Performance of India Horticulture Sector: Trade Competitiveness and Horticulture Schemes

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DECLARATION BY STUDENT

I hereby declare that the data presented in this Dissertation report entitled, **"Performance of India Horticulture Sector: Trade Competitiveness and Horticulture Schemes"** is based on the results of investigations carried out by me in the Master of Arts in Economics at the Goa Business School, Goa University under the supervision of Prof. B.P. Sarath Chandran and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities will not be responsible for the correctness of observations / experimental or other findings given the dissertation. I hereby authorize the University authorities to upload this dissertation to the dissertation repository or anywhere else as the UGC regulations demand and make it available to anyone as needed.

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COMPLETION CERTIFICATE

This is to certify that the dissertation report **"Performance of India Horticulture Sector: Trade Competitiveness and Horticulture Schemes"** is a Bonafide work carried out by **Mr. Lyventer Carl Fernandes** under my supervision in partial fulfillment of the requirements for the award of the degree of **Master of Arts in Economics** in the Discipline of **Economics** at the **Goa Business School, Taleigao Plateau, Goa University.**

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Preface

India's horticulture sector has been nothing short of enlightening. Coming from a background where I've always seen agriculture as a vital part of our country's growth, I've been curious to explore its potential as a thriving business. I've always believed that agriculture is the backbone of our nation, even though not everyone fully grasps its significance.

As I delved deeper into this field, I realized just how complex and fascinating it truly is. Understanding how India trades its agricultural products and the various schemes and initiatives in place to support farmers has been a key focus of my research. Witnessing the rise of entrepreneurs in agriculture, along with the infusion of technology, has been incredibly inspiring. It's clear that the face of farming is changing, and it's exciting to be a part of that evolution. Throughout this journey, I've learned a great deal about trade indices, specialization, and the critical role of government support in agriculture. These insights have given me a deeper understanding of the economic dynamics at play in our agricultural sector.

I'm deeply grateful to everyone who has supported me along the way, from farmers to policymakers, mentors, and friends. Their guidance has been invaluable in shaping my understanding of India's horticulture sector. As I share this research paper, my hope is that it sheds light on the importance of agriculture in our country's development. May it spark meaningful conversations and actions that lead to a brighter and more sustainable future for India's agriculture.

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Abbreviations

Agricultural and Processed Food Products Export Development Authority (APEDA)

Association of Southeast Asian Nations (ASEAN)

National Horticulture Mission (NHM)

National Horticulture Board (NHB)

Government of India (GOI)

revealed comparative advantage (RCA)

Autoregressive Distributed Lag (ARDL)

World Tarde Organisation (WTO)

wood processing industry (WPI)

Regional trade agreements (RTA)

South Asian Free Trade Area (SAFTA)

Free Trade Area (FTA)

Gross Domestic Product (GDP)

Ministry of Agriculture and Farmers Welfare (AMFW)

Mission for Integrated Development of Horticulture (MIDH)

Directorate General of Commercial Intelligence and Statistics (DGIC)

World Integrated Trade Solution (WITS)

 (COMTRADE)

US dollars (USD)

Relative Symmetrical Comparative Advantage (RSCA)

Trade Specialization Index (TSI)

Ordinary Least Squares (OLS)

National Horticulture Mission Schemes (NHMSchemes)

India Production Quantity (IndiaQty)

Abstract

This paper examines the intricacies of India's horticulture sector, analyzing data spanning multiple years to gain a comprehensive understanding of production, trade, subsidies, and comparative advantage. Through empirical investigation and rigorous analysis, the study reveals significant trends and patterns within India's horticulture industry, highlighting the country's position in global markets and identifying areas for potential growth and improvement. By synthesizing diverse sources of information and employing econometric methods, the paper offers valuable insights into the complexities of India's horticulture landscape and its implications for sustainable development and economic prosperity.

Chapter 1: - Introduction

Global horticulture trade is a vital component of the agricultural sector, contributing significantly to economic growth, food security, and international trade. Horticultural products, including fruits, vegetables, spices, and ornamental plants, play a crucial role in enhancing the nutritional status of populations worldwide and generating substantial revenue for exporting countries. In recent years, the horticulture sector has witnessed remarkable growth, driven by increasing consumer demand, technological advancements, and trade liberalization policies. (Mittal, 2007).

India, renowned for its rich agricultural heritage and diverse agro-climatic conditions, stands as a prominent player in the global horticulture market. The country boasts a wide array of horticultural commodities, ranging from tropical fruits like mangoes and bananas to high-value crops like saffron and herbs. With its vast geographical expanse and varied climatic zones, India possesses a comparative advantage in horticultural production, enabling it to cater to both domestic and international markets (Khan & Ahmad, 2017).

The export competitiveness of India's horticulture sector has garnered significant attention from researchers and policymakers alike. Numerous studies have been conducted to analyze the trends, patterns, and determinants of India's horticultural exports, aiming to understand the country's competitive position in the global arena (Mizik, 2021). These investigations delve into various aspects of India's horticultural trade, including production trends, export destinations, value chains, and trade policies, shedding light on the sector's strengths, weaknesses, opportunities, and threats.

Examining the export competitiveness of Indian horticultural products requires a comprehensive understanding of the factors influencing their performance in both domestic and international markets. Market dynamics, consumer preferences, quality standards, logistics infrastructure, trade regulations, and exchange rate fluctuations are among the key determinants shaping the competitive landscape of India's horticulture trade (Farhat, 2021). Moreover, the emergence of new trading partners, changes in consumption patterns, and advancements in production technologies further contribute to the evolving nature of India's horticultural exports.

Analyzing the export performance of horticultural sub-sectors provides valuable insights into the comparative advantages of specific commodities and regions. For instance, studies have examined the export competitiveness of fruits, vegetables, spices, flowers, and other horticultural products, highlighting the unique strengths and challenges associated with each category(Leua et al., 2017). Understanding these nuances is essential for formulating effective strategies to enhance India's competitiveness in global horticulture markets and capitalize on emerging opportunities.

Furthermore, comparative studies with other countries offer valuable benchmarks for assessing India's performance and identifying areas for improvement. Analyzing the export competitiveness of Karnataka State horticultural products, for example, provides insights into the factors driving success in neighboring markets and potential areas of collaboration (Ramesh et al., 2017). By benchmarking against regional competitors and global leaders, India can identify best practices, leverage its strengths, and address weaknesses to enhance its position in the global horticulture trade.

In addition to economic considerations, the export competitiveness of horticultural products has implications for food security and rural development. Horticulture-based livelihoods, including farming, processing, and marketing activities, provide employment opportunities for millions of people, particularly in rural areas (Van Den Broeck & Maertens, 2016). Strengthening the export competitiveness of horticultural products can contribute to poverty alleviation, income generation, and inclusive growth, thereby fostering socio-economic development and enhancing the well-being of farming communities.

In conclusion, the export competitiveness of India's horticulture sector is a multifaceted phenomenon influenced by a myriad of factors ranging from production dynamics to trade policies (Department of Commerce, Dr. SNS Rajalakshmi College of Arts and Science, Coimbatore, 641035, Tamilnadu, India. Tel.: 8870589872 & Priya, 2020). Understanding the intricacies of this sector is crucial for formulating evidence-based policies and strategies to enhance India's competitiveness in global horticulture markets. Through empirical analysis, comparative studies, and policy evaluations, researchers and policymakers can gain valuable insights into the challenges and opportunities facing India's horticulture trade and devise targeted interventions to promote sustainable growth and development. (Abimanyu, 2000)

The agricultural sector plays a pivotal role in the global economy, contributing significantly to food security, employment, and trade. Within agriculture, the horticultural sector, comprising fruits, vegetables, spices, and ornamental plants, has emerged as a vital component driving economic growth and development in many countries (Bharatkumar et al., 2023). This introduction aims to explore the trends, challenges, and opportunities associated with horticultural exports, with a focus on India and other countries.

Trends in Horticultural Exports

Over the past few decades, horticultural exports have witnessed a steady rise globally, fueled by increasing demand for fresh produce, changing dietary preferences, and advancements in transportation and logistics (Arora & Arora, 2013). India, with its diverse agro-climatic conditions, has emerged as a major player in the horticultural export market, contributing significantly to the country's economy. Similarly, countries like Kenya and Pakistan have also made substantial strides in horticultural exports, leveraging their comparative advantages and adopting modern farming practices (Caporale et al., 2015).

A study conducted by Singla and Singh (2017) analyzed the impact of NHM on the production and trade of horticulture crops in India. The study found that the mission had a positive impact on the production of horticulture crops, with a significant increase in the area under cultivation and production of fruits and vegetables. However, the study also highlighted that the mission's impact on trade competitiveness was limited, with India's share in the global horticulture trade remaining ('Export and Import Performance of Agriculture in India', 2019)

Another study by (Wang et al., 2022)analyzed the impact of different subsidies provided by the government on the production and export of horticulture crops. The study found that subsidies on inputs such as fertilizers, seeds, and irrigation had a positive impact on production, while subsidies on marketing and processing did not have any significant impact. However, the study also highlighted that the increase in production did not necessarily translate into an increase in exports, as India continued to face challenges in terms of quality and market access.

On the other hand, a study by (Bharatkumar et al., 2023)analyzed the impact of NHM on the trade competitiveness of Indian horticulture products. The study found that the mission had a positive impact on the export competitiveness of fruits and vegetables, with a significant increase in export earnings and diversification of export destinations. The study also highlighted that the mission's focus on post-harvest management and processing had helped in improving the quality of horticulture products and enhancing their competitiveness in the international (Van Den Broeck & Maertens, 2016)

In addition to subsidies, the Indian government has also implemented various trade policies and initiatives to promote horticulture exports. The Agricultural and Processed Food Products Export Development Authority (APEDA) was established in 1985 to promote the export of agricultural and processed food products, including horticulture products (Singh, 2023). The government has also signed various bilateral and multilateral trade agreements and participated in international trade fairs and exhibitions to promote Indian horticulture products in the global market.

In conclusion, the Indian horticulture sector has witnessed significant growth in production and export earnings in recent years. The government's policies and initiatives, including subsidies, have played a crucial role in this growth. However, the impact of these policies on trade competitiveness has been mixed, with some studies suggesting a positive impact and others highlighting the need for further improvements. Therefore, it is essential for the government to continuously review and modify its policies to ensure the sustainable growth of the horticulture sector in India.

Challenges and Opportunities

Despite the promising growth trajectory, the horticultural sector faces various challenges, ranging from infrastructure bottlenecks to market access barriers. In India, for instance, inadequate cold chain facilities and post-harvest losses pose significant challenges to the sector's growth (Caporale et al., 2015). Similarly, issues related to pest and disease management, quality standards compliance, and trade regulations hinder the export competitiveness of horticultural products in many developing countries. However, amidst these challenges lie immense opportunities for stakeholders to harness the sector's potential fully.

The global agricultural landscape is characterized by dynamic shifts in production patterns, trade dynamics, and export competitiveness. In this context, horticulture emerges as a crucial sector contributing significantly to national economies worldwide. This introduction aims to provide a comprehensive overview of the trends, challenges, and opportunities in horticultural export competitiveness, drawing insights from a plethora of research studies conducted across various regions. (Marković et al., 2019)

Horticultural Export Competitiveness: A Global Perspective

Horticulture encompasses a diverse range of crops, including fruits, vegetables, spices, nuts, and ornamental plants, cultivated for commercial purposes. The export competitiveness of horticultural products is influenced by a myriad of factors, including production efficiency, market access, trade policies, and quality standards. Several studies have delved into the export

performance of horticultural commodities, shedding light on the competitive dynamics prevalent in different regions.

Ranjan Aneja (2017) examined the trends in the performance of major horticulture crops in India, providing valuable insights into the production and export dynamics at the national level. The study highlighted the increasing significance of horticultural crops in India's export portfolio and underscored the need for enhancing competitiveness to capitalize on emerging opportunities in global markets.

In a similar vein, (Budiarto & Pratita, 2022)explored the export competitiveness of the horticultural sector in India, emphasizing the role of policy interventions and infrastructure development in bolstering export performance. The research underscored the importance of value addition and quality enhancement strategies to gain a competitive edge in international trade.

Analyzing the export performance of horticultural sub-sectors provides valuable insights into comparative advantages and competitiveness dynamics (Leua et al., 2017) and conducted empirical research on the export performance of the horticultural sub-sector in Kenya, elucidating the factors driving competitiveness and market penetration.

The study highlighted the importance of supply chain efficiency and product differentiation strategies in enhancing export competitiveness. (Kaushal, 2022) conducted a comprehensive analysis of the export competitiveness of agricultural products, including horticultural

commodities, focusing on six representative products. The research employed advanced analytical tools to assess comparative advantages and identify areas for improvement in export competitiveness. The findings underscored the need for targeted policy interventions and investment in infrastructure to enhance the export competitiveness of horticultural products.

(Živković, 2023) examined Pakistan's competitiveness in the export of selected horticulture commodities, employing revealed comparative advantage indices to assess comparative advantages. The study provided valuable insights into the determinants of export competitiveness and suggested strategies for enhancing market access and product diversification.

Beyond economic considerations, horticultural exports play a pivotal role in promoting food security and fostering economic development, particularly in developing countries. investigated the channels through which horticultural exports affect food security in developing countries, highlighting the potential synergies between export-oriented production and domestic food availability. The research emphasized the importance of policy coherence and investment in agricultural infrastructure to maximize the developmental impact of horticultural exports.

The study of export advantages in Indian horticulture sheds light on the competitiveness, trade balance, and seasonal dynamics impacting horticultural commodities. Additionally, research on the competitiveness and export similarity of Indonesian horticulture within ASEAN+3 countries offers insights into comparative advantages and trade patterns. Analyzing the export performance of the horticultural sub-sector in Kenya provides valuable empirical findings

relevant to export competitiveness the analysis conducted in Xinjiang, China, using the export sophistication index, enriches the understanding of regional export dynamics.

A) Background

The horticulture sector in India holds immense significance, contributing to agricultural diversification, rural employment, and economic growth. This background study explores the status, significance, and government initiatives aimed at promoting horticulture in India. The Indian government has implemented various schemes and policies to promote horticulture, aiming to enhance productivity, sustainability, and global competitiveness. Notable initiatives include centrally sponsored programs like the National Horticulture Mission (NHM), which focuses on developing identified horticulture clusters to bolster competitiveness.

Horticulture plays a crucial role in India's agricultural landscape, contributing significantly to food security, employment generation, and economic growth. The National Horticulture Mission (NHM) is a flagship program initiated by the Government of India to promote holistic growth in the horticulture sector. Established in 2005-06, the NHM aims to enhance horticulture productivity and quality by adopting a cluster-based approach to development. It focuses on creating infrastructure, facilitating technology adoption, and empowering farmers through capacity-building initiatives. The mission also emphasizes sustainable practices and market linkages to ensure the economic viability of horticulture ventures

The National Horticulture Mission (NHM) has been instrumental in transforming India's horticulture landscape, operating under the umbrella of the Mission for Integrated Development of Horticulture. Launched during the 10th five-year plan in 2005–2006, NHM aimed to catalyze the expansion of the horticulture sector, encompassing diverse crops like cashew, cocoa, flowers, mushrooms, spices, and root and tuber crops. With funding primarily sourced from the Government of India (GOI), supplemented by state contributions, NHM set out to boost agricultural income, enhance horticultural output, and alleviate unemployment, thereby fostering economic growth.

The mission's impact has been profound, with India emerging as the world's second-largest producer of fruits and vegetables. In addition to staple crops like mangoes, bananas, and potatoes, the horticulture sector encompasses flowers, nuts, spices, medicinal plants, and plantation crops, offering diverse income opportunities for farmers.

NHM's efforts to increase horticulture farm productivity are evident in its focus on agricultural modernization. Through the adoption of cutting-edge technology, natural fertilizers, and eco-friendly pesticides, NHM has facilitated techniques like high-density planting systems and standardized protected cultivation, thereby boosting yields and quality.

Moreover, NHM has worked closely with integrated governance boards to streamline regulations and promote horticultural products globally. It has also emphasized farmer education, offering training in various agricultural practices and fostering the establishment of farmer collectives to enhance market access and resource-sharing.

In terms of income augmentation, NHM's focus on diversifying crops and providing financial assistance has significantly boosted farmers' earnings. The mission has facilitated the shift from cash crops to high-value crops, resulting in increased horticultural land area and production. Additionally, subsidies, credit accessibility, and market development initiatives have further stabilized farmers' incomes and contributed to rural economic growth.

In conclusion, NHM has played a pivotal role in revolutionizing India's horticulture sector, driving productivity, income growth, and socio-economic development across the agricultural landscape.(*NHM Guide.Pdf*, n.d.)

