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Undergraduate Level Research The Governance-Corruption-Environment Nexus: Evidence from BIMSTEC Countries

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Abstract

This study is trying to investigate the interplay between democracy, corruption, and environmental degradation across the Bay of Bengal Initiative for Multisectoral and Economic Cooperation (BIMSTEC) region. The BIMSTEC group, consisting of seven diverse countries, plays an important role in regional economic cooperation and faces significant challenges related to governance and environmental sustainability. Utilizing a panel of seven BIMSTEC countries spanning a period from 2000 to 2019, this study sheds some light to investigate the complex association between political factors, specifically democracy and political stability, and their impact on environmental degradation, measured by carbon emissions. To assess this relationship, apply fixed effect and random effect estimation approach.

The result indicates that democracy and political stability have the positive impacts on carbon emissions. Our findings also affirm that corruption negatively influence the carbon emission. Regression results indicate that democracy increases carbon emissions. Our findings also show that increase in population density has a positive and significant impact on carbon emissions. Outcomes also indicate that a more politically stable country distributes more carbon emissions across the BIMSTEC region. Democratic systems frequently face delays in enacting and enforcing stringent environmental regulations due to political negotiations, interest group lobbying, and the complexities of coalition governance. Governments may prioritize economic development, often postponing environmental regulations to boost economic growth.

***Keywords*: Corruption, Democracy, Political stability, Carbon emission, BIMSTEC region, Fixed effect, Random effect**
JEL Codes: C23, C50, O57, P18

1. INTRODUCTION

Carbon emission has been the most challenging environmental issue in our time and has attracted the attention of international organizations, policymakers, and researchers. Globally, carbon emissions have increased nearly 2.5 times over the last two decades. Rapid carbon emission causing the weather variation and climate change. Due to global warming, 20 out of 23 major cyclone disasters in the world have occurred around the Bay of Bengal, particularly in Bangladesh and India in the last two decades which needed the concern on this matter. Now, it has become a global phenomenon, and the impact has wreaked havoc in almost all parts of the world. From 2000 to 2019, carbon emissions in the BIMSTEC region rose significantly, with India contributing the most, followed by Thailand and Bangladesh (see Figure 1).

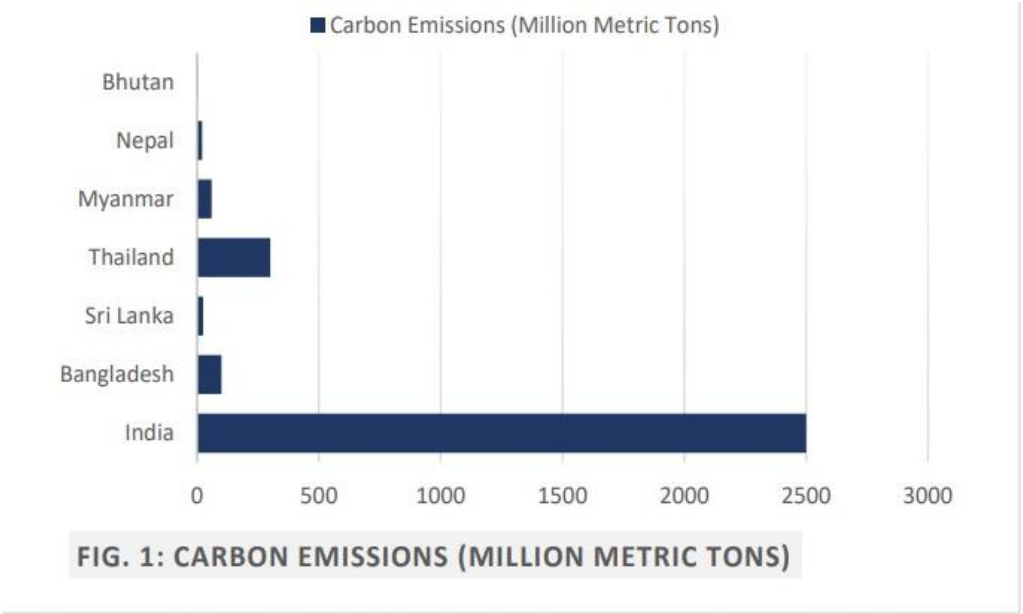

FIG. 1: CARBON EMISSIONS (MILLION METRIC TONS)

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Source: Authors' compilation based on World Bank Data

