



The Role of Sustainable Finance in Promoting Environmental Sustainability: Examining the Nexus Between Green Investment, Carbon Emissions, and Economic Growth

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ARTICLE INFO	ABSTRACT
Submission: June 27, 2026 Revised: July 09, 2026 Accepted: July 21, 2026 Available Online: August 07, 2026 Keywords: <i>Sustainable Finance, Environmental Sustainability, Green Investment, Carbon Emissions, Economic Growth, Green Finance, Sustainable Development, Pakistan.</i> Corresponding author: Mohid Sadiq Lone Email: Mohidslone@gmail.com	Environmental sustainability has become a critical global concern due to accelerating climate change, environmental degradation, and increasing carbon emissions, highlighting the need for financial systems that support sustainable development. This study examined the influence of sustainable finance on environmental sustainability by investigating the roles of green investment, carbon emissions, and economic growth within the Pakistani context. A quantitative cross-sectional research design was employed, and primary data were collected through a structured five-point Likert scale questionnaire administered via an online Google Form. The study targeted university students, academics, banking and finance professionals, corporate employees, environmental experts, and policymakers from the provinces of Punjab and Sindh, Pakistan, including participants from major public and private universities, financial institutions, and environmental organizations. Using a convenience sampling technique, data were obtained from 433 respondents and analyzed using IBM SPSS Statistics. The analysis included descriptive statistics, Cronbach's alpha reliability analysis, Pearson correlation, multiple linear regression, independent samples t-test, and one-way analysis of variance. The findings revealed that sustainable finance and green investment have significant positive effects on environmental sustainability, whereas carbon emissions exert a significant negative influence. Green investment emerged as the strongest predictor of environmental sustainability, while sustainable finance and economic growth also contributed positively to sustainable environmental outcomes. The study further identified significant differences in environmental sustainability based on respondents' gender and age groups. The results demonstrate that strengthening sustainable financial practices and promoting green investments can effectively support environmental protection while facilitating sustainable economic growth. The study contributes to the growing body of knowledge on sustainable finance by providing empirical evidence from a developing economy and offers practical implications for policymakers, financial institutions, investors, environmental organizations, and corporate decision-makers in designing policies and investment strategies that accelerate the transition toward a low-carbon and environmentally sustainable economy. The findings also provide a valuable foundation for future research on sustainable finance, green investment, and environmental sustainability in emerging economies.

Introduction

Sustainable finance is now one of the most impactful means of resolving modern economic and environmental issues. The rapid growth of climate disasters and the depletion of resources, coupled with the loss of biodiversity, have led to a renewed focus on the potential dangers posed by existing models of economic development. Traditional financial models focused on a narrow definition of profitability and ignored social and environmental costs. Due to the increasing vulnerability attributed to the changing climate and with the Paris Agreement and the SDGs in place, the pressure to adopt a more sustainable approach to finance has grown. Sustainable finance means that environmental, social, and governance (ESG) factors are built into financial systems. Investments, therefore, provide the opportunity to realize profits and contribute to the economy in an environmentally and socially sustainable way (UNEP FI, 2024, Yamano, N., et al., 2023). This new way of thinking about finance has focused governments, financial institutions, corporations, and investors on the imperative of financing a more sustainable economy (Ng et al., 2023; Zhang et al., 2024).

Sustainable finance aims to help diminish the financing gap to achieve a sustainable economy and tackle climate change. Industrial production, transportation, energy generation, and urbanization have all contributed to increasing carbon emissions and consequently, global warming. Global warming and ecosystem collapse threaten public wellbeing and the economy. The Intergovernmental Panel on Climate Change (IPCC) reported that the decoupling of economic growth from energy generation and substantial investments into renewables, advanced green infrastructure, sustainable transportation, and low-carbon technologies are indispensable to keeping global temperatures below dangerous levels (Lee, H, et al, 2023). Sustainable finance encompasses green investments and establishes the financing and capital to implement initiatives that develop energy efficiency, accelerate the adoption of renewable energy, advance better waste management, and propel the sustainable growth of industries and economies (International Energy Agency (IEA), 2023; World Bank, 2024). Sustainable finance and green investments create a new economy of integrated ecosystem preservation and economic growth and prosperity.

Sustainability research and environmental economics are most preoccupied with developing knowledge about the relationship between green investment, carbon emissions, and economic growth. Traditionally, the correlation between economic growth and heightened carbon emissions was direct. Now, there is evidence to support that green investment and sustainable finance can create an inverse relationship between economic growth and environmental pollution. The investment of nations into clean energy systems, sustainable production and green innovation can provide the means for continued economic growth while reducing the nations' environmental impacts. Sustainable finance will yield different results from country to country. This is most evident with different states of financial markets, environmental policy, institutions, technology, and policy. Sustainable finance, green investment, carbon emissions and economic growth is a relationship that is of great importance to policy makers that want to achieve their climate goals and prioritize the economic interests of their country. The objective of this research is to provide additional evidence to support that sustainable finance can replace green investment and reduce carbon emissions while also providing a foundation for economic growth that is environmentally sustainable (Yamano, N., et al., 2023).

Green Investment as a Driver of Environmental Sustainability

The allocation of financial resources toward projects that support the natural environment and sustainable development is one of the most important ways to achieve environmental sustainability in the twenty-first century. Green investments relate to the financing of technologies and business activities that support the mitigation of climate change and the sustainable use of natural resources. Renewable energy, energy efficiency, sustainable and clean agriculture and transport, as well as green manufacturing and waste management, are activities that are typically financed by a green investment. Climate change, and particularly the worrying rise of the global temperature, has made it increasingly apparent to governments, private investors, multinational corporations and international financial institutions alike, that responsible investment is essential to the transition to a low-carbon economy. There is no doubt that green investment is now a pillar of the sustainable finance framework and one of the most important mechanisms that simultaneously enhance the environment and economy (Ma, M, et al, 2023; UNEP FI, 2024).

Green investment is burgeoning hand-in-hand with technology and the global shift to new energy systems. Initiatives to develop solar and wind energy and to construct electric and smart grids are enabling countries to replace fossil fuels and improve energy and environmental systems. These investments drive innovation to reduce cost and improve efficiency of resource use and reduce negative impacts on the environment. Further, these investments create new opportunities for economic diversification and industrial competitiveness. Green investment drives innovation to develop and deploy environmentally sustainable technology.

Countries that have increased green investment have better environmental outcomes, have become more innovative and have reached their carbon neutrality goals faster (International Energy Agency, 2023; Fu, C., et al., 2023).

