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Unleashing the Dynamics Among Energy Consumption, Gross Domestic Product, Environmental Degradation and Urbanization: An Evidence from Belt and Road Initiative Countries

Muhammad Rizwan[1], Kiran Zahara Gillani[2], Maira Bashir[3], Muhammad Abubakar[4]

[1] Liverpool John Moores University, United Kingdom. Email: mrizwanUAF.edu.pk@gmail.com
[2] Department of Management Sciences, University of Okara, Pakistan. Email: kirangillani112@gmail.com
[3] Department of Management Sciences, University of Okara, Pakistan. Email: mairabashir997@gmail.com
[4] Ph.D. Scholar, Hailey College of Commerce University of the Punjab Lahore, Pakistan.
Email: prof.abubakar729@gmail.com

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ABSTRACT

Metropolitan regions rise as polluting industries like transportation and industry consume fossil fuels. Globalization may accelerate urbanization and city density. Increased wages in many emerging economies are driving more people to cities. This research analyses the impact of gross domestic product, energy, and urbanization on CO2 emissions in Belt and Road Initiative countries with the moderating effect of foreign direct investment. We selected 104 Belt and Road Initiative countries for analysis according to their income level. Data was collected from world development indicators spanning from 1990 to 2021. After utilizing the Panel Least Square Model (Regression) to examine the impact of urbanization, foreign direct investment, energy, and gross domestic product on CO2 emissions, significant findings were found. According to the findings of the study, BRICS authorities should adopt an environmental plan that minimizes CO2 emissions without limiting economic growth. According to the current study, the government should help marketplaces by creating a robust legislative context that produces long lasting value for decreasing emissions and by consistently approving new technologies that contribute to a less carbon-intensive economy.

Corresponding Author's Email: mrizwanUAF.edu.pk@gmail.com

1. Introduction

Global warming and climate change are having an impact on people all around the globe. During the last two decades, researchers have put a significant amount of effort into investigating the connections between rising gross domestic product, increasing urbanization, rising emissions of CO_2, and rising energy consumption. It has been demonstrated that expanding civilizations are detrimental to the environment due to their reliance on fossil fuels. Fossil fuels are scarce, which poses challenges to global urbanization and economic expansion. Urbanization is anticipated to accelerate most rapidly in developing nations, but it will likely continue constantly in industrialized nations. The Sustainable Development Goals-SDGs promote economically and ecologically sustainable development. If urbanization significantly reduces CO_2 emissions, these targets may be reached faster (Gökmenoğlu & Taspinar, 2016; Khoshnevis Yazdi & Shakouri, 2018). Polluting economic activities (including transportation and industry) that rely on fossil fuels are anticipated to increase urban areas' energy consumption. In the coming years, significant urbanization and urban density may be anticipated because of globalization. As a result of rising incomes in numerous developing nations, more people are migrating to urban areas. People migrate from the country to the city for various reasons, including access to improved accommodation, raising a larger family, employment opportunities, population density, and public services. Recent research has linked urbanization to greater energy demand and greenhouse gas emissions (McGee & York, 2018; Niu & Lekse, 2018). Since, urbanization's economic benefits may explain why both the commercial and residential sectors have increased their energy consumption. The effects of transitioning from agricultural to industrial production, which generates more carbon dioxide due to high energy requirements, are the subject of ongoing research (Bakirtas & Akpolat, 2018; Q. Wang & Su, 2019).

Our generation worries about how climate change will affect future generations, the global economy, local economies, and ecosystems. The research conducted by A. Rehman, Ma, Ozturk, Murshed, and Dagar (2021) posits that the use of fossil fuels throughout the Industrial Revolution has been a significant contributor to the occurrence of climate change and the phenomenon of global warming. Urbanization may have far-reaching effects on the economy and its numerous subsectors. Nonetheless, extensive urbanization is a defining characteristic of the 21st century and crucial in expanding economies worldwide. It isn't easy to ascertain which factor led to the other because economic expansion and urbanization go hand-in-hand. As towns expand, so too might their commercial energy demand and carbon footprint. Urbanization impacts ecosystems in developed and developing nations with distinct environmental effects. How devastating are urbanization's environmental effects? (Gasimli et al., 2019; Sbia, Shahbaz, & Ozturk, 2017). The economic structure has transformed significantly due to urbanization, industrialization, population growth, rising energy consumption, and technological developments. Industrialization stimulated the growth of urban areas. Urbanization and industrialization are occurring at a rate that poses challenges for long-term sustainability (Munir, Lean, & Smyth, 2020). The effects of pollution on the climate and environment are currently an explosive subject of discussion.

Carbon emissions have increasingly severe climate effects. Since rising carbon emissions are linked to rising temperatures, allowing emissions to continue rising would lead to more severe climate change consequences. In addition to rising sea levels, melting glaciers, drought, wildfires, and pollution, climate change has far-reaching consequences for ecosystems and human societies (Dwivedi et al., 2022). The developed nations are primarily accountable for the environmental devastation and adverse climate change affecting our planet. They are at the forefront of a trend that exacerbates environmental risks by increasing carbon emissions, chemical residue, and metal and other nano particles. The aggressive actions of these nations have caused climate disruption (Shen, Shuai, Jiao, Tan, & Song, 2017). Carbon emissions, economic development, and energy consumption have been prioritized due to their conflict with environmental protection. The problem seems more pervasive and serious in Belt and Road Initiative **(**B.R.I.) compared to other parts of the globe. Maintaining economic growth while addressing environmental concerns is challenging for the region (Munir et al., 2020).

1.1. Problem Statement and Research Gap

Over the last 30 years, researchers have studied environmental degradation's causes. Amri, Arouri, and Bélaïd (2019) analyzed this topic, prompting debate regarding whether environmental degradation is related to economic development. Since then, empirical study on how economic growth impacts the environment has increased. A multitude of research investigations have examined the correlation between the growth of economies and the escalation of atmospheric carbon dioxide levels. Despite scholarly curiosity, there isn't enough data on carbon dioxide emissions sources. Panel studies cannot provide a comprehensive picture of the link between CO_2 and the factors that contribute to its production in Belt and Road Initiative nations due to methodological constraints. This study is distinct from others in several significant respects. To concentrate on a manageable number of Belt and Road Initiative nations, the researchers employed panel data. Although the link between increased energy consumption and processes like industrialization, urbanization, Foreign Direct Investment, and climate change has been known for decades, the empirical findings of this study shed new light on this problem. This study focuses on recent scholarly debates and discussions on energy consumption.

This study contributes to current knowledge by explaining several crucial policy concerns for Belt and Road Initiative nations. Renewable energy has been found to have favourable impacts on energy consumption, gross domestic product growth, and CO_2 reduction (Nathaniel & Khan, 2020). Before governments approve energy-intensive projects, there must be a clear correlation between increasing economic output, expanding utilization of renewable energy sources, and population growth. Renewable energy, population growth, and economic development are being studied in Belt and Road Initiative nations to reduce carbon emissions.

In comparison to other studies, this one's findings are more recent. Previous research cannot be relied upon due to current data scarcity. This research is better than previous efforts because it utilizes current data. As global warming has become a worldwide concern and governments have become more conscious of its implications, study on the subject has increased. The findings may have significant implications for numerous fields, including energy, gross domestic product growth, Foreign Direct Investment, and climate change.

1.2. Research Objectives

The principal objective of this study is to determine how urbanization, energy consumption, and GDP influence environmental change in Belt and Road Initiative countries, with FDI serving as a moderator.

1.3. Research Questions

- Does urbanization have any impact on environmental change in Belt and Road Initiative Countries?
- Is there any impact of energy use on environmental change in Belt and Road Initiative Countries?
- How does gross domestic product impact environmental change in Belt and Road Initiative Countries?
- Does the foreign direct investment have a moderating role between urbanization, energy use, gross domestic product and environmental change in Belt and Road Initiative Countries?

