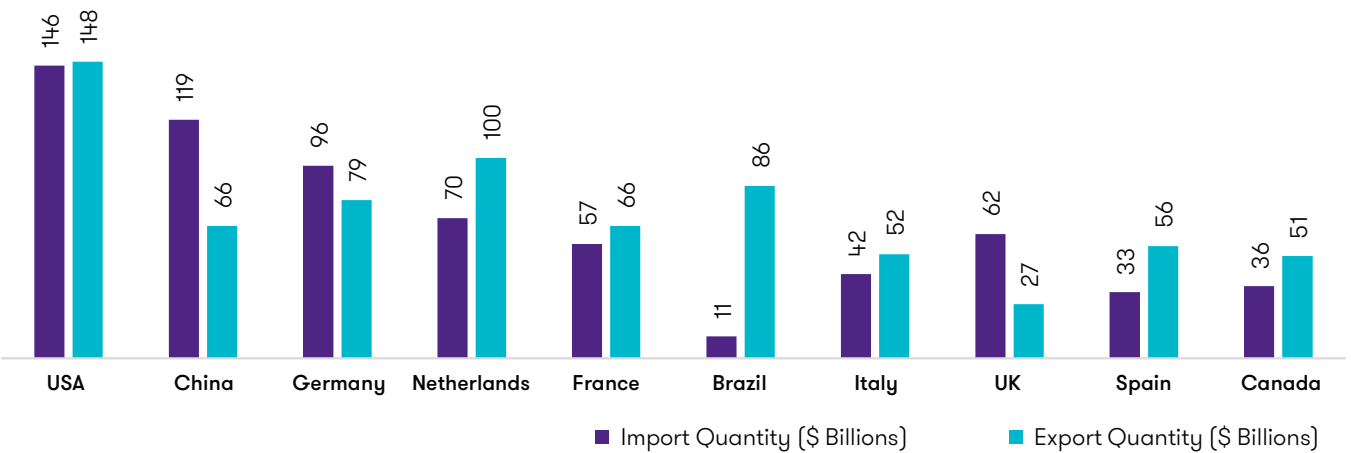
Drivers of Global Manufacturing Supply Chain Participation (Hubs & Spokes)

Impact of 1 Standard Deviation Change on Participation Ratio (%GVA)



Source - <https://sponsored.bloomberg.com/article/neom-investment-office/the-supply-chain-revolution-driving-the-future-of-sustainability-investments>

Top Ten Food Trading Countries





Challenges in supply chains faced by the Kingdom of Saudi Arabia



Reliance on imported food exposes vulnerability to supply disruptions and fluctuating international market conditions



Introduction innovative products such as camel milk demands overcoming market acceptance barriers



Diversification efforts to reduce dependency on traditional dairy call for continuous innovation and strategic planning



Increasing production of dairy alternatives challenges the balance between traditional and alternative supply chains



Mitigation of supply chain risks through domestic production requires substantial investments and operational adjustments

Megatrends and trends shaping supply chain innovation

Emerging trends such as advancements in digital technologies significantly influence supply chains, impacting various aspects including product offerings, operational processes, and network configurations. For instance, the adoption of blockchain technology, characterised by its potential for enhanced transparency, may necessitate restructuring within supply chains, potentially eliminating certain intermediaries

and altering supply chain finance mechanisms. Moreover, the integration of other technological advancements such as artificial intelligence, internet of things, and big data analytics further contributes to the evolution and optimisation of supply chain and supply chain finance solutions.

Megatrends and Trends Shaping Supply Chain Innovation (researchgate.net)

Megatrends in supply chain management

Dimensions	Megatrends	Trends
Political	Protectionism	Import tariffs
		Quotas
		Different tax structures
		Subsidies
	Political stability	Terrorism/conflict
		Social unrest
	Supranationalism	Trade agreements
		Free movement
Economic	Global trade shift	Economic growth in emerging economies
		Export growth
		Investment
		Globalisation
		Glocalisation
		Emergence of born-global firms
	Digital economy	Sharing economy
		From an economy of goods to an economy of services
	Financial innovation	Digital currencies
		Cashless payment
		The financial technologies (Fintech) revolution

Dimensions	Megatrends	Trends
Social	Population growth	Population boom in the developing countries
		Growing demand of resources (e.g. land)
	Demographic change	Ageing population boom in developing countries
		Young population boom in developing countries
		Migration flows
		Labor shortages
	Urbanisation	Megacities
		Smart cities
	Change in consumption pattern	Middle-class explosion
		Healthy diets and lifestyles
		Consumerism
	Individualism	New customer relationship
		New shopping experience
		Increase customisation
Technological	Digital natives	Change of communication patterns
		Change of purchasing patterns
		Reshaping the workplace
		Increase demand for high-qualification jobs
		Emerging skills required
	Knowledge based economy	Continuous learning culture
		Big data analytics
		Artificial intelligence
	Digital transformation	Cloud based computer systems
		Blockchain
		Internet of Things
		Robots
		Cyber-physical system
	Technology development and automatisisation	Augmented reality and virtual reality
		3D printing/additive manufacturing
		Drones
		Autonomous systems
		Automated guided vehicles
		Wearable devices
	Electrification of transport	Battery electric vehicles
		Hydrogen fuel cell electric vehicles
		Hybrid vehicles
	Renewable energy sources	Production and storage of clean energy and application to transportation and industry
		Renewable energy for industrial processes

Dimensions	Megatrends	Trends
Legal	Consumer protection laws	Cross-border payments
		Return products free of charge or under warranty
		Product safety regulations
		Privacy
	Intellectual property law	Patents
		Data sovereignty
	Social and environmental regulations	Corporate social responsibility
		Emissions control regulations
		Waste and resources management regulations
Environmental	Climate change	Pollution
	Resource scarcity	Lack of resources such as water, land, energy, food and rare earth elements
		Waste increase
	Catastrophic events/hazards	Natural disaster
		Biological risks (e.g. pandemic)
		Man-made disasters

Megatrends are reshaping society, economies, politics and the environment; so, they can be used to forecast future supply chain developments. It gives a glimpse into the opportunities and challenges that supply chain managers may face in the future; thus, they can develop an early warning system and develop as well as contingency plans. It provides an opportunity to prepare for and respond to a broad range of

potential disruptions in the future and to create more resilient and interactive supply chains. Based on these results, it is possible to formulate scenarios that describe the evolution and the implications of the identified megatrends and trends on supply chains for the next decade.

A close-up photograph of a hand wearing a white latex glove, holding a single, ripe red tomato. The tomato has a green stem and is being held above a cardboard box filled with many other similar red tomatoes. The background is blurred, showing more of the same scene. A large, semi-transparent purple circle is overlaid on the bottom left of the image, containing the chapter title.

Chapter 2:

Sustaining Inventory and Supply Chain Capabilities

Sustaining Inventory and Supply Chain Capabilities

Resilience in Supply Chain Management

Case Study: Japan's supply chain resilience post-Tsunami 2011



Strategies for Inventory Management

Best practices from the European Union's strategic food reserves

Sustaining Inventory & Supply Chain Capabilities

As per FAO, 735 million people faced hunger in 2022 while 13% of food produced was lost in the supply chain from post-harvest till retail, while another 17% is wasted in household, food services and retail. Food losses also subvert sustainability of the food production and consumption ecosystem as the land, water, energy and capital invested also get wasted. Food production as well as decomposition or disposal of wasted food both lead to an increase in greenhouse gases and affect climatic parameters. Food wastage directly impacts availability of food at affordable prices and in right quantity. Therefore, sustainable inventory capacity within supply chain is very important to curb wastage and ensure supply at fair price.

Supply chains today are global, complex, vulnerable with numerous parties involved globally. Inventory represents money to a business and keeping log of its inflow and outflow across the supply chain is very crucial in the bottom-line of enterprises. Poor management of inventory can cause loss of goods, business from clients or customers and loss of time in recuperating. Food products, being perishable in nature, and scattered across the globe, require highly efficient supply chain practices to control quality, quantity and price matrix.

Strategy for Inventory Management

Coca Cola procures most bulk ingredients & packaging material locally except corn syrup. It maintains lean manufacturing strategy to reduce wastage in supply chain



01 Lean Manufacturing – Reducing wastage and continuous improvement in operations to achieve sustainability goals

Centralized Online Real-time Electronic Public Distribution System by Gol helps supply the food commodities to intended beneficiaries without incurring losses due to corruption. It is functional in various formats including mobile handheld terminals, self-service terminals, and temporary and permanent staffed facilities



02 Digital Transformation - Integration of digital technologies to improve efficiency, visibility, and agility for real-time tracking of shipments, automated Inventory Management, and advanced analytics for demand forecasting

Walmart strategically procures directly from manufacturers who are also responsible for its inventory management as per quality & quantity requirements of the company



03 Strategic Sourcing - Identify suppliers that align with the company's sustainability goals and can deliver the required quality and quantity of materials at competitive prices

DeHaat is using AI-enabled technologies to revolutionize the supply chain and production efficiency in the farm sector. It provides end to end supply chain services to farmers for agri input supply & post-harvest procurement



04 Innovation Management - Innovations in product design, packaging, logistics, and waste management etc. It can significantly reduce environmental impact and drive efficiency.

McDonald's, KFC, Pizza Hut etc. use big data for customer sentiment analysis through social media and enhance customer experience



05 Data & Analytics – Analytics in demand forecasting, inventory management, supply chain planning, identify opportunities for sustainable sourcing, monitor supplier performance against sustainability criteria, and track the environmental impact of supply chain operation

Starbucks has the most popular app amongst customers which allows varied selections & timely delivery. In return it has very loyal customer base



06 Customer-centric Organization - Adopting customer needs and preferences, including the demand for more sustainable products and practices



07 Supply chain resilience: Companies in the supply chain need to develop close and more collaborative relationships with key suppliers and focus on those that align with the company's sustainability goals. It includes diversifying sourcing strategies to include multiple suppliers from different regions to mitigate risks associated with supply chain disruptions.

Case Study: Japan's supply chain resilience following Tsunami 2011

Japan is a net importer of food products. It exports fish, sea food and bakery products. Its agricultural and fishery areas were severely affected after 11 March 2011, earthquake and tsunami followed by nuclear crisis at Fukushima Daiichi Nuclear Plant. The net agricultural losses were estimated to be USD 21.5 billion.

The 2011 crisis of Japan had ripple effects on global tech industry as well. Considerable number of processors and part makers were devastated; the production had to be stopped. However, Japan bounced back within four months with an upswing in production. Although agricultural supply chain took longer to recover.

Catastrophe Setbacks

- Processing units, fishing harbors, fishing vessels etc. resources destroyed
- Irradiation of Food materials in affected prefectures
- Lots of labor force got killed or migrated

Immediate Measures of Resolution

- Shutting down production of fish & marine products for radiation affected food products
- Periodic checking of food products for radiation affects and preventive measures
- National & International alerts & cross-checking of supply chain inventories for irradiation

Reconfiguration Measures for Resilience

- Creating awareness about production or processing hub vulnerabilities
- Developing niche suppliers in distant tiers
- Knowledge sharing about processes, quality standards etc. with alternative suppliers

Best practices from European Union's food reserves

EU strategies and best practices are focused on sustainable agricultural practices. Their 2030 targets for sustainable food production include –

- Reduce overall use and risk of chemical pesticides by 50% and more hazardous pesticides also by 50%
- Reduce nutrient losses by at least 50% while ensuring that soil fertility is maintained; this will reduce use of fertilisers by at least 20%
- Reduce sales of antimicrobials for farmed animals and in aquaculture by 50%
- Achieve at least 25% of the EU's agricultural land under organic farming and a significant increase in organic aquaculture

These targets are to be achieved through various instruments such as legislation and regulation, financial incentives, education, research and innovation, procurement and voluntary commitments. The EU have committed to reaching the UN SDG Target to reduce food waste at retail and consumer levels by 50% by 2030 and reduce food losses along the food production and supply chains.