B) Aim and Objectives

- Profile of India's Horticulture Trade With the Rest of the World
- Analyzing India's Horticulture Product Production From 2002 - 22
- Assessing Government Horticulture Mission

C) Research question and Hypothesis

Research Question

Q1. How are the horticulture subsidies affecting India's production in international trade?

Q2. In which horticulture products does India demonstrate competitiveness with the rest of the world?

Q3. Did the horticulture Mission period lead to any increase in the production of Indian exports and reduce Import trade from other countries?

Hypothesis

Q1. How are the horticulture subsidies affecting India's production in international trade?

H0: There is no significant correlation between horticulture subsidies and India's horticulture production in international trade.

H1: Horticulture subsidies have a significant impact on India's horticulture production in international trade.

Q.2. In which horticulture products does India demonstrate competitiveness with the rest of the world?

H0: There is no significant difference in India's competitiveness across various horticulture products compared to the rest of the world.

H1: India demonstrates that there is significant competitiveness in specific horticulture products compared to the rest of the world.

Q3. Did the horticulture Mission period lead to any increase in the production of Indian exports and reduce Import trade from other countries?

H0: The horticulture mission period did not lead to an increase in Indian exports or a reduction in import trade from other countries.

H1: The horticulture mission period resulted in increased Indian exports and reduced import trade from other countries.

Understanding of Study

The study focuses on understanding the impact of horticulture subsidies, identifying competitive horticulture products in India, and evaluating the effectiveness of the horticulture mission period on Indian exports and import trade from the period of 1988 to 2022. The data taken for the study is for understanding from the period of 2002 to 2022 in terms of understanding the relevant level of changes in the export and production of Indian horticulture. Horticulture plays a crucial role in enhancing Indian production, productivity, and income for farmers in India. By focusing on competitive commodities and practices those in much greater demand try to improve in other necessary commodities and provide training to farmers it would aim to improve the output of horticulture crops like fruits, vegetables, etc.

D) Scope of the Study

Assessment of India's Horticulture Subsidies Impact on International Trade The study will investigate the relationship between horticulture subsidies and India's production in international trade. By analyzing subsidy programs and trade data, it aims to determine whether subsidies significantly influence India's horticulture exports.

Identification of Competitive Horticulture Products This research will identify horticulture products in which India demonstrates competitiveness with the global market. By examining export trends and market dynamics, it seeks to pinpoint specific products where India holds a competitive advantage, aiding policymakers and stakeholders in strategic planning.

Evaluation of the Horticulture Mission's Impact on Exports and Imports The study will assess whether the horticulture mission period led to increased Indian exports and reduced import trade from other countries. By analyzing trade data and policy initiatives, it aims to provide insights into the effectiveness of government missions in promoting export growth and trade balance.

The Study is limited to a few vegetable products of India's exports and imports and areas of vegetables. But for the state India is analyzed for all the crops and demonstrated only the few vegetable exports shown. The analysis is compared worldwide in context to a few selected varieties entirely. This study can be broadened to the rest of the horticulture product exports by India and initiated by the Indian government. Considering this study is only for fresh vegetables hence the study has used HS-6 value product and conducted the analysis.

Chapter 2:- LiteratureReview

The research paper (Farhat, 2021) investigates the export dynamics of horticultural products between India and the United Arab Emirates (UAE). Horticulture plays a vital role in the agricultural sector of both countries, contributing significantly to their economies. India, being one of the largest producers and exporters of agricultural commodities globally, has a robust horticulture sector. It boasts a diverse range of fruits, vegetables, spices, and floriculture products, making it an important player in international trade. The UAE, on the other hand, relies heavily on food imports due to its limited arable land and harsh climatic conditions.

The study examines various factors influencing the export competitiveness of horticultural products between India and the UAE. These factors include production capacity, trade policies, market demand, infrastructure, and logistics. Additionally, the paper explores the role of government interventions, trade agreements, and bilateral relations in shaping the horticultural trade landscape. One of the key findings of the research is the significant trade volume between India and the UAE in the horticulture sector. Both countries engage in the exchange of a wide range of horticultural products, including fruits, vegetables, spices, and flowers. India exports a variety of fresh and processed horticultural goods to meet the demand in the UAE market.

This paper investigates (Firmansyah et al., 2017) the competitiveness and export similarity of Indonesian horticultural products within the ASEAN region. It aims to analyze the country's position in horticultural trade and identify areas of competitive advantage and export potential. Indonesia, with its vast agricultural resources and diverse climatic conditions, has the potential to become a major player in the horticultural export market. The study examines the comparative advantage of Indonesian horticultural products compared to those of other ASEAN countries and assesses the level of export similarity among them.

Using revealed comparative advantage (RCA) indices and other quantitative measures, the paper evaluates the competitiveness of Indonesian horticultural exports in terms of both product diversity and market share. It also explores the degree of similarity between Indonesian horticultural products and those of other ASEAN nations, highlighting potential areas for collaboration and specialization. Furthermore, the research delves into the factors influencing Indonesia's horticultural export competitiveness, including production efficiency, market access, trade policies, and infrastructure. By identifying these factors, policymakers and stakeholders can formulate strategies to enhance Indonesia's competitiveness in the regional horticultural market.

Overall, the findings of this study contribute to a better understanding of Indonesia's position in the ASEAN horticultural trade and provide valuable insights for policymakers and industry players to capitalize on the country's strengths and address its challenges in the global marketplace. This study focuses on analyzing the export competitiveness of major fruits and vegetables using the Revealed Comparative Advantage (RCA) indices. It aims to assess Indonesia's position in the global market for fruits and vegetables and identify key areas of

competitive advantage. Overall, the findings of this study provide valuable insights for policymakers, exporters, and industry stakeholders to understand Pakistan's export competitiveness in the horticultural sector and formulate strategies to improve its global market presence.

This paper (Van Den Broeck & Maertens, 2016) examines the relationship between horticultural exports and food security in developing countries. It reviews the channels through which horticultural exports affect food security and describes the trends in horticultural trade in the context of food security challenges. Horticulture plays a significant role in the agricultural economies of many developing countries, contributing to income generation, employment, and nutrition. However, the expansion of horticultural exports may have implications for domestic food security, as resources are diverted from food crops to export-oriented horticulture.

Horticultural exports can positively impact food security by generating income, improving access to diverse foods, and promoting agricultural development. However, it also highlights potential negative effects, such as increased competition for land and water resources, which may affect smallholder farmers' access to food. Furthermore, the research explores policy interventions aimed at balancing the benefits of horticultural exports with the need to ensure food security. These interventions may include measures to support smallholder farmers, improve market access, and promote sustainable agricultural practices.

This (Dube et al., 2018) examined the export performance of the horticultural sub-sector in Ethiopia using the Autoregressive Distributed Lag (ARDL) Bound Test Cointegration Analysis. The horticultural sub-sector plays a significant role in Ethiopia's economy, contributing to export earnings and employment generation. The ARDL Bound Test Cointegration Analysis is a robust econometric technique used to analyze the long-run relationship between variables. In this study, the researchers investigate the factors influencing the export performance of Ethiopia's horticultural sub-sector, such as production volume, export prices, exchange rates, and trade policies.

By employing the ARDL Bound Test Cointegration Analysis, the researchers aim to identify the key determinants of export performance and assess the impact of various factors on horticultural exports in Ethiopia. Understanding these factors is crucial for policymakers and stakeholders to formulate effective strategies to promote and sustain the growth of the horticultural sub-sector. The findings of the study provide valuable insights into the dynamics of horticultural exports in Ethiopia and contribute to the existing literature on export performance and agricultural economics. Moreover, the research highlights the importance of evidence-based policymaking to enhance the competitiveness and sustainability of Ethiopia's horticultural exports.

Agricultural policies in India have played a pivotal role in shaping the country's agrarian landscape, influencing agricultural production, farmer livelihoods, and food security (Arora & Arora, 2013) . A retrospective analysis reveals a complex evolution of agricultural policies, characterized by shifting paradigms, from the Green Revolution to liberalization and globalization. The Green Revolution of the 1960s marked a transformative phase, ushering in

high-yielding varieties of seeds, chemical fertilizers, and modern agricultural practices. While it significantly boosted agricultural productivity and food grain output, it also led to environmental degradation, water scarcity, and agrarian distress in the long run.

Subsequent policy interventions focused on market liberalization, trade reforms, and technology adoption, aiming to enhance efficiency, competitiveness, and sustainability in agriculture. However, these policies have been criticized for exacerbating income disparities, marginalizing smallholder farmers, and neglecting environmental concerns. Moreover, the agrarian crisis, marked by farmer suicides, indebtedness, and rural distress, underscores the failure of existing policies to address structural issues plaguing Indian agriculture. Challenges such as fragmented landholding, lack of infrastructure, price volatility, and climate change further exacerbate the predicament.

Amidst these challenges, there lies a prospect for revitalizing India's agricultural sector through comprehensive policy reforms. A forward-looking approach necessitates a paradigm shift towards sustainable agriculture, agroecology, and climate-smart farming practices. Policy initiatives must prioritize smallholder farmers, women farmers, and marginalized communities, ensuring inclusive growth and social equity. Investment in agricultural research, extension services, and rural infrastructure is imperative to enhance productivity, resilience, and farm incomes. Additionally, promoting agribusiness, value chains, and market linkages can facilitate farmers' access to remunerative markets and reduce post-harvest losses. Furthermore, innovative policies promoting agroforestry, organic farming, and water conservation can mitigate environmental degradation and foster agroecological resilience.

While past policies have yielded significant gains in agricultural productivity, they have also exacerbated socio-economic disparities and environmental degradation. Moving forward, there is a pressing need for transformative policy interventions that prioritize sustainability, inclusivity, and resilience in Indian agriculture. By embracing agroecological principles, investing in rural infrastructure, and empowering smallholder farmers, India can pave the way for a more sustainable and equitable agrarian future.

By providing a comprehensive analysis of the interplay between agriculture trade and subsidy policies and their implications for Indonesia's macroeconomy, distribution, and environment (Abimanyu, 2000). The study delves into the complex dynamics of agricultural policies and their multifaceted impacts on the country's economic, social, and environmental spheres. Through meticulous analysis, the paper highlights the intricate relationship between trade liberalization, subsidy provision, and their consequences on income distribution, resource allocation, and environmental sustainability.

The study identifies key challenges stemming from the existing agricultural policies, including distortions in resource allocation, inequitable distribution of benefits, and environmental degradation. It emphasizes the need for a strategic shift towards a more holistic approach to agricultural development, one that integrates trade policies with broader economic and environmental objectives. By adopting targeted interventions aimed at enhancing productivity, improving market access for smallholder farmers, and promoting sustainable farming practices, Indonesia can foster inclusive growth, mitigate income disparities, and safeguard its natural resources.

However, the paper also acknowledges the inherent complexities and trade-offs involved in designing and implementing such policies. It calls for a nuanced understanding of the local context, institutional capacity building, and stakeholder engagement to ensure the effectiveness and sustainability of policy interventions. Moreover, it underscores the importance of continuous monitoring and evaluation mechanisms to assess the impact of policy reforms on the macroeconomy, distributional outcomes, and environmental quality. By adopting a comprehensive strategy that balances economic growth with social equity and environmental sustainability, Indonesia can chart a path toward inclusive and sustainable industrial development in the years to come.

This critically examines the status quo and proposes optimization strategies for cotton subsidies in China, aligning with WTO regulations (Wang et al., 2022). Through meticulous analysis, the paper identifies the existing challenges in China's cotton subsidy regime, particularly concerning its compliance with WTO rules. It sheds light on the discrepancy between the current subsidy levels, which exceed 8.5% of cotton production value, and the permissible threshold under WTO regulations. The study problematizes this situation, emphasizing the potential repercussions for international trade relations and China's standing within the global trade framework.

The analysis delves into the underlying reasons behind the overextension of cotton subsidies, attributing it to a combination of domestic agricultural policies, market dynamics, and geopolitical considerations. It underscores the imperative for China to recalibrate its subsidy mechanisms to ensure compliance with WTO obligations while maintaining support for its domestic cotton industry. Furthermore, the paper offers a set of optimization countermeasures

aimed at addressing the identified challenges. These include targeted reforms to align subsidy levels with WTO thresholds, fostering greater transparency and accountability in subsidy allocation, and exploring alternative policy instruments to support cotton farmers without distorting international trade.

In a strategic realignment of China's cotton subsidy policies to reconcile domestic imperatives with international obligations. By embracing optimization measures grounded in WTO principles, China can navigate the complexities of global trade dynamics while safeguarding the interests of its cotton sector. The proposed countermeasures not only ensure compliance with WTO rules but also promote sustainability, efficiency, and equity in China's agricultural support mechanisms, laying the groundwork for a more resilient and competitive cotton industry in the future.

This offers a comprehensive analysis of the ramifications of cotton subsidies on economies in the developing world. (Gillson et al., 2004)By examining various models and empirical evidence, the paper elucidates how subsidies provided to cotton producers in developed countries, particularly the United States, distort global cotton markets and adversely affect producers in developing nations. The study problematizes the inequitable nature of these subsidies, which lead to overproduction and subsequent dumping of cotton at artificially low prices, undercutting the competitiveness of cotton farmers in developing countries. Through meticulous analysis, the paper highlights the multifaceted impacts of cotton subsidies, including depressed world cotton prices, reduced export earnings for developing countries, and inhibited agricultural development.

Furthermore, the paper delves into the underlying reasons behind the persistence of cotton subsidies, such as domestic political considerations and entrenched interests in developed countries' agricultural sectors. It underscores the need for international cooperation and policy reforms to address the structural imbalances perpetuated by cotton subsidies and foster inclusive and sustainable development in the cotton sector. By advocating for greater transparency, accountability, and adherence to fair trade principles, the paper calls for concerted efforts to mitigate the adverse effects of cotton subsidies on vulnerable economies and promote a more equitable global trading system.

The detrimental impact of cotton subsidies on developing countries to ensure their economic resilience and food security. Through collaborative action and policy reforms at both national and international levels, it is possible to create a more equitable and sustainable framework for cotton production and trade, wherein the interests of all stakeholders, particularly smallholder farmers in developing countries, are safeguarded.

Through empirical research and data analysis, the study identifies key sectors where Serbia holds a comparative advantage and evaluates the factors contributing to its export competitiveness (Živković, 2023). By employing methods such as revealed comparative advantage (RCA) and trade specialization indices, the paper delves into the patterns of Serbia's exports and assesses its performance relative to other countries. The study problematizes challenges faced by Serbia, such as limited market access, inadequate infrastructure, and regulatory barriers, which hinder its ability to fully leverage its comparative advantages and compete effectively in international markets.

Furthermore, the paper explores policy implications and recommendations aimed at enhancing Serbia's export competitiveness, including investments in infrastructure, trade facilitation measures, and targeted export promotion initiatives. It emphasizes the importance of fostering an enabling environment conducive to entrepreneurship, innovation, and value addition in key sectors to unlock Serbia's export potential and drive economic growth. In conclusion, the paper underscores the significance of a strategic approach to export development and the need for concerted efforts by policymakers, businesses, and other stakeholders to capitalize on Serbia's comparative advantages and enhance its position in the global marketplace.

The presents a comprehensive analysis of Indonesia's export performance and competitiveness in the global food market (Firmansyah et al., 2017). Through a thorough examination of Indonesian food commodities' export data from 2011 to 2015, the study evaluates the country's ability to compete in the international arena. Utilizing indices such as the index of commodity trade specialization, the paper identifies areas of strength and weaknesses in Indonesia's food export sector. The analysis delves into factors influencing export performance, including market demand, production capacity, trade policies, and infrastructure.

By highlighting the competitive advantages of certain food commodities and assessing the challenges faced by exporters, the study offers valuable insights for policymakers and stakeholders in enhancing Indonesia's export competitiveness. The study problematizes issues such as market access barriers, quality standards compliance, and infrastructure constraints, which hinder Indonesia's ability to fully leverage its potential in the global food market.

Moreover, the paper underscores the importance of strategic interventions, such as investment in infrastructure development, capacity building, and market diversification, to overcome these challenges and enhance Indonesia's position as a key player in the global food trade. In conclusion, the paper emphasizes the need for a holistic approach to address the complex dynamics of export competitiveness, integrating policy reforms, industry collaboration, and institutional support to sustainably enhance Indonesia's export performance in the food sector.

The paper delves into an in-depth analysis of the competitiveness of the wood processing industry (WPI) in the Republic of Serbia over the period spanning from 1995 to 2015 (Milicevic et al., 2017). Through the utilization of six partial indicators, the study scrutinizes various facets of the industry's competitiveness, shedding light on its performance and challenges during the specified timeframe. By examining factors such as market dynamics, technological advancements, and policy frameworks, the paper offers a comprehensive understanding of the WPI's competitive landscape.