Increased carbon emissions have been kicking the greenhouse effect out of balance. Due to carbon emissions, polluted air harms human health and increases healthcare costs. Excessive heat can negatively impact labourers and can severely disrupt crop cycles. Air pollution and heat outages reduce productivity. Extreme weather conditions like floods can damage roads, bridges, and buildings. Climate change also affects crops, reducing food and income. Rising sea levels and decreasing labour productivity would drive the most significant losses. The severe flood in the Indian state of Kerala in 2018 was the result of high rainfall during the monsoon season. It was the worst flood ever witnessed in Kerala in nearly a century, which left 12 lakh people homeless and more than 300 people dead. Property worth more than Rs 20,000 crore was lost. As these extreme conditions are associated with a large number of deaths and destruction of assets, they compel us to study their effect on the behaviour of households, individuals, and aggregate economic outcomes, such as poverty and inequality.

Climate change hits the poorer section of society the hardest—those people living in vulnerable areas with the fewest resources to help them adapt or recover quickly from. As the effects of carbon emissions worsen, escaping poverty becomes more and more difficult. India has the highest number of people globally. A rise of 1°C in the mean long-run temperatures in India causes a rise of 53% in farm revenues of the poor and a 33% loss of their off-farm earnings compared to those who are non-poor households. India is estimated to contribute approximately 3.4 crore of the eight-crore expected heat stress-related job losses globally by 2030. The Reserve Bank of India's recent report estimates that India's GDP may be jeopardized by as much as 4.5% by 2030, due to lost working hours due to extreme heat and humidity. Climate change amplifies water stress—the proportion of total water needed to accessible water supplies—resulting in heightened competition for water, even war. Climate change is transforming weather patterns, causing more and more intense episodes of extreme weather, unreliable water supplies, augmenting water scarcity, and polluting water supplies. Such impacts can drastically affect the quantity and quality of water that children need to survive.

Long-term reliance on fossil fuels has caused severe environmental problems, including global warming, air pollution, and rising sea levels (Ghosh et al., 2023). To ensure economic growth is not hindered, we must prioritize poverty reduction and sustainable development while addressing climate change. Since a nation's democratic processes are negatively connected with environmental deterioration (Ghosh et al., 2023), good governance is essential to minimizing corruption and environmental degradation (Safdar et al., 2022; Petersen, 2024). However, corruption damages the world economy about US$2.6 trillion a year and hinders democratic processes and efforts to mitigate climate change. Promoting transparency, accountability, and civic involvement is crucial because carbon footprints are driven by fossil fuels, democracy, and political instability (You et al., 2015). These issues can be lessened by enforcing stringent regulations, teaching people to refuse bribes, and incorporating climate action into national policies. Furthermore, agroforestry, urban forestry, and reforestation are examples of nature-based solutions that improve biodiversity and lower emissions.

This paper aims to analyse the interplay among democracy, corruption and environmental degradation across the Bay of Bengal Initiative for Multisectoral and Economic Cooperation (BIMSTEC) region using a panel data approach over 20 years (2000-2019). Due to carbon emissions, which are increasing day by day, various sectors, including agriculture, tourism, manufacturing, transportation, insurance, etc., are badly affected.

The rest of this article is organized as follows: Section 2 highlights some previous empirical studies. Section 3 presents data and adopted methodology. The next section contains empirical findings and discussions. The last section provides some key takeaways and end up with some references.

2. BACKGROUND AND CONTEXT

As the time passes, humans are making rapid growth from every aspect to make their life more easy-going, more comfortable but the question is what about nature, the environment … Is it comfortable? Is it the same as before? No, it's not. Day by day, the environment has to pay for every deed the humans do for their own development. And the increased rate of carbon emission can be taken as an attention grabbing example which is becoming a critical issue on the environment from climate change to intolerable temperature rising. The researchers are taking huge interest in this topic, and our study is trying to shed some light on some key factors (democracy, corruption, political stability, GDP per capita and fossil fuel) which instigate the carbon emission directly or even indirectly. This study intends to fill the gap by investigating the effect of political factors on carbon emission.

The world has experienced a 30% rise in carbon emissions from the 19th century to the 20th century (Joshi and Beck, 2017). The data shows that since the industrial revolution the global carbon emissions were 182 times higher in 2022 than they were in 1850 (Vigna et al., 2024). And the atmospheric carbon emission levels were around 280 ppm but in 2023 carbon level reached 419 ppm representing a significant increase. In a sample of 98 countries for the year 1990, Midlarsky (1998) finds that a rise in the level of democracy increases carbon emissions per capita (Li, 2014). In this context, Lv (2017) demonstrates that democracy reduces carbon emissions but only if the

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country has reached a certain income level. Most full democracies are industrialized and high-income countries, and for this reason they emit comparably high levels of greenhouse gases per capita (Lindvall, 2021).