Short food supply chains (SFSCs)

The SFSC model has evolved as the means to access high quality, fresh, locally sourced produce, as well as a way of contributing to the social life of local communities. It encompasses different typologies and operating models. Farmers might sell their products to consumers in many ways which includes off-farm, in the neighbouring places of consumption such as farmers' markets, in shops owned by farmers themselves, in food festivals and fairs, through farm-based delivery schemes, or through one single trade intermediary (cooperative shops, specialist shops, supermarkets, etc.). Farmers can also sell their products directly to public institutions' collective catering, such as school or hospital canteens, in the framework of public procurement schemes, and to restaurants, hotels and private catering companies, direct internet sales/long distance farm-based delivery schemes etc. Overall, the SFSC model aims to reduce the "distance" between agriculture and final consumption, directly re-connecting farmers to consumers. These initiatives can be managed on an individual or collective basis.

The benefits to consumers for SFSC model are mentioned below:

- More affordable prices for food
- Provide easy access to quality products: fresh, local, "authentic", origin food
- Buy products traceable from a known producer
- Reconnect food to the farming and processing process
- Provide easy access to healthy food options
- Pursue social and ethical objectives
- Support local economy

The EU-funded H2020 project SMARTCHAIN was launched in September 2018 with the goal to accelerate the shift towards collaborative SFSCs. The project has also established a virtual platform including novel interactive tools to share knowledge and innovative practical solutions relevant to SFSCs.



Chapter 3:

Impact of Advanced Technologies

Chapter 3: Impact of Advanced Technologies

IoT, AI, and Blockchain in the F&B supply chain

Case Study: Blockchain implementation in Walmart’s supply chain for food safety



Data Analytics for Predictive Supply Chain Management

Use case: Coca-Cola’s use of AI for demand forecasting

IoT, AI, and Blockchain in F&B transport and warehousing

The F&B industry is witnessing a significant transformation in its operations due to shifting consumer preferences and supply chain disruptions. This poses a multitude of challenges ranging from waste minimisation to risks to adaptability in the company’s supply chain.

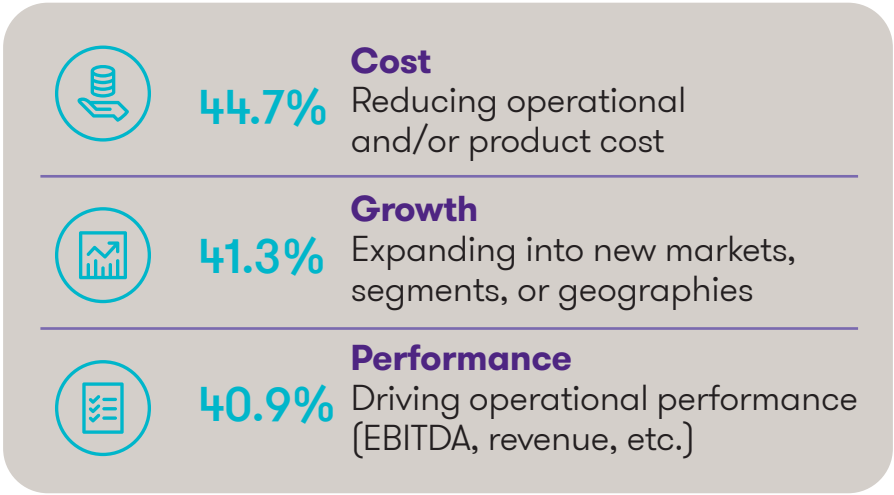
To tackle these challenges, companies are focusing on balancing their **cost**, **operational performance**, and **growth** as their top-3 key business metrics as a priority. These priorities, in turn, are leading to investment in new technologies and digital transformative initiatives within their supply chain.

Food & Beverages players key challenges

- Minimize waste
- Climate induces risks
- Accelerated compliance
- Adapting to the marketplace
- Shifting consumer trends

How are the firms responding to these challenges?

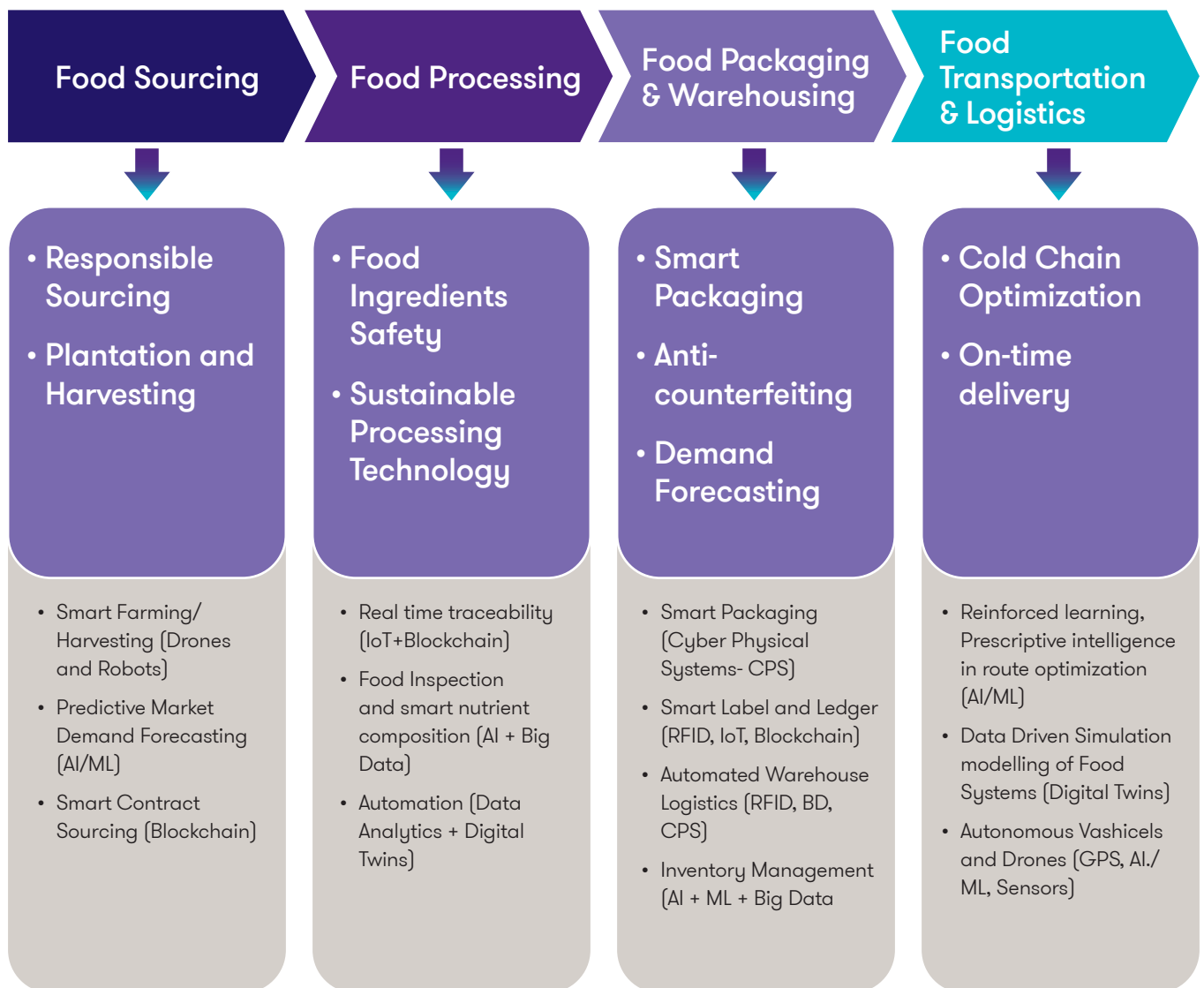
Q: Which of the following initiatives will be significant in driving IT investments at your organization?



Source: IDC EMEA, U.S. Vertical Survey, June 2019; total n = 3,607, brand-oriented value chain companies = 247, Top 3 ranked responses shown

This digital transformation targets every part of the food supply chain, from farm to fork. Some of the key technologies driving this evolution include Artificial Intelligence (AI), Internet of Things (IoT), Machine Learning (ML), Big Data (BD), Radio Frequency Identification (RFID), Cyber physical systems (CBS), Digital Twins (DT) and more.

Employing these innovative digital solutions addresses challenges at each stage of the food supply chain while prioritising consumer preferences, sustainability, and performance metrics.



The overall benefits of the technology-enabled supply chain are connectivity, transparency, end-to-end visibility, inventory monitoring and control, data privacy among participants in the

supply chain network, secure information sharing by ensuring authenticity, timelines, and integrity of transactions as well as real-time data.

Case Study 1:

The Use of Digital Twins to Tune its Supply Chain

Unilever, a multinational FMCG company, has implemented digital twin technology in its manufacturing part of the supply chain. Digital twins combine the Internet of Things (IoT), AI, and ML models to recreate a digital version of physical equipment and processes in real-time, which helps the company to simulate the operations without the need for physical equipment and energy.

The data necessary to replicate this process comes from various interconnected IoT devices embedded in the various equipment which sends out real-time information about the operations. The model then uses AI and ML to formulate digital twins of the processes.

It continuously collects sensor data and processes it to predict errors and simulations of various scenarios.

During the COVID-19 pandemic, digital twins helped Unilever to enable key operational KPIs to be worked remotely for the leadership team working off-site.

This project has saved approximately USD 2.8 million at just one site where the pilot was conducted with 1% energy savings and 3% productivity benefits.

Unilever has been able to reduce the daily alerts requiring action by 90% with reduced interruption and timely interventions.

This capability has propelled Unilever to aim for a global virtual control room to operate factory processes remotely. With advancements in data analytics and the successful implementation of digital twins, the creation of a virtual operational control room is more of a reality than a dream.

Case Study 2:

Data Analytics for Predictive Supply Chain Management: Coca-Cola's use of Artificial Intelligence (AI) for demand forecasting

In the high-stakes environment of global supply chains, accurate demand forecasting is critical for optimising efficiency and enhancing business performance. Coca-Cola, a global brand with a complex product range and expansive distribution network, exemplifies the strategic application of technology to tackle these challenges. The company has adeptly integrated Artificial Intelligence (AI) into its demand forecasting and inventory management systems, leveraging vast data sets and sophisticated algorithms to revolutionise its supply chain management.

Historically, inaccuracies in demand forecasting have led to significant economic repercussions, such as the estimated USD 470 billion loss due to overstocking and a 4% average revenue loss from understocking among US retailers in 2018. In response, Coca-Cola's implementation of AI facilitates a comprehensive analysis of historical sales, market trends, weather conditions, and social media sentiments, among other factors. This enables the identification of demand patterns and accurate prediction of future needs with remarkable precision.