Green investment creates positive environmental, economic and social outcomes. Investment in sustainable infrastructure and clean technologies provides jobs and improves foreign direct investment and industrial and market productivity. Green investment, unlike traditional investment, removes the profit-environmental trade off, making sustainable economic growth an attainable goal. Recently, the financial markets have been transformed to provide ample funding for environmentally sustainable projects by green bonds, sustainability-linked loans, climate funds, and an assortment of ESG-related investments. This has created positive marketplaces and has made public and private involvement in sustainability initiatives more accessible (Xu, X et al., 2025; Qing, L et al., 2024).

Carbon Emissions, Economic Growth, and the Importance of Sustainable Finance

The current rise in carbon emissions presents an enormous obstacle in achieving global sustainable development. Carbon emissions as a consequence of the industrialization of the economy, fueled by urban development, use of fossil fuels, increased transport, and manufacturing, are all major contributors to global warming and climate change. Growing levels of greenhouse gases are resulting in the rapid deterioration of the environment, harmful impact on the biological diversity of the planet, and increasing risks to human health as well as the public's social and economic well-being. The Intergovernmental Panel on Climate Change (IPCC) estimates that the world's ecosystems are at the point of no return, and we must drastically reduce carbon emissions if we are to avoid the significant rise in the world's temperatures (Xiong, Y, et al., 2023). As such, the reduction of carbon emissions has become the primary focus of global climate change treaties and countries' sustainability strategies.

The relationship between economic growth and increased carbon emissions and the greater use of energy (fossil fuels) has been evident as industrial production and the building of urban infrastructure has expanded. This has posed a great challenge to policy-makers trying to balance economic growth with the preservation of the environment. With the advent of sustainable finance models, policy trade-offs are less evident as these models enable the growth of the economy at the same time as investing in the preservation of the environment. Sustainable finance has the potential to finance the rapidly growing economy using renewable energy, green and clean technologies, and investing in the high-public benefit use of green and efficient infrastructure (Sampene, A, et al., 2024).

Sustainable finance is essential for addressing the relationship between carbon emissions and economic growth. It helps finance carbon-neutral development pathways. Existing financial instruments, such as green bonds, climate finance, sustainable investment funds, and ESG financing, encourage the adoption of cleaner production, enhanced energy efficiency, and the use of climate-friendly infrastructures. These investments reduce the carbon intensity of the economy while promoting the nexus of innovation, the modernization of industries, and the preservation of economic sustainability. Sustainable finance also supports more corporate environmental accountability and responsibility in business. It does this by enabling firms to incorporate environmental performance into financing and operational activities, thus achieving the much-desired twin objectives of better financial returns and enhanced environmental sustainability (Jamel, M, et al., 2024).

Research Objectives

- To examine the impact of sustainable finance on promoting environmental sustainability.
- To investigate the relationship between green investment, carbon emissions, and economic growth.
- To analyze the mediating role of green investment in the relationship between sustainable finance and environmental sustainability.

Problem Statement

Promoting sustainable economic development remains crucial yet difficult due to the increase in environmental degradation and carbon emissions. Sustainable finance is aimed at funding projects that are environmentally conscious. However, there are still gaps in research in assessing the role of sustainable finance in green investments, carbon emissions reduction, and economic growth. Existing research has tended to examine each of these components in isolation. Additionally, variations in financial systems,

environmental systems, and stages of economic development among countries have resulted in conflicting observations in the role of sustainable finance in achieving sustainability. This research attempts to bridge the gap using sustainable finance to track green investments, carbon emissions, and economic growth. It is hoped that this research will provide evidence that will assist policy makers and financial and economic stakeholders in their efforts to strike a balance between long term environmental sustainability and sustainable economic growth.

Significance of the Study

This sustainable finance study examines green investments as a means to attain environmental sustainability, considering the effects of carbon emissions and economic growth. The results will show how sustainable finance aids the shift to a low-carbon economy. This study will help policymakers, financial institutions, and investors by aiding the creation of solid financial and environmental policies and fostering sustainable investments. This study aids businesses by helping them develop environmentally responsible financial strategies. Sustainable finance research will also help fill the existing gaps in the literature and help future researchers on the topics of sustainable finance, green investment, and sustainable economic growth. The study contributes valuable information to the body of sustainable finance and green investments. These insights help to further the efforts of the United Nations and others in achieving the sustainable development goals and climate change mitigation efforts.

Literature Review

The role of sustainable finance in achieving the environmental dimension of sustainability is through the integration of environmental, social, and governance (ESG) considerations in economic activities. Sustainable finance promotes value creation in various forms, whereas traditional finance systems prioritize profit maximization. As explained by Friede et al. (2015), the integration of sustainability in financing systems positively influences the performance of firms in the long run and promotes the investment of savings in a responsible manner. In the same manner, Schoenmaker and Schramade (2019) are of the opinion that sustainable finance allows financial institutions to channel funds to initiatives that produce both positive economic and environmental value. Sustainable finance has become a means to support the shift to a low-carbon economy and sustainable environment because of the increasing pressures to counter climate change, loss of biodiversity, and depletion of resources. The absence of financial support from the private and public sectors limits the achievement of the Sustainable Development Goals (SDGs) and the commitments made to climate change by the signatories of the Paris Agreement, as stated by the United Nations and other global Initiatives (Tariq, et al., 2023; Hunjra, et al., 2023).

The connection between sustainable finance and environmental sustainability relies on the idea that financial markets can lead to positive environmental impacts by directing capital to investments that promote sustainability. As stated by Tekin, B et al. (2025), the availability of green financial instruments (i.e., green bonds, sustainability-linked loans, climate funds, and ESG investment portfolios) has increased opportunities for funding clean energy, clean technologies, and sustainability-related infrastructure. Such funding efforts have the ability to improve energy efficiency and reduce reliance on fossil fuels, as well as support the development of environmentally sustainable methods of production. In the same manner, Hussain, S et al., (2024) have indicated that countries with advanced sustainable financial markets have a better overall state of the environment as a result of their funding of green innovation and activities focused on the reduction of carbon emissions. Therefore, sustainable finance is a financial system and a supportive policy framework that encourages green economic activities.

