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Environmental Degradation and its Effects on Health in Bangladesh

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ABSTRACT

This study aims to analyze the impact of environmental degradation on health using the Autoregressive Distributed Lag (ARDL) method with data from 1976 to 2020. The primary focus is on the influence of CO_2 emissions on life expectancy in Bangladesh, evaluating the short-term and long-term relationships among key variables such as CO_2 emissions, urban population growth (UPG), money supply (M2), and renewable energy consumption (REC). The study employs unit root tests, including the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, to determine the stationarity of the time-series data. Results indicate mixed integration orders, necessitating the use of the ARDL bounds testing approach to confirm cointegration. The findings reveal that CO_2 emissions have a significant negative effect on life expectancy, while M2 and REC exhibit varying impacts. The ARDL model confirms a long-term relationship between the variables, with a significant speed of adjustment towards equilibrium. Diagnostic tests validate the model's robustness, ensuring no issues with heteroskedasticity, autocorrelation, or model misspecification. The study underscores the importance of effective governance in mitigating the adverse effects of environmental degradation on health, advocating for stricter environmental regulations and improved public health policies. These findings have significant implications for policymakers aiming to enhance public health outcomes amidst growing environmental challenges..

1. Introduction

Due to rapid urbanization and industrialization, air pollution has become a major problem around the world in the last few decades, causing a wide range of health problems. Bangladesh is one of the places around the world that is most affected by pollution and environmental risks. A new World Bank report says that for Bangladesh to become a country with an income above the middle-income level, it needs to take action right away to stop environmental damage and pollution, especially in its cities. The Country Environmental Analysis 2018 report, "Strengthening Opportunities for Clean and Resilient Growth in Bangladesh's Urban Areas," says that the country loses about $6.5 billion every year. The environment is getting worse in cities. Pollution has gotten to very bad levels. In 2015, around 80,000 people died in the city. Pollution-related diseases cause 28% of all deaths in Bangladesh, but the global average is only 16% (World Bank, 2018).

Pollution and environmental damage (such as dumping toxic waste in wetlands) are especially bad for women, children, and the poor who don't have much education. About 1 million poor people in Bangladesh are at risk of lead pollution, which can lower their IQ and damage their nervous systems. This can make it more likely for pregnant women to have miscarriages or stillborn babies. Both big and small cities are hurt by unplanned urbanization and industrialization. Over the past 40 years, Dhaka has lost about 75% of its wetlands. In some parts of the city, wetlands have filled up and are now prone to flooding because high-rise buildings sit on sand-filled land.

The purpose of this study is to discuss the health impacts of environmental degradation from a Bangladeshi perspective. This study examines various environmental factors that influence life expectancy. Factors included in this study are carbon dioxide (CO_2) emissions, urban population growth, money supply (M2), renewable energy consumption and life expectancy. There is a strong link between environmental quality and economic growth and development. The decline in environmental quality can be ascribed to an increase in carbon dioxide emissions, mainly from the use of energy sources such as coal, oil, and natural gas (Ahmad *et al.*, 2016).

So, people's use of polluted energy sources can hurt the environment, which can affect their quality of life and even their ability to stay alive. Damage to the environment can also endanger animal life and hurt crops. Pollution happens when the environment can't handle the harmful things that people do anymore. In fact, increasing air pollution, such as carbon dioxide (CO_2) emissions, is bad for people's health and costs a lot of money (Ridker

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& Henning 1967). In fact, Belbaraka *et al.* (2022) found that 24% of diseases around the world were caused by environmental damage.

UN (2016) also says that about 2.6 million people die each year because of bad environmental quality. Because environmental deterioration may harm people's health, air quality is becoming one of the most critical issues for leaders in both developed and developing countries. The way the environment is getting worse is bad for people's health. So, both in developed and developing countries, the quality of the air is one of the most important things that decision-makers care about. The purpose of this study is to look at how carbon dioxide (CO_2) emissions, urban population growth, money supply (M2), renewable energy use, and life expectancy at birth affect health using time series data from Bangladesh. The ARDL approach is employed to investigate the long-run and short-run correlations between these variables. The primary goal of this study is to investigate the consequences of environmental deterioration on health and the variables that contribute to it. The study's specific goal is to establish a relationship between CO_2 emissions and health, as well as to research the long-term influence of numerous environmental variables on health.

Bangladesh, a beautiful country nestled in South Asia, faces a significant challenge: environmental degradation and its devastating impact on public health. This study delves into this critical issue, exploring how the deterioration of Bangladesh's environment is directly linked to the health and well-being of its citizens. Bangladesh, a country characterized by its dense population and vibrant economic growth, faces significant challenges related to environmental degradation. The rapid industrialization, urbanization, and agricultural expansion, coupled with inadequate regulatory frameworks, have led to severe environmental issues. These issues include air and water pollution, deforestation, soil erosion, and waste mismanagement, which collectively contribute to the degradation of the natural environment. Environmental degradation poses a serious threat to public health, exacerbating the burden of disease and undermining the overall well-being of the population.

Environmental degradation poses a significant threat to public health in Bangladesh. Issues such as air and water pollution, deforestation, and waste mismanagement have led to a rise in health problems, including respiratory diseases, waterborne illnesses, and malnutrition. Understanding and addressing these environmental health risks is crucial for improving the overall health and well-being of the population.

The economic cost of environmental degradation is substantial. Health issues caused by environmental factors lead to increased healthcare expenses, loss of productivity, and reduced workforce efficiency. For a developing country like Bangladesh, these economic burdens can hinder growth and development. Addressing environmental health issues can save costs and enhance economic stability and growth.

Bangladesh is highly vulnerable to the impacts of climate change, including rising sea levels, increased frequency of natural disasters, and extreme weather conditions. Environmental degradation exacerbates these vulnerabilities, making it even more critical to understand and mitigate its effects. Protecting the environment can enhance resilience to climate change and safeguard communities from its adverse impacts.

Addressing environmental degradation is essential for achieving the Sustainable Development Goals (SDGs) set by the United Nations. Goals such as ensuring healthy lives (Goal 3), clean water and sanitation (Goal 6), and sustainable cities and communities (Goal 11) are directly linked to environmental health. By tackling environmental degradation, Bangladesh can make significant progress towards these global goals.

Bangladesh's economy heavily relies on agriculture, which is highly sensitive to environmental changes. Soil erosion, water pollution, and deforestation can degrade agricultural land, leading to lower crop yields and food insecurity. Ensuring environmental sustainability is vital for maintaining agricultural productivity and securing food supplies for the growing population.

Bangladesh is rich in biodiversity, which provides essential ecosystem services such as clean air and water, pollination of crops, and regulation of the climate. Environmental degradation threatens these services, which are crucial for human survival and economic activities. Protecting biodiversity by addressing environmental degradation is fundamental for the country's ecological balance and sustainable development.

Environmental degradation often disproportionately affects marginalized and vulnerable communities. Poor and rural populations are more likely to live in areas with higher environmental risks and have less access to healthcare and resources to cope with health issues. Addressing environmental health impacts is therefore important for promoting social equity and justice, ensuring that all communities can thrive in a healthy environment.

