Original Article

Green Governance: A Route to Enduring Development in a Developing Nation—A Case Study on Bangladesh

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Abstract

The main objective of this study was to determine how green governance can lead to sustainable development in Bangladesh. This study also includes factors that come into effect while ensuring green governance, such as policies and regulations regarding green governance, stakeholder engagement (SE), monitoring and reporting (MR), resource management (RM) and green technologies (GT). Data were collected through a survey questionnaire in which 330 respondents participated, and the data were analysed using SPSS software. The findings of this quantitative study support that policies and regulations, SE, MR, RM, GT, and so on, can lead Bangladesh to implement green governance as a pathway to sustainability. The findings of this study may contribute to the development of green governance, which may bring the country to the forefront of sustainable development and a growing market through sustainable products and services. Bangladeshi people and companies will become aware of environmental laws, regulations and guidelines; how to track environmental indicators, such as carbon emissions, water quality, biodiversity and sustainable development indicators; and how they can implement green governance. This study used a structured survey questionnaire to identify and quantify constraints on the practical implications of Green Governance in Bangladesh.

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Introduction

The concept of green governance refers to government, organisational civilisation and community efforts to maintain environmental sustainability and manage natural resources responsibly. Essentially, it is a holistic approach to governance that prioritises organisations and protects the environment while balancing economic development and social progress (Gulsrud et al., 2018; Khan et al., 2022). Green governance integrates environmental considerations into governance structures, policies and practices, promoting the harmonious coexistence of civilisation and nature (Jackson, 2019).

Green governance merges at all levels, ranging from policy to community initiatives, as it aims to harmonise economic growth with environmental sustainability. This is paramount for developing countries, such as Bangladesh, which face severe ecological degradation and climate vulnerabilities. Recent studies show that a well-rounded sustainable governance system can lead to economy-focused resiliency, ecological preservation and socio-economic inclusiveness simultaneously (Fang et al., 2022; Hasan et al., 2021; Hossain et al., 2023).

Bangladesh has experienced unfettered deforestation, increasing pollution and climate phenomena such as rising seas, unpredictable rain cycles and heightened cyclones. These challenges put the country at its centre (Haque et al., 2022). In response, the country is appreciating The Bangladesh Delta Plan 2100, which proposes natural, positive, energy-sustainable and environmentally friendly urbanisation as essential for national progress (Abid et al., 2021). By adopting effective green governance, Bangladesh can curb severe economic and environmental challenges while simultaneously guaranteeing increased economic diversification, food security and poverty reduction (Hossain & Bhuiyan, 2022).

At the global level, green governance is being consolidated with circular economy models, carbon-neutral initiatives and climate-resilient infrastructure (Durán-Romero et al., 2020). Bangladesh launched its Green Growth Framework, which focuses on environmental conservation, clean energy use, modern agricultural methods and industrial development (Daily Sun, 2024; Xue et al., 2022). If carried out effectively, these initiatives can significantly enhance the ecological health of Bangladesh and allow the country to assume a leadership role in sustainable development efforts in the world, which would result in an influx of green investment and the development of green markets (Ikram et al., 2021).

The environmental challenges plaguing Bangladesh include deforestation, water and air pollution and climate change. Sustainable natural resource management (RM) can be improved through green governance, which offers practical solutions to address these issues (Aftab et al., 2022; Doytch & Narayan, 2021; Song et al., 2019). To enhance living standards and decrease poverty, Bangladesh should prioritise green governance, which could lead to the benefits of sustainable practices such as renewable energy, eco-tourism and sustainable agriculture (Zhang et al., 2020). Climate change impacts such as rising sea levels, more frequent cyclones, and changing rainfall patterns are among Bangladesh's most pressing challenges (Rahman & Hossain, 2019). However, effective green governance will enable a country to adapt to and minimise these negative impacts.

Many trends are going on these days that concern green governance, including promoting renewable energy sources such as solar and wind power, planning for a sustainable future, integrating circular economy practices, and designing climate-resilient infrastructure (Sharma et al., 2020). Bangladesh can remain at the forefront of sustainable development by understanding and implementing such trends (Ahmed et al., 2020). Protection of biodiversity is one of the most important global priorities. For example, the Sundarban mangrove forest is a unique ecosystem in Bangladesh with a wealth of biodiversity of global significance (Albitar et al., 2022). Currently, the world cares more about shifting towards eco-friendly practices; hence, Bangladesh can take itself into the growing market through sustainable products and services. Through the implications of green governance, Bangladesh can seize the economic opportunities available, which might include the export of sustainable goods and attracting eco-conscious investments (Ahmed, 2019).

Several studies have explained and described the concept of green governance (Debbarma & Choi, 2022; Gladun et al., 2021; Li et al., 2020). Other theoretical studies have focused on how green governance can transform and how it can be applied to sustainable development (Li, 2022; Robinson & Ji, 2022; Shah et al., 2022). Some researchers have examined the Chinese perspective of green governance and its implications for sustainable development (Liu et al., 2022; Wei & Shang, 2023). Several studies have focused on the use of environmental and social governance for sustainable development (Bulbul & Ahmed, 2019; Gustafsson & Lidskog, 2018; Haque et al., 2022). A study was conducted on the Higher Education Sustainability Initiative (HESI), which encourages higher education institutions (HEIs) to create ambitious pledges to attain one or more of the United Nations' sustainable development objectives (Moon et al., 2018).