2. Literature Review

2.1. Urbanization and Environmental Change

Over the past several decades, urbanization's influence on CO_2 generation has been studied. Zhang et al. (2021) examined 1960–2019 data using A.R.D.L. (Autoregressive Distributed Lag Model), FMOLS (Fully Modified Ordinary Least Square), and DOLS (Dynamic Ordinary Least Square) strategies such that findings demonstrated that Malaysian urbanization and CO_2 emissions were statistically significant. Academic researchers used Granger causality to study Brazil, Russia, India, China, and South Africa (BRICS) urbanization and carbon emissions from 1985 to 2014. E. Rehman and Rehman (2022) researched five of Asia's most populated countries between 2001 and 2014 to investigate how urbanization and rising populations affected the amount of greenhouse gas emissions produced. Rapid population and economic expansion in India are contributors to the global climate. Due to escalating energy consumption and rapid urbanization, China and Pakistan are currently ranked among the most polluting nations globally.according to Akram, Li, Anser, Irfan, and Watto (2023) renewable energy has positive impact on climate change.

Liu and Bae (2018) examined CO_2 emissions, gross domestic product growth, industrialization, and urbanization in China using the V.E.C.M. (Vector Error Correction Model) and A.R.D.L. (Autoregressive Distributed Lag Model). There is a correlation between real gross domestic product growth, industrialization development, and urbanization expansion, with each contributing 0.6%, 0.3%, and 1.0% to annual increases in carbon dioxide emissions. As per Almaida et al. (2024) islamic banks are more sustable as compare to others. Q. Wang, Wang, and Li (2022) investigated how urbanization influenced the development of G.D.P. as well as environmental quality. One hundred thirty-four different countries contributed their data to the study. High-income countries have U-shaped gross domestic product growth-CO_2 emission correlations, whereas low- and middle-income countries have inverted U-shaped correlations. The study has associated rising urban populations and CO_2 emissions (Vo & Vo, 2021). Urbanization may temporarily reduce CO_2 emissions, but this effect may be temporary. After that, the trend may begin to decline once more progressively. Gierałtowska, Asyngier, Nakonieczny, and Salahodjaev (2022) examined 163 nations to confirm these results. Urbanization in the BRICS countries lowered carbon dioxide emissions from 1914 to 2014 (Balsalobre-Lorente, Driha, Halkos, & Mishra, 2022; Li & Haneklaus, 2022). As per Waqas Ahamd Watto, Khan, Monium, and Abubakar (2019) finding leadership having impact on work behaviour.

2.2. Energy Use and Environmental Change

Based on FMOLS (Fully Modified Ordinary Least Square) data encompassing the period from 1995 to 2017, electricity generation emerged as the predominant Source of carbon dioxide emissions in each of the 50 representative developing nations. Methods including Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) were utilized in the study. Transitioning to renewable energy sources reduces emissions more than economic growth (Khan, Peng, & Li, 2019). The increased use of renewable energy enhances environmental and economic health. Khan et al. (2019) assessed the global impact of energy consumption on CO_2 emissions by employing the S.U.R. (seemingly unrelated regressions) model and the Generalized Method of Moments. They conclude that there is a high link between the variables examined and that this association becomes even stronger as the levels of pollution increase.So Waqas Ahmad Watto, Monium, Qurban, and Ali (2020) eithical and in role perfoemance are interlinked. By examining energy consumption in Nigeria and Indonesia, Odugbesan and Rjoub (2020), demonstrate the variables' long-term belonging. The concepts of energy and growth are inherently forward-moving and unidirectional. The data suggests the presence of a Granger causal link between the increase in energy use and the growth of economic production. There seems to be a connection between the growth of gross domestic product, carbon dioxide emissions and energy use. As per Xin, Bin Dost, Akram, and Watto (2022) renewable energy is constance for getting sustainable energy

2.3. G.D.P. and Environmental Change

Adebayo (2020) utilized ARDL (Autoregressive Distributed Lag Model) and DOLS (Dynamic Ordinary Least Square) approaches on data collected between 1970 and 2009 to demonstrate that a rising gross domestic product in Malaysia led to a decline in carbon dioxide emissions. Mexican carbon dioxide emissions increased with economic expansion. Vo, Vo, Ho, and Nguyen (2020) used FMOLS (fully modified ordinary least squares) and DOLS (Dynamic Ordinary Least Square)estimators to analyze the relationship between carbon dioxide emissions and gross domestic product growth in the Association of Southeast Asian Nations-ASEAN region, with data spanning from 1971 to 2014. The study conducted by Teng, Khan, Khan, Chishti, and Khan (2021) shed light on the correlation between increasing economic affluence and the concurrent increase in carbon dioxide emissions. Mehdi and Slim (2017)employed three kinds of ordinary least squares models to find a relationship between North African gross domestic product growth and CO_2 emissions from 1980 to 2011: flexible minimum O.L.S., ordinary least squares, and difference of means O.L.S. The research conducted by Z. Wang, Rasool, Zhang, Ahmed, and Wang (2020) examines data spanning from 1996 to 2017 and utilizes the A.R.D.L. (Autoregressive Distributed Lag Model) model to investigate the relationship between the combined CO_2 emissions and gross domestic product of G7 nations. The findings indicate a simultaneous increase in both variables.as Xiang, Shaikh, Tunio, Watto, and Lyu (2022) use same model. According to Tenaw and Beyene (2021), Sub-Saharan African economic growth caused environmental degradation between 1990 and 2015. Their analysis encompassed the years 1990 to 2015. During times of economic crisis, the weaknesses of many economies become more obvious.

2.4. The moderating role of Foreign Direct Investment

Foreign Direct Investment's moderating influence on energy usage, G.D.P., and CO_2 emissions has received little attention. Adebayo and Beton Kalmaz (2021) conducted an analysis of the interrelationships among Egypt's gross domestic product, energy consumption, foreign direct investment, urbanization, and carbon dioxide emissions. The conclusions of this research indicate that the escalation of CO_2 emissions in South Africa may be attributed to the concurrent rise in economic activity, energy intensity, and urbanization. Odugbesan and Rjoub (2020) examined Turkey's CO_2 emissions from 1960 to 2016 due to energy consumption, economic growth, foreign direct investment, and urbanization using FMOLS (Fully Modified Ordinary Least Square)and DOLS (Dynamic Ordinary Least Square). A growing economy, urban population, and energy use increase CO_2 emissions. The A.R.D.L. (Autoregressive Distributed Lag Model) in Bangladesh gathered and made data available from the 1970s to the early 2010s. Raihan, Muhtasim, Pavel, Faruk, and Rahman (2022) studied 1990–2019 time series data using FMOLS (Fully Modified Ordinary Least Square) and DOLS (Dynamic Ordinary Least Square) and found that urbanization and economic expansion increase CO_2 emissions. So Hussain et al. (2022) gave same model. In their study, Al-Mulali et al. (2013)evaluated 30 years of MENA urbanization, energy usage, Foreign Direct Investment, and carbon dioxide emissions data. While adjusting for per-city G.D.P., Wu et al. (2021) , examined CO_2 emissions and B.R.I. (Belt and Road Initiative) urbanization from 1990 to 2018 using the D-H causation model. Growing cities in low- and middle-income nations create more CO_2. The G.D.P. (gross domestic product) growth and CO_2 emissions of 15 countries with strong renewable energy penetration were investigated by (Saidi & Omri, 2020). According to Ulucak (2022), to attract foreign investment and boost their economies, developing countries are more likely to change their policies. According to the study of Adeel-Farooq, Riaz, and Ali (2021), countries that implemented stricter environmental regulations were able to attract greater levels of foreign direct investment. Muhammad, Long, Salman, and Dauda (2020) incorporated participants hailing from Singapore, Thailand, Indonesia, Malaysia, and the Philippines into their study. They discovered that Foreign Direct Investment had a negative impact on the top 20% of polluting sectors in each country. The research study of Caetano, Marques, Afonso, and Vieira (2022) found no discernible linear correlation between foreign direct investment and carbon emissions across a sample of 32 O.E.C.D. countries. For pollution reasons, the inflexion point positively correlates with carbon emissions, and Foreign Direct Investment flows to the left. De Vita, Li, and Luo (2021) have shown a correlation between carbon emissions resulting from foreign direct investment and gross domestic product per capita. Foreign Direct Investment and carbon emissions are reversed in low-income countries. While foreign direct investment into countries with high incomes may assist in cutting carbon emissions, the opposite may be true for countries with low incomes.

