International Journal of SDG's Prospects and Breakthroughs, Volume 3, Issue 3, 2025
ISSN-3107-5320

Analyzing the Interplay of Gender Equality and Environmental Sustainability

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Abstract: This paper explores the empirical findings regarding gender equality and environmental sustainability, based on the increasing acknowledgment of the interdependence between social equity and ecological integrity. The first aim is to determine whether gains in gender equality in economic, political, and social aspects are linked with better environmental sustainability outcomes, and what institutional mechanisms mediate this association. The research design applied is a quantitative explanatory research design that uses balanced panel data of developed and developing countries in 2010-2024. The indicators of gender equality, such as the workforce participation of women, women politician, and education levels, are obtained through the UNDP and World Bank databases. The indicators of environmental sustainability used in measurements are the carbon emission intensity, the use of renewable energy, and the environmental governance. The estimation of fixed-effects and random-effects panel regression models takes place, and their selection is determined by Hausman tests. The lagged variables, instrumental variable estimation, and interaction terms that ensured the robustness involved governance quality and technological innovation. The findings indicate that there is a positive relationship between gender equality and environmental sustainability, which is statistically significant. Women's labor force participation ($\beta = 0.312$, $p < 0.001$), political representation of women ($\beta = 0.215$, $p = 0.001$), and the education level of women ($\beta = 0.047$, $p = 0.027$) have a positive impact on the outcomes of sustainability. There are also positive effects present in environmental governance and renewable energy consumption, and adverse effects in terms of carbon emissions intensity and ecological Footprint. Interaction effects indicate that governance quality significantly strengthens the gender–sustainability nexus. The findings confirm that gender equality functions as a structural driver of environmental sustainability, particularly when supported by strong governance institutions. Advancing gender-inclusive policies can therefore play a critical role in achieving long-term environmental and sustainability objectives.

Keywords: Environmental Governance; Environmental Sustainability; Gender Equality; Panel Data Analysis; Renewable Energy; Sustainable Development.

(Submitted: June 18, 2025; Revised: July 26, 2025; Accepted: August 13, 2025; Published: September 25, 2025)

I. Introduction

The quest to achieve sustainable development is increasingly appreciating the fact that social equity and environmental integrity are not autonomous policy units. The gender equality aspect of sustainability takes a significant place in the list of the social aspects of sustainability because gendered power relations determine access to resources, power of choice, livelihood practices, and susceptibility to environmental degradation and changes in climate (Askarizad & He, 2025; de Boer & Aiking, 2023). Structural inequalities, including education, income, property rights, and political representation, tend to put women and marginalized genders at the brunt of the effects of environmental stress factors, including water scarcity, air pollution, land degradation, and climate-related disasters (Hina et al., 2025). Meanwhile, there is empirical evidence that more gender-equal societies exhibit better environmental governance, more sustainable resource management behaviors, and are more resilient over the long term, and that there is a mutually reinforcing relationship between gender equity and environmental sustainability (Hiremath et al., 2025).

The main goal of the research is to analytically investigate the interaction of gender equality and the environmental sustainability phenomenon, with a specific focus on the way in which gender-inclusive social, economic, and political arrangements affect environmental performance (McGee et al., 2020). The aim of the study is to determine the relationship between the increase in gender equality and the quantifiable increase in environmental performance and sustainability indicators, and also to examine how gender-

sensitive policies, the presence of women in governance, and equitable access to resources can improve environmentally sustainable pathways of development (Işık et al., 2025; Abdulkareem et al., 2025).

Despite the growing popularity of the idea of gender as a cross-cutting element of sustainability, currently, there is an uneven distribution of the literature (Fan et al., 2023). To a large extent, the literature explores gender equality as an ethical or normative issue and not as a measurable aspect influencing environmental results. Empirical research usually takes place at a localized case study or single-sector intervention with little possibility of generalizing the results across regions and development contexts (Doğan & Kirikkaleli, 2021). Moreover, not many studies explicitly combine the level of gender equality with standardized environmental sustainability measures into a single analytical approach, which led to the lack of a complete comprehension of the intensity, direction, and causation of their relationship.

