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Empowering women for a sustainable future: Integrating gender equality and environmental stewardship

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ABSTRACT

This study examines the impact of gender equality and government policies on environmental sustainability in Indonesia. Based on a survey of 500 respondents and a quantitative cross-sectional analysis, the results show that access to education and employment, political participation, healthcare and reproductive rights, protection from violence and discrimination, and women's economic empowerment positively contribute to environmental sustainability. However, government policies do not significantly moderate this relationship, suggesting that policy effectiveness depends on local social and cultural factors. To enhance impact, policies should be better tailored to local contexts. The study recommends increasing women's roles in politics and the economy, strengthening healthcare services, and ensuring protection from gender-based violence and discrimination. These findings offer practical insights for policymakers and development practitioners on integrating gender equality into environmental sustainability strategies.

1. Introduction

Climate change and environmental degradation are pressing global challenges that require collective and innovative actions to address them (Atichasari et al., 2023; Doh et al., 2018; Kahpi et al., 2024). In Indonesia, environmental issues such as deforestation, land degradation, water pollution, and climate change have significant impacts on communities (Haryanto, 2018; Rahmania, 2024; Rahmania et al., 2024). Meanwhile, women empowerment has emerged as a key factor in achieving sustainable development goals (Dias, 2021; Ghosh et al., 2023; Sertyesilisik, 2023). The integration of gender equality and environmental stewardship not only creates opportunities for inclusive development but also strengthens conservation and ecosystem restoration efforts (Abhilash, 2021; Leach, 2016). However, there remains a gap in the literature regarding how gender policies can specifically contribute to environmental sustainability in Indonesia. This study aims to fill this gap by examining the relationship between gender equality and environmental management within the context of local policies and practices.

Indonesia has a long history of dealing with gender inequality

(Wijers, 2019). Despite progress in recent decades, women in Indonesia still face various challenges, including limited access to education, economic opportunities, and decision-making processes (Susilowati & Mafruhah, 2023; Widiastuti et al., 2024). This is exacerbated by a patriarchal culture that often places women in disadvantaged positions. In many rural communities in Indonesia, women often play a central role in managing natural resources and households, contributing significantly to local sustainability practices. However, these roles are often under-recognized and under-supported. Gender inequality can hinder women's contributions to sustainability efforts, whereas women empowerment can enhance the effectiveness and inclusiveness of environmental actions (Koralagama et al., 2017; Stephens et al., 2018). While the link between gender and sustainability has been widely explored in a global context, studies on the specific impact of women's empowerment on environmental sustainability in Indonesia remain limited. Therefore, this research seeks to highlight how empowering women can be a key element in fostering more effective environmental policies.

The Central Bureau of Statistics (BPS) reported that Indonesia's Gender Empowerment Index (GEI) scored 76.9 points in 2023, an increase of 0.31 points from 2022. Although the annual increases are

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sometimes small, the GEI has consistently risen over the past 14 years. The highest increase occurred in 2019, with a rise of 3.14 points, bringing the score to 75.24. The score in 2010 was 68.15 points, reflecting an overall increase of 8.75 points over the past 14 years. The GEI is an indicator used to measure the achievement of gender justice and equality based on political participation and decision-making. This is assessed by the proportion of men and women in parliament, economic participation, and decision-making, which are measured by two indicators: the proportion of men and women as legislators, senior officials, and managers, as well as the percentage of men in professional and technical positions and economic resources, measured by estimated male and female income (Katadata, 2024).

Furthermore, the role of women in forest management is crucial, as they not only focus on economic aspects but also consider social and sustainability factors. During the Conference of the Indonesian Women's Forest Guardians and Managers Forum (FP3HI), it was revealed that the majority of social forestry permit holders are men, highlighting gender inequality. Although women possess various strengths, such as a non-confrontational approach to conflict resolution and meticulous use of forest resources, they still face significant barriers. The main challenge for women in forest management is the patriarchal culture that dominates the forestry sector. Despite existing gender mainstreaming policies, their implementation is still lacking on the ground. Additionally, indigenous women often face a double burden and lack recognition within both state and customary patriarchal systems. However, despite these challenges, many women have successfully managed forests, gaining national and international recognition (Katadata, 2023).

Studies show that when women have better access to education, training, and resources, they can drive positive changes in environmental practices and build community capacity to tackle environmental challenges (Donkor & Mazumder, 2021; Franco & Tracey, 2019; Kwauk & Casey, 2022). For instance, women involved in natural resource management often demonstrate innovation and resilience in implementing environmentally friendly and sustainable techniques. However, despite the great potential of women empowerment in the context of sustainability, challenges remain in Indonesia (Yusuf et al., 2021, pp. 1–13). Gender stereotypes, limited access to resources, and the underrepresentation of women in environmental decision-making processes often constrain their contributions. Additionally, policies supporting gender equality and sustainability need to be enhanced and more effectively implemented (Valduga et al., 2023).

Therefore, it is crucial to explore how the integration of gender equality and environmental stewardship can strengthen sustainability efforts in Indonesia. Previous literature has demonstrated that women play a crucial role in natural resource management, yet there is a lack of systematic studies examining the mechanisms linking gender equality to environmental policies in Indonesia. As such, this study not only contributes to a deeper understanding of gender and environmental issues but also provides evidence-based recommendations for policymakers. Through an integrated approach, women empowerment can be a driving force for sustainable social and environmental transformation. This study aims to explore how gender equality and environmental stewardship can complement and reinforce each other and identify effective strategies to advance both simultaneously. By understanding this relationship more deeply, we hope to build a more just and sustainable future for all in Indonesia.

Additionally, this research makes three key contributions. First, it empirically establishes the moderating role of government policies in strengthening the relationship between gender equality and environmental sustainability, a perspective that has been underexplored in existing literature. Second, it provides a region-specific analysis of Indonesia, offering localized insights that account for socio-political and economic dynamics unique to developing economies. Third, the study integrates a cross-disciplinary approach by linking gender studies with environmental policy, demonstrating how gender-inclusive policies can serve as catalysts for sustainable development. These contributions offer

actionable insights for policymakers, advocating for more targeted and effective gender equality policies that not only promote social justice but also enhance environmental resilience.

Additionally, this research makes three key contributions. First, it empirically establishes the moderating role of government policies in strengthening the relationship between gender equality and environmental sustainability, a perspective that has been underexplored in existing literature. Unlike prior studies that focus on gender or environmental policies in isolation, this research takes an integrated approach, highlighting the intersection of these two critical areas. This allows for a more comprehensive understanding of how gender empowerment can drive environmental resilience.

Second, it provides a region-specific analysis of Indonesia, offering localized insights that account for socio-political and economic dynamics unique to developing economies. Previous research has largely focused on Western contexts, leaving a gap in understanding how gender and environmental policies interact in Southeast Asia. By analyzing Indonesia's specific challenges and opportunities, this study provides a nuanced perspective that can inform policy adaptations in other Global South nations.

Third, the study integrates a cross-disciplinary approach by linking gender studies with environmental policy, demonstrating how gender-inclusive policies can serve as catalysts for sustainable development. While many studies examine gender and sustainability separately, this research bridges these disciplines to offer a holistic framework. By incorporating perspectives from environmental governance, gender studies, and public policy, the study presents a novel analytical model that policymakers can use to design more effective interventions.

These contributions offer actionable insights for policymakers, advocating for more targeted and effective gender equality policies that not only promote social justice but also enhance environmental resilience.

Therefore, the research questions guiding this study are as follows.

Q1: How does equitable access to education and employment affect environmental sustainability in Indonesia?

Q2: In what ways do women's political engagement and economic participation shape environmental sustainability efforts at local and national levels?

Q3: How do reproductive health rights and protection from gender-based violence and discrimination contribute to women's active involvement in environmental sustainability initiatives?

Q4: What role do social norms, cultural frameworks, and legal protections play in facilitating or hindering women's contributions to environmental sustainability?

Q5: To what extent do government policies and institutional frameworks moderate the relationship between gender equality and environmental sustainability, and what are their measurable impacts?

2. Literature review

2.1. Gender equality and environmental sustainability

According to Nanni (2023), gender equality means ensuring that individuals of all genders have equal rights, responsibilities, and opportunities in all aspects of life, including economic, social, political, and cultural participation. Key aspects include equal access to education and employment (Walker et al., 2019), political representation (Kowalewska, 2020), healthcare and reproductive rights (Cook, 2020), and protection from violence and discrimination (Stark et al., 2021). Moreover, gender equality is also linked to improved environmental sustainability outcomes, highlighting the broader implications of equitable access and participation in society (Gupta & Roy, 2023; Kuteesa et al., 2024; Suzor et al., 2019). Achieving gender equality enhances individual well-being, economic growth, and social stability, requiring

collective efforts from governments, organizations, and communities.

According to Mensah (2019), environmental sustainability ensures that current human needs are met without compromising future generations' ability to meet theirs. It involves managing natural resources and protecting the environment to maintain ecosystem balance and quality of life. Key aspects include conserving natural resources (Tomićević et al., 2010), reducing emissions and pollution (Jiang et al., 2020), and effective waste management (Das et al., 2019). Biodiversity conservation (Paoli et al., 2010), climate change adaptation and mitigation (Landauer et al., 2019), and community engagement (Baba et al., 2021) are also essential. Achieving environmental sustainability requires collaboration among governments, businesses, and communities to ensure a healthy and habitable planet for future generations.

Gender equality plays a crucial role in promoting environmental sustainability (Leal Filho et al., 2023). Given the intersection between gender equality and environmental sustainability, researchers argue that an inclusive approach to sustainability policies is necessary for long-term ecological resilience. Equal access to education and employment enables individuals, regardless of gender, to contribute to sustainable development through innovation and informed decision-making (Ferdous & Uddin, 2021). Women's political participation and representation lead to stronger environmental policies and governance, as female leaders often prioritize sustainability initiatives (Humayra et al., 2024). Additionally, improved healthcare and reproductive rights support population stability and resource management, reducing environmental pressures (Saraswati et al., 2024). Ensuring freedom from violence and discrimination allows women to actively participate in environmental efforts without fear, fostering inclusive and sustainable solutions (Nourbakhsh & Baghbanno, 2023).