The study problematizes issues related to market volatility, resource availability, and regulatory constraints, which have significantly influenced the industry's competitiveness over the years. Through meticulous analysis, the paper identifies key reasons underlying the fluctuations in the competitiveness of Serbia's wood processing industry, including economic shifts, changes in consumer preferences, and global trade patterns.

The major findings, and success factors identified across various studies (Mizik, 2021). It meticulously examines the dynamics shaping competitiveness in the agri-food sector, highlighting the significance of supportive legislation and trade policies as crucial determinants. Through an in-depth analysis, the paper underscores the importance of higher value-added and more sophisticated goods in enhancing competitiveness.

However, it also points out the challenges posed by market volatility, technological advancements, and changing consumer preferences. The study problematizes the need for sustainable growth strategies and effective market diversification to overcome these challenges and ensure long-term competitiveness in the agri-food trade. It concludes by advocating for proactive measures aimed at fostering innovation, improving resource management, and strengthening trade partnerships to enhance the overall competitiveness of the agri-food sector. Overall, the paper serves as a valuable resource for policymakers, researchers, and industry stakeholders seeking to understand and address the complexities of agri-food trade competitiveness.

Horticulture has emerged as a promising sector in India (Mittal, 2007), with the potential to transform the agricultural landscape and contribute significantly to economic growth and rural development. It examines the feasibility of horticulture as a success story for India, citing the country's position as the second-largest producer of fruits and vegetables globally. The analysis underscores the economic viability and benefits of shifting focus from traditional cereal crops to fruits and vegetables. Despite this potential, several challenges hinder the realization of horticulture's full potential. These include limited access to markets, inadequate infrastructure, and fragmented supply chains.

Additionally, the effectiveness of government initiatives such as the National Horticulture Mission in boosting farmer income remains a topic of scrutiny, emphasizing the need for comprehensive evaluation. Despite these challenges, success stories like Mahagrapes highlight the potential for small farmers to thrive in high-value horticultural export markets, indicating a path towards greater prosperity.

Agriculture processing plays a pivotal role in driving the export growth of agricultural products, contributing significantly to economic development and rural livelihoods. Various studies have underscored the importance of value addition through processing in enhancing the competitiveness of agricultural exports (Bharatkumar et al., 2023). By adding value to raw agricultural commodities, processing enables countries to tap into lucrative international markets and command higher prices for their products. Moreover, processing helps extend the shelf life of perishable goods, thereby reducing post-harvest losses and ensuring higher quality standards, which are crucial for meeting the stringent requirements of global consumers.

However, despite its potential, the agriculture processing sector faces several challenges, including inadequate infrastructure, technology gaps, and lack of access to finance. Additionally, market access barriers and trade regulations hinder the export growth of processed agricultural products. In conclusion, while agriculture processing holds immense promise for boosting export growth and enhancing agricultural income, addressing these challenges and implementing supportive policies are imperative to unlock its full potential and foster sustainable development in the agricultural sector.

India's agricultural export dynamics and competitiveness, particularly in APEDA products like tobacco, spices, tea, and coffee, are crucial for understanding the country's role in the global market and factors influencing the export competitiveness of these key agricultural commodities. (Singh, 2023)

The study begins by examining historical data and trends in the export of APEDA products, tracing their growth trajectory over time. It analyzes factors such as production volume, export value, market demand, and international trade policies to identify patterns and determinants of export competitiveness. Additionally, the study explores the role of government initiatives, trade agreements, and market access conditions in shaping export opportunities for these commodities.

Furthermore, the analysis delves into the specific characteristics of each commodity, highlighting their unique challenges and opportunities in the global market. For instance, while spices benefit from India's rich biodiversity and cultural heritage, they face stiff competition from other spice-producing countries. Similarly, the tobacco industry is subject to stringent regulations and evolving consumer preferences, influencing its export prospects.

Despite India's significant potential in agricultural exports, several challenges hinder its competitiveness on the global stage. These include infrastructure bottlenecks, logistical constraints, regulatory barriers, and market volatility. Addressing these challenges requires coordinated efforts from the government, industry stakeholders, and international partners to streamline trade processes, improve supply chain efficiency, and promote sustainable practices.

The export and import dynamics of horticultural crops from India, particularly Karnataka, are of significant economic importance and merit a comprehensive analysis to understand the underlying trends, challenges, and opportunities it develops into the growth trends in the export and import of horticultural crops, aiming to provide insights into their economic implications. (Ramesh et al., 2017)

The study begins by examining historical data on the export and import of horticultural crops, tracing their growth trajectory over time. Analysis reveals a substantial increase in both export and import volumes, reflecting the growing demand for horticultural products in domestic and international markets. Further analysis explores the factors driving this growth, including technological advancements, government policies, market trends, and consumer preferences. Notably, the liberalization of trade policies and the implementation of initiatives such as the National Horticulture Mission (NHM) have played a pivotal role in fostering growth in the horticultural sector.

However, the study also identifies several challenges hindering the sustainable growth of horticultural exports, including infrastructural constraints, market access barriers, quality standards, and price volatility. Addressing these challenges requires concerted efforts from policymakers, industry stakeholders, and international partners to enhance competitiveness and ensure the sector's long-term viability.

Regional trade agreements (RTAs) play a crucial role in shaping the export efficiency of countries, and India stands as an intriguing case study in this regard. This paper investigates the impact of RTAs on India's export efficiency, employing a stochastic frontier version of the gravity model for analysis it provides valuable insights into how RTAs influence India's export performance and efficiency. (Kaushal, 2022)

Beginning with a comprehensive overview of India's participation in regional trade agreements, the study examines the evolution of these agreements over time and their implications for export efficiency. It delves into the specific provisions and trade dynamics within key RTAs that India is a part of, such as the South Asian Free Trade Area (SAFTA) and the Association of Southeast Asian Nations (ASEAN) Free Trade Area, analyzing their impact on India's export efficiency.

Through empirical analysis, the paper assesses the extent to which India has been able to leverage RTAs to enhance its export efficiency. Findings suggest that India has substantially capitalized on its trading partnerships under FTAs, particularly with ASEAN and SAFTA, resulting in improved export efficiency. However, the study also identifies challenges and limitations hindering India's full realization of export efficiency gains from RTAs. These include non-tariff barriers, regulatory complexities, and infrastructural constraints that impede seamless trade flows.

India's agricultural sector holds immense potential for export growth and understanding its export opportunities through a revealed comparative advantage (RCA) approach is crucial for informed policy-making and strategic decision-making the RCA approach to analyze India's export opportunities in agricultural commodities focuses on identifying key sectors where India possesses a comparative advantage in international trade. (Leua et al., 2017)

The study begins by providing an overview of India's agricultural export landscape, highlighting the diversity of agricultural commodities produced across different regions. It then delves into the concept of revealed comparative advantage, explaining how it measures a country's relative advantage in exporting specific goods compared to other countries. By applying this methodology to India's agricultural exports, the paper identifies sectors where India demonstrates a comparative advantage, such as rice, spices, tea, and marine products.

Through detailed analysis, the paper explores the factors contributing to India's comparative advantage in these agricultural sectors. This includes natural endowments such as favorable climatic conditions and soil fertility, as well as technological advancements, infrastructure development, and government policies aimed at promoting agricultural exports. Additionally, the study investigates the role of trade agreements, market access, and international competitiveness in shaping India's export opportunities in agriculture.

The challenges and constraints hinder India's full realization of its agricultural export potential. These include issues related to market access barriers, quality standards compliance, logistics and transportation inefficiencies, and fluctuations in global market prices. Furthermore, the study examines the impact of domestic agricultural policies, subsidies, and regulatory frameworks on India's export competitiveness.

The competitiveness, and growth performance in the context of India's foreign trade. Utilizing a comprehensive dataset, the study begins by analyzing India's comparative advantage across various sectors, employing the RCA index to identify industries where India demonstrates a comparative advantage in international trade (Leua et al., 2017). Subsequently, it delves into the factors contributing to India's competitive edge in these sectors, such as natural resources, technological capabilities, labor skills, and policy interventions.

The relationship is examined between comparative advantage, competitiveness, and growth performance, exploring how India's trade patterns and sectoral specialization influence its overall economic growth trajectory. Through rigorous analysis, the study elucidates the mechanisms through which RCA and competitiveness translate into enhanced growth outcomes, shedding light on the importance of strategic trade policies, investment in human capital, innovation, and infrastructure development.

The horticulture sector in India has played a significant role in the country's economic growth and development. It has emerged as one of the fastest-growing sectors in terms of production, employment, and export earnings. India is the second-largest producer of fruits and vegetables in the world, contributing around 14% to global production. The horticulture sector has also

witnessed a significant increase in its contribution to the Indian economy, with its share in the country's agricultural GDP increasing from 12% in 2000-01 to 28% in 2019-20 (Ministry of Agriculture and Farmers Welfare, 2021). This growth can be attributed to various factors, including favorable government policies and initiatives, technological advancements, and increasing demand for horticulture products in both domestic and international markets.

The Indian government has been actively promoting the horticulture sector through various policies, schemes, and subsidies. The National Horticulture Mission (NHM) launched in 2005-06 aimed to promote holistic growth of the horticulture sector by providing support for production, post-harvest management, processing, and marketing. The mission also aimed to increase the productivity of horticulture crops, promote diversification, and enhance the competitiveness of Indian horticulture products in the global market. The NHM was later subsumed under the umbrella scheme of the Mission for Integrated Development of Horticulture (MIDH) in 2014-15, which continues to provide financial and technical support to the horticulture sector (Ministry of Agriculture and Farmers Welfare, 2021).

One of the main objectives of these schemes and subsidies is to increase the production of horticulture crops and make them globally competitive. However, the impact of these policies on India's horticulture trade competitiveness has been a subject of debate among researchers and policymakers. Some studies suggest that the subsidies have led to an increase in the production and export of horticulture products, while others argue that they have not been able to achieve

Chapter 3:- Methodology

Particularly, in the context of India's horticulture sector, where subsidies play a pivotal role, unraveling the impact of these subsidies on international trade becomes a matter of significant inquiry. This paper involves a robust research design and approach. Adopting a comparative analysis framework allows for a better understanding of India's agricultural subsidy programs vis-à-vis those of other nations. By examining subsidy structures, expenditure patterns, and their repercussions, the research sheds light on India's competitive positioning in the global trade arena.

Drawn data from diverse sources, including government databases, trade publications, and expert interviews, ensures a comprehensive dataset. The study is based on secondary data which enabled this research to capture the intricacies of subsidy implementation and its subsequent impact on trade volumes and commodities. In tandem with data collection, meticulous attention is paid to defining and measuring key variables. Subsidy expenditures, and trade volumes as focal points of analysis. Employing sophisticated measurement techniques such as tarde Indexes and modeling with regression analysis facilitates the identification of causal relationships between subsidy levels and trade outcomes.

The data series analyses unveil trends, patterns, and correlations embedded within the data. By deciphering these statistics. Lastly, ethical considerations underpin the entire research endeavor. Upholding principles of data privacy, confidentiality, and transparency ensures the integrity and credibility of the study. By adhering to ethical standards, which uphold the sanctity of the research process, fostering trust and reliability in the research findings.

In conclusion, the methodology employed in this research paper serves as a roadmap for unraveling the complexities of India's horticulture subsidies and their ramifications on international trade. Through a judicious blend of research design, data collection, measurement techniques, statistical analyses, and ethical considerations, the study endeavors to unearth actionable insights that can inform policy decisions, foster trade growth, and propel India's horticulture sector onto the global stage.

Research Design and Approach

The study adopts a quantitative research design to analyze the impact of horticulture subsidies on India's production in international trade and the effects of the National Horticulture Mission (NHM) on Indian exports and imports. The research approach involves collecting and analyzing data from various sources such as WITS, COMTRADE, APEDA, NHM, and NHB Publication. The subsidy data had production levels, and competitiveness, influencing India's position in global trade. A quantitative approach was used to analyze trade data and subsidy expenditures, providing empirical evidence of their impact on international trade dynamics

Data Collection Methods and Sources

This section describes the methods and sources used to collect data for the study. Sources include the World Integrated Trade Solution (WITS) database for export and import trade values, the National Horticulture Board and National Horticulture Mission for NHM data, and the Directorate General of Commercial Intelligence and Statistics (DGIC) and Agricultural and Processed Food Products Export Development Authority (APEDA) for vegetable production data. Secondary data sources may include government reports, academic publications, and industry databases.

Variables and Measurement Techniques

This section outlines the key variables and measurement techniques employed in the study. Key variables include. Export and Import Trade of India: Measured in terms of trade values in thousand dollars. NHM Data: Indicators related to NHM implementation and outcomes. Vegetable Production of India and Rest of the World: Quantified in terms of production volume and value. Measurement techniques may include data aggregation, normalization, and statistical analysis methods to ensure the accuracy and reliability of the findings.

Chapter 4:- Data Analysis and Findings

Data analysis is a systematic process of inspecting, cleansing, transforming, and interpreting raw data to extract valuable insights and inform decision-making. It involves a variety of methods and techniques to uncover patterns, trends, and relationships within datasets. The Techniques mainly used are Index and Trade indicators with some statistical understanding of the paper.

This chapter aims to answer research questions and gain a deeper understanding. It encompasses descriptive analysis to summarize data, exploratory analysis to uncover hidden patterns, and outcomes, and prescriptive analysis to recommend optimal actions. It's divided into four categories. First will examine the Profile of horticulture of India's trade with the rest of the world. That will give us an understanding of where and how much India is trading in terms of exports and imports. The next sub-part will illustrate India's Ranking and horticulture production levels to understand the growth of India's Production level. Last will see the level of subsidy allocated in each scheme and asses the distortion period pre and post of the National Horticulture Mission period.

A:- Profile of India's Horticulture Trade With the Rest of the World

This part will examine the level of trade India is engaged in from the period of 2002 to 2022,

The Volume at which period is higher or lower, and whether the trade is in surplus or deficit.

Table 4. 1:- India Export and Import and Total Trade Value of Horticulture 2002 – 22

Years	Total Export	Total Imports	Total Trade	Total Balance
2002	142383.902	30541.848	172925.75	111842.054
2003	170873.847	22017.539	192891.386	148856.308
2004	206298.12	20738.339	227036.459	185559.781
2005	197247.007	29201.38	226448.387	168045.627
2006	323509.88	31528.321	355038.201	291981.559
2007	430526.369	37083.281	467609.65	393443.088
2008	507275.71	47907.145	555182.855	459368.565
2009	621606.122	44291.125	665897.247	577314.997
2010	627541.063	48220.839	675761.902	579320.224
2011	691826.057	78258.111	770084.168	613567.946
2012	533634.728	107094.396	640729.124	426540.332
2013	874135.867	102477.279	976613.146	771658.588
2014	640005.268	180896.266	820901.534	459109.002
2015	807726.368	226935.742	1034662.11	580790.626
2016	671535.53	183546.204	855081.734	487989.326
2017	630728.514	167039.995	797768.509	463688.519
2018	617627.024	166160.511	783787.535	451466.513
2019	552292.699	133531.273	685823.972	418761.426
2020	523907.867	153571.822	677479.689	370336.045
2021	644692.776	185736.49	830429.266	458956.286

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The table presents data on India's horticulture trade between 2002 and 2022, showcasing the total export, import, trade value, and trade balance of horticultural products. Over this period, there's been a notable increase in export value, soaring from $142.4 million in 2002 to $844.6 million in 2021. Correspondingly, total imports have steadily risen from $30.5 million to $185.7 million during the same timeframe. Total trade value has surged significantly, climbing from $172.9 million to $1,030.4 million in 2021. Despite the rise in imports, India maintains a positive trade balance throughout most years, indicating a trade surplus, suggesting that the value of exported horticulture products exceeds that of imported ones. This positive balance

underscores India's competitiveness in the global horticulture market, highlighting its capacity to satisfy international demand while also meeting domestic needs. Such growth reflects India's potential as a major player in global horticulture trade, promising further expansion and diversification in the future.

