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Investigating Green Finance as a Mediator in the Relationship between Predictors and Environmental Sustainability

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Abstract: The study aims to explore the mediating role of green finance in the relationship between its key predictors—regulatory environment, financial institutions, investor demand, technological innovation, public awareness, and education—and the implementation of green finance management practices and their impact on environmental sustainability. By examining these relationships, the research seeks to highlight the significant influence of green finance on promoting sustainable environmental practices. The findings of this investigation are expected to contribute to the advancement of green projects, thereby enhancing environmental sustainability in the long run.

Keywords:
Green Finance, Environmental Sustainability, Regulatory Environment, Financial Institutions, Investor Demand, Technological Innovation, Public Awareness, Education, Green Finance Management Practices.

Introduction

The landscape of industrial development is increasingly shaped by the influence of financial institutions and their support for various enterprises. Both private and government institutions play a crucial role in fostering the growth of micro, small, medium, and large-scale enterprises. However, a notable gap exists in the emphasis on green projects, which are vital for safeguarding society from diverse types of pollution. Recognizing this, state and central governments have initiated numerous green projects focusing on renewable energy sources such as solar, wind, hydro, and biogas.

A financial ecosystem is made up of a number of markets, products, and organizations that operate within a system of laws and regulations. Financial institutions serve as a middleman between the major borrowing and savings sectors. A competitive edge is something that financial institutions must strive for among the swift changes occurring in the technical, economic, social, demographic, and regulatory domains. The financial industry is undergoing a profound upheaval that may be ascribed to several reasons including as technological advancements, global consolidation and restructuring, deregulation, and shifting demographic patterns. The main factor that maintains the financial sector's vibrancy is IT.

Green projects are essential for mitigating environmental pollution and ensuring sustainable development. It is obvious that supporting sustainable efforts is greatly aided by green finance. Therefore, the provision of green funding by a nation's leadership is crucial for the shift from a booming economy to a green economy (Khan KI, Nasir A, Rashid T, 2022). Nations all over the globe have made investments in green projects to advance, develop, and use eco-friendly technology to protect the environment and optimize environmental performance in order to ensure green economic growth. Tang, Meng, Li-Bo (2020) mentioned that regulatory agencies are likely to look for more financially acceptable resources that are environmentally acceptable since new stakeholders and institutions have a better awareness of environmental challenges. When new avenues for funding resources and green finance emerge, this kind of environmental proactivity will be necessary to build environmental legitimacy.

According to Chen & Xie (2023) one important area that tackles the urgent global issues of environmental sustainability and financial stability is the confluence of green finance and innovation. Despite extensive research on green finance and innovation, a number of themes and gaps continue to surface, highlighting the subject's complexity.

Innovation is encouraged by green funding tools and regulations, particularly in the fields of renewable energy and environmental technology (Han, Tan, Zhu & Liu, 2023). Whether green funding encourages sustainable technology and how it influences green innovation has been the subject of several studies. He, Iqbal and Fangli (2023) through their research on green bonds, green banking, and green finance reform legislation, they have provided empirical support for the idea that combining green practices and financial incentives may spur environmental innovation.

Despite the importance of these projects, there is a need for a structured approach to evaluate the impact of green finance on environmental sustainability. This research aims to fill this gap by developing a comprehensive model that examines the relationship between green finance and environmental sustainability in India.

To achieve this, a structured questionnaire was employed to gather opinions from various respondents on green finance and its environmental impact. The study identifies several independent factors—regulatory environment, financial institutions, investor demand, technological innovation, and public awareness and education—that indirectly influence the advantages of green finance. The findings indicate that these factors contribute to environmental sustainability through a full mediation model, where green finance acts as a mediating variable.

The research provides a detailed analysis of these relationships using various diagrammatic representations, correlation matrices, and structural equation modeling. By illustrating the indirect relationships among independent, mediating, and dependent variables, this study offers valuable insights into the dynamics of green finance and its role in promoting environmental sustainability.

Overall, this research contributes to the understanding of green finance's impact on environmental sustainability and underscores the importance of integrating green initiatives in financial and industrial development strategies.

Background

The earlier research concepts are belonging to financial institutions and its impact on industrial development. There are various private and government institutions are helping a lot to develop micro, small, medium and large-scale enterprises and the very few projects are majorly concentrating on green projects. The green projects are essential to safe guard the society from various sorts of pollutions. The state and central governments have taken initiatives to introduce various green projects. The various green energy projects include: solar, wind, hydro and biogas projects. The Eco-friendly projects are very much essential to safe guard the society from various types of pollutions. Therefore, it is very much essential to develop the nation in all aspects. The present research facilitates to develop the green projects in India. A structure questionnaire developed to collect the opinion from various respondents with respect to opinion on the green finance and its impact on environmental sustainability.

The importance of environmental sustainability and green finance has gained more attention in recent years, which has boosted focus in both academic research and real-world applications. The world is today facing an unprecedented environmental catastrophe, with growing urgency around problems including biodiversity loss, resource depletion, and climate change. Under the general heading of sustainable finance, green finance focuses on financial strategies and investments that have a positive impact on the environment in addition to producing financial gains.

Research Methodology

Research Design:

This study utilized an exploratory research design to investigate the impact of green finance on environmental sustainability in India. This design facilitated the exploration of relationships and patterns among variables related to green finance initiatives.

Data Collection:

-Sampling Technique: Simple random sampling was employed to collect data from a diverse group of stakeholders involved in or affected by green finance projects.

-Sample Size: A structured questionnaire was administered to gather opinions and data on perceptions regarding green finance and its impact on environmental sustainability.

Data Analysis:

- Statistical Techniques: Descriptive and inferential statistics were used to analyze the collected data.