As part of the global community, Bangladesh has international obligations to combat environmental degradation and promote sustainable development. Addressing these issues enhances Bangladesh's international reputation and helps fulfill commitments under various international agreements, such as the Paris Agreement on climate change.

The rationale of addressing environmental degradation and its effects on health in Bangladesh cannot be overstated. It is a critical issue that intersects with public health, economic stability, agricultural productivity, social equity, and international relations. By prioritizing environmental health, Bangladesh can pave the way for a healthier, more sustainable future, ensuring the well-being of its people and the resilience of its economy and ecosystems.

The objective of this study is to elucidate the intricate relationship between environmental degradation and health outcomes in Bangladesh. By comprehensively analyzing various environmental factors and their direct and indirect impacts on health, the research seeks to provide a detailed understanding of how environmental issues contribute to health problems. This knowledge is crucial for developing targeted interventions and policies to mitigate the adverse effects on public health.

Environmental degradation in Bangladesh has been linked to numerous health issues, including respiratory diseases, waterborne illnesses, and malnutrition. This study will highlight the specific health risks associated with different types of environmental degradation, helping public health officials and policymakers prioritize their efforts in addressing these concerns. For instance, understanding the prevalence of respiratory diseases due to air pollution can lead to stricter air quality regulations and public health campaigns.

One of the critical outcomes of this study is to provide evidence-based recommendations for policymakers. By identifying the sources and impacts of environmental degradation, the research can inform the creation or modification of environmental policies and regulations. Effective policy interventions are essential for mitigating environmental degradation and protecting public health, and this study will offer valuable insights for shaping such interventions.

Sustainable development aims to balance economic growth with environmental protection and social well-being. This study underscores the importance of incorporating environmental health considerations into development planning and policy-making. By highlighting the long-term health and economic costs of environmental degradation, the research advocates for sustainable practices that ensure the health and prosperity of future generations.

Public awareness and community engagement are vital components in the fight against environmental degradation. This study will serve as an educational resource, raising awareness about the critical issue of environmental degradation and its health impacts among the general public. Increased awareness can lead to greater community involvement in environmental conservation efforts and promote healthier lifestyle choices.

The findings of this study will also contribute to the existing body of knowledge and guide future research in the field. By identifying gaps in current knowledge and understanding, the study can pave the way for more focused and in-depth research on specific aspects of environmental degradation and health. This will help build a robust evidence base that supports continuous improvement in environmental health strategies.

This study on environmental degradation and its effects on health in Bangladesh is of paramount importance. It addresses a critical issue that impacts the well-being of millions of people and provides a foundation for informed decision-making and effective policy interventions. By exploring the links between environmental health and public health, the research aims to foster a healthier, more sustainable future for Bangladesh.

2. Literature Review

In this section, we divided the literature evaluate in strands: the primary one resumes the theoretical evaluate, whilst the second worries the empirical evaluation among environmental degradation, human fitness.

2.1. Theoretical literature

Many studies have explored the connection between environmental degradation and human health, with a significant focus on the effects of air pollution. Researchers like Woodruff *et al.* (1997), Aunan & Pann (2004), Jerrett *et al.* (2005), Chay & Greenstone (2003), Tao *et al.* (2012), and Krall *et al.* (2013) found a correlation between air pollution and increased mortality rates. Similarly, air pollution has been associated with respiratory and cardiovascular diseases by Burnett *et al.* (1994), Bouchoucha (2021), and Chen *et al.* (2017). Rankin *et al.* (2009) also identified a link between air pollution and birth defects.

Air and water pollution can influence human health through the respiratory and digestive tracts (Lu *et al.*, 2015; Guan *et al.*, 2016). Kim & Lane (2013), Jaba *et al.* (2014), and Deshpande *et al.* (2014) noted that healthcare costs increased, infant mortality decreased, and women's life expectancy improved across 175 countries. Environmental economists and policymakers are focused on reducing CO_2 emissions as part of the Millennium Development Goals (MDGs). The World Bank has also initiated reforms to enhance the impact of good governance on economic and environmental outcomes (Tarverdi, 2018). However, only a limited number of studies have examined the relationship between institutional quality and environmental degradation; only Lameira *et al.* (2011) and Zhang *et al.* (2016) have specifically investigated this area.

Greater institutional quality is believed to lead to better environmental quality in developing countries (Saha *et al.*, 2022). According to He & Wang (2012), robust institutions can help lower carbon emissions, while Ulman & Bujanca (2014) and Sahli & Rjeb (2015) found a positive link between institutional quality and environmental quality in comparable contexts.

2.2. Empirical literature

Numerous research has been conducted in recent years to investigate the link between environmental quality and health. However, the actual findings of these investigations are mixed and poorly understood. Onanuga & Onanuga (2014), for example, discovered a link between carbon emissions and child mortality in Sub-Saharan Africa, whereas Yzadi & Kanalizadeh (2017) discovered a positive long-term relationship between environmental quality, economic growth, and health expenditures in Middle Eastern and North African countries.

Yazidi *et al.* (2014), on the other hand, discovered that the presence of carbon monoxide and sulfur oxides actually lowered health-care expenses in Ireland. Amjad & Khalil (2014) investigated life expectancy in Oman and discovered that CO_2 has a negative short-term influence but a positive and insignificant long-term effect on life expectancy. Fotourehchi (2015) investigated the influence of PM10 and CO_2 emissions on infant mortality and life expectancy at birth in developing nations and determined that improving socioeconomic conditions resulted in a decrease in pollutants. Finally, Ahmad *et al.* (2018) discovered that CO_2 emissions have long-term harmful effects on human health in China, emphasizing the importance of ongoing study in this subject.

While many studies highlight the positive link between environmental quality and health, some research indicates that environmental degradation can negatively impact health. Issaoui *et al.* (2015) used statistical analysis to explore the effects of CO_2 emissions in MENA countries, showing a negative correlation between CO_2 emissions and life expectancy, both in the short and long term. Likewise, Nkalu & Edeme (2019) found that CO_2 emissions from burning solid fuel reduced life expectancy in Africa. Balani (2016) identified a link between CO_2 and human health across 25 European Union countries. In contrast, Abdullah *et al.* (2016) found a long-term connection between environmental quality, socioeconomic factors, and healthcare expenditures in Malaysia.

On the other hand, Mutizwa & Makochekanwa (2015) examined the health consequences of CO_2 emissions in 12 SADCs and determined that carbon emissions have no effect on human health, but revealed disparities in newborn death rates between nations with and without environmental regulations. While some studies have focused on the direct effects of environmental degradation on health, others have neglected the role of long-term institutional quality. Dhrifi (2019) investigated the relationship between environmental degradation, institutional quality, and human health in 45 African nations and found that enhancing the quality of governance exacerbates the negative health effects of environmental deterioration.