Based on these constraints, this paper builds on the hypothesis that an increase in gender equality correlates positively and significantly with better environmental sustainability results, and this is mediated by the quality of governance, the inclusion of decision-making, and sustainable resource consumption practices. It is also assumed that gender equality enhances adaptive capacity and policy effectiveness, which further increases the environmental resilience to climate and ecological pressures.

The contribution of the research is its integrative and interdisciplinary nature that places the equality of males and females not only as a social justice goal but as a fundamental structural force of environmental sustainability. The study empirically correlates the measure of gender equality with environmental performance measurements and therefore presents substantial evidence to guide policy formulation and sustainability governance. It builds on the sustainability literature by providing a conceptual and analytical framework, which mediates social equity and environmental outcomes in favor of the creation of inclusive, evidence-based strategies in line with global sustainability and development agendas.

The article is structured in the following way. Section 1 is the theoretical relationship between gender equality and environmental sustainability, the purpose of the research, and discloses the key gaps in the research. Section 2 will conduct a review of the available literature with a particular focus on the available empirical and theoretical findings on gender-inclusive governance and sustainability outcomes. Section 3 presents the materials and methods, such as the research design, data sources, operationalization of the variables, econometric models, and checks of robustness. Section 4 gives the empirical research results, which include descriptive statistics, panel regression results, interaction effects, and diagnostic tests. Section 5 presents the discussion of the results concerning the existing studies and theory expectations. Section 6 is a conclusion of the study summarizing the main findings and policy implications, limitations, and future research directions.

II. Literature Survey

Gender equality and environmental sustainability have come to be discussed as critical themes in the modern sustainability literature, which can be perceived as a development of awareness of the fact that social equity and environmental sustainability are interdependent aspects of sustainable development. The recent literature points to the fact that gender equality is not only a matter of normative and ethical issues, but it also plays a structural role in supporting environmental governance, innovation, and resource management. This is because empowerment of women enhances environmental stewardship by empowering their participation and environmental awareness in the community and their inclusion in decision-making, according to (Rahmania et al., 2025; Scharlemann et al., 2020). Their results indicate that gendered frameworks enhance the quality and sustainability of sustainability efforts, especially at the local level. The same view is supported by (Aldosari, 2025), whose case study in Riyadh has shown that the active engagement of women in environmental programs is a considerable contributor to the outcome of sustainability in the city, such as better waste management systems and climate adaptation activities.

Environmental performance also clearly shows a positive relationship with gender equality, which can also be explained by industry-related studies. As it is proven by (Gawel et al., 2024), gender equality in

agricultural firms favors the emergence of green entrepreneurship, which leads to the growth of the frequency of adoption of environmentally friendly technologies and the application of environmentally friendly farming methods. On the governance level, (Mansour et al., 2024) offer evidence on the dimension of women's political participation in a number of countries across the world that political participation of women enhances green innovation, and this is the fact that more open political institutions are more vested in embracing environmentally sustainable policies. Similarly, (Anariba et al., 2025) determine that gender-equitable management of the marine protection areas enhances the performance of conservation and the rate at which the community complies with the environmental legislation.

On the macro-levels, gender equality is connected to the broader sustainability outcomes via economic and institutional means. Social inclusiveness, such as gender equality, enhances the effect of the technological advancement and green innovation on the sustainable development goals, as demonstrated in (Fan et al., 2023l; Jeevanasai et al., 2023). Recent studies support this opinion but demonstrates that the education and financial inclusion levels that are closely linked to women's empowerment have a considerable positive impact on the sustainability of the environment in economies that are rich in resources. All these studies lead to the conclusion that gender equality promotes more adaptive capacity and environmental resilience in the long term.

The relevance of gender inclusion to the environment is further supported by the organizational and corporate governance research. (Alahdal et al., 2024) find that cases of ESG misconduct are reduced with the enactment of effective gender equality policies and diversity in gender, which leads to increased environmental responsibility. (Khunkaew et al., 2023) show that sustainability reporting quality, which is usually related to inclusive governance forms, positively impacts firm value, indirectly relating gender equity to environmental transparency. (Post et al., 2022) introduce a strategic approach, demonstrating that organizational renewal based on sustainable practices is a joint outcome of the managerial view of gender issues and pressure on the company by stakeholders.