The use of AI allows Coca-Cola to adeptly navigate consumer demand fluctuations, ensuring that products are available where and when needed, thus minimising stockouts and overstock situations. This strategic approach not only improves customer satisfaction but also enhances economic efficiency across key business performance indicators, demonstrating a leading-edge application of technology in global supply chain management.

One of the vital factors that affect supply chain efficiency and business performance is demand forecasting. Accurate demand forecasting allows the organisation to cut supply chain costs and disruption.

Accurately forecasting demand and managing inventory can be complex and challenging and inaccurate demand forecasts can lead to stockouts, dissatisfied customers, and missed sales opportunities. On the other hand, overstocking can result in wastage, increased costs, and inefficient use of resources.

Supply chain-related disruption including overstocking alone has resulted in an estimated loss of USD 470 billion for US retailers in 2018. And understocking leads to 4% loss on average in retailers' revenue.

Meeting consumer demand for a globally recognised brand like Coca-Cola is no small feat with a diverse range of products and an extensive distribution network.

To ensure its products are consistently available at the right time and place to meet customer demand, Coca-Cola has Strategically implemented AI for demand forecasting and inventory optimisation.

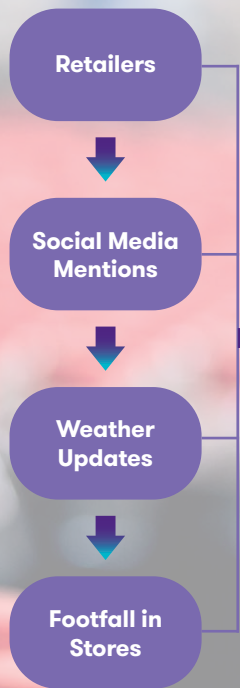
By utilising the power of data and advanced algorithms, Coca-Cola has revolutionised its Supply Chain Management.

Coca-Cola's demand forecasting process has undergone a remarkable transformation with the integration of AI by analysing historical sales data, market trends, weather patterns, social media sentiment, and several other variables.

AI algorithms helped Coca-Cola identify patterns and predict future demand with a high degree of accuracy. AI enables the company to capture these subtle shifts in consumer demand and make informed decisions regarding the production and distribution of real-time data integration to enable seamless demand forecasting. This, in turn, helped the company achieve better economic output for its key business KPIs.

AI-driven Demand Forecasting

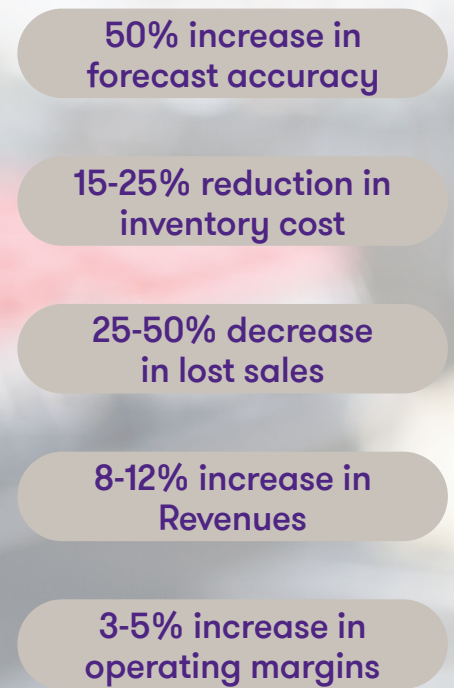
Data inputs



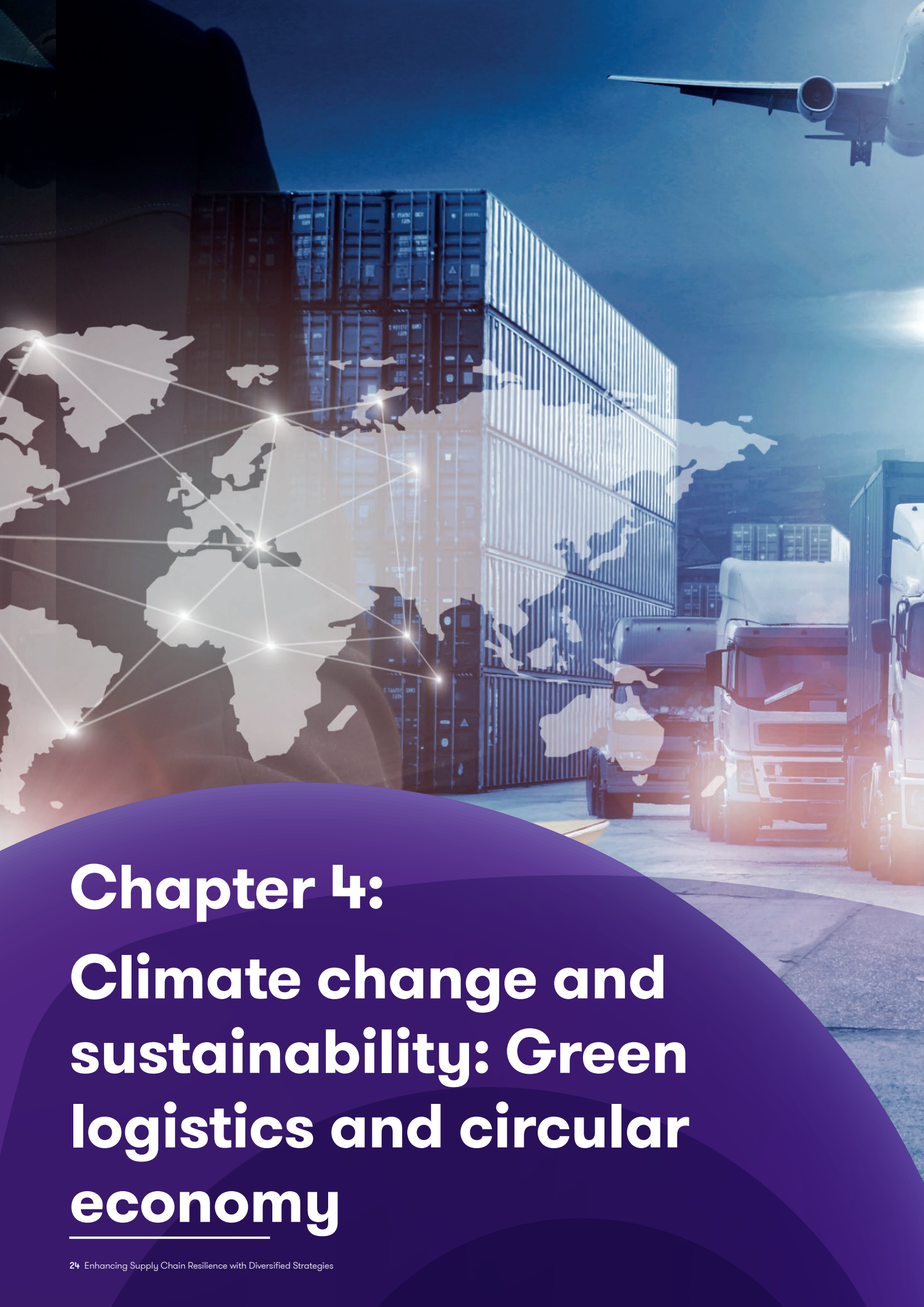
Business Outputs



Impact of the adoption of AI in Demand Forecasting



In an era of rapidly changing consumer preferences and intensifying competition Coca-Cola has embraced AI as a powerful tool to ensure its products are available at the right time and place by leveraging AI-driven demand forecasting and inventory optimisation.



Chapter 4: **Climate change and sustainability: Green logistics and circular economy**

Climate change and sustainability: Green logistics and circular economy

Green logistics

Due to various regulatory hurdles related to the industry, the nature of perishable goods involved, and supply chain fragmentation, logistics plays a critical role in these aspects, which often go unnoticed.

Climate change has emerged as the biggest challenge faced by every country globally. The world has been profoundly affected by rising global temperatures and sea levels increasing, among other climate change-induced effects..

With food production accounting for around one-third of all emissions, it plays a vital role in helping to reduce the impacts of climate change. The global supply chain and corporations contribute significantly to these emissions and global warming.

More than 75% of greenhouse gases associated with the industrial sector come from their supply chains.

Given the context of various supply chain disruption events such as COVID-19 and the climate footprint of the supply

chain, green logistics has emerged as a critical method to make the global F&B (Food and Beverage) supply chain more resilient.

The logistics sector contributed **10% of global GDP** and **10% of total global emissions** with a market value of **USD 8.9 trillion in 2023**, which expected to grow to **USD 18.2 trillion by 2030**. This growth, if unattended, will lead to more carbon emissions, high pollution levels, and public health issues.

Green logistics entails all initiatives aimed at reducing carbon emissions and ecological waste resulting from various logistics activities, including the planning and implementation of an efficient flow of goods and services from origin to consumption, encompassing both forward and reverse logistics.

The Logistics sector has three main components:



1. Transportation



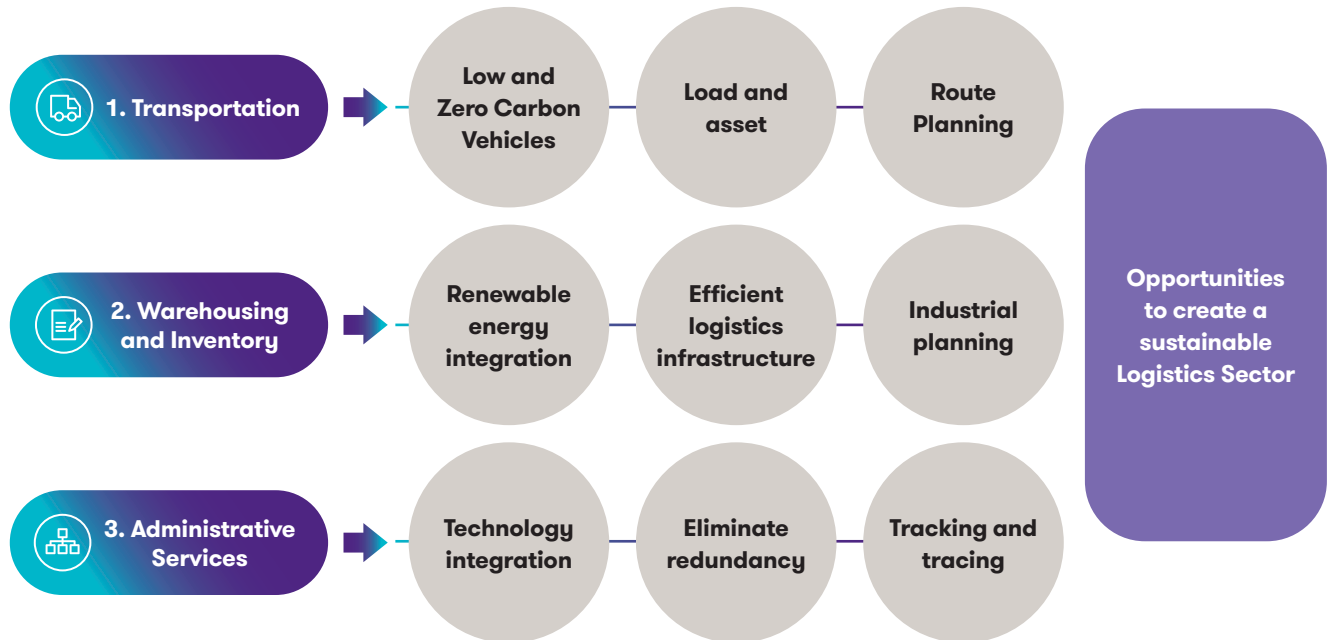
2. Warehousing and Inventory



3. Administrative Services

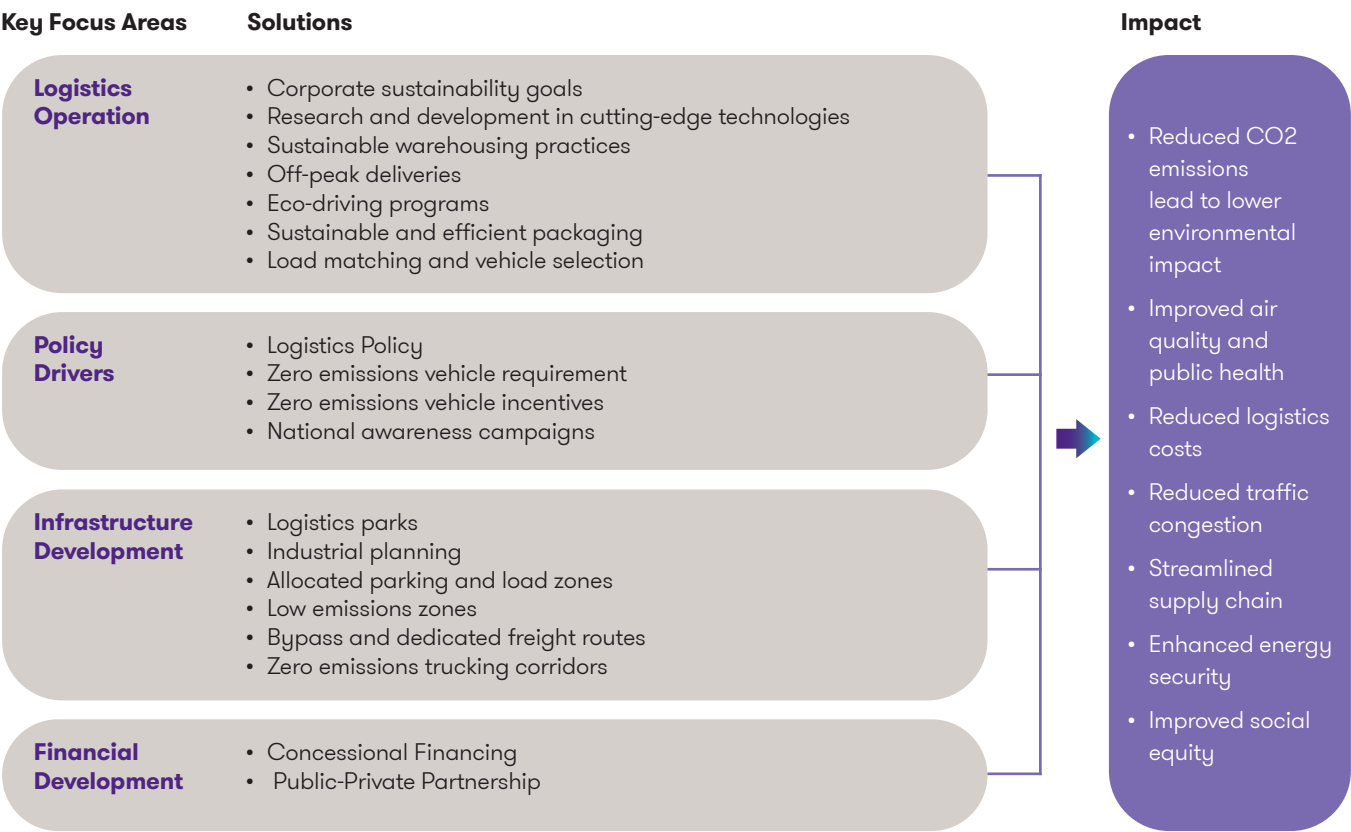
Each area represents different opportunities to develop sustainable practices for the logistics sector.

Exhibit 1: Sustainable logistics and their impact



According to the RNI report, corporates and policymakers can implement 19 solutions across four areas to enforce sustainable logistics policies and practices.

Exhibit 2: Solutions across four areas for sustainable logistics



Numerous strategies adopted by companies fall under the purview of green logistics, which includes considering social, economic, and environmental factors to make logistics more sustainable.

Case study: Sustainable initiatives in Indian warehousing and logistics

India's logistics sector has adopted various initiatives and interventions designed to reduce the climate footprint of the sector. India's initiatives in promoting sustainability in the warehousing and supply chain logistics sector are robust and multifaceted, focusing on environmental, social, and economic aspects.

Contributing 14.4% to the country's GDP, the logistics sector in India is currently growing at the rate of 10-12%. With more than 20 million people employed in the sector.

India has launched several sustainability initiatives being adopted in the Indian logistics sector, focusing on **energy efficiency, green transportation, and eco-friendly packaging**. By implementing these sustainable practices, India aims to reduce carbon emissions, lower operational costs, and improve overall competitiveness.

Energy efficiency: Improving energy efficiency in warehouse and logistics operations is essential for reducing environmental impact and operational costs. Incorporating measures such as solar panels, energy-efficient lighting, roof insulation, and rainwater harvesting can significantly lower energy consumption and carbon emissions. For example, solar panels on warehouse roofs can provide up to 20% of electricity needs. LED lighting can reduce energy consumption by up to 90% compared to traditional lighting. Proper roof insulation can lead to energy savings by reducing heating, ventilation, and air conditioning (HVAC) usage. Rainwater harvesting can help conserve water resources and reduce the facility's water consumption.

Sustainable packaging: In 2019, the value of the packaging market in India reached USD 50.5 billion and is expected to grow to USD 204.81 billion by 2025 at a CAGR of 26.7%. Meanwhile, the consumption of packaging in the country doubled from 4.3 PPPA in 2010 to 8.6 PPPA in 2020. Due to the increased growth of the packaging industry in India, sustainable packing has become significantly important to limit packaging waste. Sustainable packing includes **source reduction, the use of reusable containers, and biodegradable materials, and supply chain collaboration to optimise resources**. Consequently, such practices will allow for saving resources and reduce waste disposal, moving the companies to the circular economy of packaging.

Green Transportation: Being one of the largest sources of carbon emission, transportation has been a constant challenge in the logistics sector. Several efforts have been initiated to

provide green transportation in India, including **low-emission vehicles, electric vehicles, and alternative fuels**. Faster Adoption & Manufacturing of EVs (FAME) India incentives for electric vehicles and alternative fuels address the usage of long periods. This aims to move away reliance from on fossil fuels and reduce vehicular emissions. For instance, an average of 1.5 million grams of CO₂ can be saved annually per car by having only one electric vehicle on the road: E10 equals 20% reduced CO emissions and 20% reduced HC, two-wheelers correlate with an average 50% reduction for E20, and E20 equals using 20% less CO and HC.

This initiative indicates the country's commitment to environmental stewardship and economic resilience for a greener future in Indian logistics.

Circular economy

The escalating population, coupled with finite resources and a surge in waste production, represents the critical challenge of inefficient management and supply chains for global food security and availability.

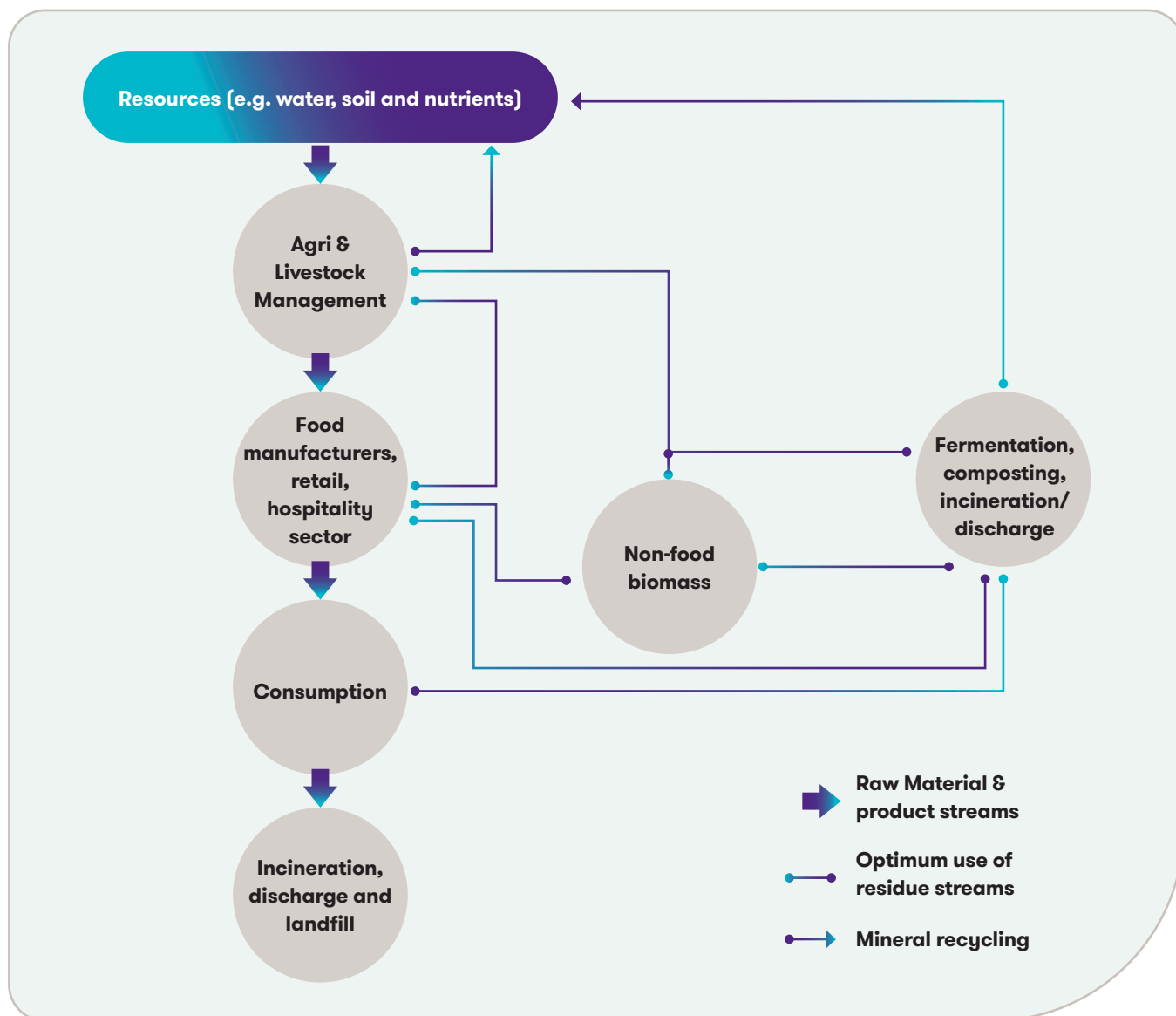
Moreover, substantial consumption of natural resources by food losses and waste is acknowledged as a critical global issue due to its alarming environmental, economic, and social repercussions.

1.3 billion tons of foods are lost or wasted globally, constituting one-third of food produced for consumption.

~14% of food produced is wasted between harvest and retail due to supply chain-related issues.

To ensure resilience, our food systems need to be sustainable. A sustainable food system provides food security and adequate nutrition for everyone while also preserving economic, social, and environmental resources to guarantee enough food, water, and prosperity for future generations.