Patterns that indicate a positive correlation between sustainable finance and environmental sustainability are evident in both developed and developing countries. Lee and Min (2015) claim that the adoption of sustainable financial strategies allows firms to invest in the development of less polluting production processes and operations, resulting in improved environmental performance. Wang et al. (2023) also recognized that sustainable finance has an important role in lessening environmental harm by increasing green investments and providing financing for renewable energy. The International Energy Agency (IEA, 2023) has reported that sustainable finance allows countries to move faster to a clean energy system with a lower carbon emission intensity. Many scholars cite the impact of finance on sustainable development as being contingent on the quality of the institutions and the state of the environmental regulations, governance, and the financial markets. In the context of developing countries, particularly, the lack of a strong regulatory framework and poor environmental disclosure create significant barriers for sustainable finance to achieve environmental improvements (Zakari, A, 2022).

The Relationship between Green Investment, Carbon Emissions, and Economic Growth

Green investment plays a dual role in the context of ecodevelopment. First, it invests in long-term economic growth. Second, it commits to the protection of the ecosystem. Green investment entails financing projects that promote sustainability such as renewable resources, clean technologies, an energy-efficient building stock, sustainable and clean transportation systems, and green production industrial systems. Eyraud et al. (2013), as cited in this article, assert that green investment is critical in moving the innovation and the infrastructure of the green economy, thus making the shift from high carbon to low carbon economic systems. Additionally, Ali et al. (2024) contend that enhanced investment in green technologies protects the environment and creates economic sustainability through the stabilization of ecofriendly industries. As governments attempt to achieve their obligations under international climate change agreements, green investments continue to offset environmental losses and achieve economic stabilization.

Multiple studies have analyzed the relationship between green investment and carbon emissions in environmental economics. Fossil fuel consumption, mass production, and transport have been identified as the primary causes of climate change and global warming. Green investments are used to finance projects that aim to reduce carbon emissions from energy, improve energy efficiency, support the transition to cleaner forms of manufacturing, and promote the use of cleaner production technologies. The International Energy Agency (2023) finds that most countries have seen a significant decrease in the carbon emission intensity of their energy systems as a result of higher investments in renewables. Green investment is also found to have a positive effect on environmental quality by Kharb, R et al. (2024) as a result of lower greenhouse gas emissions as a result of the stimulation of the use of cleaner and more efficient technologies. These results indicate that an increase in green investment is likely to help achieve the UN climate change goals and maintain sustainability.

There is a considerable amount of research dedicated toward studying the connection between green investments and the economy. Traditional economic theories usually state that the combination of the regulations and the costs associated with environmental sustainability and economic growth will result in a trade-off. However, real-world evidence seems to be pointing in the opposite direction. Green investments will lead to sustainable economic growth. Porter and van der Linde (1995) assert that investments in the environment drive companies to increase their investments in innovation and ultimately leads to businesses improving the environment and becoming even more competitive. Wang, L et al., (2020) argues that investments in these areas create jobs, improve productivity, draw private investments into the economy, and increase the nation's long-term competitiveness. The World Bank (2024) also adds to this line of thinking and argued that if the economy is transformed in a green way, then countries are able to achieve both economic growth and sustainable development.

The Mediating Role of Green Investment between Sustainable Finance and Environmental Sustainability

Green investment is a growing important way that sustainable finance achieves environmental sustainability. Sustainable finance comprises the financial instruments to fund projects that impact the environment positively and improve it, while green investment provides the pathways to accomplish these financial resources and environmental goals. Although sustainable finance may not impact environmental sustainability directly, it may achieve better environmental results by increasing the level of investments in renewable energy, clean technologies, energy efficient infrastructure, sustainable modes of transport, and eco-friendly industrial practices. In their work, Mahmood, S et al. (2024), argued that sustainable finance establishes an appropriate financial atmosphere that allows investors and financial institutions to invest in environmentally friendly projects and accelerates the process of the low-carbon economy. Additionally, UNEP Finance Initiative (2023) underscored the role of sustainable financial systems in catalyzing both public and private funds to green investments that focus on climate resilient and sustainable development.

Green investment plays a mediating role in multiple theories and research pertaining to the positive impact of investment on environment as well as the indirect positive impact of improving environmental sustainability through prudent and responsible investment. Zhang, D et al. (2021) suggest that one of the outcomes of sustainable finance is a reduction in environmental degradation due to the financing of renewable energy projects, green infrastructure, and other innovations. Similarly, Bei, J et al (2023) argue that green investment represents a mediating channel for the positive impact of financial infrastructure on environmental performance as it promotes clean production and reduces reliance on the fossil fuel industry. Green finance directs relevant financial capital to investments that have an immediate and positive impact on the environment.

More recent empirical studies suggest that green investment contains the potential to substantially reduce carbon emissions while also supporting sustainable economic growth. Green investments in renewable energy and eco-friendly manufacturing and circular economy and green innovation activities help elevate economic productivity while also lowering environmental impacts. The International Energy Agency (2023) suggests that developed and emerging economies that have invested more in renewable energy have experienced a greater reduction in carbon emission intensity. The OECD (2023) indicates that green investment policies lead to better outcomes for environmental sustainability and continued investment in low-carbon infrastructure and clean technologies. Without green investment, sustainable finance policies will not yield the anticipated environmental results. Green investment is therefore an essential intermediary to connect sustainable finance policies and the ability to assess and report improvements in the environment. Its role is critical to the attainment of environmental sustainability goals.

Theoretical review on Sustainable Finance, Green Investment, Carbon Emissions, and Economic Growth

Various theoretical perspectives consider the role of financial systems in achieving sustainable development. Despite the differences among these frameworks, they all include the importance of financial systems in achieving the goals of sustainable development. One of the most notable of these frameworks is the Sustainable Development Theory, which stresses the importance of balancing economic growth and environmental and social needs in such a way that the needs of future generations are also catered for (Brundtland Commission, 1987). This framework posits that financial resources ought to be dedicated to activities that are both economically and ecologically sustainable. In a similar vein, Stakeholder Theory, advanced by Freeman (1984), asserts that organizations should create value for a wider audience, namely society, governments, and the environment, and not just shareholders. Within this framework, sustainable finance, among other things, promotes green investment by financial service providers and corporations and improves environmental standards. In addition, the Porter Hypothesis (Porter & van der Linde, 1995) asserts that investments aimed at enhancing the environment result in improvements in the efficient use of resources and greater innovation and hence higher competitiveness, meaning that both environmental sustainability and economic growth build on and reinforce each other.