Like most studies, green governance has been heavily criticised and debated, yet its implementation has seldom been addressed, especially in Bangladesh, where few case studies have been conducted (Abid et al., 2020; Doytch & Narayan, 2021). Most academic efforts have been made with regard to theoretical innovations or case studies from different Asian countries, such as India, Pakistan and China (Baidya & Nandi, 2020; Zhai et al., 2022; Zheng et al., 2022), without considering the socio-environmental and policy particularities of Bangladesh. However, no study has focused on the holistic integrated dimensions of green governance, including legal instruments, stakeholder participation, environmental protection monitoring systems, targeted RM, and the use of advanced technologies in sustainable development from a developing country's perspective. Therefore, this study seeks to meet this specific goal and fill this gap through empirical analysis. Against this background, the key objective of this study is to determine how green governance can lead to sustainable development in Bangladesh. This quantitative study collected responses from 330 respondents.

The hypotheses in this study were formulated based on a comprehensive review of the literature and theoretical underpinnings of green governance and sustainability. Constructs such as Policy & Regulations (PR), Stakeholder Engagement (SE), Monitoring & Reporting, RM, and Green Technologies (GT) were selected based on their recurrent citations in the environmental governance literature. Each hypothesis aligns these constructs with the practical implications of green governance in Bangladesh, structured through a deductive approach (Table 1).

Table 1. Hypotheses Development Process.

Independent Variable	Hypotheses Development Process	Sources of Construct
Policy and regulations (PR)	Environmental regulations are laws and policies enacted by governments and regulatory bodies to limit or control the environmental impact of human activities.	Borsatto and Bazani (2020); Zhang et al. (2021)
	Carbon pricing policies are government policies that place a price on carbon emissions to encourage lower greenhouse gas emissions.	Green (2021); Roser (2021); Khurshid et al. (2022)
Stakeholder engagement (SE)	Public consultations involve soliciting feedback and input from the public regarding policies, plans and projects.	De Vries and Petersen (2019); Cheng et al. (2020)
	Multi-stakeholder partnerships refer to collaborations between NGOs, communities, industry and the government to jointly address sustainability issues.	Lozano et al. (2019); Wu et al. (2020)
	Corporate social responsibility initiatives refer to the actions taken by companies to address sustainability issues.	Elkington and Dahan (2019); Grewatsch and Kleindienst (2020)
Monitoring and reporting (MR)	Environmental Impact Assessments (EIAs) are systematic evaluations of the environmental consequences of proposed projects.	Briassoulis (2021a); Bajpai et al. (2020)
	Carbon footprint measurement and reporting quantify GHG emissions from organisations or products.	Chen et al. (2020); Klaaßen and Stoll (2021)
	Sustainable Development Indicators (SDIs) track progress towards long-term development goals.	Kishimoto et al. (2019)
Resource management (RM)	Sustainable land-use practices, such as avoiding deforestation and promoting efficient irrigation.	Kishimoto et al. (2019); Visser et al. (2019)
	Water conservation measures include improving irrigation, rainwater harvesting and regulating industrial use.	Corral-Fernández et al. (2019); Anser et al. (2020)

(Table 1 continued)

(Table 1 continued)

Independent Variable	Hypotheses Development Process	Sources of Construct
	Circular economy approaches involve reusing resources, reducing waste and regenerating the natural systems.	Fan et al. (2019)
Green technologies (GT)	Renewable energy sources include solar, wind and hydropower.	Baidya and Nandi (2020); Oliveira et al. (2021)
	Energy-efficient building design to reduce energy use while maintaining comfort.	Janda et al. (2020); Eichholtz et al. (2020)
	Electric vehicles and infrastructure are needed to charge them.	Boesch et al. (2020); International Energy Agency (2020)

Hypotheses Development

Policy & Regulations

Government policies such as renewable energy targets, carbon taxes and emission standards have significant impacts on RM and GT. According to Hao et al. (2021), policies, such as carbon taxes, have been shown to reduce greenhouse gas (GHG) emissions. Green tools, such as nuclear power and renewable energy, can help decarbonise the national clean energy agenda, which is crucial for maintaining environmental quality. Yue et al. (2022) stated in their article that the use of renewable energy resources can be expanded as a means of achieving carbon neutrality, which requires innovative energy systems.

Environmental Regulations (PR-1)

Environmental regulations are laws and policies enacted by governments and regulatory bodies to limit or control the environmental impacts of human activities. Borsatto and Bazani (2020) argue that regulatory pluralism can be used to design policy mixes for environmental protection. Air and water pollution, waste management and biodiversity conservation are issues that can be addressed by these regulations. Environmental protection and business social responsibility have been explored from the business, economic and legal perspectives (Zhang et al., 2021). Environmental regulations are implemented to ensure that individuals, businesses and industries operate in ways that have low environmental impact.

Carbon Pricing Policies (PR-2)

According to Green (2021), carbon pricing policies are government policies that place a price on carbon emissions in order to encourage lower GHG emissions. By establishing carbon prices, it is possible to establish a mechanism whereby those who cause emissions pay for countermeasures that benefit society and the environment (Roser, 2021). A carbon tax assesses the fee per ton of CO_2 emitted, whereas a cap-and-trade system captures the total emissions and allows businesses to trade emission allowances (Khurshid et al., 2022). Based on the above discussion, we can hypothesise that

H_1: Policy and Regulations influence the practical implications of Green Governance.

Stakeholder Engagement

SE is essential for promoting sustainable RM and GT. Stakeholders, such as NGOs, local communities and industry, play a dynamic role in influencing the development of green policies and regulations (Stocker et al., 2020). Studies have shown that effective SE leads to better RM and GT outcomes. For example, Pelyukh et al. (2021) found that SE in sustainable forest management led to more effective forest conservation practices.