Furthermore, women's economic empowerment enhances their ability to invest in sustainable practices, from green entrepreneurship to resource-efficient businesses (Labidi & Gtifa, 2023). Supportive social and cultural norms encourage collective responsibility for environmental conservation, dismantling barriers that limit women's contributions (Abd El Basset et al., 2024). Strong legal rights and protections provide the foundation for gender-inclusive environmental policies, ensuring long-term sustainability (Calderón-Argelich et al., 2023). By integrating gender equality into environmental strategies, societies can achieve a more resilient and sustainable future.

Moreover, Research indicates that education plays a crucial role in promoting environmental sustainability. Quality education in sustainability fields is essential for preventing environmental degradation and preparing individuals for sustainable development jobs (Maniatis, 2024). Higher employee education levels positively impact corporate environmental sustainability reporting, quality, and initiatives (Fang & Li, 2024). In Asian countries, a 1 % increase in the UNDP Education Index is associated with a 0.23 % improvement in fossil fuel efficiency, highlighting education's role in fostering environmental awareness (Shang et al., 2024). Environmental education programs in China have shown significant improvements in perceived air and water quality, waste reduction, and energy consumption reduction, with web-based programs demonstrating particular success (C. Yang & Fang, 2024). These findings underscore the importance of prioritizing education and awareness initiatives, aligning curricula with sustainability principles, and empowering individuals and communities to actively engage in environmental conservation.

H1. Equal access to education and employment positively affects environmental sustainability.

In addition, recent studies demonstrate a positive relationship between women's political participation and environmental sustainability. Increased female representation in parliaments and regional assemblies is associated with reduced particle pollution (PM_{2.5}) in the European Union (Koengkan et al., 2024). Globally, women's political participation promotes green innovation, particularly in developed countries and those with high carbon emissions (J. Wang et al., 2025). Female

parliamentarians advocate for environmentally friendly fiscal policies, including reduced fossil fuel subsidies, increased environmental taxes, and higher environmental spending (Kandemir et al., 2024). A critical mass of at least 30 % female representation enhances environmental policy outcomes. In European regions, women's political empowerment is consistently linked to improved air quality (Rios et al., 2024). These findings highlight the importance of gender diversity in governance for addressing environmental challenges and suggest that promoting women's political participation can contribute to achieving multiple Sustainable Development Goals.

H2. Political participation and representation of women positively impact environmental sustainability.

Then, prior researches indicates that improved healthcare and reproductive rights for women positively influence environmental sustainability. Access to family planning and maternal health services can help lower population growth, which in turn reduces environmental pressures and climate change risks (Saraswati et al., 2024). Women's health and rights are essential for their empowerment and progress, with implications for sustainable development (Ojong et al., 2024). Environmental sustainability in healthcare is increasingly recognized as important, requiring interdisciplinary collaboration and addressing challenges in implementation (Balay-Odao et al., 2024). Hospitals' environmental practices can positively impact both service quality and financial performance, though persistent efforts may only lead to enduring financial benefits (Han et al., 2024). The interconnection between women's health, reproductive rights, and climate change highlights the need for a holistic approach to advance women's health and rights in a more inclusive and sustainable manner.

H3. Improved healthcare and reproductive rights for women positively influence environmental sustainability.

Subsequently, women's entrepreneurship has been found to have a negative effect on carbon dioxide emissions, as women often operate in less energy-intensive sectors (Chen et al., 2024). However, firms led by women CEO-Chairs are more likely to be targeted by environmental activists, possibly due to their perceived managerial power and collaborative traits (Yu & Liu, 2024). In sub-Saharan African manufacturing firms, gender diversity on boards is inversely linked to environmental sustainability disclosure, while the presence of foreign nationals has a positive impact (Zhu et al., 2024). Social design approaches can contribute to addressing gender-based violence, a key issue in achieving gender equality and the Sustainable Development Goals (Lima & Guedes, 2024). These findings underscore the complex interplay between gender equality, corporate governance, and environmental sustainability, suggesting that empowering women can positively influence sustainability efforts in various contexts.

H4. Freedom from violence and discrimination for women positively contributes to environmental sustainability.

Next, latest studies demonstrate a positive relationship between women's empowerment and environmental sustainability. In BRICS economies, women's political empowerment and leadership positions significantly reduce carbon emissions (Ganda, 2024). Similarly, in Central and Eastern European countries, higher levels of women's empowerment positively impact eco-efficiency in small farms (Czyżewski et al., 2024). Corporate environmental responsibility also benefits from women's influence, with a significant reduction in greenhouse gas emissions observed within specific empowerment and financial ranges (Li et al., 2024). In rural Ethiopia, women's economic empowerment correlates positively with the adoption of modern, cleaner energy sources (Dumga & Goswami, 2024). These findings collectively suggest that promoting gender equality and enhancing women's access to resources, decision-making power, and leadership roles can be an effective strategy for mitigating climate change and fostering environmental sustainability across various contexts and

economies.

H5. Economic empowerment of women positively affects environmental sustainability.

Thereafter, many studies explore the complex relationships between gender equality, cultural norms, and environmental sustainability. In sub-Saharan Africa, women's participation in farm decision-making can positively influence climate-smart agriculture adoption, though this varies by country due to social and cultural factors (Perelli et al., 2024). Board-level governance, particularly sustainability committees, significantly impacts sustainability reporting across economic, environmental, and social dimensions (Alta'any et al., 2024). In Asian contexts, collectivist culture promotes pro-environmental behavior through altruistic and biospheric values, with socioeconomic status moderating this relationship (Y. Yang et al., 2024). However, socio-cultural factors may negatively impact economic sustainability in G7 countries, while environmental deterioration shows a positive effect, challenging the traditional Environmental Kuznets Curve hypothesis (Najia et al., 2024). These findings highlight the intricate interplay between cultural norms, gender equality, and environmental sustainability, emphasizing the need for context-specific policies to promote sustainable development.

H6. Supportive social and cultural norms for gender equality positively impact environmental sustainability.

Finally, earlier research highlights the positive influence of strong legal rights and protections for women on environmental sustainability. Atta and Sharifi (2024) emphasize the role of the rule of law in promoting sustainable development, identifying gaps in literature regarding fundamental rights and environmental quality. Trireksani et al. (2024) find that board gender diversity enhances sustainability performance, particularly in countries with supportive cultural and legal frameworks. Alharbey and Ben-Salha (2024) demonstrate that institutions, including the rule of law and control of corruption, positively impact environmental quality, suggesting that effective governance is crucial for sustainability. Furthermore, Chen et al. (2024) reveal that women entrepreneurship contributes to lower carbon emissions in India, as women often engage in less energy-intensive sectors. Collectively, these studies underscore the interconnectedness of gender equity, legal frameworks, and environmental sustainability, advocating for policies that enhance women's roles in sustainable practices.

H7. Strong legal rights and protections for women positively influence environmental sustainability.

2.2. Government policies as moderator

Government policies supporting gender Equality encompass various measures and regulations designed to address gender inequality and ensure equal access for all genders in various aspects of life (Koehler, 2016). These policies include laws prohibiting gender discrimination, empowerment programs that provide equal educational and employment opportunities, and regulations ensuring reproductive health rights. Additionally, they cover protections against gender-based violence, initiatives to increase women's political representation, and efforts to reduce wage gaps and ensure fair treatment in the workplace. By integrating gender equality principles into public policies, governments aim to create an environment that supports and promotes equal rights and opportunities for all individuals (Leach et al., 2016).

As a moderating variable, government policies supporting gender equality can influence the strength or direction of the relationship between independent variables and environmental sustainability outcomes. For example, policies that support women's political representation can strengthen the positive impact of women's political participation on environmental sustainability by ensuring that inclusive and responsive environmental policies are implemented. Similarly, policies providing protection against violence can enhance women's

contributions to sustainability initiatives by creating a safe and supportive environment for their participation (Akinwale, 2023).

Overall, government policies supporting gender equality play a crucial role in facilitating and strengthening the relationship between gender equality and environmental sustainability (Al Amosh, 2025; Lawless et al., 2022; Panda et al., 2024; Perelli et al., 2024). By providing necessary support and reducing barriers, these policies not only increase opportunities for women to engage in sustainability efforts but also ensure that gender perspectives are integrated into environmental policymaking. This can lead to better and more inclusive sustainability outcomes, contributing to the broader goals of sustainability. Therefore, the hypotheses are as follows.

H8. Government policies moderate the relationship equal access to education and employment on environmental sustainability.

H9. Government policies moderate the relationship political participation and representation of women on environmental sustainability.

H10. Government policies moderate the relationship improved healthcare and reproductive rights for women on environmental sustainability.

H11. Government policies moderate the relationship freedom from violence and discrimination for women on environmental sustainability.

H12. Government policies moderate the relationship economic empowerment of women on environmental sustainability.

H13. Government policies moderate the relationship supportive social and cultural norms for gender equality on environmental sustainability.

H14. Government policies moderate the relationship strong legal rights and protections for women on environmental sustainability.

This study highlights the link between women's empowerment and environmental sustainability, aligning with findings that equal access to education, political participation, legal protection, and economic empowerment significantly contribute to environmental conservation efforts (see Fig. 1). This research reinforces the idea that when women have equal access to resources and decision-making, they are more likely to adopt sustainable practices, both in their daily lives and in policy-making. Compared to previous studies that focus primarily on environmental aspects without considering gender dimensions, this research introduces a new perspective by emphasizing that sustainability policies must be inclusive and gender-equitable. For instance, while earlier studies primarily addressed technical strategies such as emission mitigation and resource conservation (Bilgili et al., 2024; Ige et al., 2024; Prina et al., 2023; Shaheen et al., 2022; Z. Wang et al., 2023), this study underscores that women's empowerment serves as a key enabler in enhancing the effectiveness of these strategies. Thus, its findings contribute to the development of the field by providing empirical evidence that integrating gender equality into environmental policies can improve sustainability outcomes and accelerate progress toward sustainable development goals. In addition, Fig. 2 presents the conceptual framework of this study, highlighting the relationship between gender equality and environmental sustainability. It presents key variables such as education, political participation, economic empowerment, and legal protections, demonstrating how these factors contribute to sustainable environmental practices and policies.