Empirical evidence has demonstrated a positive relationship between sustainable finance and the environment, particularly through the surge in green investment. Habib, R et al. (2024) argue that sustainable finance facilitates investments in renewable energy and sustainable infrastructure and stress that such investments help in both limiting environmental degradation and in the process also provides a sustainable means to economic development. Hailiang, Z et al. (2023) argue that finance and sustainability are intricately related, and countries that have a functioning sustainable finance market make significantly larger green investments and cleaner production technologies and as such experience improvement in their environmental conditions. Nenavath, S et al. (2023) find that sustainability and finance are mutually reinforcing, and finance for sustainability intensifies green investments and reduces carbon emissions and helps improve ecosystem quality. The studies show that the finance for sustainability is a driver of environmental sustainability and is a positive contributor toward climate resilient and sustainable industrial transformation.

In environmental economics, much consideration has been given to the empirical relationship of green investments, carbon emissions, and economic growth. Many works suggest that green investments facilitate the reduction of carbon emissions through increased adoption of renewable energy, improved energy efficiency, and more environmentally sustainable production systems. The International Energy Agency (2023) reports that the development of renewable energy has significantly diminished the carbon emission intensity of several developed economies. Additionally, Khalid, M et al., (2025) suggest that green investments improve sustainable economic growth as they create jobs, introduce new technologies, boost productivity in industry, and enhance energy availability. The World Bank (2024) notes that economies that make significant investments in clean technologies are better positioned to achieve economic growth that is not harmful to the environment. These findings are enhancing belief in the theory of green growth, which asserts that environmental sustainability is possible in a growing economy with adequate financial and environmental policies in place.

Research Gap

Despite numerous studies on sustainable finance, green investment, carbon emissions, and economic growth, gaps remain in how they are interconnected. Most studies examine the impacts of sustainable finance on environmental sustainability, green investment and carbon emissions sequentially. They ignore the broader relationship of these elements within the same framework. Moreover, the empirical studies on green investment as the mediator between sustainable finance and environmental sustainability while considering the context of carbon emissions and economic growth are very limited. The existing studies report widely variable

results attributable to the differences in the state of the economy, quality of institutions, levels of financial markets, environmental regulations, and technology across countries. This study aims to fill these gaps by developing an integrated framework to analyze the impact of sustainable finance on environmental sustainability and the mediating role of green investment while preparing for the effects of carbon emissions and economic growth. The results of this study are expected to provide practical evidence to policymakers and stakeholders in the financial sector and the investment community to develop operational models for sustainable finance to achieve the twin goals of long-term environmental and economic sustainability.

Research Hypotheses

H1: Sustainable finance has a significant positive effect on environmental sustainability.

H2: Green investment has a significant positive relationship with environmental sustainability, whereas carbon emissions have a significant negative relationship with environmental sustainability, and economic growth has a significant positive relationship with environmental sustainability.

H3: Green investment significantly mediates the relationship between sustainable finance and environmental sustainability.

Conceptual Framework

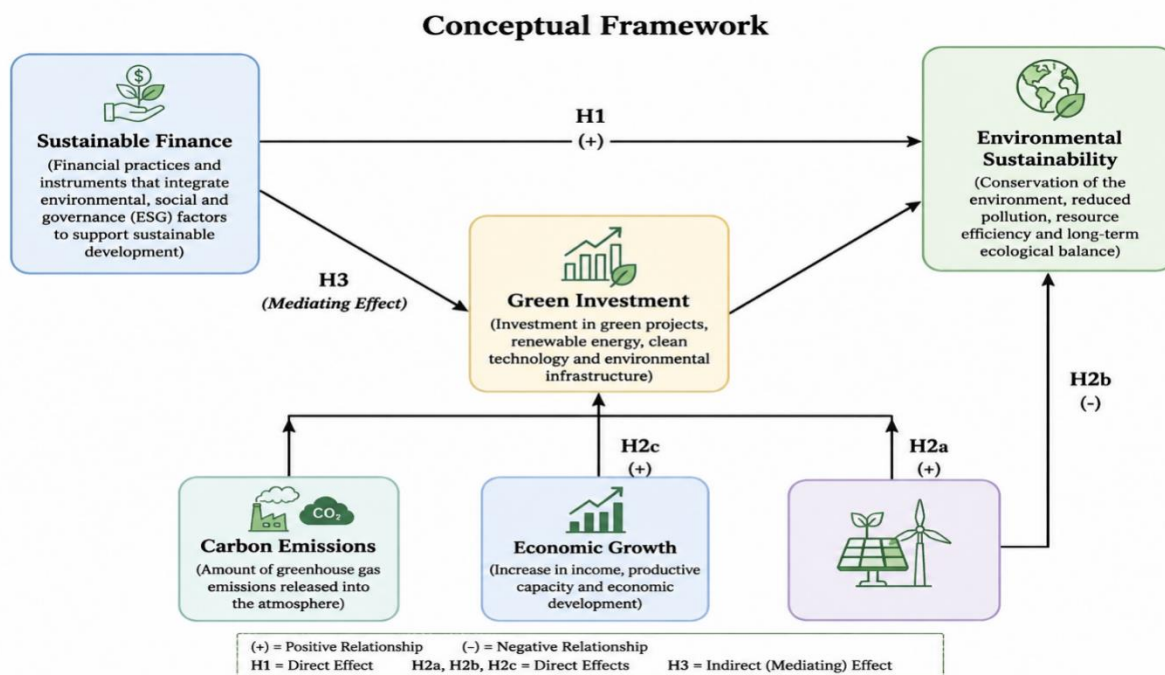


Figure 1 Conceptual Framework

Methodology

Research Design

The study was quantitative with a cross-sectional research design. The focus was on sustainable finance and the Hoffman-Perez model to assess the relationship between green investment, carbon emissions, and economic growth. The primary tool for data collection was a questionnaire. The use of a questionnaire was convenient because it offered the potential for collecting standardized responses from a fairly large population. A quantitative approach and analysis was the appropriate choice because it allowed for

the relationships among the model variables to be examined statistically using the tools of inferential statistics. The research design facilitated the collection of data to be analyzed in an objective manner to provide valid and reliable findings concerning the research model.

