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A VECM Analysis on the Impact of Agricultural Exports, Financial Openness and Trade Openness on India's Ecological Footprint

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ABSTRACT

The 21st century has witnessed a surge in concerns surrounding environmental degradation, prompting investigations into its contributing factors. This study delves into the impact of agricultural exports and financial openness on the ecological footprint of India, utilizing time series data for a comprehensive analysis. Employing unit root tests and the VECM model for cointegration analysis, the study offers compelling insights. The findings reveal a positive association between agricultural exports and a reduction in India's ecological footprint in both the long and short run, suggesting that increased agricultural exports contribute to environmental sustainability. The study demonstrates a positive association between financial openness and the ecological footprint, indicating that increasing financial openness leads to environmental sustainability in India. These findings align with previous studies highlighting the potential trade-offs between economic growth and environmental protection. Conversely, the study identifies trade openness is negatively associated with the Ecological Footprint, increase in trade openness leads to an increase in environmental degradation. Furthermore, the study identifies economic growth as an additional factor significantly impacting India's ecological footprint. These findings underscore the complex interplay between various economic and environmental forces. This study contributes to the ongoing dialogue on sustainable development by providing valuable empirical evidence on the specific case of Ind. The findings offer policymakers crucial insights for crafting strategies that promote economic growth while minimizing environmental harm.

Keywords:- *Agricultural Exports, Financial Openness, Trade Openness, Ecological Footprint, VECM.*

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CHAPTER ONE
INTRODUCTION

The geographic reach of environmental policies has become a subject of intense debate, with concerns escalating over the past few decades. Recognizing that environmental challenges often transcend national boundaries, (Vogel, 2011) emphasizes the need for international cooperation to address critical problems. Globalization has further underscored this need, as international trade, while contributing to economic growth across the globe, has also brought with it significant environmental concerns for both exporting and importing nations.

(Huang & Labys, 2002) aptly highlight the potential conflict between economic prosperity and environmental degradation. While trade undoubtedly enhances economic welfare, this benefit can be undermined by the negative consequences of environmental damage. This complex dynamic fuels policy disputes concerning the impact of international trade flows on environmental conditions.

One school of thought, as articulated by (Gallagher, 2009), suggests that economic growth induced by trade can eventually lead to increased investments in environmental protection, resulting in a net positive outcome. This so-called "pollution haven hypothesis" posits that as nations reach higher income levels, they prioritize environmental quality and address the issues generated by previous economic activity.

However, the validity of this hypothesis is contested. Critics argue that relying solely on economic growth to drive environmental stewardship is insufficient, as it overlooks the immediate and potentially irreversible damage caused by unsustainable practices. Moreover, the geographical distribution of environmental costs and benefits often favors developed nations, with developing nations bearing the brunt of pollution and resource depletion associated with global trade.

The relationship between international trade, environmental policies, and sustainability requires careful consideration. While economic growth offers potential for environmental improvements, it is crucial to adopt proactive measures to mitigate the harmful impacts of trade on the environment. Moving forward, international cooperation, innovative policy frameworks, and a commitment to sustainable development are essential to ensure that economic progress does not come at the cost of environmental degradation.

A. Ecological Footprint-

The ecological footprint serves as a quantifiable measure of the demands on the planet. It considers both the resources consumed (water, land) to produce the goods and services and the waste generated (pollution) that needs to be absorbed by the environment (Jorgenson, 2003). This makes it a valuable tool for assessing environmental degradation and understanding the overall impact on the planet's health (Liu, Kim, Liang, & Kwon, 2018). Ecological Footprint measures precisely the demand humanity places on Earth's ecosystems to provide for all its needs. The footprint considers two essential aspects. Biocapacity represents the Earth's ability to regenerate resources and absorb waste, like a planet-wide income statement. Demand reflects our collective consumption of these resources, akin to expenses on the Earth's budget. The Ecological Footprint helps to understand:

- Sustainability: If the human footprint exceeds biocapacity, they live beyond Earth's means, leading to resource depletion, environmental degradation, and climate change.
- Comparison: comparison of the footprints of different individuals, communities, or nations to identify areas for improvement and track progress towards sustainability.
- Decision-making: It informs policy decisions, business strategies, and individual lifestyle choices by highlighting the environmental impact of human actions.

While globally the average person carries an ecological footprint of 2.7 global hectares (gha), India sits slightly lower at 0.9 gha. However, with a population exceeding 1.3 billion, this translates to a massive national footprint, the third-highest in the world, exceeding its biocapacity by nearly 150%. This means India is using 1.5 times the renewable resources its own land can provide, relying on other countries' ecological assets to sustain its consumption. While a lower individual footprint compared to developed nations might seem positive, several factors make India's situation worrisome. India's population is expected to surpass 1.5 billion by 2030, significantly increasing overall resource demand. Rapid economic growth is leading to a rise in meat consumption, energy-intensive lifestyles, and increased waste generation, further straining the limited resources. Deforestation, water scarcity, and soil erosion are already prevalent, jeopardizing long-term ecological sustainability.

Environmental degradation, the pollution of air, water, and soil, severely damages critical aspects of our planet like mountains, forests, and water sources. These essential elements sustain all living beings, and their decline poses serious long-term threats to human life and well-being (Rehman & Zeb, 2020). Environmental degradation is no longer a future threat but a present reality in India. Air pollution, water contamination, and declining biodiversity are causing serious health, economic, and social problems. This urgency arises from Climate Change, Public Health Crisis, and Economic Losses. Several factors contribute to India's environmental challenges Excessive reliance on fossil fuels, intensive agriculture practices, and inadequate waste management are major

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contributors. While providing economic benefits, rapid industrial growth often lacks adequate environmental safeguards, leading to air and water pollution.

➢ *Major Sectors Contributing to India's Footprint are:*

- Agriculture: Intensive farming practices, water overuse, reliance on chemical fertilizers and pesticides, and food waste contribute significantly.
- Energy: Heavy dependence on fossil fuels like coal for electricity generation leads to high carbon emissions.
- Industry: Manufacturing processes, particularly in sectors like textiles, steel, and chemicals, generate air and water pollution and deplete resources.
- Transportation: Rising vehicle ownership, reliance on personal vehicles, and inadequate public transport infrastructure contribute to emissions and resource use.
- Urbanization: Growing cities put pressure on resources like water and energy, generate large amounts of waste, and contribute to urban heat island effects.

B. Agricultural Exports-

India's agricultural sector, a vital cog in its economic engine, extends its influence beyond domestic borders through a thriving export market. This essay delves into the significance of agricultural exports for India's GDP and employment, tracing their growth journey, exploring recent developments, and acknowledging the potential environmental ramifications. India, predominantly reliant on agriculture, holds a crucial position in its economy, constituting 65% of employment and contributing 18% to the GDP (Bais & Bahadur, 2023). Agricultural exports contribute significantly to India's GDP, accounting for roughly 10% in 2021-22. This translates to a substantial sum, with exports reaching $50 billion in the same year. This income generation fuels economic growth and national development. The sector employs a staggering 65% of India's workforce, with exports creating additional opportunities for farmers, processors, and allied industries. This fosters rural livelihoods and mitigates poverty.

India's export basket has diversified beyond traditional staples like rice and spices. Products like marine products, processed foods, and horticulture are gaining traction, reflecting a shift towards value-added exports. The government plays a proactive role through schemes like the Agri-Export Policy and the creation of Special Economic Zones (SEZs) to boost infrastructure, address logistics challenges, and facilitate market access. The adoption of technologies like precision agriculture and e-commerce platforms is streamlining processes, enhancing efficiency, and improving product quality, contributing to export competitiveness. Regional trade agreements like the South Asian Free Trade Agreement (SAFTA) offer promising avenues for expanding market reach and boosting exports. Strengthening the value chain through improved storage facilities, processing units, and cold chains will reduce post-harvest losses and enhance export value.

While agricultural exports offer economic benefits, it's crucial to acknowledge the potential environmental costs. Overexploitation of resources, intensive farming practices, and chemical use can lead to soil degradation, water depletion, and biodiversity loss. Sustainable practices and responsible resource management are essential to ensure long-term export viability and environmental well-being. Economic growth is closely tied to agricultural trade, resulting in amplified usage of inputs like chemical fertilizers, pesticides, diesel, and electricity for irrigation. This surge in agricultural production processes has led to heightened carbon emissions and escalating environmental pollution concerns. As the second-largest global agricultural output producer and leading wheat cultivator, India's agricultural sector likely significantly influences CO2-related indicators. While agriculture in India is deeply interconnected with the environment, concerns about unpredictable weather and global warming introduce risks to farming (Bais & Bahadur, 2023). Despite its prominent role, the Indian agriculture sector contends with challenges such as rapid agricultural land shrinkage, low-value addition, and technological lag. The paradoxical dynamic of incessant resource demand in trade activities against the backdrop of ecological constraints necessitates a nuanced approach (Joshi P. A., 2015). Linking the swift expansion of trade with the environmental pollution scenario is deemed essential. The contention arises that the unchecked growth of trade may contribute to the ineffective reduction of environmental pollution, particularly in developing countries. This raises fundamental questions about the relationship between agricultural trade and environmental pollution in India, prompting an examination of whether economic growth invariably results in environmental degradation.

The agriculture sector, responsible for 14% of the country's GHG emissions, necessitates a nuanced understanding of the transformational characteristics and the intricate relationship between agricultural land and GHG pollution (Pathak, 2023). To formulate effective economic growth strategies, policymakers must comprehend the impact of agricultural trade on both economic growth and environmental pollution (Niu, et al., 2020).

C. Financial Openness

India's FDI journey started cautiously in 1975, with inflows hovering below 1% of GDP. However, liberalization reforms in the 1990s ushered in a new era, with FDI peaking at 4.2% of GDP in 2007-08. Since then, it has fluctuated between 1-2%, reflecting both global economic trends and domestic policy shifts. FDI bridges the domestic savings-investment gap, providing much-needed capital for infrastructure development, industrial modernization, and job creation. Foreign companies often bring advanced

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technologies and management practices, enhancing domestic capabilities and competitiveness. FDI can lead to increased exports by foreign affiliates, integrating India into global value chains and boosting foreign exchange reserves. The Indian government has actively promoted FDI through various policies. Sectors like retail, defense, and civil aviation have seen a gradual easing of FDI restrictions, attracting investments and enhancing competition. These zones offer tax benefits and streamlined regulations, attracting foreign companies and creating export-oriented hubs. The government has established single-window clearance systems and streamlined approval processes to expedite FDI inflows. Studies suggest FDI has contributed 15-20% of India's GDP growth since the 1990s and created millions of jobs, particularly in sectors like manufacturing and services. FDI has played a vital role in financing infrastructure projects in sectors like roads, ports, and telecommunications, improving connectivity and logistics. Foreign companies often invest in training their employees and collaborating with local institutions, fostering skill development and innovation.

While Foreign Direct Investment (FDI) holds immense potential for India's economic growth, its relationship with environmental degradation requires careful consideration. The influx of foreign capital can bring cleaner technologies, efficient resource management practices, and investments in renewable energy, potentially mitigating environmental damage. However, concerns arise due to potential negative impacts associated with certain types of FDI. Unsustainable resource extraction by some foreign companies, particularly in mining and extractive industries, can lead to deforestation, water depletion, and soil erosion. Additionally, lax environmental regulations or inadequate enforcement can create conditions where foreign companies prioritize short-term profit over long-term environmental sustainability. This can manifest in practices like industrial waste mismanagement, air pollution from manufacturing units, and the adoption of environmentally harmful technologies. Furthermore, large-scale infrastructure projects driven by FDI can sometimes lead to land acquisition and displacement of communities, impacting biodiversity and ecosystem services. These issues necessitate a proactive approach from the government and stakeholders.

(Koengkan, Fuinhas, & Marques, 2018) argue that increased financial openness leads to a larger loan supply at lower costs. This, in turn, incentivizes firms to invest in and consume more, potentially driving up demand for fossil fuels and other non-environmentally friendly resources. Similarly, (Aydin & Turan, 2020) suggests that greater financial flows stimulate the production of non-environmental commodities and energy-intensive practices, both contributing to environmental degradation. In simpler terms, easier access to capital through financial openness might encourage businesses to expand, but not necessarily in sustainable ways. Increased investment and consumption could lead to higher demand for fossil fuels and other environmentally harmful resources, ultimately harming the environment.

D. Trade Openness

India's trade openness, primarily measured by exports as a percentage of GDP has witnessed a remarkable transformation since 1975. In the pre-liberalization era, trade restrictions and inward-looking policies kept exports below 10% of GDP. However, the economic reforms of the 1990s ushered in a new chapter, with exports steadily rising to reach a peak of 24% in 2010-11. Since then, the figure has fluctuated around 20%, reflecting evolving global conditions and domestic policy shifts. Exports act as an engine of economic growth, creating jobs, fostering technological advancements, and generating foreign exchange reserves. They diversify the economy, making it less susceptible to domestic shocks. Open trade allows Indian businesses to access wider markets, boosting competitiveness and promoting economic integration with the global economy. Openness attracts foreign direct investment (FDI) and technology transfer, leading to infrastructure development, industrial modernization, and improved productivity.

However, these benefits come with environmental costs. Increased resource extraction for export-oriented production can lead to deforestation, water depletion, and biodiversity loss. Growing production and transportation for exports contribute to air and water pollution, greenhouse gas emissions, and hazardous waste generation. Agricultural exports can drive deforestation, soil erosion, and loss of natural habitats. Studies suggest a positive correlation between trade openness and deforestation in India, particularly due to increased demand for timber and agricultural products. Export-oriented industries like textiles and leather have been linked to water pollution from untreated wastewater discharge. Coal-based energy use in manufacturing for exports significantly contributes to India's carbon footprint.