Figure 4. 1:- India Export and Import and Total Trade Value of Horticulture 2002 – 22
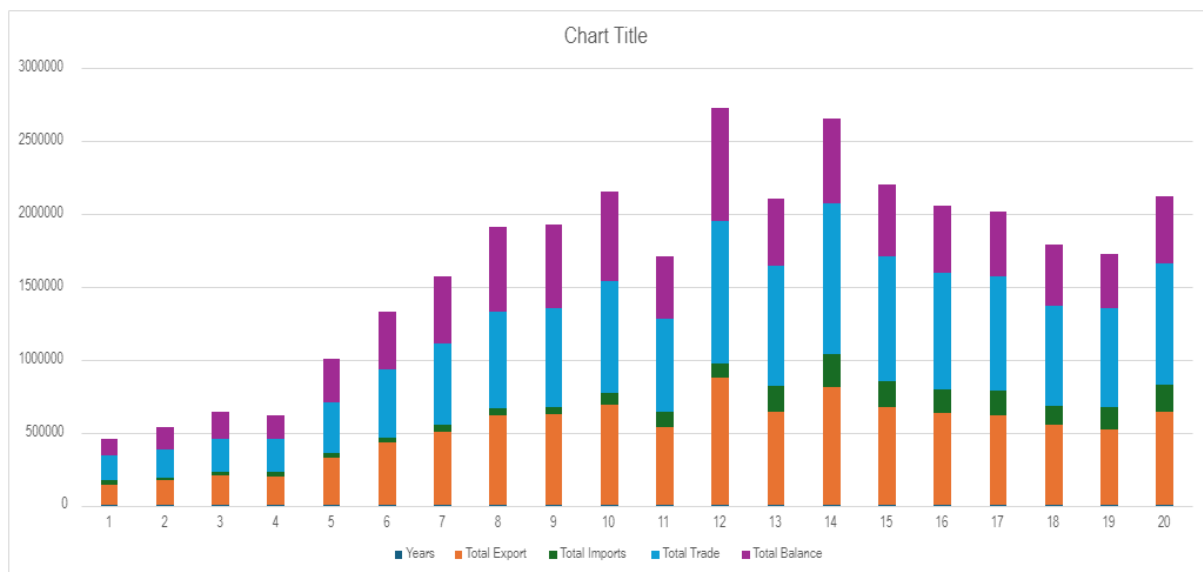
The bar graph illustrates the trade dynamics of India's horticulture products over the years, highlighting fluctuations in export and import levels. It's evident that the years 2012 and 2014 stand out as periods of heightened trade activity, with trade levels peaking during these years. Subsequently, there appears to be a trend of decreasing import levels and increasing export levels in the following years. This trend suggests a shift towards greater export orientation and reduced dependency on imports during these periods. Overall, the graph underscores the importance of the years 2012 and 2014 as significant milestones in India's horticulture trade, indicating robust engagement with global markets and strategic trade policies that favor export growth.

Table 4. 2:- India's Top 20 Exporters of Fresh Vegetables from the Year 2002 – 22

Countries	India's Top 20 Exporters (1000 USD)	Annual Growth Rate
Bangladesh	222378.523	4.76%
Malaysia	150284.719	4.76%
United Arab Emirates	101969.922	4.76%
Sri Lanka	91401.451	4.76%
Pakistan	89299.628	5.26%
United States	66634.808	4.76%
Nepal	59841.744	4.76%
Indonesia	47053.358	4.76%
Qatar	39190.423	4.76%
United Kingdom	30301.219	4.76%
Saudi Arabia	27036.05	4.76%
Vietnam	24839.231	5.56%
Kuwait	24792.368	4.76%
Germany	23039.54	4.76%
Singapore	20659.647	4.76%
Oman	19207.444	4.76%
Philippines	17966.854	4.76%
Netherlands	16380.03	4.76%
Thailand	12141.104	4.76%
Sweden	11058.757	4.76%

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The table provides insights into India's significant role as the largest exporter of horticulture products to various countries worldwide. Among 199 countries listed, India emerges as the primary exporter of horticultural goods to a select group of nations. The top 20 exporters are identified based on the total value of exports from India to each country spanning from 2002 to 2022, with values denoted in thousands of US dollars. For instance, a value of "222,378.523" translates to a total export value of $222,378,523. Additionally, the table includes an Annual Growth Rate column, indicating the year-on-year growth in export value to each specific country. Notably, India's export relationship with these countries demonstrates a positive trend, with a steady growth rate. While Pakistan and Vietnam exhibit higher growth rates, the remaining 18 countries maintain a consistent growth rate of 4.76% over the years. This consistent growth signifies India's robust trade relations with these nations, reflecting a strong presence and competitiveness in the global horticulture export market.

Figure 4. 2:- India's Top 20 Exporters of Fresh Vegetables from the Year 2002 – 22
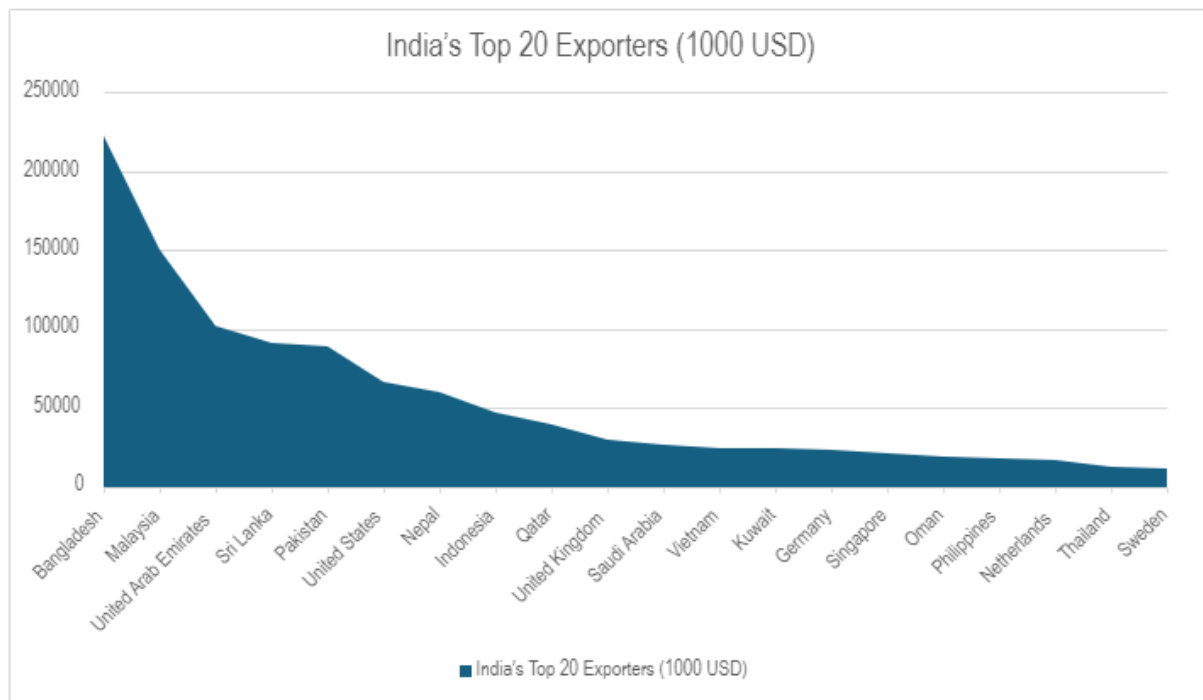
The waterfall picture graph visually represents the total export values of horticulture products from India to various countries between 2002 and 2022. Each country's export value is denoted by a bar on the positive scale side of the graph. Bangladesh emerges as the highest exported country by India during this period, while Sweden represents the lowest. The graph effectively illustrates the relative magnitudes of export values to different countries, providing a clear visual comparison of India's export relationships with various trading partners. The values depicted on the graph represent the total export value in thousands of US dollars, showcasing the significance of each country in India's horticulture export landscape.

Table 4.3:- India's Top 20 Importers of Fresh Vegetables from the Year 2002 – 22

Countries	India's Top 20 Importers (1000 USD)	Annual Growth Rate
Sri Lanka	95050.179	4.76%
Vietnam	88284.045	4.76%
Indonesia	47427.017	4.76%
Brazil	30305.955	4.76%
Afghanistan	23669.275	8.33%
Turkey	19467.692	12.50%
United Arab Emirates	16744.275	5.26%
Egypt, Arab Rep.	16353.546	10.00%
Singapore	13102.357	5.88%
United States	7309.809	5.26%
Ecuador	4883.158	7.69%
Canada	3052.234	14.29%
Netherlands	2334.813	6.25%
Iran, Islamic Rep.	2299.841	16.67%
Madagascar	2057.462	5.26%
Pakistan	1779.745	9.09%
China	1672.116	5.00%
Australia	1362.159	12.50%
Unspecified	1241.25	10.00%
France	1119.981	7.14%

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The table presents India's top 20 importers of fresh vegetables from other countries, spanning from 2002 to 2020. It provides a list of countries from which India imports fresh vegetables, with values denoted in thousands of US dollars (USD). For example, a value like "95050.179" may represent a total import value of $95,050,179. The Annual Growth Rate column indicates the year-on-year growth in the import value of fresh vegetables from India for each country. However, there's a discrepancy in the analysis of import growth rates, as indicated by the commodity data in Table 4.5, suggesting that India hasn't significantly increased its import volumes over time. The growth rate values in the table likely reflect cumulative import values over the period from 2002 to 2020, rather than annual growth rates. This discrepancy highlights the need for accurate data interpretation and underscores the importance of verifying growth rate calculations against actual import trends to ensure data accuracy and reliability.

However, there is a problem in the import analysis, In the growth rate, since in the commodity data the data which will be shown in Table 4.5 indicated India hasn't been purchasing more of

imports. The value over here in growth rate is not accurate but merely extends over time. It means from the year 2002 to 2022 this must amount of trade has been Imported by India not annually but over the period.

Figure 4. 3:- India's Top 20 Importers of Fresh Vegetables from the Year 2002 – 22
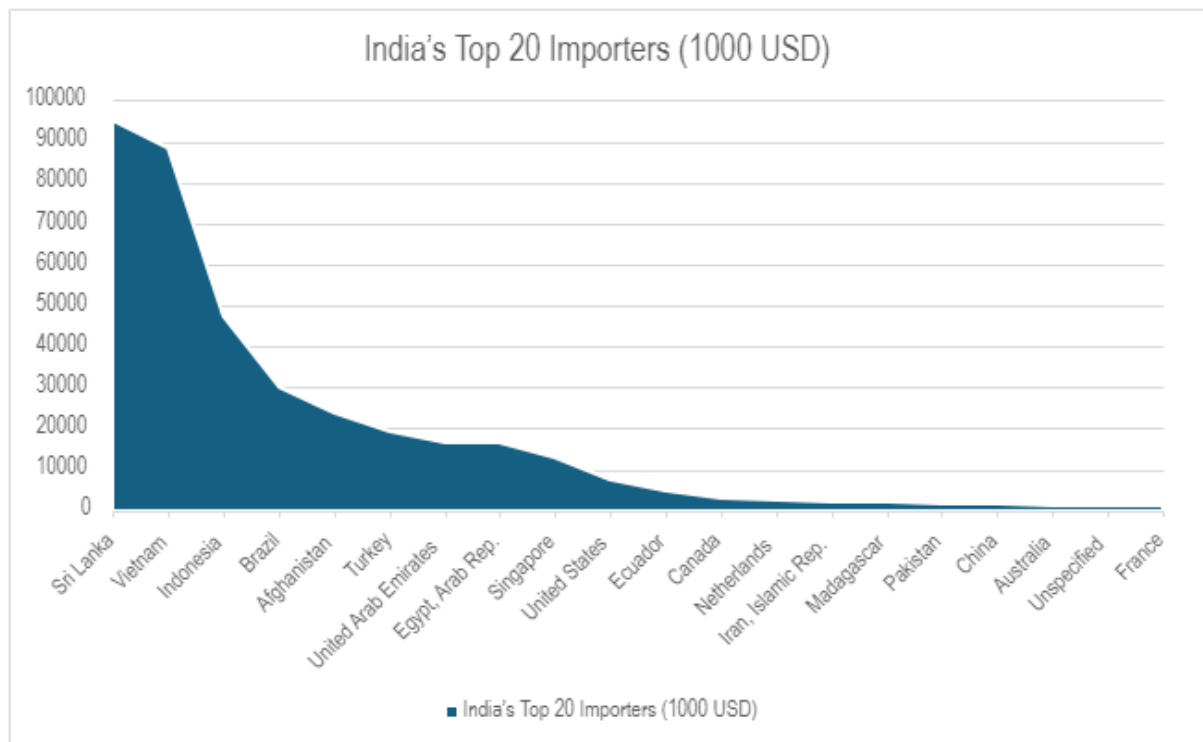
The graph illustrates India's import values of fresh vegetables from various countries over the period from 2002 to 2022, with the data presented as cumulative sum values rather than annual figures. This depiction allows for a comprehensive understanding of the overall trade volume over the specified timeframe. Sri Lanka emerges as the leading importer of fresh vegetables from India, with the highest trade volume reaching around $90,000 (in thousands of US dollars). Conversely, France ranks lowest among the top 20 importers, indicating relatively lower import volumes compared to other countries in the dataset. The graph provides valuable insights into the distribution of India's fresh vegetable imports among different trading partners,

highlighting the varying levels of trade engagement and the importance of each country in India's import landscape.

Continuing from Sri Lanka, the graph reveals Vietnam, Indonesia, Brazil, Afghanistan, and Turkey as significant importers of fresh vegetables from India, following a similar trend of substantial trade volumes. Vietnam emerges as the second-largest importer, demonstrating a robust trade relationship with India in the fresh vegetable sector. Indonesia follows closely behind, indicating a significant demand for Indian fresh produce in the Southeast Asian market. Brazil's presence among the top importers underscores the bilateral trade ties between the two countries, with Brazil importing notable quantities of fresh vegetables from India over the years. Afghanistan and Turkey also feature prominently in India's fresh vegetable export landscape, highlighting the diverse range of trading partners and the global reach of India's horticultural products. This detailed breakdown of India's top importers provides a nuanced understanding of the geographical distribution and magnitude of fresh vegetable trade with different countries, offering valuable insights for policymakers, traders, and stakeholders in the agricultural sector.

Table 4. 4:- India's Commodity Export of Agriculture from the year 2002 - 22

Year	Brinjal	Beans	Cauliflowers	Cucumbers	Cabbage	Onions	Other	Peas	Chillies	Potatoes	Sweet potatoes	Tomatoes	Growth Rate
2002	0	18.601	0	10071.491	0.953	75425.366	19911.107	1186.084	32322.972	1000.185	22.129	2425.014	8.33%
2003	161.702	164.073	19.212	9907.91	41.116	117701.124	16057.275	1885.234	23035.969	671.66	33.919	1194.653	8.33%
2004	602.628	280.244	10.68	3310.739	24.663	166504.496	14302.774	1189.142	18133.131	356.547	16.308	1566.768	8.33%
2005	543.099	466.357	38.065	606.401	42.561	152836.965	16154.405	765.398	23387.174	1395.467	150.595	860.52	8.33%
2006	1946.658	725.001	8.164	376.481	26.437	226423.773	36364.542	549.795	47285.465	1533.389	80.911	8189.264	8.33%
2007	799.991	1078.012	6.84	146.047	50.836	263593.913	46898.636	527.496	94989.139	2010.211	102.653	20322.595	8.33%
2008	32.112	101.086	25.947	1917.345	250.751	330584.644	48431.428	1605.801	85100.137	3218.61	122.16	35885.689	8.33%
2009	19.82	56.059	165.116	320.871	230.567	474861.942	62684.038	1084.887	49621.864	1594.789	160.353	30805.816	8.33%
2010	36.056	52.677	93.846	194.174	77.248	465439.909	74811.12	596.682	55551.477	5486.656	163.188	25038.03	8.33%
2011	50.196	47.934	163.647	279.482	106.881	370002.472	77504.206	423.602	147168.998	9773.709	228.566	86076.364	8.33%
2012	146.568	68.415	48.358	139.353	139.806	294697.847	85167.907	1280.036	95049.853	3080.512	207.866	53608.207	8.33%
2013	83.368	63.396	31.711	120.977	21.304	600886.391	65562.884	1155.915	129911.937	6671.08	210.285	69416.619	8.33%
2014	748.652	242.361	37.973	650.152	125.394	322148.162	89109.557	8134.634	116955.062	8097.913	194.014	93561.394	8.33%
2015	48.841	122.524	116.666	366.575	101.603	428377.873	102298.692	2313.674	206208.55	659.308	207.586	66904.476	8.33%
2016	7.92	301.588	108.32	333.107	48.67	382440.956	112093.491	684.885	98396.18	864.935	175.16	76080.318	8.33%
2017	39.094	122.73	227.975	407.785	54.858	423218.424	121815.418	589.486	69500.049	599.399	171.799	13981.497	8.33%
2018	23.041	85.838	247.415	212.288	108.425	419311.44	121319.831	161.665	50702.144	834.673	138.278	24481.986	8.33%
2019	12.918	85.853	312.439	525.499	443.553	367328.015	112402.913	393.759	41275.518	720.795	161.127	28630.31	8.33%
2020	82.425	113.06	176.698	733.105	417.921	346640.304	97536.771	287.799	37364.358	4640.881	346.363	35568.182	8.33%
2021	262.08	68.026	136.246	876.127	192.275	449456.865	103856.242	140.933	52967.851	8971.257	300.182	27464.692	8.33%
2022	313.278	191.206	245.909	879.167	189.817	524591.413	93080.893	740.112	53355.849	4654.859	384.734	21137.429	8.33%
Total Result	5960.447	4455.041	2221.227	32375.076	2695.639	7202472.294	1517364.13	25697.019	1528283.677	66836.835	3578.176	723199.823	8.33%

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The table provides insights into India's commodity export of agricultural products to other countries, with a focus on horticultural products. It highlights India's consistent export growth rate of approximately 8.33% over the years, indicating a sustained and healthy level of trade with other nations. Among the horticulture products exported by India, onions, other crops, peas, and chilies emerge as key commodities with notable export volumes over the years. The values presented in the table represent the total export value from India to each country between 2002 and 2022, with figures denoted in thousands of US dollars (USD). For example, a value like "2425.014" may represent a total export value of $2,425.014. Additionally, the table identifies the countries where India has been the largest exporter in specific years, providing insights into India's dominant position in certain export markets. The Annual Growth Rate column indicates the year-on-year growth in export value to each specific country, with positive percentages reflecting India's consistent and steady growth in export volumes. This data underscores India's significant role as a major exporter of agricultural commodities,

particularly horticultural products, and highlights the country's strong trade relations with other nations in the global market.