Public Consultations (SE-1)

Public consultations are a form of SE that involve soliciting feedback and input from the public on policies, plans and projects related to RM and GT. According to De Vries and Petersen (2019), public consultations provide an opportunity for stakeholders to express their opinions and concerns, which can then be incorporated into the policy and decision-making processes. Similarly, Cheng et al. (2020) found that public consultations were effective in promoting stakeholder participation and building trust between stakeholders and decision makers.

Multistakeholder Partnerships (SE-2)

Multistakeholder partnerships refer to collaborations between multiple stakeholders, such as NGOs, local communities, industry and government, to jointly address sustainability issues related to RM and GT (Wu et al., 2020). Multi-stakeholder partnerships can leverage the expertise and resources of different stakeholders, leading to more effective and innovative solutions to sustainability challenges, as mentioned by Lozano et al. (2019). Lozano et al. (2019) also found that multistakeholder partnerships were effective in promoting SE and building consensus on sustainability issues.

Corporate Social Responsibility Initiatives (SE-3)

Corporate social responsibility initiatives refer to actions taken by companies to address sustainability issues related to RM and GT. According to Elkington and Dahan (2019), corporate social responsibility initiatives can benefit companies by improving their reputation and increasing their competitiveness while also contributing to sustainable development. Similarly, Grewatsch and Kleindienst (2020) find that corporate social responsibility initiatives are effective in promoting SE and building trust in local communities.

H_2: Stakeholder Engagement influences the practical implications of Green Governance.

Monitoring and Reporting (MR)

Monitoring involves tracking environmental indicators such as carbon emissions, water quality and biodiversity. Reporting involves communicating information to stakeholders in order to ensure transparency and accountability.

Environmental Impact Assessments (MR-1)

An environmental impact assessment (EIA) is a systematic assessment that identifies and forecasts the potential environmental consequences of a proposed project or development (Morrison-Saunders et al., 2016). EIAs assess the impacts of a variety of factors, including water, air, soil, biodiversity and human health, and propose mitigation measures if negative effects are observed (Gupta & Patel, 2019). EIAs are critical tools for ensuring that projects are designed and implemented in an environmentally sustainable manner (Briassoulis, 2021a). In many countries, EIAs are required before infrastructure projects such as roads, dams and power plants can be approved (Bajpai et al., 2020).

Carbon Footprint Measurement and Reporting (MR-2)

Carbon footprint measurement and reporting is the process of quantifying and disclosing the volume of GHG emissions produced by a person, organisation, or product. Measuring a carbon footprint entails identifying the sources of emissions, calculating GHG emissions and reporting results in a clear and accessible manner (Chen et al., 2020). Carbon footprint reporting is critical for organisations to identify their contribution to climate change and take steps to reduce emissions. It can also assist organisations in demonstrating their commitment to sustainability and gaining a market-competitive advantage (Klaaßen & Stoll, 2021).

Sustainable Development Indicators (MR-3)

Sustainable development indicators (SDIs) are quantitative and qualitative measures that track progress toward long-term development objectives (SDGs). SDIs measure poverty, health, education, energy, biodiversity and governance to assess the sustainability of economic, societal and ecological systems (Kishimoto et al., 2019). SDIs are critical tools for governments, businesses and civil societies to identify areas of progress and challenges in their pursuit of sustainable development.

H_3: Monitoring and reporting influence the practical implications of Green Governance.

Green Governance

As a controllable variable, green governance includes factors such as policies and regulations, SE, monitoring and reporting. Studies have shown that effective green governance leads to better RM and GT outcomes. Li et al. (2020) found that effective green governance is essential for promoting sustainable fisheries management.

Resource Management

Green governance has a significant effect on RM. Effective green governance can lead to better conservation practices, the sustainable use of resources, and better ecosystem management. Song et al. (2019) found that effective green governance leads to better conservation practices in marine ecosystems. E. Corral-Fernández et al. (2019) mentioned that green governance practices, such as SE and the use of incentives, were effective in promoting soil conservation practices in Spain.

Sustainable Land Use Practices (RM-1)

By utilising land resources sustainably, future generations will be able to meet their personal needs without compromising the present generation's ability to do so. Such practices include avoiding deforestation, promoting reforestation, using efficient irrigation methods and minimising soil degradation. According to Kishimoto et al. (2019), sustainable land-use practices can minimise GHG emissions and moderate climate change. Moreover, effective green governance can promote sustainable land-use practices by regulating land-use changes, promoting sustainable agriculture and providing incentives for farmers to adopt sustainable land-use practices (Visser et al., 2019).

Water Conservation Measures (RM-2)

Water conservation measures refer to strategies and practices aimed at reducing water consumption, waste and pollution. Such measures can include improving irrigation efficiency, recycling wastewater, promoting rainwater harvesting and regulating industrial water use (N. Corral-Fernández et al., 2019). Green governance can play a significant role in encouraging water conservation measures by providing incentives for water conservation, regulating industrial water use, and promoting public awareness campaigns regarding water conservation. Green governance can encourage the sustainable management of water resources such as rivers, lakes and aquifers by regulating their use and preventing pollution (Anser et al., 2020).