- Structural Equation Modeling (SEM): SEM was employed to develop and test a theoretical model exploring the relationships between independent variables (regulatory environment, financial institutions, investor demand, technological innovation, public awareness and education), mediating variables, and the dependent variable (environmental sustainability).

Research Instrument:

- Questionnaire Development: A structured questionnaire was developed based on extensive literature review and expert consultation to ensure comprehensive coverage of relevant factors.

This methodology provided a systematic approach to examining the complex dynamics of green finance and its potential contributions to environmental sustainability within the Indian context.

Brief Description of the Diagrams

The diagrammatical representation of the model will give complete picture about the analysis. There are various types of diagrams like: with mediation, without mediation which is direct effect and the linkages between the independent and dependent factors and the linkages between mediating and dependent factors and the various other sorts of relationships which are very much essential of the model assessment. Therefore, there are various types of diagrams of the model will give clear picture about the analysis.

Detailed Description of the Invention

Table1: Correlation Matrix of Green Finance

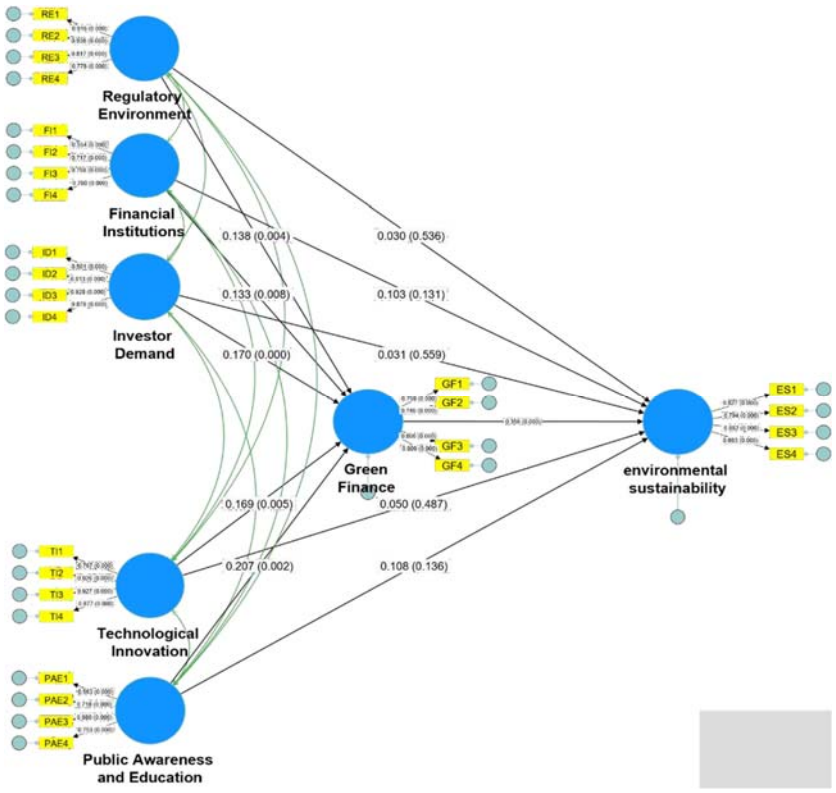
	FI	GF	ID	PAE	RE	TI	ES
FI	1.000						
GF	0.413	1.000					
ID	0.395	0.384	1.000				
PAE	0.407	0.437	0.316	1.000			
RE	0.406	0.356	0.224	0.332	1.000		
TI	0.427	0.431	0.383	0.449	0.341	1.000	
ES	0.340	0.490	0.269	0.348	0.259	0.319	1.000

Sources: Survey Significant (P<.05) at 5%

The correlation matrix will give clear insight among different factors included in the model. The values will range from -1 to +1 and the 0 indicates that there is no correlation. Therefore, correlation is very much essential to determine the relationship among the various factors. For Instance, the financial Institutions has shown the strong positive correlation with remaining factors like 0.427 with TI, and a weak positive correlation of 0.340 with Environmental sustainability. FI shows a modest positive correlation of 0.413 with green finance. Furthermore, GF has a moderate positive correlation of 0.437 with PAE, while PAE demonstrate a moderate

positive correlation of 0.407 with FI. Furthermore, ID exhibits a moderate positive correlation of 0.395 with FI and a weaker positive correlation of 0.384 with GF. Moreover, RE has a reasonable positive correlation of 0.449 with TI and a weaker positive correlation of 0.406 with FI. Lastly, Environmental sustainability demonstrates a moderate positive correlation of 0.490 with GF and a weaker positive correlation of 0.348 with PAE. These correlation coefficients elucidate the relationships between the various factors, aiding in comprehending their interdependencies within the dataset. The model developed with the help of three different category of variables namely: Independent, Mediating and Dependent variables. The list of independent variables are the factors of predictors of green finance and the mediating factor is a green finance and the dependent factor is environmental sustainability. Therefore, the model will give clear picture in the contemporary scenario to assess the effectiveness of the model. Further, the model witnesses two different types of mediation analysis. They are full mediation and partial mediation. The full mediation will happen through the interaction of mediating factor and the partial mediation will happen where there is no mediation in the analysis.