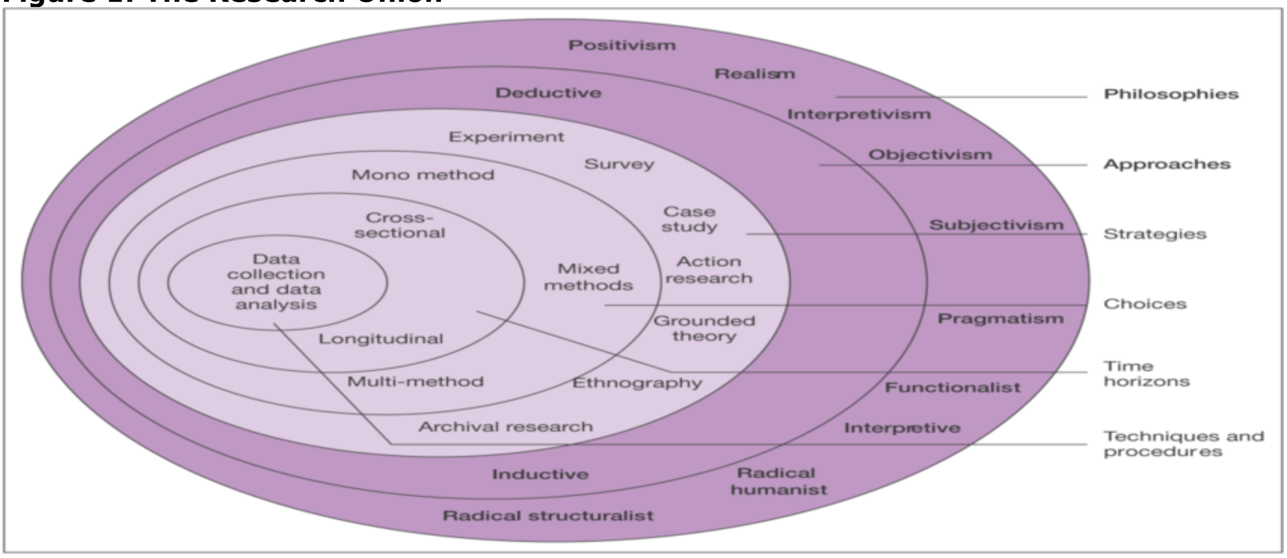
2.5. Hypothesis

- There is a significant impact of urbanization on environmental change.
- There is a significant impact of energy use on environmental change.
- There is a significant impact of gross domestic product on environmental change.
- Foreign Direct Investment plays a moderating role in the relationship between urbanization, energy use, gross domestic product and environmental change.

3. Research Methodology

The researchers discussed the study's methodology in this part. It looked at the philosophical assumptions that supported the entire investigation. This study took a positivist approach. The many gauges used in the current probe have also been thoroughly discussed. The accompanying image depicts "The Saunders Research Onion," the theoretical foundation of the approach used in this study.

Figure 1: The Research Onion



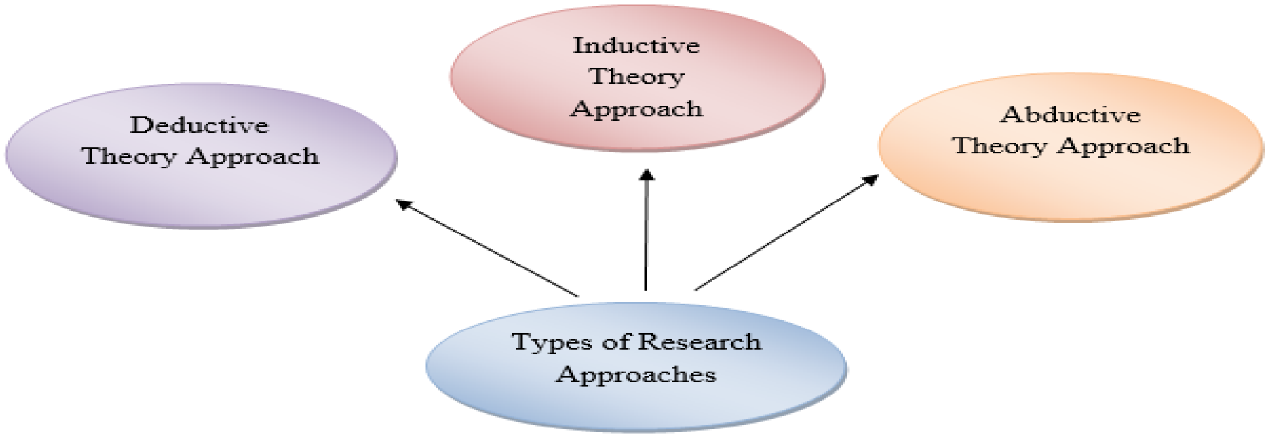
Source: (Saunders Mark et al., 2019)

An instance of such a research approach is illustrated in the work conducted by Saunders, Lewis, and Thornhill (2009). One could potentially break down the process of expanding the scope of the study into more manageable segments. It is applicable in any setting and has the potential to motivate scientists to devise novel methodologies.

3.1. Research Approach

A research endeavour used theoretical frameworks, and the study's conclusions made sense. On the other hand, the study's structure and methods are contingent on theoretical clarity before data collection begins. The researchers' theoretical assumptions govern each of the three study methodologies. The first two strategies are deductive and inductive theories. Recently, the abductive theory has come to light as a feasible possibility as a third way (Saunders et al., 2009).

Figure 2: Types of Research Approaches



Source: Developed by the Author

3.1.1. Deductive Approach

Deductive researchers formulate hypotheses by drawing upon pre-existing knowledge and theory, subsequently subjecting these predictions to empirical scrutiny. The term "inductive theory" is employed to describe this mode of reasoning (Bryman, 2016). Deductive reasoning, which involves following a linear and logical path, can be used to validate an existing hypothesis. This method uses quantitative data and a methodical research plan to confirm the study's conclusions (Saunders et al., 2009).

3.1.2. Inductive approach

The inductive theory-building approach is the antithesis of developing a theory from empirical facts. The researcher uses this strategy to broaden the scope of the hypothesis by starting with existing empirical facts. On the other hand, the deductive technique moves from a more general to a more detailed analysis of the idea (Saunders et al., 2009). Techniques employing this method to research attempt to learn more about the topic at hand by approaching it from several perspectives and considering the consequences of the event in question. Qualitative data is collected at this step in the study process, and the strategy is more adaptable. While using an inductive method to research, the researcher is less concerned with generalization (Saunders et al., 2009).

3.1.3. Approach chosen

Every viable remedy for an issue has equal and opposite benefits and cons. Because the researcher could draw on prior information to construct hypotheses, a logical procedure was used, and the idea was tested. This opened the door for a positivistic approach. Because the researcher developed hypotheses based on preliminary information, it is apparent that a positivistic technique is viable. The resource-based perspective and the concept of competitive advantage are the foundation for various assumptions about innovation strategy based on accessible data. These ideas were examined using quantitative data.

3.2. Data Source and Sampling

From 1990 to 2021, the W.D.I. (World Development Indicators) issued an annual report on the economic status of Belt and Road Initiative (BRI) countries. CO_2 (Carbon dioxide emissions) are frequently substituted when calculating the aggregate pollution burden per citizen in the countries under consideration. The factors to be considered include the average annual energy consumption of the countries in question, the proportion of the world's population residing in urban areas, and the annual growth rate of per capita gross domestic product. The percentage of gross domestic product that the country received due to net Foreign

Direct Investment inflows is calculated by subtracting the amount of new Foreign Direct Investment from the amount of Foreign Direct Investment outflows from the country reporting the data.