Circular Economy Approaches (RM-3)

Using a circular economy approach, resources are reused for as long as possible, waste is reduced, and natural resources are regenerated. Such approaches include redesigning products to make them more durable and reusable, promoting closed-loop recycling systems, and reducing the use of raw materials. Green governance can promote circular economy approaches by providing regulatory frameworks that incentivise businesses to adopt circular practices, promoting public awareness campaigns about the benefits of circular economy approaches, and encouraging collaborations among stakeholders to facilitate the transition to circular economies. In addition, effective green governance can facilitate the implementation of circular economy approaches by supporting research and development efforts, providing funding for circular economy projects, and promoting international cooperation in circular economy initiatives (Fan et al., 2019).

H_4: Green Governance helps firms through Resource Management.

Green Technologies

Green governance also plays a crucial role in promoting GT. Effective green governance can lead to increased investment in GT and expansion of new technologies. For example, Baidya and Nandi (2020) found that effective green governance led to increased investment in renewable energy technologies. Janda et al. (2020) found that green governance practices such as energy efficiency standards and labelling were effective in promoting the approval of energy-efficient technologies in the construction sector in Europe.

Renewable Energy Sources (GT-1)

Renewable energy sources can replenish themselves naturally and can be repeatedly used. Solar energy, wind energy and hydropower are renewable energy sources (Irfan et al., 2021). According to Baidya and Nandi (2020), effective green governance has resulted in increased investment in renewable energy technologies. This is due to the fact that green governance adopts the expansion and utilisation of renewable energy technologies. Oliveira et al. (2021) discovered that the use of renewable energy sources in buildings can significantly reduce carbon emissions.

Energy-efficient Building Design (GT-2)

An energy-efficient building design entails creating structures that use less energy to provide the same level of comfort as traditional structures. According to Janda et al. (2020), green governance practices, such as energy efficiency standards and labelling, have been effective in promoting the embracing of energy-efficient technologies in the construction sector in Europe. Eichholtz et al. (2020) found that energy-efficient buildings have higher occupancy and rental rates than traditional buildings.

Electric Vehicles and Charging Infrastructure (GT-3)

Electric vehicles (EVs) run on electricity rather than fossil fuels. The charging infrastructure refers to the network of charging stations that EVs can use to recharge their batteries. International Energy Agency (IEA) (2020) reported that the number of electric passenger cars on the road will exceed 10 million by 2020, indicating the increasing popularity of EVs. Another study, published in 2020 by Boesch et al., discovered that installing a public charging infrastructure was effective in increasing EV adoption.

Figure 1 presents how the five independent variables, such as policy and regulations, stakeholder engagement, monitoring and reporting, resource management, and green technologies, influence the dependent variable, that is, green governance. The developed model will be tested statistically in the data analysis section.

H_5: Green Governance helps to create Green Technologies.

Graphical Model.

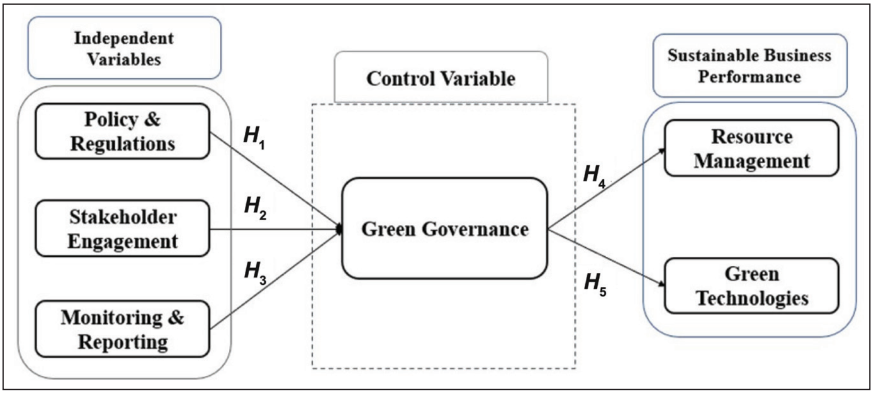

Figure 1. Model Developed by the Researchers.

Methodology

Research Design

This study used a quantitative approach to assess the connection between sustainable development and green governance in Bangladesh through statistical analysis. A standardised survey questionnaire was used to gather data from 330 respondents from a diverse range of industries, including government departments, environmental organisations, businesses and academic institutions, both online and offline.

Method of Data Analysis

SPSS was used as the main analytical tool to ensure in-depth and methodical analysis of the collected data. SPSS is a well-known statistical program for data administration, advanced analytics and visualisation. The selection of SPSS was driven by its capacity to manage sizable datasets effectively and perform intricate statistical analyses with precision and dependability.

Measurement

The constructs used in this study were created based on a survey of published journals. There were three independent and two dependent constructs in the conceptual model. The literature cited in Table 2 was used to generate constructs.

Sampling Plan

A structured questionnaire was developed to gather primary data. According to the questionnaire's first section, the respondents were demographically diverse. In the final section, respondents scored construct items on a 5-point Likert scale, starting with 'strongly agree' and ending with 'strongly disagree'. The total sample size was 330, which was sufficiently large for this study (Hair et al., 2018).

Table 2. Literature Used to Generate the Constructs.