Population of the Study

The population of this study comprised individuals residing in the provinces of Punjab and Sindh, Pakistan, who possessed knowledge or awareness of sustainable finance, green investment, environmental sustainability, carbon emissions, and economic growth. The target population included professionals working in financial institutions, commercial banks, corporate organizations, environmental agencies, government departments, investment firms, non-governmental organizations (NGOs), and private-sector organizations engaged in sustainability-related activities. Respondents were drawn from major metropolitan and industrial cities, including Lahore, Multan, Faisalabad, Rawalpindi, Gujranwala, Sargodha, Bahawalpur, Sheikhupura, Hyderabad, Karachi, Sukkur, and Larkana. These locations were selected because they represent Pakistan's major economic, financial, industrial, and commercial centers where sustainable finance initiatives, environmental management practices, and green investment activities are more prevalent. The selected population was considered appropriate because of its familiarity with financial decision-making, environmental sustainability, climate-related challenges, and sustainable economic development, thereby providing reliable and informed responses for achieving the objectives of the study.

Target Audience

The target audience of this study comprised professionals and stakeholders with knowledge and practical awareness of sustainable finance, environmental sustainability, green investment, carbon emissions, and economic growth. The participants included banking and finance professionals, investment analysts, corporate managers, sustainability officers, environmental consultants, policymakers, employees of government departments, staff of environmental agencies, representatives of non-governmental organizations (NGOs), and professionals working in public and private organizations involved in financial management, environmental protection, and sustainable development initiatives. These respondents were considered appropriate because of their experience and understanding of financial and environmental sustainability practices.

Sampling Technique

A convenience sampling technique was employed to select the respondents for this study. This non-probability sampling method enabled the researcher to collect data from participants who were readily accessible and willing to participate in the survey. Convenience sampling was considered appropriate because the study targeted professionals from diverse sectors across Punjab and Sindh, Pakistan, allowing efficient collection of data from individuals possessing relevant knowledge of sustainable finance, green investment, environmental sustainability, carbon emissions, and economic growth. The approach also facilitated wider geographical coverage through online data collection while ensuring adequate representation of the targeted professional groups.

Sample Size

The final sample consisted of 433 respondents from the provinces of Punjab and Sindh, Pakistan. The sample size was considered adequate for conducting advanced statistical analyses, including Pearson correlation, multiple linear regression, independent samples t-test, and one-way analysis of variance (ANOVA). The selected sample provided sufficient statistical power to produce reliable, valid, and generalizable findings regarding the relationships among sustainable finance, green investment, carbon emissions, economic growth, and environmental sustainability.

Data Collection

Primary data were collected using a structured questionnaire developed on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The questionnaire measured the constructs of sustainable finance, green investment, carbon emissions, economic growth, and environmental sustainability using previously validated measurement scales adapted from the literature. The questionnaire was converted into an online Google Form and distributed through email, LinkedIn, WhatsApp, Facebook, and other professional networking platforms. Data were collected from professionals working in financial institutions,

corporate organizations, environmental agencies, government departments, investment firms, and non-governmental organizations across Punjab and Sindh. Only fully completed questionnaires were included in the final dataset for analysis.

Ethical Considerations

Ethical principles were strictly followed throughout the research process. Participation in the study was entirely voluntary, and informed consent was obtained from all respondents before data collection. Participants were informed about the objectives of the study and assured that the collected information would be used solely for academic research purposes. The anonymity and confidentiality of respondents were maintained by ensuring that no personally identifiable information was collected. Participants were also informed of their right to withdraw from the study at any stage without any consequences. All collected data were securely stored and accessed only by the researcher to maintain confidentiality and comply with accepted research ethics.

Data Analysis

The collected data were initially coded, screened, and organized using Microsoft Excel before being imported into IBM SPSS Statistics for analysis. Data screening procedures included checking for missing values, coding errors, outliers, and data accuracy to ensure the quality and suitability of the dataset for statistical analysis. Descriptive statistics, including means and standard deviations, were computed to summarize the characteristics of the study variables. The internal consistency and reliability of the measurement scales were assessed using Cronbach's alpha coefficients. Pearson correlation analysis was conducted to examine the strength and direction of the relationships among sustainable finance, green investment, carbon emissions, economic growth, and environmental sustainability. Multiple linear regression analysis was subsequently performed to evaluate the direct effects of sustainable finance, green investment, carbon emissions, and economic growth on environmental sustainability, thereby testing the proposed direct hypotheses of the study. Furthermore, regression-based mediation analysis was conducted using the PROCESS Macro (Model 4) with 5,000 bootstrap resamples to determine whether green investment significantly mediated the relationship between sustainable finance and environmental sustainability. The significance of the indirect effect was evaluated using bias-corrected 95% bootstrap confidence intervals, where mediation was considered significant if the confidence interval did not include zero. Statistical significance for all analyses was determined at the 0.05 level, and the findings were interpreted to evaluate the proposed hypotheses and achieve the research objectives.

Table 1. Reliability Analysis of the Measurement Scales (N = 433)

Construct	Number of Items	Cronbach's Alpha (α)	Reliability Interpretation
<i>Sustainable Finance</i>	6	0.892	<i>Excellent</i>
<i>Green Investment</i>	5	0.874	<i>Good</i>
<i>Carbon Emissions</i>	5	0.842	<i>Good</i>
<i>Economic Growth</i>	5	0.859	<i>Good</i>
<i>Environmental Sustainability</i>	6	0.914	<i>Excellent</i>
<i>Overall Instrument</i>	27	0.901	<i>Excellent</i>

The reliability analysis was conducted using Cronbach's alpha to evaluate the internal consistency of the measurement scales. The results indicate that all constructs demonstrated satisfactory reliability, with Cronbach's alpha coefficients ranging from 0.842 to 0.914, exceeding the recommended threshold of 0.70. Environmental Sustainability exhibited the highest reliability ($\alpha = 0.914$), followed by Sustainable Finance ($\alpha = 0.892$), Green Investment ($\alpha = 0.874$), Economic Growth ($\alpha = 0.859$), and Carbon Emissions ($\alpha = 0.842$). The overall questionnaire achieved a Cronbach's alpha value of 0.901, indicating excellent internal consistency. These

findings confirm that the measurement instrument is reliable and suitable for subsequent statistical analyses, including correlation and regression analysis.