Achieving this requires transitioning from a linear to a circular economy model. The Circular Economy for the Food Production System.



Implementing a circular economy approach yields significant quantitative and qualitative benefits that can transform businesses and communities. This economic model emphasises the reduction, reuse, and recycling of materials to create a closed-loop system, minimising waste and extending the lifecycle of resources. Here are some of the key positive impacts:



Reduction in material costs: Companies can substantially reduce their raw material costs by reusing materials and products. Studies suggest that businesses could save up to USD 700 billion annually on material costs in the consumer goods sector alone by adopting circular economy principles.



Increased efficiency: Circular strategies often lead to more efficient use of materials and energy. For instance, remanufacturing processes can use up to 80% less energy than manufacturing new products, which directly translates into cost savings and reduced environmental impact.



Waste reduction: By designing out waste and keeping products and materials in use, the circular economy significantly reduces waste generation. For example, in the electronics sector, circular practices could reduce waste by 50% by 2030.



Job creation: The shift towards a circular economy is expected to create a net increase in jobs due to the rise of new industries and services in recycling, remanufacturing, and product lifecycle extension. Estimates suggest that this could create more than 700,000 jobs at a net economic benefit of €1.8 trillion in the EU by 2030.



Case Study: Dutch Food Strategy for Circular Economy by 2047

The Netherlands holds a significant position in the global agri-food industry, known for its pioneering progress in technology and highly efficient production methods.

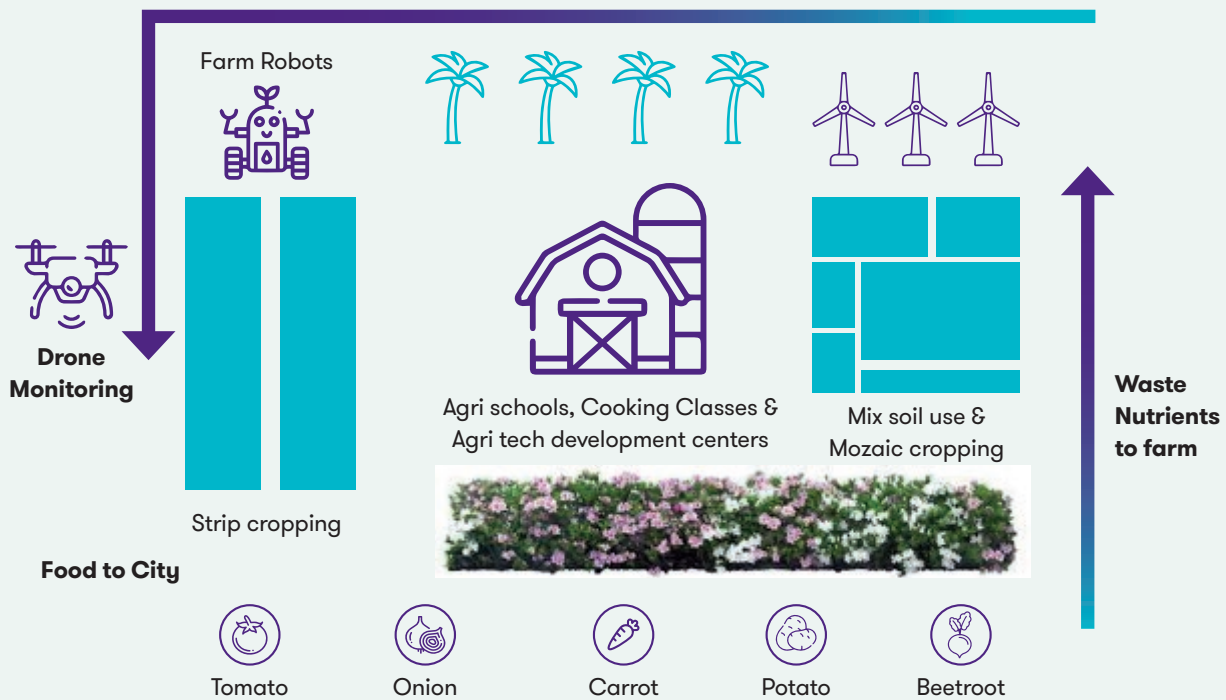
Renowned for its innovative greenhouse cultivation practices, it not only sustains its food supply but also stands out as one of the largest agriculture exporters with 123 billion Euros in exports in 2023.

This also comes with a price on the natural resources and the resulting impact on climate change due to supply chain-related emissions.

Taking a significant step towards promoting sustainability, the Dutch government has launched a National Plan on Circular Economy.

Under the National Plan on Circular Economy, the Dutch government has emphasised the importance of food and agriculture sector as most important in achieving the success.

Circular food supply chain



The Netherlands is aiming to cut down food waste by 80% by 2050 with strategies, such as reducing by products, e.g., wheat middling and food waste to close the loop on cycles. They are also recycling food waste and crop residues into resources by feeding inedible byproducts to farm animals, which then convert them into food and manure effectively recycling nutrients back into the food system. Additionally, they are efficiently utilising byproducts that cannot be consumed by humans. For example, heat treating animal contaminated food waste and feeding it to pigs, poultry, fish and insects to contribute to a food system.

In terms of water management innovation, smart toilets and advanced systems are being implemented to recycle up to 95% of household water for activities such as flushing toilets and gardening by 2050. This helps reduce reliance on drinking water while enhancing recovery from excreta.

Furthermore, there is an emphasis on community engagement through initiatives like community supported agriculture (CSA) where citizens actively participate in decision making processes related to crop selection and share risks, with farmers. This promotes consumption practices and supports sustainable farming methods.

Regenerative farming focuses on practices such, as intercropping, agroforestry and soil health maintenance to boost biodiversity, soil quality and ecosystem benefits for an ecofriendly food system. Government regulations support circular economy principles by stressing responsibility, corporate ethics and environmental limits awareness. Local and national efforts strive to reform organisations and encourage decision making.

The above value chain for agriculture is envisioned to achieve the National Circular Economy by the government.



Chapter 5:

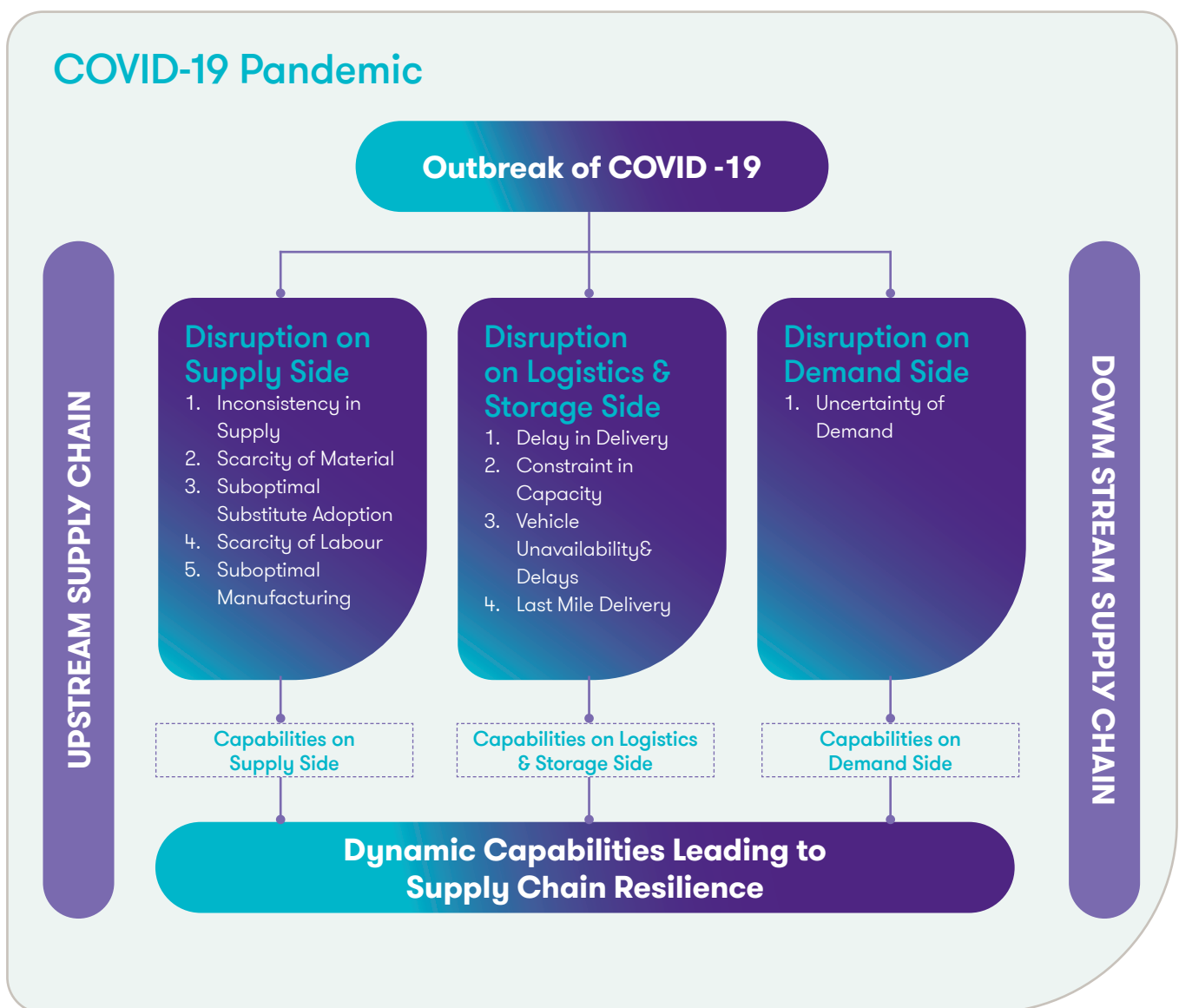
De-risking food sourcing

De-risking food sourcing

F&B industry in India

A joint report by the Confederation of Indian Industry (CII) and Grant Thornton predicts exciting growth for India's consumer market. By 2025, India is expected to become the world's fifth-largest consumer market, with food and beverages leading the way. This translates into a massive opportunity for companies in the food and beverage sector within India. (Memon, [2021])

Major global events disrupting supply chains:



F&B industry in India

Source: [Raj, 2022]

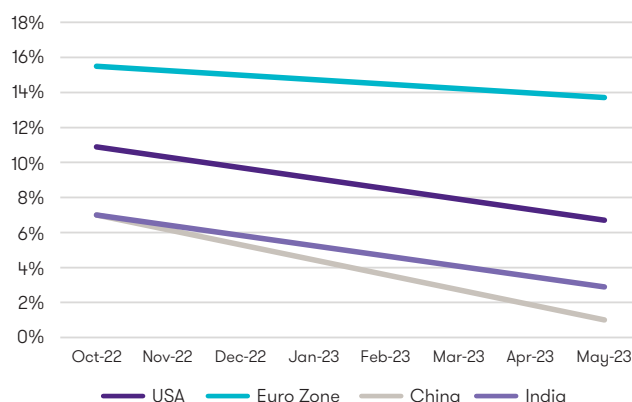
- Nutraceuticals have become increasingly valuable in combating COVID-19 complications, augmenting treatment efforts and fortifying individuals' immunity. This surge in demand has propelled India's nutraceutical market towards rapid growth, with projections reaching USD 18 billion by 2025, as consumers prioritise preventive healthcare during the pandemic and gravitate towards supplements such as vitamin capsules and zinc supplements to boost immunity.
- The F&B segment has undergone a revolution by moving from offline to online procurement.
- Restaurants in India are overhauling their operations to ensure a secure dining environment post-lockdown, emphasising social distancing, reduced human contact, and stringent hygiene measures. Embracing innovative solutions such as robot servers and QR code-based menus to minimise physical interaction, establishments such as Robot in Chennai and Cloves in Ahmedabad are leading the way in adapting to the evolving dining landscape. (Memon, [2021])

Geopolitical instabilities like the Russia- Ukraine war:

One of the major impacts of the war started in February 2022 was a slowdown in pace of economic growth and increased inflation, at a time when countries were still grappling with the effects of the pandemic. Disruptions to two major trade routes and economic sanctions by many countries on Russia increased global oil, gas, and food prices. Global wheat and fertiliser supply chains were disrupted, as Russia and Ukraine collectively contribute approximately 30% of global wheat exports. The steep rise in wheat prices was further escalated by India's export ban to curb domestic inflation and safeguard supplies.