Constructs	Items	Relevant Literature
Policy and regulations (PR)	Environmental regulations	Borsatto and Bazani (2020); Zhang et al. (2021)
	Carbon pricing policies	Green (2021); Roser (2021); Khurshid et al. (2022)
Stakeholder engagement (SE)	Public consultations	De Vries and Petersen (2019); Cheng et al. (2020)
	Multistakeholder partnerships	Lozano et al. (2019) Elkington and Dahan (2019);
	Corporate social responsibility initiatives	Grewatsch and Kleindienst (2020)
Monitoring and reporting (MR)	Environmental impact assessments (EIAs)	Briassoulis (2021a); Bajpai et al. (2020)
	Carbon footprint measurements and reports	Chen et al. (2020); Klaaßen and Stoll (2021)
	Sustainable development indicators (SDIs)	Kishimoto et al. (2019)
Resource management (RM)	Sustainable land-use practices	Kishimoto et al. (2019); Visser et al. (2019)
	Water conservation measures	N. Corral-Fernández et al. (2019); Anser et al. (2020)
	The circular economy approaches	Fan et al. (2019)
Green technologies (GT)	Renewable energy sources	Baidya and Nandi (2020); Oliveira et al. (2021)
	Energy-efficient building design	Janda et al. (2020); Eichholtz et al. (2020); Li et al. (2018)
	Electric vehicles and charging infrastructure	Boesch et al. (2020); International Energy Agency (2020)

We conducted a Multistage Sampling by selecting and visiting the distributors of the three selected industries based on Simple Random Sampling, where a lottery was performed to select the distributors. We took the age group of 16–64 because these groups would be able to understand and reply to the questions with sufficient strategic and realistic thought; therefore, the 0–15 age group was excluded. Additionally, we focused our poll mainly on current and potential clients residing in the city of Dhaka. A group of 11 people, both male and female, were arranged to make the survey more efficient.

Stage 1: Every eight thanas in one cluster were distributed randomly among all 48 Thanas in Dhaka using a cluster lottery. This resulted in the creation of six cluster groups, each consisting of eight thanas. From each cluster, the top eight thanas were chosen: Motijheel, Paltan, Ramna, Khilgaon, Dhanmondi, Mohammadpur and Hazaribagh in 'Dhaka'.

Stage 2: We created a list of Solar Panel Distributors and identified 31 enlisted distributors. It is based on five dimensions that are significant for choosing distributors: Socioeconomic Status, Population Density, Geographical Location, Infrastructure and Availability of Services. Thirteen solar panel distributors were finalised for this study.

We identified 16 enlisted distributors from our list of Hybrid Car Distributors in Bangladesh. Based on the five dimensions of the discussed Socioeconomic Status, population density, geographical location, infrastructure and availability of services, we finalised nine outlets of Hybrid Car Distributors in Bangladesh.

Finally, we made a list of ‘Eco-Friendly AC Distributors’ in Bangladesh, where 12 distributor names have been found. Based on the five dimensions mentioned above, we selected ‘eight outlets of Eco-Friendly AC Distributors’ in Bangladesh. Therefore, the total sample size was 30, with 13 samples from Solar Panel Distributors and Suppliers, nine from hybrid car distributors and eight from Eco-friendly AC distributors.

The respondents were selected from each outlet using systematic random sampling. A random number ‘5’ was generated using an Excel spreadsheet. A survey was conducted with every 5th consumer who came out of the outlets.

Table 3 presents the sample size and area selection criteria. It also focuses on the scaling technique used in the structured questionnaire.

Table 3. Sampling Plan.

Sample Respondents	Selection Criteria	Industry-wise Distributors and Customers Who Are Using the Products in Dhaka City
	Area	Dhaka city
	Time	May–June, 2023
Sample size	Solar panel industry	143
	Hybrid car industry	99
	Eco-friendly AC industry	88
	Total	330
Scaling technique	Multiple-choice Questions, 5-point Likert Scale	

Table 4. Reliability Test (Pilot Survey).

Constructs	Cronbach’s Alpha
Policy and regulations (PR)	0.955
Stakeholder equity (SE)	0.853
Monitoring and reporting (MR)	0.887
Resource management (RM)	0.702
Green technology (GT)	0.756

Pilot Survey

Data Analysis of Pilot Survey

Reliability

According to Table 4, all five constructs have 'Cronbach's Alpha' values greater than '0.7'. As a result, it can be determined that all constructs are reliable enough for further study.

Regression

Resource Management

The R-value is 0.928 (Table 5), which is greater than 0.5, which means the three independent items—PR, SE and MR—are good influencing factors for increasing RM. The R^2 and adjusted R^2 values were quite close, and the significance value of the ANOVA table was 0.000, which was less than 0.05, indicating that the model summary was valid. In the coefficient table, the significance values of all three items/constants are 0.005, 0.004 and 0.000, less than 0.05, indicating that PR, SE and MR can strongly explain variation in RM.

Green Technology

The R-value is 0.840 (Table 6), which is greater than 0.5, which means that the three independent items—PR, SE and MR—are good influencing factors for increasing RM. The R^2 and adjusted R^2 values were quite close, and the significance value of the ANOVA table was 0.000, which was less than 0.05, indicating that the model summary was valid. In the coefficient table, the significance values of all three items/constants are 0.003, 0.005 and 0.001, less than 0.05, indicating that PR, SE and MR can strongly explain the variation in GT.

Table 5. Dependent Variable—Resource Management (RM).

Model Summary						
Model	R	R^2	Adjusted R^2	Std Error of the Estimate		
1	0.928[a]	0.860	0.844	0.25538		
Coefficients[b]						
		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std Error	β	t	Sig.
1	(Constant)	0.696	0.247		2.816	0.009
	Mean_PR	0.203	0.065	0.277	3.104	0.005
	Mean_SE	0.278	0.089	0.336	3.141	0.004
	Mean_MR	0.363	0.089	0.463	4.074	0.000

Notes: [a]Predictors: (Constant), Mean_MR, Mean_PR, Mean_SE.
[b]Dependent Variable: Mean_RM.