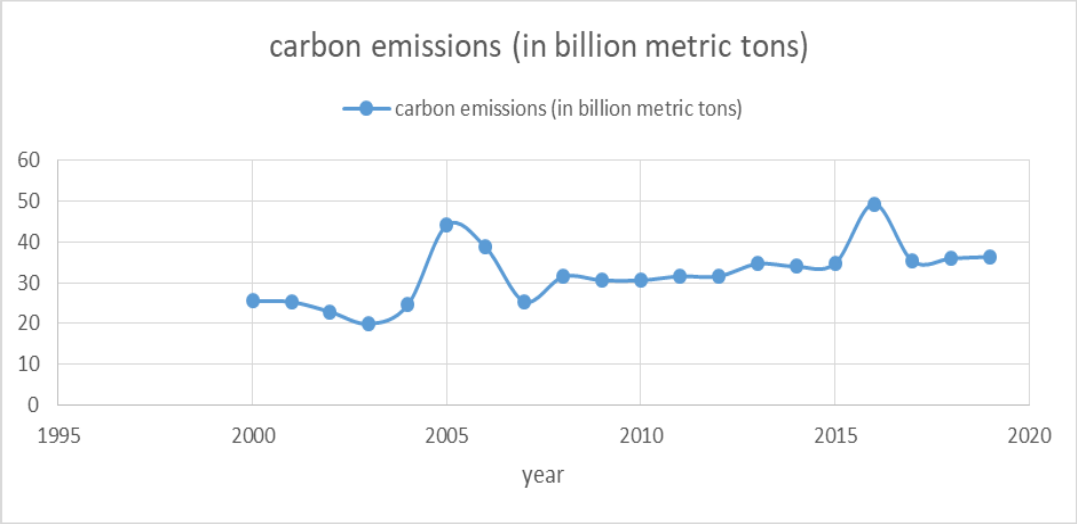
Corruption is the abuse of entrusted power or position for personal gain and benefit, involving dishonesty and illegal activities. The empirical studies in political science shows that democracy has limited effectiveness in the presence of corruption. Corruption can disturb the functioning of democracy in long term projects such as carbon reduction (Povetkina, 2018). Zhang et al. (2016) demonstrate that corruption has negative direct and positive indirect effects on carbon emissions. Ren et al. (2021) finding states that corruption increases carbon emission in the short run but in long run it reduces carbon emissions. Leitao (2021) empirical results suggest that corruption index and economic growth have a statistically significant positive impact on carbon emission.

Moreover, political stability is a situation where a country's government is peaceful, predictable, orderly, and well-governed. The data shows that a rise in political stability by 1% enhances carbon footprint by 0.08% at a significance level of 5%. Oyewo et al. (2024) findings suggest that Political stability has a positive and significant effect on carbon emissions performance. This refers to higher levels of political stability associated with increased carbon emissions rates. Benlemlih et al. (2022) claim that high political stability significantly reduces carbon emission in the short run but not in the long run.

Many studies show that a certain income level of a country can influence the level of carbon emission either negatively or positively. Khan et al. (2020) estimated results indicate that energy consumption and economic growth increase the carbon emission in both short run and long run in Pakistan. Nikensari et al. (2019) states that economic activities that require energy for example industry contribute 60% to carbon emissions. This is also in line with the contribution of the industrial sector which reaches 19.8% of national GDP, meaning that an increase in GDP causes environmental degradation in the form of carbon emissions (Ahmed et al., 2023). Between 2005 - 2012, the GHG emissions in India has increased by 44.8%, in Bangladesh 23.6% and in Thailand 18.2% along with their GDP.

Long et al. (2015) noticed in their study that the carbon emission has increased rapidly with coal consumption. Mostly electricity, cement production and other economic activities are linked with coal consumption which emits a great deal of carbon into the natural atmosphere. Energy supply is the largest single source of emissions, accounting for 26% of total 2004 global greenhouse gas emissions (Brenna, 2005). These emissions originate from the burning of coal, natural gas and oil for electricity and heat. According to the United States Environmental Protection Agency (2015) almost all (95%) of the world's transportation energy comes from petroleum based fuels, largely gasoline and diesel (Brenna, 2005). As we see , emission levels are highly correlated with level of energy use, in large part because almost 75% of all carbon dioxide stems from energy production or energy related activities, the majority coming from fossil fuel combustion (Baumert et al., 2005).