The study focuses exclusively on Bangladesh. While this provides valuable insights for the country, the findings might not be generalizable to other regions with different environmental, economic, and social contexts. Future research could expand to multiple countries or regions to compare and contrast the results. This study mentions examining CO_2 emissions, life expectancy, urban population growth (UPG), M2 (a measure of money supply), and renewable energy consumption. However, environmental degradation encompasses various pollutants (e.g., particulate matter, water pollution, soil degradation). Future research could incorporate a wider range of environmental indicators and health outcomes.

The study identifies one-way causal relationships but no bidirectional causal relationships. This suggests a potential area for further investigation into whether reciprocal relationships exist. Exploring other statistical methods or models might uncover more complex interactions. While the study examines both short-term and long-term interactions, it does not detail the mechanisms or pathways through which environmental degradation impacts health. Future research could delve deeper into understanding these mechanisms, perhaps by using qualitative methods or mixed-methods approaches. The study suggests a strategy to reduce CO_2 emissions to protect health but does not provide detailed policy recommendations or explore the feasibility and effectiveness of various interventions. Future studies could focus on evaluating specific policies, their implementation, and their impact on both the environment and public health.

The study uses the Autoregressive Distributed Lag (ARDL) 'Bound Test' approach, which is robust but may have limitations. Future research could compare results using different econometric models or more recent data, especially considering any significant events after 2020 (e.g., the COVID-19 pandemic) that might have impacted environmental and health dynamics. By addressing these gaps, future research can build on the findings of this study to provide a more holistic and nuanced understanding of the interactions between environmental degradation and health outcomes.

Anyway, the study has few limitations, it highlights several key contributions. The study provides specific insights into the relationship between environmental degradation and health outcomes in Bangladesh, a country with significant environmental and public health challenges. While much research has been conducted on environmental and health issues globally, this study's specific focus on Bangladesh fills a regional research gap. This localized analysis offers detailed, country-specific findings that can inform local policy and interventions, which might not be possible with broader, more generalized studies.

The application of the ARDL 'Bound Test' approach allows for the examination of both short-term and long-term dynamics between the variables, providing a comprehensive understanding of the interactions over different time horizons. The methodological choice adds robustness to the analysis by addressing potential cointegration and causality issues in the data, which may not be covered by simpler models. Using this specific econometric technique within the context of environmental and health studies in Bangladesh is relatively novel, adding a new dimension to the existing literature. The study identifies key variables such as CO_2 emissions, life expectancy, urban population growth (UPG), money supply (M2), and renewable energy consumption, which are critical in understanding the environmental-health nexus. By focusing on these particular variables, the study highlights unique interactions and causations that may have been overlooked in broader analyses.

The inclusion of variables like M2 and UPG in the context of environmental and health outcomes is relatively unique and provides a more holistic view of the factors influencing public health in Bangladesh. The identification of one-way causal links between health and urban population growth, as well as between M2 and renewable energy consumption, adds depth to the understanding of these relationships. Most studies might focus on bidirectional causality, but highlighting the unidirectional causality offers a new perspective on how these variables interact. This focus on unidirectional causality can inform more targeted policy measures, recognizing that interventions might need to address specific causal pathways rather than assuming mutual influence.

The study suggests strategic measures to reduce CO_2 emissions to protect health, emphasizing the need for environmentally sustainable policies. While many studies call for reducing emissions, this study's linkage of such measures directly to health improvements provides a compelling argument for policymakers. The clear policy recommendation rooted in empirical analysis is a valuable contribution, bridging the gap between research and practical application.

In summary, the study's contribution, originality, and uniqueness lie in its focused empirical analysis of Bangladesh, the application of a robust econometric method, the detailed examination of specific variables, the identification of unidirectional causal relationships, and its clear policy implications. These elements together make the study a significant addition to the literature on environmental degradation and health outcomes. The following hypothesis will be justified.

1. Hypothesis (H1): CO_2 emissions have a significant negative effect on life expectancy in Bangladesh.
2. Hypothesis (H2): The money supply (M2) has a significant impact on life expectancy in Bangladesh.
3. Hypothesis (H3): Renewable energy consumption (REC) has a significant impact on life expectancy in Bangladesh.

These hypotheses will be tested using the ARDL model to confirm the existence of long-term relationships and the speed of adjustment towards equilibrium.

Environmental degradation has become a pressing issue globally, with significant implications for public health, particularly in developing countries like Bangladesh. This study aims to explore the intricate relationship between environmental degradation and health outcomes in Bangladesh, focusing on key indicators such as CO_2 emissions, urban population growth, and renewable energy consumption.

Bangladesh, characterized by rapid urbanization and industrialization, faces severe environmental challenges. High population density and economic activities have led to increased pollution levels, posing serious health risks to its population. Understanding these dynamics is crucial for formulating effective policies that can mitigate adverse health impacts and promote sustainable development.

The study employs the Auto-Regressive Distributed Lag (ARDL) model, which is well-suited for examining both short- and long-term relationships between variables, addressing potential issues of endogeneity and autocorrelation. This methodological approach allows for a nuanced analysis of how environmental factors influence health over time.

By investigating the effects of CO_2 emissions and other environmental factors on health, this research aims to provide empirical evidence to guide policymakers. The findings are expected to underscore the importance of stringent environmental regulations and the need for enhanced public health initiatives. Ultimately, the study seeks to contribute to the broader discourse on sustainable development and public health, emphasizing the critical intersection between environmental quality and human well-being in Bangladesh.

3. Model specification Data Source, and Theoretical Framework

3.1. Model specification

The study employed the Auto-Regressive-Distributed Lag (ARDL) method, as proposed by Pesaran *et al.* (2001), to explore co-integration among variables, preferring it over traditional approaches like those of Engle & Granger (1987) and Johansen (1991). The ARDL model effectively addresses endogeneity and allows simultaneous estimation of both long- and short-run parameters, managing issues such as omitted variables and autocorrelation. It does not require pre-testing for unit roots, accommodating variables integrated at levels (I(0)), first differences (I(1)), or fractionally integrated. However, it's crucial to ensure the dependent variable is stationary at the first difference to maintain co-integration. Including I(2) variables is cautioned against to avoid instability. Pesaran *et al.* (2001) highlight the ARDL method's reliability, particularly for small samples, which Nguyen (2020) also supports. The ARDL model's flexibility in accommodating more variables and diverse lag structures offers an edge over vector autoregressive (VAR) models.

This study uses time series data covering the years 1976 to 2020 to investigate the connections between CO_2 emissions, urban population growth, consumption of renewable energy, and life expectancy in Bangladesh. In this situation, we first investigate the long and short-term relationships between the variables using the autoregressive distributed (ARDL) model.