3. Methodology

This study employs a comprehensive quantitative research design to examine the influence of gender equality factors on environmental sustainability and the moderating role of government policies. The methodology outlined below details the research design, population, sampling procedures, measurement instruments, data analysis techniques, and ethical considerations used to achieve the study's objectives (see Fig. 3).

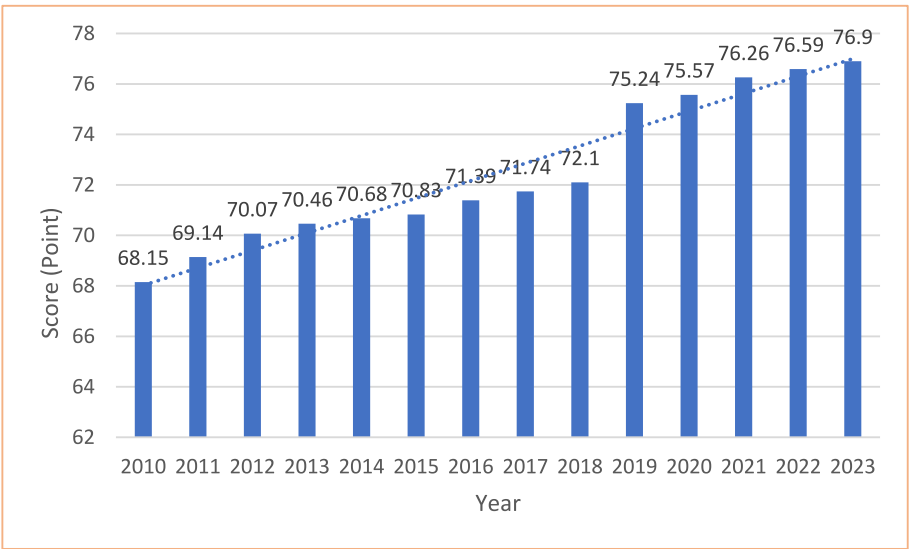


Fig. 1. Indonesia's gender empowerment index (source: Katadata, 2024).

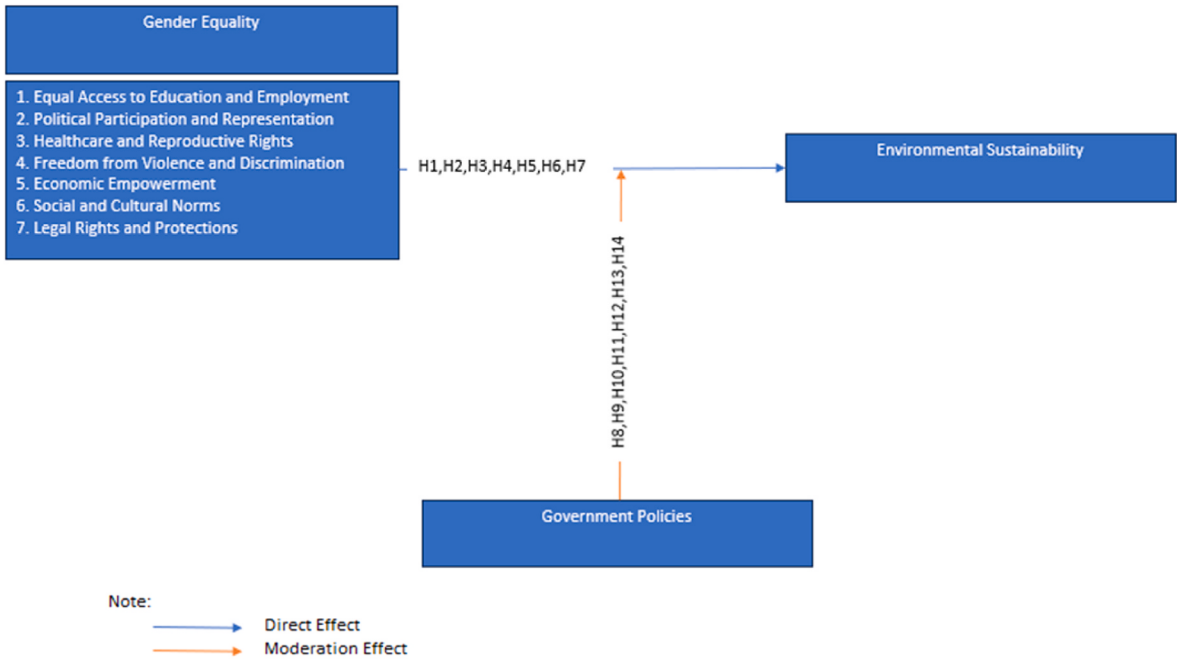


Fig. 2. Research model.

3.1. Research design

This study employs a quantitative research design with a cross-sectional approach. The objective is to evaluate how government policies supporting gender equality moderate the relationship between various gender equality factors and environmental sustainability. The cross-sectional design enables data collection at a single point in time to analyze these relationships and assess the moderating impact of policies. A quantitative approach is particularly suitable because it allows for statistical generalization and the identification of patterns across large datasets (Creswell & Creswell, 2018). Additionally, the structured nature of quantitative research ensures objectivity and reproducibility, which enhances the reliability of the findings (Hair et al., 2021).

3.2. Population and sample

The research population consists of individuals and communities in Banten Province, Indonesia, involved in environmental sustainability initiatives and those affected by gender equality policies. The sample was selected using stratified random sampling to ensure representation across different demographic groups, including gender, age, and geographic location. A total of 500 questionnaires were distributed, with 477 responses received. Of these, 417 were complete and suitable for analysis. Stratified random sampling was chosen to minimize selection bias and improve the representativeness of the sample (Bryman & Cramer, 2012).

3.3. Measurement instruments

The research instruments include a questionnaire designed to assess

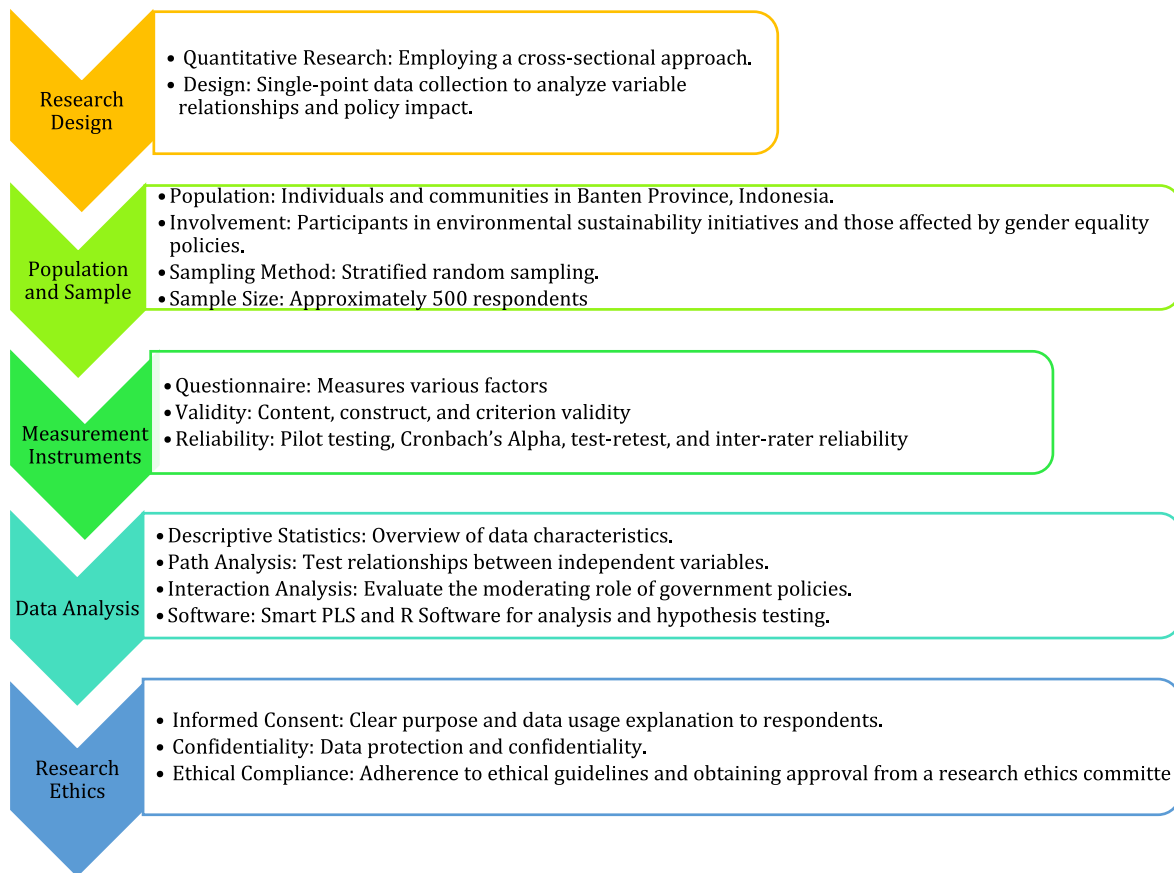


Fig. 3. Methodology flow chart.

access to education and employment, political participation and representation, healthcare and reproductive rights, freedom from violence and discrimination, economic empowerment, social and cultural norms, and legal rights and protections. Government policies were evaluated through policy document analysis and interviews with policymakers. Validity was ensured through content, construct, and criterion validity, confirming that the questionnaire covered all relevant aspects, measured intended theoretical constructs, and produced results consistent with external criteria. Reliability was established through pilot testing, Cronbach's alpha for internal consistency, test-retest reliability, and inter-rater reliability when multiple raters were involved. These measures align with best practices in social science research to ensure instrument accuracy and reliability (DeVellis, 2006).