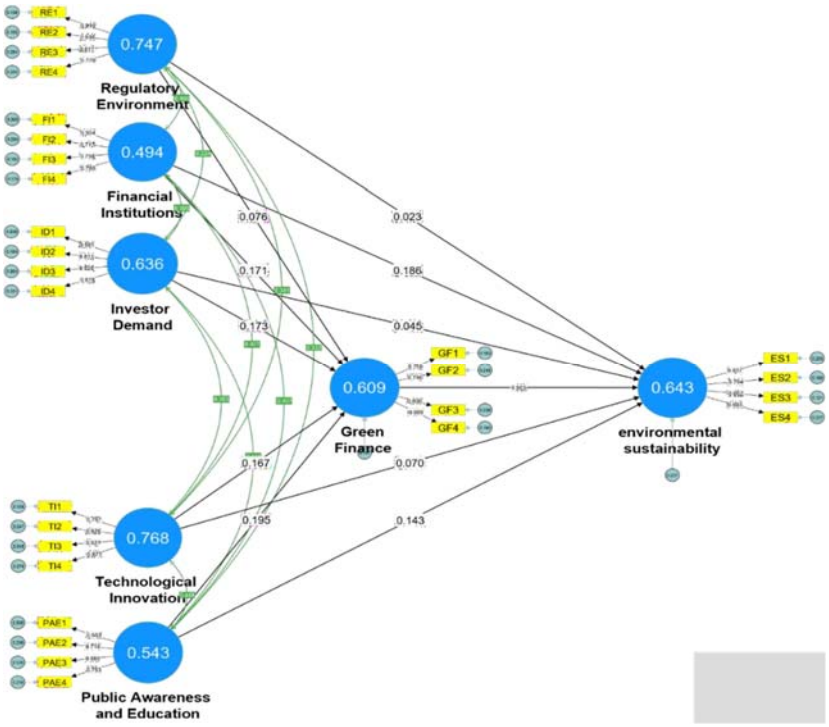
Figure 1: Structural Equation Model with Path Co-efficient and P-Values for Direct and In-Direct Effect



The path co-efficient of 0.133 recommends that for every one unit increase in the influence of financial institutions, there is an equivalent 0.133 units increase in green finance initiatives.

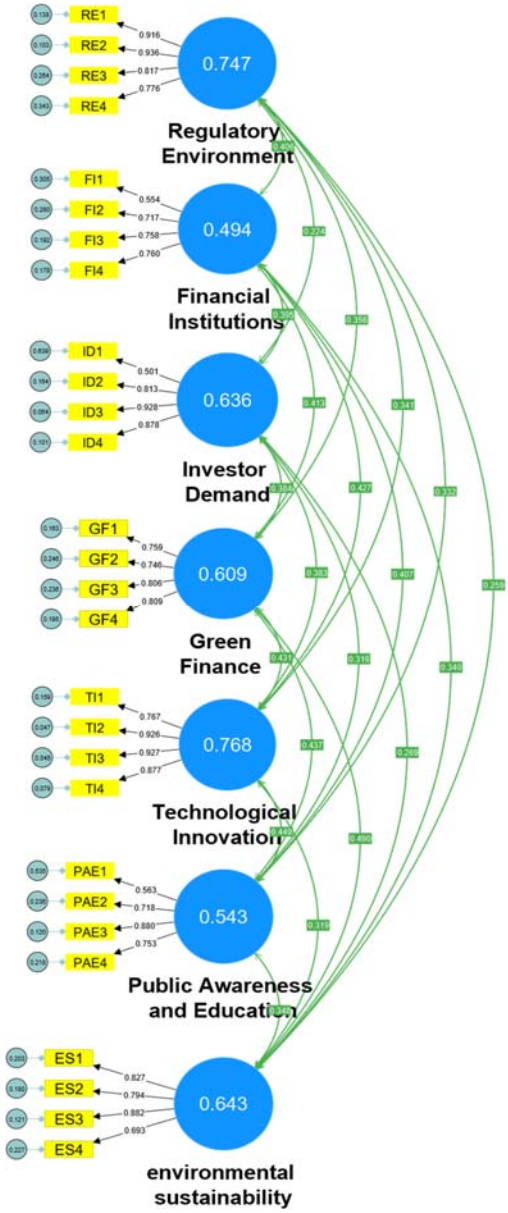
Further there is a positive correlation between financial institutions and green finance and between them there is a significant (p = 0.008) indicating there is a strong relationship among the variables. A path coefficient of 0.103recommends that for every one unit increase in the influence of financial institutions, there is an equivalent 0.103 units increase in environmental sustainability. However, the relationship is not statistically significant (p = 0.131) observed that there is a strong relationship between the variables. Path coefficient of 0.356 specifies that for each unit increase in green finance, there is an equivalent 0.356 units increase in environmental sustainability. This highpoint a strong positive relationship between green finance initiatives and environmental sustainability. The path coefficient of 0.170, for each unit increase in investor demand, there is a corresponding 0.170 unit's increase in green finance initiatives. The association is highly statistically important (p = 0.000), suggesting a genuine association. Path coefficient of 0.031, the relationship between investor demand and environmental sustainability is not much strong. The relationship is not statistically significant (p = 0.559). Path coefficient of 0.207 indicates that for each unit increase in public awareness and education, there is a corresponding 0.207 unit's increase in green finance initiatives. This highlights a strong positive relationship. Path coefficient of 0.108 specifies a positive relationship between public awareness and education and environmental sustainability. However, the relationship is not statistically significant (p = 0.136), suggesting it could likely occur due to random chance. The path coefficient of 0.138 suggests a reasonable positive relationship between the regulatory environment and green finance initiatives. Positive path coefficient of 0.030, the relationship between the regulatory environment and environmental sustainability is not that much of strong. The RMSEA value is 0.074 which is less than the standard significant value at 0.08. The GFI value is 0.885 and the AGFI value is 0.858 indicating reasonably well fit. The PGFI value which is less than 1 shows a reasonable fit. Standardized Root Mean Square Residual (SRMR): SRMR measures the average standardized difference between the observed and model- implied correlations. Values less than 0.08 indicate a good fit. Here, SRMR is 0.051, suggesting a good fit. The NFI value is 0.899 which is less than 1. The TLI value is 0.919 suggest a moderate fit. The CFI value is 0.930 which indicates that the model proved a good fit index. Therefore, it is witnessed from the analysis that all the values have shown satisfied criterions.