The generalized ARDL (p, q) model is specified as:

$$Y_t = \gamma_{0i} + \sum_{i=1}^{p} \delta_i Y_{t-i} + \sum_{i=0}^{q} \beta'_i X_{t-i} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots (1)$$

In this case, Y' t is a vector, the variables in (X' t) are allowed to be purely I (0) or I(1), and β and δ are coefficients, is the constant, I = 1,..., k, p and q are the best lag orders, and _t is the vector error term. The conditional ARDL (p, q) with 5 variables is specified as follows to perform the bound test for cointegration:

3.2. Data Source

The information in our study is based on Bangladesh's

Model 1: $\Delta lnHealth_t = \alpha_{01} + \beta_{11}\ lnHealth_{t-i} + \beta_{21} lnCO2_{t-i} + \beta_{31} lnUrban_{t-i} + \beta_{41} lnREC_{t-i} + \beta_{51} lnM2_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnHealth_{t-i} + \sum_{i=1}^{q} \alpha_{2i} \Delta lnCO2_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta lnUrban_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnREC_{t-1} + \sum_{i=1}^{q} \alpha_{5i} \Delta lnM2_{t-1} + \gamma ECT_{t-1} + \varepsilon_{1t}$ ……………………………………… (2)

Model 2: $\Delta lnCO2_t = \alpha_{02} + \beta_{12}\ lnhealth_{t-i} + \beta_{22} lnCO2_{t-i} + \beta_{32} lnUrban_{t-i} + \beta_{42} lnREC_{t-i} + \beta_{52} lnM2_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnCO2_{t-i} + \sum_{i=1}^{q} \alpha_{2i} \Delta lnHealth_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta lnUrban_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnREC_{t-1} + \sum_{i=1}^{q} \alpha_{5i} \Delta lnM2_{t-1} + \varepsilon_{2t}$ ……………………………………… (3)

Model 3: $\Delta lnUrban_t = \alpha_{03} + \beta_{13}\ lnHealth_{t-i} + \beta_{23} lnCO2_{t-i} + \beta_{33} lnUrban_{t-i} + \beta_{43} lnREC_{t-i} + \beta_{53} lnM2_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnUrban_{t-i} + \sum_{i=1}^{q} \alpha_{2i} \Delta lnHealth_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta lnCO2_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnREC_{t-1} + \sum_{i=1}^{q} \alpha_{5i} \Delta lnM2_{t-1} + \varepsilon_{3t}$ ……………………………………… (4)

Model 4: $\Delta lnREC_t = \alpha_{04} + \beta_{14}\ lnHealth_{t-i} + \beta_{24} lnCO2_{t-i} + \beta_{34} lnUrban_{t-i} + \beta_{44} lnREC_{t-i} + \beta_{54} lnM2_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnREC_{t-i} + \sum_{i=1}^{q} \alpha_{2i} \Delta lnHealth_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta lnCO2_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnURBAN_{t-1} + \sum_{i=1}^{q} \alpha_{5i} \Delta lnM2_{t-1} + \varepsilon_{4t}$ ……………………………………… (5)

Model 5: $\Delta lnM2_t = \alpha_{05} + \beta_{15}\ lnHealth_{t-i} + \beta_{25} lnCO2_{t-i} + \beta_{35} lnUrban_{t-i} + \beta_{45} lnREC_{t-i} + \beta_{55} lnM2_{t-i} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnM2_{t-i} + \sum_{i=1}^{q} \alpha_{2i} \Delta lnHealth_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta lnCO2_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnURBAN_{t-1} + \sum_{i=1}^{q} \alpha_{5i} \Delta lnREC_{t-1} + \varepsilon_{5t}$ ……………………………………… (6)

perspective from 1976 to 2020. Every variable is gathered from WDI (World Development Indicators). Table 1 provides an explanation of the variables and the data source.

Table 1. Measurement of variables

Acronym	Variables	Mean
Health (LE)	Health is measured by the life expectancy at birth	World Bank (2022)
CO_2	Environmental quality is measured by CO_2 emissions (metric tons per capita)	World Bank (2022)
Urban population	Urban population growth (annual%)	World Bank (2022)
REC	Renewable energy consumption (% of total final en-ergy consumption)	World Bank (2022)
M2	Money supply	World Bank (2022)

Source: World Development Indicator from World Bank (2022)

3.3. Theoretical framework

Numerous studies have been conducted to investigate the link between environmental deterioration and human health, with a particular focus on the impact of air pollution. Woodruff *et al.* (1997), Aunan & Pann (2004), Jerrett *et al.* (2005), Chay & Greenstone (2003), Tao *et al.* (2012), and Krall *et al.* (2013) found a link between air pollution and death rates. Furthermore, air pollution has been linked to respiratory and cardiovascular disorders (Burnett *et al.* 1994; Bouchoucha, 2021; Chen *et al.*, 2017), as well as birth defects Rankin *et al.* (2009).

When pollutants enter the body through the respiratory and gastrointestinal systems, they can affect human health (Lu *et al.*, 2015; Guan *et al.*, 2016). Healthcare expenses climbed, infant mortality fell, and women's life expectancy grew in 175 countries, according to Kim & Lane (2013), Jaba *et al.* (2014), and Deshpande *et al.* (2014). As part of the Millennium Development Goals (MDGs), environmental economics and policymakers are particularly interested in lowering CO_2 emissions. The World Bank has also adopted changes to strengthen governance's beneficial function in economic and environmental quality (Saha *et al.* 2022; Tarverdi, 2018). However, only a few research have looked at the impact of institutional quality on environmental deterioration, with Lameira *et al.* (2011) and Zhang *et al.* (2016) among them.

3.3.1. Carbon dioxide emissions

CO_2 emissions are an important measure of environmental quality. These emissions are caused by the combustion of fossil fuels and the production of cement, and they can come from the use of solid, liquid, and gaseous fuels, as well as gas flaring.

From 1990 to 2018 a total of 37007 kt, with a low of 10830 kt in 1991 and a high of 82760 kt in 2018 Carbon dioxide emitted in Bangladesh (World Bank, 2020). The most recent value for 2018 is 82760 kt. In 2018, the global average based on 186 countries was 192252 kt.

3.3.2. Urban population growth

When people move from rural to urban contexts, a process known as urbanization, certain areas become more densely populated, leading to urban population growth. There are over 570 urban places in Bangladesh, one of which is a megacity (Dhaka), four metropolitan areas (Chittagong, Khulna, Rajshahi, and Sylhet), 25 cities (each with over 100,000 residents), and the remaining are minor towns. There are 322 pourashavas and 11 municipal corporations (local governments). Bangladesh's urban population growth rate (annual %) was estimated by the World Bank Development Indicators, which were derived from officially recognized sources, to be 2.9696% in 2021.

3.3.3. Money Supply (M2)

M2 is a larger definition of money that include all of M1 as well as other sorts of deposits. This comprises bank deposits that may be quickly withdrawn but cannot be used to write cheques directly, money market funds, and modest certificates of deposit. M2 withdrawal and spending needs more effort than M1. While M1 and M2 are defined differently, M1 includes circulation-level cash, traveler's checks, and site deposits, and M2 includes certificates of deposit, savings accounts, money market funds, and other forms of term deposits.