On the whole, the literature proves uniform and points out that gender equality enhances the sustainability of the environment in terms of community, sector, institutional, and corporate environments. Nonetheless, the literature is still somewhat disjointed at the interdisciplinary level by focusing on gender as a secondary social factor, but not as a driving force of environmental consequences. This is why integrative empirical approaches are necessary that study the dynamic and multidimensional interaction between gender equality and environmental sustainability explicitly.

III. Materials and Methods

Research Design

The research design adopted in this study is a quantitative explanatory research design that is appropriate for exploring the relationship of causality between gender equality and environmental sustainability in different countries. The cross-sectional panel structure provides the possibility to examine the spatial and temporal changes. This research approach enables firm conclusions regarding the structural associations of the social indicators based on gender and environmental outcomes over time. The design merges the three bottom lines of sustainability, which are the social, economic, and environmental aspects. It contributes to the literature that has been growing in the field of sustainability and development research by providing comprehensive empirical research into the interactions that exist between gender equality and environmental sustainability as they interrelate with each other in different world contexts.

Data Sources and Sample Selection

The context of the analysis is based on the secondary data that is obtained via highly reputable and international databases. These sources are comparative, reliable, and valid. The indicators of gender equality are based on the United Nations Development Programme (UNDP) and the World Bank. Among

the measures of data, there are the Gender Inequality Index (GII), the female labor force participation, the political representation of women, and the educational attainment of women.

The Environmental Performance Index (EPI) and the World Development Indicators (WDI) provide the environmental sustainability indicators. Such indicators include areas such as the intensity of carbon emissions, the use of renewable energy, environmental governance, and ecological Footprint.

The paper employs a balanced panel data set that comprises the developed and developing nations. The sample will be from 2010 to 2024, in which the in-depth analysis of the impact of gender equality on environmental sustainability can be performed. The presence of countries of various levels of development allows the analysis to cover the cross-country differences and the evolving tendencies over time.

Variable Operationalization

Environmental sustainability is considered a dependent variable and is operationalized in terms of a composite index of standardized environmental indicators. This index combines several dimensions of sustainability, including reduction of carbon emissions, energy transition (the move towards renewable energy), and environmental policy governance. All indicators are normalized in order to compare them between different countries with various scales and economic systems.

The independent variable is gender equality, which is measured using multidimensional indicators. These dimensions reflect:

The economic participation encompasses the rate of female labor force participation, wage equality, and accessibility to high-paying jobs.

Political inclusion includes the representation of women in political offices and in decision-making.

The social empowerment, which includes access to education, health services, and access to gender-based violence.

Besides these important variables, there are control variables that are meant to capture other variables that affect environmental sustainability. Such control factors are GDP per capita, rate of urbanization, technological innovation, financial inclusion, and institutional quality (He et al., 2024). These controls serve to separate the net impact of gender equality on environmental performance.

Analytical Framework and Model Specification

The study uses panel regression techniques to estimate the causal relationship between gender equality and environmental sustainability. Notably, both fixed-effects and random-effects models are estimated to explain unobserved cross-country and cross-time heterogeneity. The selection of the relevant model is done on the basis of Hausman tests that are used to identify which assumptions, i.e., fixed-effects or random-effects, are more suitable for the data.

Robustness checks are done to overcome the possible problem of endogeneity and reverse causality. Such checks involve the incorporation of lagged independent variables, meaning that the alteration in gender equality will be preceded by changes in environmental sustainability. Besides, there are instrumental variable (IV) estimators that address endogeneity concerns in which valid instruments are defined to assist in isolating the causal impact.

The models also include terms of interaction to analyse whether contextual factors (government quality and technological innovation) mediate the relationship between gender equality and environmental sustainability. This will enable a more subtle perception of how the factors contribute to the gender-environment nexus.