Figure 2: Structural Equation Model with Path Co-efficient, Factor Loadings and Average Extraction Values (AVE)



The structural equation model (SEM) fit explains an overall satisfactory fit. The ChiSqr/df ratio of 3.052 falls within a satisfactory series, representing a rational fit (Bentler, 1990). The RMSEA of 0.062, with a 90% confidence interval between 0.057 and 0.066, suggests a satisfactory fit, with values closer to 0 indicating better fit (Browne & Cudeck, 1993; Steiger, 1990). Additionally, the GFI and AGFI values of 0.885 and 0.858, respectively, indicate a moderate fit (Hair et al., 2013). The PGFI at 0.717 for model complexity (Marsh et al., 1996). The Standardized Root Mean Square Residual (SRMR) of 0.051 recommends a rational fit (Hu & Bentler, 1999). The NFI, TLI, and CFI values of 0.899, 0.919, and 0.930, respectively, indicate good fit (Bentler, 1990). Therefore, it is witnessed from the analysis that all the values have satisfied the criterion values under the acceptable phenomenon.

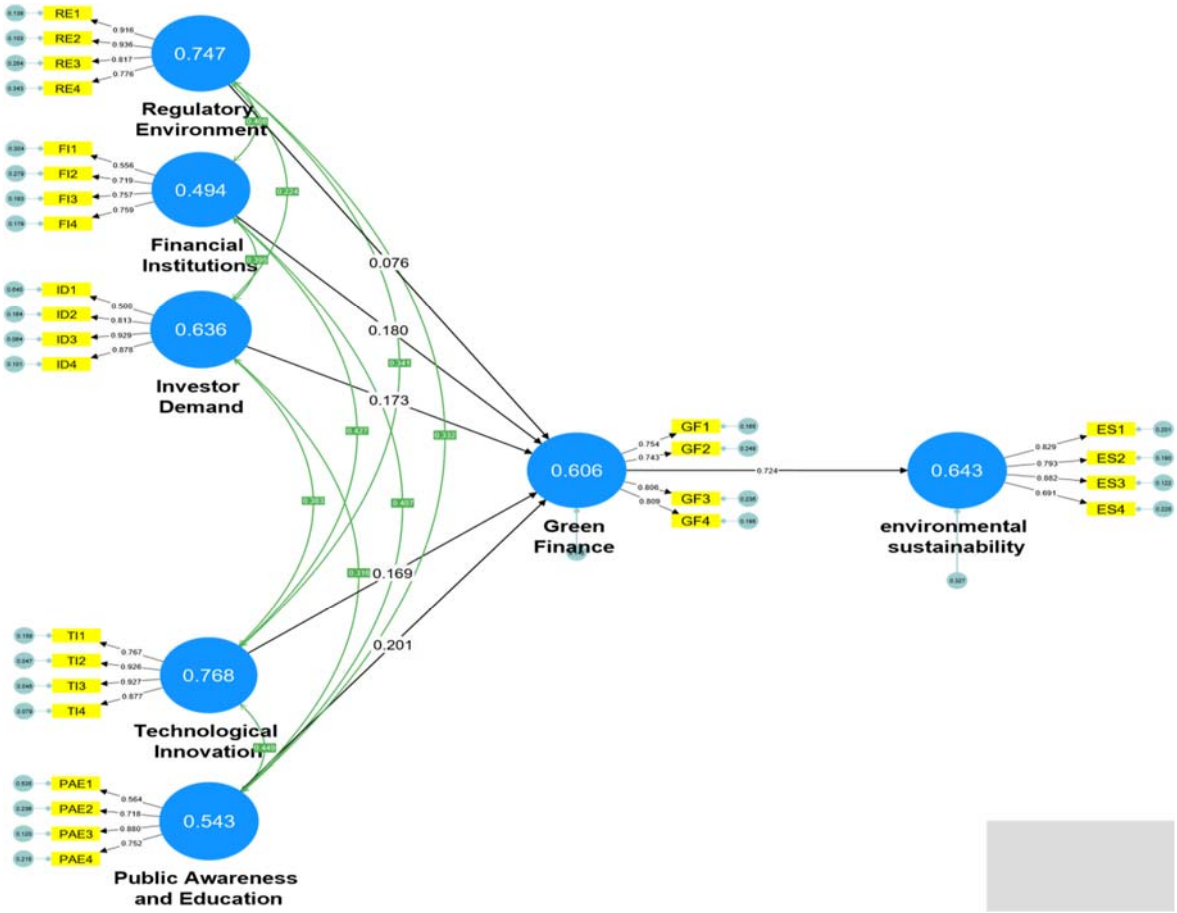
Figure3: Confirmatory Factor Analysis of Green Finance Factor Loadings with Average Variance Extraction



The Factor loadings of environmental sustainability is as ES1 (0.827), ES2 (0.794), ES3 (0.882), and ES4 (0.693) display optimistic loads, with ES3 show the highest association, indicating good relationship among the factors. Financial impact indicators, FI1 through FI4, also reveal positive loadings ranging from 0.554 to 0.760, explaining a positive relationship with the latent factor financial impact, with FI4 having the highest loading. Green initiatives and strategies, as characterized by GF1 (0.759), GF2 (0.746), GF3 (0.806), and GF4 (0.809), exhibit positive relations, with GF4 display the strongest relationship. Similarly, innovation and development indicators, ID1 through ID4, display positive loadings fluctuating from 0.501 to 0.928, with ID3 exhibiting the maximum relation. Public awareness and engagement pointers, PAE1 through PAE4, also reveal positive loadings, with PAE3 having the maximum

loading of 0.880. Responsibility and ethics indicators, RE1 through RE4, show positive relations ranging from 0.776 to 0.936, with RE2 showing the strongest relationship. Lastly, technological innovation pointers, TI1 through TI4, exhibit positive loadings ranging from 0.767 to 0.927, with TI3 showing the maximum association. Therefore, it is witnessed from the research that, all the factor loadings have shown that there is a significant positive loading of all the factors.