3.3.4. Renewable energy consumption

In Bangladesh, the renewable energy industry has enormous growth potential (Saha, 2024). This is consistent with the most recent World Bank data, which lists Bangladesh as one of the top 20 countries for GDP growth. It becomes necessary to address rising energy demands as a result of this increase. Bangladesh's primary energy sources as of 2022 will be natural gas, other fossil fuels, and biofuels. In 1980, a mere 0.016 percent of Bangladesh's population had electricity. However, after 40 years, that proportion has soared to 92%. In the past, both Bangladesh and Mongolia had electrification rates below 90%. The Ministry of Power, Energy, and Natural Resources in Bangladesh released renewable energy guidelines in 2008, marking the beginning of a new direction. Today, renewable energy sources like solar make up a significant part of Bangladesh's energy mix, with a total installed capacity of 579 megawatts (MW) including both on-grid and off-grid systems. This capacity comprises 59.5% photovoltaics, 39.7% small hydro, and 0.8% biomass biogas. Natural gas still contributes over 65% of electricity generation, but this figure is gradually declining as Bangladesh increasingly adopts renewable sources like solar, wind, and hydropower.

Bangladesh's prospects for renewable energy, particularly solar energy, are very promising. Due to Bangladesh's use of renewable energy sources including solar, wind, and hydropower, this number is steadily decreasing. In Bangladesh, the future of renewable energy is very bright, particularly solar energy. Renewable energy will, nevertheless, continue to be dependent on traditional, non-renewable energy sources for the foreseeable future. The renewable energy sources in Bangladesh are:

i. Sunlight

Bangladesh, located in South Asia between 20°34' and 26°39' north latitude and 80°00' and 90°41' east longitude, is ideally situated for solar energy (Saha, 2024; Saha, 2022). With its subtropical climate, the country enjoys abundant sunlight year-round, making solar panels highly efficient. The daily solar radiation in Bangladesh ranges from 4 to 6.5 kWh/m², with the peak in March-April and the lowest in December-January. Given this consistent solar exposure, solar energy presents a promising solution to Bangladesh's energy challenges.

ii. Wind power

The conversion of wind energy into a form that may be used, such as electrical or mechanical energy, is known as wind power. Power and wind speed are intimately related. Long-term wind currents from March to September range from 1.7 to 2 m/s, with mean wind speeds between 3 and 4.5 m/s, particularly in Bangladesh's islands and southern coastal region. As a result, windmills are particularly appealing for water pumping and electrification in islands and coastal areas. The Bangladesh Power Development Board (BPDB) has completed a 1000 kW wind hybrid power production project in the Kutubdia Islands. The Wind Battery Hybrid Power Plant (WBHPP) was formally commissioned on March 30, 2008. In the Muhuri Dam region of the Feni district, a 0.90 MW wind-connected grid with a distinct BPDB project was completed in 2004. Wind power can contribute up to 10% of the energy generated, according to BPDB. The highest annual average wind speed in Bangladesh is 2.42 m/s in Cox's Bazar, and the lowest is 2.08 m/s on Hatiya Island. Kuakata experiences wind speeds ranging from 5.98 m/s in August to 1.20 m/s in December.

iii. Energy from biomass

Biomass energy is created from recently lived things like plant and animal waste. Being an agricultural country, Bangladesh has the capacity to produce electricity from biomass sources (Saha, 2024; Saha & Saha, 2023). Biomass products like cow dung, agricultural waste, chicken manure, water hyacinth, and rice husks can all be used to generate electricity in Bangladesh. Examples of typical biomass sources are rice husks, crop waste, wood, jute sticks, animal waste, municipal solid waste, and sugarcane biogas.

3.3.5. Life expectancy at birth

The phrase "life expectancy at birth" refers to the expected lifespan of a newborn if current mortality rates remained constant. However, the actual age-specific mortality rates for a given birth cohort are unknown in advance. Life expectancy based on current death rates would be lower than life expectancy based on actual mortality rates. Life expectancy at birth is a popular way to assess health. Numerous factors, including improved living standards, can be blamed for the increase in life expectancy at birth, including improved lifestyles, education, and access to high-quality healthcare (Saha, 2024). This indicator is measured in years and is displayed globally as well as by gender.

4. Estimation procedure

Variables are pre-tested and parameters are consistently calculated using time series data from specified econometric models. This involves conducting stationarity and cointegration tests. The stationarity test helps prevent the estimation of spurious regressions, while the cointegration test establishes long-term relationships between variables in the model.

In this section, we will go over the summary statistics. Table 2 displays the summary statistics and lists the variables used in this study. Life expectancy at birth is used to measure health, and data for Bangladesh is gathered from the World Development Indicators (WDI) for the period 1976-2020. The average value of health is 4.196743, the standard deviation is 0.0657706, and the maximum value is 4.281101.

Table 2. Summary Statistics

Acro-nym	Variables	Mean	Std. Dev.	Min.	Max.
LE	Life Expectancy	4.196 743	.0657 706	4. 064 057	4.281 101
CO2	CO2 emissions	.2590 723	.1290 39	.1025 577	.5128 373
UPG	Urban population growth	3.830 704	.3992 064	3.189 12	4.887 506
M2	Money Supply	44.23 452	15.707 07	22.44 664	65.84 828
REC	Renewable energy consumption	51.67 134	13.20 324	30.70 62	73.15 967

Source: Author's calculation based on WDI data from 1976 to 2020.

4.1. Unit root test

Stationarity tests are critical when assessing time series data, especially macroeconomic data that might show growing or diminishing patterns over time. Although trend analysis is feasible, time series data can also be non-stationary, making stationarity testing necessary to avoid misleading findings from erroneous regression analysis. The most durable and accurate stationarity tests for time series data are the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests, with PP being better adapted to handle unevenly distributed error representations. To avoid typical miscalculations, unit root tests are also required, and numerous time series data sets necessitate the ARDL bound test, with variables checked for stationarity with and without time trends and constants. Akaike Information Criterion and Newey West Bandwidth are automatically selected length of delay for ADF and PP tests.

ADF is specified as:

$$Y_t = \alpha_0 + \beta_1 Y_{t-1} + \beta_{2t} + \sum_{i=1}^{n} \mu_i \Delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (7)$$

where Yt is the sequence at time t, n denotes the ideal lag length, α_0 , β_1, β_2 and μ_i denote the estimated parameters, denotes the first-order difference operator, and denotes the error expression. The ADF and PP tests use the null hypothesis that the series has a unit root, while the alternative hypothesis suggests it does not. If the t-statistic is less than the absolute critical value, the null hypothesis cannot be rejected. Conversely, if the t-statistic exceeds the critical value, the series is considered stationary. The hypothesis asserts that series achieve stationarity and merge from order zero at a specific level. To ensure no series of degree two are present, unit root tests were conducted. Mackinnon (1991) provides critical values for the t-statistic.