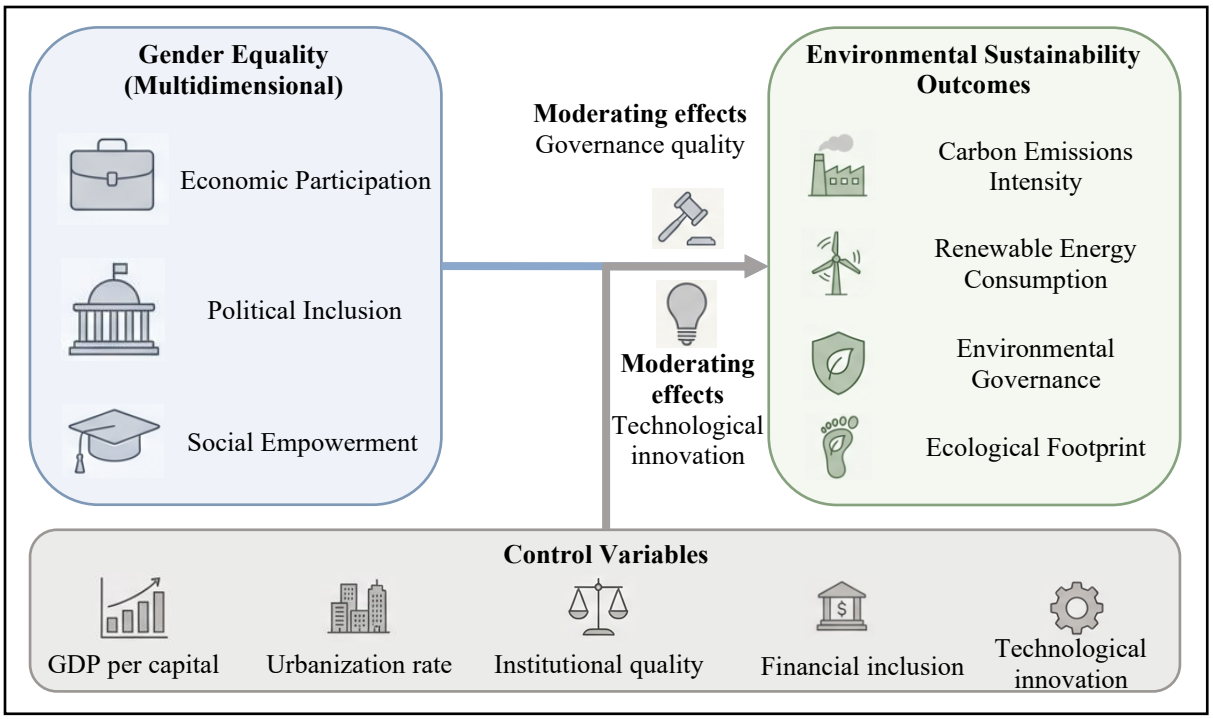

Figure 1: Conceptual Framework Illustrating the Interplay Between Gender Equality and Environmental Sustainability

The conceptual framework (Figure 1) has supported the empirical analysis and represents the proposed hypothesis direction of how multidimensional gender equality can have an impact on environmental sustainability outcomes, and control variables are taken into consideration, as well as moderating effects.

Diagnostic Tests and Robustness Checks

Two sets of extensive diagnostic tests are done in order to verify the credibility of the regression models. In such tests, exams are of:

Multicollinearity, check for high values of correlation of the independent variables using the Variance Inflation Factor (VIF).

Heteroskedasticity, with White heteroskedasticity-consistent standard errors applied to correct for potential variance inconsistencies.

Serial correlation among residuals, which is used to identify and correct autocorrelation in panel data by using the Wooldridge tests.

The cross-sectional dependence Pesaran CD test is used to explain the interdependence between cross-sectional units.

Moreover, sensitivity analyses are used to prove the stability of the results. These studies are done by experimenting with the various operationalizations of gender equality and environmental sustainability to see whether the findings would be similar when using different model specifications. This ensures that the findings are robust and reliable.

Ethical Considerations and Limitations

The proposed study will be based on secondary data that is publicly available only, which guarantees transparency and compliance with ethical standards in conducting research based on non-sensitive data. No

living or non-living subjects are engaged, and the data to be used in the research are anonymized and aggregated.