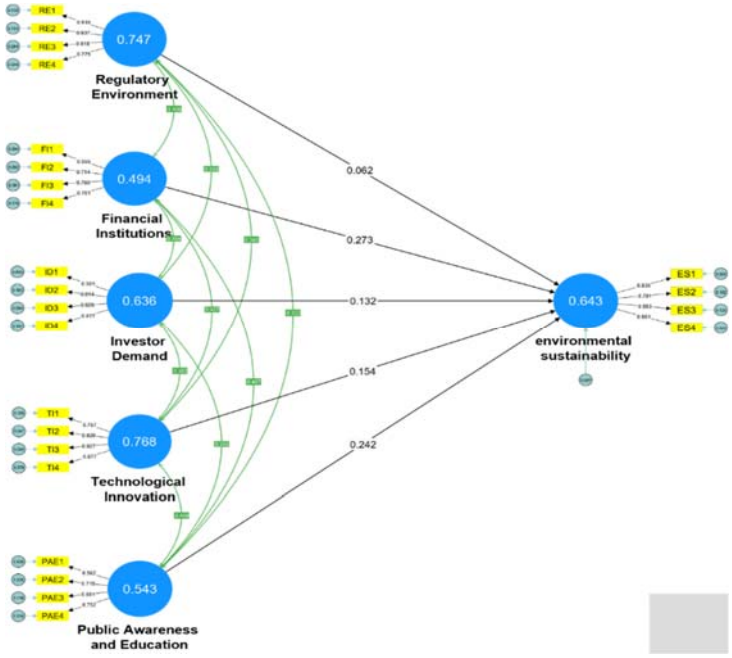
Figure 4: Structural Equation Model with Path Co-efficient and Average Extraction Values (AVE) of In-Direct Effect (Full- Mediation)



The fit indices for the projected model propose an overall acceptable fit to the data.
The chi-square test produces a significant outcome (χ^2 = 1024.126, df = 334, p = 0.000). The ChiSqr/df ratio of 3.066 falls within a satisfactory range, suggesting a rational fit despite the important chi-square. The RMSEA of 0.062, with a 90% confidence interval between 0.058 and 0.066, specifies a satisfactory fit. The GFI and AGFI values of 0.883 and 0.858, respectively, propose a reasonable fit. The SRMR of 0.059 suggests a reasonable fit, with values below 0.08 generally considered acceptable. Additionally, the NFI, TLI, and CFI

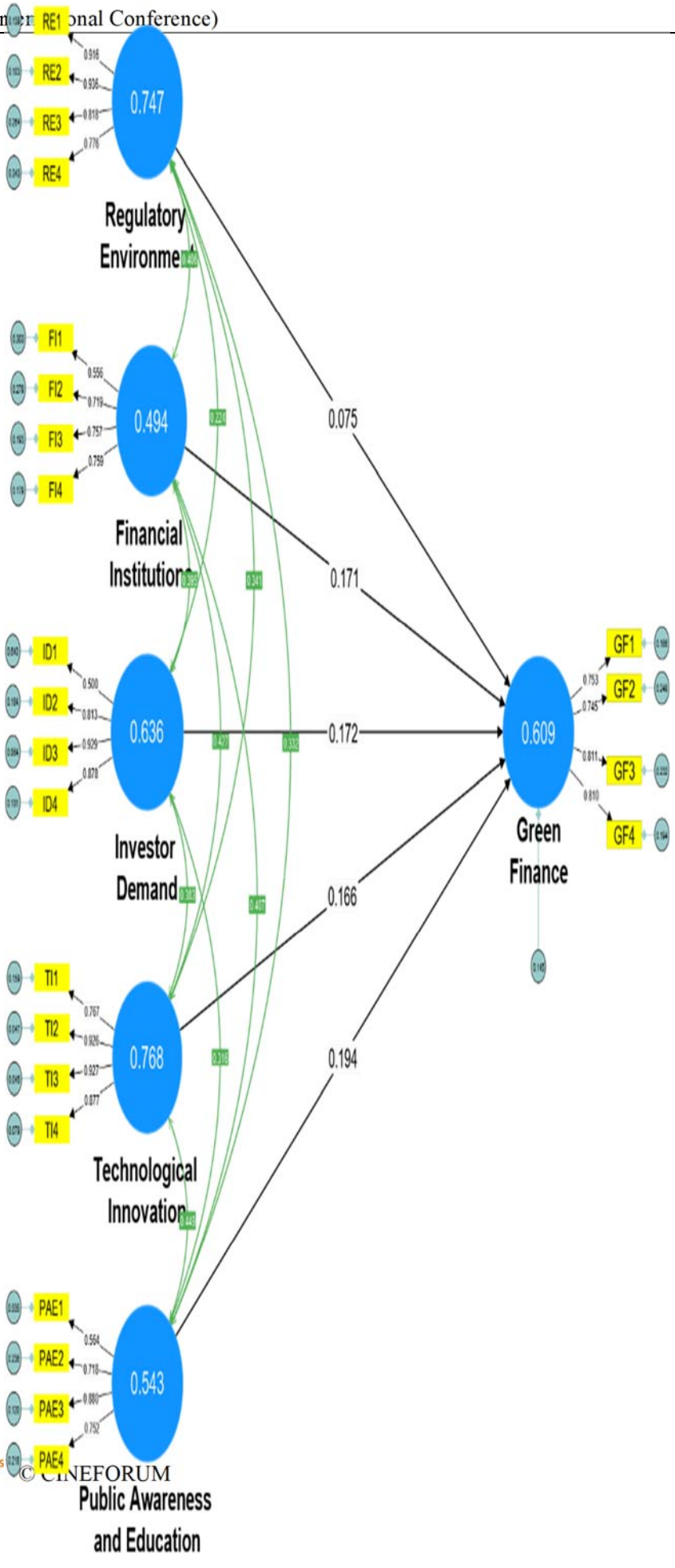
values of 0.897, 0.919, and 0.928, respectively, indicate good fit. Therefore, it is evident from the above values that all the values in the model showing good fit.