Table 6. Model Summary and Coefficients.

Model Summary					
Model	R	R^2	Adjusted R^2	Std Error of the Estimate	
1	0.840[a]	0.705	0.671	0.36166	

Coefficients[b]						
		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std Error	β	t	Sig.
1	(Constant)	1.925	0.350		5.501	0.000
	Mean_PR	–0.306	0.093	–0.427	–3.299	0.003
	Mean_SE	0.388	0.126	0.481	3.094	0.005
	Mean_MR	0.456	0.126	0.597	3.618	0.001

Notes: [a]Predictors: (Constant), Mean_MR, Mean_PR, Mean_SE.
[b]Dependent Variable: Mean_GT.

Table 7. Reliability Test (Final Survey).

Constructs	Cronbach's Alpha
Policy and regulations (PR)	0.948
Stakeholder equity (SE)	0.843
Monitoring and reporting (MR)	0.884
Resource management (RM)	0.694
Green technology (GT)	0.715

Data Analysis of Final Survey

Reliability

We conducted a reliability test (Table 7) for the five constructs on the basis of our final survey, where the value of 'Cronbach's Alpha' for four constructs is higher than 0.7, and one construct, which is 'Resources Management', is 0.694 closer to 0.7; this is the maximum value without deleting any items. Therefore, all constructs are reliable.

Data Analysis from Regression

Resource Management

The R-value is 0.928, which is greater than 0.5, indicating that the three independent items—PR, SE and MR—are good influencing factors for increasing RM. The R^2 and adjusted R^2 values (Table 8) were quite close, and the significance value of the ANOVA table was 0.000, which was less than 0.05, indicating that the model summary was valid (Table 9). In the coefficient table, the significance values of all three items/constants are 0.005, 0.004 and 0.000, respectively, less than 0.05, indicating that PR, SE and MR can strongly explain variations in RM.

Table 8. Regression for Dependent Variable—Resource Management (RM).

Model Summary				
Model	R	R^2	Adjusted R^2	Std Error of the Estimate
1	0.932[a]	0.868	0.867	0.23839

Note: [a]Predictors: (Constant), policy and regulations (PR), stakeholder engagement (SE), monitoring and reporting (MR).

Table 9. ANOVA and Coefficient Test.

ANOVA[a]						
Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	122.343	3	40.781	717.607	0.000[b]
	Residual	18.526	326	0.057		
	Total	140.870	329			
Coefficients[a]						
		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std Error	β	*t*	Sig.
1	(Constant)	0.599	0.069		8.634	0.000
	Mean_PR	0.199	0.018	0.266	11.233	0.000
	Mean_SE	0.293	0.023	0.348	12.522	0.000
	Mean_MR	0.378	0.023	0.483	16.271	0.000

Notes: [a]Dependent variable: Resource management (RM).
[b]Predictors: (Constant), policy and regulations (PR), stakeholder engagement (SE), monitoring and reporting (MR).

Green Technology

The R-value is 0.842 (Table 10), which is greater than 0.5, indicating that three independent items—PR, SE and MR—are good influencing factors for increasing RM. The R^2 and adjusted R^2 values were quite close, and the significance value of the ANOVA table was 0.000, which was less than 0.05, indicating that the model summary was valid. In the coefficient table, the significance values of all three items/constants are 0.003, 0.005 and 0.001, less than 0.05, indicating that PR, SE and MR can strongly explain the variation in GT.

Factor Analysis

These communalities provide insight into the degree of association between each variable and the underlying constructs extracted through principal component analysis (PCA). Variables with communalities close to 1.000, such as 'Environmental Regulations', 'Carbon Pricing Policies', 'Public Consultations', 'Multi-Stakeholder Partnership', 'Carbon footprint measurement and measurement', 'Sustainable development indicators (SDIs)' and 'Water conservation measures', are strongly represented by the identified factors, indicating high reliability in their relationship with the constructs (communalities range from 0.874 to 0.974).

Table 10. Regression for Dependent Variable, Green Technology (GT).

Model Summary				
Model	R	R^2	Adjusted R^2	Std Error of the Estimate
1	0.842[a]	0.709	0.706	0.32678

Note: [a]Predictors: (Constant), policy and regulations (PR), stakeholder engagement (SE), monitoring and reporting (MR).

Table 11. ANOVA and Coefficient Test.

ANOVA[a]						
Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	84.762	3	28.254	264.585	0.000[b]
	Residual	34.812	326	0.107		
	Total	119.574	329			

Coefficients[a]						
		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std Error	β	*t*	Sig.
1	(Constant)	2.160	0.095		22.698	0.000
	Mean_PR	–0.314	0.024	–0.454	–12.896	0.000
	Mean_SE	0.349	0.032	0.450	10.874	0.000
	Mean_MR	0.444	0.032	0.617	13.957	0.000

Notes: [a]Dependent variable: Green technology (GT).
[b]Predictors: (Constant), policy and regulations (PR), stakeholder engagement (SE), monitoring and reporting (MR).

Table 11 (ANOVA) shows that the regression model is statistically significant (F = 264.58, $p < .001$), meaning that the predictors (Policy and Regulations, Stakeholder Engagement, Monitoring and Reporting) jointly explain a significant amount of variation in Green Technology adoption.