3.4. Data analysis

Data were analyzed using path analysis and structural equation modeling (SEM). Path analysis tested the relationships between independent variables such as equal access to education and employment, political participation and representation, healthcare and reproductive rights, freedom from violence and discrimination, social and cultural norms, and legal rights and protections. Interaction analysis assessed the moderating role of government policies. SmartPLS was utilized for SEM and path analysis to examine complex relationships and interactions among variables. Additionally, R software was used for further statistical analyses, including generating three-dimensional visualizations to enhance data interpretation. SEM was selected because it allows for simultaneous estimation of multiple relationships while accounting for measurement errors, making it ideal for examining complex social phenomena (Byrne, 2016).

3.4.1. Justification of methods

To justify the selection of analytical methods, the following considerations were taken into account.

- Equations:** The relationships among variables were modeled using the SEM equation: $Y = \beta_0 + \beta_1 X + \beta_2 M + \beta_3 (X \times M) + \epsilon$ where Y represents environmental sustainability, X represents gender equality factors, M represents government policies, and $X \times M$ represents the moderating effect.
- Advantages:** SEM allows for the simultaneous analysis of multiple dependent and independent variables while controlling for measurement errors. Path analysis enhances the ability to test direct, indirect, and moderating effects within a single model, providing a more comprehensive understanding of complex relationships. These advantages make SEM a widely accepted method in social sciences (Kline, 2015).
- Limitations:** Despite its strengths, SEM requires a large sample size to ensure robust results. Additionally, cross-sectional data restricts causal inference, as relationships are observed at a single point in time rather than longitudinally. However, previous studies have demonstrated that cross-sectional SEM is effective for hypothesis testing in psychology-related research (Hoyle & Isherwood, 2013).

3.5. Research ethics

This study adhered to strict research ethics standards. All respondents received clear information about the research purpose and data usage. Written consent was obtained before data collection. Data were kept confidential and used solely for research purposes. The study complied with applicable ethical guidelines, including approval from a

research ethics committee. Ethical considerations are critical in social research to ensure the protection of participants and data integrity (Israel & Hay, 2006).

4. Result and findings

4.1. Descriptive statistics

Table 1 summarizes the latent variable statistics for a dataset of 417 observations, highlighting median, minimum, maximum, excess kurtosis, and skewness for each variable. Economic empowerment shows a median of 0.597 with a wide range and right-skewed distribution, while Environmental Sustainability has a lower median and moderate positive skew. Equal Access to Education and Employment and Healthcare and Reproductive Rights both exhibit high skewness and excess kurtosis, indicating concentrations of lower scores with significant high extremes. Freedom from violence and discrimination and legal rights and protections also display right-skewed distributions, though with varying degrees of kurtosis. Government policies and Political participation are highly right-skewed, suggesting a concentration around lower values with impactful outliers. Social and cultural norms show a moderate right-skew, reflecting similar patterns of concentration and extremes.

Moreover, The Box Plot and Bar Chart of Key Variables provide essential visual insights into the distribution and central tendencies of the main constructs in this study. The Box Plot highlights the range, median, quartiles, and potential outliers for each variable, offering a clear view of data dispersion and skewness. It visually captures variability and identifies extreme values that may influence the overall analysis. Meanwhile, the Bar Chart complements this by presenting the average values of key variables, facilitating direct comparisons among constructs. Together, these visual tools enhance our understanding of underlying data patterns and distributions, aiding in the interpretation of complex statistical findings.

The Box Plot and Bar Chart of key variables reveal considerable variation in data distribution across constructs. The Box Plot indicates significant outliers and variability, particularly in “Political participation and representation,” which shows a wide range and high skewness, while “Government policies” has a lower median with higher kurtosis. The Bar Chart highlights that “Economic empowerment” and “Social and cultural norms” have relatively high average values, whereas “Government policies” and “Healthcare and reproductive rights” show lower averages, reflecting different levels of central tendency and variability across the variables (see Fig. 4).

Data analysis reveals that most variables exhibit high kurtosis, indicating distributions with heavier tails compared to a normal distribution. Political participation and representation show the highest kurtosis and skewness, indicating a highly skewed distribution towards higher values, while Environmental sustainability demonstrates a distribution closer to normal with more balanced variation. Variables such as Equal access to education and employment and Government policies also exhibit high kurtosis and skewness, suggesting substantial variation possibly influenced by outliers. The heatmap highlights the intensity of correlations between variables, while the 3D density plot illustrates the

spread of data across variable combinations. Overall, the data indicates significant disparities in the distributions of the measured variables (see Fig. 5).

4.2. Validity and reliability

The analysis of constructs examines their reliability and validity using various metrics. Constructs such as Equal Access to Education and Employment, Political Participation, and Healthcare and Reproductive Rights have high outer loadings, indicating strong item relationships with the constructs, often above 0.9. Reliability is assessed through Cronbach’s Alpha, Composite Reliability (CR), and rho_A, with values above 0.7 for Cronbach’s Alpha and close to 1.0 for CR and rho_A indicating strong internal consistency. For example, Healthcare and Reproductive Rights show high reliability with Cronbach’s Alpha of 0.935, rho_A of 0.936, and CR of 0.958. The Average Variance Extracted (AVE) measures how much variance in indicators is explained by the construct, with values above 0.5 for constructs like Freedom from Violence and Discrimination, Economic Empowerment, and Social and Cultural Norms, indicating effective measurement. Overall, the constructs exhibit high reliability and validity (see Table 2).

In addition, the Heterotrait-Monotrait Ratio (HTMT) analysis indicates that most The Heterotrait-Monotrait Ratio (HTMT) analysis shows that most constructs, such as Economic Empowerment and Environmental Sustainability, have adequate discriminant validity, with HTMT values below 0.85. Some constructs, like Equal Access to Education and Employment with Healthcare and Reproductive Rights, approach 0.785, indicating correlation but still within acceptable limits. Overall, the HTMT results suggest good discriminant validity (see Table 3).

In Structural Equation Modeling (SEM), the Goodness of Fit (GoF) evaluates how well the model aligns with observed data and explains data variation. GoF is calculated using the formula $GoF = \sqrt{(AVE \times R^2)}$, where AVE is the Average Variance Extracted and R^2 represents the average squared multiple correlations. Key constructs in the model show varying GoF values: Equal Access to Education and Employment has a GoF of 0.783, and Political Participation and Representation shows 0.777, both indicating solid fits. Healthcare and Reproductive Rights (0.787) and Freedom from Violence and Discrimination (0.804) also reflect good fits. Economic Empowerment has the highest GoF at 0.834, followed by Social and Cultural Norms at 0.831, indicating the best model fits. In contrast, Legal Rights and Protections (0.768), Environmental Sustainability (0.710), and Government Policies (0.679) exhibit weaker fits, suggesting less alignment with observed data.

4.3. Path analysis

Table 4 presents the results of the path analysis, indicating that all hypotheses regarding the impact of various constructs on environmental sustainability are supported. Each construct—Economic empowerment, Equal access to education and employment, Freedom from violence and discrimination, Healthcare and reproductive rights, Legal rights and protections, Political participation and representation, and Social and

Table 1
Latent variable statistics.

Variable	Abbreviation	Obs.	Median	Min	Max	Excess Kurtosis	Skewness
Economic empowerment	ECONOM	417	0.597	3.875	1.0410	1.552	0.805
Environmental sustainability	ENVIRON	417	0.235	4.139	1.3370	1.116	0.570
Equal Access to Education and Employment	EQUAL	417	0.084	4.602	1.0900	2.586	1.057
Freedom from Violence and Discrimination	FREE	417	0.623	4.035	1.0830	1.538	0.783
Government policies	GOV	417	0.026	4.543	1.3480	2.384	0.941
Healthcare and reproductive rights	HEALT	417	0.081	4.578	1.0670	2.678	1.070
Legal rights and protections	LEGAL	417	0.619	4.157	1.1500	1.572	0.768
Political participation and representation	POLITICAL	417	0.083	5.139	1.0440	3.733	1.320
Social and cultural norms	SOCIAL	417	0.600	3.875	1.0380	1.552	0.808