Table 4. 5:- India's Commodity Import of Agriculture from the year 2002 - 22

Year	Brinjal	Beans	Cauliflowers	Cucumbers	Cabbage	Onions	Other	Peas	Chillies	Potatoes	Sweet potatoes	Tomatoes	Growth Rate
2002	0.046	0.106	0	0	0	0.051	35.781	5707.314	24798.55	0	0	0	0.42%
2003	0.048	0.125	0	3.999	12.423	0.053	46.472	1277.326	20463.219	210.128	3.746	0	0.42%
2004	0	0.496	0	0	0	0	6.952	1.759	20702.21	0	0	26.922	0.42%
2005	0.544	0.176	0	0	0	1854.764	68.065	1.191	27264.355	0	0	12.285	0.42%
2006	0.102	0.056	0	0	0	9.852	89.513	0	31393.717	0	0	35.081	0.42%
2007	0		0	0	0.396	57.764	206.7	0	36792.074	0	0	26.347	0.45%
2008	0	1.399	0	0.141	0	15.019	485.29	0.239	47350.456	0	0	54.601	0.42%
2009	0.678	0.306	0	0.176	60.843	177.076	497.001	86.596	43437.203	0	0	31.246	0.42%
2010	0.659		0	0	0	2691.266	545.667	0	44939.995	0	0	43.252	0.45%
2011	0	2.48	0	0	0	4047.448	1363.554	0.131	72843.074	0	0	1.424	0.42%
2012	0	0.434	0	0	0	0	462.5	0	106540.211	88.675	0	2.576	0.42%
2013	0	0.044	0	0.094	0	5712.946	168.745	0	96410.838	181.563	0	3.049	0.42%
2014	0	61.879	0	0	0	252.74	282.657	97.748	180119.708	81.534	0	0	0.42%
2015	0	0	4.832	0	0.003	31351.681	187.717	98.445	195259.146	33.918	0	0	0.42%
2016	0	0	0	0	0	31.742	342.07	0	183172.392	0	0	0	0.42%
2017	1.848	0	0	0.795	0	1825.074	331.536	0	164876.622	0	0	4.12	0.42%
2018	1.162	0	0.931	0	4.551	1227.426	281.772	42.183	164602.486	0	0	0	0.42%
2019	0	0	0	0	0	39832.762	541.992	0	93146.535	0	9.955	0.029	0.42%
2020	0	0	0	0	0	67667.713	273.643	56.354	85569.934	4.178	0	0	0.42%
2021	0	0.985	0.496	0	0.492	13854.172	75.428	1.138	171735.713	0	68.066	0	0.42%
2022	0	8.168	0.089	0.609	0	813.134	89.974	15.499	202702.466	353.405	29.487	0	0.42%
Total Result	5.087	76.654	6.348	5.814	78.708	171422.683	6383.029	7385.923	2014120.904	953.401	111.254	240.932	0.42%

Source:- WITS (World Integrated Tarde Solution), UN – COMTRADE

Earlier it was mentioned that Table 4.5 highlights a discrepancy between the import growth rates observed in Table 4.3 and the actual commodity trade values in Table 4.5. While Table 4.3 suggests higher import growth rates compared to exports, Table 4.5 reveals that India hasn't been importing a significant amount of commodities from other countries. This discrepancy raises questions about the accuracy of interpreting import growth rates solely based on percentage figures without considering the actual trade volumes.

Despite the consistent growth rate of horticultural product imports at approximately 0.42% over the years, the actual import values remain relatively low, indicating limited reliance on imported horticultural products. Notably, horticultural imports such as onions, other crops, and chilies have been prominent over the years, suggesting a focus on specific commodities where domestic production may fall short, or demand exceeds local supply. The growth rates in import values imply a steady increase in imports, albeit at a slower pace compared to exports, underscoring India's cautious approach to import dependence in the agricultural sector. This criticism highlights the importance of considering both growth rates and actual trade values for a comprehensive understanding of India's agricultural import dynamics.

Table 4. 6:- India's and other countries Horticulture Production (Vegetables) Ranking from the years 2002 – 22

Vegetables	Rank 1	Rank 2	Rank3	Ranks 4	Rank 5	India Position
Brinjal	United Kingdom	Pakistan	Bhutan	United Arab Emirates	France	20
Beans	United Kingdom	United Arab Emirates	Maldives	Qatar	Maldives	19
Cauliflowers	Japan	United Arab Emirates	Nepal	Bhutan	Maldives	10
Cucumbers	France	United States	United Arab Emirates	Spain	Netherlands	11
Cabbage	United Arab Emirates	United States	Maldives	Mauritius	Kuwait	8
Onions	Bangladesh	Malaysia	Sri Lanka	United Arab Emirates	Nepal	67
Other	United Arab Emirates	United Kingdom	Qatar	Saudi Arabia	Kuwait	47
Peas	Pakistan	Saudi Arabia	United Arab Emirates	United Kingdom	Nepal	89
Chillies	Germany	Japan	Netherlands	Sweden	United States	12
Potatoes	Nepal	Russian Federation	Sri Lanka	United Arab Emirates	United States	56
Sweet potatoes	Belgium	Maldives	Nepal	United Arab Emirates	United States	73
Tomatoes	Bangladesh	Nepal	Pakistan	Qatar	United Arab Emirates	12

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The table presents a comparative analysis of India's position in the international horticulture trade landscape, focusing on different types of commodities ranked by export levels. The ranking is based on the highest levels of exports achieved by each country in the world-to-world trade order.

By examining India's ranking across various horticultural crops, such as cauliflower and cabbage, it provides insights into India's relative performance compared to other countries in the global horticulture market. The table offers a glimpse into the competitive dynamics of international trade, highlighting the strengths and advantages of other countries in horticulture production and export.

Additionally, it identifies the top five countries based on commodity production levels at the global scale, namely the United Kingdom (UK), United States, United Arab Emirates (UAE), Maldives, Qatar, and Nepal. Table 4.7 further supplements this analysis by providing information on the ranked countries' total trade volume and share in metric tonne production level, offering a comprehensive understanding of the horticultural trade dynamics at the international level. This holistic approach enables policymakers and stakeholders to assess India's standing and level of gross production value in the context of global horticulture trade, facilitating informed decision-making and strategic planning in the agricultural sector.

Table 4. 7:- India's and other countries Horticulture Production (Vegetables) from the years 2002 – 22

Vegetables	Rank 1	Rank 2	Rank3	Ranks 4	Rank 5	India Position
Brinjal	397466.828	552128.079	10322.27	1409983.799	91728.188	228271.495
Beans	397466.828	1409983.799	98257.431	372798.337	98257.431	751.392
Cauliflowers	67854.682	1409983.799	385333.926	10322.27	98257.431	45.65
Cucumbers	91728.188	504192.862	1409983.799	35538.293	84667.007	130.841
Cabbage	1409983.799	504192.862	98257.431	70968.101	274073.8	2028.685
Onions	2049781.411	1548331.677	924732.02	1409983.799	385333.926	1376.072
Other	1409983.799	397466.828	372798.337	281474.633	274073.8	2895.243
Peas	552128.079	281474.633	1409983.799	397466.828	385333.926	48.306
Chillies	161204.552	67854.682	84667.007	85401.825	504192.862	7179.57
Potatoes	385333.926	45162.998	924732.02	1409983.799	504192.862	13348.878
Sweet potatoes	21964.923	98257.431	385333.926	1409983.799	504192.862	13.511
Tomatoes	2049781.411	385333.926	552128.079	372798.337	1409983.799	108050.565

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The additional explanation provides further context to the numeric values associated with the ranked order of countries in the table. It elucidates that the values represent the export trade value of each ranked country in the international market, measured in metric tonne export production. This information enhances the understanding of the table's content by clarifying that the values denote the volume of horticultural products exported by each country. Furthermore, the reference to the accompanying graph suggests that visualizing the data in graphical form would facilitate a clearer understanding of which countries hold prominent positions as exporters of specific horticultural commodities. By correlating the ranked order of countries with their respective export trade values, stakeholders can discern patterns and trends in the global horticulture trade, enabling more informed decision-making and strategic planning in the agricultural sector.

Figure 4. 4:- India's and other countries Horticulture Production (Vegetables) from the years 2002 – 22
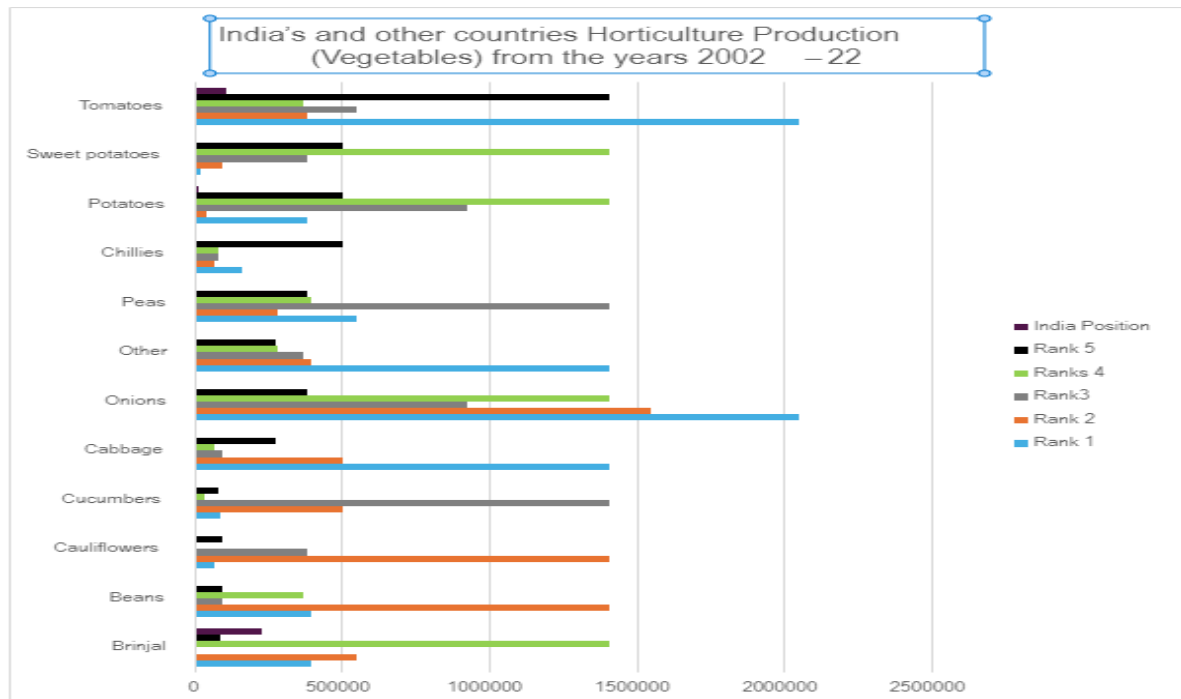
The bar chart provides a visual representation of the horticulture commodities on the Y-axis and the production level in metric tonnes on the X-axis, segmented by rank groups of exporting countries. Rank 1 countries emerge as the primary exporters across all commodities, particularly excelling in the export of onions and tomatoes. They secure the top position in onion and tomato exports, indicating their dominance in these markets. Rank 2 countries follow closely, exhibiting notable exports of onions, cauliflower, and beans. Similarly, rank 3 countries stand out as higher exporters of cucumbers.

The chart allows for a clear comparison of production levels across different commodities and rank groups, facilitating an understanding of which crops are highly exported by each rank group of countries.

By aggregating the production levels from the top 5 rank countries for each commodity, we can determine which commodity experiences the highest trade volume nationwide. This analysis provides valuable insights into the export dynamics of horticultural products, enabling stakeholders to identify key export trends and opportunities for market growth and diversification.

Table 4. 8:- The RCA-(Revealed Comparative Advantage) on India's HS-6 Product

RCA For INDIA												
Product Description	Brinjal	Beans	Cauliflowers	Cucumbers	Cabbage	Onions	Other	Peas	Chillies	Potatoes	Sweet potatoes	Tomatoes
2002	0	0.004588857	0	0.703374578	0.000115369	4.800370767	0.919028567	0.855896654	4.431820772	1.697716982	0.031864036	0.042790907
2003	0.045378327	0.031703592	0.0020733	0.522117854	0.003830492	5.995778655	0.621096029	1.097198069	3.420048175	0.935504021	0.041564505	0.017649678
2004	0.121311676	0.037647495	0.00090671	0.141056514	0.002074265	6.34966751	0.481016631	0.603207097	2.404838562	0.372237512	0.013639985	0.019801261
2005	0.122139826	0.067173925	0.00312724	0.028227097	0.00370331	6.864166669	0.503618447	0.361914366	3.670562249	1.34453153	0.125259974	0.011376356
2006	0.314923495	0.07298827	0.000457821	0.010238003	0.001628699	5.847331952	0.64779683	0.14787341	3.619084358	0.886330131	0.041063145	0.067559331
2007	0.091095629	0.080732712	0.000325337	0.003233459	0.002514412	4.758734023	0.65663351	0.123599596	4.463308475	0.745416056	0.039728979	0.123664175
2008	0.002958855	0.006492559	0.001009468	0.035514828	0.010646584	5.191508577	0.625960829	0.252046338	3.293034148	0.745392254	0.036414841	0.182462058
2009	0.001510395	0.00286849	0.00497292	0.005464231	0.008337325	5.966655283	0.561079412	0.141963274	1.824996304	0.335410947	0.034068867	0.131783496
2010	0.002738827	0.003045371	0.002876859	0.003218115	0.002708178	5.007845142	0.779417646	0.082979287	1.744049073	1.277758703	0.034722663	0.104922238
2011	0.003504612	0.00280623	0.004587113	0.004476956	0.004143541	3.786344411	0.779934021	0.052363375	2.953055889	1.478499702	0.015793848	0.330524036
2012	0.013128825	0.004878827	0.001734249	0.002630986	0.006119686	4.481686035	1.241057234	0.175332854	1.970758938	0.689896921	0.043858639	0.260694725
2013	0.004662727	0.002261457	0.000696432	0.001411537	0.000637909	4.697597029	0.539914572	0.089220026	1.788887585	1.137043407	0.026150724	0.220541262
2014	0.058855492	0.01405956	0.001201753	0.010480555	0.005491011	4.034761306	0.943064981	1.00564925	1.841446083	2.254984482	0.026663803	0.395145439
2015	0.003257671	0.0053489	0.002965773	0.00493289	0.003386994	3.935270012	0.88058687	0.227998921	2.120259255	0.151742423	0.018426543	0.240544277
2016	0.000636258	0.015849967	0.003143343	0.005060506	0.001940257	4.240612372	1.128497279	0.082498501	1.409377635	0.190680764	0.013263158	0.331770736
2017	0.003105491	0.006218619	0.006706819	0.006732449	0.002208373	5.317649301	1.200541063	0.063252166	1.387015452	0.131405451	0.011714227	0.063757356
2018	0.001875235	0.004222039	0.007220047	0.003313032	0.004387032	5.041091014	1.20907339	0.0181293	1.631759044	0.184803665	0.009171345	0.111868163
2019	0.001213786	0.00482543	0.009838051	0.00977287	0.020122646	4.267159262	1.241689096	0.053187986	1.642932908	0.145612247	0.011492937	0.152140354
2020	0.007915075	0.006083791	0.005724546	0.014019618	0.021802106	4.685493615	1.138089575	0.041803771	1.657976795	1.21109729	0.026708182	0.190531608
2021	0.021300788	0.002929471	0.003559153	0.012881171	0.00779006	5.341736291	1.006676371	0.015640325	1.476710672	2.101313218	0.0200067	0.121135107
2022	0.0252481	0.007888898	0.005367426	0.011380264	0.007725257	5.348789136	0.822274894	0.084834202	1.419983947	0.987103739	0.0257004	0.088731112

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The table presents the revealed comparative advantage (RCA) for India's horticultural productions from 2002 to 2022, aiming to assess India's position in global trade and production. It evaluates whether India has an absolute comparative advantage in certain horticulture products or needs to improve its competitiveness. The selection of the 12 horticulture

productions focuses on fresh vegetable produce, reflecting a primary concern in India's agricultural sector. Highlighted in green are the horticulture productions where India demonstrates an absolute comparative advantage consistently across all 20 years. Specifically, India exhibited a strong comparative advantage in onions and chilies throughout the entire period, indicating that its production of these commodities surpasses the worldwide share value consistently.