The growing population causes the increase in the use of energy such as fossil fuels which results in environmental degradation in the form of carbon emission (Nikensari et al., 2019). Liu et al. (2017) findings suggest that population density dominates over urbanization rate in changing per capita GHG emission. Within cities, the buildings consume 36% of energy and produce 40% of emissions (Zarco-Perinan et al., 2021).



Source: Authors' compilation based on World Bank Data

In the diagram, we demonstrate the rapid increase rate of carbon emission and it reached its highest in 2016 which is 49.4 billion metric tons after 2005. In between the time period from 2000-2019 the global carbon emission has increased by approximately 47%.

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Here in this study, we are trying to explores the link between political factors and carbon emission and how it impacts environmental degradation. It mainly focuses on the BIMSTEC region with the time period from 2000-2019.

The researcher determines the following problems in a threefold manner: (1) How can a democracy without corruption be effective in the welfare of a country's carbon emission problem? (2) As a country becomes economically developed will it continue to deteriorate the environmental quality? (3) How does population affect carbon emission in the BIMSTEC region in 2000-2019?

In a nutshell, this study is trying to examine the interplay among democracy, corruption and environmental degradation across the Bay of Bengal Initiative for Multisectoral and Economic Cooperation (BIMSTEC) region using a panel data estimation technique over the period of twenty years (2000-2019).

3. LITERATURE REVIEW

This section provides some important findings from previous empirical research. Subsequently, we will delve into several noteworthy studies that provide valuable insights into this particular area of inquiry. A strand of literature on environmental impact of several socio-political factors viz., democratic governance, militarization has studied in shaping policy implementations.

Clulow and Reiner (2022) examine the effect of democracy on renewable energy transition in the context of 135 developing countries across Europe, North America, Latin America, Asia, Africa, and Oceania. This study sheds light on the relationship between democracy and the use of low-carbon energy sources in developing economies. The study includes a set of controls including solar, wind, hydro, and nuclear energy used for electricity generation, spanning a period of 40 years of data from 1980 to 2020. This study uses cross-country comparison using time series data to investigate the shares of renewable energy used by 135 countries for electricity generation. This paper uses a two-level hierarchical model. Empirical results show that democracy has negative effects on solar, wind, and hydro energy utilization. Moreover, democracy has a positive influence on nuclear energy utilization within countries. Empirical results also show that emerging democratic countries are more likely to invest in hydro and nuclear energy compared to authoritarian countries with more developed economies.

Ghosh et al. (2023) investigate the spillover effects of democracy and renewable energy consumption on the environmental quality in the BRICS (Brazil, Russia, India, China, and South Africa) countries. This study examines the relationship between economic expansion, population, renewable energy, democracy, and carbon emissions in the BRICS countries. The study includes carbon emissions as a dependent variable and a bunch of controls, including economic expansion (GDP), population, use of renewable energy, and democracy, spanning a period of 30 years of data from 1990 to 2019. This study employs cross-sectional data from five different countries and an extended STIRPAT model, including the variables of democracy and democracy with GDP, to examine the case of the BRICS countries over 30 years. Empirical results show that GDP and population have a positive influence on increasing levels of carbon emissions, and increased use of renewable energy sources reduces environmental degradation and carbon emissions. Interestingly, the findings also show that the connection between good democracy and economic growth has a positive impact on creating a sustainable environment and in reducing carbon emissions.

Chou et al. (2019) investigate the influence of democracy on emissions and energy efficiency in the context of 26 countries in America. This study sheds light on the interplay between the development of democracy, carbon emissions, and energy efficiency. The study includes carbon emissions and energy efficiency as dependent variables and a set of controls, including democracy indicators, manufacturing value added, gross capital formation, labor force, price level, GDP, capital formation, and labor input, spanning a period of 23 years of data from 1990 to 2013. This study employs the quantile approach to examine how democracy and other factors affect America. Empirical results show that the deepening of democracy has a significant impact on the reduction of national carbon emissions and has a positive impact on energy efficiency. Moreover, the further application of quantile regression also indicates that the influence of democratization on carbon emissions and countries' energy-efficient scores is significant. Empirical results also illustrate the reduction of emissions or the improvement of energy-efficient outcomes from the enhancement of democratic institutions.