3.3. Empirical Model

The empirical model of the study was:

$$CO2\,(t) = \alpha + \beta 1X\,1 + \beta 2X\,2 + \beta 3X3 + \beta 4X4 + \epsilon$$

Where
X 1 = Urbanization
X 2 = Energy use
X 3 = Gross Domestic Product
X 4 =Foreign direct investment
α = Constant unknown factor
t = Time series
ϵ= denotes a random error term

The value of the coefficient indicates the degree to which the dependent variable, in this case, economic growth, varies while the values of all other independent variables are maintained constant. Є represents error intervals, and βeta 1, βeta 2, βeta 3 and βeta 4 give the range of possible values for coefficients.

3.4. Variables Details

As a dependent variable, annual CO_2 emissions in milligrams per individual have been chosen initially. The second set of independent variables consists of gross domestic product, energy consumption, and urbanization. Among the moderating variables is foreign direct investment, which represents the percentage of a nation's gross domestic product derived from investments executed by international corporations.

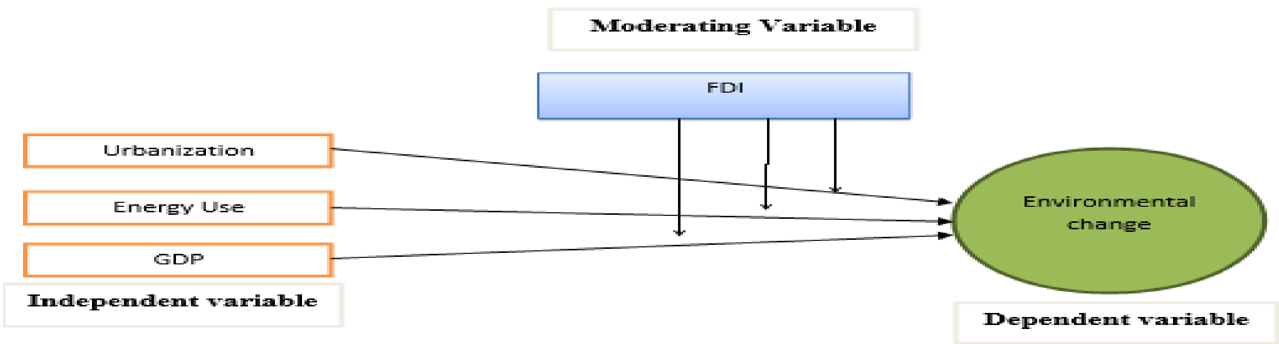
Table 1: Variables and their Source

Variables	Dimensions/Proxies	Source
Dependent Variable		
Environmental change	CO2 emission metric tons per capita	World Development Indicators (W.D.I.)
Independent Variable		
Urbanization	Urban population as a percentage of the total population	World Development Indicators (W.D.I.)
G.D.P.	Gross domestic product per capita annual growth	World Development Indicators (W.D.I.)
Energy use	Energy use kg of oil equivalent per capita	World Development Indicators (W.D.I.)
Moderating Variable		
Foreign Direct Investment	Foreign direct investment percentage of G.D.P.	World Development Indicators (W.D.I.)

3. Theoretical Framework

Within the theoretical framework, it identifies the factors that were studied and those that were not.

Figure 3: Framework



3.2. Econometric Method

The descriptive analysis method was used in this investigation. We use the modified Dickey-Fuller-ADF to find out whether the panel time series are dependent on one another. In our econometric model, we employ panel least squares (P.L.S.). For this purpose, Eviews software has been used.

4. Data Analysis

4.1. Descriptive Statistics

The main aim of descriptive statistics is to categorize and delineate various attributes of a given dataset. A dataset collects data from a specific population, including responses or observations. Once the process of data collecting has been completed, the first stage of statistical analysis involves the classification of responses by the process of determining the mean value of a single variable, such as age, or utilizing correlation analysis to investigate the association between two variables, such as age and creativity.
Here, the following are the descriptive statistics of our study.

Table 2: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Co_2 Emissions	4.912872	5.133406	5.608662	3.316069	0.919686	-1.28438	2.977036	1.374794	0.502883
Urbanization	30.21780	29.21800	35.42600	28.00200	2.990720	1.307705	2.998580	1.425078	0.490397
Gross Domestic Product	6.491216	5.236709	11.27866	3.512719	3.109867	0.715481	2.078896	0.603351	0.739578
Energy	1706.775	1715.309	1780.140	1560.566	87.40492	-1.04798	2.675891	0.937104	0.625908
Foreign Direct Investment	20.05744	21.60033	30.99522	8.738066	9.080857	-0.10309	1.563333	0.438858	0.802977

4.2. Regression

Table 3: Regression

Variable	Urbanization	G.D.P.	Energy	Foreign Direct Investment	C
Coefficient	0.019834	-0.01609	0.002086	-0.03388	-0.41545
Std. Error	0.001895	0.00608	1.82E-05	0.00654	0.088111
t-Statistic	10.46628	-2.64643	114.8187	-5.18043	-4.71501
Prob.	0	0.0082	0	0	0

Dependent Variable: Co2 Emissions

Table 4

R-squared	0.894981
Adjusted R-squared	0.894818
F-statistic	5500.99
Prob(F-statistic)	0
Durbin-Watson stat	0.087987

4-2 has panel least squares for the year 1990 to 2021. Total number of observations is 2587. Co2 emission is our dependent variable. However, urbanization, G.D.P. (gross domestic product) and energy are our exploratory/independent variables. However, Foreign Direct Investment is moderation in this study. B indicates the beta coefficient.

$$Co2\ emission = a + B(1) * Urbanization + B(2) * Gross\ Domestic\ Product + B(3) * Energy + B(4) * Foreign\ Direct\ Investment + e$$

Examine how the two variables are connected using the coefficient intercept. The correlation between urbanization, energy consumption, and carbon emissions is statistically significant and positive, as indicated by their respective coefficients. Urbanization and energy consumption increases could each contribute 0.019834 and 0.002086 percent, or one-tenth of a percentage point, to gross domestic product growth, respectively. gross domestic product and the expansion of the GDP are inversely correlated (coefficient = -0.016091). There is a negative correlation between carbon dioxide emissions and increases in gross domestic product (-0.016091 units per unit of gross domestic product). Carbon dioxide emissions have been shown to correlate negatively with foreign direct investment in recent years. For the results to be deemed statistically significant and reject the null hypothesis, each independent variable must possess a value below 0.05. A beta value was allocated to the independent variables due to the substantial influence they exerted on the dependent variable. The R2 statistic measures the extent to which a set of independent variables influences a dependent variable. As demonstrated by the data, the coefficient of determination, denoted by the letter R, is

0.894981. We can likely attribute 89% of the change in CO_2 emissions to the interaction between urbanization, gross domestic product, energy, and Foreign Direct Investment if this estimate holds. The residual 11% of the variability in CO_2 emissions can be attributed to other independent variables. The model exhibits a satisfactory fit to the data, as indicated by an R-squared value exceeding 60%.

4.3. Correlation

Correlation analysis is a technique utilized by statisticians to examine the possible relationship between two variables or datasets. When market researchers apply correlation analysis to numerical data collected through research methods such as surveys and polling to identify observable trends, patterns, and relationships among the variables under investigation, the importance of this phenomenon becomes evident.