The Coefficients Table also presents the following findings:

- **Policy & Regulations (PR):** PR has a significant but negative effect (β = –0.454, $p < .001$), indicating that stricter policies may hinder green technology adoption.
- **Stakeholder Engagement (SE):** Shows a positive impact (β = 0.450, $p < .001$), suggesting that more engagement boosts adoption.
- **Monitoring and Reporting (MR):** This has the strongest positive effect (β = 0.617, $p < .001$), highlighting that better monitoring systems greatly encourage green technology use.

Table 11 is highly significant, with stakeholder engagement and monitoring/reporting being strong positive drivers of green governance, whereas policies and regulations appear to have an inverse relationship.

Those with moderate communalities (0.734 to 0.885), including '(CSR) Corporate Social Responsibility', 'Sustainable land use practices', 'Energy efficient building design' and 'Electric Vehicles and Charging Infrastructure', contribute to the factors, but also possess some unique variance. Variables with lower communalities (0.318 to 0.790), such as 'Environment Impact Assessments (EIAs)', 'Circular economy approaches', 'Renewable Energy Sources' and 'Annual spending on any sort of CSR (environment)-related activities', may have weaker associations with the identified factors or contain significant unexplained variance, suggesting the need for further investigation into their relationship with the underlying constructs. The table depicts the variance explained by each principal component extracted through PCA. The first component exhibited the highest initial eigenvalue of 10.650, explaining 53.248% of the total variance with a cumulative percentage of 53.248%. The second component contributed 16.490% of the variance (cumulative 69.738%), whereas the third and fourth components explained 8.313% and 7.176% of the variance, cumulatively reaching 78.051% and 85.227%, respectively. The subsequent components show diminishing percentages of the explained variance. Rotation of the components did not significantly alter the explained variance. Overall, the initial components, particularly the first four, play a substantial role in capturing variance within the dataset, with diminishing returns observed in the latter components.

The component matrix illustrates the relationships between the environmental sustainability variables and the components extracted from the PCA. Each cell represents the correlation coefficient between variables and. Variables with higher absolute values in a component indicated stronger associations with that component. For instance, 'Mean_RM', 'Mean_MR', 'Mean_SE', 'Sustainable development indicators (SDIs)' and 'Carbon footprint measurement and measurement' exhibit strong correlations with Component 1, suggesting that they are primarily influenced by this component.

Similarly, 'Multi-Stakeholder Partnership', 'Water conservation measures' and 'Environmental Regulations' Environmental Regulations show strong associations with Component 4, implying a unique influence of this component on these variables. This analysis aids in understanding the underlying factors driving environmental sustainability practices and policies.

The rotated component matrix illustrates the relationships between environmental sustainability variables and the components extracted from PCA with varimax rotation. Each cell represents the correlation coefficient between the variable and the component after rotation. The rotation method aims to simplify the interpretation of components by maximising the variance of the loadings. Variables such as 'Carbon footprint measurement and measurement', 'Sustainable development indicators (SDIs)' and 'Water conservation measures' exhibit strong correlations with Component 1, suggesting a common underlying factor influencing these variables. Similarly, 'Mean_PR', 'Environmental Regulations' and 'Carbon Pricing Policies' Carbon Pricing Policies are strongly associated with Component 2, implying a shared influence on corporate social responsibility and policy-related variables. This analysis provides a clearer understanding of the underlying factors driving environmental sustainability practices and policies and facilitates informed decision-making in environmental management.

The component transformation matrix reveals the reshaping of the original components extracted through PCA after rotation with Varimax with Kaiser

Table 12. Summary of Hypothesis Testing Results.

Hypothesis	Construct	β Coefficient	Sig. Value	Result
H_1	Policy & regulations	0.266	0.000	Supported
H_2	Stakeholder engagement	0.450	0.000	Supported
H_3	Monitoring & reporting	0.617	0.000	Supported
H_4	Green governance → RM	0.483	0.000	Supported
H_5	Green governance → GT	0.617	0.000	Supported

normalisation. Component 1 maintains its structure with a high loading on itself (0.612) and moderate loadings on Components 2 (0.486), 3 (0.445) and 4 (0.437). Component 2 experienced a significant transformation, demonstrating a high loading on itself (0.864) and notable negative loadings on Components 1 (–0.325) and 3 (–0.356). Similarly, Component 3 shows a high loading on itself (0.642) and moderate loadings on Components 1 (–0.709) and 4 (0.287), while Component 4 undergoes substantial changes with a high loading on itself (–0.840) and moderate loadings on Components 1 (0.132), 2 (0.120) and 3 (0.513). This transformation elucidates how the original components are reoriented and realigned after rotation, providing valuable insights into the rotated component structure and facilitating a deeper understanding of the underlying relationships among variables.

Table 12 presents the findings of the tested hypotheses. All five hypotheses were accepted.

Hypotheses Testing and Discussion

H_1: Policy and Regulations influence the practical implications of Green Governance.

As the significance level for the data analysis was .000, this finding was supported by the data analysis. The β coefficient value indicates 26.6% of the dependent variable, suggesting that, when firms have effective policies and regulations in place, they are likely to have a positive influence on their execution of Green Governance practices ($\beta = 0.266$).

Therefore, H_1 is accepted.

These findings match the views of Jänicke and Jörgens (2020), who state that PR play crucial roles in the practical implications of green governance. Another study by Johnson et al. (2020) found similar results, highlighting the significant influence of PR on the practical implications of green governance in organisations.

H_2: Stakeholder Engagement influences the practical implications of Green Governance.