Pohjolainen et al. (2024) examine the roles of national affluence, carbon emissions, and democracy in a study on climate perceptions in the context of 23 European countries. This study sheds some light on the relationship between national-level factors and individual-level climate perceptions. The analysis is based on survey data from Round 8 of the European Social Survey with 44,387 respondents, collected in 2016-2017. This paper uses multilevel modeling (MLM) to examine the influence of national-level characteristics, including affluence, carbon emissions, and level of democracy, on what individuals perceive, think, feel, and do regarding climates. Empirical results demonstrate that democracy amplifies the interplay between climate concern and perceived climate responsibility. Moreover, results also illustrate that carbon emissions have less effectiveness on individual climate perceptions, and national affluence and democracy raise perceived climate responsibility.

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Brenna (2015) investigates the effect of democracy on greenhouse gas emissions in the context of 184 developing countries. This study explores the relationship between regime type and carbon emissions. The study includes carbon dioxide as the dependent variable and a set of controls, including income, income squared, trade, population density, war, Kyoto, oil, gas, and coal, to analyze the level of carbon emissions, spanning a period of 20 years of data from 1990 to 2010. This paper investigates how democracy level, dichotomous democracy and autocracy variables, and civil liberties influence carbon emissions per capita. This study employs cross-country comparison using time series data to analyze the level of emissions across 184 countries. This paper employs multiple imputation using amelia II, ordinary least squares with panel-corrected standard errors (PCSE), and fixed effects models. Empirical results show that democracies have larger reductions in their per capita carbon emissions compared to less democratic countries, and autocracies have larger reductions in their per capita carbon emissions compared to more democratic countries. Moreover, the results also emphasize that countries with a high degree of civil liberties have larger reductions in their per capita carbon emissions.

Li and Reuveny (2006) have investigated both theoretical and empirical aspects regarding how democracy affects environmental degradation. This study looks at the relationship between democracy and environmental degradation, specifically the effect of political regime type on environmental harms caused directly by human behaviors. The paper analyzes data over several time periods, including carbon emissions per capita (1961–1997 across 143 countries), organic water pollution (1980–1998 across 112 countries), deforestation rates (1980–2000 with a focus on the 1980s and 1990s), and land degradation (1980s across 105 countries).The study includes a set of dependent variables, including carbon emissions and nitrogen oxides emissions per capita, deforestation rate, land degradation, and water pollution, and a set of controls, including trade, real GDP per capita, population, conflict, and real GDP per capita squared. This study uses a regression model to investigate the impact of democracy on five dimensions of human-caused environmental deterioration. Empirical results show that a higher level of democracy leads to less carbon emissions per capita, less nitrogen oxides emissions per capita, less organic pollution in water, lower deforestation rates, and less land degradation. Furthermore, results also show that the effect of democracy on environmental degradation varies in size across degradation types and nonmonotonic effects of democracy that vary across the environmental indicators.

Tsur (2024) investigates the diverse effects of democracy on greenhouse gas emissions in the context of 150 countries, from developing to developed countries. This study examines the relationship between key characteristics of democracy and greenhouse gas emissions, with the aim of informing the design and implementation of climate policies within specific democratic contexts. This empirical paper consists of two modified overlapping groups of dependent variables— greenhouse gas emissions and carbon emissions—and a bunch of controls, including direct popular voting, civil society participation, liberal democracy, political civil liberties, freedom of expression, and judicial constraint on the executive, spanning a period of 30 years of data from 1990 to 2021. This paper uses threshold GDP analysis with fixed-effects regression to analyze the impact of different democratic attributes on greenhouse gas emissions. Empirical results show that direct popular voting stands out as the most effective in reducing emissions in both groups of greenhouse gases; civil society participation emerges as the second most effective in reducing emissions, and liberal democracy and political civil liberties reduce effectiveness. Moreover, results also show that freedom of expression reduces emissions effectively in high GDP countries, and judicial constraint on the executive reduces carbon emissions but remains ineffective in mitigating emissions from the broader greenhouse gas group.

Muttakin et al. (2022) analyzed in their study whether a country's level of democracy and culture are associated with greenhouse gas emission intensity of corporations across 37 countries. This study intends to fill the gap by investigating the effect of national culture in the association between level of democracy and GHG emission intensity. Drawing on Hofstede's cultural dimension, the paper examines the impact of national culture- focusing on individualism, uncertainty and greenhouse gas emission intensity, using a cross-country sample of 7,993 firm year observations spanning a period of 10 years from 2006 to 2016. Their findings suggest the importance of the holistic political approach to understanding the association between democracy and GHG emissions. Future studies may draw on a cross-country approach and investigate the usage of various types of databases, from which rich media coverage of environmental and GHG pollution activities and conflict can be accessed.