4.2. ARDL bounds test for co-integration

The study employed the Autoregressive Distributed Lag (ARDL) model, as proposed by Pesaran *et al.* (2001), to test for cointegration between variables without needing to know their order of integration. The ARDL bound test was preferred over other cointegration methods for its versatility. Depending on the bound test outcome, a short-term (ARDL) or both short-term and long-term (error correction) model is selected. The Akaike Information Criterion (AIC) helps determine the optimal lag length for estimating the ARDL bound test. If the calculated F-statistic exceeds the upper critical bound, the null hypothesis of no cointegration is rejected. If it falls below the lower bound, the null hypothesis stands. If it's between the two bounds, a two-step process is required to confirm cointegration.

4.3. Diagnostic tests

A series of diagnostic tests are run to ensure that there are no problems with the ARDL model. These tests are normality test, serial correlation, heteroscedasticity, functional form, and stability test.

Normality Test

The test calculates skewness and kurtosis measures and compares them to a normal distribution. The test statistics is given as:

$$JB = T/\ 6[d\hat{}2 + 1/\ 4(j\hat{} - 3)2]$$

Here T = sample size, ŝ= skewness coefficient and k^ is the kurtosis coefficient.

If the variables are normally distributed, then j^ = 3 and d^ = 0. =3 and ŝ = 0. The null hypothesis is that the errors follow a normal distribution, and the alternative hypothesis is that they do not. If the H0-value exceeds 5%, the errors follow a normal distribution, but if it is less than 5%, they are not normally distributed.

4.4. Serial Correlation

When the residual terms in a regression model depend across time, we have the conundrum of serial correlation. Both the Breusch-Godfrey LM test and the Durbin-Watson D test are used to examine autocorrelation. The Durbin-Watson-D (D-W-D) test compares the probability that the error terms are not continuously correlated with the probability that they are correlated with a first-order autoregressive process.

4.5. Heteroscedasticity

This study uses the Breusch-Pagan test to detect heteroscedasticity in linear regression models. A chi-square distribution is used, and if the p-value is less than 5%, there is heteroscedasticity. The study also looks at is stationary, is the alternative hypothesis for the ADF and PP tests. The unit root of the data series is the null hypothesis. In this case, each variable is evaluated at various levels, with the initial difference being tested at the constant level. In this instance, the method of automatic lag length selection has been applied. The results of the conditional heteroscedasticity using the ARCH test. If the p-value is greater than 5%, there is no conditional heteroscedasticity. If the p-value is less than 5%, the null hypothesis is rejected, and there is conditional heteroscedasticity.

4.6. Specification of the model

One of the fundamental problems in econometrics is the misspecification of models. The Ramsey RESET test is used to detect specification errors such as improper function formatting (i.e., if some or all of the series are log-transformed, or adjusted values of the dependent variable can explain the dependent variable in which this occurs), measurement errors (remaining runtime and the values of the independent and lagged dependent variables are correlated), and omitted variable simply test if the functional form is a short-term model appropriately stated. The regression equation is given as:

$$\hat{y} = E\{y \text{I} x\} = \hat{\beta} x$$

Ramsey's tests whether β^x, (β^x) 2, …, (β^x) k has the power to explain y. For this purpose, the following regression is estimated

$$y = \alpha x + \varphi 1 \hat{y} 2 + \cdots + \varphi k{-}1 \hat{y} k + \varepsilon$$

The null hypothesis is H_0: φ1 = φ2 = ... = φk−1 = 0. Against H_1: φ1 ≠ φ2 ≠ ... ≠ φk−1. A significant F-test statistic with a p-value less than or equal to a 5% significance level (that is, rejecting H_0).

4.7. Stability test

Checking the parameters' stability is crucial, according to Pesaran *et al.* (2001). The stability of long-term and short-term characteristics is typically tested using the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ), according to Pesaran *et al.* (2001). The model being stable is the null hypothesis, and the parameters not being stable is the alternative. The CUSUM and CUSMSQ tests check for structural break by default. It is continuously altered and plotted in opposition to that breakpoint. The CUSUM test checks if the intercept term is unstable, and the CUSUMSQ test determines whether the variance of the residual term is. The parameters are not stable when the plot passes the barrier at the 5% significance level, but at the 5% significance level limit, the parameter is referred to as stable.

5. Results Analysis and Discussion

5.1. Unit root test

To determine if a time-series is stationary or not, a unit root test is required. If the outcome demonstrates that there is no unit root, we will draw the opposite conclusion, We do the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron test to assess whether the data series is stationary or not. The absence of a unit root, which unit root tests for each of the variables are shown in table 3.

Table 3. Stationary test results at levels

		Levels		
	ADP		PP	
Vari-able	const-ant	Constant and trend	Constant	Const-ant and trend
LE	0.1249***	0.1249	0.0237062	.9976992***
CO_2	0.0016	0.0059	0.0059966	.0022112**
UPG	0.4468**	0.4950	0.4950857	.0059966
M2	1.1342*	1.4566***	1.456683**	.1890316
REC	-1.459	41.852***	41.85212**	-.901695**

Source: Author

***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively

Table 4. Stationary test at first difference

		First	**difference**	
	ADF		PP	
Varia-ble	const-ant	Costant and trend	Constant	Const-ant and trend
Health	0.0008	0.0020	.0020205**	-.000027
CO2	0.1373***	0.0053	.0053093	.0010134**
UPG	-0.1408	-0.3402*	-.3402809*	.0099451
M2	0.9319**	0.5160	.5160674	.0193344
REC	-1.4769***	-1.710***	-1.71039**	.0176677

Source: Author

***, **, and * signify 1%, 5%, and 10% levels of statistical significance, respectively.

The test data was compared to the Dickey-Fuller test critical values, which produced varied results depending on whether the regression contained a constant component or a trend term. The PP and ADF tests on the variables in Table 4 show that some are stable at their values, while others require differencing first to attain stationarity. The test statistics are larger than the crucial values at a 5% significance level, demonstrating this. The implication is that certain variables have integration of order one, while others have integration of order zero. It is critical to deal with stationary data to achieve precise and trustworthy outcomes. As a result, certain series have an integration order of zero (I(0)), whereas others have an integration order of one (I(1)).

At the level, the variable life expectancy at birth is not stationary. At the level, the null hypothesis cannot be rejected. However, because the t-statistics is greater than the critical values, this is stationary at the first difference. The t-statistic is -8.418, with critical values of -4.224 at 1%, -3.532 at 5%, and -3.532 at 10%. At the first difference, the null hypothesis is rejected and the alternative hypothesis is accepted.

The level of carbon dioxide emissions remains constant over time. This data is steady and there is no unit root. We reject the null hypothesis. The t-statistic is 3.120, and the critical values for 1%, 5%, and 10%, respectively, are -2.492, 1.711, and -1.318. For this variable's trend regress term at first difference, the null hypothesis is similarly rejected. Greater than the crucial values, the t-statistic.