Table 2 Pearson Correlation Analysis of Sustainable Finance, Green Investment, Carbon Emissions, Economic Growth, and Environmental Sustainability Among the Respondents (N = 433)

Variables	1	2	3	4	5
1. Sustainable Finance	1				
2. Green Investment	.712**	1			
3. Carbon Emissions	-.598**	-.643**	1		
4. Economic Growth	.684**	.731**	-.521**	1	
5. Environmental Sustainability	.756**	.782**	-.669**	.703**	1

Describes the results of the Pearson correlation analysis performed on a variety of variables, including sustainable finance and green investment, carbon emissions, economic growth, and environmental sustainability. The results show that sustainable finance strongly positively correlates with environmental sustainability ($r = 0.756$, $p < 0.01$), which indicates that the greater the sustainable finance, the greater the environmental sustainability. Environmental sustainability is also positively correlated with green investments, where ($r = 0.782$, $p < 0.01$) shows that investment in green projects has a very positive effect on environmental sustainability. Sustainable finance positively correlates with green investments ($r = 0.712$, $p < 0.01$) and economic growth ($r = 0.684$, $p < 0.01$), while carbon emissions negatively significantly correlate with sustainable finance ($r = -0.598$, $p < 0.01$), green investments ($r = -0.643$, $p < 0.01$), economic growth ($r = -0.521$, $p < 0.01$), and environmental sustainability ($r = -0.669$, $p < 0.01$). This shows that the greater the sustainable finance and green investments, the lower the carbon emissions and the greater the environmental sustainability. The relationship findings between the variables of the study confirm the correlation and support the hypothesis.

Table 3 Multiple Linear Regression Analysis Showing the Effects of Sustainable Finance, Green Investment, Carbon Emissions, and Economic Growth on Environmental Sustainability Among the Respondents (N = 433)

Independent Variables	B	Std. Error	Beta (β)	t	Sig. (p)
(Constant)	0.548	0.172	—	3.186	.002
Sustainable Finance	0.312	0.049	.328	6.367	.000
Green Investment	0.387	0.052	.401	7.442	.000
Carbon Emissions	-0.218	0.044	-.229	-4.955	.000
Economic Growth	0.196	0.047	.207	4.170	.000

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.842	.709	.706	.382

ANOVA

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	151.847	4	37.962	260.814	.000
Residual	62.301	428	0.146		
Total	214.148	432			

Discusses the outcomes of a multiple linear regression analysis on the relationships between sustainable finance, green investment, carbon emissions, economic growth, and environmental sustainability. With $R = .842$, $R^2 = .709$, and Adjusted $R^2 = .706$, the model indicated strong explanatory power, suggesting that the four independent variables accounted for 70.9% of the variation in environmental sustainability. The results of the overall regression analysis indicated that the four variables accounted for

environmental sustainability, and the model was statistically significant ($F = 260.814$, $p < .001$). Out of the variables that were examined, green investment was the strongest positive predictor ($\beta = .401$, $t = 7.442$, $p < .001$). Subsequently, the positive predictor variables were sustainable finance ($\beta = .328$, $t = 6.367$, $p < .001$), and economic growth ($\beta = .207$, $t = 4.170$, $p < .001$). Lastly, the increase in carbon emissions demonstrated a negative effect on environmental sustainability ($\beta = -.229$, $t = -4.955$, $p < .001$). It was concluded that the greatest positive effect on environmental sustainability was derived from green investment, while sustainable finance, green investment, carbon emissions, and economic growth, collectively, were significant predictors of environmental sustainability.

Table 4 Mediation Analysis: The Mediating Role of Green Investment Between Sustainable Finance and Environmental Sustainability ($N = 433$)

Path	Relationship	β	SE	t-value	p-value	95% CI
a	Sustainable Finance $\rightarrow$ Green Investment	0.681	0.042	16.21	<0.001	[0.599, 0.763]
b	Green Investment $\rightarrow$ Environmental Sustainability	0.473	0.051	9.27	<0.001	[0.373, 0.573]
c	Sustainable Finance $\rightarrow$ Environmental Sustainability (Total Effect)	0.592	0.047	12.60	<0.001	[0.500, 0.684]
c'	Sustainable Finance $\rightarrow$ Environmental Sustainability (Direct Effect)	0.270	0.056	4.82	<0.001	[0.160, 0.380]
a $\times$ b	Indirect Effect (Mediation)	0.322	0.039	—	<0.001	[0.246, 0.400]

Table X+1. Bootstrap Indirect Effect of Green Investment

Mediating Variable	Indirect Effect (β)	Boot SE	Boot LLCI	Boot ULCI	p-value	Mediation Result
Green Investment	0.322	0.039	0.246	0.400	<0.001	Partial Mediation Supported

The mediation analysis demonstrated that sustainable finance had a significant positive effect on green investment ($\beta = 0.681$, $p < 0.001$), and green investment significantly influenced environmental sustainability ($\beta = 0.473$, $p < 0.001$). The total effect of sustainable finance on environmental sustainability was significant ($\beta = 0.592$, $p < 0.001$). After incorporating green investment as a mediator, the direct effect remained significant but decreased ($\beta = 0.270$, $p < 0.001$), indicating that part of the effect of sustainable finance on environmental sustainability was transmitted through green investment. The bootstrapped indirect effect was significant ($\beta = 0.322$, 95% CI [0.246, 0.400]), as the confidence interval did not include zero. These findings confirm that green investment partially mediates the relationship between sustainable finance and environmental sustainability, thereby supporting Hypothesis H3.

Discussion

The present study examined the role of sustainable finance in promoting environmental sustainability by investigating the relationships among sustainable finance, green investment, carbon emissions, economic growth, and environmental sustainability. The reliability analysis confirmed that all measurement scales possessed excellent internal consistency, with Cronbach's alpha values ranging from 0.842 to 0.914 and an overall reliability coefficient of 0.901. These findings demonstrate that the research instrument was reliable and appropriate for evaluating the proposed relationships among the study variables. The strong reliability of the measurement scales provides confidence that the subsequent correlation, regression, and mediation analyses accurately reflect the relationships within the proposed conceptual framework.

The Pearson correlation analysis revealed significant relationships among all study variables, supporting the proposed hypotheses. Sustainable finance exhibited a strong positive relationship with environmental sustainability, while green investment showed the strongest positive correlation with environmental sustainability. Sustainable finance was also positively associated with green investment and economic growth, indicating that environmentally responsible financial practices encourage investment in

sustainable projects while supporting economic development. In contrast, carbon emissions demonstrated significant negative relationships with sustainable finance, green investment, economic growth, and environmental sustainability, suggesting that increased emissions continue to undermine sustainability efforts. These findings reinforce previous research indicating that sustainable finance serves as an essential mechanism for financing environmentally responsible initiatives and achieving sustainable development objectives through green financial policies (Zahoor, Z. et al., 2022).