Chou et al. (2019) examined the study of world development indicators to analyse the relationship between the development of democracy development, co2 emissions and energy efficiency in the context of 26 countries. The study explores whether democracy plays a significant role on co2 emissions and energy efficiency In this study, the database of world bank's WDI (world development indicator), freedom house and polity index is used to collect and analyse relative data about energy use, economic and democratic indicators. In order to curb the tendency of global warming, UNFCCC (the United Nations Framework Convention on Climate Change) completed the Paris agreement in France, in the year of 2015. This agreement sets the target to control the global rise of temperature. The Paris agreement came into force in 2016, which symbolized the goal of international GHG reduction entering a new era. . They conduct the study utilizing the database reference from freedom house, polity IV project spanning from 1990 to 2013. They apply Quantile regression analysis to observe the influence of democratization on carbon dioxide emission and countries energy efficiency and the OLS regression analysis.

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The development of democratic system is significantly correlated with education, urbanization, age, income and income inequality of a country. Still the study shows some deficiencies. They have not figured out the reason why the legal and social or political mechanisms derived from democratization could affect energy use and environmental quality of a country, which remains to be further discussed. What's more, they are not sure whether the empirical results of our study could be applied to specific regions such as Africa, Middle East or other regions. Clulow (2018) investigates in this article whether democracies help countries to mitigate climate change. Utilizing data from the freedom house, polity IV and V-Dem indices, World Bank World Development indicators and the world resources institute climate data explorer it conducts a large-N investigation of emissions level of 147 countries. It gives a more sophisticated understanding about the influence of democracy on emissions by building a random coefficient model that allows the effect of democratization to vary between countries .Clulow also uses many other articles on this topic. The empirical analyses presented in this article provide strong evidence that democracy is an influential driver of emissions levels. The findings also suggest that the effect of democracy on emission varies significantly between different types of electoral systems. The article uses cross-section time series data to analyse the absolute emission level spanning of 22 years from 1990 to 2012. In this article Clulow apply OLS regression along with random effect and fixed effect. The results also show that the democratization of the same country does not always translate into lower emissions levels. The empowerment of environmental NGOs could prove to be a critical strategy in helping to ensure that the environmental impact of democratizing reforms, which are often pursued for non-environmental reasons, is positive.

Lindvall and Karlsson (2023) has explored the article and presented a review of research on democracy climate nexus which analysed the strengths and weaknesses of democracies in mitigating climate change around 100 countries. The research identified 72 articles verifying a correlation between the level of democracy and environmental performance, particularly related to local air pollutants. Democracies have proven more responsive to environmental degradation than autocratic regimes. Other studies confirm an association between democracy and water quality, biodiversity and soil erosion respectively. Several studies have found that the level of democracy has insignificant or even negative environmental effects. The overview shows that various scholars and studies interpret the democracy-climate nexus quite differently. Systematically exploring the literature on climate democracy nexus, and the capacities of various governing systems, many provide insights into which governance models may speed up climate transformation. This article presents the data of more than two decades of research on this topic. They apply quantile regression analysis as methodology. The paper demonstrates that democracies tend to generate better climate policy outputs, while the empirical evidence for democratic development to result in lower co2 emissions is weak. The influence of democracy on climate policy performance is difficult due to the profoundly different challenges. The review demonstrates that democracy, together with the development of renewable energy, improvement of governance capacity and reduction of income inequality, can contribute to the transformation towards a low carbon future.

You et al. (2015) has analyzed in their study that many determinants including Co2 emissions, democrats, and financial openness have a severe impact on global warming and climate change. They use the EKC hypothesis which indicates that the environmental degradation initially exaggerates when a country's per capita income is low, as the economy grows environmental degradation falls. Using a panel data model over the 1980 – 1998 period, Frazin and Bond (2006) find evidence the country's level of democracy and its associated freedoms is related positively to its environmental quality. Utilizing the panel quantile regression fixed effect model they derive different parameters estimates for various conditional quantiles of parameters. They also apply OLS regression analysis. They research on the sample set of 87 and 97 countries and the spanning of 20 years from 1985 to 2005. Using a panel dataset of 107 cities in 42 countries over the period of 1971 – 1996, Bernauer and Koubi (2009), find that democracies and especially presidential systems have a positive effect on air quality. Empirical evidence regarding the EKC hypothesis for Co2 is mixed, as some studies find linear relationships between Co2 emissions and per capita GDP. They find that economic prosperity and population size have a positive and significant effect on pollution. The most important finding is that democracy is highly significant and has the positive sign at lower quantile yet the magnitude decreases towards the higher quantile and in turn it becomes insignificant. However, it turns into negative and becomes insignificant again at higher quantiles. Further further studies are needed to achieve the unobserved individual heterogeneity and distributional heterogeneity with panel quantile regression with fixed effect model.