International trade has played a pivotal role in facilitating technology transfer and fostering increased levels of consumption (Sharma, 2018). Widely acknowledged as a catalyst for sustainable economic growth, international trade enables the cost-effective generation of products and services by reshaping demand toward more competitive outputs (Purnama & Yao, 2019). Recognizing the significance of agriculture in India's GDP, the reduction of trade barriers stands to augment agricultural export earnings. A net expansion in foreign direct investment and trade openness can create multiplier effects, contributing to economic development and poverty alleviation. (Kalaitzi & Cleeve, 2017). Trade policies, while recognized as insufficient tools for reducing global emissions, can be instrumental within a well-functioning international trading framework to address environmental challenges. Hence, the intricate interplay between agricultural trade, economic growth, and environmental concerns emerges as a crucial focus for both governmental policy formulation and academic research.

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E. Economic Growth

Before liberalization in the 1990s, the economy was characterized by slow and controlled growth, hovering around 3-5% annually. However, economic reforms propelled India onto a faster trajectory, with GDP growth averaging 6-7%. This sustained growth has translated to significant improvements in living standards and poverty reduction. Higher GDP translates to increased production, investments, and job creation, fostering economic prosperity. Growth enables investments in education, healthcare, and infrastructure, improving the quality of life for citizens.

Increased production and consumption lead to higher demand for water, minerals, and fossil fuels, potentially exceeding their sustainable limits. Expanding infrastructure and resource extraction can lead to deforestation, habitat loss, and endangerment of species. Economic growth in a globally interconnected economy relies heavily on external linkages, trade relations, and foreign investments. This heightened economic activity, however, contributes to increased energy consumption, resulting in the release of CO2 and SO4 emissions (Ahad & Khan, 2016). India faces severe consequences of climate change, posing a persistent threat to its agricultural sector. Projections indicate a potential 5-25% reduction in crop yields by 2050, impacting food security and livelihoods, as changing climate conditions force farmers to adapt cultivation patterns (World Bank, 2023). The adverse effects of globalization on the environment have been increasingly acknowledged, with the interconnected global market contributing to environmental deterioration. Global warming, projected to increase temperatures by 1-2°C by 2050, disrupts monsoon patterns, leading to more frequent and intense droughts and floods. (World Bank, 2023) The implications of these climate changes extend to water scarcity, with a projected 25% decrease in availability by 2050, further jeopardizing agricultural yields (World Bank, 2023).

F. Need for the Study-

India is a major agricultural exporter, driven by factors like increasing global demand and government incentives. While exports contribute to economic growth and farmer income, concerns exist about the potential for Expansion of agricultural land for export crops might lead to deforestation, soil degradation, and biodiversity loss. India has witnessed increasing financial openness in recent years, attracting foreign investments and technology. However, potential drawbacks include the influx of foreign capital might promote the adoption of high-yielding but resource-intensive technologies, exacerbating the ecological footprint. Though India has committed to achieving the Zero Carbon Goal and reducing its environmental impact there is a need to analyze the impact of various economic activities on its ecological footprints to frame and execute sustainable policies and practices. Existing literature has examined the relationship between financial openness, trade openness, and environmental indicators like carbon emissions or land use change. However, limited research explores the specific impact on the EF, which considers a broader range of environmental pressures. Also, the existing literature has studied the relationship between energy consumption, and urbanization on EF but there is scope for the study of Agricultural Exports on the Ecological Footprint in the Indian Context.

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CHAPTER TWO
LITERATURE REVIEW

- (Haq, et al., 2021) The contemporary discourse on environmental degradation has emerged as a central topic of discussion in the 21st century. This study investigates the nexus between agricultural exports, financial openness, and ecological footprints in Pakistan, employing time series data analysis. The research employs unit root tests to assess data for unit root issues and utilizes the Autoregressive Distributed Lag (ARDL) model for cointegration analysis. The findings of the study indicate that agricultural exports play a crucial role in mitigating ecological footprints both in the short and long run, suggesting that an increase in agricultural exports could effectively curb environmental degradation in Pakistan. Conversely, the study reveals that financial openness is associated with an increase in ecological footprints, thereby contributing to environmental degradation in the country. Additionally, the research identifies trade openness, economic growth, and energy consumption as other significant factors influencing ecological footprints. This comprehensive exploration of the relationship between agricultural exports, financial openness, and ecological footprints contributes valuable insights to the ongoing discourse on environmental sustainability in Pakistan.
- (Afesorgbor & Demena, 2021) Several studies have examined the relationship between Foreign Direct Investment (FDI) and environmental emissions, yielding varying conclusions. However, a recent meta-analysis, encompassing 65 primary studies and 1006 elasticities, presents a nuanced understanding. Initially suggesting a significant reduction in emissions, this effect diminishes upon considering study heterogeneity and disaggregating data by country development levels and pollutant types. Surprisingly, the meta-analysis concludes that FDI's impact on environmental emissions is close to zero after accounting for these factors. It highlights FDI's potential to contribute positively to emissions reduction efforts, with consistent findings observed across different countries and pollutants.
- (Huang, Chen, Xiang, Xu, & Akram, 2021) The accelerated growth of the global economy has brought environmental concerns to the forefront, affecting the trajectory of sustainable development. This study examines the relationship between foreign direct investment (FDI) inflows and carbon emissions in G20 economies from 1996 to 2018. Findings suggest that while FDI can exacerbate carbon emissions, higher economic development and regulatory quality can mitigate its impact, offering valuable insights for policymakers in crafting effective environmental policies.
- (Topcu, 2021) This study investigates the influence of export, import, and renewable energy consumption on Turkey's ecological footprint, employing a range of statistical tests and econometric models. Through the application of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, Johansen Cointegration Test, and Fully Modified Ordinary Least Square (FMOLS), Dynamic Ordinary Least Squares (DOLS), and Canonical Cointegrating Regression (CCR) Models, the research provides comprehensive insights. Existing literature emphasizes the critical role of trade and energy consumption in shaping a country's ecological footprint. This study corroborates the positive impact of export and renewable energy consumption in reducing Turkey's ecological footprint. Conversely, it identifies a negative relationship, indicating that import has an increasing impact on the ecological footprint of the country. The findings underscore the importance of reducing dependency on imported resources while emphasizing investments in preserving biological capacity. As Turkey seeks to optimize its ecological footprint, policymakers should prioritize strategies promoting export-oriented growth and renewable energy utilization.
- (Rehman, et al., 2021) Globalization's technological strides and economic advancements have linked people globally, fostering modern economies. However, the negative ecological impact, particularly on biodiversity, is often overlooked amidst rapid economic and industrial growth. This study explores the relationship between globalization, energy consumption, trade, economic growth, and fuel importation on Pakistan's ecological footprint from 1974 to 2017, utilizing a linear ARDL technique and limited information maximum likelihood. Prior research acknowledges globalization's role in environmental degradation, emphasizing the need for a balanced approach. The study reveals that, in the long run, globalization, energy usage, trade, and GDP growth positively influence the ecological footprint, while fuel importation exhibits an adverse linkage. Limited information maximum likelihood results support positive linkages between globalization, energy usage, trade, and fuel importation, contrasting with an adverse linkage to GDP growth. The linear Gaussian model reinforces a constructive linkage between globalization and energy usage, emphasizing the need for strategic policies to mitigate CO2 emissions and promote sustainable economic growth in Pakistan.
- (Ali, Manzoor, Tufail, & Rashid, 2022) This paper explores the nexus between trade openness, foreign direct investment (FDI), and environmental quality in Pakistan, employing the ARDL bound test for cointegration and residual-based diagnostic tests. The study, spanning from 1975 to 2019, contributes to the existing literature on the environmental implications of economic policies. Previous research has extensively investigated the impact of trade openness and FDI on environmental quality, with varying perspectives. The current study aligns with a growing body of literature emphasizing the complex relationship between economic activities and environmental outcomes. Specifically, the findings reveal that FDI is consistently detrimental to environmental quality, affecting both the short and long run. In contrast, trade openness exhibits a nuanced impact, showing an improvement in environmental quality over the long run while causing harm in the short run. This aligns with previous studies that underscore the temporal dynamics of the relationship between trade policies, foreign investment, and environmental outcomes.

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- (Kazemzadeh, Koengkan, Silva, Osmani, & Fuinhas, 2022) This research spans 16 emerging countries over the period 1990 to 2014, employing a two-step approach. Initially, a Slacks-Based Data Envelopment Analysis (SBM–DEA) model assesses annual resources and energy efficiency, revealing Turkey and Hungary as top performers, while China and India rank lowest. The subsequent panel quantile regression analyzes the impacts of resources and energy efficiency, export quality, and various variables on the ecological footprint. Findings indicate that enhanced resources, energy efficiency, and trade openness correlate with reduced ecological footprints, whereas GDP, fossil fuel consumption, and population contribute to environmental deterioration. Importantly, the study identifies nuanced impacts, with export quality and urban population exacerbating ecological footprints in specific quantiles. These results underscore the multifaceted policy interventions required to address distinct variables influencing ecological footprints in emerging countries.
- (Mate, 2019) The global food system, spanning from fertilizer production to food packaging, contributes significantly to human-caused greenhouse gas emissions, amounting to one-third of the total emissions. Carbon footprint, constituting over 50% of the ecological footprint globally, serves as a crucial indicator of greenhouse gas intensity across various economic activities, aiding in both raising awareness of global warming and informing policy decisions. Despite its widespread use, the application of carbon footprint analysis within the agricultural sector remains relatively scarce in existing literature. This study aims to fill this gap by examining agriculture-specific factors influencing the global carbon footprint. Utilizing data from the Global Footprint Network and the World Bank databases spanning from 1961 to 2013, the research employs a panel dataset comprising 133 countries over a 53-year period. Employing a feasible generalized least squares estimator and panel tests, the study finds that economic development and agricultural production, including arable land, agricultural machinery, and fertilizer use, positively impact the carbon footprint. Additionally, agricultural trade is found to exert a positive influence on the carbon footprint, while a higher share of rural population and agricultural development are associated with a decrease in carbon footprint growth.
- (Muoneke, Okere, & Nwaeze, 2022) This study focuses on examining the impact of agricultural and globalization factors on environmental sustainability in the Philippines, specifically using carbon and non-carbon ecological footprint proxies. Controlling variables like fossil fuel usage, economic growth, urbanization, and financial development, the research employs the autoregressive distributed lag (ARDL) framework, revealing a stable long-term relationship among the variables. Results suggest an inverted U-shaped pattern in the Environmental Kuznets Curve (EKC), indicating that as agricultural development progresses, the ecological footprint initially rises before declining due to increased efficiency and lower carbon output. Furthermore, the study identifies that while financial globalization has a positive long-term impact on ecological footprint, trade globalization shows a negative and significant effect. Additionally, empirical findings highlight the need for optimizing agricultural land use and integrating cleaner, low-carbon technologies such as solar, geothermal, and wind energy to mitigate environmental degradation.
- (Usman & Makhdum, 2021) This study delves into the dynamic interplay among ecological footprint, agriculture value-added, forest area, renewable and non-renewable energy usage, and financial development across BRICS-T nations from 1990 to 2018. By addressing cross-sectional dependency and employing advanced panel unit root, cointegration, long-run elasticity, and causality tests, it uncovers significant insights. The results suggest that an increase of 1% in agriculture value-added elevates the ecological footprint of BRICS-T countries by 0.2201%, while a similar increase in non-renewable energy and financial development amplifies the ecological footprint by 0.5507% and 0.0404%, respectively. Conversely, a rise of 1% in forest area and renewable energy utilization contributes to a reduction in ecological footprint by 0.7483% and 0.2248%, respectively, signifying their positive impact on environmental quality over the long term. Furthermore, causality analysis reveals a feedback loop between agriculture, financial development, and ecological footprint, indicating their mutual influence. Additionally, the study identifies a growth-oriented relationship between forest area, renewable, and non-renewable energy utilization to ecological footprint.
- (Rehman & Zeb, 2020) The study investigates factors contributing to environmental degradation in Pakistan, focusing on pollutants from economic growth. Carbon dioxide (CO2) emissions are the dependent variable. Key determinants include economic growth, population, energy consumption, and industrialization, with data from 1972 to 2018. Using ARDL, the study reveals long-term relationships. Results show population growth, energy consumption, and industrialization positively impact environmental degradation, while economic growth has a negative effect. Recommendations include controlling population growth, promoting clean energy, and strengthening EPAs.
- (Balogh & Jambor, 2020) This paper offers a systematic literature review providing insights into the environmental implications of agricultural trade, drawing from recent international economics literature. The authors examine the prevailing perspectives on the subject and outline key findings regarding pollution consequences while suggesting potential solutions. The literature review underscores a prevailing skepticism towards extended trade or trade liberalization in agriculture within contemporary environmental studies. Most recent research tends to emphasize the adverse environmental impacts associated with expanded agricultural trade. The majority of studies do not present a favorable view of the consequences of such trade liberalization. Only a limited number of papers posit that certain countries or regions might experience environmental benefits from engaging in agricultural trade. Specifically, the study highlights that the crop, livestock, and processed food sectors are identified as contributors to environmental degradation, further emphasizing the nuanced challenges posed by agricultural trade. In conclusion, the literature review serves to consolidate diverse perspectives on the environmental dimensions of agricultural trade, emphasizing the need for a comprehensive understanding of its impacts and potential mitigations.