This fact is supported by the significance level (0.000) below 0.5 in the data analysis. In addition, the value of $\beta = 0.450$ indicates that 45.0% of the stakeholders have a significant positive impact on the practical implications of Green Governance. Thus, this hypothesis is accepted. This view is supported by Shahzad et al. (2020), who mentioned that SE creates positive pressure on organisations' adoption of environmental practices. Blühdorn and Deflorian (2019) supported the hypothesis that SE influences the practical implications of Green Governance. Danso et al. (2019) found that SE plays a noteworthy role in driving environmental performance and sustainability practices in organisations.

> H_3: Monitoring and reporting influence the practical implications of Green Governance.

The data collection substantiated this hypothesis (significance level: 0.000). The value of the β coefficients in the regression model for the dependent variable GT indicates that 61.7% of the dependent variable can be clarified by this construct ($\beta = 0.617$).

> H_4: Green Governance helps firms through Resource Management.

H_4 identifies whether Green Governance helps firms through RM. This was supported by the data analysis, with a significance level of <0.05. A coefficient of 0.4883 indicates that 48.3% of the customers agree that Green Governance assists firms in managing their resources.

Therefore, hypothesis 4 is accepted. There is a significant rapport between green governance and RM, because organisations that practice green governance have effective RM strategies, leading to improved efficiency, reduced waste and enhanced sustainability (Briassoulis, 2021a; Johnson & White, 2021; Smith et al., 2020).

> H_5: Green Governance helps to create Green Technologies.

Finally, H_5 emphasises the establishment of GT with the help of Green Governance. In the regression model for GT (Danso et al., 2019), this construct is significant, with a β coefficient of 0.617, suggesting that 61.7% of the dependent variable is described by this construct. This hypothesis is consistent with the findings of Li and Luo (2020), who explore the relationship between green governance and technological innovation. Their study highlights the significance of MR techniques in promoting the development of GT.

Managerial Implications

Understanding the practical implications of green governance is crucial for managers to design and implement effective sustainability strategies. Including Ecological Factors in Decision-Making: Managers must include ecological factors in their decision-making processes (Briassoulis, 2021b; Jänicke & Jörgens, 2020). This includes considering the potential environmental impact of corporate activities, analysing alternative eco-friendly options and making educated decisions that match long-term goals.

Adoption of GT and Practices

Organisations should adopt GT and practices to reduce the use of resources, emissions and waste generation. This could include investing in renewable energy sources, developing energy-efficient technologies and implementing sustainable production processes (Guo et al., 2020).

Improving SE

Managers should actively engage stakeholders to improve transparency and obtain support for their long-term efforts. This can be accomplished through regular communication, collaboration and solicitation of inputs to build a sense of shared responsibility for environmental goals (Barko et al., 2021).

Finally, managers should expand their sustainability focus beyond the limits of their firms by applying green supply chain management strategies. Working collaboratively with suppliers and consumers to decrease carbon emissions, promote recycling and reuse, and pick environmentally friendly suppliers are all part of this (Rausch-Phan & Siegfried, 2022).

The managerial implications of green governance include incorporating environmental factors into decision-making, deploying GT and practices, increasing stakeholder participation and implementing green supply chain management. These implications necessitate managers to be proactive in developing sustainability and connecting organisational strategies with environmental goals. By embracing green governance principles, organisations can contribute to a more sustainable future while improving their reputation and competitive advantage.

Limitations and Future Research

The first limitation of this study was the sample size; the sources of distributors were online; therefore, the recently updated list is not included here. Second, researchers do not know the actual customer size. Therefore, this aspect should be analysed in future studies. The third limitation is the informal distribution of products between distributors, which was not included in the dataset. Further research should be conducted in other countries.

Conclusion

In conclusion, green governance in Bangladesh has proven to be a significant pathway for sustainable development through the implementation of environmentally friendly policies and practices. This approach has resulted in positive transformations in sectors such as energy, agriculture and waste management. The literature review shows that policies and regulations, SE, MR, RM and GT can lead to green governance in Bangladesh. The aim of this project was to examine how sustainable development in Bangladesh can be achieved through green governance, and how factors such as policies and regulations related to green governance, SE, monitoring and reports, RM and GT can contribute to this.

Carbon taxes can reduce GHG emissions, and renewable energy and nuclear power can help decarbonise the clean energy agenda, which plays a critical role in maintaining the environment. Forest conservation practices are more effective when stakeholders are engaged in sustainable management. Chen et al. (2020) discussed the importance of identifying sources of emission, calculating GHG emissions, and reporting these results. Efficient green governance can improve soil and marine ecosystem conservation practices. The European building sector has adopted energy-efficient technologies more effectively as a result of green governance practices such as energy efficiency standards and labelling.

Based on these results, firms are more likely to implement Green Governance practices when they have effective policies and regulations. SE is critical for green governance and sustainability initiatives and supports the hypothesis that SE can affect the practical consequences of sustainability initiatives. MR, specifically in terms of developing GT, are essential for the success of green governance initiatives. Green governance and RM are also strongly related. Organisations that practice green governance are more efficient, reduce waste and enhance sustainability through effective RM strategies. This study supports the importance of MR techniques to promote the development of GT. The outcomes of this study emphasise the integration of green policies and regulations into governance frameworks, which have led to improved RM, reduced environmental degradation, increased use of renewable energy sources, enhanced energy access, adoption of sustainable agricultural practices and positive impacts on waste management. Bangladesh can progress towards a more sustainable and resilient future across various sectors by integrating green policies, regulations and practices.

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