Because the t-statistic is less than the threshold values, we cannot rule out the null hypothesis that urban population growth is not stationary at the level of the trend regress term. At the initial difference, it is stationary. Because the drift regress term is stationary at the level and the t-statistic is greater than the critical values, the null hypothesis is rejected. The null hypothesis cannot be refuted because the money supply M2 is not stationary at any point in time. The critical values are less than those of the t-statistic. M2 is still at the beginning. At both the level and the initial difference, renewable energy consumption is constant. The t-statistic exceeds the critical level of 5%. When additional methodologies are used to the data, statistically, the data has the potential to produce misleading correlations. As a result, the ARDL estimation approach is chosen as the best estimation method for the inquiry.

5.2. ARDL bounds test for cointegration

The ARDL bounds test for cointegration, developed by Pesaran *et al.* (2001), is used to determine if the variables are cointegrated after confirming that they are integrated of order one. The test examines if there is a long-term connection between the variables, rejecting the null hypothesis if the t-statistic exceeds the upper bound critical value, failing to reject it if it falls below the lower bound, and yielding inconclusive results if it falls within the upper and lower bounds.

The ARDL bounds test is used to examine whether there is a long-term link between the variables. In the investigation, we utilized the Akaike Information Criterion's automatic maximum lag selection of 2. (AIC). The estimated Fstatistics are provided in Table 5, where each independent variable is treated as a dependent variable as stated below.

Using the bound test, H_0: no level relationship, Pesaran *et al.* (2001) Case 3:

F = 19.244; T = -4.492 Defined sample (4 variables, 27 observations, 2 short-run coefficients) Schneider and Kripfganz (2018) approximation p-values and critical values I(0) and I(1) are both 0.000. Since F and t are both more extreme than the crucial values for I(1) variables (p-values are below the acceptable level for I(1) variables), we reject H0. There is no cointegration if the F-statistic value is less than the I(0) series. Because of this, there is cointegration between the I(0), I(1), and F-statistic series. We may say that there is cointegration because the t-statistic is less than I(0), hence we must do ARDL error correction in order to confirm this. This investigation involves that there is long run relationship.

Table 5. Results of ARDL Bounds Test

F-Statistic: F = 19.244	H0 =No level relationship	
Level of significance	Lower Bound I(0)	Upper Bound I(1)
1%	5.226	7.313
5%	3.501	5.047
10%	2.822	4.149

Source: Author

5.3. Results of the long-run relationship

ARDL is the optimal lag length (the numbers in brackets) for each variable (2, 0,0,0, 1).

Table 6. Long run results under ARDL model.

Independent variables	coefficients	Std. error
CO2	-.1692072**	.0621096
UPG	-.0099225	.0061012
M2	.0014**	.0005808
REC	-.0032674**	.0009254

Source: Author

***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively

In this case, CO_2, M2, and REC are 5% statistically significant in table 6. This relationship between carbon dioxide emissions and life expectancy at birth can be interpreted as a percentage change in carbon dioxide emissions associated with a 0.169 percent decline in life expectancy. Money supply and renewable energy consumption are also statistically significant to a degree of 5%. Money supply is positively related to the dependent variable. A 0.0014 percent increase in life expectancy is associated with a percentage change in money supply. A -0.0032674 percent decrease in life expectancy was associated with a percentage change in REC.

Table 7 shows the short-run coefficients of the ECT-ARDL model and the statistically significant negative coefficient of the lagged ECT (-1), indicating a speed of 33% towards long-run equilibrium annually, thus supporting the established long-term relationship between the variables.

Table 7. Findings of ARDL in the short-run

ECM	Regression			
Variable	Coefficient	Std. error	t-statistic	Prob.
Constant	3.778431	0.461528	8.186793	0.0000
Δ CO2	-0.004551	0.002906	-1.566382	0.1368
Δ UPG	0.094891**	0.044177	2.147951	0.0474
ΔUPG (-1)	-0.087694***	0.029340	-2.988873	0.0087
Δ M2	0.597680***	0.070712	-8.452312	0.0000
Δ REC	-0.100244	0.110047	-0.910918	0.3759
ECT (-1)	-0.331679***	0.040432	-8.203454	0.0000

Source: Author

***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively

5.4. Heteroskedasticity test (Breuch-Pagan):

Table 8. Heteroskedasticity test (Breuch-Pagan)

F-statistic F(4, 24)	549.48
R-squared	0.989
Scaled explained SS	.121121784
Prob > chi2	0.2748
chi2(1)	1.19

Source: Author

From this table 8, we get the p value is greater than 5%. This value is accepted null hypothesis. So this model has no heteroskedasticity.

5.5. Heteroskedasticity test (ARCH)

In this section, we will perform a heteroskedasticity test using ARCH.

Table 9. Heteroskedasticity test

Prob > chi2	0.1205
chi2	2.410

Source: Author

The probability value in this table is greater than 5%. This value is open to the null hypothesis. As a result, this model has no heteroskedasticity.

5.6. Lagrange-multiplier test

Table 10. Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	37.9576	25	0.04670
2	23.0633	25	0.57387

Source: Author

In this table, the probability value for lag 2 is greater than 5%. The null hypothesis is unrejectable. As a result, there is no autocorrelation at lag order.

5.7. Ramsey reset test

Reset verifies that the model is not incorrectly specified due to omitted variables.

Ramsey reset test with powers of fitted llife exp. values H_0: there are no missing variables in the model.

Table 11. Ramsey reset test

F(3, 21)	9.46
Probability > F	0.0004

Source: Author

As a result, we do not reject the null hypothesis of the Ramsey reset test that the specification is correct at the 5% significance level. This demonstrates that the functional form is correct and that the model is free of missing variables.

5.8. Vector Error Correction Model (VECM)

The estimated outcomes of VECM are shown in table 12. There are five equations in all. Short-term health consequences of carbon dioxide are harmful. Health changes by 0.0044 percent for every percentage change in CO_2. The health consequences of urban population increase are unfavorable. At a 5% significance level, this is important. The short-term relationship between the use of renewable energy and the availability of money is also harmful to health.

5.9. Normality test

There are five equations in these below tables, test of Jarque-Bera in table 13. The parameters are not normally distributed if the p-value is less than 0.05, but they have a normal distribution if it is more than the 5% level of significance. In this instance, the equations have a normal distribution. Table 14 shows that when the p-value is less than or equal to 0.05, the skewness test for normalcy rejects the normality hypothesis. We cannot rule out normality because the p-value for this skewness test table is more than 0.05. The p-value in table 15 is higher than 0.05. A normal distribution exists for each equation.