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- (Udemba, 2020) This study addresses India's status as the world's third-largest emitter of greenhouse gases, focusing on the examination of the relationship between ecological footprint and key factors such as agriculture, energy use, population, and foreign direct investment (FDI). Utilizing a Linear Autoregressive Distributed Lag (ARDL) model along with diagnostic tests and Granger causality estimation, the research seeks to uncover the complex dynamics involved. Previous literature has consistently highlighted India's significant contribution to global greenhouse gas emissions. Within this context, the study reveals a positive correlation between ecological footprint and factors such as agriculture, energy use, and population. Notably, it identifies a negative association between ecological footprint and foreign direct investment (FDI). This implies that policies should prioritize initiatives that enhance the economy through increased FDI and sustainable agricultural practices. The research underscores the importance of a policy framework that addresses the dual goals of economic development and environmental sustainability. Emphasizing the need for careful management of energy use and enhancing environmental performance, the study provides actionable insights for policymakers.
- (Nasim, Ahmad, Bashir, & Noreen, 2022) This article delves into the examination of the influence of trade openness on Pakistan's key sectors – industrial, agriculture, and services – utilizing time series data for empirical insights. Through the application of the ARDL (Autoregressive Distributed Lag) model, the study investigates the impact of trade openness on these sectors. The empirical findings reveal that Foreign Direct Investment (FDI) and capital formation act as driving forces, steering the economy towards the industrial sector. Foreign direct investment, however, exhibits a negative and significant impact on the agriculture sector. Moreover, gross capital formation negatively affects both the agricultural and industrial sectors but demonstrates a positive influence on the services sector. The overall analysis underscores the substantial impact of trade openness on the growth of different sectors within the Pakistani economy. In the broader context, this research emphasizes the pivotal roles played by foreign direct investment and capital formation in shaping the economic landscape. By shedding light on the intricate relationships between trade openness and sectoral dynamics, this study contributes valuable insights to the existing literature on economic development in Pakistan.
- (Pan, Cristia, Ghardallou, Tahir, & Ali, 2023) This study delves into the intricate interconnections among economic growth, ecological footprint, and climate change, with a particular focus on the context of Pakistan. Employing the Johansen co-integration technique, the authors rigorously analyze both short-run and long-run relationships between economic growth, ecological footprint, and carbon dioxide emissions. The empirical findings underscore the positive effects of urbanization, financial development, and economic growth on ecological footprints. Notably, the study identifies that urbanization, financial development, economic growth, and temperature contribute positively to ecological footprints, while rainfall and carbon dioxide emissions exhibit a negative impact on ecological footprints. In the existing body of literature, this research adds significant value by unraveling the nuanced relationships between economic growth, ecological footprints, and climate-related factors in the specific context of Pakistan. The emphasis on the positive influences of urbanization, financial development, and economic growth, coupled with the proposed strategy to mitigate ecological footprints through carbon dioxide reduction, contributes essential insights to the broader discourse on sustainable development and environmental equilibrium.
- (Saghaian, Mohammadi, & Mohammadi, 2022) This paper investigates the impact of agricultural product exports on environmental quality across developed and developing countries from 2002 to 2020, utilizing panel data and instrumental variable regression models. In this context, the study contributes to the Environmental Kuznets Curve (EKC) literature by exploring the relationship between agricultural exports and pollution emissions. Existing research has primarily focused on the negative association between trade openness and environmental quality. This study reveals that total agricultural exports contribute to increased pollution from greenhouse gas emissions in developing countries, while simultaneously decreasing N2O emissions in developed countries. The findings emphasize the detrimental effect of expanding agricultural product exports from developing nations on environmental quality. Notably, raw agricultural exports are identified as a significant contributor to pollution emissions in these countries. As a result, the study underscores the importance of policymakers taking into account the environmental consequences of agricultural activities and emphasizes the need to enhance farmers' awareness to mitigate these adverse effects.
- (Liu, Kim, Liang, & Kwon, 2018) This study examines the Environmental Kuznets Curve (EKC) hypothesis using ecological footprint as an indicator in Japan, Korea, and China. As these countries develop, they balance export demand and sustainable growth amid climate change. The EKC model is employed with Error Correction Methodology (ECM) from 1990 to 2013. Additionally, besides GDP, export products and market diversification are introduced as economic development proxies. Results show an inverted U-shaped relationship between economic growth and ecological footprint for Korea and Japan, aligning with EKC theory. However, China's data does not follow this trend. Interestingly, greater export diversification correlates with larger ecological footprints.
- (Aydin & Turan, 2020) This study investigates the influence of economic growth, financial openness, trade openness, and energy intensity on the ecological footprint of BRICS nations from 1996 to 2016 within the framework of the environmental Kuznets curve (EKC). The research examines the effects of financial and trade openness on the ecological footprint individually and collectively through three models. Findings reveal that the EKC hypothesis does not universally apply to all BRICS countries. Specifically, while the EKC model incorporating financial openness holds true only for India, the model incorporating trade openness is valid for both India and South Africa. Moreover, financial openness has mitigated environmental pollution in India and South Africa, while trade openness has reduced pollution in China and India but increased it in South Africa. Notably, energy intensity has amplified environmental pollution across all countries except Russia in both models. Thus, policymakers are urged to implement measures targeting energy intensity reduction in BRICS nations.

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- (Koengkan, Fuinhas, & Marques, 2018) This study examines the influence of financial openness on environmental degradation in MERCOSUR countries from 1980 to 2014. Using the Panel Autoregressive Distributed Lag (PARDL) framework, specifically the Unrestricted Error Correction Model (UECM), the research aims to distinguish between short- and long-term effects of variables. The findings indicate that financial openness contributes to increased CO2 emissions both in the short and long run. Additionally, economic growth, primary energy consumption, and agricultural production are identified as factors driving emissions growth in MERCOSUR countries. These empirical results contribute to the existing literature on the environmental impact of financial development and underscore the necessity for policymakers to reconsider the financing approach for the energy mix.
- (Arif, Arif, & Khan, 2021) This study examines the relationship between Foreign Direct Investment (FDI) and environmental quality across 123 nations from 1996 to 2018. Findings reveal a significant negative impact of FDI on environmental emissions in the global sample. Employing a VAR model, the analysis incorporates factors such as environmental regulation and economic growth. Results suggest that while FDI promotes short-term economic growth, its long-term effects are limited. Notably, FDI positively influences environmental quality in developed nations but exhibits adverse consequences in developing countries. Moreover, the study underscores the role of FDI spillover in ameliorating environmental pollution, emphasizing its potential for beneficial impacts beyond direct investment.
- (Venkatray, 2022) This study focuses on investigating the impact of Foreign Direct Investment (FDI) on carbon emissions specifically within the BRICS nations. Analyzing both short-run and long-run dynamics, the authors find no significant long-run relationship between FDI and CO2 emissions in these countries. However, in the short run, there is a discernible association indicating that increasing FDI leads to a reduction in carbon emissions. These findings underscore the potential for FDI to positively influence environmental outcomes in BRICS nations. Consequently, the study advocates for policy measures that encourage FDI liberalization alongside the strengthening of environmental regulations to leverage the observed short-term benefits for long-term sustainability goals.
- (Yaqoob, Babi, & Khalid, 2022) This study examines the influence of tourism, natural resources, globalization, and foreign direct investment (FDI) on the ecological footprint across five nations: USA, UK, Pakistan, China, and India, spanning from 1995 to 2020. Results indicate that tourism exerts a positive effect on China and Pakistan, while exhibiting a negative impact on India. Additionally, FDI is found to exacerbate environmental degradation in India and China but enhances the ecosystem in the UK. The research highlights the diverse effects of tourism on the ecological footprint across different countries and underscores the nuanced impact of FDI on environmental degradation, emphasizing the need for tailored policy interventions to address environmental concerns effectively.
- This study explores the influence of foreign direct investment (FDI), renewable and non-renewable energy consumption, economic growth, trade openness, and natural resources on the ecological footprint. The findings reveal that FDI, renewable energy consumption, and GDP exhibit a negative association with the ecological footprint. Conversely, non-renewable energy consumption and trade openness are positively correlated with the ecological footprint. Notably, the study underscores the importance of encouraging eco-friendly manufacturing processes and technology adoption in India to mitigate environmental degradation. Furthermore, promoting renewable energy consumption while simultaneously reducing reliance on non-renewable sources emerges as a crucial strategy for sustainable development and environmental conservation.
- (Emmanuel, Fonchamnyo, Thierry, & Dinga, 2023) This study investigates the impact of foreign capital, domestic capital formation, institutional quality, and democracy on the ecological footprint across a global panel of 101 countries spanning from 1995 to 2017. While macroeconomic indicators were not considered, the analysis reveals that domestic capital formation contributes to environmental degradation, contrasting with the positive influence of institutional quality. Employing cointegration and causality methodologies, the study utilizes Autoregressive Distributed Lag (ARDL) techniques for panel data analysis. Notably, the research highlights the role of the private financial system in reducing environmental degradation in high-income countries and the mitigating effect of urbanization on long-term environmental degradation at the panel level.
- (Doytch & Ashraf, 2021) This study examines the theory of ecologically unequal exchange through the lens of Foreign Direct Investment (FDI), specifically focusing on two modes of entry: Greenfield FDI (GFDI) and cross-border M&A sales. Findings suggest that GFDI poses greater harm to ecosystems compared to cross-border M&A transactions. Moreover, the research identifies ecologically unequal exchange, with distinct impacts observed in developed and developing nations. As a result, the study provides different policy recommendations tailored to address the environmental implications of GFDI and cross-border M&A, underscoring the need for nuanced approaches to mitigate ecological footprints in varying contexts.
- (Udeagha & Ngepah, 2021) The literature suggests a dynamic interplay between trade openness and environmental quality, with divergent views on the net effect. Previous studies have emphasized the potential negative impact of trade openness on environmental quality, supported by empirical evidence. Conversely, technological innovation is widely acknowledged as a driver for improving environmental conditions. Leveraging the dynamic autoregressive distributed lag (ARDL) simulation framework, this study reevaluates the relationship using extensive time series data spanning from 1960 to 2020. It underscores the long-term deterioration of environmental quality associated with trade openness while highlighting the pivotal role of international collaboration and technological advancement in mitigating environmental degradation and fostering sustainability efforts.

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- (Tran & Do, 2021) Existing literature presents divergent perspectives on the relationship between trade openness and environmental degradation, particularly in developing economies. While some studies suggest a positive association between trade openness and environmental deterioration, others propose potential environmental benefits. Methodologically, researchers have employed various econometric techniques to explore this dynamic, including autoregressive distributed lag models and Granger causality tests. Specifically focusing on ASEAN developing countries such as Vietnam, Thailand, Malaysia, Indonesia, and the Philippines, this study contributes to the discourse by examining the impact of trade openness on carbon dioxide and nitrous oxide emissions. The findings reveal nuanced outcomes, with trade openness correlating with environmental degradation in Malaysia and Indonesia, while showing a short-term reduction in carbon emissions in Vietnam and the Philippines with higher trade openness. This study adds empirical insights to inform policy discussions aimed at balancing economic growth with environmental sustainability in these contexts.
- (Anwar & Elfaki, 2021) The literature presents a growing body of research exploring the intricate nexus between energy consumption, economic growth, trade openness, capital formation, and environmental degradation. Existing studies have highlighted the complex dynamics and interdependencies among these factors, particularly in emerging economies like Indonesia. While some findings suggest a positive correlation between energy consumption, economic growth, and environmental degradation, others emphasize the mitigating effects of factors such as trade openness and capital formation. This study contributes by examining these relationships in the Indonesian context over the period from 1965 to 2018, shedding light on the nuanced interactions and implications for sustainable development policies.
- (Weili, Khan, & Khamphengxay, 2021) Existing literature has extensively examined the multifaceted relationship between trade openness, renewable energy consumption, foreign direct investment (FDI), and carbon emissions in both developed and developing nations. Studies have employed a variety of methodological approaches, including static, dynamic, and long-run estimators, to analyze these complex interactions. While findings have been mixed, a consensus emerges regarding the differential impacts across country types. Specifically, trade openness is found to reduce carbon emissions in developed countries, yet its effect on environmental degradation in developing nations remains contentious. Moreover, the role of renewable energy consumption emerges as a crucial factor in enhancing environmental quality, with evidence suggesting positive outcomes in both developed and developing economies. This paper contributes to this ongoing discourse by providing comprehensive insights into the nuanced relationships between trade openness, renewable energy consumption, FDI, and carbon emissions on a global scale.
- (Chen, 2023) Existing literature extensively explores trade openness, environmental pollution, and pollution control mechanisms in China. Studies on 30 Chinese provinces from 2007 to 2017 indicate trade openness increases carbon emissions, impacting pollution control. Recent research investigates technological innovation as a mediator in this relationship. Understanding how trade influences pollution control mechanisms is crucial, with technology possibly mitigating trade's adverse environmental effects. This study contributes by examining trade openness, technological innovation, and pollution control in China's provincial economies.
- (Bashir & Javaid, 2023) Research on environmental degradation in Asia has focused extensively on the impacts of industrial expansion and trade openness. Panel data analysis spanning 16 Asian economies from 1992 to 2020 has revealed significant findings regarding the relationships between these factors and CO2 emissions. Notably, industrial value addition and population density have been identified as drivers of CO2 emissions, exacerbating environmental degradation. Conversely, trade openness, government expenditure, and GDP have demonstrated potential in mitigating CO2 emissions, suggesting avenues for environmental policy intervention. Utilizing unit root tests and the Panel ARDL technique, this study contributes valuable insights into the complex interplay between industrial expansion, trade openness, and environmental degradation in Asia.
- (Trong, et al., 2023) The literature extensively investigates the role of financial inclusion, ecological innovation, economic growth, and globalization in the MENA region. This study contributes by examining their direct impacts on ecological footprint. It highlights the significant roles of financial inclusion, economic growth, and globalization on ecological outcomes. Additionally, the study emphasizes the importance of ecological innovation in reducing ecological footprint, offering policy implications for sustainability in the MENA context.
- (Kaur & Kaur, 2023) The literature extensively explores the intricate relationship between urbanization, economic growth, and environmental quality, often through the lens of the Environmental Kuznets Curve (EKC) hypothesis. This paper contributes by examining this relationship using time-series analysis across 10 selected Asian countries from 1990 to 2018. The findings affirm the validity of the EKC hypothesis for countries like China, Bangladesh, Nepal, India, Thailand, and Malaysia, suggesting that as economic growth progresses, environmental quality initially deteriorates but then improves. However, for the Philippines, Indonesia, Cambodia, and Vietnam, a U-shaped relationship emerges between economic growth and ecological footprint, indicating a different pattern where economic growth initially exacerbates environmental degradation before eventually leading to improvement.
- (Özlem, Samet, & Serhat, 2022) Existing literature extensively examines the impacts of economic growth, renewable and non-renewable energy production, and trade openness on ecological footprints across various countries and regions. This study contributes to this body of research by investigating these relationships specifically within the context of Turkey, utilizing annual data spanning from 1980 to 2016. Findings suggest that economic growth, along with both renewable and non-renewable energy production, positively influences the ecological footprint in the long term. However, unlike some previous studies, trade openness was found to have no significant effect on the ecological footprint in Turkey. By offering insights into the unique