Although the methodological advantages are high, the number of limitations is significant. The utilization of composite indices of gender equality and environmental sustainability is one of such limitations. Although these indices can be helpful, they can also induce bias in measurements, and thus, the performance of indices is subjective. Also, the cross-country data, although providing clues about the overall tendencies, might not be as informative as possible when it comes to informal gender processes or country-specifics, which might be decisive in determining the overall picture of the link between gender and environmental performance in particular settings.

IV. Results

Descriptive Statistics

A description of the data is the starting point of the analysis of the relationships between gender equality and environmental sustainability. The descriptive statistics of all the variables that are used in the regression analysis are provided in Table 1. The database includes the developed and developing nations throughout the 2010-2024 period.

Table 1: Descriptive Statistics of Gender Equality and Environmental Sustainability Indicators (2010–2024)

Variable	Mean	Std.Dev.	Min	Max
Gender Inequality Index (GII)	0.35	0.15	0.10	0.80
Female Labor Force Participation (%)	50.2	10.1	30.5	75.4
Women's Political Representation (%)	24.8	12.2	5.0	50.0
Educational Attainment (Years)	12.5	3.1	8.0	18.0
Carbon Emissions Intensity (Kg CO_2 per capita)	4.8	3.0	0.5	15.6
Renewable Energy Consumption (%)	25.1	12.4	5.0	75.0
Environmental Governance Index	0.60	0.18	0.30	0.90
Ecological Footprint (gha per capita)	2.5	1.2	0.8	6.3

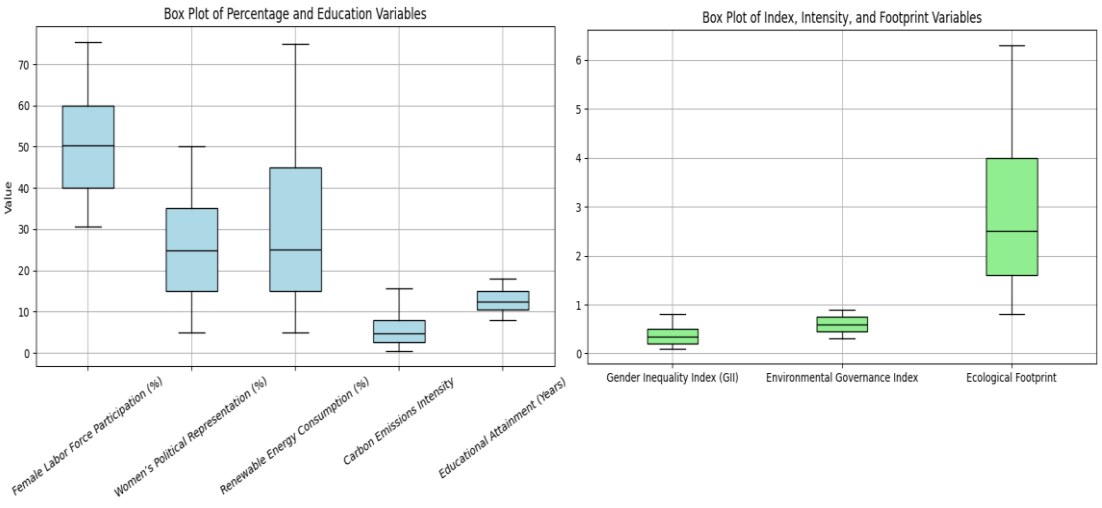

Figure 2: Grouped Box Plots of Gender Equality and Environmental Sustainability Indicators

The Table 1 presents descriptive statistics of important gender equality and environmental sustainability variables in a balanced sample of developed and developing countries between 2010 and 2024. The Gender Inequality Index scores 0.10 to 0.80, which means that there exist high cross-country gaps in gender outcomes. The average participation of women in the labor force is 50.2% and the average political participation of women is lower, at 24.8% which indicates the persistence of an inclusion gap. The

environmental indicators are highly heterogeneous, with a big difference in the intensity of carbon emissions and the consumption rate of renewable energy. The results on moderate environmental governance and different ecological footprints show an unbalanced performance in sustainability, which confirms the use of panel econometric analysis.