Figure 5: Structural Equation Model with Path Co-efficient and Average Extraction Values (AVE) of Direct Effect (Partial- Mediation)



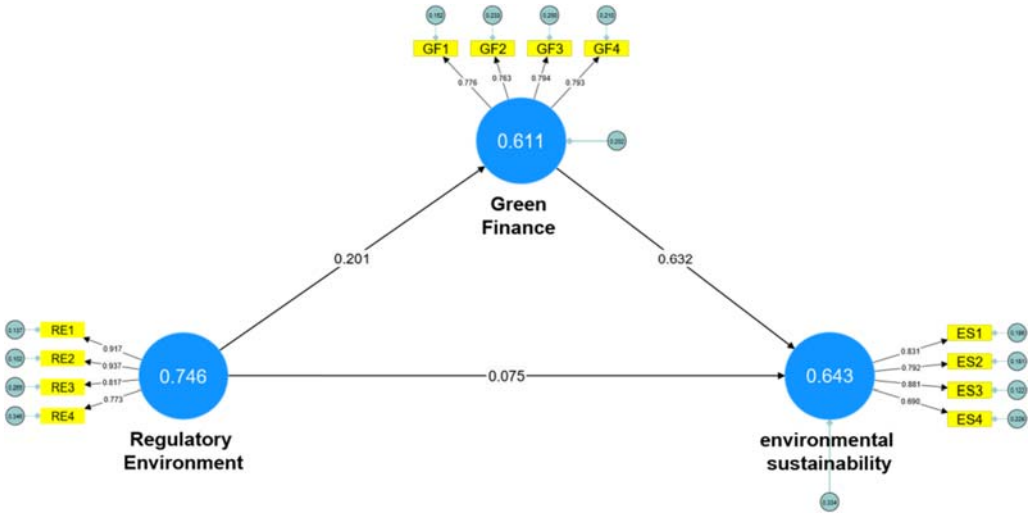
The fit indices for the assessed model propose an overall satisfactory fit to the data. The chi-square test yields a significant result (χ^2 = 806.731, df = 237, p = 0.000). The Chi-Sqr/df ratio of 3.404 falls within a acceptable range, suggesting a sensible fit. The RMSEA of 0.067, with a 90% confidence interval between 0.062 and 0.072, indicates an acceptable fit. The GFI and AGFI values of 0.892 and 0.863, respectively, suggest a moderate fit, indicating that the model explains a reasonable variance. The PGFI at 0.705 penalizes for model complexity. The SRMR of 0.051 suggests a reasonable fit, with values below 0.08 generally considered acceptable. Additionally, the NFI, TLI, and CFI values of 0.906, 0.920, and 0.931, respectively, indicate good fit, with values closer to 1 suggesting better fit. Therefore, it is evident from the analysis that all the values in the model have shown a good fit of the model.

Figure 6: Structural Equation Model with Path Co-efficient and Average Extraction Values (AVE) and Mediator as a dependent Factor



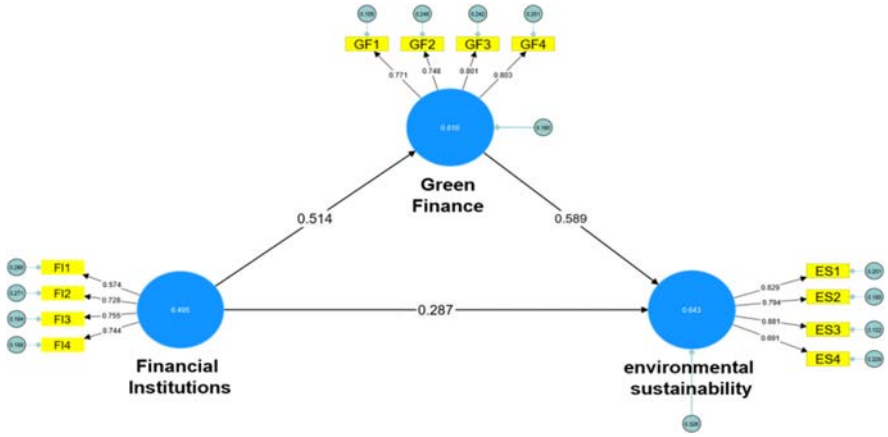
The Chi-Square value of 2.588 falls within a satisfactory range, representing a sensible fit. The RMSEA of 0.054, with a 90% confidence interval between 0.049 and 0.060, suggests a good fit, The GFI, AGFI values of 0.914 and 0.891, respectively, suggest a reasonable to good fit. The PGFI is 0.722 The SRMR of 0.050 suggests a reasonable fit, with values below 0.08 generally considered acceptable. Additionally, NFI, TLI, and CFI values of 0.926, 0.946, and 0.953, respectively, designate good fit, with values closer to 1 suggesting better fit. Furthermore, the AIC and BIC values of 739.291 and 1009.660, respectively, suggest. Therefore, it is witnessed form the all the values that, all the values have shown good fit.

Figure 7: Green Finance as a Mediator and linkage between Regulatory Environment and Environmental Sustainability



The Chi-Square value of 4.242 falls within an acceptable range, indicating a reasonable fit (Bentler, 1990). The Root Mean Square Error of Approximation (RMSEA) of 0.077 suggests a fair fit (Browne & Cudeck, 1993; Steiger, 1990). The GFI and AGFI values of 0.940 and 0.908, respectively, suggest a good fit (Hair et al., 2013). The PGFI at 0.614 explains model complexity (Marsh et al., 1996). The SRMR of 0.044 suggests a reasonable fit (Hu & Bentler, 1999). Additionally, NFI, TLI, and CFI values of 0.948, 0.948, and 0.960, respectively, indicate good fit, with values closer to 1 signifying improved fit (Bentler, 1990).