The RCA is calculated by comparing the sum product value of India's production each year to the total production of that product globally. This comparison allows for the determination of India's share of production relative to the global share. The results help identify areas where India excels and where it may need to focus on improving its competitiveness.

The emphasis on absolute advantage commodities highlighted in green suggests that India should prioritize and further develop its production capabilities in these areas. This strategic approach can enhance India's position in the global horticulture trade, maximize its export potential, and contribute to the country's overall economic growth and development.

Table 4. 9:- The RSCA (Revealed Symmetric Comparative Advantage) on India's HS-6 Product

						RSCA For INDIA						
Product Description	Brinjal	Beans	Cauliflowers	Cucumbers	Cabbage	Onions	Other	Peas	Chillies	Potatoes	Sweet potatoes	Tomatoes
2002	-1	-0.990864208	-1	-0.174139867	-0.999769288	0.655194456	-0.04219397	-0.077646213	0.631799339	0.258632387	-0.938239856	-0.917930035
2003	-0.913182958	-0.938541279	-0.995861979	-0.313958702	-0.99236825	0.714113311	-0.233733205	0.046346633	0.547516244	-0.033322576	-0.920188324	-0.965312861
2004	-0.783625412	-0.927436832	-0.998188223	-0.752761564	-0.995860058	0.727878847	-0.350423728	-0.247499468	0.412600638	-0.457473639	-0.973087122	-0.961166431
2005	-0.782309079	-0.874108759	-0.993765018	-0.945095598	-0.992620708	0.745681891	-0.330124676	-0.468521113	0.571786031	0.146951118	-0.777367049	-0.977503219
2006	-0.521001037	-0.863953275	-0.999084777	-0.979731503	-0.996747899	0.707915431	-0.213741866	-0.742352409	0.567013753	-0.060259796	-0.921113056	-0.873432176
2007	-0.8330199	-0.850596338	-0.999349538	-0.993553925	-0.994983789	0.652701446	-0.207267623	-0.779993519	0.633921458	-0.145858601	-0.923578201	-0.77989122
2008	-0.994099748	-0.987098644	-0.997983099	-0.931406432	-0.978931143	0.676976948	-0.230041933	-0.597384969	0.534129026	-0.145874227	-0.929729217	-0.691386194
2009	-0.996983765	-0.994279429	-0.990103374	-0.989130928	-0.983463223	0.712918191	-0.281164804	-0.751369808	0.292034472	-0.497666321	-0.934107161	-0.767122429
2010	-0.994537307	-0.99392775	-0.994262786	-0.993584416	-0.994598273	0.667101939	-0.123963227	-0.846757389	0.271150061	0.121943867	-0.932885082	-0.810082131
2011	-0.993015254	-0.994403246	-0.990867666	-0.991085996	-0.991747114	0.58214457	-0.123637155	-0.900484232	0.494062301	0.193060222	-0.968903439	-0.503167133
2012	-0.974082615	-0.990289721	-0.996537507	-0.994751836	-0.987835074	0.63514875	0.107564069	-0.701645618	0.32677136	-0.183504139	-0.91596824	-0.586426881
2013	-0.990717827	-0.995487291	-0.998608105	-0.997180905	-0.998724996	0.648974824	-0.298773345	-0.836176302	0.282868191	0.064127573	-0.949031416	-0.638617277
2014	-0.888831871	-0.972270741	-0.997599379	-0.979256295	-0.989077951	0.602761704	-0.029301655	0.002816669	0.296133046	0.385557747	-0.948057382	-0.433542298
2015	-0.993505813	-0.989359116	-0.994085994	-0.990182647	-0.993248878	0.594753682	-0.0634978	-0.628665926	0.35902762	-0.736499377	-0.963813703	-0.61219558
2016	-0.998728294	-0.96879467	-0.993733013	-0.989929948	-0.996127	0.61836521	0.060369952	-0.847577616	0.169910117	-0.679711356	-0.973820901	-0.501759985
2017	-0.993808247	-0.987639626	-0.986675726	-0.986625148	-0.995592987	0.683426556	0.091132616	-0.881021326	0.162133618	-0.767712891	-0.976842815	-0.880128008
2018	-0.996256551	-0.991591424	-0.985663416	-0.993395816	-0.99126426	0.668933973	0.094643026	-0.964387037	0.240052008	-0.688043394	-0.981824008	-0.798774412
2019	-0.99757537	-0.990395485	-0.980515587	-0.98064343	-0.960548574	0.620288679	0.107815619	-0.898996215	0.243264937	-0.745791392	-0.9772753	-0.735899618
2020	-0.984294162	-0.987905995	-0.988616076	-0.972348428	-0.957326167	0.648227553	0.064585496	-0.919747322	0.247547983	0.095471733	-0.947973179	-0.679921799
2021	-0.958286945	-0.994158171	-0.99290694	-0.974565286	-0.984540417	0.684628955	0.003327079	-0.969201055	0.192477336	0.355111896	-0.960771433	-0.783906318
2022	-0.950747307	-0.9843457	-0.989322459	-0.977495579	-0.984667929	0.6849793	-0.097529251	-0.843599691	0.173548237	-0.006489979	-0.949887122	-0.83700087
RSCA refers to Revealed Symmetric Comparative Advantage The index varies from zero to one for product categories in which countries and regions have a revealed comparative advantage and from minus one to zero for product categories in which countries/regions have a revealed comparative disadvantage.												

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The process begins with the calculation of the Revealed Comparative Advantage (RCA), which determines the horticulture commodities in which India holds a comparative advantage over other countries globally. This indicator helps identify areas where India's production capabilities surpass those of its international competitors. Following the RCA calculation, the Relative Symmetrical Comparative Advantage (RSCA) is computed to assess whether India's production is self-sufficient and profitable. The RSCA value, ranging from -1 to +1, provides insight into India's trade balance and profitability in horticulture production. A negative RSCA value indicates an imbalance or lack of profitability in trade, suggesting that India may not be exploiting its comparative advantage effectively. Conversely, a positive RSCA value indicates a profitable level of production, signalling that India is leveraging its comparative advantage to benefit from international trade.

The RSCA index serves a crucial role in refining the RCA values, ensuring that they are finite and within a manageable range. While the RCA value can potentially extend beyond 1 or even to infinity, the RSCA index constrains this range, providing a more accurate assessment of a country's true comparative advantage and trade profitability. This economic interpretation of revealed comparative advantage underscores the benefits of international trade, emphasizing that countries can profitably exchange goods even when they specialize in the production of different commodities.

Table 4. 10:- The TSI (Trade Specialization Index) on India's HS-6 Product

Product Description	Brinjal	Beans	Cauliflowers	Cucumbers	Cabbage	Onions	Other	Peas	Chillies	Potatoes	Sweet potatoes	Tomatoes
						TSI For INDIA						
2002	-1	0.988667	No Exp/Imp	1	1	0.999999	0.996412	-0.6558783	0.131727	1	1	1
2003	0.999406	0.998477	1	0.99919309	0.535927	0.999999	0.994228	0.19222023	0.059145	0.523405	0.801089	1
2004	1	0.996466	1	1	1	1	0.999028	0.99704593	-0.06615	1	1	0.96621426
2005	0.997999	0.999245	1	1	1	0.97602	0.991609	0.99689273	-0.07655	1	1	0.97184938
2006	0.999895	0.999846	1	1	1	0.999913	0.995089	1	0.201982	1	1	0.99146899
2007	1	1	1	1	0.984541	0.999562	0.991224	1	0.441619	1	1	0.99741048
2008	1	0.972698	1	0.99985293	1	0.999909	0.980159	0.99970237	0.28501	1	1	0.99696157
2009	0.933847	0.989142	1	0.99890359	0.582423	0.999254	0.984267	0.85216004	0.06646	1	1	0.99797348
2010	0.964102	1	1	1	1	0.988502	0.985518	1	0.105596	1	1	0.99655105
2011	1	0.901615	1	1	1	0.978359	0.965422	0.99938169	0.337827	1	1	0.99996691
2012	1	0.987393	1	1	1	1	0.989198	1	-0.057	0.944039	1	0.9999039
2013	1	0.998613	1	0.99844719	1	0.981164	0.994866	1	0.148024	0.947009	1	0.99991216
2014	1	0.593222	1	1	1	0.998432	0.993676	0.9762528	-0.21262	0.980064	1	1
2015	1	1	0.920459596	1	0.999941	0.863608	0.996337	0.91837467	0.027273	0.902144	1	1
2016	1	1	1	1	1	0.999834	0.993915	1	-0.30109	1	1	1
2017	0.909726	1	1	0.99610847	1	0.991412	0.994572	1	-0.40694	1	1	0.99941082
2018	0.903979	1	0.992502396	1	0.919434	0.994163	0.995366	0.5861328	-0.52902	1	1	1
2019	1	1	1	1	1	0.804339	0.990403	1	-0.38588	1	0.883623	0.99999797
2020	1	1	1	1	1	0.673346	0.994405	0.67250612	-0.39212	0.998201	1	1
2021	1	0.971454	0.992745462	1	0.994895	0.940195	0.998549	0.98397984	-0.52855	1	0.630325	1
2022	1	0.918064	0.999276417	0.99861556	1	0.996905	0.998069	0.95897625	-0.58325	0.858871	0.857627	1

A TSI value close to 1 indicates a high degree of specialization in exporting the product, meaning the country is primarily an exporter of that product. A TSI value close to -1 indicates a high degree of specialization in importing the product, meaning the country relies heavily on imports of that product. A TSI value close to 0 indicates a balanced trade or lack of specialization in that product.

Source:- WITS (World Integrated Tarde Solution), UN - COMTRADE

The Trade Specialization Index (TSI) serves as a valuable tool for assessing a country's economic structure and competitiveness by measuring the extent to which its economy is focused on producing and exporting specific goods relative to other countries. This index provides insights into a country's trade patterns, market preferences, and export concentration.

By analysing trade specialization indices such as the Revealed Comparative Advantage (RCA) Index and the Revealed Symmetric Comparative Advantage (RSCA) Index, policymakers and stakeholders can gain a comprehensive understanding of a country's export dynamics and competitive advantage in international trade.

The RCA Index helps identify the horticulture commodities in which India holds a comparative advantage over other countries globally. It highlights India's strengths and areas of specialization in horticulture production and export. Similarly, the RSCA Index assesses whether India's production is self-sufficient and profitable, indicating the profitability of India's trade relationships in the horticulture sector. Together, these indices provide a nuanced perspective on India's trade specialization in horticultural products.

By integrating information from the RCA, RSCA, and TSI indices, we can deduce that India exhibits trade specialization in most horticulture commodities, except for chilies. The red highlights in the analysis indicate instances where India's comparative advantage or trade profitability may be lacking, suggesting areas for potential improvement or strategic focus. Overall, the combination of these indices offers a comprehensive assessment of India's trade specialization in the horticulture sector, enabling policymakers and stakeholders to make informed decisions to enhance India's competitiveness and maximize its economic gains from international trade.

B:- Analyzing India's Horticulture Product Production From 2002 - 22

Table 4. 11:- India Horticulture Production from 2002 - 22

India Production from 2003 – 2021													
Sr No.	Years	Beans	Cauliflower	Chillies	cucumber	Potatoes	Tomato	Brinjal	Cabbage	Peas	Sweet Potato	Onion	Other Crop
1	2003	0	0	0	0	26502.3	6458.7	7925.2	4939.4	1754	3245.3	5750.5	0
2	2004	0	4318.4	0	0	27898.4	7457.3	8430	5542.4	1838.8	1066.55	6995	0
3	2005	0	5323.06	0	0	29174.66	9820.43	9364.65	5637.24	2269.99	1067.18	9432.46	0
4	2006	0	5578.79	0	0	28599.61	10054.65	9452.97	5589.17	2401.9	1146.12	10847.21	0
5	2007	0	5796.63	0	0	34462.61	10260.61	9595.8	5887.79	2559.99	1119.74	12157.18	0
6	2008	0	6531.92	0	0	34390.9	11148.85	10377.61	6869.64	2916.49	1094.6	13564.53	0
7	2009	0	5988.48	0	0	36577.3	12433.1	10562.7	7281.7	3029.4	1046.58	12158.7	0
8	2010	0	6744.93	0	0	42339.4	16826.45	11895.85	7948.9	3517.42	1072.84	15117.75	0
9	2011	1151.4	7348.92	0	607.16	41482.79	18653.29	12634.14	8412.11	3744.81	1132.36	17511.1	19459.29
10	2012	1268.9	7886.71	0	640.99	45343.59	18226.61	13443.59	8534.25	4006.17	1087.88	16812.99	21310.48
11	2013	1370.21	8573.26	2271.15	678.14	41555.37	18735.84	13557.83	9039.22	3868.64	1227.82	19401.69	19108.14
12	2014	2203.96	7925.83	1983.53	678.01	48009.19	16383.87	12588.51	8584.8	4651.54	1454.35	18927.42	25048.57
13	2015	2334.32	8089.75	2240.91	1201.83	43417.04	18731.97	12515.22	8805.94	4810.77	1459.05	20931.23	22707.04
14	2016	2011.77	8496.14	3632.51	1131.37	48589.19	20693.17	12487.44	8806.77	5335.98	1499.03	22409.54	21556.99
15	2017	2276.86	8615.79	3590.35	1246.94	51295.41	19745.49	12779.54	9036.69	5415.52	1156.05	23245.55	22319.9
16	2018	2355.61	9082.78	3782.95	1588.41	50189.55	19007.24	12679.76	9127.49	5562.04	1141.19	22819.41	21117.82
17	2019	2269.07	8941.5	4118.49	1655.92	48561.94	20550.11	12682.47	9272.04	5848.17	1121.34	26091.38	20944.62
18	2020	2594.67	9224.69	4363.18	1651.93	56172.56	21180.52	12767.51	9560.02	5845.9	1119.24	26641.02	21550.33
19	2021	2519.85	9282.77	4220.72	1608.29	53602.6	20300.19	0	9606.21	5679.83	0	31128.9	22555

Source:- APEDA (Agricultural and Processed Food Products Export Development Authority)

India's fresh vegetable production over the years, but there were some gaps in data availability for certain crops until 2011. This growth is reflected in the table showing production levels from 2002 to 2022. To make sense of this data, it's suggested that a graph be used for better visualization. The table likely indicates the quantities of various horticultural vegetables produced annually in India. However, it seems that some crops may not have had recorded production figures for certain years, possibly due to data collection issues or other factors.

Starting from 2011, when data for all crops became available, there seems to have been a remarkable uptick in production. This period could be referred to as the "horticulture impact period," signifying a time when concerted efforts were made to boost vegetable cultivation. Analysing the graph generated from this data could offer insights into the trends and patterns of vegetable production in India over the years. It could reveal which crops experienced the

most significant growth, identify any periods of stagnation or decline, and highlight the overall trajectory of the horticultural sector.

By closely examining the graph, one could potentially uncover the factors driving the increase in production, such as technological advancements, changes in agricultural practices, government policies, or shifts in consumer demand. Understanding these factors could be crucial for policymakers, farmers, and stakeholders in the agricultural industry to sustain and further enhance vegetable production in India.