Table 5: Correlation Analysis

	Co2 Emissions	Urbanization	G.D.P.	Energy	Foreign Direct Investment
Co2 Emissions	1.000000	0.595707	-0.01891	0.943156	0.080300
Urbanization	0.595707	1.000000	0.072731	0.577818	0.153930
Gross Domestic Product	-0.01891	0.072731	1.000000	-0.00288	0.153467
Energy	0.943156	0.577818	-0.00288	1.000000	0.115695
Foreign Direct Investment	0.080300	0.153930	0.153467	0.115695	1.000000

4.4. Unit Root Test

4.4.1. High Income

Table 6: Co2 (1st) (CO2_EMISSIONS)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-36.54956		-3.437236	-2.864469	-2.568383
Prob.*	0.0000				

Table 7: Urban (1st) (Urbanization)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-31.92729		-3.43653	-2.864157	-2.568215
Prob.*	0.0000				

Table 8: Gross Domestic Product (Level) (G.D.P.)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-12.89796		-3.436955	-2.864345	-2.568316
Prob.*	0.0000				

Table 9: Energy (1st)(Energy)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-6.963345		-3.442919	-2.866976	-2.569727
Prob.*	0.0000				

Table 10: Foreign Direct Investment (level)(Foreign Direct Investment)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-5.952147		-3.437012	-2.86437	-2.56833
Prob.*	0.0000				

CO2 emissions were subjected to the A.D.F. (augmented Dickey–Fuller) test, and the obtained p-value of 0.0000 is significantly less than the predetermined significance level of 0.05. An extremely small t-statistic of -36.54956 was also determined, and it falls far short of any potential upper limit. A summary of the data is provided in the table that follows. This presents compelling evidence that refutes the alternative hypothesis. The initial difference in the series of CO2 emissions is presumed to be stationary and devoid of origins. The t-statistic for the urbanization test in the A.D.F. (augmented Dickey–Fuller) was -31.92729, and the corresponding p-value was 0.0000. In comparison to the 0.05 and 1.8 cutoffs, both of these values are considerably less. This enables us to refute the null hypothesis confidently.

It is determined that the urbanization series is stationary and devoid of unit roots at the first difference level. An A.D.F. (augmented Dickey–Fuller) test was performed on the gross domestic product data, yielding a significance level of 0.0000. This value is deemed statistically significant as it is lower than the predetermined threshold of significance of 0.05. The test statistic obtained was -12.89796, which is lower than all of its critical values. As a result, it is necessary to reject the null hypothesis. Unit root absence and stability of the gross domestic product series are demonstrated at the level. In contrast to the presupposed significance value of 0.05, the Augmented Dickey-Fuller-ADF test for energy yields a significantly smaller p-value (0.0000). Additionally, the t-statistic (-6.963345) is observed to be less than all of its critical values. This enables us to refute the null hypothesis confidently. Furthermore, it can be asserted that the energy in the first difference series exhibits stationarity and is proportional to the sample size. The statistical analysis indicates that the p-value obtained (0.0000) through an Augmented Dickey-Fuller-ADF test on foreign direct investment is below the predetermined significance level (alpha) of 0.05. Besides being negative with respect to its minimum, maximum, and median values, the t-statistic (-5.952147) is also below these values. This enables us to refute the null hypothesis confidently. Foreign direct investments are characterized by stationarity and the absence of unit roots.

4.4.2. Low Income

Table 11: Co2 (Level) (CO_2_Emissions)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-4.340362		-3.451491	-2.870743	-2.571744
Prob.*	0.0005				

Table 12: Urban (Level) (Urbanization)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-4.705972		-3.43718	-2.86445	-2.56837
Prob.*	0.0001				

Table 12: Gross Domestic Product (level) (G.D.P.)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-12.78139		-3.43822	-2.8649	-2.56862
Prob.*	0.0000				

Table 13: Energy (1st) (Energy)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-5.0675		-3.46045	-2.87468	-2.57385
Prob.*	0.0000				

Table 14: Foreign Direct Investment (level) (Foreign Direct Investment)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-11.5744		-3.43814	-2.86487	-2.5686
Prob.*	0.0000				

Using the A.D.F. (augmented Dickey–Fuller) test performed on Co2 emissions, statistical significance was established at the 0.05 level of alpha (Table), with a p-value of 0.0000. Additionally, the t-statistic value of -4.340362 is observed to be lower than all of its critical values. This enables us to refute the null hypothesis confidently. The data indicate that CO2 emissions appear to be a stationary, unit-root-free time series. The null hypothesis is rejected with a high degree of probability based on the results of the A.D.F. (augmented Dickey–Fuller) test for urbanization at a significance level of 0.05. This is demonstrated by a t-statistic of -4.705972, which at the 0.0000 level is statistically significant. We can confidently refute the null hypothesis in light of the available data. The time series of the urbanization rate was observed to be consistent and free from unit roots. An Augmented Dickey-Fuller-ADF test was performed on the gross domestic product data, yielding a significance level of 0.0000. This value is deemed statistically significant as it is lower than the predetermined threshold of significance of 0.05. The test statistic obtained was -12.78139, which is lower than all of its critical values. Based on our research results, it is more probable that the competing theory is accurate. The series of gross domestic product at this level of detail is consistent and devoid of unit roots. The statistical analysis indicates that the null hypothesis is not supported by substantive evidence, as the p-value (0.0000) derived from the Augmented Dickey-Fuller-ADF test conducted on the energy variable is smaller than the predetermined significance level (0.05). Furthermore, it is illustrated that the t-statistic (-5.067500) falls below each of its critical values, providing additional evidence to reject the null hypothesis. At this time, the evidence is adequate to reject the null hypothesis. Furthermore, it can be asserted that the energy in the first difference series exhibits stationarity and is proportional to the sample size. The t-statistic is -11.57440, lower than all of its critical values. A p-value of 0.0000 means the Foreign Direct Investment ADF (augmented Dickey–Fuller) test is statistically significant. This enables us to refute the null hypothesis confidently. The series of foreign direct investments is characterized by stationarity and lacks a unit root.

4.4.3. Upper Middle Income

Table 15: Co2 (level) (CO2_Emissions)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-5.254234		-3.43564	-2.86376	-2.568
Prob.*	0.0000				

Table 16: Urban (Level) Urbanization

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-5.141768		-3.43513	-2.86354	-2.56788
Prob.*	0.0000				

Table 17: Gross Domestic Product (level) (G.D.P.)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-14.03825		-3.43549	-2.8637	-2.56797
Prob.*	0.0000				

Table 18: Energy (1st) (Energy)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-21.72558		-3.43908	-2.86528	-2.56882
Prob.*	0.0000				

Table 19: Foreign Direct Investment (Level) (Foreign Direct Investment)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-7.857694		-3.43597	-2.86391	-2.56808
Prob.*	0.0000				

The significance level of alpha = 0.05 was achieved, as indicated in the table, and the t-statistic obtained from the A.D.F. test utilized to quantify CO_2 emissions was smaller than the critical value of -5.254234. This indicates that the null hypothesis ought to be rejected with great conviction. Empirical evidence suggests that the series of CO_2 emissions exhibits a stationary characteristic and lacks a unit root. At the 5% level of significance, the t-statistic of -5.141768 and the p-value of 0.0000 obtained from the A.D.F. test of urbanization are both considered modest. We can now reject the null hypothesis with certainty. Regarding unit roots or trends, the time series of the urbanization rate makes no assumptions. The expected p-value for the gross domestic product Augmented Dickey-Fuller-ADF test is found to be less than the predetermined level of significance of 0.05.

The t-statistic result of -14.03825 is significantly lower than the minimum, maximum, and significance thresholds. We conclude, on the basis of our data, that the alternative hypothesis is more credible than the null and therefore reject it. The stability of the gross domestic product series and the absence of unit roots at the level. The energy A.D.F. test yielded a t-statistic of -21.72558, which is less than the minimum, maximum, and mode. The obtained p-value of 0.0000 is below the conventional threshold of 0.05, which is considered to be statistically significant. This indicates that the null hypothesis ought to be rejected with great conviction. Furthermore, it can be posited that the energy in the initial difference series exhibits stationarity and is proportional to the sample size. The statistical analysis reveals that the p-value produced by the Foreign Direct Investment ADF test (0.0000) is significantly smaller in magnitude than the anticipated alpha level (0.05). Additionally, the t-statistic (-7.857694) is significantly smaller than all cutoff values. It is possible to refute the null hypothesis using the available evidence. Research has established that foreign investment exhibits the characteristics of a stationary non-unit-root series.