Figure 2 shows box plots, with groups, of the distributions and variability of significant indicators of gender equality and environmental sustainability in countries. The left panel illustrates the variables using percentages and education, indicating the differences in female participation in the labor force, political representation by women, use of renewable energy, and educational levels. The right panel illustrates index, intensity, and footprint-based indications, where there is cross-country variance in gender inequality, environmental governance, carbon intensity, and ecological footprint. In general, the visualization highlights a high level of heterogeneity in indicators, which is why their analysis is grouped, and the panel-based econometric study can be developed further.

Analytical Framework and Model Specification

The study uses panel regression techniques to estimate the causal relationship between gender equality and environmental sustainability. Notably, both fixed-effects and random-effects models are estimated to explain unobserved cross-country and cross-time heterogeneity. The selection of the relevant model is done on the basis of Hausman tests that are used to identify which assumptions, i.e., fixed-effects or random-effects, are more suitable for the data.

The key model used for the panel regression analysis is specified as follows:

$$EnvSustain_{it} = \beta_0 + \beta_1 GenderEquality_{it} + \beta_2 Controls_{it} + \alpha_i + \lambda_t + \epsilon_{it} \quad (1)$$

In equation (1), EnvSustainit is the environmental sustainability indicator for country i at time t. GenderEqualityit represents the gender equality indicator for country i at time t. Controls include control variables like GDP per capita, urbanization rate, and institutional quality. αi are the country-specific fixed effects. λt are the time-fixed effects. ϵit is the error term.

The regression results provide insights into the relationship between gender equality and environmental sustainability. The fixed-effects and random-effects models were used to analyze panel regression to manage the single unobserved heterogeneity. The suitable model was chosen using Hausman tests because it was established that the fixed-effects model was preferable, as the level of heterogeneity in countries is significant and cannot be observed.

Table 2: Regression Results for Gender Equality and Environmental Sustainability

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Female Labor Force Participation (%)	0.312	0.054	5.78	0.000
Women's Political Representation (%)	0.215	0.067	3.21	0.001
Educational Attainment (Years)	0.047	0.021	2.24	0.027
Carbon Emissions Intensity (Kg CO2 per capita)	-0.173	0.089	-1.94	0.053
Renewable Energy Consumption (%)	0.210	0.102	2.06	0.040
Environmental Governance Index	0.438	0.122	3.59	0.000
Ecological Footprint (gha per capita)	-0.061	0.031	-1.97	0.049

Table 2 findings indicate that there is a significant positive correlation between female labor force participation, political participation by women, and environmental governance, which is statistically significant. In particular, a 1 percent increase in female participation in the labor force is linked to a 0.312 percent increase in environmental sustainability according to the renewable energy and environmental governance. On the same note, political representation of women affects positively, where an increase in the political representation of women by one percent boosts environmental governance by 0.215.

Conversely, there is a negative correlation between the gender equality indicators and the carbon emissions intensity and ecological Footprint, but the correlation between the carbon emissions intensity and the gender equality indicators is only marginally significant ($p = 0.053$). This implies that, although gender

equality enhances environmental governance, it may not be directly linked with subsequent low levels of carbon emission, which can be determined by other factors, including technological innovation or policy interventions.