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dynamics of these factors in Turkey, this research enriches our understanding of the complex interactions between economic development, energy production, trade, and environmental sustainability.

- (Umar, Manas, & Arif, 2023) The literature extensively explores the relationship between environmental degradation and economic growth, often through the lens of the Environmental Kuznets Curve (EKC) hypothesis. This study focuses on India, employing Autoregressive Distributed Lag models to investigate this nexus. The findings reveal heterogeneous and footprint-specific patterns within the growth-environment relationship. Specifically, an inverted N-shaped EKC is observed for cropland, while an N-shaped EKC characterizes forest, grazing, water, and built-up land footprints. In contrast, a monotonic increasing relationship is identified for the carbon footprint. By delineating these complex dynamics, this research adds nuance to our understanding of how economic growth impacts various environmental indicators in India, contributing to the broader discourse on sustainable development.
- (Ansari, Villanthenkodath, Akram, & Rath, 2023) This study examines the influence of energy poverty on key macroeconomic indicators, focusing specifically on the technological threshold-based approach to assessing energy poverty. This method is chosen for its perceived advantages over alternative methodologies in elucidating the dynamic relationship between ecological footprint and energy poverty within sub-Saharan African nations over the period spanning from 1995 to 2018. Utilizing second-generation panel unit root and panel cointegration tests, the study initially establishes the presence of a long-term association among the variables under consideration. Subsequently, employing both random effects model and fully modified ordinary least squares estimation techniques, the study computes the long-term elasticities. The findings from these analyses suggest that energy poverty significantly diminishes the ecological footprint, yet it does not exert a discernible impact on economic growth within the sub-Saharan African context. Hence, the findings imply that addressing energy poverty could serve as a viable policy lever for promoting environmental conservation in developing countries.
- (Acar, Altıntaş, & Haziyev, 2023) This study explores the compatibility between environmental preservation and the pursuit of economic growth and financial development, both crucial for enhancing societal well-being. Focusing on Azerbaijan, we employ the ARDL bound test with structural breaks spanning from 1996 to 2017. Our research aims to enrich the existing literature by: (i) employing ecological footprint as a metric to assess the impact of economic growth and financial development on the environment, (ii) employing a structural break econometric method to capture temporal variations in the relationship between the variables, and (iii) focusing specifically on Azerbaijan. Our findings reveal an inverted U-shaped Environmental Kuznets Curve relationship between economic growth and ecological footprint, indicating an initial deterioration followed by improvement in environmental quality with economic advancement. Additionally, financial development is found to mitigate ecological footprint. These results underscore the importance of integrating environmental considerations into policymaking, financial practices, production processes, and individual choices, alongside fostering economic and financial development.
- (Vu, et al., 2023) While economic growth, globalization, and ecological footprint have been studied together, there's limited research on financial inclusion and ecological innovation in the MENA region. This study fills this gap by examining their dynamic relationship using various statistical methods. Data from 1990 to 2017 are collected for MENA panel economies, revealing cross-sectional dependence, stationarity, and slope heterogeneity among variables. CS-ARDL analysis shows significant direct impacts of financial inclusion, economic growth, and globalization on exacerbating environmental issues like the ecological footprint. However, ecological innovation plays a significant role in reducing environmental degradation. Robustness checks confirm these findings, offering policy implications.
- (Uddin, Saqib, Kousar, & Usmam, 2023) This study aims to explore the influence of energy consumption, financial development, and economic growth on the ecological footprint across 119 developed and developing nations from 2002 to 2018. Utilizing panel unit root and autoregressive distributed lag (ARDL) models, the research investigates this relationship. The ARDL outcomes suggest that in developed countries, factors such as energy consumption, financial development, urbanization, globalization, foreign direct investment, and population growth positively correlate with the ecological footprint. Conversely, the human development index and natural resources exhibit a negative association with the ecological footprint in developed nations. In contrast, in developing countries, energy consumption, financial development, urbanization, foreign direct investment, and population growth are found to positively impact the ecological footprint over the long term. However, the human development index, natural resources, and globalization are observed to have a negative influence on the ecological footprint. These findings underscore the necessity for tailored policy interventions in both developed and developing countries to mitigate their ecological footprint.
- (Javeed, Siddique, & Javed, 2023) This study investigates the interplay between economic activities and environmental sustainability in Asia, a region heavily impacted by environmental challenges due to its large population. Analyzing data from 1990 to 2017, various econometric techniques including panel OLS, fixed effects, and fully modified-OLS are employed to assess the relationship between economic growth, globalization, renewable energy, and ecological footprint (EFP). Findings indicate that increasing the share of renewable energy improves environmental quality, while economic growth and globalization exert varying degrees of pressure on the environment. Granger causality analysis reveals bidirectional relationships between EFP and globalization, as well as between EFP and energy intensity. The study emphasizes the importance of implementing sustainable environmental policies in Asian countries to mitigate further environmental degradation.

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CHAPTER THREE
RESEARCH METHODOLOGY

A. Objectives of the Study

In light of growing concern for sustainable economic growth in each sector of India and sound financing decisions the following objectives are undertaken for the study:

- To examine the relationship between agricultural exports and the ecological footprint of India.
- To assess the impact of financial openness on the ecological footprint of India in the short run and the long run.
- To analyze the impact of trade openness and economic growth on the ecological footprint of India in the short run and the long run.
- To test whether there exists a causal relationship between the independent variables and the dependent variable.

B. Scope of the Study

The study will focus on the period 1975 to 2022, considering the agricultural export data, financial openness indicators, trade openness, economic growth data, and ecological footprint metrics specific to India. However, the years with a negative value of Economic growth and Financial Openness have been eliminated from the analysis.

C. Variables

The dependent variable for the study is the Ecological footprint of India.

The independent variables considered in the study are Agricultural Exports and Financial Openness. Trade Openness and Economic Growth (GDP growth) have been taken as control variables.

- Ecological Footprint: The amount of land and resources needed to sustain our current consumption and waste disposal habits.
- Agricultural Exports: Goods produced in agriculture (crops, livestock, etc.) that are sold to other countries.
- Financial Openness: The degree to which a country allows foreign investment and financial transactions.
- Trade Openness: The extent to which a country participates in international trade, measured as trade volume as a percentage of GDP.
- Economic Growth: An increase in the value of goods and services produced in an economy over time.

Table 1: Data

Variable Type	Variable Name	Abbreviation	Description	Source	Literature
Dependent Variable	Ecological Footprint	EF	Measured in global hectare (GHA)	Ecological Footprint Network Online Database	(Haq, et al., 2021)
Independent Variable	Agricultural Exports	AX	Percentage of merchandise exports	World Bank Indicators	(Haq, et al., 2021)
Independent Variable	Financial Openness	FO	Ratio of net inflows of FDI to GDP	World Bank Indicators	(Yaqoob, Babi, & Khalid, 2022)
Independent Variable	Trade Openness	TO	Percentage of total GDP	World Bank Indicators	(Afesorgbor & Demena, 2021)
Independent Variable	Economic Growth	GDP	Per capita growth	World Bank Indicators	(Haq, et al., 2021)

D. Hypothesis

To study the objectives of the study the following hypotheses are formulated:

- H0: Agricultural Exports do not have an impact on the Ecological Footprint of India in the short run.
- H0: Agricultural Exports do not have an impact on the Ecological Footprint of India in the long run.
- H0: Financial Openness does not have an impact on the Ecological Footprint of India in the short run.
- H0: Financial Openness does not have an impact on the Ecological Footprint of India in the long run.
- H0: Trade Openness does not have an impact on the Ecological Footprint of India in the short run.
- H0: Trade Openness does not have an impact on the Ecological Footprint of India in the long run.

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E. Method of Data Collection

The data collection method deployed for the study is the secondary data collection. The data for the independent variables, Agricultural Exports (agricultural exports as a percentage of total merchandise exports), Financial Openness (FDI inflows as a percentage of GDP), Trade Openness (Trade as a percentage of GDP), and Economic Growth (GDP per capita growth %) has been taken from World Bank Indicators. The data for the Ecological footprint of India has been taken from the Ecological Footprint Network Online Database.

F. Model Specification-

From the foregoing, this study specified the following functional form of the relationship between ecological footprint, agricultural exports, and financial openness by incorporating various explanatory variables and ecological footprint to serve as dependent variables:

$$EF = f(AX, FO, TO, GDP) \quad (1)$$

where: EF – Ecological Footprint measured in global hectare (GHA)

AX – Agricultural Exports as the percentage of total merchandise exports.
FO – FDI as a percentage of GDP
TO – Trade as a percentage of GDP
GDP – per capita growth percentage

The equation (1) above can be further transformed into a mathematical model as follows:

$$LN\_EF = \alpha + \beta 1 LN\_AX + \beta 2 LN\_FO + \beta 3 LN\_TO + \beta 4 LN\_GDP + \varepsilon t \quad (2)$$

The variables involved in the study are converted into logarithmic values to maintain uniformity.

Here, α is the constant of the equation.

β_1, β_2, β_3, and β_4 are the constant terms of the variables.

εt is the error term

G. Econometric Model

The econometric model used for the data analysis and interpretation is the Vector Error Correction Model. The Vector Error Correction Model (VECM) excels at capturing both the long-term equilibrium relationships and the short-term dynamics of endogenous variables. This model reveals how variables adjust toward long-term stability while exhibiting short-term fluctuations. Notably, endogenous variables are compelled to converge to their co-integrated relationships in the long run. (Jaupllari & Zoto, 2013)

To examine the time series characteristics of each variable within the VECM framework, this paper adheres to a three-stage strategy. The first stage entails establishing the stationarity of the time series, often achieved through tests like the Augmented Dickey-Fuller (ADF) test. Following stationarity assessment, the second stage involves determining the order of integration of each variable, typically using the ADF test. If the variables exhibit integration at the same order (e.g., I(1)), the Johansen cointegration technique is employed to uncover the long-term relationships and short-term dynamics. (Jaupllari & Zoto, 2013)

The Vector Autoregression (VAR) model leverages the inherent statistical properties of data to capture the interdependencies within a system. It generalizes the univariate autoregressive model by incorporating lagged values of all endogenous variables, effectively creating a "vector" of time series variables. Introduced to the economic field by Sims (1980), the VAR model became a popular tool for dynamic analysis of economic systems. (Zou, 2018)

Building upon VAR, Engle and Granger (1987) proposed the Vector Error Correction Model (VECM), which integrates cointegration and error correction mechanisms. This model assumes the existence of long-term equilibrium relationships (cointegration) among variables and utilizes error correction terms to capture deviations from these stable states. Notably, the VECM can be viewed as a VAR model with additional constraints imposed by the cointegration relationships. (Zou, 2018)

Crucially, the presence of cointegration in the VECM ensures that even amidst short-term dynamic fluctuations, the long-term behavior of endogenous variables remains constrained and ultimately converges toward the established cointegration relationships. (Zou, 2018)

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➢ *The model is Represented in the Form of the Following Equation-*

$$\Delta Y\_t = \alpha\beta_o + \Sigma_i \beta_i \Delta Y\_(t\text{-}i) + \gamma * ECT\_(t\text{-}1) + \varepsilon\_t \quad (3)$$

Where:

- ΔY_t: Vector of changes in the variables at time t (differenced series)
- $\alpha\beta_o$: Vector of intercept terms
- $\Sigma_i \beta_i \Delta Y\_(t\text{-}i)$: Sum of lagged changes in the variables (capturing short-term dynamics)
- γ: Vector of error correction coefficients (ECTs)
- ECT_(t-1): Error correction term (captures long-run equilibrium)
- ε_t: Vector of Error terms.