4.4.4. Lower Middle Income

Table 20: Co2 (1st) (CO2_Emissions)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-3.368031		-3.441	-2.86613	-2.56927
Prob.*	0.0125				

Table 21: Urban (Level) (Urbanization)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-5.026136		-3.43513	-2.86354	-2.56788
Prob.*	0.0000				

Table 22: Gross Domestic Product (level) (G.D.P.)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-15.66241		-3.43534	-2.86363	-2.56793
Prob.*	0.0000				

Table 23: Energy (1st) (Energy)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-12.41708		-3.4431	-2.86706	-2.56977
Prob.*	0.0000				

Table 24: Foreign Direct Investment (level) (Foreign Direct Investment)

Augmented Dickey-Fuller test statistic		Test critical values:	1% level	5% level	10% level
t-Statistic	-8.940041		-3.43568	-2.86378	-2.56801
Prob.*	0.0000				

The outcomes of an A.D.F. test performed on CO_2 emissions are presented in the table; the p-value is considerably less than the predetermined significance level of 0.05. The test yielded a p-value of -3.368031%, which is below the 5% threshold and thus indicates statistical significance. This enables us to refute the null hypothesis confidently. The first disparity observed in the series of CO_2 emissions is regarded as stationary and devoid of a unit root. Statistically, the t-statistic of -5.026136 is significant in comparison to the predetermined threshold value of =0.05. The implications of the A.D.F. test results pertaining to urbanization are extensive, given their significance level of 0.0000. This enables us to refute the opposing theory unequivocally. We conclude that the urbanization rate time series is devoid of a discernible trend and, therefore, contains no unit root. The analysis of the G.D.P. statistics was conducted utilizing the Augmented Dickey-Fuller-ADF test, with a determined significance level of 0.0000. Significantly below the 0.05 threshold used to determine statistical significance, this value is present. The resulting test statistic, which has a value of -15.66241, is below the acceptable thresholds of 0, 1, and 2. It seems reasonable, in light of the evidence, to deny the null hypothesis and accept the alternative. Unit origins are absent from the series of G.D.P. levels. With a p-value of 0.0000, the significance level for the Augmented Dickey-Fuller (A.D.F.) test is considerably less than the conventional threshold of 0.05. The test statistic value of -12.41708 is statistically significant because it is less than each of the critical values. This enables us to refute the null hypothesis confidently. Furthermore, it can be asserted that the energy in the first difference series exhibits stationarity and is proportional to the sample size. The p-value obtained from Foreign Direct Investment testing using the Augmented Dickey-Fuller-ADF method was 0.0000, a value significantly below the conventional p-value of 0.05. Additionally, the test statistic value of -8.940041 falls below the critical threshold of 1. This presents compelling evidence that refutes the alternative hypothesis. When examining Foreign Direct Investment, one observes that the figures are linear and free from unit roots.

5. Discussion, Conclusion and Recommendations

5.1. Discussion and Conclusion

The coefficient derived from a regression model can be utilized for statistical testing, which can then be used to confirm or refute a hypothesis. The urbanization coefficient is statistically significant with CO2 emission with a value of 0.019834 (p-value = 0.0000). This evidence supports the competing hypothesis. As predicted by our model, urban areas will continue to produce more carbon dioxide as their populations grow. The results obtained in the current investigation align with those reported in prior research papers(Q. Wang et al., 2022).The correlation between energy consumption and carbon dioxide emissions is positive, as indicated by the energy coefficient (0.002086) and the statistically significant p-value. This conclusion makes logic in light of previous research into the subject—our findings support Adeneye et al. (2021), which are consistent with prior research. Given the observed p-value and the negative coefficients for G.D.P. (gross domestic product) and foreign direct investment (-0.016091 and -0.033879, respectively), the alternative hypothesis is deemed acceptable. Foreign direct investment and gross domestic product are inversely related to carbon dioxide emissions. Our research is strengthened and validated by the results of (Begum, Sohag, Abdullah, & Jaafar, 2015; Kirikkaleli & Kalmaz, 2020). This research illuminates B.R.I.'s (Belt and Road Initiative) environmental degradation causes. This research offers solutions to maintain environmental and economic health.

5.2. Implications

The researchers who conducted the research concluded that there would be reciprocal benefits to adopting an environmental plan to reduce CO_2 emissions throughout B.R.I. (Belt and Road Initiative) countries without slowing economic development. To aid the private sector in reducing its dependence on fossil fuels, the existing body of research suggests that the federal government establish a legal structure that incentivizes the advancement of low-carbon technology and provides a sustainable and foreseeable return on investment for long-term emission reductions. In an effort to mitigate the discharge of carbon dioxide into the air, which results from the combustion of fossil fuels for industrial processes and electricity production, Belt and Road Initiative-BRI participating governments have put forth carbon capture, storage, and emission trading initiatives. In order to achieve the critical objective of eliminating greenhouse gas emissions by 2050, reform and improvement of carbon policy, refunds on carbon pricing and other related measures must be implemented (Yoshino, Rasoulinezhad, & Taghizadeh-Hesary, 2021). Government funding and support may be available for enterprises and renewable energy technologies. These actions will assist the economy in increasing its reliance on carbon-free energy sources while decreasing its reliance on conventional energy sources. The government hopes these measures will accelerate economic development and transition without compromising environmental safeguards.

According to the conclusions, optimizing the current energy consumption structure requires prioritizing sustainable or renewable energy. BRI (Belt and Road Initiative) might minimize greenhouse gas emissions by switching to renewable energy. As they aggressively expand their renewable resources, the B.R.I. (Belt and Road Initiative) nations could establish technical assistance networks with other nations. These governments may decide to increase their investments in infrastructure for renewable energy sources. Since renewable energy reduces emissions, B.R.I. (Belt and Road Initiative) governments may lower costs while restricting fossil fuel usage in industry, businesses, and residences. There is a possibility that B.R.I. (Belt and Road Initiative) nations will implement programs to improve their energy efficiency. It is conceivable that B.R.I. (Belt and Road Initiative) nations would increase their expenditure on innovative energy-saving devices and advocate for more research in this area. New methods of accumulating, transforming, and utilizing energy may emerge during this time. Government regulation may also facilitate the development and dissemination environmentally responsible urban and smart development technologies. If B.R.I. (Belt and Road Initiative) governments value economic growth and environmental quality, they should prioritize green and sustainable urbanization in their planning, development, and promotion efforts. Technology can ease the planning of extensive land use and necessary infrastructure, reduce energy consumption, and enhance city residents' health. The environmental damage caused by urbanization makes it all the more essential to plan for urban expansion in a way that prioritizes resource conservation, incorporates innovative technology, and propagates eco-friendly behaviours. Policymakers are warming to "green urbanization" because it may reduce urbanization's environmental effect by using more renewable resources in the built environment. Electric cars, solar lighting, and ethanol-blended gas are examples. Carbon dioxide emissions and energy consumption in urban areas can be reduced through the installation of energy-efficient business and residential equipment and the adoption of renewable energy sources.

Increasing forested land in B.R.I. (Belt and Road Initiative) should be a top priority for countries seeking to reduce their carbon footprint and increase their climate resilience, according to the findings of this study. B.R.I.'s (Belt and Road Initiative) capacity to combat climate change may be enhanced by forest preservation, protection, agroforestry, afforestation, replanting, ecological forest organization, improved natural renaissance, urban forestry, and wood-based bioenergy. The focus of policy and action in the B.R.I. (Belt and Road Initiative) forestry sector will be on reducing greenhouse gas emissions through reducing deforestation, managing fires, reforestation, and restoration. Deforestation and forest fires in B.R.I. (Belt and Road Initiative) account for significant global CO_2 emissions, which could be reduced if B.R.I. (Belt and Road Initiative) nations increased investment and enacted stringent forest regulations.