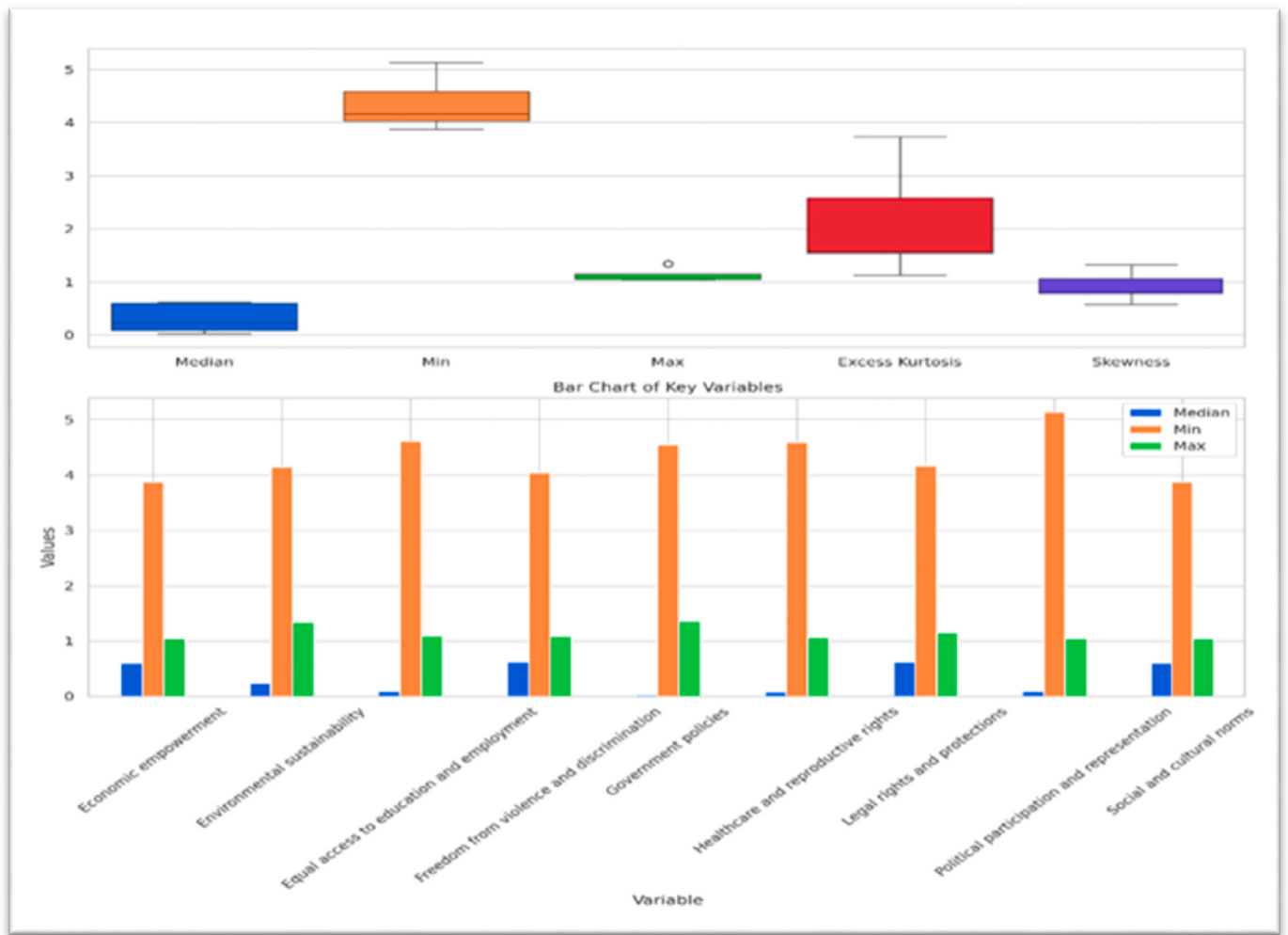


Fig. 4. Distribution and central tendencies of key variables.

cultural norms—demonstrates a statistically significant positive effect on Environmental sustainability, with p-values of 0.000. The T statistics for all paths exceed the critical value of 2.0, confirming the robustness of these relationships. Among these, FREE and ECONOM show particularly strong impacts, with T statistics of 4.639 and 4.043, respectively, underscoring their significant roles in advancing environmental sustainability. Overall, the findings emphasize that a diverse range of factors, including economic, social, and political dimensions, contribute meaningfully to environmental outcomes (see Table 4).

4.4. Moderation analysis

The path analysis for hypotheses H8 through H14 reveals that the interactions between factors such as education access, employment, political participation, healthcare rights, freedom from violence, economic empowerment, social norms, and legal rights with government policies do not significantly impact environmental sustainability. None of these hypotheses are supported, with p-values exceeding 0.05, indicating that government policies do not effectively moderate the relationship between these social and economic factors and environmental sustainability (see Table 5). The simple slope graphs further illustrate that factors like education and employment, political participation, and healthcare rights have a stronger impact on environmental sustainability when government intervention is low. The steeper slope in the low-intervention scenarios suggests that these factors influence sustainability more significantly without heavy government involvement. High

government intervention, however, tends to stabilize or reduce these effects, indicating a dampening role of government policies in this context (see Fig. 6).

Fig. 6 presents a series of simple slope graphs illustrating the interaction effects between government intervention and various social and economic factors on environmental sustainability. Each graph compares the influence of a specific factor—equal access to education and employment, political participation, healthcare rights, freedom from violence, economic empowerment, social norms, and legal protections—under conditions of high and low government intervention. In all graphs, the blue lines represent scenarios with low government intervention, while the red lines indicate high government intervention. A common trend across the graphs is that the slopes of the blue lines are steeper compared to the red lines, signifying that in low-government intervention settings, these factors have a stronger positive impact on environmental sustainability. Conversely, high government intervention appears to moderate or dampen this effect, resulting in flatter slopes.

For example, in the case of economic empowerment and political participation, the blue lines rise more sharply, indicating that these factors significantly enhance environmental sustainability when government intervention is minimal. Similarly, access to education, healthcare rights, and social norms also show stronger effects in low-intervention scenarios. This pattern suggests that government policies may play a stabilizing rather than an amplifying role in these relationships, potentially reducing the direct influence of social and economic factors on environmental sustainability.

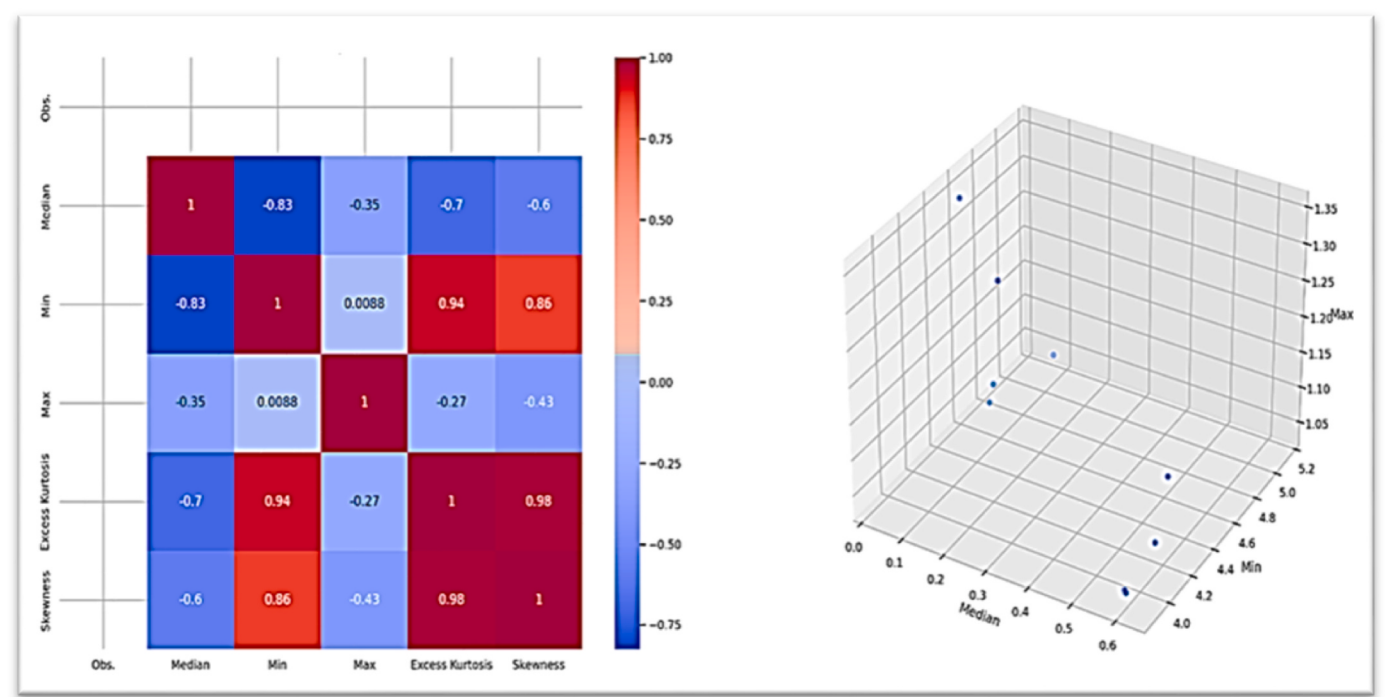


Fig. 5. Correlation and density of key variables.

Overall, these findings indicate that while government intervention does not negatively impact environmental sustainability, it does not necessarily enhance the effects of the examined factors. This highlights the importance of grassroots initiatives, community-driven efforts, and decentralized approaches in promoting sustainable environmental outcomes.

The findings highlight that economic empowerment, equal access to education and employment, freedom from violence and discrimination, healthcare and reproductive rights, legal protections, political participation, and social norms all have a significant positive impact on environmental sustainability. The statistical analysis confirms the strength of these relationships, with economic empowerment (ECONOM) and freedom from violence (FREE) showing the most substantial effects. These results emphasize the interconnectedness of social, economic, and political factors in advancing environmental sustainability.

However, moderation analysis reveals that government policies do not significantly influence these relationships. The interactions between government policies and various social and economic factors show no meaningful impact on environmental sustainability, as indicated by p-values above 0.05. The analysis suggests that in contexts of low government intervention, factors like education access, employment, and political participation play a more significant role in promoting sustainability. High government intervention appears to dampen these effects, stabilizing rather than enhancing their influence. These findings suggest that bottom-up initiatives and independent social efforts may be more effective in driving environmental sustainability than heavy government regulation.

5. Discussions

The path analysis results indicate that hypotheses H1 through H7 are accepted, suggesting that various aspects related to women’s empowerment and gender equality have a significant positive impact on environmental sustainability in Indonesia. Specifically, equal access to education and employment (H1) shows that when women have the same opportunities as men in education and job prospects, it can promote greater awareness and sustainable practices in environmental

management. Women’s political participation and representation (H2) also positively contribute to environmental sustainability, indicating that women’s involvement in political decision-making can bring a more inclusive perspective focused on sustainability in public policies.

Moreover, improvements in women’s healthcare and reproductive rights (H3), as well as freedom from violence and discrimination (H4), positively influence environmental sustainability, suggesting that when women feel safe and healthy, they are better equipped to contribute to conservation efforts. Women’s economic empowerment (H5) also positively affects environmental sustainability, indicating that when women have greater economic control, they are more likely to support and implement environmentally friendly practices. Supportive social and cultural norms that promote gender equality (H6) and strong legal rights and protections for women (H7) also positively impact environmental sustainability, demonstrating that a supportive social environment and strong legal protections can enhance women’s participation in sustainability efforts.

Our research shows that equal access to education and employment (H1) enhances environmental sustainability. This finding aligns with studies from countries like Spain, which indicate that gender equality in education and employment can foster greater awareness and sustainable practices. Women often lead in sustainability initiatives and green policies both in professional and personal spheres (de Miguel González & Sebastián-López, 2022). This underscores the importance of gender-responsive policies in education and workforce participation to maximize environmental benefits. The positive impact of women’s political participation (H2) on environmental sustainability is supported by research from countries such as Portugal. In Portugal, women’s political representation is associated with more progressive environmental policies. This is because women in political roles tend to prioritize sustainable and community-based policies (Espírito-Santo et al., 2018). Therefore, increasing women’s representation in decision-making processes should be a policy priority to enhance sustainability outcomes. Improvements in women’s healthcare and reproductive rights (H3), which are linked to better environmental outcomes in our study, are consistent with findings from countries like Ethiopia. In Ethiopia, better healthcare access for women leads to higher engagement in

Table 2
Confirmatory factor analysis.