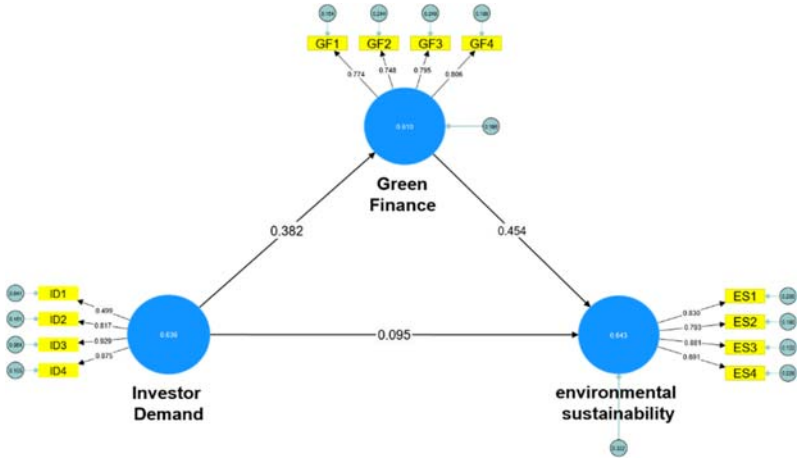
Figure 8: Green Finance as a Mediator and linkage between Financial Institutions and Environmental Sustainability



The chi-square value of 4.460 falls within an acceptable range, indicating a reasonable fit. The RMSEA value of 0.080 suggests a reasonable fit (Browne & Cudeck, 1993; Steiger, 1990). The Goodness-of-Fit Index (GFI) and Adjusted Goodness-of-Fit Index (AGFI) values of

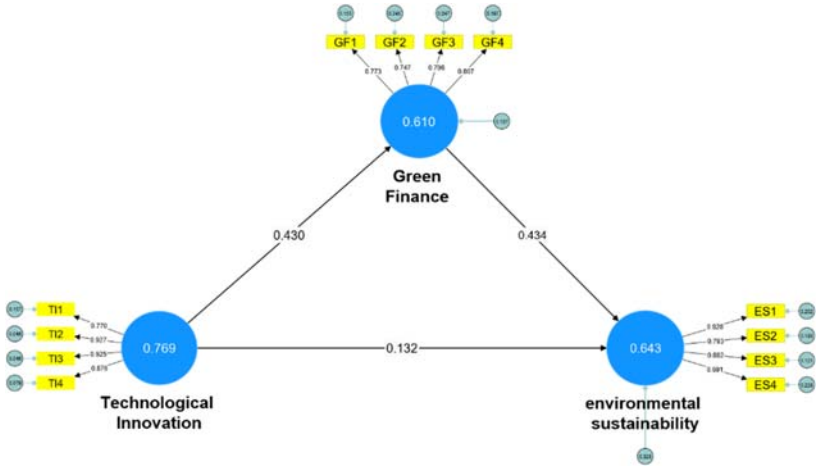
0.935 and 0.900, respectively, suggest a good fit (Hair et al., 2013). The PGFI value of 0.611explains model complexity (Marsh et al., 1996). The SRMR value of 0.053 suggests a reasonable fit, with values below 0.08 generally considered acceptable (Hu & Bentler, 1999). Additionally, the NFI, TLI, and CFI values of 0.927, 0.926, and 0.942, respectively, indicate good fit, (Bentler, 1990)

Figure 9: Green Finance as a Mediator and linkage between Investor Demand and Environmental Sustainability



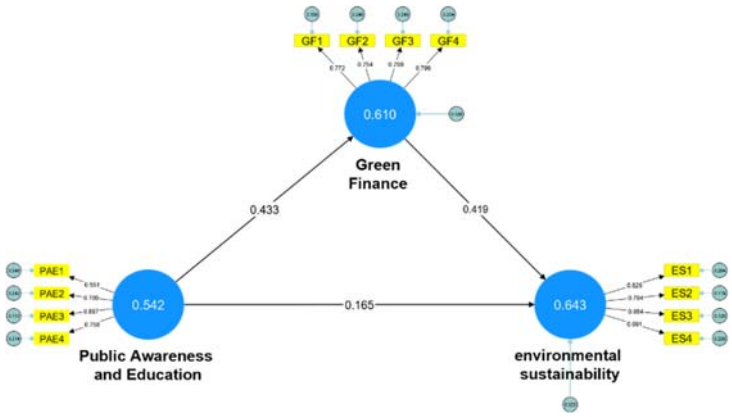
From the above model witnessed that the chi-square test yields a significant result (χ^2 = 209.093, df = unspecified, p = 0.000), indicating potential disparities between the model and observed data (Bollen & Long, 1993). The Chi-Square value of 4.100 falls within an acceptable range, indicating a reasonable fit (Bentler, 1990). The Root Mean Square Error of Approximation (RMSEA) of 0.076 suggests a fair fit, although it slightly exceeds the conventional threshold of 0.05, with values closer to 0 indicating better fit (Browne & Cudeck, 1993; Steiger, 1990). The Goodness-of-Fit Index (GFI) and Adjusted Goodness-of-Fit Index (AGFI) values of 0.939 and 0.907, respectively, suggest a good fit (Hair et al., 2013). The PGFI at 0.614 (Marsh et al., 1996). The SRMR of 0.046 proposes a sensible fit (Hu & Bentler, 1999). Additionally, the Normed Fit Index (NFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI) values of 0.944, 0.944, and 0.957, respectively, indicate good fit (Bentler, 1990).