4. ANALYTICAL FRAMEWORK

Our goal is to assess the impact of democracy and corruption on carbon emissions and identify optimal policy strategies to reduce emissions. Let us define our key variables as follows:

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$C:$ Carbon emissions

D: Level of democracy of the economy

K: Corruption level of the economy

X: Other factors

We now model carbon emissions as a function of democracy, corruption, and other controls

$$C = C(D, K, X)$$

After then we construct an objective function subject to resource constraint or policy constraint that reflect the relationships between D, K, and X. Our goal is to minimize the C (carbon emissions). The objective function is defined as follows

$$Min\, C(D, K, X) = [(1 - \beta_1)D + \beta_2 K - \beta_3(D.K)] \tag{4.1}$$

Where:

$1 - \beta_1$ measures reduction in carbon emissions due to democracy

β_2 represents emissions due to corruption in the economy

β_3 captures how democracy influences the impact of corruption in an economy

We now introduce our constraint as follows

$$D + wK \leq R \tag{4.2}$$

Now, we construct our Lagrangian function as follows:

$$\mathcal{L}(D, K, X, \lambda) = C(D, K, X) + \lambda(R - D - wK)$$

To solve, we simply take partial derivatives of $\mathcal{L}$ with respect to $\mathrm{D}, \mathrm{K}, \mathrm{X}$ and λ, and set them to zero

$$\frac{\partial \mathcal{L}}{\partial D} = \frac{\partial C}{\partial D} - \lambda = 0 \tag{4.3}$$

$$\frac{\partial \mathcal{L}}{\partial K} = \frac{\partial C}{\partial K} - \lambda w = 0 \tag{4.4}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = R - D - wK = 0 \tag{4.5}$$

We now have a system of equations that can be solved simultaneously and get the optimal values for D^* and K^*. Based on the parameter values we shall be able to interpret how changes in democracy (D) and corruption (K) influence environmental decline in terms of carbon emissions (C).

5. DATA AND MODEL

5.1. Context

Our study primarily focuses on a panel of seven countries including Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka, and Thailand of the BIMSTEC region for the period 2000-2019. The choice time frame depends on the availability of data of the relevant variables across our study region. We enhance our model utilizing five factors as potential controls. These includes democracy index, political stability, control of corruption, per capita income, and population density. We use a country level dataset, obtaining from an array of sources. The description of variables including its sources are listed in Table 1. Utilizing a panel data estimation approach, the current study is trying to shed some light on the influence of political factors on environmental damage in terms of carbon dioxide emissions across the study region.

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Table 1. Variable description

Variable Name	Description	Source
CO2	Per capita Carbon dioxide emissions	WDI
Demo	Democracy Index. It ranges from 0 to 1 (most democratic)	OWD
Corr	Control of Corruption	WDI
Pols	Political stability	WGI
GDP	GDP per capita (Constant 2015 US$)	WDI
Popd	Population density (people per sq. km of land area)	WDI

Notes: WDI - World Development Indicators; OWD - Our World In Data; WGI - World Governance Indicators

5.2. Model specification

The present study is endeavouring to assess the influence of corruption, the level of democracy on carbon dioxide emissions across BIMSTEC countries focusing on nations within the region, spanning a period of twenty years from 2000 to 2019. To model the scenario, a panel data econometric approach is utilized. Subsequently, the baseline econometric model is formulated as follows:

$$CO_{2,it} = \beta_0 + \beta_1 Demo_{it} + \beta_2 Corr_{it} + \beta_3 Pol_{it} + \beta_4 \ln(GDP)_{it} + \beta_5 Pop_{it} + v_{it} \quad (5.2.1)$$

Where:

$CO_{2\,it}$ denotes the carbon emissions over country i at year t; $Demo_{it}$ is the democracy indicator; $Corr_{it}$ is the corruption indicator; Pol_{it} measures the political stability indicator; $ln\,(GDP)_{it}$ indicates the per capita GDP indicator; Pop_{it} denotes the population density; $\beta_0, ...,\beta_5$ are the estimable parameters, and v_{it} indicates the idiosyncratic error.

6. EMPIRICAL FINDINGS

This section exhibits the econometric results to test the relationship between democracy, corruption and environmental degradation (carbon emission). Table 2 reveals the general descriptive statistics for all variables utilized in our empirical study.