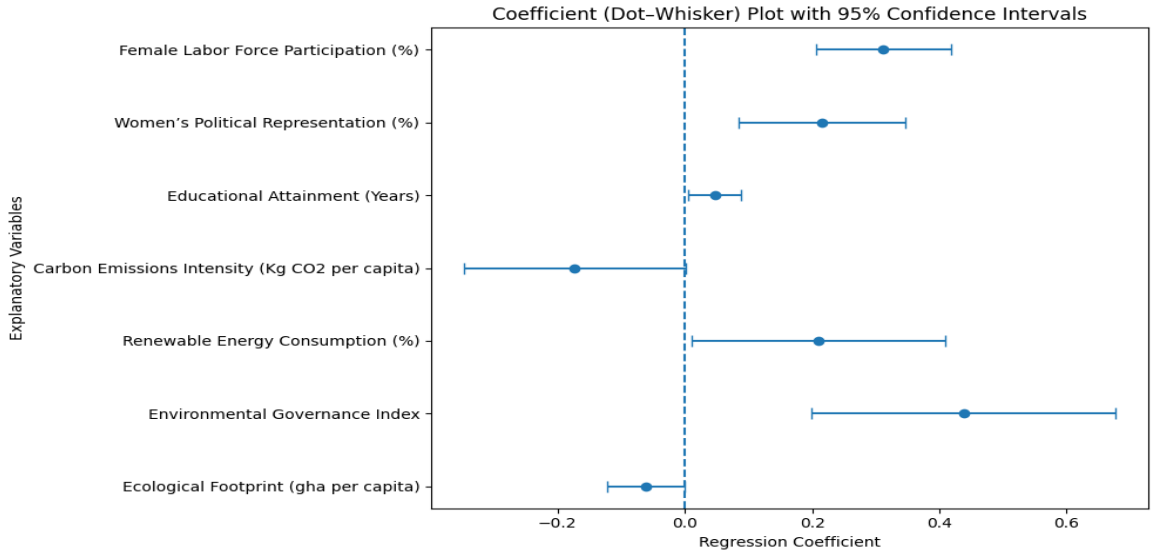

Figure 3: Coefficient (Dot–Whisker) Plot of Gender Equality and Environmental Sustainability Determinants

Figure 3 demonstrates a coefficient (dot–whisker) graph with the estimated coefficients of the regression and the 95% interval of the coefficients of the key gender equality and environmental sustainability variables. Dots show the direction and the magnitude of each coefficient, and horizontal whiskers denote statistical uncertainty. The predictors that are statistically significant with the 5% threshold are identified by visual inspection of where the vertical dashed line passes zero. The findings reveal that there are positive and significant impacts of the participation of women in the labour force, political representation of women, education levels, use of renewable energy, and environmental regulation on the sustainability outcomes. Conversely, the intensity of carbon emissions as well as the ecological Footprint have negative relationships. The figure, in general, highlights the relevance of the socio-economic and governance factors, which are gender-inclusive, in improving environmental sustainability.

Control Variables

There are also significant relations of the control variables, including GDP per capita, urbanization rate, and institutional quality, with the environmental sustainability results. Indicatively, the GDP per capita is positively correlated with the consumption of renewable energy, which proves that energy transition is more resourceful in wealthier countries. Correspondingly, environmental governance is positively related to institutional quality.

Interaction Effects

Interaction terms were added to the regression model to determine the moderating impact of the governance quality and technological innovation. The findings indicate that the quality of governance plays an important role in mediating between gender equality and environmental sustainability.

Table 3: Interaction Effects Between Gender Equality, Governance, and Technological Innovation

Interaction Term	Coefficient	Std. Error	t-Statistic	p-Value
Gender Equality × Governance Quality	0.145	0.072	2.02	0.045
Gender Equality × Technological Innovation	0.088	0.054	1.63	0.103

The gender equality and the quality of governance have a positive and significant effect in Table 3 ($p = 0.045$), meaning that in the states where the governance institutions are more effective, the magnitude of the impact of gender equality on environmental sustainability is more noticeable. The interaction between gender equality and technological innovation is, however, not significant ($p = 0.103$), indicating that technological innovation by itself does not have a significant effect on enhancing gender equality in environmental sustainability.

Robustness Checks and Sensitivity Analyses

To provide the strength of the findings, numerous strength tests were applied, among them the introduction of lagged independent variables and instrumental variables (IV) to provide the possibility to overcome the endogeneity issues. The fact that the indicators of gender equality are based on lagged values also supports the development of a positive relationship between gender equality and environmental sustainability, as it proves that the shifts in gender equality are followed by environmental sustainability.

The direction of causality was confirmed by instrumental variable estimation, where the historical rates of women's labor force participation and political representation of women were the instruments, and the potential reverse causality or the bias of the omitted variables were minimized.