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CHAPTER FOUR
ANALYSIS & INTERPRETATION

A. Analysis of the Data

➢ *Descriptive Statistics*

Table 2: Descriptive Statistics

Variables	EF	AX	TO	FO	GDP
Mean	0.802415	2.144517	0.946668	4.489868	30.68436
Median	0.771279	1.87278	0.765407	4.437254	26.44709
Maximum	1.082215	4.998066	3.620523	8.184368	55.79372
Minimum	0.574696	0.942789	0.002584	1.162592	12.21927
Std. Dev.	0.16054	1.001118	0.880725	1.96067	14.8971
Skewness	0.358528	1.026986	0.81503	-0.04847	0.237157
Kurtosis	1.780687	3.277434	3.229061	1.819368	1.538672
	L_EF	**L_AX**	**L_TO**	**L_FO**	**L_GDP**
JB	2.857	2.191	4.091	5.9271	3.8548
Probability	0.2395	0.3343	0.1292	0.0516	0.1455
Observations	42	42	42	42	42

Table 2 depicts the descriptive analysis of the variables used in the current study. The dependent variable is the ecological footprints which is a suitable measure for environmental degradation, the Table shows that on average from 1975 to 2022, the ecological prints in India are estimated as 0.80 hectares while its maximum value is 1.08 hectares. The average agricultural exports are 2.144% of merchandise exports with 4.99 and 0.94% as their maximum and minimum values respectively. Financial openness has a mean value of 4.489 with 8.18 and 4.43 as its maximum and minimum values respectively. Trade openness has maximum and minimum values of 3.63 and 0.76 respectively and its mean during the study period is 0.94. The Jarque-Berra (JB) statistic shows that the variables of the study are normally distributed after taking a natural log of all variables.

➢ *Unit Root Test*

A unit root test is a statistical hypothesis test used to assess the presence of a unit root in a time series variable. A unit root implies that the variable's past values don't influence its current value, and it tends to drift away from its initial value over time, making it non-stationary. stationarity implies that the statistical properties of the variable, such as its mean and variance, remain constant over time.

- **Null Hypothesis H0:** The variable has a Unit Root.
- **Alternate Hypothesis H1:** The variable has no Unit Root.

Table 3: Unit Root Test Results

	At Level			At First Difference		
Variables	**t-stat**	**p-value**	**Result**	**t-stat**	**p-value**	**Result**
L_EF	-3.523623	0.3057	NS	-3.526609	0	S
L_AX	-3.523623	0.159	NS	-3.526609	0	S
L_TO	-3.523623	0.8904	NS	-3.526609	0.0001	S
L_FO	-3.523623	0.3762	NS	-3.526609	0	S
L_GDP	-3.523623	0	S	-3.529758	0	S

- Ecological Footprint: From Table 3 it can be observed that the p-value value at the level is 0.3057 which is not less than 0.05. Hence, we accept the null hypothesis, the variable is non-stationary at the level. However, at first difference p-value is 0 which is less than 0.05, hence the variable is stationary at first difference. We reject the null hypothesis with a 95% confidence level.
- Agricultural Exports: From Table 3 it can be observed that the p-value value at the level is 0.159 which is not less than 0.05. Hence, we accept the null hypothesis, the variable is non-stationary at the level. However, at first difference p-value is 0 which is less than 0.05, hence the variable is stationary at first difference. We reject the null hypothesis with a 95% confidence level.
- Trade Openness: From Table 3 it can be observed that the p-value value at the level is 0.8904 which is not less than 0.05. Hence, we accept the null hypothesis, the variable is non-stationary at the level. However, at first difference p-value is 0 which is less than 0.05, hence the variable is stationary at first difference. We reject the null hypothesis with a 95% confidence level.

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- Financial Openness: From Table 3 it can be observed that the p-value value at the level is 0.3762 which is not less than 0.05. Hence, we accept the null hypothesis, the variable is non-stationary at the level. However, at first difference p-value is 0 which is less than 0.05, hence the variable is stationary at first difference. We reject the null hypothesis with a 95% confidence level.
- GDP: From Table 3 it can be observed that the p-value value at the level is 0 which is less than 0.05. Hence, we accept the null hypothesis, the variable is stationary at the level. However, at first difference p-value is 0 which is less than 0.05, hence the variable is stationary at first difference. We reject the null hypothesis with a 95% confidence level.

The augmented Dicker-Fuller test has been used to check the stationarity of the variables used in the study. Table 3 shows that all the variables are stationary at the first difference at 5% significance level. Since all the variables are stationary at I(1), a cointegration test can be used to check the existence of long-run relationships among the variables.

➢ *Lag Selection Criteria*

Table 4: Akaike Information Criteria

Information Criteria by Rank and Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Log Likelihood by Rank (rows) and Model (columns)					
0	72.45175	72.45175	81.29491	81.29491	82.08066
1	88.20676	88.89764	94.07031	99.59202	100.2336
2	100.5579	101.6503	106.2859	112.3323	112.7421
3	109.4613	111.3366	115.0514	123.1630	123.5483
4	112.8783	116.5980	118.6117	126.7367	127.1198
5	112.8879	119.3405	119.3405	129.4838	129.4838
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	-2.372588	-2.372588	-2.564745	-2.564745	-2.354033
1	-2.660338	-2.644882	-2.703516	-2.929601	-2.761679
2	-2.777895	-2.732513	-2.814295	-3.016614*	-2.887105
3	-2.723064	-2.666829	-2.752570	-3.008149	-2.927413
4	-2.393913	-2.379899	-2.430586	-2.636833	-2.605989
5	-1.894397	-1.967025	-1.967025	-2.224188	-2.224188
Schwarz Criteria by Rank (rows) and Model (columns)					
0	-1.317038*	-1.317038*	-1.298086	-1.298086	-0.876264
1	-1.182568	-1.124890	-1.014636	-1.198500	-0.861689
2	-0.877905	-0.748079	-0.703196	-0.821071	-0.564896
3	-0.400855	-0.217954	-0.219251	-0.348164	-0.182984
4	0.350516	0.533418	0.524953	0.487594	0.560660
5	1.272252	1.410734	1.410734	1.364681	1.364681

- Analysis- The Akaike Information criteria shows the presence of two lags and a linear relationship with intercept and trend.

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➢ *Cointegration Test:*

Table 5: Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.737890	106.9241	88.80380	0.0014
At most 1	0.462090	54.70339	63.87610	0.2315
At most 2	0.357576	30.52092	42.91525	0.4716
At most 3	0.189801	13.26315	25.87211	0.7175
At most 4	0.121558	5.054628	12.51798	0.5886

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.737890	52.22066	38.33101	0.0007
At most 1	0.462090	24.18247	32.11832	0.3367
At most 2	0.357576	17.25778	25.82321	0.4363
At most 3	0.189801	8.208517	19.38704	0.8025
At most 4	0.121558	5.054628	12.51798	0.5886

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

- Analysis- The cointegration results show the presence of one cointegrating equation at a 5% significance level. Both the Trace Test and the Maximum Eigenvalue Test indicate the presence of one cointegrating equation at a 5% significance level. The result confirms cointegration and the presence of long-run relationships among the variables.

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➢ *Vector Error Correction Model:*

The presence of cointegrating vectors between variables indicates a long-run relationship among the variables; therefore, the VEC model can be applied. Structural short and long-run relationships are indicated in VECM estimation.

The estimation of the results for analyzing the short-run relationship between the variables yields the following result:

- VECM estimation results with two lags estimate the coefficient of the Error Correction Term D(L_EF) of the model is -0.49, this implies that the system corrects its previous period disequilibrium at a speed of approximately 49 percent annually. It also implies that almost 49 percent of deviation from the long-run equilibrium is smoothed in one year. As suggested by the estimate the speed of adjustment is robust, it only takes two years for the disequilibrium to readjust after major shocks. In line with a prior expectation, the sign of the ECT coefficient is significant and negative, indicating there is a long-run causality from Agricultural Exports, Trade Openness, GDP, and Financial Openness.
- In the short run, the t-stat value for D(L_AX (-1)) [-2.17] and D(L_AX(-2)) [-2.088] is significant. Agricultural Exports with one lag and two lags have a significant impact on the environmental footprints in the short run.
- In the short run, the t-stat value for D(L_TO(-1)) [2.56] is significant. Trade Openness with one lag has a significant impact on the environmental footprints in the short run.
- In the short run, the t-stat value for D(L_GDP(-1)) [2.144] is significant. GDP with one lag has a significant impact on the environmental footprints in the short run.
- However, Financial Openness (L_FO) does not have any short-run impact on the Ecological Footprint (L_EF).

The estimation of the results for analyzing the long-run relationship between the variables yields the following result-

The estimation result of the cointegration equation (long-run relationship) at the top of Table 4 indicates that there is a significant long-run relationship between Ecological footprint and agricultural exports. The t-stat value of AX is [-10.30] is significant in the long run.

The result indicates that a one percent increase in Agricultural exports is associated with a 18 percent decrease in Ecological Footprint. The relationship between trade openness and ecological footprint is also significant.

The t-stat value of TO [3.11] is significant in the long run. A one percent increase in trade openness is associated with a 9.1 percent increase in ecological footprint.

Though, Financial Openness was not a significant variable in the short run the t-stat value of L_FO [-6.25] is significant in the long run. A one percent increase in the value of L_FO is associated with a 5 percent decrease in the value of L_EF.

However, the t stat value of GDP [0.16452] is not a significant variable in the long run contrast to the results in the short run.

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Table 6: VECM Estimates

Cointegrating Eq:	CointEq1
L_EF(-1)	1
L_AX(-1)	-0.1817148163420438 0.01762692185661602 [-10.3089]
L_TO(-1)	0.09184546957628336 0.0295079453003467 [3.11257]
L_FO(-1)	-0.04937531982597563 0.007909433774802629 [-6.24259]
L_GDP(-1)	0.003186395939047254 0.01936821122283354 [0.16452]
@TREND(78)	-0.01639866124738459 0.001228958215468708 [-13.3435]
C	0.3590361872989328

Error Correction:	D(L_EF)	D(L_AX)	D(L_TO)	D(L_FO)	D(L_GDP)
CointEq1	-0.4928987... 0.12524417... [-3.93550]	2.32788547... 1.69521994... [1.37321]	0.77977255... 0.43153173... [1.80699]	9.03220352... 3.11185110... [2.90252]	-5.2141998... 2.73769262... [-1.90460]
D(L_EF(-1))	0.14787657... 0.17332020... [0.85320]	0.11167564... 2.34594437... [0.04760]	-0.3859275... 0.59717881... [-0.64625]	1.00174337... 4.30636132... [0.23262]	-5.5038897... 3.78857895... [-1.45276]
D(L_EF(-2))	0.26078963... 0.18345043... [1.42158]	2.48393898... 2.48306021... [1.00035]	-1.2535285... 0.63208274... [-1.98317]	0.07453577... 4.55805968... [0.01635]	0.47355606... 4.01001396... [0.11809]
D(L_AX(-1))	-0.0421842... 0.01943535... [-2.17049]	-0.1078914... 0.26306379... [-0.41013]	0.11647828... 0.06696498... [1.73939]	1.10186556... 0.48289625... [2.28179]	-1.1046628... 0.42483443... [-2.60022]
D(L_AX(-2))	-0.0329626... 0.01578321... [-2.08847]	0.11124130... 0.21363087... [0.52072]	0.07290500... 0.05438144... [1.34062]	0.83233184... 0.39215411... [2.12246]	-0.7725547... 0.34500283... [-2.23927]
D(L_TO(-1))	0.12587191... 0.04913719... [2.56164]	0.03511195... 0.66508763... [0.05279]	0.16171165... 0.16930335... [0.95516]	-0.2197797... 1.22087620... [-0.18002]	0.93583018... 1.07408216... [0.87128]
D(L_TO(-2))	-0.0039222... 0.05038569... [-0.07785]	0.46814760... 0.68198647... [0.68645]	0.10237616... 0.17360508... [0.58971]	0.63319614... 1.25189676... [0.50579]	-0.0263074... 1.10137292... [-0.02389]
D(L_FO(-1))	-0.0094607... 0.00713200... [-1.32652]	0.11675899... 0.09653399... [1.20951]	-0.0103173... 0.02457349... [-0.41986]	0.13753606... 0.17720380... [0.77615]	0.05067742... 0.15589741... [0.32507]
D(L_FO(-2))	-0.0119253... 0.00744554... [-1.60168]	0.04392707... 0.10077784... [0.43588]	0.03680616... 0.02565380... [1.43473]	0.01064430... 0.18499407... [0.05754]	-0.3120712... 0.16275101... [-1.91748]
D(L_GDP(-1))	0.01851682... 0.00863340... [2.14479]	0.13720760... 0.11685595... [1.17416]	0.00558204... 0.02974661... [0.18765]	0.37412160... 0.21450806... [1.74409]	-0.5337771... 0.18871633... [-2.82846]
D(L_GDP(-2))	-0.0009873... 0.00812253... [-0.12155]	0.14578797... 0.10994116... [1.32605]	0.00646934... 0.02798639... [0.23116]	0.21837341... 0.20181482... [1.08205]	-0.3824131... 0.17754929... [-2.15384]
C	0.00506273... 0.00578949... [0.87447]	-0.1095049... 0.07836263... [-1.39741]	0.04978754... 0.01994783... [2.49589]	0.09546927... 0.14384731... [0.66368]	0.05055787... 0.12655160... [0.39950]
R-squared	0.49112781...	0.36437049...	0.41928325...	0.51334136...	0.65964392...
Adj. R-squared	0.28380951...	0.10541032...	0.18269495...	0.31507303...	0.52098033...
Sum sq. resids	0.01344078...	2.46241809...	0.15956409...	8.29750087...	6.42212952...
S.E. equation	0.02231158...	0.30199448...	0.07687510...	0.55435985...	0.48770549...
F-statistic	2.36895543...	1.40705225...	1.77220618...	2.58912431...	4.75715318...
Log likelihood	100.135343...	-1.4714554...	51.8893866...	-25.160260...	-20.164271...
Akaike AIC	-4.5197611...	0.69084387...	-2.0456095...	1.90565440...	1.64944980...
Schwarz SC	-4.0078960...	1.20270899...	-1.5337444...	2.41751952...	2.16131492...
Mean dependent	0.01454378...	-0.0378105...	0.03132942...	0.08785852...	0.01505172...
S.D. dependent	0.02636429...	0.31929129...	0.08503419...	0.66983777...	0.70466220...