Table 2. Summary Statistics of the study variables

Variable	Obs.	Mean	Std. dev.	Min	Max
CO2	140	1.105	1.110	0.092	4.039
GDP	140	6044.413	4298.454	1123.416	17116.310
Pols	140	-0.805	0.839	-2.149	1.284
Corr	140	-0.448	0.719	-1.673	1.590
Demo	140	0.415	0.193	0.095	0.736
Popd	140	331.155	364.495	14.997	1266.905

Source: Authors' Calculation based on secondary data

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Now we proceed towards estimation. Firstly, we perform fixed effects estimation technique. Table 3 shows the estimation results considering the fixed effect (FE) method. Here we observe that in the context of BIMSTEC region, democracy influences the environmental degradation positively. For 1 unit change in democracy variable, ln(CO2) will increase by 1.153 unit, and the variable is significant at 1% level. The rest of the controls affects carbon emission in a positive manner. For 1 unit change in political stability variable, carbon emission will increase by 0.146 unit and the variable is significant at 1% level. Findings suggest that more politically stable economies emit more carbon. Politically stable economies attract more investment and promote industrial growth. This industrialization often relies on fossil fuels, particularly in developing economies. Governments may prioritize economic development, often postponing environmental regulations to boost economic growth.

Table 3: Results for Fixed-Effects (FE) Estimation

Ln(CO2)	Coefficient	Std. error	t-stat	p-value
Demo	1.153	0.159	7.260	0.000
Corr	0.163	0.102	1.600	0.112
Pols	0.146	0.050	2.940	0.004
Popd	0.007	0.001	9.070	0.000

Source: Authors' Estimation based on secondary datasets

Next, we move on to the random effect estimation method. Table 4 illustrates the random effect estimation results. Consistent with previous findings, this study also reflects a similar kind of association that that politically stable economies within the BIMSTEC region tend to exhibit higher levels of carbon emissions. For 1 unit change in Pols, ln(CO2) will increase by 0.146 unit, and the variable is significant at 1% level. Moreover, the variable Demo is also positive and significant. Democratic systems frequently face delays in enacting and enforcing stringent environmental regulations due to political negotiations, interest group lobbying, and the complexities of coalition governance. Furthermore, the variable Popd has a positive association with the Ln(CO2), and the variable is also significant at 1% level. As populations grow in a rapid manner, and urbanize, there is a shift towards the energy-intensive lifestyles viz., greater use of vehicles, appliances, and construction materials which are strongly linked to increased carbon emissions in the economy.

Table 4: Results for Random Effects (RE) Estimation

Ln(CO2)	Coefficient	Std. error	t-stat	p-value
Demo	1.009	0.163	6.210	0.000
Corr	0.272	0.103	2.640	0.008
Pols	0.172	0.052	3.310	0.001
Popd	0.005	0.001	7.650	0.000

Source: Authors' Estimation based on secondary datasets

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Next, we perform Hausman test to determine whether the fixed effects model or the random effects model is more appropriate for this study. Based on the chi-square statistic and its corresponding p-value, the study concludes that the fixed effects model is the appropriate choice for our estimation. The result for the Hausman test is presented in Table 5.

Table 5. Results for Hausman Test

chi2(4)	16.20
Prob > chi2	0.0028

Source: Authors' Estimation based on secondary datasets

7. CONCLUSIONS

We conduct our study to understand the relationship between carbon emission and the political factors including democracy, corruption, political stability, GDP per capita and population density. our study employs panel data analysis along with fixed effect and random effect estimation techniques. Based on the Hausman test the study determine whether we should select fixed effect or random effect estimation strategy. The study concentrates specifically on BIMSTEC region for data collection. Our analysis covers a 20 years of time period, spanning from 2000 to 2019. In this paper, we investigate the interplay between carbon emission and political factors.

The result indicates that democracy and political stability has the positive impacts on carbon emissions. Our findings also affirm that corruption negatively influence the carbon emission. Regression results indicate that democracy increases carbon emissions. Our findings also show that increase in population density has a positive and significant impact on carbon emissions. Outcomes also indicate that a more politically stable country distributes more carbon emissions across the BIMSTEC region. Democratic systems frequently face delays in enacting and enforcing stringent environmental regulations due to political negotiations, interest group lobbying, and the complexities of coalition governance. Governments may prioritize economic development, often postponing environmental regulations to boost economic growth.

Ethics Statement

No potential conflict of interest are reported by the author(s).

Notes: Since this is an undergraduate-level empirical work, we restrict our analysis to simple panel FE and RE methods. In the subsequent stage, we plan to extend the study using a simultaneous equations including robustness validation.

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