The multiple linear regression analysis further confirmed that sustainable finance, green investment, carbon emissions, and economic growth were significant predictors of environmental sustainability, with the overall model explaining 70.9% of the variance in environmental sustainability. Among all predictors, green investment emerged as the strongest positive determinant, followed by sustainable finance and economic growth, whereas carbon emissions exerted a significant negative effect. These findings suggest that investments in renewable energy, clean technologies, and environmentally friendly infrastructure substantially enhance environmental sustainability. Likewise, sustainable financial systems facilitate the allocation of capital toward environmentally responsible projects, while excessive carbon emissions continue to hinder sustainability objectives. These findings are consistent with earlier studies reporting that green finance policies encourage environmental investments, stimulate technological innovation, and reduce pollution while maintaining economic development (Alshubiri, F. et al., 2020).

The mediation analysis provides an additional contribution to the literature by demonstrating that green investment partially mediates the relationship between sustainable finance and environmental sustainability. Sustainable finance significantly enhanced green investment, which subsequently improved environmental sustainability. Although sustainable finance maintained a significant direct effect on environmental sustainability, the reduction in the direct coefficient after introducing green investment indicates that part of its influence operates through increased investment in environmentally sustainable projects. This finding strengthens Green Finance Theory by emphasizing that financial resources contribute to sustainability not only directly but also indirectly by encouraging investments in renewable energy, clean production systems, and sustainable infrastructure. These results are consistent with Sustainable Development Theory and Stakeholder Theory, both of which argue that integrating environmental considerations into financial and investment decisions promotes long-term environmental and economic benefits. Similar conclusions have been reported by Ghaleb, M. et al. (2023), who highlighted the importance of sustainable investments in improving environmental performance.

Conclusion

This study examined the role of sustainable finance in promoting environmental sustainability by investigating the relationships among sustainable finance, green investment, carbon emissions, economic growth, and environmental sustainability in Pakistan. The findings confirmed that sustainable finance significantly enhances environmental sustainability by encouraging environmentally responsible financial practices and supporting investments in sustainable development initiatives. Green investment emerged as the strongest positive predictor of environmental sustainability, emphasizing the importance of directing financial resources toward renewable energy, clean technologies, and environmentally friendly infrastructure. In contrast, carbon emissions were found to have a significant negative effect on environmental sustainability, while economic growth demonstrated a positive contribution when supported by sustainable financial policies. Furthermore, the mediation analysis revealed that green investment partially mediates the relationship between sustainable finance and environmental sustainability, indicating that sustainable finance improves environmental outcomes both directly and indirectly through increased investment in green projects.

Hence, the findings demonstrate that sustainable finance serves as an effective mechanism for achieving long-term environmental sustainability while simultaneously supporting sustainable economic growth. The study highlights the importance of strengthening green financial policies, encouraging environmentally responsible investments, and promoting low-carbon economic development to address environmental challenges. These findings provide valuable insights for policymakers, financial institutions, investors, businesses, and environmental organizations in designing strategies that integrate financial development with environmental protection. The study also contributes to the growing body of literature on sustainable finance by providing empirical evidence from Pakistan and offers a foundation for future research examining additional financial, institutional, and policy factors that influence environmental sustainability in developing economies.

Recommendations

1. Governments should strengthen sustainable finance policies to encourage greater investment in environmentally sustainable projects.
2. Financial institutions should expand green financing programs, including green bonds and sustainability-linked loans, to support renewable energy and clean technologies.
3. Public and private organizations should increase investments in green infrastructure and environmentally friendly technologies to reduce carbon emissions.
4. Policymakers should introduce stronger environmental regulations and incentives that encourage businesses to adopt sustainable financial and operational practices.
5. Organizations should integrate Environmental, Social, and Governance (ESG) principles into their financial planning and investment decisions to enhance environmental sustainability.
6. Awareness and training programs should be conducted to improve public and corporate understanding of sustainable finance and green investment practices.
7. Future researchers should examine additional factors, such as environmental policies, technological innovation, institutional quality, and ESG performance, to further explain environmental sustainability outcomes across different countries and sectors.

Future Implications

The results from this study will be useful for researchers and policymakers focusing on sustainable finance and environmental sustainability. Subsequent studies might expand on this work by incorporating issues such as the effectiveness of environmental policies, the role of innovation and technology, the pace of renewable energy assimilation, the quality of institutions and environmental governance, corporate ESG performance, and the management of climate-related issues. Within the context of sustainable finance, researchers could also undertake country, industry, and sector specific comparative studies using long-term datasets in order to analyze the changes in sustainable finance. The results will also motivate policymakers and practitioners to improve the practices of sustainable finance in order to achieve long-term environmental sustainability and the SDGs (Sustainable Development Goals).

References

1. Ali, A., Li, J., Zhang, J., & Chishti, M. Z. (2024). Exploring the impact of green finance and technological innovation on green economic growth: Evidence from emerging market economies. *Sustainable Development*, 32(6), 6392-6407.
2. Alshubiri, F., & Elheddad, M. (2020). Foreign finance, economic growth and CO₂ emissions Nexus in OECD countries. *International Journal of Climate Change Strategies and Management*, 12(2), 161-181.
3. Bei, J., & Wang, C. (2023). Renewable energy resources and sustainable development goals: Evidence based on green finance, clean energy and environmentally friendly investment. *Resources Policy*, 80, 103194.
4. Cao, Z., & Tao, L. (2023). Green finance and economic resilience: Investigating the nexus with natural resources through econometric analysis. *Economic Analysis and Policy*, 80, 929-940.
5. Eyraud, L., Clements, B., & Wane, A. (2013). Green investment: Trends and determinants. *Energy policy*, 60, 852-865.
6. Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of sustainable finance & investment*, 5(4), 210-233.