Figure 4. 5:- India Horticulture Production from 2002 - 22
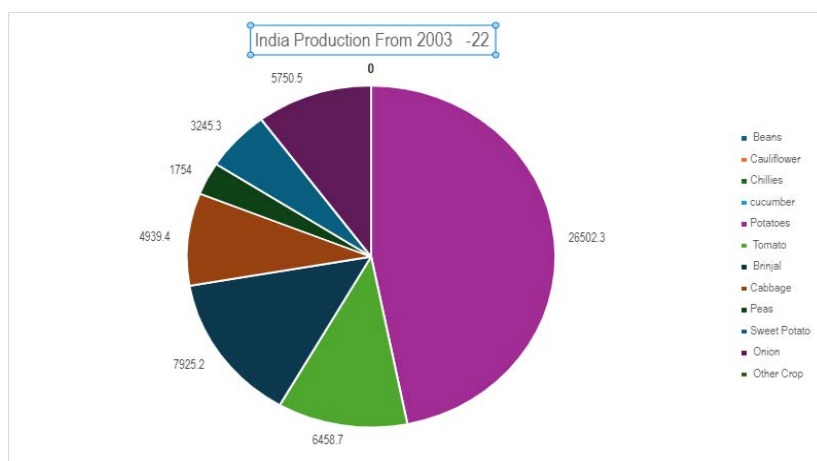
From the chart, it's evident that cabbage holds the largest share of production, followed by tomato and brinjal. These three vegetables seem to dominate the production landscape, indicating their significance in India's horticultural sector. The remaining portion of the pie chart likely represents the production levels of other vegetables, which collectively make up a smaller share compared to cabbage, tomato, and brinjal. Among these, crops such as cucumber and cauliflower are mentioned as having relatively lower production levels.

Interestingly, peas and chilies seem to occupy a notable mid-range position in terms of production levels. This suggests that while they may not have the highest production volumes like cabbage or tomato, they still contribute significantly to India's overall vegetable output. Analysing the distribution of production in this way can provide valuable insights into the diversity of India's vegetable cultivation and the relative importance of different crops in meeting domestic demand. It also highlights the varying levels of production across different vegetable types, which could inform strategies for resource allocation, market planning, and agricultural policies aimed at promoting sustainable growth in the horticultural sector.

Table 4. 12:- India State Wise Horticulture Production from 2002 - 22

Sr No.	State	Beans	Cauliflower	Chillies	Cucumber	Potatoes	Tomato	Brinjal	Cabbage	Peas	Sweet Potato	Onion	Other Crop
						India State Wise Production from 2002 – 2021							
1	Andaman & Nicobar	0	0	1.12	5.65	0	4.36	19.3	6.08	0	8.72	0	80.35
2	Andhra Pradesh	2005.3	507.02	3638.98	1355.72	1394.29	51387.28	11934.76	1987.19	337.84	266.79	14975.98	9075.15
3	Arunachal Pradesh	6.94	34.91	1.57	3.1	235.74	58.53	11.26	78.65	0.82	0.05	0	66.22
4	Assam	198.38	5694.83	19.12	823.92	14251.62	6282.82	3984.01	10362.9	319.18	575.3	825.34	76.14
5	Bihar	1258.65	19279.02	4127.59	449.97	125101.42	18359.89	21344.46	13386.16	1108.72	276.7	21848.42	7325.16
6	Chattisgarh	765.05	6258.32	1592.43	0.12	9372.94	14239.79	8908.51	5432.06	1490.58	724.51	4733.5	15310.14
7	Dadra & Nagar Haveli	0	0	0	0	0	14.4	17.6	0	0	0	0	4.5
8	Daman & Diu	0.26	0.05	0.45	1.4	0.04	0.04	0.12	0.22	0.04	0.04	0.04	0
9	Delhi	0	917.78	0	26.13	249	255.93	265.11	7	125.72	0	239.2	595.67
10	Gujarat	5302.13	8503.41	0	0	46941.36	20005.13	21782.05	10063.63	0	0	26599.72	28343.59
11	Haryana	0	10005.98	1120.05	1511.69	11992.45	8023.14	4415.35	4874.15	1965.91	0	9862.42	11958.26
12	Himachal Pradesh	538.54	1608.88	124.43	0	3307.44	7330.05	351.23	2518.94	4850.41	0	756.22	2194.87
13	Jammu & Kashmir	420.38	1454.53	127.51	497.11	2291.05	1427.88	609.9	1206.73	1333.97	85.64	1089.51	4270.11
14	Jharkhand	2214.41	5812.54	2161.74	278.65	10195.46	5080.31	4762.73	5976.22	4731.37	3.78	4835.27	4515.46
15	Karnataka	1609.73	1342.32	6358.65	1313.72	9369.43	33016.69	6839.52	3567.66	359.99	731.96	41661.12	6124.19
16	Kerala	23.4	21.21	57.28	183.7	92.7	109.87	118.94	84.08	130.79	1069.71	1.03	3561.43
17	Lakshadweep	0.18	0	0.03	0.07	0	0.02	0.08	0	0.03	0.4	0	0.04
18	Madhya Pradesh	660.55	11567.96	4896.38	1370.62	38877.93	28369.4	12402.5	8326.46	10312.5	985.48	43541.48	20425.44
19	Maharashtra	1069.32	4993.22	2553.47	445.04	5483.11	18165.26	8523.27	5988.5	558.27	341.33	110684.02	4173.85
20	Manipur	13.99	451.01	26.9	7.01	99.83	453.18	67.33	1241.94	946.5	0	48.92	700.31
21	Meghalaya	71.71	382.88	0	51.43	3105.91	407.47	143.06	455.35	22.43	290.28	50.95	331.74
22	Mizoram	65.72	26.24	9.33	31.26	51.17	180.45	193.93	724.03	24.73	13.3	78.15	552.4
23	Nagaland	187.74	46.25	349.16	114.42	639.97	216.68	42.6	1278.42	109.02	160.69	69.05	745.1
24	Orissa	571.39	12312.79	0	351.16	3996.64	25607.87	36576.94	19830.75	917.77	7415.88	6399.82	14269.36
25	Others	0.28	238.49	4.01	60.73	78.32	70.63	78.64	2.54	33.3	3.18	83.92	1688.72
26	Pondicherry	0.72	0	0.39	0	0	2.97	43.71	0	0	2.3	2.28	20.54
27	Punjab	0	4615.16	112.75	671.8	40590.21	3340.54	1261.61	1684.19	4695.26	0	3334.52	1542.06
28	Rajasthan	32.18	624.74	141.01	136.36	2796.57	1537.66	431.46	144.98	422.6	145.31	14838.24	670.3
29	Sikkim	95.15	57.45	15.14	4.68	890.83	101.83	26.15	108.87	168.36	2.49	125.67	171.37
30	Tamil Nadu	1434.47	494.15	323.34	279.72	1539.12	11718.91	2994.33	2373.94	24.53	249.21	7051.42	16370.02
31	Telangana	682.17	240.26	1103.99	496.26	504.34	9071.59	1624.57	457.61	5.1	12.39	2778.65	2424.97
32	Tripura	133.7	800.05	156.97	181.1	2100.73	700.24	856.22	1093.8	19.67	8.4	12.7	1948.23
33	Uttar Pradesh	1055.05	4997.73	442.17	621.86	250320.94	8857.62	2700.68	3397.16	36060.55	4645.37	7263.38	44850.58
34	Uttarakhand	443.28	647.84	0	0	7498.33	1699.09	424.67	1143.7	1456.44	0	685.48	1218.38
35	West Bengal	1495.85	34583.68	882.67	1414.57	194795.52	20570.87	51984.19	40677.87	2524.96	4178.01	7467.14	31752.9

**Source:-** APEDA (Agricultural and Processed Food Products Export Development Authority)

This table likely provides data on the production values, measured in metric tonnes, for each of the 12 vegetables across approximately 30 different states in India. By examining this data, one can gain insights into the contribution of each state to the overall production of different

vegetables. For example, certain states might excel in the production of specific vegetables due to favorable climatic conditions, soil types, or agricultural practices.

To better visualize and comprehend these patterns, it's suggested that a graph be used to represent the data. A graph could illustrate which states are performing better in the cultivation of vegetables. A Pie chart showing the share percentage value of each state production for each vegetable.

Analyzing this graph could reveal interesting trends, such as states with high production levels across multiple vegetables, states specializing in the cultivation of certain vegetables, or states experiencing fluctuations in production over time. Understanding these dynamics could offer valuable insights for policymakers, agricultural researchers, and farmers seeking to optimize production strategies, address supply chain challenges, and promote sustainable agricultural development across different regions of India.

Figure 4. 6:- State-wise Horticulture Production from the year 2003 - 2022
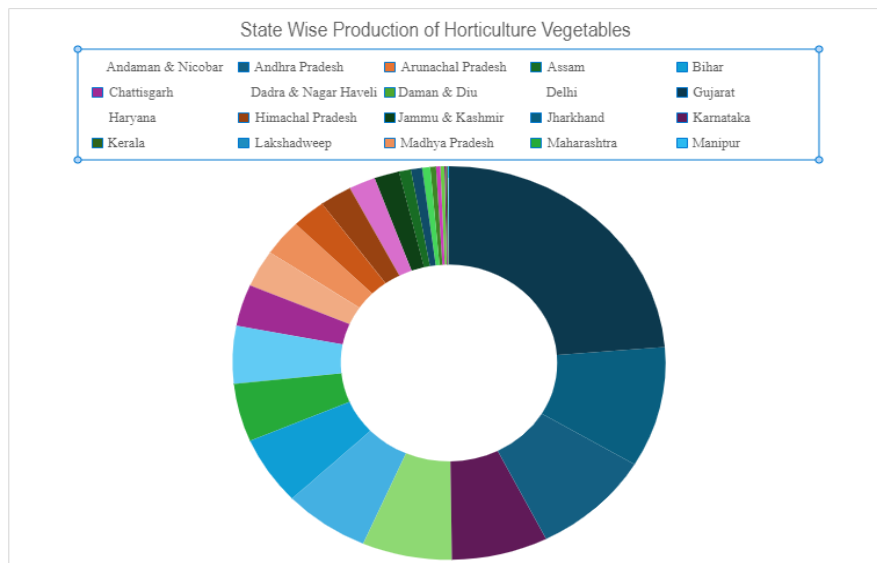
In this chart, each state's contribution to the overall production and export of these products is depicted. From the chart, it's evident that certain states stand out as the highest producers. These include Gujarat, Jammu and Kashmir, and Andhra Pradesh, which seem to lead the pack in terms of production levels. Following closely behind are states like Himachal Pradesh, Daman and Diu, Manipur, Bihar, and Maharashtra.

On the other hand, there are states with comparatively lower production levels, such as Andaman and Nicobar, Haryana, and Chhattisgarh. It's noted that most high-producing states are in the northern part of India, with some exceptions. However, there are a few states in the northern region, like Chhattisgarh and Haryana, that exhibit lower levels of production compared to their counterparts.

This distribution pattern suggests a regional variation in horticultural production within India, with certain areas demonstrating higher productivity levels than others. The dominance of

northern states in overall production underscores the importance of factors like climate, soil conditions, agricultural infrastructure, and government policies in shaping agricultural outcomes across different regions. Understanding these dynamics can help policymakers and stakeholders devise targeted interventions to promote balanced agricultural development and optimize the utilization of resources for horticultural production nationwide.

C:- Assessing Government Horticulture Mission

Table 4. 13:- National Horticulture Mission (NHM) Production from 2002 - 22

India NHM Export Data		
Years	Qty	US$ Thousand
1988	765.18	1508.01
1989	5248.65	3179.04
1990	4449.28	5386.53
1991	8419.06	6575.06
1992	7020.53	7766.07
1993	9138.87	7812.2
1994	6288.01	7890.43
1995	9446.52	12879.93
1996	5208.61	12490.42
1997	5850.88	15052.05
1998	6062.38	15768.79
1999	8177.88	19368.06
2000	12299.44	14778.61
2001	6178.68	13737.42
2002	10657.63	20834.34
2003	5169.83	11907.58
2004	6726.58	14711.48
2005	7522.15	20997.57
2006	8104.09	26971.94
2007	10125.05	35029.4
2008	8535.52	26090.66
2009	8883.71	30414.46
2010	11622.34	40569.92
2011	15205.81	60018.62
2012	17168.01	63701.6
2013	17816.7	67817.01
2014	12499.3	69956.43
2015	13104.28	80891.5
2016	11288.63	78429.58
2017	14463.13	104032.44
2018	16151.15	122763.52
2019	14796.06	101512.15
2020	17177.18	108832.36
2021	11549.91	100789.85
2022	13605.72	103275.6

Source:- National Horticulture Board (NHB)

This data includes metrics such as metric tonne production values and the corresponding US dollar values of goods produced. Additionally, it mentions the value of purchasing that occurred from the year 1988 to 2022. The NHM scheme, implemented in the year 2004-05 and fully enacted by the year-end of 2005, appears to be a significant factor in this context. It would be insightful to examine the trends in production values and US dollar values of goods before, during, and after the implementation of this scheme to understand its impact.

Before the scheme's implementation, from 2002 to 2004, it's worth investigating if there were any notable fluctuations or trends in production values and US dollar values. These years could serve as a baseline for comparison. Following the full implementation of the scheme in 2005, one would expect to see changes in production values and US dollar values reflecting the scheme's objectives and interventions. This period could be characterized by increased investment, improved infrastructure, and targeted support to enhance horticultural production.

Post-implementation, from 2006 to 2022, it's essential to assess whether there were sustained improvements or any subsequent fluctuations in production values and US dollar values. This analysis could shed light on the scheme's long-term effectiveness and its enduring impact on India's horticultural sector. Table 4.15, which presumably shows the resources allocated and the actual budget distributed during the scheme's implementation years, would be instrumental in understanding the financial aspects of the NHM scheme. By correlating this budget allocation data with the production and value metrics, one can identify any structural changes or relationships between the scheme's implementation and India's horticultural production.

Overall, this analysis aims to elucidate how the NHM scheme influenced India's horticultural sector, whether it led to structural changes, and how its implementation impacted production values and the economic value of goods produced over time.

Table 4. 14:- National Horticulture Mission (NHM) Scheme Resource Allocation from 2002 - 22

Scheame (In Rupees)	Development of Commercial Horticulture (Subsidy)	Legal charges for court cases under soft loan scheme	Capital Investment Subsidy for Cold Storages	Technology Development/Promotion for Horticulture	Market Information Service for Horticulture Crops	Horticulture Promotion Services	Establishment Expenses - Centre	Administrative Expenses - Centre	Service Charges waived under One Time Settlement scheme
2008	992729947	1312129	138440070	17567756	35877127	2498750	0	0	960000
2009	949497622	1099521	160000000	25658004	44128313	4040507	0	0	9250276
2010	757650142	997842	515126210	35483302	55454729	2211964	0	0	3504952
2011	908413120	867123	453941230	39375037	56335256	2297574	0	0	1937558
2012	514622366	830703	493172483	84886078	60615273	127833310	0	0	0
2013	505381589	3971647	576395475	87457735	73315130	5662970	0	0	126350927
2014	4874100	3787448	473265162	7363018	72569091	9590606	0	0	837365
2015	1052521167	715250	1443341398	68536688	75929237	2173604	0	0	0
2016	15313894	0	2496697234	32240879	78066813	1637860	0	0	0
2017	1812031818	3035866	575698321	26993765	81654029	2009972	0	0	3835264
2018	2965815893	807227	447676300	17116243	95230885	0	0	0	0
2019	1544312141	490223	873518400	28076710	1958186	1008230	63635259	28537638	689730
2020	508270053	355500	543913800	16649101	0	3459459	0	28644671	4563108
2021	269999500	67500	265311300	4777496	0	28397661	54236661	24497262	16577154
2022	817041548	163500	1026537500	-1973043119	27175274	66210455	30148275	0	5766567

**Source:-** National Horticulture Board (NHB) Publication

The table presents a comprehensive overview of schemes and expenditures aimed at fostering the development and promotion of commercial horticulture in India from 2008 to 2022. Firstly, the "Development of Commercial Horticulture (Subsidy)" scheme showcases fluctuating subsidy amounts, peaking notably in 2018, indicative of varying levels of government investment in horticulture development.

Legal charges incurred under the Legal charges for court cases under soft loan scheme signify potential legal hurdles faced during the implementation of horticulture-related initiatives. The Capital Investment Subsidy for Cold Storages scheme reflects fluctuating subsidy

disbursements, with peaks in 2016 and 2022, reflecting heightened support for cold storage infrastructure. Technology Development/Promotion for Horticulture exhibits varying expenditure, suggesting intensified efforts in technological advancements during peak years like 2012 and 2016.

Market Information Service for Horticulture Crops expenses depict fluctuations, highlighting variations in efforts to provide market information to horticulture farmers. Horticulture Promotion Services expenses show spikes in 2012 and 2022, indicating intensified promotional activities. Establishment and administrative expenses fluctuate, reflecting operational changes. Finally, the variation in expenses waived under the Service Charges Waived under the One Time Settlement Scheme underscores shifting implementations of settlement schemes. Overall, these fluctuations in expenditure reflect evolving priorities, policy interventions, and challenges encountered in India's horticulture sector over the years.