Determinant resid covariance (dof adj.)	8.269325183322832e-09
Determinant resid covariance	1.3151214344197 98e-09
Log likelihood	122.0690542103601
Akaike information criterion	-2.875336113351802
Schwarz criterion	-0.06007794297855451
Number of coefficients	66

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➢ *Auto Correlation LM Test*

The Autocorrelation LM Test is a statistical test used to detect the presence of autocorrelation in the residuals of a regression model. In simpler terms, it checks if the errors in the model are correlated with themselves over time.

Table 7: Autocorrelation Test Estimates

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	23.07023	25	0.5735	0.915851	(25, 68.4)	0.5836
2	16.98491	25	0.8823	0.648038	(25, 68.4)	0.8864
3	28.55602	25	0.2829	1.175404	(25, 68.4)	0.2935
4	20.97884	25	0.6938	0.821500	(25, 68.4)	0.7022
5	17.33896	25	0.8691	0.663067	(25, 68.4)	0.8735
6	15.87107	25	0.9186	0.601190	(25, 68.4)	0.9215
7	34.89300	25	0.0902	1.498285	(25, 68.4)	0.0963
8	20.67267	25	0.7107	0.807893	(25, 68.4)	0.7188
9	19.52082	25	0.7715	0.757168	(25, 68.4)	0.7783
10	24.77419	25	0.4751	0.994571	(25, 68.4)	0.4860

- Analysis- At a 5% significant level, the serial autocorrelation results yield satisfactory results. 10 lags we accept the null hypothesis at a 5% significance level that there is no autocorrelation in the data.

➢ *Residual Heteroskedasticity Test*

A Residual Heteroskedasticity Test checks if the variance of the residuals in a regression model is constant across all observations. In simpler terms, it assesses whether the errors in the model have an unequal spread at different levels of the independent variable(s).

Table 8: Heteroskedasticity Test Estimates

VEC Residual Heteroskedasticity Tests (Levels and Squares)
Date: 02/02/24 Time: 11:13
Sample: 1978 2022
Included observations: 39

Joint test:

Chi-sq	df	Prob.
311.7161	330	0.7578

Individual components:

Dependent	R-squared	F(22,16)	Prob.	Chi-sq(22)	Prob.
res1*res1	0.658870	1.404678	0.2454	25.69592	0.2650
res2*res2	0.393939	0.472727	0.9483	15.36363	0.8462
res3*res3	0.358527	0.406482	0.9744	13.98257	0.9021
res4*res4	0.576620	0.990506	0.5179	22.48819	0.4311
res5*res5	0.688539	1.607764	0.1667	26.85302	0.2169
res2*res1	0.573757	0.978965	0.5278	22.37650	0.4376
res3*res1	0.461010	0.622053	0.8510	17.97939	0.7072
res3*res2	0.430365	0.549462	0.9044	16.78424	0.7752
res4*res1	0.667580	1.460541	0.2207	26.03563	0.2502
res4*res2	0.533232	0.830831	0.6627	20.79605	0.5334
res4*res3	0.744031	2.113978	0.0644	29.01720	0.1444
res5*res1	0.484967	0.684816	0.7980	18.91370	0.6507
res5*res2	0.446707	0.587172	0.8779	17.42158	0.7397
res5*res3	0.479501	0.669988	0.8109	18.70054	0.6637
res5*res4	0.423450	0.534149	0.9143	16.51456	0.7896

- Analysis- At a 5% significance level, the test results accept the null hypothesis that there exists homoskedasticity.

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➢ *Residual Normality Test*

A Residual Normality Test examines whether the residuals in the regression model follow a normal distribution, often resembling a bell curve. This assumption is crucial for many statistical tests in regression analysis.

Table 9: Normality Test Results

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 02/02/24 Time: 11:17
Sample: 1978 2022
Included observations: 39

Component	Skewness	Chi-sq	df	Prob.*
1	-0.312650	0.635375	1	0.4254
2	0.054648	0.019412	1	0.8892
3	-0.118430	0.091167	1	0.7627
4	-0.456807	1.356375	1	0.2442
5	0.111283	0.080496	1	0.7766
Joint		2.182824	5	0.8233

Component	Kurtosis	Chi-sq	df	Prob.
1	2.454724	0.483155	1	0.4870
2	2.787650	0.073275	1	0.7866
3	2.463860	0.467099	1	0.4943
4	2.867785	0.028407	1	0.8662
5	2.264193	0.879794	1	0.3483
Joint		1.931729	5	0.8585

Component	Jarque-B...	df	Prob.
1	1.118530	2	0.5716
2	0.092687	2	0.9547
3	0.558266	2	0.7564
4	1.384781	2	0.5004
5	0.960289	2	0.6187
Joint	4.114553	10	0.9420

*Approximate p-values do not account for coefficient

- Analysis- At a 5% significance level the results conclude that the residuals are multivariate normal.

➢ *Granger Causality Test*

We use the Granger causality test for it provides useful information on the variables for the prediction of the other variables included in the analysis. We should notice that Granger causality indicates what variables may signal a subsequent change of the other variables included in the study. The Granger causality test is a statistical hypothesis test used to analyze potential causal relationships between two-time series variables. It assesses whether the past values of one variable, X, contain useful information for predicting the future values of another variable, Y.

- **Null Hypothesis H0:** X does not granger cause Y.
- **Alternate Hypothesis H1:** X does granger cause Y.

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Table 10: Granger Causality Test Estimates

Dependent variable: D(L_EF)			
Excluded	Chi-sq	df	Prob.
D(L_AX)	5.848792	2	0.0537
D(L_TO)	6.716567	2	0.0348
D(L_FO)	4.685482	2	0.0961
D(L_GDP)	5.996324	2	0.0499
All	21.05408	8	0.0070
Dependent variable: D(L_AX)			
Excluded	Chi-sq	df	Prob.
D(L_EF)	1.010766	2	0.6033
D(L_TO)	0.503697	2	0.7774
D(L_FO)	1.745906	2	0.4177
D(L_GDP)	2.193368	2	0.3340
All	6.869736	8	0.5508
Dependent variable: D(L_TO)			
Excluded	Chi-sq	df	Prob.
D(L_EF)	4.497673	2	0.1055
D(L_AX)	3.232690	2	0.1986
D(L_FO)	2.153764	2	0.3407
D(L_GDP)	0.062655	2	0.9692
All	16.21060	8	0.0395
Dependent variable: D(L_FO)			
Excluded	Chi-sq	df	Prob.
D(L_EF)	0.054930	2	0.9729
D(L_AX)	6.274976	2	0.0434
D(L_TO)	0.263887	2	0.8764
D(L_GDP)	3.166513	2	0.2053
All	16.58917	8	0.0347
Dependent variable: D(L_GDP)			
Excluded	Chi-sq	df	Prob.
D(L_EF)	2.112257	2	0.3478
D(L_AX)	7.687848	2	0.0214
D(L_TO)	0.777727	2	0.6778
D(L_FO)	3.707642	2	0.1566
All	21.04432	8	0.0070

Table 10 shows the results of the test. We find that there are the following relationships at a significance level of 10%:

- AX Granger Causes EF (Prob.= 0.0537)
- TO Granger Causes EF (Prob.=0.0348)
- GDP Granger Causes EF (Prob.=0.0961)
- FO Granger Causes EF (Prob.=0.0499)
- AX Granger Causes FO (Prob.=0.0434)
- AX Granger Causes GDP (Prob.=0.0214)

Therefore, a change in agricultural exports, Trade openness, GDP, and financial openness in advance indicates a level of change in the Ecological Footprint. Also, a change in Agricultural Exports indicates an advanced change in the levels of financial openness and the GDP.

➢ *Robustness of VECM Model-*

Assessing model stability is a crucial step before drawing statistical inferences, as highlighted in the discussion. The figure illustrates the characteristics of the roots of the polynomial, which serves as a tool for examining the stability of short-run causality among endogenous variables in the Vector Error Correction Model (VECM).

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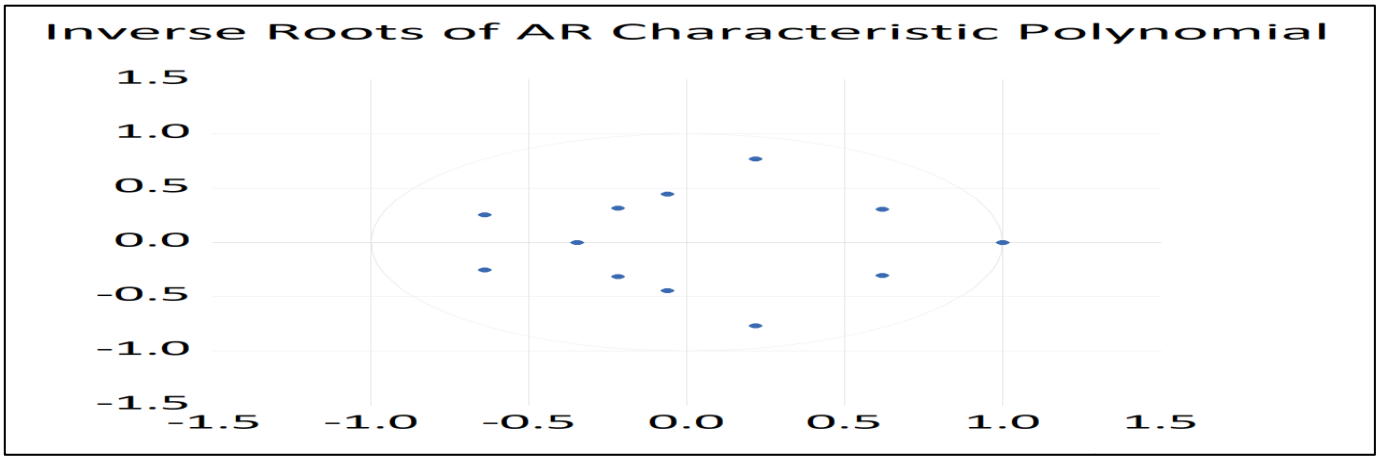

Fig 1: Lag Root Structure Graph

The VECM specification inherently assumes the presence of one unit root, while the check for VAR stability ensures that there are no roots outside the unit circle, with eigenvalues of the respective matrix being precisely one or less, excluding the initial unit root of 1. Consequently, as the model satisfies VAR stability conditions, it can be deemed statistically acceptable for making meaningful inferences. This assessment is integral to the validity of our statistical inferences within the context of the study. (Asumadu-Sarkodie & Owusu, 2016).