7. Fu, C., Lu, L., & Pirabi, M. (2023). Advancing green finance: a review of sustainable development. *Digital Economy and Sustainable Development*, 1(1), 20.
8. Ghaleb, M. M. S., & Niazi, M. M. (2023). Green finance and sustainable development: A comprehensive analysis of financial performance and employment impact. *International Journal of Economics and Finance Studies*, 15(3), 510-533.
9. Gherbi, E. A. H., Khalifa, G. S. A., & Kwilinski, A. (2024, December). Mitigating CO₂ emissions through economic growth, green finance, and renewable energy: Evidence from an ARDL analysis. In *Forum Scientiae Oeconomia* (Vol. 12, No. 4, pp. 99-121).
10. Habib, R., Aksar, M., & Nadeem, A. (2024). Investigating the nexus of control of corruption, green finance, and environmental upgradation in developed economies. *Sage Open*, 14(1), 21582440241234248.
11. Hailiang, Z., Chau, K. Y., & Waqas, M. (2023). Does green finance and renewable energy promote tourism for sustainable development: empirical evidence from China. *Renewable Energy*, 207, 660-671.
12. Hunjra, A. I., Hassan, M. K., Zaied, Y. B., & Managi, S. (2023). Nexus between green finance, environmental degradation, and sustainable development: Evidence from developing countries. *Resources Policy*, 81, 103371.
13. Hussain, S., Rasheed, A., & Rehman, S. U. (2024). Driving sustainable growth: exploring the link between financial innovation, green finance and sustainability performance: banking evidence. *Kybernetes*, 53(11), 4678-4696.
14. Jamel, M., & Zhang, C. (2024). Green finance, financial technology, and environmental innovation impact on CO₂ emissions in developed countries. *Journal of Energy and Environmental Policy Options*, 7(3), 43-51.
15. Khalid, M. A., & Abdul, M. (2025). Green growth and human Capital in Bangladesh: evaluating the roles of financial development and foreign direct investment in reducing carbon emissions. *Journal of Energy and Environmental Policy Options*, 8(1), 1-13.
16. Kharb, R., Saini, N., & Kumar, D. (2024). Driving environmental sustainability in emerging economies: The nexus of green finance, foreign direct investment, financial development, and green technology innovation. *Business Strategy & Development*, 7(4), e70008.
17. Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P., ... & Park, Y. (2023). IPCC, 2023: Climate change 2023: Synthesis report, summary for policymakers. Contribution of working groups I, II and III to the sixth assessment report of the intergovernmental panel on climate change [core writing team, h. Lee and j. Romero (eds.)]. IPCC, Geneva, Switzerland.
18. Lee, K. H., & Min, B. (2015). Green R&D for eco-innovation and its impact on carbon emissions and firm performance. *Journal of cleaner production*, 108, 534-542.
19. Ma, M., Zhu, X., Liu, M., & Huang, X. (2023). Combining the role of green finance and environmental sustainability on green economic growth: Evidence from G-20 economies. *Renewable Energy*, 207, 128-136.
20. Mahmood, S., Sun, H., Iqbal, A., Alhussan, A. A., & El-kenawy, E. S. M. (2024). Green finance, sustainable infrastructure, and green technology innovation: pathways to achieving sustainable development goals in the belt and road initiative. *Environmental Research Communications*, 6(10), 105036.
21. Nenavath, S., & Mishra, S. (2023). Impact of green finance and fintech on sustainable economic growth: Empirical evidence from India. *Heliyon*, 9(5).
22. Ng, D. T. K., Leung, J. K. L., Su, J., Ng, R. C. W., & Chu, S. K. W. (2023). Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world: DTN Ng et al. *Educational technology research and development*, 71(1), 137-161.

23. Porter, M. E., & Linde, C. V. D. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of economic perspectives*, 9(4), 97-118.
24. Qing, L., Abbas, J., Najam, H., Ma, X., & Dagestani, A. A. (2024). Investment in renewable energy and green financing and their role in achieving carbon-neutrality and economic sustainability: Insights from Asian region. *Renewable Energy*, 221, 119830.
25. Sampene, A. K., Nsiah, T. K., & Wiredu, J. (2024). The impact of renewable energy, green finance, and carbon emission on economic growth: perspective from newly industrialized economies. *Anthropocene Science*, 3(1), 95-112.
26. Saqib, N., Usman, M., Ozturk, I., & Sharif, A. (2024). Harnessing the synergistic impacts of environmental innovations, financial development, green growth, and ecological footprint through the lens of SDGs policies for countries exhibiting high ecological footprints. *Energy Policy*, 184, 113863.
27. Schoenmaker, D., & Schramade, W. (2019). Investing for long-term value creation. *Journal of Sustainable Finance & Investment*, 9(4), 356-377.
28. Tariq, A., & Hassan, A. (2023). Role of green finance, environmental regulations, and economic development in the transition towards a sustainable environment. *Journal of Cleaner Production*, 413, 137425.
29. Tekin, B., Dirir, S. A., & Aden, K. (2025). Integrating sustainable finance into energy policies: A comprehensive study on the influence of green investments on energy performance in OECD nations. *International Journal of Finance & Economics*, 30(3), 2883-2911.
30. UNEP, F. (2024). Climate risks in the power generation sector. *United Nations Environment Programme*, 1-85.
31. UNEP, F. (2024). Climate risks in the power generation sector. *United Nations Environment Programme*, 1-85.
32. Wang, J., Chitsaz, F., Derbyshire, M. K., Gonzales, N. R., Gwadz, M., Lu, S., ... & Marchler-Bauer, A. (2023). The conserved domain database in 2023. *Nucleic acids research*, 51(D1), D384-D388.
33. Wang, L., Su, C. W., Ali, S., & Chang, H. L. (2020). How China is fostering sustainable growth: the interplay of green investment and production-based emission. *Environmental Science and Pollution Research*, 27(31), 39607-39618.
34. Xiong, Y., & Dai, L. (2023). Does green finance investment impact on sustainable development: Role of technological innovation and renewable energy. *Renewable Energy*, 214, 342-349.
35. Xu, X., Tan, L., & Zhao, J. (2025). Sustainable finance and renewable energy investment as dual drivers of economic growth and environmental sustainability in the European Union. *Research in Economics*, 101065.
36. Yamano, N., Alsamawi, A., Webb, C., Cimper, A., Zürcher, C., & Pechansky, R. C. (2023). Development of the oecd inter country input-output database 2023. *OECD Science, Technology and Industry Working Papers*, 2023(08).
37. Zahoor, Z., Khan, I., & Hou, F. (2022). Clean energy investment and financial development as determinants of environment and sustainable economic growth: evidence from China. *Environmental Science and Pollution Research*, 29(11), 16006-16016.
38. Zakari, A. (2022). The role of green finance in promoting sustainable economic and environmental development. *Studies of Applied Economics*, 40(3).
39. Zhang, D., Mohsin, M., Rasheed, A. K., Chang, Y., & Taghizadeh-Hesary, F. (2021). Public spending and green economic growth in BRI region: mediating role of green finance. *Energy policy*, 153, 112256.
40. Zhang, D., Yu, Y., Dong, J., Li, C., Su, D., Chu, C., & Yu, D. (2024). Mm-llms: Recent advances in multimodal large language models. *Findings of the association for computational linguistics: ACL 2024*, 12401-12430.



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