Construct	Items	Indicators	Outer Loading	Cronbach's Alpha	rho_A	CR	AVE
Equal access to education and employment	EQUAL1	The enrollment rate of women in higher education is equal to that of men	0.937	0.929	0.93	0.955	0.875
	EQUAL2	Equal access to job opportunities without gender discrimination	0.947				
	EQUAL3	Company policies support gender equality in recruitment and promotion	0.922				
Political participation and representation	POLITICAL1	The percentage of women in political leadership positions is equal to that of men	0.924	0.921	0.921	0.950	0.864
	POLITICAL2	Increased participation of women in elections and political decision-making	0.931				
Healthcare and reproductive rights	POLITICAL3	Laws support gender representation in political parties	0.933	0.935	0.936	0.958	0.885
	HEALT1	Women have access to high-quality reproductive health services	0.965				
	HEALT2	Adequate information and education about reproductive health are available	0.942				
Freedom from violence and discrimination	HEALT3	Health policies protect and ensure reproductive rights	0.914	0.958	0.958	0.973	0.923
	FREE1	Significant reduction in cases of gender-based violence	0.921				
	FREE2	Anti-discrimination laws and policies are effectively enforced	0.982				
Economic empowerment	FREE3	Support services for victims of gender-based violence are easily accessible	0.978	0.996	0.996	0.997	0.991
	ECONOMIC1	Women have equal access to economic resources and financial services	0.998				
	ECONOMIC2	Increase in the number of women engaged in entrepreneurship	0.995				
Social and cultural norms	ECONOMIC3	Policies support equal pay between men and women	0.995	0.994	0.994	0.996	0.987
	SOCIAL1	Social norms increasingly support gender equality in families and communities	0.993				
	SOCIAL2	Reduction in gender stereotypes in media and education	0.998				
Legal rights and protections	SOCIAL3	Greater social acceptance of diverse gender roles	0.990	0.904	0.906	0.941	0.842
	LEGAL1	Comprehensive legal frameworks ensure equal rights for all genders	0.958				
	LEGAL2	Effective enforcement of laws that protect against gender-based discrimination	0.961				
Environmental sustainability	LEGAL3	Legal support and services are readily available for those facing gender-based injustice	0.828	0.977	0.977	0.979	0.718
	ENVIRON1	Significant annual decrease in per capita greenhouse gas emissions	0.911				
	ENVIRON2	Improved efficiency in water usage within the agricultural and industrial sectors	0.871				
	ENVIRON3	Increasing annual percentage of energy generated from renewable sources	0.914				
	ENVIRON4	Expansion of protected areas and biodiversity conservation efforts	0.898				
	ENVIRON5	Implementation of effective recycling systems with an increasing percentage of waste being recycled	0.86				
	ENVIRON6	Improvement in urban air quality with a reduction in airborne pollutants	0.886				
	ENVIRON7	Implementation of environmental policies that support sustainable development	0.854				
	ENVIRON8	Increased public awareness and participation in environmentally friendly practices	0.848				
	ENVIRON9	Sustainable land use practices that minimize deforestation and land degradation	0.877				
	ENVIRON10	Adoption of climate change adaptation strategies across various sectors, including agriculture and housing	0.875				
	ENVIRON11	Increased incorporation of environmental education in school curricula	0.857				
	ENVIRON12	Growth in the use of public transportation and reduction in private vehicle usage	0.875				
	ENVIRON13	Increased adoption of green technologies in industries and households	0.795				
	ENVIRON14	Enhanced infrastructure and community resilience to climate change impacts	0.797				
	ENVIRON15	Higher number of businesses adopting and reporting on sustainability practices	0.793				
	ENVIRON16	Adoption of sustainable fishing practices to maintain marine biodiversity	0.819				
	ENVIRON17	Growth in eco-tourism and sustainable tourism initiatives that minimize environmental impact	0.732				
	ENVIRON18	Significant decrease in the use of single-use plastics through bans and alternatives	0.759				
Government policies	GOV1	The measurable impact of government policies on societal well-being	0.718	0.942	0.945	0.951	0.659
	GOV2	Speed at which new policies are adopted and implemented across relevant sectors	0.789				
	GOV3	The extent to which government policies are transparent and accountable to the public	0.807				

(continued on next page)

Table 2 (continued)

Construct	Items	Indicators	Outer Loading	Cronbach's Alpha	rho_A	CR	AVE
	GOV4	Level of involvement of various stakeholders in the policy-making process	0.831				
	GOV5	The rate at which citizens and businesses adhere to established government policies	0.868				
	GOV6	The effectiveness of budget and resource allocation to support policy goals	0.862				
	GOV7	Regular monitoring and evaluation of policy outcomes to ensure goals are met	0.829				
	GOV8	Degree of coordination between different levels of government in policy implementation	0.828				
	GOV9	The strength of legislative backing for key government policies	0.826				
	GOV10	The flexibility of government policies to adapt to changing circumstances and emerging challenges	0.748				

Table 3

Heterotrait-monotrait ratio (HTMT).

Construct ^{a)}	ECONOM	ENVIRON	EQUAL	FREE	GOV	HEALT	LEGAL	POLITICAL	SOCIAL
Economic empowerment	–								
Environmental sustainability	0.627	–							
Equal access to education and employment	0.775	0.692	–						
Freedom from violence and discrimination	0.803	0.66	0.705	–					
Government policies	0.810	0.815	0.730	0.719	–				
Healthcare and reproductive rights	0.813	0.695	0.785	0.775	0.805	–			
Legal rights and protections	0.708	0.696	0.713	0.712	0.821	0.730	–		
Political participation and representation	0.807	0.713	0.628	0.742	0.729	0.790	0.822	–	
Social and cultural norms	0.762	0.630	0.779	0.713	0.778	0.717	0.812	0.629	–

^a EQUAL = Equal access to education and employment; POLITICAL= Political participation and representation; HEALT= Healthcare and reproductive rights; FREE= Freedom from violence and discrimination; ECONOM = Economic empowerment; SOCIAL= Social and cultural norms; LEGAL = Legal rights and protections; ENVIRON = Environmental sustainability; GOV = Government policies.

Table 4

Path analysis result.

Hypothesis	Construct ^{a)}	Original Sample	STDEV	T Statistics	P Values	Result
H1	ECONOM - > ENVIRON	0.307	0.321	4.043	0.000	Supported
H2	EQUAL - > ENVIRON	0.112	0.144	3.115	0.000	Supported
H3	FREE - > ENVIRON	0.309	0.311	4.639	0.000	Supported
H4	HEALT - > ENVIRON	0.139	0.146	2.253	0.000	Supported
H5	LEGAL - > ENVIRON	0.202	0.218	3.701	0.000	Supported
H6	POLITICAL - > ENVIRON	0.195	0.233	2.275	0.000	Supported
H7	SOCIAL - > ENVIRON	0.125	0.139	3.206	0.000	Supported

^a EQUAL = Equal access to education and employment; POLITICAL= Political participation and representation; HEALT= Healthcare and reproductive rights; FREE= Freedom from violence and discrimination; ECONOM = Economic empowerment; SOCIAL= Social and cultural norms; LEGAL = Legal rights and protections; ENVIRON = Environmental sustainability; GOV = Government policies.

Table 5

Moderation testing result.

Hypothesis	Construct ^{a)}	Original Sample	STDEV	T Statistics	P Values	Result
H8	EQUAL ^a GOV - > ENVIRON	0.106	0.121	1.31	0.191	Not Supported
H9	POLITICAL ^a GOV - > ENVIRON	−0.103	0.092	1.424	0.155	Not Supported
H10	HEALT ^a GOV - > ENVIRON	0.074	0.100	0.352	0.725	Not Supported
H11	FREE ^a GOV - > ENVIRON	−0.269	0.199	1.256	0.210	Not Supported
H12	ECONOMIC ^a GOV - > ENVIRON	0.234	11.232	0.009	0.993	Not Supported
H13	SOCIAL ^a GOV - > ENVIRON	−0.032	11.222	0.004	0.997	Not Supported
H14	LEGAL ^a GOV - > ENVIRON	0.007	0.132	0.439	0.661	Not Supported

^a EQUAL = Equal access to education and employment; POLITICAL= Political participation and representation; HEALT= Healthcare and reproductive rights; FREE= Freedom from violence and discrimination; ECONOM = Economic empowerment; SOCIAL= Social and cultural norms; LEGAL = Legal rights and protections; ENVIRON = Environmental sustainability; GOV = Government policies.

environmental conservation activities, as healthy and empowered women can more fully participate in sustainability efforts (Bayeh, 2016).