Due to the war, India faced inflation in essential food items such as wheat, rice, sugar, edible oils, and pulses. Over the next financial year, the country was resilient and performed well as compared to other major economies in curbing food inflation.

Y-O-Y Food price inflation



Source: [FAO, 2023]



Indian measures to curb inflation:

India took a wide range of agricultural and food policy responses, such as import tariff for rice, cuts in excise duty on diesel and petrol, an increase in the production of organic and inorganic fertilisers, and the implementation of a fertiliser

subsidy policy (Ritter, Mockshell, & Blanco, 2023), to curb increasing prices of essential commodities and safeguard domestic stockpile.

Figure 1 Timeline of major measures undertaken to curb food inflation



As a strategy, India has often imposed export control measures in the face of increased global prices. India had imposed a ban on export of non-basmati rice during the 2007-08 and 2010-11 food price crises. Similarly in 2022, a wheat export ban was imposed, fearing domestic inflation and rising import demand from the rest of the world due to the Russia-Ukraine conflict. This was followed by the ban on export of non-basmati rice with immediate effect in July 2023. These measures help to stabilise volatile domestic retail prices but create shocks in the global

market since India accounts for ~40% of the global rice exports, supplying to nearly 140 countries.

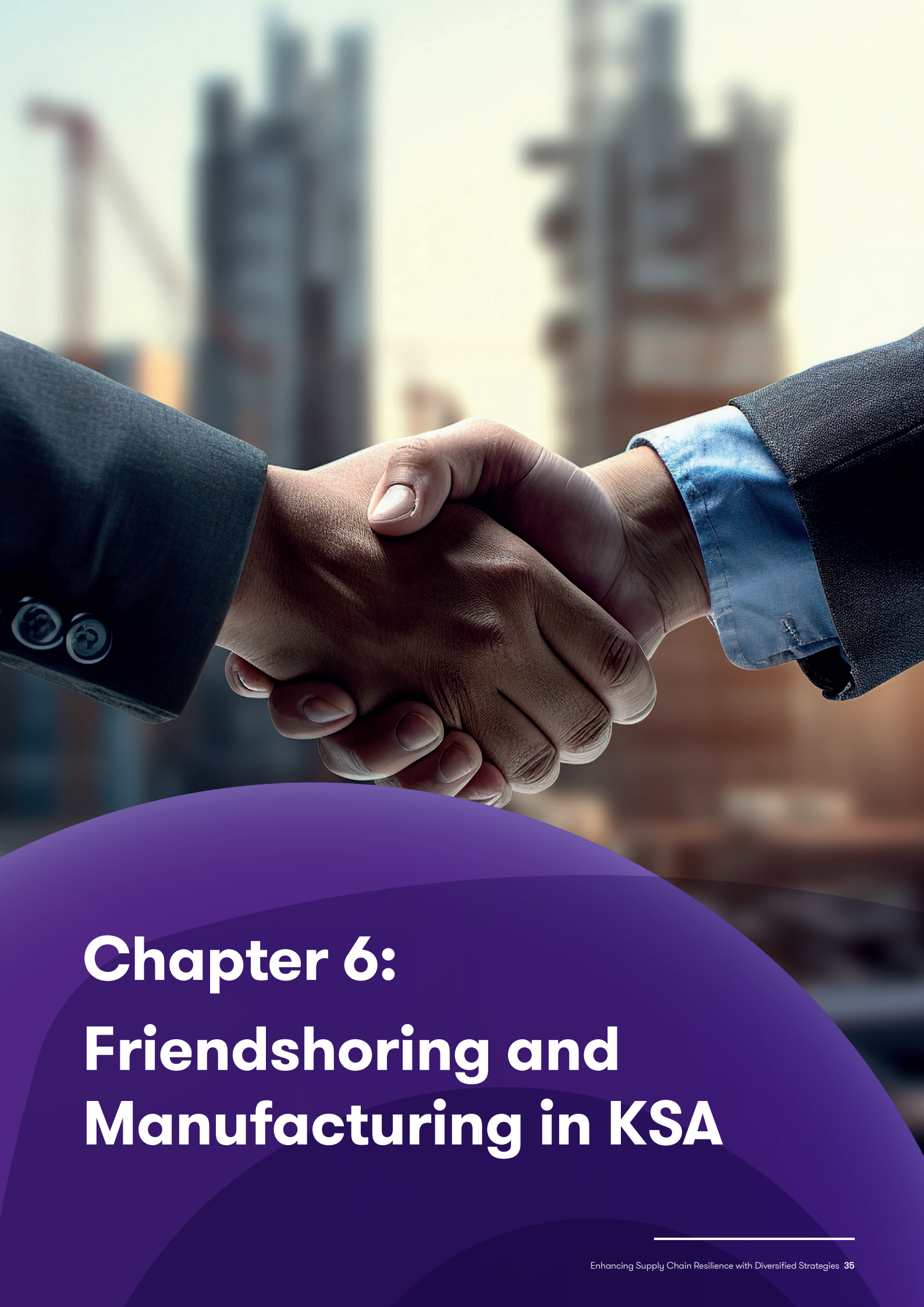
Following February 2022, with an increasing demand for Indian produce, wheat exports from India increased, filling part of the gap in the global markets caused by the halt of exports from Ukraine.

Case study: Policies on onion exports

Another case of export control measures is the onion export ban implemented in December 2023 as a response to domestic supply crunch. The Indian Government initially imposed a 40% export duty on onions, later reduced to 20% due to opposition from farmers. However, this measure failed to curb exports and stabilise prices. Subsequently, the Government introduced a Minimum Export Price (MEP) of USD 800 per metric ton, resulting in a marginal reduction in exports. Finally, onion exports were completely banned to address domestic supply concerns and control rising prices.

Way ahead

Taking lessons from major supply chain shocks, several countries are now taking the self-sufficiency in agricultural production to de-risk their food supply chains. Increasing domestic production will reduce import dependency thereby shielding countries from excess inflation and potential supply gaps in cases of disruptions in supply chains. China is a net importer of agricultural produce. However, the Government's approach to food security aims to achieve self-sufficiency through focus on domestic supply. They are also trying to diversify supply chains through the Belt and Road Initiative and increasing imports from Brazil following a trade-war with the US. Caribbean countries are working on increasing agricultural production and urging consumers to buy local food. India is adopting various schemes to strengthen local production such as focus on agricultural intensification, increasing domestic palm oil production through National Food Security Mission – oilseeds and oil palm, increasing domestic pulses production under Rashtriya Krishi Vikas Yojana, and various initiatives under Mission for Integrated Development of Horticulture.



Chapter 6:

Friendshoring and

Manufacturing in KSA

Friendshoring and Manufacturing in KSA

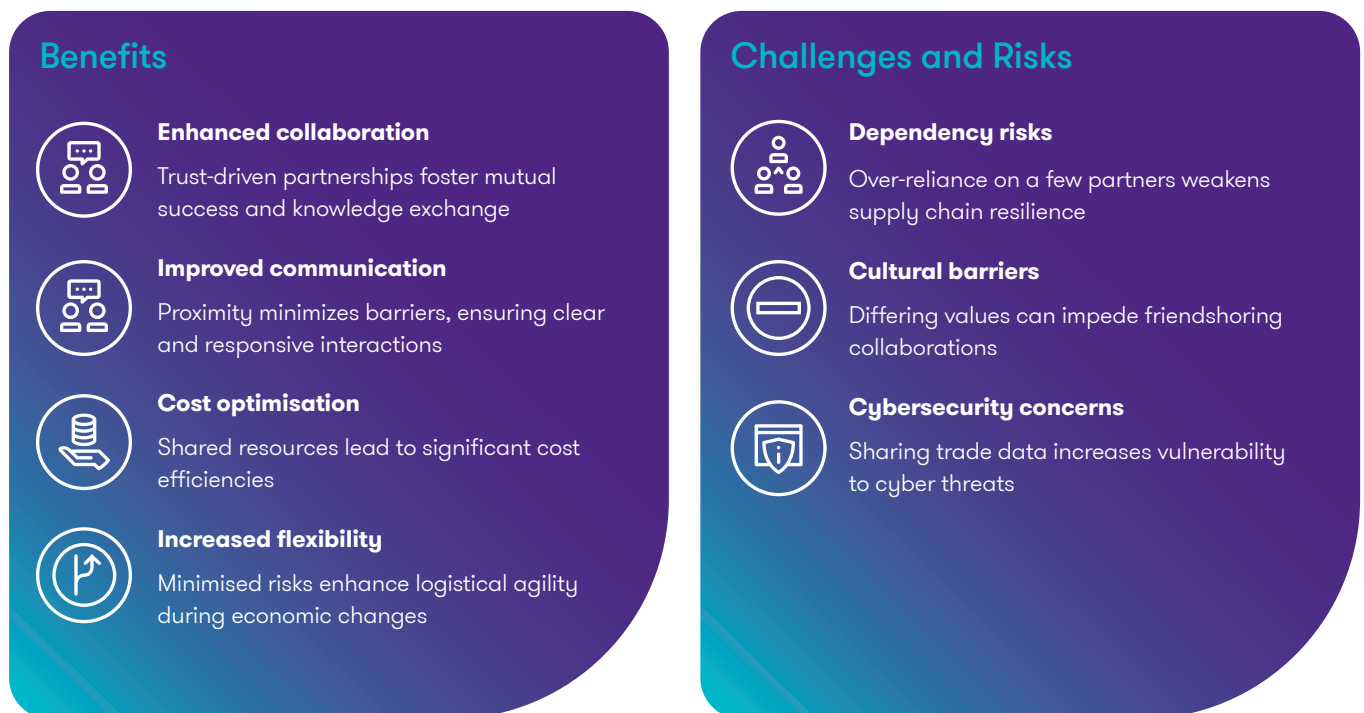
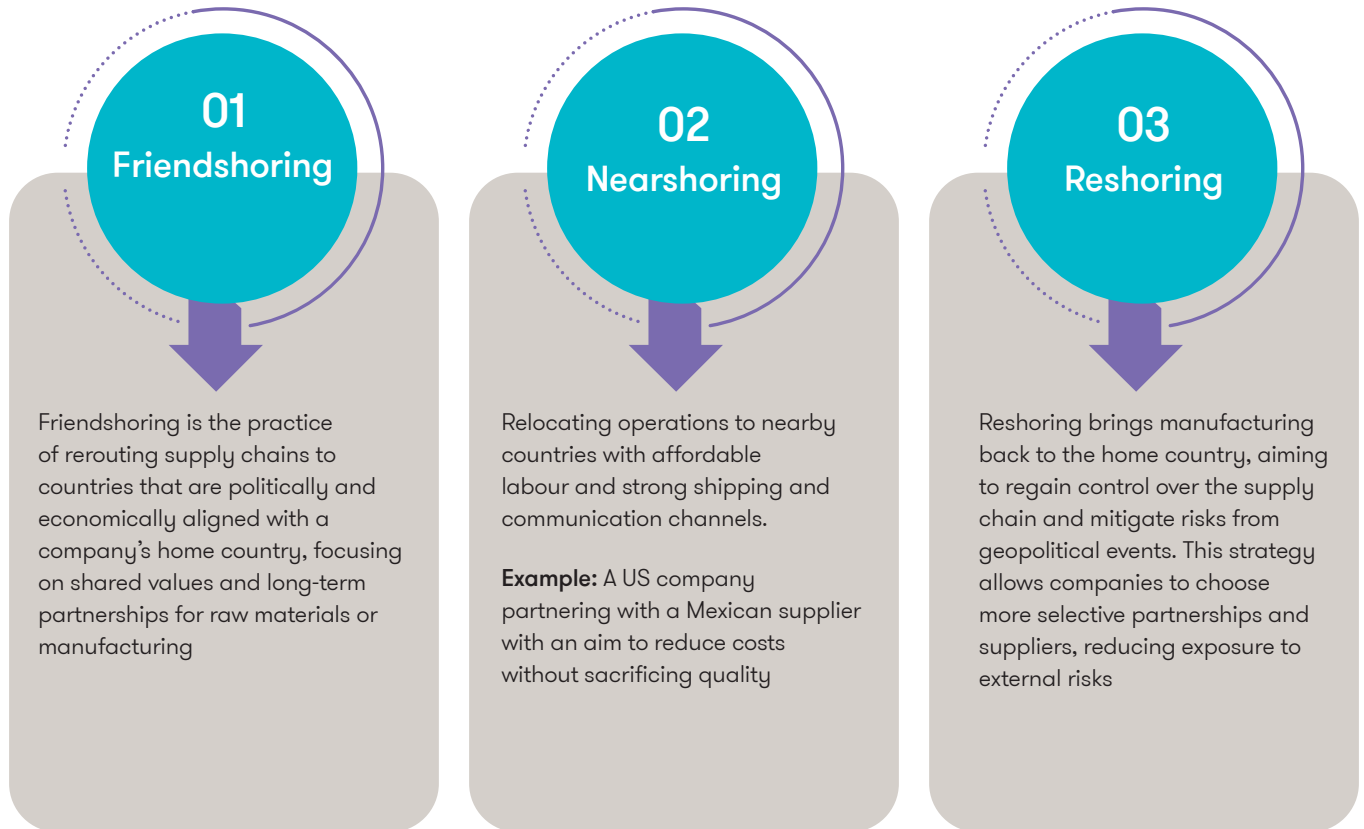
Case Study:

US-Mexico-Canada Agreement (USMCA) as a model of friendshoring

Amid rising geopolitical tensions and trade challenges, the “Friendshoring” strategy has become prominent method to strengthen supply chains by fostering partnerships with trusted allies and like-minded countries. In the food and beverage (F&B) sector, this approach can bolster local manufacturing by investing in agricultural infrastructure and processing facilities.

This not only enhances operational efficiency but also improves transparency, traceability, and sustainability. For instance, both Saudi Arabia and the US are exploring “Friendshoring” strategies to transform their supply chains and reduce vulnerabilities. As Saudi Arabia makes progress on its Vision 2030 initiative, emphasising economic diversification and sustainable growth, the country’s strategic location and commitment to innovation make it a significant player in reshaping global supply chains.

In order to mitigate the challenges and exploring the opportunities, following methods could be adopted for better trade relations and achieving the targeted trade volume that the other countries have already adopted.



Case Study: CPTPP - A Friendshoring Triumph

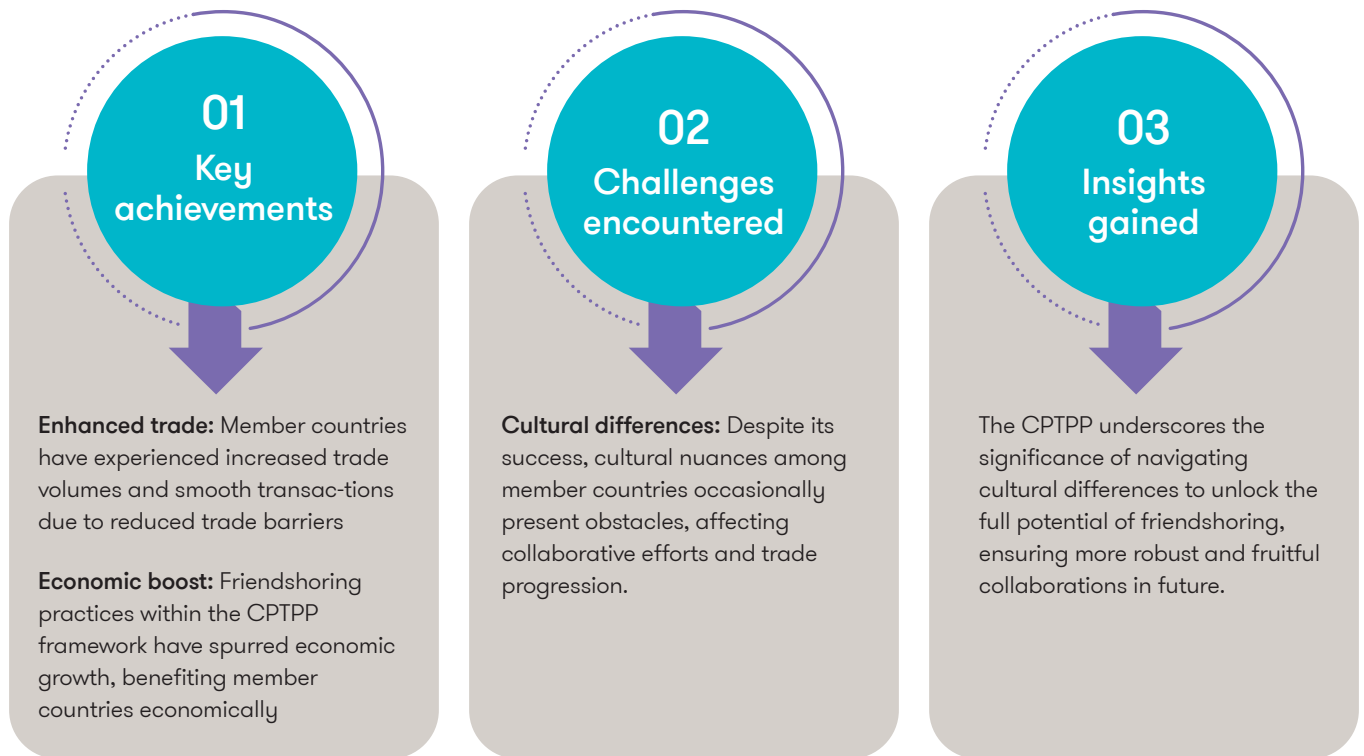


Disclaimer: Maps are for graphical purposes only. They do not represent a legal survey

Source- cptpp-countries

Background

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) is a landmark free trade agreement involving countries such as Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam.



The changing landscape of manufacturing

Recent global shifts, including US-China trade tensions, the Covid-19 pandemic, and geopolitical changes, have prompted a re-evaluation of sourcing strategies in the manufacturing sector. Traditional supply chains are undergoing transformation, leading to increased interest in alternative approaches, such as Friendshoring, to boost local manufacturing and reduce dependency on imports

The Role of Friendshoring in Manufacturing

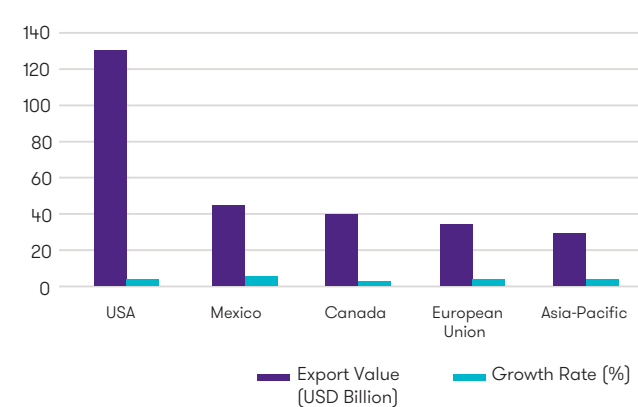


Friendshoring in action

A notable example of Friendshoring involves US-based manufacturing companies partnering with Mexican producers. This collaboration leverages Mexico’s manufacturing strengths, proximity to the US market, and favourable trade agreements to optimise production, reduce costs, and enhance supply chain efficiency.

Such strategic alliances exemplify the benefits of regional collaboration and mutual growth in the manufacturing sector.

The Role of Friendshoring in Manufacturing



Data Source: Manufacturing Industry Reports 2022

Enhancing local manufacturing capabilities through friendshoring

The global supply chain landscape has undergone significant transformations due to various geopolitical and economic factors, including US-China trade tensions, the Covid-19 pandemic, and geopolitical shocks. These disruptions have prompted a re-evaluation of supply chain strategies, leading to shifts in sourcing patterns and an increased focus on resilience and independence.

Reducing dependency on imports

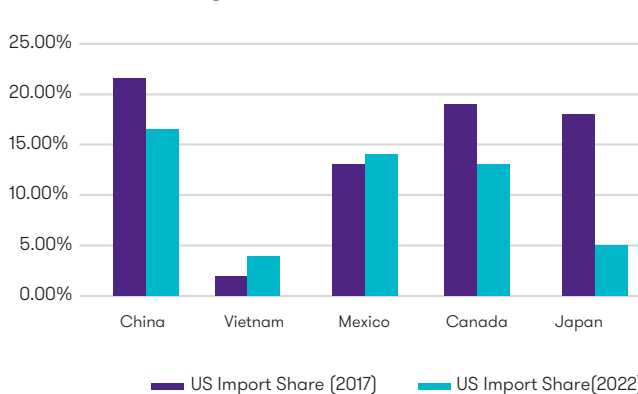
Friendshoring and nearshoring strategies offer promising avenues to reduce dependency on imports and bolster local manufacturing capabilities. By forging stronger partnerships with neighbouring countries or trusted allies, companies can leverage:

- Shared economic systems
- Regulatory frameworks
- Logistical advantages to streamline production and distribution processes

Examples

Let’s consider the example of the US, where recent data illustrates a shift in sourcing patterns. Direct sourcing from China has declined, while low-wage locations like Vietnam and nearshoring alternatives such as Mexico have seen an uptick in import shares. This reallocation reflects an early phase of reshoring and nearshoring activities aimed at reducing dependency on Chinese supply chains.

Shift in US Sourcing Patterns



Data Source: Goods trade data (Census Basis) and services trade data (BOP basis) are from the US Census Bureau; downloaded in June 2023

The table above highlights the changing dynamics of US imports, showcasing a decline in dependency on Chinese imports and an increase in sourcing from Vietnam and Mexico. These shifts underscore the potential of friendshoring and nearshoring strategies in diversifying supply chains and reducing dependency on single-source suppliers.