➢ *Impulse Test:*

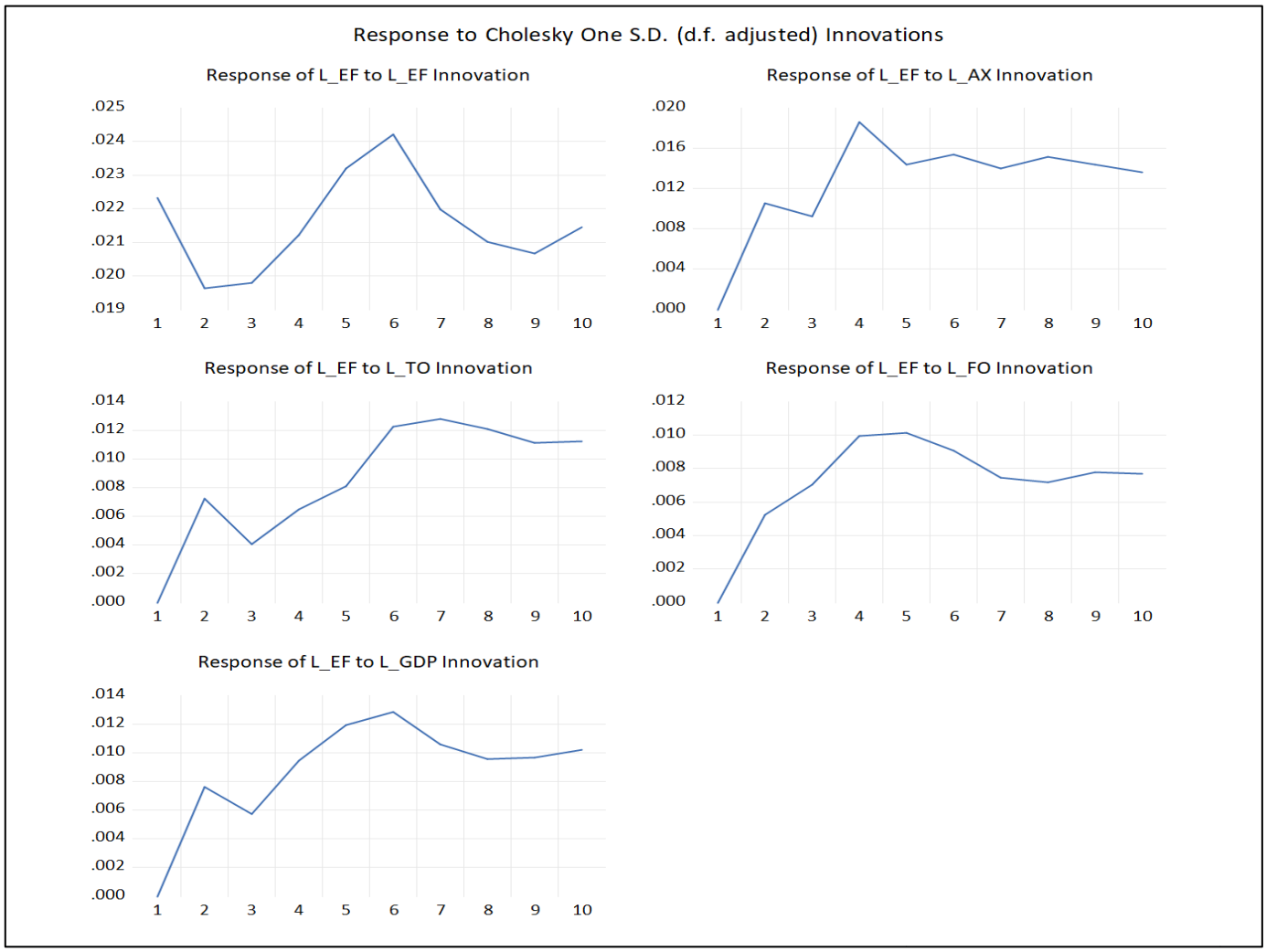

Fig 2: Impulse Test Graph

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- One standard deviation increase in the level of AX leads to a 0.010 standard deviation increase in the levels of EF in the first period. The response decreases to 0.009 in the second period. The response function concludes that the relation is positive and the shock has longer effects on EF.
- Like AX, TO also has a positive relationship with EF. One standard deviation shock in the value of TO leads to a 0.007 standard deviation shock in the value of EF. The highest impact is observed in periods 6 and 7.
- One standard deviation change in FO in period 1 creates a shock of 0.005 standard deviation in the value of EF. The effect of the shock increases in period 2 0.007 and stabilises to 0.010 in period 4 after which a falling trend is observed. Like the other two variables, FO also shows a long-term positive effect on the value of EF.

B. Interpretation

➢ *Hypothesis 1- Agricultural Export does not have an Impact on the Ecological Footprint of India in the Short Run*

In the short run, the t-stats value for D(L_AX (-1)) [-2.17] and D(L_AX(-2)) [-2.088] is significant at a 5% significance level. This implies that the first and the second lag value of the agricultural exports impact the ecological footprint of India in the short run.

- Result: At a 5% significance level, the null hypothesis that AX does not impact the EF in the short run is rejected. AX does impact the EF both in the short run.

➢ *Hypothesis 2- Agricultural Export does not have an Impact on the Ecological Footprint of India in the Long Run*

In the long run, the t-stat value [-10.3089] is significant at a 5% level. This confirms that AX impacts the EF in the long run.

- Result- At a 5% significance level, the null hypothesis that AX does not impact the EF is rejected. AX does impact the EF both in the short and the long run.

The test estimates show that the coefficient of AX is negative. One percent increase in the AX causes a -18 percent decrease in the value of the EF of India.

➢ *Hypothesis 3- Financial Openness does not have an impact on the Ecological Footprint of India in the short run.*

In the short run, the t-stats value for D(L_FO (-1)) and D(L_FO (-2)) [-1.60168] are not significant at a 5% significance level.

- Result: At a 5% significance level, the null hypothesis that FO does not impact the EF in the short run is accepted. FO does not impact the EF in the short run.

➢ *Hypothesis 4- Financial Openness does not have an impact on the Ecological Footprint of India in the long run.*

In the long run, the t-stat value [-6.24259] is significant at the 5% level. This confirms that FO impacts the EF of India in the long run.

- Results- At a 5% significance level, the null hypothesis that FO does not impact the EF is rejected. FO does impact the EF in the long run.

The test estimates show that the coefficient of FO in the long run is negative. A one percent increase in the value of FO decreases the EF value by -5% percent.

➢ *Hypothesis 5- Trade Openness does not have an impact on the Ecological Footprint of India in the short run*

In the short run, the t-stat value for D(L_TO (-1)) [2.56] is significant. Trade Openness with one lag has a significant impact on the environmental footprints in the short run.

- Results- At a 5% significance level, the null hypothesis that TO does not impact the EF is rejected. TO does impact the EF in the short run.

➢ *Hypothesis 6- Trade Openness does not have an impact on the Ecological Footprint of India in the long run*

The t-stat value [3.11257] in the long run is significant at the 5% significance level. This implies that TO impacts the EF of India both in the short as well as long run.

- Results- At a 5% significance level, the null hypothesis that TO does not impact the EF is rejected. TO does impact the EF in the long run.

The test estimates show that the value of the coefficient of the TO is positive. A one percent increase in the value of the TO impacts the value of EF by 9% percent.

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C. Findings

- The relationship between the Agricultural Exports and the Ecological Footprint in the Indian context was found to be negative. It means the increase in the agricultural exports decreases the Ecological Footprint of India. The findings are in line with the existing work of (Haq, et al., 2021)
- which has established the relationship between agricultural exports and the ecological footprint in the context of Pakistan. The study showed that agricultural exports are negatively associated with ecological footprint in the long run. It implies an increase in agricultural exports for Pakistan has reduced the impact on environmental degradation.
- The relationship between Financial Openness and the Ecological Footprint in the Indian context was found to be negative in the long run. It means the increase in financial openness decreases the ecological footprint in the Indian context. The findings are in line with existing studies that have established the negative impact of Financial Openness (FDI inflow as a percentage of GDP) on environmental degradation (Huang, Chen, Xiang, Xu, & Akram, 2021). The findings established the role of Financial Openness in reducing the environmental footprint.
- The relationship between Trade Openness and Ecological Footprint was found to be positive in the long run. It indicates that an increase in Trade will lead to a decrease in environmental quality. Trade openness is directly linked with environmental deterioration. The findings are in line with the existing work (Afesorgbor & Demena, 2021) which has analysed the impact of trade openness on environmental pollution. An increase in trade openness leads to an adverse effect on the environmental quality of the country.
- The relationship between the GDP and Ecological Footprint is not significant in the long run for the Indian context in contrast to the short-run relationship which is significant.

D. Implications

Despite boasting $50.2 billion in exports, India needs to drive agricultural exports to its full potential through farmer empowerment utilizing Agri credits, training in agricultural practices, streamlining the logistics, and promoting Brand India to enhance their global recognition and competitiveness. This will enable Indian agricultural exports along with reducing the ecological footprint in the long run. India has been a Net Agricultural Exporter (Bhatia, Mehta, Bhardwaj, & Nimbrayan, 2021), the agricultural exports constitute 12.07% of the total merchandise exports (DGCI&S, 2023). The agricultural sector has always been of crucial importance to the Indian economy. Governments have focused on the growth of agriculture exports and more efforts need to be put into increasing the export value as it will lead to a decrease in environmental degradation in the long run.

FDI in India has been rising due to several reasons like economic reforms, including the liberalization of the policies, growing markets, skilled workforce, and cost advantages. Foreign companies often bring in advanced technologies with lower environmental footprints, prompting domestic firms to adopt similar practices (UNCTAD, 2022). Some FDI inflows are subject to stringent environmental regulations and compliance requirements, setting higher standards for domestic players as well. Growing global awareness of environmental issues encourages FDI in sectors like renewable energy and clean technologies, promoting sustainable practices in India. Indian government should promote the flow of FDI while ensuring the flow is directed towards the initiatives taken which are environment conscious.

Findings demonstrate the link between trade and increased global emissions and underscore the crucial need for integrating environmental considerations into trade policy formulation. This implies a shift towards "greener" trade policies that prioritize environmental sustainability alongside economic objectives. One key implication is the alignment of environmental taxes with a firm's participation in global trade. This ensures that companies operating internationally are held accountable for their environmental impact, regardless of their location. This approach necessitates a collaborative effort, involving policymakers, businesses, and consumers, to ensure a smooth transition towards a greener future for international trade.

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CHAPTER FIVE
SUMMARY

A. Summary

The 21st century has witnessed a surge in concerns surrounding environmental degradation, prompting investigations into its contributing factors. This study focuses on the impact of agricultural exports and financial openness on India's ecological footprint, aiming to provide valuable insights into the complex interplay between economic activities and environmental sustainability. The need for the study arises from India's status as a major agricultural exporter and the increasing financial openness in recent years. While agricultural exports contribute to economic growth, concerns exist regarding potential environmental impacts such as deforestation and soil degradation. Existing literature has explored the relationship between financial openness, trade openness, and environmental indicators, but limited research specifically examines the ecological footprint in the Indian context. This study aims to fill this gap by analyzing the impact of agricultural exports and financial openness on India's ecological footprint.

The study's objectives include examining the relationship between agricultural exports and the ecological footprint of India, assessing the impact of financial openness on the ecological footprint in the short and long run, analyzing the effects of trade openness and economic growth on the ecological footprint, and testing for causal relationships between the variables.

The research methodology employed a comprehensive approach, utilizing time series data and econometric models for analysis. Unit root tests and the Vector Error Correction Model (VECM) were used for cointegration analysis, providing a robust framework for examining the relationships between agricultural exports, financial openness, and India's ecological footprint. The study focuses on the period from 1975 to 2022, considering agricultural export data, financial openness indicators, trade openness, economic growth data, and ecological footprint metrics specific to India. The dependent variable is the Ecological Footprint of India, while the independent variables include Agricultural Exports and Financial Openness. Trade Openness and Economic Growth serve as control variables in the analysis.

The study reveals compelling insights into the impact of agricultural exports and financial openness on India's ecological footprint. A positive association is observed between increasing agricultural exports and a reduction in the country's ecological footprint, indicating that agricultural exports contribute to environmental sustainability. Financial openness is also found to have a positive impact on the ecological footprint, suggesting that greater financial openness leads to environmental sustainability in India. However, trade openness shows a negative association with the ecological footprint, implying that increased trade openness may lead to environmental degradation. Economic growth is identified as an additional factor significantly impacting India's ecological footprint only in the short run, highlighting the complex interplay between economic activities and environmental forces.

The findings of the study have significant implications for policymakers and stakeholders in India. By understanding the relationships between agricultural exports, financial openness, trade openness, and the ecological footprint, policymakers can craft strategies that promote economic growth while minimizing environmental harm. The study underscores the importance of sustainable development practices in achieving a balance between economic prosperity and environmental conservation.

B. Conclusion

In conclusion, this study has provided valuable insights into the impact of agricultural exports and financial openness on India's ecological footprint. Through a comprehensive analysis of data spanning from 1975 to 2022, the research has shed light on the complex interplay between economic activities and environmental sustainability in the Indian context.

The findings of the study reveal significant relationships between agricultural exports, financial openness, and India's ecological footprint. Increased agricultural exports are associated with a reduction in the country's ecological footprint, indicating a potential avenue for promoting environmental sustainability through agricultural trade. Moreover, the study highlights the positive impact of financial openness on the ecological footprint, underscoring the role of foreign investment and financial transactions in fostering environmental conservation.

However, the research also identifies trade openness as a factor negatively impacting India's ecological footprint, suggesting that greater participation in international trade may lead to environmental degradation. Additionally, economic growth is recognized as a significant factor influencing the country's ecological footprint, emphasizing the need for a balanced approach that considers both economic prosperity and environmental protection.

By understanding the intricate relationships between agricultural exports, financial openness, and the ecological footprint, policymakers can work towards crafting policies that prioritize environmental conservation alongside economic development.

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C. Future Scope & Limitations:

➢ *Future Scope:*

- Policy Implications: The study opens avenues for exploring policy interventions that can enhance the positive impact of agricultural exports on India's ecological footprint. Future research could focus on identifying specific policy measures that promote sustainable agricultural practices and environmental conservation.
- Technology Adoption: Investigating the role of technology adoption in mitigating the environmental impact of agricultural exports could be a promising area for future research. Analyzing how advanced technologies can reduce resource-intensive practices and enhance sustainability in the agricultural sector would be valuable.
- Comparative Studies: Conducting comparative studies with other countries could provide insights into best practices for balancing economic growth with environmental sustainability. Comparing India's approach to agricultural exports and financial openness with that of other nations could offer valuable lessons for policy formulation.

➢ *Limitations:*

- Generalizability: The study focuses specifically on the Indian context, and the findings may not be directly applicable to other countries with different socio-economic and environmental dynamics. Future research could explore the generalizability of the results across diverse regions and economies.
- External Factors: The study may not account for all external factors that could influence the relationships between agricultural exports, financial openness, and the ecological footprint. Future research could consider additional variables such as climate change impacts, policy changes, and global market trends for a more comprehensive analysis.

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REFERENCES

[1]. Acar, S., Altıntaş, N., & Haziyev, V. (2023). The effect of financial development and economic growth on ecological footprint in Azerbaijan: an ARDL bound test approach with structural breaks. *Environ Ecol Stat*.