Furthermore, our findings that freedom from violence and discrimination (H4) enhances environmental sustainability are consistent with

global studies. For example, research in Kenya shows that women who are free from violence are more likely to be involved in and lead community-based environmental projects. A safe and just environment allows women to contribute more effectively to environmental issues (Bannister & Moyi, 2019). Economic empowerment (H5) that improves

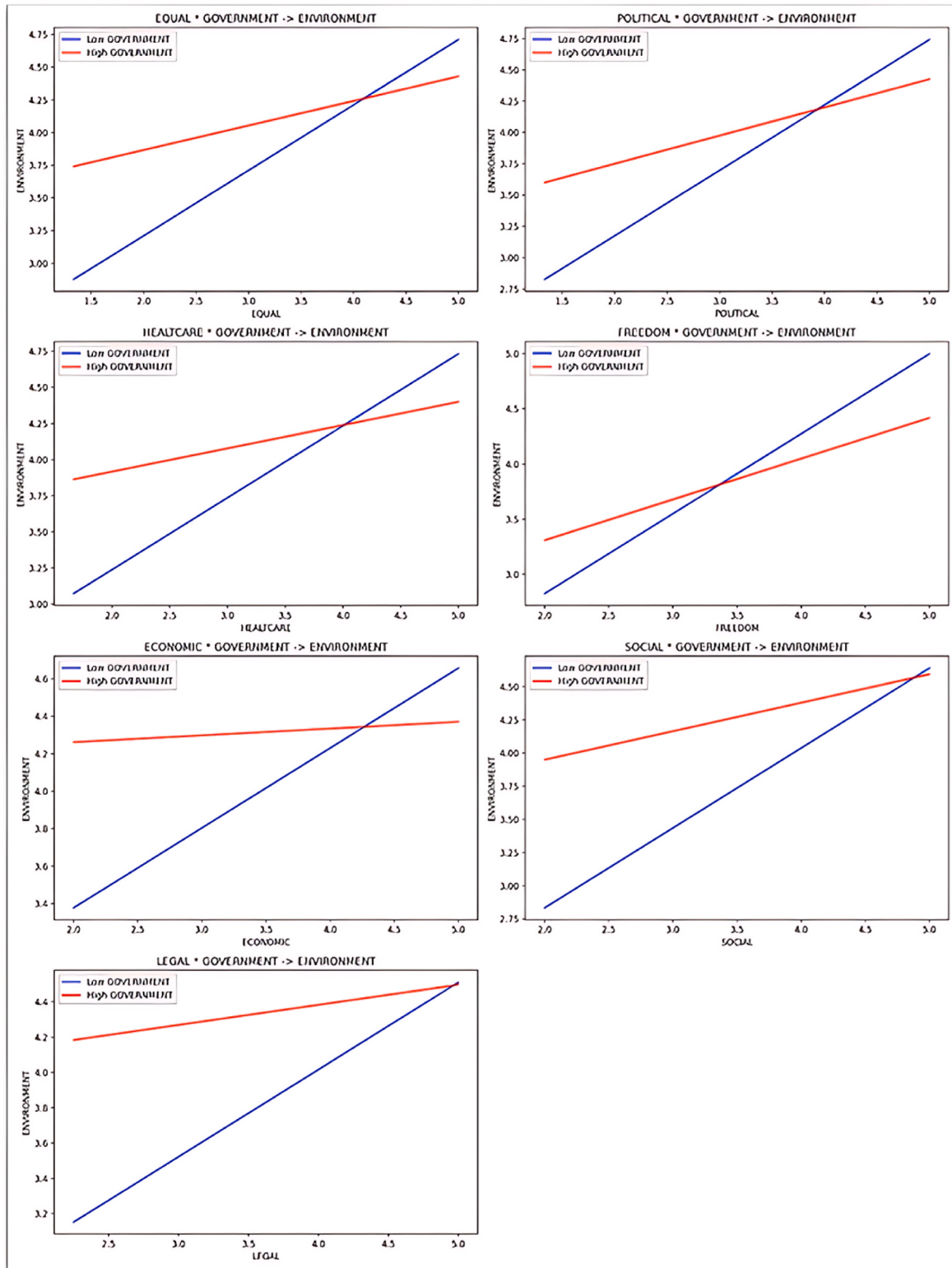


Fig. 6. Simple slope analysis.

environmental sustainability is supported by research in countries like USA. In USA, women's economic independence leads to greater investment in sustainable practices (Atif et al., 2020). Empowered women often use their financial resources to support and implement eco-friendly technologies and practices. Thus, financial inclusion strategies should be expanded to encourage more women to invest in sustainable ventures.

Finally, our findings on supportive social norms (H6) and strong legal protections (H7) align with research from countries like USA, China, India, and Australia. In these countries, strong gender equality frameworks are associated with higher levels of environmental sustainability. These support structures create an environment where women can engage more actively in sustainability efforts (Leal Filho et al., 2023; Shinbrot et al., 2019).

Theoretical implications of these findings suggest that concepts of women's empowerment and gender equality are not only essential in social and economic contexts but also crucial for achieving environmental sustainability goals. In the managerial context in Indonesia, these findings indicate that companies and the government need to strengthen efforts that support gender equality, not only as part of corporate social responsibility (CSR) but also as a strategy to support environmental sustainability. Integrating programs that enhance women's access to education, health, and economic opportunities, while protecting their rights, can contribute to greater environmental awareness and action across various sectors. Consequently, corporations should integrate gender-responsive sustainability strategies into their operational frameworks to maximize environmental impact. Therefore, environmental sustainability in Indonesia can be driven through policies and practices that comprehensively support women's empowerment.

The path analysis results indicate that hypotheses H8 through H14 are not supported, meaning that government policies did not significantly moderate the relationships between various dimensions of women's empowerment and environmental sustainability in Indonesia. This lack of moderation attributed to several factors observed during the research. One reason is that the government policies in place may not be sufficiently robust or effectively implemented to influence these specific relationships. For instance, while policies may exist on paper, their practical enforcement and impact on ground-level initiatives related to gender equality and environmental sustainability might be weak or inconsistent.

The complexity of interactions between government policies and societal factors like education, employment, and healthcare often limits the effectiveness of policies in promoting environmental sustainability through women's empowerment. These dimensions are deeply embedded in cultural and economic contexts, making them resistant to change by policy alone. Government policies may also lack specificity in addressing how women's empowerment impacts environmental outcomes, leading to a diluted effect. This aligns with studies from Africa, where policies often fail to achieve practical impact due to implementation challenges and lack of integration with socio-economic factors. To address this, policymakers should adopt a multi-sectoral approach that ensures better alignment between gender, environmental, and economic policies.

The rejection of hypotheses H8 through H14 suggests that government policies may not be as influential in moderating the relationship between women's empowerment and environmental sustainability as initially thought. This challenges the assumption that policy interventions alone can bridge gaps between gender equality and environmental outcomes, highlighting the need for a more integrated approach that includes community engagement and cross-sector collaboration. Therefore, the Indonesian government must strengthen policy enforcement mechanisms to ensure that gender and environmental policies produce tangible results. In Indonesia, these findings suggest that organizations and policymakers should focus on grassroots initiatives and independent strategies to promote gender equality and environmental sustainability, rather than relying solely on government interventions. A reevaluation of existing policies is also necessary to ensure they effectively support these interconnected goals.

Several expected relationships in this study were found to be insignificant, particularly the moderating role of government policies in linking women's empowerment to environmental sustainability. This finding has crucial implications for both policy development and practical implementation. One key reason for the lack of significance is that existing policies, while present on paper, may lack sufficient enforcement mechanisms, leading to weak implementation at the grassroots level. Limited institutional capacity, inadequate funding, and bureaucratic inefficiencies often hinder the translation of policy objectives into tangible outcomes. As a result, policies intended to enhance gender equality and environmental sustainability may remain ineffective in practice.

Moreover, the complexity of interactions between government policies and socio-economic structures presents another major challenge. Education, employment, and healthcare, as critical dimensions of women's empowerment, are deeply embedded in societal norms and economic systems. Policies alone are insufficient if they fail to address underlying cultural and structural barriers, such as gender biases in the labor market, unequal access to quality education, and societal expectations that limit women's participation in decision-making processes. For example, in regions where patriarchal norms dominate, policy interventions may face resistance from local communities, reducing their effectiveness in fostering women's leadership in environmental sustainability initiatives.

From a practical standpoint, these findings highlight the urgent need for a more integrated, multi-stakeholder approach to women's empowerment and environmental sustainability. Rather than relying solely on government policies, private sector actors, non-governmental organizations (NGOs), and local communities must be actively involved in promoting gender-inclusive sustainability initiatives. Corporate social responsibility (CSR) programs should prioritize women's leadership in green entrepreneurship and community-driven environmental conservation projects. At the same time, grassroots organizations should play a role in fostering local engagement, ensuring that gender equality efforts are contextually relevant and culturally sensitive.

In terms of policy implications, this research suggests that Indonesian policymakers need to reevaluate existing policies to ensure they are not only well-designed but also effectively enforced. Policies should be accompanied by clear implementation frameworks, better resource allocation, and monitoring mechanisms to measure impact. Additionally, rather than adopting one-size-fits-all policies, a localized and participatory policy approach is needed. Governments should work closely with communities to understand region-specific challenges and develop targeted interventions that align with local socio-economic realities.

Beyond policy and practical considerations, the findings of this study also carry significant social implications. The lack of government policy effectiveness in moderating the relationship between women's empowerment and environmental sustainability suggests broader systemic issues related to social inclusion and equity. If policies fail to create meaningful change, women—particularly those from marginalized backgrounds—may continue to face barriers to economic and environmental participation. This, in turn, could exacerbate existing social inequalities and limit the potential for inclusive sustainable development.

To address these challenges, it is essential to promote social awareness and advocacy campaigns that shift societal perceptions of women's roles in sustainability. Media, educational institutions, and local influencers should be leveraged to challenge traditional gender norms and highlight the contributions of women in environmental management. Furthermore, gender-sensitive capacity-building programs should be expanded, equipping women with the skills and knowledge necessary to engage in sustainability efforts effectively.

Overall, the insignificant findings regarding policy moderation serve as a critical reminder that policy interventions alone are insufficient. A holistic approach that combines policy reform, grassroots engagement, and social transformation is necessary to ensure that women's empowerment contributes meaningfully to environmental sustainability in Indonesia. This requires stronger partnerships between the government, private sector, and civil society organizations to drive systemic change and sustainable impact.

6. Conclusion

The findings of this study have significant practical and policy implications, particularly in highlighting the direct relationship between women's empowerment and environmental sustainability in Indonesia.

The supported hypotheses (H1–H7) clearly indicate that various aspects of gender equality, such as education, economic empowerment, political participation, and access to healthcare, play a crucial role in promoting sustainable environmental practices. However, it is important to acknowledge that while these factors contribute to environmental sustainability, their impact may vary across different socio-economic and geographical contexts. Future research should explore these variations to provide more targeted policy recommendations. These findings make it evident that both governmental and private sector actors must urgently and systematically integrate gender equality principles into national and corporate sustainability frameworks to achieve tangible environmental outcomes. This further reinforces the need for both the government and the private sector to integrate gender equality principles into broader sustainability frameworks.