Figure 10: Green Finance as a Mediator and linkage between Technological Innovation and Environmental Sustainability



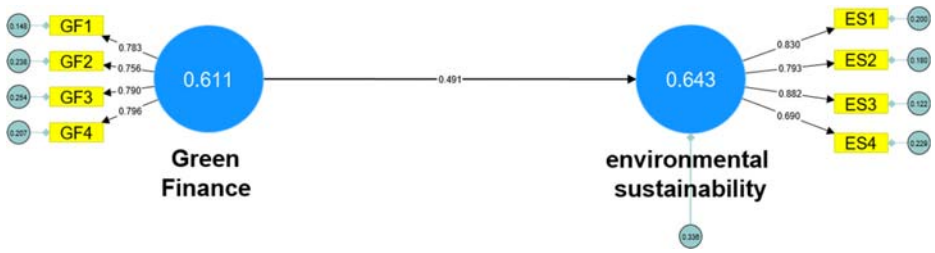
The ChiSqr/df ratio of 3.613 falls within an acceptable range, indicating a reasonable fit despite the significant chi-square (Bentler, 1990). The Root Mean Square Error of Approximation (RMSEA) of 0.070 suggests a fair fit (Browne & Cudeck, 1993; Steiger, 1990). The Goodness-of-Fit Index (GFI) and Adjusted Goodness-of-Fit Index (AGFI) values of 0.945 and 0.916, respectively, suggest a good fit, indicating that the model explains a substantial amount of variance in the observed data (Hair et al., 2013). The PGFI at 0.618 (Marsh et al., 1996). The SRMR of 0.038 suggests a reasonable fit (Hu & Bentler, 1999). Additionally, the NFI, TLI, and CFI values of 0.957, 0.959, and 0.969, respectively, indicate good fit, with values closer to 1 suggesting better fit (Bentler, 1990).

Figure 11: Green Finance as a Mediator and linkage between Public Awareness and Environmental Sustainability



The fit indices for the estimated model indicate a somewhat acceptable fit to the data, albeit with certain limitations. The chi-square test yields a significant result (χ^2 = 287.969, df = unspecified, p = 0.000). The chi-square ratio of 5.646. The Root Mean Square Error of Approximation (RMSEA) of 0.093 suggests a fair. The GFI and AGFI values of 0.920 and 0.877, respectively, suggest a moderate fit. The PGFI at 0.601 SRMR of 0.047 suggests a reasonable fit. The NFI, TLI, and CFI values of 0.914, 0.907, and 0.928, respectively.

Figure 12: The Linkage between Green Finance and Environmental Sustainability



The fit indices for the projected model suggest a good fit to the data. The chi-square test yields important result (χ^2 = 78.963, df = unspecified, p = 0.000), indicating the Chi Sqr/df ratio of 4.156 falls within an acceptable range. The RMSEA of 0.076 suggests a fair fit. The GFI) and AGFI values of 0.966 and 0.936, respectively, suggest a good fit. The PGFI at 0.510. The SRMR of 0.035 suggests a reasonable fit, with values below 0.08 generally considered satisfactory. Additionally, the NFI, TLI, and CFI values of 0.965, 0.961, and 0.973, respectively, indicate good fit.

Claims:-

1. The developed model which is unique and might not have developed earlier in the contemporary context.
2. The model will give better results to use the green financial services and for environmental sustainability.
3. The application of the model will give better results.

Summary of Findings

The research revealed that various independent factors, such as the regulatory environment, financial institutions, investor demand, technological innovation, and public awareness and education, exhibit an indirect relationship with the benefits of green finance. These factors collectively contribute to environmental sustainability. The study demonstrated that the relationship among these factors is indirect rather than direct, indicating a full mediation model. This model elucidates the interactions among independent, mediating, and dependent factors, confirming that green projects play a critical role in the observed outcomes. Additionally, other independent factors might also influence the overall analysis, suggesting a complex interplay in the effectiveness of green finance initiatives.

Ethical Considerations:

Ethical considerations were paramount throughout the research process to ensure the integrity and validity of the study:

- Informed Consent: Participants were fully informed about the nature and purpose of the study, and their voluntary participation was sought.
- Confidentiality: Measures were taken to protect the confidentiality of participants' responses and personal information.
- Avoidance of Harm: Steps were taken to minimize any potential harm or discomfort to participants during data collection and analysis.
- Transparency: The research methods, findings, and interpretations were communicated transparently, ensuring accountability to stakeholders.

Limitations:

Despite rigorous methodology and ethical considerations, several limitations were identified:

- Sampling Bias: The use of simple random sampling may not fully capture the diversity of perspectives within the population.
- Generalizability: Findings are context-specific to the Indian setting and may not be universally applicable.
- Data Collection Challenges: Dependence on self-reported data via questionnaires may introduce response bias.
- Time Constraints: The study's timeframe limited the depth and scope of data collection and analysis.

Conclusion:

In conclusion, this study underscored the significant impact of green finance initiatives on environmental sustainability in India. The findings revealed that regulatory environments, financial institutions, investor demands, technological innovations, and public awareness and education play crucial roles in facilitating green finance practices. Through structural equation modeling, it was demonstrated that these factors indirectly influence environmental sustainability, highlighting a full mediation effect.

The research contributes to understanding the intricate relationships between financial mechanisms and environmental outcomes, emphasizing the need for integrated policy frameworks and stakeholder collaborations to foster sustainable development. Recommendations include enhancing regulatory frameworks, promoting financial innovations, and intensifying public awareness campaigns to bolster green finance initiatives.

Overall, this study provides a foundational framework for future research and policy interventions aimed at advancing sustainable development goals through effective green finance strategies.

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