5.3. Future research opportunities

For other developing nations to use diverse econometric models or micro disaggregated data, there is a need for additional research. Many potential growth drivers were overlooked in this study but may be investigated in future studies. Trade liberalization, monetary growth, industrialization, high-quality institutions, internationalization, technical progress, the discovery of new natural resources, reduction of human impact on the environment, etc. Carbon dioxide represented environmental damage in this study. B.R.I. (Belt and Road Initiative) may decrease carbon emissions from consumption and other pollutants such as nitrous oxide (N2O), sulfur dioxide (SO2), methane (CH4), carbon monoxide (C.O.), ground-level ozone (O3), hydrogen sulfide (H2S), and other S.L.C.F. CO2 emissions are an indication of environmental degradation. Water and sediment contamination are additional indicators of environmental degradation that could be utilized in the future to examine this correlation within the context of B.R.I. (Belt and Road Initiative) nations. Future researchers can use panel estimates and time series studies to aggregate data from various nations and generalize their findings. These could be beneficial for drawing parallels to this study's findings and elucidating the pertinent literature.

5.4. Recommendations

Governments should prioritize sustainable urbanization to preserve environmental quality despite the fact that urbanization dramatically increases CO_2 emissions. Governmental and business organizations in B.R.I. (Belt and Road Initiative) may benefit from relocating their operations outside cities if they implement more sustainable urban development strategies. The leaders of B.R.I.'s (Belt and Road Initiative) main cities must reduce the environmental impact of their countries' transport networks. The capacity of urban trees to absorb greenhouse gases may reduce the detrimental effects of air pollution. The government needs to make more information on environmental data available to the public, such as the outcomes of urban environmental quality monitoring and the locations of key pollution sources. Recycling rates may be increased, and energy waste can be reduced, both of which are efforts businesses and people can make to take more responsibility for the environment. If CO_2 emissions can be reduced more effectively and timely, this may positively impact the health of city residents and the general public.

Reference

Adebayo, T. S. (2020). Revisiting the EKC hypothesis in an emerging market: an application of ARDL-based bounds and wavelet coherence approaches. *SN Applied Sciences, 2*(12), 1945. doi:https://doi.org/10.1007/s42452-020-03705-y

Adebayo, T. S., & Beton Kalmaz, D. (2021). Determinants of CO 2 emissions: empirical evidence from Egypt. *Environmental and Ecological Statistics, 28*, 239-262. doi:https://doi.org/10.1007/s10651-020-00482-0

Adeel-Farooq, R. M., Riaz, M. F., & Ali, T. (2021). Improving the environment begins at home: Revisiting the links between FDI and environment. *Energy, 215*, 119150. doi:https://doi.org/10.1016/j.energy.2020.119150

Akram, H., Li, J., Anser, M. K., Irfan, M., & Watto, W. A. (2023). Assessing the impact of human capital, renewable energy, population growth, economic growth, and climate change policies on achieving the sustainable development goals. *Environmental Science and Pollution Research, 30*(56), 119285-119296. doi:https://doi.org/10.1007/s11356-023-30649-8

Almaida, A., Abbas, U., Watto, W., Asdullah, M., Fahlevi, M., & Ichdan, D. (2024). The Islamic effect: Exploring the dynamics of Islamic events on sustainable performance of Islamic and conventional stock markets. *Uncertain Supply Chain Management, 12*(1), 235-248. doi:https://doi.org/10.5267/j.uscm.2023.10.002

Amri, F., Arouri, M., & Bélaïd, F. (2019). Economic Growth and Environmental Degradation: The Role of Sectoral Dynamics and Social Sustainability in MENA Countries. *J. Energy & Dev., 45*, 159.

Bakirtas, T., & Akpolat, A. G. (2018). The relationship between energy consumption, urbanization, and economic growth in new emerging-market countries. *Energy, 147*, 110-121. doi:https://doi.org/10.1016/j.energy.2018.01.011

Balsalobre-Lorente, D., Driha, O. M., Halkos, G., & Mishra, S. (2022). Influence of growth and urbanization on CO2 emissions: The moderating effect of foreign direct investment on energy use in BRICS. *Sustainable Development, 30*(1), 227-240. doi:https://doi.org/10.1002/sd.2240

Begum, R. A., Sohag, K., Abdullah, S. M. S., & Jaafar, M. (2015). CO2 emissions, energy consumption, economic and population growth in Malaysia. *Renewable and Sustainable Energy Reviews, 41*, 594-601. doi:https://doi.org/10.1016/j.rser.2014.07.205

Bryman, A. (2016). *Social research methods*: Oxford university press.

Caetano, R. V., Marques, A. C., Afonso, T. L., & Vieira, I. (2022). A sectoral analysis of the role of Foreign Direct Investment in pollution and energy transition in OECD countries. *Journal of Environmental Management, 302*, 114018. doi:https://doi.org/10.1016/j.jenvman.2021.114018

De Vita, G., Li, C., & Luo, Y. (2021). The inward FDI-Energy intensity nexus in OECD countries: A sectoral R&D threshold analysis. *Journal of Environmental Management, 287*, 112290. doi:https://doi.org/10.1016/j.jenvman.2021.112290

Dwivedi, Y. K., Hughes, L., Kar, A. K., Baabdullah, A. M., Grover, P., Abbas, R., . . . Bunker, D. (2022). Climate change and COP26: Are digital technologies and information management part of the problem or the solution? An editorial reflection and call to action. *International Journal of Information Management, 63*, 102456. doi:https://doi.org/10.1016/j.ijinfomgt.2021.102456

Gasimli, O., Haq, I. u., Naradda Gamage, S. K., Shihadeh, F., Rajapakshe, P. S. K., & Shafiq, M. (2019). Energy, trade, urbanization and environmental degradation nexus in Sri Lanka: bounds testing approach. *Energies, 12*(9), 1655.

Gierałtowska, U., Asyngier, R., Nakonieczny, J., & Salahodjaev, R. (2022). Renewable energy, urbanization, and CO2 emissions: a global test. *Energies, 15*(9), 3390. doi:https://doi.org/10.3390/en15093390

Gökmenoğlu, K., & Taspinar, N. (2016). The relationship between CO2 emissions, energy consumption, economic growth and FDI: the case of Turkey. *The Journal of International Trade & Economic Development, 25*(5), 706-723. doi:https://doi.org/10.1080/09638199.2015.1119876

Hussain, S., Hoque, M. E., Susanto, P., Watto, W. A., Haque, S., & Mishra, P. (2022). The Quality of Fair Revaluation of Fixed Assets and Additional Calculations Aimed at Facilitating Prospective Investors' Decisions. *Sustainability, 14*(16), 10334. doi:https://doi.org/10.3390/su141610334

Khan, S., Peng, Z., & Li, Y. (2019). Energy consumption, environmental degradation, economic growth and financial development in globe: Dynamic simultaneous equations panel analysis. *Energy Reports, 5*, 1089-1102.