- **Trade evolution:** From 2012-2022, US imports have shifted towards lower-income countries.
- **Key partners:** Mexico and Vietnam showed steady growth as pivotal trade partners for the US.
- **Opportunity:** Friendshoring emphasises regional collaboration, offering potential for manufacturing growth

In the context of the food and beverage sector, companies can explore friendshoring opportunities by partnering with neighbouring countries or allies with strong agricultural capabilities. For instance, Saudi Arabia could consider strengthening its trade relations with countries like Egypt or Turkey, known for their agricultural prowess, to enhance local food production and reduce dependency on imports.

Kingdom of Saudi Arabia

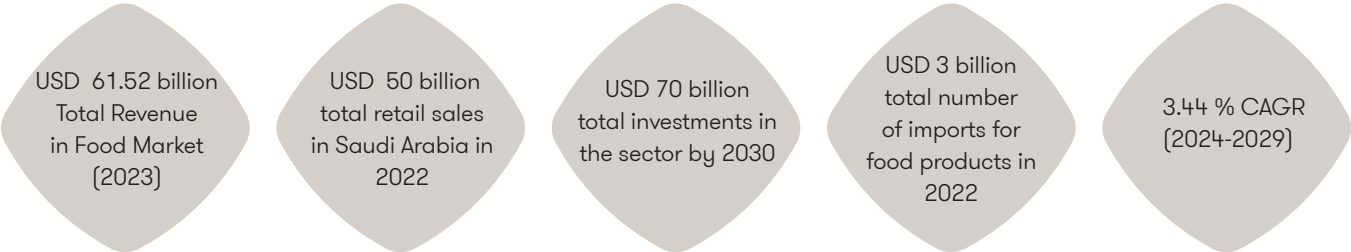
Kingdom of Saudi Arabia (KSA), a “fossil fuel superpower” is one of the top twenty economies in the world, a country with a business-friendly and trade-oriented environment.

From 2017, the values of food imports rose at an annual growth rate of 7.25%, and the country’s food market is expected to continue to grow annually by 9.34% until 2029. Food imports also continued to rise, especially for cereals, rice, meat, and dairy products.

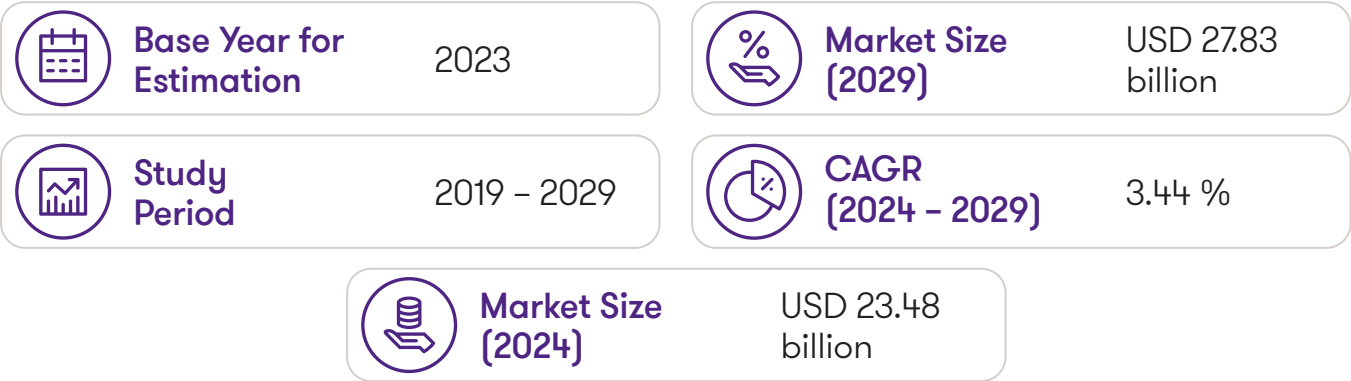


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Market overview



KSA Food & Beverage Market Size



The Saudi Arabia Food & Beverage Market size is estimated at USD 23.48 billion in 2024, and is expected to reach USD 27.83 billion by 2029, growing at a CAGR of 3.44% during the forecast period (2024-2029).

- The Saudi Arabian food and beverage market is growing significantly, driven by the expanding food and dairy sectors and increasing consumer demand, particularly for milk and dairy products.
- Local food producers are experiencing growth, attracting interest from global companies seeking to capitalise on the market's potential.
- Dairy consumption in Saudi Arabia saw a notable increase during Ramadan, with milk production exceeding 7 million litres per day.
- Daily transportation and distribution of dairy products require more than 10,000 trucks, serving approximately 38,000 retail stores.

To enhance local food production and reduce dependency on imports, Saudi Arabia can explore partnerships with neighbouring countries such as Egypt or Turkey, known for agricultural capabilities.

Saudi Arabia's Global Trade and Logistics Ambitions

Investment:

Saudi Arabia commits 10 billion riyals (USD 2.7 billion) to lure global logistics firms

Initiative goal:

The country aims to secure 40 billion riyals in investments, aspiring to rank among the world's top 15 economies by 2030.

Strategic focus:

- Establishing special economic zones
- Emphasising transport, logistics, digital infrastructure, and renewable energy sectors
- Encouraging manufacturing of green metals, hydrogen production, and advanced recycling

Why Saudi Arabia?

- Robust and fastest-growing economy in the G20
- Strategic location at the crossroads of three continents
- Abundant resources including oil, gas, and renewable energy

Saudi Arabia's vision:

Positioning as the regional hub for transport, logistics, and renewable energy

Strategic advantage:

- Resilient economy
- Strategic location connecting Asia, Europe, and Africa
- Competitive costs for resources and labour

Investment targets:

- Green metals manufacturing
- Green hydrogen production devices
- Advanced recycling industries

Regional collaboration:

- Engaging neighbouring countries to fortify trade alliances
- Leveraging friendshoring to bolster manufacturing capacities and reduce external dependencies

Persian Gulf Region's Logistics & Trade Hub

Benefits and risks of involvement in a multi-stakeholder supply chain approach

Stakeholders	Benefits of Involvement	Risks of Involvement
Manufacturers and retailers in importing countries	<ul style="list-style-type: none"> More sustainable sourcing without creating new supply chains can be cost-effective. A stable and sustainable supply chain offers benefits to manufacturers and retailers 	<ul style="list-style-type: none"> Sustainability may not offer value to companies where it's not a concern. Adopting standards set by competitors based on unique sourcing criteria can be challenging
Social NGOs	<ul style="list-style-type: none"> Organisations can extend their influence on pricing for small-holders and employment practices, leading to a broader impact 	<ul style="list-style-type: none"> Collaborating with competitors may require compromising to reach agreements, risking perception issues.
Environmental NGOs	<ul style="list-style-type: none"> Increased likelihood of preserving valuable forests and wildlife corridors for continuous habitat connectivity. Environmental practices like terracing and cover crops can become standard business practices 	<ul style="list-style-type: none"> Adopting standards from organisations with different core interests or priorities can pose challenges
Responsible Plantations and Growers Organisations	<ul style="list-style-type: none"> More growers adopting good practices from responsible businesses can create a level playing field 	<ul style="list-style-type: none"> Costs of implementation and documentation
Smallholder farmers	<ul style="list-style-type: none"> Potential for improved participation, sustainability and business performance 	<ul style="list-style-type: none"> Challenges include limited influence in the process and associated implementation and documentation costs
Governments/public sector	<ul style="list-style-type: none"> Adopted standards align with local laws and regulations in producing countries. Participation in the process demonstrates responsiveness and accessibility. 	<ul style="list-style-type: none"> This involvement may reduce the influence of local officials

Source- Using RSPO as an example. Based in part on Tennyson, R. & Wilde L., 2000 The guiding hand: brokering partnerships for sustainable development (ed. S. McManus). United Nations Department of Public Information, 116 pp

Conclusion

Supply chain optimisation

Emphasising lean practices, digital integration, and agile approaches ensures sustainable and resilient food supply chains

Tech revolution

Leveraging AI, IoT, and Blockchain technologies can significantly enhance supply chain efficiency in the F&B industry, prioritising cost reduction and operational performance

Eco-friendly Logistics

Logistics, responsible for 10% of global emissions, requires eco-friendly strategies to combat climate change and supply chain disruptions as well to enhance efficiency while reducing waste and emissions

Circular Economy

Addressing the one-third food waste challenge, a circular economy emphasises waste reduction, reuse, and recycling, ensuring sustainable food systems

Secure food sourcing

Amid global disruptions such as the COVID-19 pandemic and geopolitical tensions, the F&B industry seeks stable sourcing strategies. Countries are implementing policies to stabilise prices, ensure food security, and boost domestic production

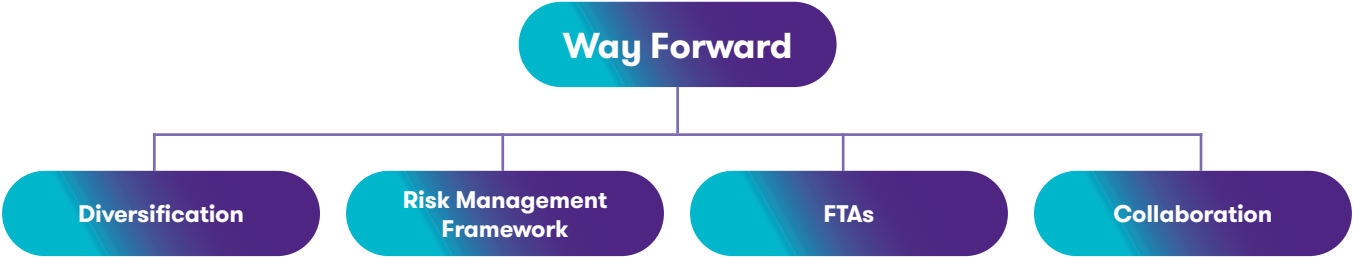
Global Friendshoring in manufacturing

“Friendshoring” is gaining traction as a strategy to strengthen supply chains. By fostering partnerships with aligned countries, this approach aims to enhance operational efficiency and reduce import dependency

Multi-stakeholder engagement

NGOs, universities, and local networks provide crucial insights, ensuring practicality and commitment in sustainability projects

Way Forward



Diversification

By diversifying sourcing locations, suppliers, transportation routes, and production facilities, organizations can mitigate the impact of disruptions and enhance their resilience.

Therefore, businesses must strike a balance between diversification and efficiency, leveraging technology, data analytics, and strategic partnerships to optimize their supply chain resilience

Risk Management Framework

It includes building Consensus through coordination and Collaboration, Diversification of Sourcing, Production and shipping, Develop capacity for new alternatives, Investment and Financing and Technological advancements.

By adopting these frameworks risk can be mitigated considerably in the supply chain and enhance their resilience

Free Trade Agreements

(FTAs) can play a crucial role in mitigating risks in the food supply chain by fostering greater market access, promoting regulatory harmonization, and enhancing cooperation among trading partners, following are the points to be considered.

Diversification of sourcing, Regulatory structure, Transparency and Traceability, Dispute resolution mechanism, technical assistance

Collaborations

Collaborations will help in information sharing, joint planning, goal congruence, joint problem solving, risk and reward sharing, and the sharing of resources. During any disruption, firms collaborate with relief providers, governments, and their competitors at a horizontal level. Similarly, at a vertical level, these firms, necessarily also collaborate with their suppliers and buyers.

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