[2]. Afesorgbor, S. K., & Demena, B. A. (2021). Trade Openness and Environmental Emissions: Evidence from a Meta-Analysis. *Environmental and Resource Economics*.

[3]. Ahad, M., & Khan, W. (2016). Does Globalization Impede Environmental Quality in Bangladesh? The Role of Real Economic Activities and Energy Use. *Bulletin of Energy Economics*.

[4]. Ali, L., Manzoor, A., Tufail, M., & Rashid, R. M. (2022). The Environmental Consequences of FDI and Trade Openness: Evidence from Pakistan. *GMJACS*. doi:12.02.2022.257.

[5]. Ansari, M. A., Villanthenkodath, M., Akram, V., & Rath, B. N. (2023). The nexus between ecological footprint, economic growth, and energy poverty in sub-Saharan Africa: a technological threshold approach. *Environ Dev Sustain*.

[6]. Anwar, N., & Elfaki, K. E. (2021). Examining the Relationship Between Energy Consumption, Economic Growth and Environmental Degradation Indonesia: Do Capital and Trade Openness Matter? *International Journal of Renewable Energy Development*. doi:10.14710/IJRED.2021.37822.

[7]. Arif, U., Arif, A., & Khan, F. N. (2021). Environmental impacts of FDI: evidence from heterogeneous panel methods. *Environmental Science and Pollution Research*. doi:10.1007/S11356-021-17629-6.

[8]. Asumadu-Sarkodie, S., & Owusu, P. A. (2016). The relationship between carbon dioxide and agriculture in Ghana: a comparison of VECM and ARDL model. *Environmental Science and Pollution Research*.

[9]. Asumadu-Sarkodie, S., & Owusu, P. A. (2016). The relationship between carbon dioxide and agriculture in Ghana: a comparison of VECM and ARDL model. *Environmental Science and Pollution Research*.

[10]. Aydin, M., & Turan, Y. E. (2020). The influence of financial openness, trade openness, and energy intensity on ecological footprint: revisiting the environmental Kuznets curve hypothesis for BRICS countries. *Environmental Science and Pollution Research*.

[11]. Bais, P., & Bahadur, P. S. (2023). Agriculture in Indian Economy and Contribution of Science and Technology. *Asian Journal of Applied Science and Technology*.

[12]. Balogh, J. M., & Jambor, A. (2020). The Environmental Impacts of Agricultural Trade: A Systematic Literature Review. *Sustainability*. doi:10.3390/SU12031152.

[13]. Bashir, F., & Javaid, M. F. (2023). Industrial Expansion, Trade Openness and Environmental Degradation in Asia: A Panel Data Analysis. *Review of economics and development studies*. doi:10.47067/reads.v9i1.477.

[14]. Bhatia, J., Mehta, D. V., Bhardwaj, D. N., & Nimbrayan, P. K. (2021). Export-Import Performance of Major Agricultural Commodities in India. *Economic Affairs*.

[15]. Chen, Y. (2023). Trade Openness and Environmental Pollution Management: Push or Pull? *Frontiers in business, economics and management*. doi:10.54097/fbem.v9i1.8332.

[16]. DGCI&S. (2023, Dec 21). *Directorate General of Commercial Intelligence and Statistics*. Retrieved from Directorate General of Commercial Intelligence and Statistics: https://www.dgciskol.gov.in/

[17]. Doytch, N., & Ashraf, A. (2021). The Ecological Footprints of Greenfield FDI and Cross-border M&A Sales. *Environmental Modeling & Assessment*. doi:10.1007/S10666-021-09777-3.

[18]. Emmanuel, O. N., Fonchamnyo, D. C., Thierry, M. A., & Dinga, G. D. (2023). Ecological footprint in a global perspective: the role of domestic investment, FDI, democracy and institutional quality. *Journal of Global Responsibility*. doi:10.1108/jgr-09-2022-0091.

[19]. FAO. (2018). *FAO in India*. Retrieved from FAO: https://www.fao.org/india/en/

[20]. Gallagher, K. P. (2009). Economic Globalization and the Environment. *Department of International Relations*.

[21]. Haq, I. u., Khan, D., Taj, H., Abbas, A., Khalid, M., Awais, M., & Allayarov, P. (2021). Agricultural Exports, Financial Openness and EcologicalFootprints: An Empirical Analysis for Pakistan. *International Journal of Energy Economics and Policy*. doi: https://doi.org/10.32479/ijeep.11744.

[22]. Huang, H., & Labys, W. C. (2002). Environment and Trade: A Review of Issues and Methods. *International Journal of Global Environmental Issues*.

[23]. Huang, Y., Chen, F. W., Xiang, J., Xu, Z., & Akram, R. (2021). The Impacts of FDI Inflows on Carbon Emissions: Economic Development and Regulatory Quality as Moderators. *Sustainable Energy Systems*.

[24]. Jaupllari, D. S., & Zoto, D. O. (2013). An Assessment of Demand for Imports through VECM Model. *Journal of Knowledge Management, Economics and Information Technology*.

[25]. Javeed, S., Siddique, H., & Javed, F. (2023). Ecological footprint, globalization, and economic growth: evidence from Asia. *Environmental Science and Pollution Research*.

[26]. Jorgenson, A. K. (2003). Consumption and Environmental Degradation: A Cross-National Analysis of the Ecological Footprint. *Social Problems*.

[27]. Joshi, P. A. (2015). Challenges of agricultue economy of India. *The Business and Management Review*.

[28]. Kalaitzi, A. S., & Cleeve, E. (2017). Export-led growth in the UAE: multivariate causality between primary exports, manufactured exports and economic growth. *Eurasian Business Review*.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1081

[29]. Kaur, R., & Kaur, T. P. (2023). Modelling Urbanization, Economic Growth, and Ecological Footprint Using Environment Kuznets' Curve in Selected Asian Countries. *International Journal of Social Ecology and Sustainable Development*. doi:10.4018/ijsesd.321167.
[30]. Kazemzadeh, E., Koengkan, M., Silva, N., Osmani, F., & Fuinhas, J. A. (2022). Do energy efficiency and export quality affect the ecological footprint in emerging countries? A two-step approach using the SBM–DEA model and panel quantile regression. *Environment Systems and Decisions*.
[31]. Koengkan, M., Fuinhas, J. A., & Marques, A. C. (2018). Does financial openness increase environmental degradation? Fresh evidence from MERCOSUR countries. *Environmental Science and Pollution Research*.
[32]. Liu, H., Kim, H., Liang, S., & Kwon, O.-S. (2018). Export Diversification and Ecological Footprint: A Comparative Study on EKC Theory among Korea, Japan, and China. *Sustainability*.
[33]. Malik, A. W., Rahman, A. U., Qayyum, T., & Ravana, S. D. (2020). Leveraging Fog Computing for Sustainable Smart Farming Using Distributed Simulation. *IEEE Internet of Things Journal*.
[34]. Mate, B. J. (2019). The Determinants of Carbon Footprint: Role of Agriculture. doi:10.22004/AG.ECON.285052.
[35]. Muoneke, O. B., Okere, K. I., & Nwaeze, C. N. (2022). Agriculture, globalization, and ecological footprint: the role of agriculture beyond the tipping point in the Philippines. *Environmental Science and Pollution Research*.
[36]. NABARD. (2023, 12 30). *NABARD*. Retrieved from NABARD: https://www.nabard.org/
[37]. Nasim, I., Ahmad, R., Bashir, F., & Noreen, S. C. (2022). Trade Openness as a Determinant of Sectoral Growth in Pakistan: A Time Series Analysis. *Review of education, administration and law*. doi:10.47067/real.v5i2.219.
[38]. Niu, B., Peng, S., Li, C., Liang, Q., Li, X., & Wang, Z. (2020). Nexus of embodied land use and greenhouse gas emissions in global agricultural trade: A quasi-input–output analysis. *Journal of Cleaner Production*.
[39]. Özlem, K. A., Samet, T., & Serhat, Ç. (2022). The impact of economic growth, renewable energy, non-renewable energy and trade openness on the ecological footprint and forecasting in Turkey: An case of the ARDL and NMGM forecasting model. *The journal of operations research, statistics, econometrics and management information systems*. doi:10.17093/alphanumeric.1144398
[40]. Pan, C., Cristia, J. F., Ghardallou, W., Tahir, M., & Ali, B. (2023). Modelling the ecological footprints, climate change and economic growth nexus. *Geological Journal*. doi:10.1002/gj.4767
[41]. Parida, P. C., & Sahoo, P. (2007). Export-led Growth in South Asia: A Panel Cointegration Analysis. *International Economic Journal*.
[42]. Pathak, H. (2023). Impact, adaptation and mitigation of climate change in Indian agriculture. *Environmental Monitoring and Assessment*.
[43]. Purnama, P. D., & Yao, M. H. (2019). The Relationship between International Trade and Economic Growth. *International Journal of Applied Business Research*.
[44]. Rehman, A., Radulescu, M., Ma, H., Dagar, V., Hussain, I., & Khan, M. K. (2021). The Impact of Globalization, Energy Use, and Trade on Ecological Footprint in Pakistan: Does Environmental Sustainability Exist? *Energies*.
[45]. Saghaian, H. S., Mohammadi, H., & Mohammadi, M. N. (2022). The Effects of Agricultural Product Exports on Environmental Quality. *Sustainability*. doi:10.3390/su142113857.
[46]. Sharma, C. (2018). Exporting, access of foreign technology, and firm's performance: Searching the link in Indian manufacturing. *The quaterly review of economics and finance*.
[47]. Sharma, C. (2018). Exporting, access of foreign technology, and firms' performance: Searching the link in Indian manufacturing. *The Quarterly Review of Economics and Finance*.
[48]. Topcu, B. A. (2021). The impact of export, import, and renewable energy consumption on turkey's ecological footprint. doi:10.17261/PRESSACADEMIA.2021.1376
[49]. Tran, N. V., & Do, L. T. (2021). Environmental Effects of Trade Openness in the Presence of Structural Breaks: New Insights from 5-ASEAN Developing Countries. *Environmental Modeling & Assessment*. doi:10.1007/S10666-021-09784-4.
[50]. Trong, L. V., Paramaiah, Bushra, T., Muhammad, N., Nguyen, T. M., & Pham, Q. H. (2023). Effect of Financial Inclusion, Eco-Innovation, Globalization, and Sustainable Economic Growth on Ecological Footprint. *The Engineering Economics*. doi:10.5755/j01.ee.34.1.32402.
[51]. Uddin, I., Saqib, N., Kousar, R., & Usmam, M. (2023). Heterogeneous role of energy utilization, financial development, and economic development in ecological footprint: How far away are developing economies from developed ones. *Environmental Science and Pollution Research*.
[52]. Udeagha, M. C., & Ngepah, N. (2021). Does trade openness mitigate the environmental degradation in South Africa. *Environmental Science and Pollution Research*. doi:10.1007/S11356-021-17193-Z.
[53]. Udemba, E. N. (2020). Mediation of foreign direct investment and agriculture towards ecological footprint: a shift from single perspective to a more inclusive perspective for India. *Environmental Science and Pollution Research*. doi:10.1007/S11356-020-09024-4
[54]. UK Polo, V. (2006). Export composition and growth of selected low-income African countries: evidence from time-series data. *Applied Economics*.
[55]. Umar, F., Manas, P., & Arif, B. D. (2023). On the nexus between growth and disaggregated ecological footprints-empirical evidence from India. *Journal of Environmental Planning and Management*. doi:10.1080/09640568.2023.2171279.
[56]. UNCTAD. (2022). *World Investment Report 2022.* UNCTAD.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1081

[57]. Usman, M., & Makhdum, M. S. (2021). What abates ecological footprint in BRICS-T region? Exploring the influence of renewable energy, non-renewable energy, agriculture, forest area and financial development. *Renewable Energy*.
[58]. Venkatray, B. (2022). Does foreign direct investment reduce carbon emission? evidence from the panel of brics countries. *Economic Thought journal*. doi:10.56497/etj2267402.
[59]. Vogel, D. (2011). The Environment and International Trade. *Journal of Policy History*.
[60]. Vu, T. L., Paramaiah, C., Tufail, B., Nawaz, M. A., Xuyen, N. T., & Huy, P. Q. (2023). Effect of Financial Inclusion, Eco-Innovation, Globalization, and Sustainable Economic Growth on Ecological Footprint. *Engineering Economics*.
[61]. Weili, H. K., Khan, I., & Khamphengxay, S. (2021). Renewable Energy Consumption, Trade Openness, and Environmental Degradation: A Panel Data Analysis of Developing and Developed Countries. *Mathematical Problems in Engineering*. doi:10.1155/2021/6691046.
[62]. Williamson, R. B. (1978). The Role of Exports and Foreign Capital in Latin American Economic Growth. *Southern Economic Journal*.
[63]. World Bank. (2023, Dec). *Agriculture and Food*. Retrieved from World Bank: https://www.worldbank.org/en/topic/agriculture
[64]. Yaqoob, T., Babi, M., & Khalid, R. (2022). Does Globalization, Tourism, Foreign Direct Investment, and Natural Resources Influencing Ecological Footprint? *Chinese Journal of Urban and Environmental Studies*. doi:10.1142/s2345748122500178.
[65]. Zou, X. (2018). VECM Model Analysis of Carbon Emissions, GDP, and International Crude Oil Prices. *Discrete Dynamics in Nature and Society*.