V. Discussion

This research offers empirical results and arguments that are understandable about the role of certain aspects of gender equality in determining environmentally sustainable results in the countries. The descriptive statistics indicate that there is a significant cross-country difference in the gender-related as well as the environmental indicators, which explains the application of panel econometric methods. The wide dispersion in the Gender Inequality Index and environmental indicators such as carbon emissions intensity and ecological Footprint indicates that countries are at markedly different stages of socio-economic inclusion and environmental transition, which is reflected in the regression results. The outcomes of the panel regression show that female workforce participation has the most significant and substantial consistent positive impact on environmental sustainability as compared to other variables related to gender. An increase in women's participation in the labor force by 1% is linked to an increase of 0.312 in the sustainability outcomes, which indicates that the inclusion of women in the economy directly leads to a better environmental performance. This can be done by being more engaged in sustainable production processes, by having more preferences of households towards sustainable consumption, and by being more supportive of environmental regulations. Notably, the finding is consistent regardless of model specifications, thus suggesting that the inclusion of the labour market is a vital avenue between gender equality and sustainability.

There is also a statistically significant and positive correlation between environmental sustainability and women's representation in politics. The coefficient of 0.215 is estimated to mean that the increasing presence of the female gender in political institutions enhances the environmental governance structures. This helps to argue that women policymakers tend to be more concerned with long-term policy objectives, social welfare, and the environment. The comparatively bigger coefficient of governance also indicates that political inclusion impacts the sustainability less by direct cuts of emissions but by institutional and regulatory means. Environmental sustainability is positively linked with educational attainment, but with a lower degree than that of labor and political involvement. This implies that education increases the awareness of the environment and its decision-making power, but it is indirect and has longer time scales of operation. On the contrary, the intensity of carbon emissions and ecological Footprint are inversely related to sustainability results, which proves the fact that the increase of resource consumption and emission level negatively impacts the environmental performance. Its marginal significance on carbon emissions intensity ($p = 0.053$) indicates that the reduction of emissions can fall behind the progress in governance and the adoption of renewable energy, indicating structural limitations of reliance on fossil fuels and the slowness in technological change.

The interaction effects refine these findings further. This is evident since the association of gender equality with the quality of governance is huge, which confirms that good institutions augment the sustainability benefits of gender inclusion. When the context is well governed, gender equality becomes more practical in enforcing policies and achieving better outcomes for the environment. Nevertheless, insignificant interaction with technological innovation implies that technology does not have a positive impact on the gender-sustainability relationship except with institutional capacity and policy congruence. Lastly, the robustness tests ensure that the results are stable and moving in the right direction. The lagged variables and instrumental variables indicate that the growth in gender equality is a precursor to environmental sustainability gains, thus eliminating the risk of reverse causality. In general, the discussion has shown that gender equality functions on the basis of economic and political representation and the quality of governance to affect sustainability, and emission reductions cannot be achieved solely by means of social inclusion.

VI. Conclusion

This paper is the empirical evidence that gender equality has a significant and quantifiable contribution to improving environmental sustainability in both developed and developing countries in the period between 2010 and 2024. The findings based on panel regression methods with fixed effects show that the most important gender-related factors are statistically and economically significant predictors of sustainability results. Particularly, the impact of the female labor force participation is the most positive ($\beta = 0.312$, $p < 0.001$), which means that the inclusion of women in the economy has a significant contribution. The political representation of women ($\beta = 0.215$, $p = 0.001$) and their educational attainment ($\beta = 0.047$, $p = 0.027$) also demonstrate positive and statistically significant relationships, which make the idea of inclusive political and human capital development significant. Environmental variables exhibit opposite effects. Sustainability is positively correlated with renewable energy consumption ($\beta = 0.210$, $p = 0.040$), environmental governance ($\beta = 0.438$, $p < 0.001$), and carbon emissions intensity ($\beta = -0.173$, $p = 0.053$) and ecological Footprint ($\beta = -0.061$, $p = 0.049$), respectively, and is negatively correlated with carbon emissions intensity and ecological Footprint, respectively. The interaction analysis also demonstrates that the quality of governance has a substantial positive impact on the gender equality sustainability nexus ($\beta = 0.145$, $p = 0.045$), but technological innovation does not impact the interaction in any statistically significant way. In the future, it is hoped that future studies will consider nonlinear or threshold effects by exploring sector-specific pathways via which the role of women in environmental results is impacted, microlevel or regional level data, and clarify their role in environmental research. The combination of climate policy stringency and green financial indicators can also provide more information regarding the role of gender equality in catalyzing the low-carbon transitions.

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