The ARCH test, on the other hand, demonstrates that the models are ARCH-free. Also, Ramsey's RESET test

Table 12. Estimated results of VECM

Dependent Variable	Independent variable					
		Lagged 1st difference vatiables values				
	ΔLE	ΔCO_2	ΔUPG	ΔM2	ΔREC	ΔECT_{t-1}
ΔLE	-2.888243**		-.014692	.0012051	-.0038373	.0243643
	(.9234193)		(.0124514)	(.0010875)	(.0028379)	(.0475762)
ΔCO_2	5.502149	-2.785557		.0470858***	-.0663887*	2.028265**
	(11.47513)	(4.451691)		(.0135147)	(.0352662)	(.5912194)
ΔUPG	-31.46547	-51.65579	-3.570923		.2237609	24.2019**
	(188.4461)	(73.10622)	(2.541019)		(.5791462)	(9.709079)
ΔM2	78.93151	62.9443	.1701961	-.1392507		4.481354
	(108.8667)	(42.23401)	(1.467966)	.1282162		(5.609008)
ΔREC	-2.888243**		-.014692	.0012051	-.0038373	.0243643
	(.9234193)		(.0124514)	(.0010875)	(.0028379)	(.0475762)
ΔLE	5.502149	-2.785557		.0470858***	-.0663887*	2.028265**
	(11.47513)	(4.451691)		(.0135147)	(.0352662)	(.5912194)

Source: Author

Standard errors are enclosed in parenthesis. *p < 0.10, **p < 0.05, ***P < 0.01

Table 13. Jarque-Bera test

Variables	Prob > chi2
LE	0.57988
CO_2	0.18560
UPG	0.48372
M2	0.75492
REC	0.59641
All	0.67691

Source: Author

Table 14. Skewness test

Variables	Prob > chi2
LE	0.29904
CO_2	0.06877
UPG	0.36742
M2	0.36742
REC	0.48313
All	0.28384

Source: Author

Table 15. Kurtosis test

Variables	Prob > chi2
LE	0.91506
CO_2	0.81256
UPG	0.42366
M2	0.88752
REC	0.46166
All	0.93803

is frequently used to confirm the right definition of the functional form. At a significance level of 5%, the null hypothesis of no omitted variable bias cannot be discarded. Finally, we examine the stability of the parameters across time. As proposed by Pesaran *et al.* (2001) we utilized the cumulative sum (CUSUM) and the cumulative sum squared (CUSUMSQ) to determine whether the parameters are stable.

6. Conclusion

The study aimed to examine the impact of environmental degradation on health using the ARDL method and data from 1976 to 2020. Results indicate that CO_2 emissions negatively affect health in Bangladesh, but effective governance can improve this effect. The study provides

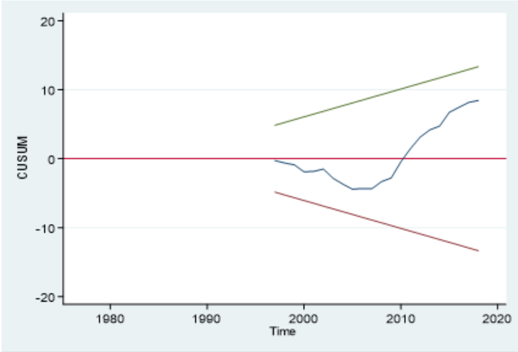

Figure 1 (A) CUSUM
Source: Author

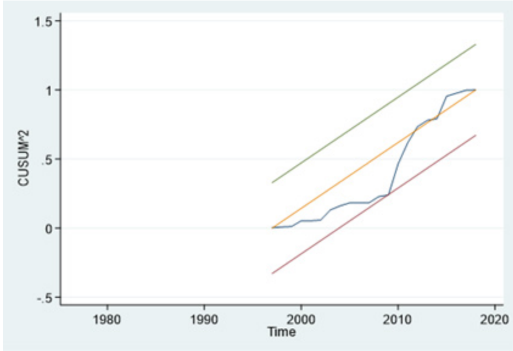

Figure 1 (B) CUSUMSQ
Source: Author

theoretical implications for the role of institutions in moderating the impact of environmental quality on health, and managerial implications for policymakers to improve health status by implementing environmental laws through good governance.

According to our empirical findings, CO_2 emissions have a detrimental influence on health in Bangladesh. We also looked at the relationship between environmental degradation and health, with the objective of finding which indicator reduces the inverse impact of carbon emissions on health. According to the findings, when there is good governance, the consequences of carbon emissions on health improves. Findings of this study have a lot of theoretical ramifications. This study contributes to our knowledge of how institutions in Bangladesh might attenuate the influence of environmental quality on health. Second, our findings have a number of management significance for authorities looking to raise life expectancy: Bangladesh ought to practice effective governance to guarantee the successful implementation of environmental legislation, which can lessen the harmful impacts of air pollution and enhance health status.

Increasing budget allocation to the health sector can help Bangladesh deal with the impact of environmental hazards on human well-being (Saha, 2023). The provision of green spaces can also mitigate the negative effects of the environment. Limited public intervention and government investment in the health system make it challenging to improve life expectancy and reduce mortality rates. The study's limitations include the use of a single measure of health and a narrow focus on institutional quality. Future research can expand the sample size, employ different requirements, and incorporate additional measures of health to improve the study's robustness.

Bangladesh's environment is under threat from the country's growing urban population. More food, housing, medicine, etc. are needed due to the overpopulation. As a result of the excessive demands of the rapidly expanding population, deforestation is growing. Due to the excessive population density in urban areas, carbon dioxide levels are rising and the environment is getting worse. Nature is losing its pristine beauty, which is bad for us and dangerous. Many waterborne and airborne diseases, including Ebola, anthrax, chickenpox, influenza, smallpox, tuberculosis, tapeworm, have infected us. Cholera, hookworm, E. coli, etc. Finally, the analysis demonstrated that a proportionate rise in environmental deterioration over time would have an adverse effect on health that was greater than a proportionate fall.

This study outlines a comprehensive approach to tackle environmental degradation and safeguard public health in Bangladesh.

Key Strategies:

1. Strengthen Regulations: Enforce existing environmental laws, update policies, and introduce stricter penalties for violations. Conversely, incentivize businesses adopting green practices.

2. Enhance Air & Water Quality: Implement measures to reduce air pollution (vehicle emissions, clean energy sources) and water pollution (industrial controls, sustainable agriculture). Additionally, ensure access to safe drinking water through infrastructure and monitoring.

3. Promote Sustainable Agriculture: Foster soil conservation techniques, efficient water management, and agroforestry practices to maintain healthy agricultural lands.

4. Improve Waste Management: Develop comprehensive waste management plans, promote waste segregation at source, and educate the public on proper disposal and recycling.

5. Enhance Disaster Preparedness: Establish early warning systems, invest in climate-resilient infrastructure, and train communities for disaster response.

6. Green Urban Development: Integrate green spaces and sustainable urban planning principles, invest in public transportation, and promote energy-efficient buildings and renewable energy.

7. Strengthen Public Health Systems: Implement health surveillance systems, improve healthcare access, and educate the public about environmental health risks.

8. Foster Research & Innovation: Support research on environmental health links, encourage innovative solutions, and improve data collection on environmental and health indicators.

9. Encourage Community Participation: Engage communities in conservation efforts and decision-making, raise public awareness, and support grassroots initiatives.

10. International Cooperation: Foster global partnerships, seek international funding and expertise, and align national policies with international environmental and health standards.

A collaborative effort from government, industry, and citizens is crucial to implement these recommendations. By addressing environmental degradation and enhancing resilience, Bangladesh can create a healthier future for all.

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