Khoshnevis Yazdi, S., & Shakouri, B. (2018). The effect of renewable energy and urbanization on CO2 emissions: A panel data. *Energy Sources, Part B: Economics, Planning, and Policy, 13*(2), 121-127. doi:https://doi.org/10.1080/15567249.2017.1400607

Kirikkaleli, D., & Kalmaz, D. B. (2020). Testing the moderating role of urbanization on the environmental Kuznets curve: empirical evidence from an emerging market. *Environmental Science and Pollution Research, 27*(30), 38169-38180. doi:https://doi.org/10.1007/s11356-020-09870-2

Li, B., & Haneklaus, N. (2022). Reducing CO2 emissions in G7 countries: The role of clean energy consumption, trade openness and urbanization. *Energy Reports, 8*, 704-713. doi:https://doi.org/10.1016/j.egyr.2022.01.238

Liu, X., & Bae, J. (2018). Urbanization and industrialization impact of CO2 emissions in China. *Journal of cleaner production, 172*, 178-186. doi:https://doi.org/10.1016/j.jclepro.2017.10.156

McGee, J. A., & York, R. (2018). Asymmetric relationship of urbanization and CO2 emissions in less developed countries. *PLoS One, 13*(12), e0208388. doi:https://doi.org/10.1371/journal.pone.0208388

Muhammad, S., Long, X., Salman, M., & Dauda, L. (2020). Effect of urbanization and international trade on CO2 emissions across 65 belt and road initiative countries. *Energy, 196*, 117102. doi:https://doi.org/10.1016/j.energy.2020.117102

Munir, Q., Lean, H. H., & Smyth, R. (2020). CO2 emissions, energy consumption and economic growth in the ASEAN-5 countries: A cross-sectional dependence approach. *Energy Economics, 85*, 104571. doi:https://doi.org/10.1016/j.eneco.2019.104571

Nathaniel, S., & Khan, S. A. R. (2020). The nexus between urbanization, renewable energy, trade, and ecological footprint in ASEAN countries. *Journal of cleaner production, 272*, 122709. doi:https://doi.org/10.1016/j.jclepro.2020.122709

Niu, H., & Lekse, W. (2018). Carbon emission effect of urbanization at regional level: Empirical evidence from China. *Economics, 12*(1), 20180044. doi:https://doi.org/10.5018/economics-ejournal.ja.2018-44
Odugbesan, J. A., & Rjoub, H. (2020). Relationship among economic growth, energy consumption, CO2 emission, and urbanization: evidence from MINT countries. *Sage Open, 10*(2), 2158244020914648. doi:https://doi.org/10.1177/2158244020914648
Raihan, A., Muhtasim, D. A., Pavel, M. I., Faruk, O., & Rahman, M. (2022). Dynamic impacts of economic growth, renewable energy use, urbanization, and tourism on carbon dioxide emissions in Argentina. *Environmental Processes, 9*(2), 38. doi:https://doi.org/10.1007/s40710-022-00590-y
Rehman, A., Ma, H., Ozturk, I., Murshed, M., & Dagar, V. (2021). The dynamic impacts of CO2 emissions from different sources on Pakistan's economic progress: a roadmap to sustainable development. *Environment, Development and Sustainability, 23*(12), 17857-17880. doi:https://doi.org/10.1007/s10668-021-01418-9
Rehman, E., & Rehman, S. (2022). Modeling the nexus between carbon emissions, urbanization, population growth, energy consumption, and economic development in Asia: Evidence from grey relational analysis. *Energy Reports, 8*, 5430-5442. doi:https://doi.org/10.1016/j.egyr.2022.03.179
Saidi, K., & Omri, A. (2020). The impact of renewable energy on carbon emissions and economic growth in 15 major renewable energy-consuming countries. *Environmental research, 186*, 109567. doi:https://doi.org/10.1016/j.envres.2020.109567
Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*: Pearson education.
Sbia, R., Shahbaz, M., & Ozturk, I. (2017). Economic growth, financial development, urbanisation and electricity consumption nexus in UAE. *Economic research-Ekonomska istraživanja, 30*(1), 527-549.
Shen, L., Shuai, C., Jiao, L., Tan, Y., & Song, X. (2017). Dynamic sustainability performance during urbanization process between BRICS countries. *Habitat International, 60*, 19-33. doi:https://doi.org/10.1016/j.habitatint.2016.12.004
Tenaw, D., & Beyene, A. D. (2021). Environmental sustainability and economic development in sub-Saharan Africa: A modified EKC hypothesis. *Renewable and Sustainable Energy Reviews, 143*, 110897. doi:https://doi.org/10.1016/j.rser.2021.110897
Teng, J.-Z., Khan, M. K., Khan, M. I., Chishti, M. Z., & Khan, M. O. (2021). Effect of foreign direct investment on CO 2 emission with the role of globalization, institutional quality with pooled mean group panel ARDL. *Environmental Science and Pollution Research, 28*, 5271-5282. doi:https://doi.org/10.1007/s11356-020-10823-y
Ulucak, R. (2022). Analyzing energy innovation-emissions nexus in China: a novel dynamic simulation method. *Energy, 244*, 123010. doi:https://doi.org/10.1016/j.energy.2021.123010
Vo, D. H., & Vo, A. T. (2021). Renewable energy and population growth for sustainable development in the Southeast Asian countries. *Energy, Sustainability and Society, 11*(1), 30. doi:https://doi.org/10.1186/s13705-021-00304-6
Vo, D. H., Vo, A. T., Ho, C. M., & Nguyen, H. M. (2020). The role of renewable energy, alternative and nuclear energy in mitigating carbon emissions in the CPTPP countries. *Renewable Energy, 161*, 278-292. doi:https://doi.org/10.1016/j.renene.2020.07.093
Wang, Q., & Su, M. (2019). The effects of urbanization and industrialization on decoupling economic growth from carbon emission–a case study of China. *Sustainable Cities and Society, 51*, 101758. doi:https://doi.org/10.1016/j.scs.2019.101758
Wang, Q., Wang, X., & Li, R. (2022). Does urbanization redefine the environmental Kuznets curve? An empirical analysis of 134 Countries. *Sustainable Cities and Society, 76*, 103382. doi:https://doi.org/10.1016/j.scs.2021.103382
Wang, Z., Rasool, Y., Zhang, B., Ahmed, Z., & Wang, B. (2020). Dynamic linkage among industrialisation, urbanisation, and CO2 emissions in APEC realms: evidence based on DSUR estimation. *Structural Change and Economic Dynamics, 52*, 382-389. doi:https://doi.org/10.1016/j.strueco.2019.12.001
Watto, W. A., Khan, Z., Monium, A., & Abubakar, M. (2019). How Do Ethical Leadership and Organizational Justice Affect Work Outcomes? Does Perceived Organizational Support Mediate the Relationships? *Business Perspective Review, 1*(1), 53-70.
Watto, W. A., Monium, A., Qurban, A., & Ali, I. (2020). The Impact Of Ethical Context On Employees In-Role Performance And Citizenship Behavior In Telecom Sector Of Pakistan: The Mediating Role Of Perceived Organizational Support. *International Journal of Environmental, Sustainability, and Social Science, 1*(1), 25-35.
Wu, J., Abban, O. J., Boadi, A. D., Haris, M., Ocran, P., & Addo, A. A. (2021). Exploring the relationships among CO 2 emissions, urbanization, economic growth, economic structure, energy consumption, and trade along the BRI based on income classification. *Energy, Ecology and Environment, 6*, 213-231. doi:https://doi.org/10.1007/s40974-020-00176-0
Xiang, H., Shaikh, E., Tunio, M. N., Watto, W. A., & Lyu, Y. (2022). Impact of corporate governance and CEO remuneration on bank capitalization strategies and payout decision in income shocks period. *Frontiers in Psychology, 13*, 901868.

Xin, Y., Bin Dost, M. K., Akram, H., & Watto, W. A. (2022). Analyzing Pakistan's Renewable Energy Potential: A Review of the Country's Energy Policy, Its Challenges, and Recommendations. *Sustainability, 14*(23), 16123. doi:https://doi.org/10.3390/su142316123

Yoshino, N., Rasoulinezhad, E., & Taghizadeh-Hesary, F. (2021). Economic impacts of carbon tax in a general equilibrium framework: empirical study of Japan. *Journal of Environmental Assessment Policy and Management, 23*(01n02), 2250014. doi:https://doi.org/10.1142/S1464333222500144

Zhang, L., Li, Z., Kirikkaleli, D., Adebayo, T. S., Adeshola, I., & Akinsola, G. D. (2021). Modeling CO2 emissions in Malaysia: an application of Maki cointegration and wavelet coherence tests. *Environmental Science and Pollution Research, 28*(20), 26030-26044. doi:https://doi.org/10.1007/s11356-021-12430-x