From a practical perspective, these findings suggest that organizations, businesses, and civil society groups should develop initiatives specifically aimed at increasing women's participation in sustainability efforts. Specifically, stakeholders should implement targeted programs that directly engage women in leadership roles within environmental projects, ensuring that their contributions influence decision-making and project outcomes. Corporate social responsibility (CSR) programs can be designed to empower women in green entrepreneurship, renewable energy projects, and environmental conservation initiatives. Additionally, community-based interventions led by NGOs and local organizations should focus on grassroots programs that equip women with skills in sustainable agriculture, waste management, and climate resilience. To enhance effectiveness, these interventions should be tailored to local contexts, taking into account cultural norms, economic conditions, and resource availability. These actions will not only strengthen women's roles in environmental initiatives but also improve the overall effectiveness of community-level sustainability programs. Education and awareness campaigns also play a critical role in shaping future female leaders with strong environmental consciousness, making the integration of environmental education with gender equality topics in schools and universities a necessity.

Beyond practical applications, this study also presents key policy implications that must be addressed. The lack of support for hypotheses H8–H14 suggests that current government policies do not significantly influence the relationship between women's empowerment and environmental sustainability. This highlights a critical policy disconnect where gender equality efforts are not yet fully leveraged to advance environmental sustainability agendas. This misalignment indicates that existing policies may lack proper coordination across different governmental agencies, leading to fragmented and inconsistent policy implementation. This indicates several policy gaps that need to be addressed. One of the main challenges is weak policy implementation. Although Indonesia has various policies supporting gender equality, their enforcement mechanisms remain ineffective, limiting their impact on environmental sustainability. Therefore, stronger implementation, monitoring, and accountability mechanisms for existing policies are essential. Hence, reinforcing policy implementation through improved monitoring systems, performance evaluations, and clear accountability structures is vital to closing this gap.

Furthermore, the lack of policy integration remains a major barrier. Many environmental policies have yet to explicitly incorporate gender-responsive strategies. The findings underscore the urgent need for policymakers to embed gender considerations into climate action plans, green financing mechanisms, and regulatory frameworks to create more holistic and effective sustainability policies. Policymakers must ensure that gender issues are embedded in climate action plans, sustainability regulations, and environmental funding mechanisms. In addition, policymakers should establish gender-sensitive budgeting mechanisms to ensure adequate resource allocation for women's empowerment initiatives in environmental sustainability efforts. The study's findings also suggest that top-down government approaches have been less effective compared to community-based initiatives. Thus, the government must

collaborate more closely with local communities, especially women's groups, in designing socially and culturally relevant environmental policies. By adopting a participatory approach that involves grassroots women's networks, policies can become more contextually appropriate and yield greater on-the-ground impact. Additionally, stronger legal and institutional support is necessary to enable women to actively participate in environmental decision-making.

The social impact of these findings also cannot be ignored. Women's empowerment in environmental sustainability is not only a matter of policy effectiveness but also part of a broader social transformation. If gender barriers persist, the potential of women as agents of environmental change will remain underutilized. This can exacerbate social inequality, reinforce restrictive gender roles, and hinder the success of various sustainability initiatives. Therefore, social change initiatives should focus on dismantling deep-rooted gender biases that limit women's roles in environmental governance. The study calls for addressing these socio-cultural constraints through targeted awareness campaigns, gender-sensitive leadership development, and the institutionalization of inclusive community engagement practices. Moreover, gender norms and cultural expectations play a crucial role in shaping environmental behaviors. In communities where women are excluded from decision-making processes, their ability to adopt sustainable practices such as household waste reduction, clean energy adoption, or participation in conservation efforts is significantly constrained. Therefore, addressing socio-cultural challenges through awareness campaigns, local advocacy, and community-based reforms is essential to achieving meaningful progress.

Overall, this study underscores that while women's empowerment has a positive impact on environmental sustainability, current government policies have yet to strengthen this relationship effectively. An integrated strategy is essential, combining robust gender-responsive policy reforms, private sector mobilization, grassroots empowerment, and cultural transformation, to fully unlock the potential of women as leaders in environmental sustainability. A more comprehensive approach is required, encompassing policy reforms, private sector engagement, grassroots movements, and social transformation. Future policy efforts should also focus on the intersectionality of gender, poverty, and environmental sustainability to develop more inclusive and equitable solutions. By strengthening gender-responsive policy enforcement, encouraging private sector participation, and addressing socio-cultural barriers, Indonesia can maximize the potential of women as key drivers in achieving more inclusive and sustainable environmental progress.

6.1. Theoretical, practical, and social implications

The study's findings underscore the importance of integrating gender into environmental sustainability theories, as women's empowerment is shown to be a crucial factor in promoting sustainable practices. The acceptance of hypotheses H1–H7 highlights this connection, suggesting that theories on environmental sustainability should incorporate gender dimensions to reflect the role of women in driving sustainability efforts. Conversely, the rejection of hypotheses H8–H14 indicates that government policies alone may not effectively mediate the relationship between women's empowerment and environmental outcomes, pointing to the need for theoretical frameworks that account for broader societal and cultural factors.

From a practical perspective, organizations and policymakers in Indonesia should focus on developing holistic strategies that combine gender equality with environmental sustainability. For businesses, this involves enhancing women's access to education, healthcare, and economic opportunities, which not only fulfills corporate social responsibility but also contributes to broader sustainability goals. Government agencies must also improve policy enforcement and consider community-based initiatives to address the complex interactions between gender and environmental issues.

Socially, the study highlights the critical role of women's empowerment in fostering a more sustainable future. Promoting gender equality through access to education, employment, and legal protections enables women to contribute more effectively to environmental conservation efforts. Supportive social norms and legal frameworks are essential for creating an inclusive environment where women can actively engage in sustainability initiatives, leading to more equitable and sustainable outcomes for society as a whole.

In addition, this study provides specific managerial and policy recommendations derived from the study's findings to enhance women's role in achieving environmental sustainability.

Short-term policies.

1. Engage private sector actors, NGOs, and local communities in designing and implementing gender-responsive sustainability initiatives.
2. Develop corporate social responsibility (CSR) programs that prioritize women's leadership in green entrepreneurship and community-based conservation projects.
3. Empower grassroots organizations to strengthen local engagement in gender-sensitive and culturally relevant sustainability efforts.

Medium-term policies.

4. Review and reformulate government policies to be more specific in linking women's empowerment with environmental sustainability.
5. Strengthen policy implementation mechanisms through enhanced institutional capacity, adequate budget allocation, and effective monitoring and evaluation systems.
6. Apply localized and participatory policy approaches to ensure interventions address region-specific needs and challenges.
7. Align national policies with community-based programs to create a more tangible impact on women's empowerment and environmental sustainability.

Long-term policies.

8. Launch public awareness campaigns that challenge traditional gender norms and encourage women's active participation in environmental management.
9. Involve media, educational institutions, and community leaders in reshaping public perceptions of women's contributions to sustainability.
10. Expand gender-sensitive training and capacity-building programs to enhance women's skills and knowledge in sustainability fields.

6.2. Limitations and recommendations for future studies

This study has several limitations that affect its findings.

The study focuses only on Indonesia, making its findings less applicable to other countries with different socio-economic, cultural, and political contexts.

1. Dependence on Available Data

The study relies on existing datasets that may have inaccuracies, inconsistencies, or gaps, affecting result reliability. Future research should prioritize higher-quality data.

2. Weak Policy Moderation Effects

Government policies did not significantly influence the relationship between women's empowerment and environmental sustainability due to implementation challenges, lack of political will, and institutional weaknesses.

3. Cross-Sectional Data Limitations

The study uses cross-sectional data, limiting its ability to establish causal relationships. Longitudinal studies are needed for a better understanding of long-term effects.

4. Lack of Comparative Analysis

The study does not compare Indonesia's findings with other countries, limiting insights into alternative policy approaches and best practices.

5. Exclusion of Additional Influencing Factors

Other key factors like community engagement, economic conditions, and private sector contributions are not extensively considered, requiring a more holistic approach in future research.

6. Challenges in Measuring Social and Cultural Influences

The study does not fully account for traditional gender roles, societal norms, and cultural resistance, which significantly impact women's roles in sustainability efforts.

7. Limited Focus on Grassroots and Private Sector Contributions

It primarily examines government policies while overlooking the roles of grassroots movements, NGOs, and private sector initiatives in driving gender-inclusive sustainability.

8. Policy Fragmentation and Lack of Integration

Gender and environmental policies in Indonesia often lack coordination across sectors, leading to inefficiencies. A more integrated policy approach is necessary for greater impact.

By addressing these limitations, future studies should be.

- Conduct cross-national comparative analyses by incorporating alternative theoretical frameworks, such as intersectionality or ecofeminism, to assess the applicability of findings in different socio-economic and political contexts.
- Utilize longitudinal data combined with mixed-method approaches to establish deeper causal relationships between women's empowerment and environmental sustainability.
- Improve data collection methodologies by integrating participatory research methods, such as focus group discussions and community-based participatory research, to enhance reliability and comprehensiveness.
- Investigate the role of community engagement, social movements, and local economic conditions while also considering the influence of institutional frameworks and governance quality in influencing sustainability outcomes.
- Explore qualitative approaches, such as ethnographic studies or narrative analysis, to understand cultural and societal barriers to women's participation in environmental efforts.
- Assess the effectiveness of corporate and grassroots initiatives through comparative case studies that examine diverse gender-responsive sustainability strategies across sectors and regions in advancing gender-responsive sustainability strategies.

CRedit authorship contribution statement

Tia Rahmania: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization.
Fatchiah Kertamuda: Formal analysis, Data curation. **Septantri Shinta Wulandari:** Visualization, Validation, Investigation, Formal analysis.
Asep Marfu: Software.

Declaration of the use of AI

This research utilizes AI technology for data analysis and writing. AI was used as a tool to assist in the research process, not as a replacement for scientific judgment.

Data availability statement

The data underlying this research are available upon request. To access the data, please contact the author via email.

Ethical statement

This study was conducted in accordance with the American

Psychological Association (APA) Ethical Principles and was reviewed and approved by the Psychology Committee Ethic, University of Paramadina. Informed consent was obtained from all participants, ensuring they were fully aware of the study's objectives and their rights. The confidentiality and anonymity of participants were upheld throughout the research. All data were handled with the highest level of care and used exclusively for research purposes. No conflicts of interest were reported.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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