Figure 4. 7:- National Horticulture Budget Allocated from 2008 to 2022
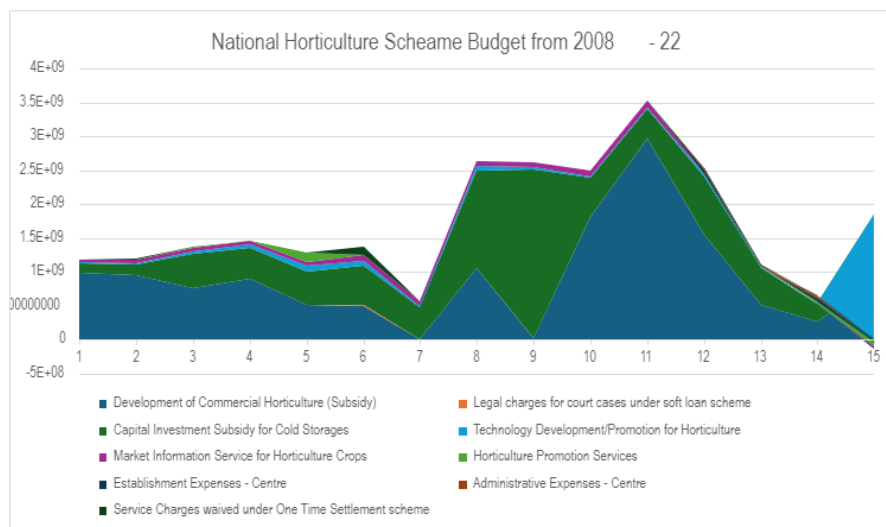
The graph provides a visual representation of the trends and volumes of subsidies allocated for various horticulture products. Notably, the volume of the Capital Investment Subsidy for Cold Storage stands out as the highest among all subsidies, indicating significant government investment in enhancing cold storage infrastructure.

This suggests a strategic focus on preserving perishable goods and reducing reliance on chemical preservation methods. On the other hand, the volume of subsidies for the Development of Commercial Horticulture appears to be substantial, reflecting investments in essential materials and tools necessary for crop production.

These two subsidies collectively account for a significant portion of the overall budget allocated by the National Horticulture Department Board. The allocation of resources towards these schemes underscores the government's commitment to fostering growth and sustainability in the horticulture sector, with a specific emphasis on infrastructure development and agricultural practices that prioritize quality and sustainability.

Figure 4. 8:- Analyzing India Production Value and National Horticulture Scheme effect from the year 2002 – 22.

Now let's observe the structural change of the India production quantity pre-NHM period and post-NHM period. This observation we let us know, whether India's NHM policy has brought a significant change or not.

```
Model 1: OLS, using observations 1988-2022 (T = 35)
Dependent variable: IndiaQty

                 coefficient      std. error     t-ratio  p-value
    ---------------------------------------------------------------
    const        -521904          116568         -4.477   9.01e-05 ***
    Years         264.931          58.2787        4.546   7.40e-05 ***
    NHMSchemes      9.06538e-07     5.90050e-07   1.536   0.1343

Mean dependent var    9906.479    S.D. dependent var    4195.594
Sum squared resid     2.02e+08    S.E. of regression    2512.843
R-squared             0.662390    Adjusted R-squared    0.641290
F(2, 32)             31.39200     P-value(F)            2.85e-08
Log-likelihood      -322.1156     Akaike criterion      650.2312
Schwarz criterion    654.8972     Hannan-Quinn          651.8419
rho                   0.198535     Durbin-Watson         1.523079
```

The table presents the outcomes of an Ordinary Least Squares (OLS) regression analysis, a statistical method used to estimate the relationship between a dependent variable and one or more independent variables.

The dependent variable, IndiaQty, presumed to represent the quantity of India, is analysed against independent variables, likely Years and NHMSchemes. Coefficients reveal the estimated impact of each independent variable on IndiaQty, indicating that for every unit

increase in Years or NHMSchemes, IndiaQty is expected to rise by 4.546 units and by their respective coefficients, respectively.

T-ratios and p-values assess the statistical significance of these coefficients, with both Years and NHMSchemes demonstrating a significant relationship with IndiaQty. The R-squared and adjusted R-squared statistics measure the model's goodness of fit, indicating that approximately 66% of the variation in IndiaQty can be explained by the model.

The F-statistic and associated p-value confirm the overall statistical significance of the regression model is good. Additional statistics such as log-likelihood and information criteria provide further insights into model comparison and selection. In summary, the OLS regression analysis highlights a statistically significant positive relationship between Years, NHMSchemes, and IndiaQty, underscoring their influence on import quantities from India.

Figure 4. 9:- Observing Structural change from the period 1988 – 2004

```
Model 2: OLS, using observations 1988-2004 (T = 17)
Dependent variable: IndQty

                  coefficient     std. error      t-ratio    p-value
   ------------------------------------------------------------------
   const          265836          435505          0.6104     0.5514
   Years           -131.854       219.158        -0.6016     0.5570
   NHMAmount          0.375579      0.202180      1.858      0.0844   *

Mean dependent var    6888.706    S.D. dependent var    2665.455
Sum squared resid     76184594    S.E. of regression    2332.757
R-squared             0.329800    Adjusted R-squared    0.234057
F(2, 14)              3.444640    P-value(F)            0.060734
Log-likelihood       -154.3033    Akaike criterion      314.6067
Schwarz criterion     317.1063    Hannan-Quinn          314.8551
rho                  -0.005830    Durbin-Watson          1.847770
```

The table presents the outcomes of a regression analysis using Ordinary Least Squares (OLS), a statistical technique used to examine relationships between variables. The analysis spans from 1988 to 2004, aiming to understand the factors influencing IndiaQty, which presumably represents the quantity of India.

Coefficients depict the estimated impact of independent variables, such as Years and NHMSchemes, on IndiaQty. A positive coefficient suggests an increase in IndiaQty with each unit increase in the independent variable, assuming all other factors remain constant. The std. error measures the variability of coefficients if the study were repeated with different data samples where the error is significant not higher than the normal data set range value.

The t-ratio assesses the statistical significance of coefficients, with values above 2 typically considered significant. However, in this table, only the t-statistic for Years is shown to be statistically significant. The p-value indicates the probability of obtaining a t-statistic as extreme as observed, assuming the coefficient is zero. A p-value less than 0.05 is typically considered significant, but here, neither Years nor NHMSchemes demonstrate statistical significance.

The R-squared statistic evaluates how well the model explains variations in IndiaQty, with a higher value indicating a better fit. The adjusted R-squared adjusts for the number of independent variables and serves as a more reliable measure. The F-statistic assesses the overall significance of the model, where a significant value indicates a meaningful relationship between variables.

However, in this case, the F-statistic suggests the model lacks significance. Other statistics, such as log-likelihood and information criteria, aid in comparing different models. Overall, the analysis indicates a weak relationship between Years and IndiaQty, with NHMSchemes, potentially limiting the model's explanatory power.

Figure 4. 10:- Observing Structural change from the period 2004 – 2022

```
Model 3: OLS, using observations 2004-2022 (T = 19)
Dependent variable: IndiaQty

                    coefficient        std. error     t-ratio  p-value
         ------------------------------------------------------------------
   const        -667508                 248141          -2.690   0.0161  **
   Years              337.236           123.460          2.732   0.0148  **
   NHMSchemes           8.59473e-07       6.45795e-07    1.331   0.2019

Mean dependent var     12439.23    S.D. dependent var    3482.018
Sum squared resid      1.08e+08    S.E. of regression    2602.518
R-squared              0.503439    Adjusted R-squared    0.441368
F(2, 16)               8.110795    P-value(F)            0.003696
Log-likelihood        -174.7477    Akaike criterion      355.4954
Schwarz criterion      358.3288    Hannan-Quinn          355.9749
rho                    0.443063    Durbin-Watson         1.089928
```

The table delves into the results of an Ordinary Least Squares (OLS) regression analysis, aiming to discern the relationship between the dependent variable, likely representing the quantity of India (IndiaQty), and independent variables like Years and NHMSchemes, spanning the years 2004-2022.

The coefficients reveal the anticipated impact of each independent variable on IndiaQty, with the coefficient for Years suggesting that with each unit increase, IndiaQty is projected to rise by 2.732 units, all else held constant. Standard error gauges the variability of coefficients across different data samples, while t-ratios assess the statistical significance of each coefficient.

Notably, while the t-statistic for Years is statistically significant, indicating a meaningful relationship with IndiaQty, NHMSchemes' t-statistic fails to meet significance thresholds. P-values further underscore these findings, with Years demonstrating statistical significance (p = 0.0148), unlike NHMSchemes (p = 0.2019). The R-squared value (0.5034) signifies that the model elucidates approximately 50% of the variation in IndiaQty, with the adjusted R-squared corroborating the model's reliability.

The F-statistic (8.1108) and its associated p-value (<0.05) indicate the model's overall statistical significance. However, NHMSchemes' lack of significance prompts scrutiny. Supplementary statistics like log-likelihood and information criteria facilitate model comparison. In essence, while the OLS regression model is statistically significant, it's crucial to interpret NHMSchemes' impact cautiously, given its insignificance.

Figure 4. 11:- Critical value and the calculated value of this model from the period 1988 – 2022 structural change.
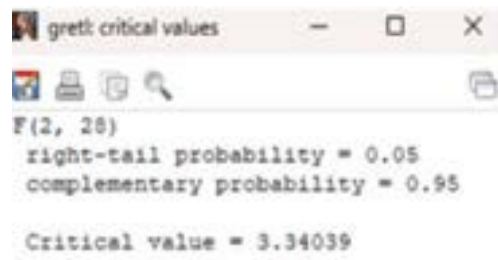
This table displays the results of an F-test, a common hypothesis test to determine if a regression model is meaningful. F-statistic is the right-tail probability, which is 0.05 in this case (95% confidence level) tells us the chance of getting a result like this if the model were random. The complementary probability, 0.95 here, is just the opposite. The critical value, 3.34039, helps us compare the F-statistic to a calculated value.

Calculation

$$S_4 = (S_2) + (S_3) \qquad\qquad \text{Step 1}$$

$$S_4 = 76184594 + 1.080$$

$$S_4 = 76184595.8 \qquad\qquad d.f = 17 - 2 = 15$$

$$S_5 = (S_1) + (S_4) \qquad\qquad \text{Step 2}$$

$$S_5 = 2.02000 - 76184595.8$$

$$S_5 = -76184593.8 \qquad\qquad d.f = 19 - 2 = 17$$

$$Formula = \frac{(S_5)/K}{(S_4)/(n_1 + n_2) - 2k} \qquad\qquad \text{Step 3}$$

$$d.f = (15 + 17) - 2(2)$$

$$d.f = 32 - 4$$

$$d.f = 28$$

$$Formula = \frac{(-76184593.8)/2}{(76184595.1)/28}$$

$$Formula = \frac{-38092296.9}{2720878.35}$$

$$Formula = -14$$

At 95 % level will either accept the True null hypothesis or Reject the true null hypothesis. At 0.05 % rejection the Critical value is 3.3409 and the calculated value is -13.99. Hence we reject the null hypothesis and accept alternate hypothesis. That means there is a structural change over from the period of 1988 – 2005 to 2005 – 2022 of the horticulture scheme impacting the India's production in horticulture product.

Figure 4. 12:- Thematic Map for Correlation between India Quantity Production and NHM Scheme.
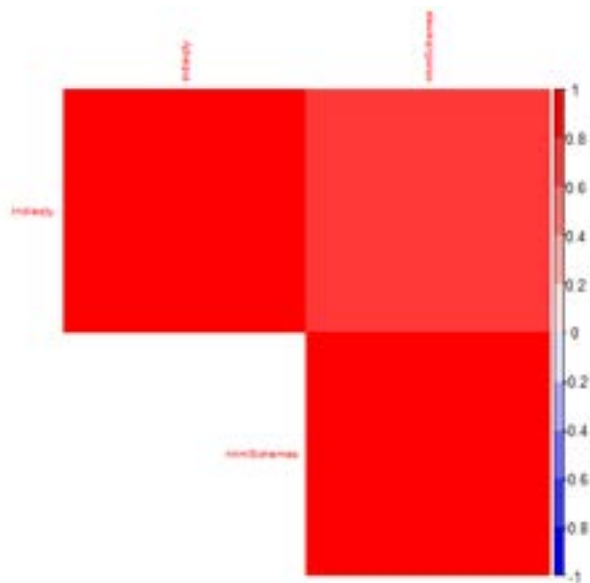
The graph above illustrates the correlation between India's production value and various horticulture schemes. Red indicates a high correlation between the variables. The graph is divided into four quadrants, each showing the implication and impact of the subsidy value. The absence of a quadrant suggests either a lack of correlation or no relationship between certain years. The values on the graph predominantly indicate a positive correlation, as they are situated closer to the 0 to 1 scale, signifying a positive relationship between the variables. Conversely, values farther from zero indicate a weaker correlation or no relationship at all.

Commands in R studio

```r
library(wooldridge)
library(PerformanceAnalytics)
library(car)
library(tidyverse)
library(dplyr)
library(corrplot)
# Load necessary libraries
library(corrplot)
summary(Gretal_Data)
str(Gretal_Data)
# Remove the mean of "indiaqty" and "nhmSchemes"
Gretal_Data$indiaqty <- Gretal_Data$indiaqty - mean(Gretal_Data$indiaqty, na.rm = TRUE)
Gretal_Data$nhmSchemes <- Gretal_Data$nhmSchemes - mean(Gretal_Data$nhmSchemes, na.rm = TRUE)
# Select the variables you want to calculate correlations with
selected <- Gretal_Data[c("indiaqty", "nhmSchemes")]
# Calculate the correlation matrix for the selected variables
correlation_matrix <- cor(selected, use = "complete.obs")
# Create a correlation graph
# Set up the color palette
col <- colorRampPalette(c("blue", "white", "red"))(10)
# Plot the correlation matrix
corrplot(correlation_matrix, method = "color", col = col, type = "upper", tl.cex = 0.6)
```

D:- Summary and Findings

The valuable insights into the relationship between Indian horticulture production and the allocation of resources through various schemes. The tables, graphs, and regression analyses have shed light on several key findings.

Firstly, the substantial investment in schemes such as the Development of Commercial Horticulture and Capital Investment Subsidy for Cold Storages indicates a significant focus on enhancing horticulture production and storage infrastructure. The consistent allocation of resources over the years suggests a sustained effort by the government to support and promote the horticulture sector.

Additionally, the revealed comparative advantage (RCA) and revealed symmetric comparative advantage (RSCA) analyses highlight India's strengths in certain horticulture commodities, particularly onions and chilies. This indicates that India has a comparative advantage in the production and export of these commodities, which aligns with the investment in schemes aimed at bolstering horticulture production. Furthermore, regression analyses have provided evidence of a statistically significant relationship between the years and horticulture scheme resources with Indian horticulture production. This implies that the allocation of resources through schemes over time has had a tangible impact on horticulture production in India. Overall, these findings underscore the importance of strategic resource allocation and policy support in driving growth and sustainability in India's horticulture sector, ultimately contributing to food security, economic development, and international trade competitiveness.

Conclusion

Throughout this study, we've delved into the intricate dynamics of India's horticulture sector, examining various facets ranging from production trends to the impact of government schemes. Our journey began with an exploration of production data, where we observed notable fluctuations over time. From there, we transitioned into an analysis of export and import trends, uncovering India's position as a key player in the global horticulture market. The subsequent examination of top export and import destinations provided valuable insights into India's trade relationships and commodity strengths.

As we delved deeper into the data, the significance of government schemes became increasingly evident. The allocation of resources through schemes such as the Development of Commercial Horticulture and Capital Investment Subsidy for Cold Storages emerged as pivotal drivers of sectoral growth. The detailed analyses of subsidy allocations and their correlation with production values revealed a nuanced relationship, emphasizing the strategic importance of policy support in fostering agricultural development.

Furthermore, the concept of revealed comparative advantage (RCA) sheds light on India's strengths in specific horticulture commodities, notably onions and chilies. This analysis underscored India's competitive edge in certain agricultural products, highlighting the potential for targeted investments and export promotion initiatives.

The regression analyses provided a quantitative lens through which to assess the impact of time and scheme resources on horticulture production. The statistically significant relationship between these variables underscored the importance of sustained policy interventions in driving sectoral growth and resilience.

In conclusion, our comprehensive study has illuminated the multifaceted nature of India's horticulture sector, from production dynamics to trade patterns and policy implications. By leveraging data-driven insights and empirical analyses, we've gained a deeper understanding of the factors shaping the sector's trajectory. Moving forward, strategic investments in infrastructure, research, and market access will be crucial to unlocking the full potential of India's horticulture sector, driving sustainable growth, and fostering resilience in the face of evolving challenges.

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