Is There Any Correlation Between Poverty, Income Inequality, and Environmental Degradation in Low-Income Countries?

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Abstract. Comprehensive and integrated solutions that address economic, social, and environmental factors are imperative to effectively tackle the complex interrelation between poverty, income inequality, and environmental degradation in low-income countries. To break the cycle of degradation and improve the well-being of vulnerable communities, efforts to alleviate poverty and reduce income inequality must go hand in hand with strategies for sustainable environmental management. Establishing a direct relationship between poverty, income inequality, and environmental degradation in low-income countries is crucial. If such a connection exists, it would have significant implications for policymakers and stakeholders addressing these challenges. The study employed advanced statistical techniques such as panel data regression with the Driscoll Kray coefficient estimator to explore the intricate relationship between poverty, income inequality, and environmental degradation in low-income countries. The study's findings are significant as they shed light on the key factors contributing to these countries' environmental degradation, allowing governments and policymakers to take informed actions toward sustainable development.

Keywords: Environment, Degradation, Low-Income Countries, Poverty, Inequality.

1 Introduction

The increasing concerns for sustainable development have emerged due to the deterioration of the environmental quality caused by economic activities. Among the agendas of the sustainable development goals initiated by the United Nations are poverty alleviation and climate action. All countries, including low-income countries, must eradicate poverty and establish environmentally sustainable habitats for future generations (1). Despite developed and developing countries, the interrelation of pov-

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erty, income inequality, and environmental degradation in low-income countries is a complex and multifaceted issue requiring comprehensive and integrated solutions addressing economic, social, and ecological factors (2). To break the cycle of degradation and improve the well-being of vulnerable communities, efforts to alleviate poverty and reduce income inequality must go hand in hand with strategies for sustainable environmental management. Establishing a direct causal relationship between poverty, income inequality, and environmental degradation in low-income countries is crucial. If such a connection exists, it would have significant implications for policymakers and stakeholders addressing these challenges. Efforts to tackle poverty and environmental degradation require integrated policies and development initiatives. Sustainable Development Goals (SDGs) are crucial in breaking the poverty and environmental decline cycle. SDGs aim to promote economic growth, reduce inequality, and ensure ecological sustainability, all while alleviating poverty (3).

This study expands upon the existing research in a few ways. Initially, it comes across research investigating the connection between poverty, income inequality, and environmental deterioration in low-income nations. Numerous studies concentrate solely on low- or middle-income countries (LMICs) or developing nations. The motivation for this study was drawn from the research conducted by (4).

1.1 Poverty and Environmental Degradation

Particularly in countries with low incomes1, poverty can force individuals and communities to exploit natural resources to survive, indirectly worsening the environmental quality (5). The COVID-19 pandemic and other major disruptions from 2020 to 2022 have greatly impeded global initiatives to alleviate poverty, leading to a loss of three years in terms of development. Low-income countries experienced a greater impact and are currently in the process of recovering. In 2022, the global number of individuals experiencing extreme poverty reached 712 million, indicating an increase of 23 million compared to 2019 (6). This often leads to unsustainable practices such as overfishing, deforestation, and soil degradation. For instance, impoverished communities may depend on unsustainable agricultural practices to fulfil their immediate food needs, which can result in soil erosion and degradation in the long run.

Economic growth is crucial in reducing poverty, especially when it is not associated with increasing inequality and environmental damage. Some research has examined the correlation between income and CO2 emissions and has indicated that an increase in wealth negatively impacts environmental quality up to a certain level. From the perspective of emerging nations, increased income may alleviate poverty and exacerbate environmental issues (7). There exists a cyclical relationship between poverty and environmental degradation. Impoverished communities may engage in

[1] Low-income countries included Afghanistan, Burkina Faso, Burundi, Central African Republic, Chad, The Democratic Republic of Congo,, Ethiopia, The Gambia, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, South Sudan, Sudan, Syrian Arab Republic, Togo, Uganda, and Yemen Republic.

activities that further degrade the environment due to a lack of sustainable alternatives, perpetuating the cycle of poverty and environmental decline. This cycle can be particularly challenging to break without addressing poverty and environmental degradation concurrently (5).

Furthermore, poverty worsens the vulnerability of communities to the consequences of environmental decline and natural calamities. Impoverished communities usually do not have sufficient resources to tackle the aftermath of floods, droughts, and storms, which leads to more suffering and damage. Moreover, regions with poverty may lack the infrastructure and resources necessary to respond effectively to natural disasters, exacerbating the impact of environmental catastrophes. Therefore, low-income countries are selected in this study due to their challenges in stimulating economic growth, eradicating poverty, reducing income inequality, and improving the standard of living for their less privileged people. The activities of economic acceleration aiming to reduce poverty require higher energy use and carbon emissions that worsen the environmental quality (5)

1.2 Income Inequality and Environmental Degradation

The unequal distribution of income has a diverse impact on various social and economic classes of the regions. Income inequality can result in unequal access to resources and opportunities (8), leading to overconsumption by the wealthy and a greater strain on the environment (5). Wealthier individuals and communities may have more access to resources such as land, water, and energy, which can lead to increased consumption and environmental impact. Industries targeting low-income areas for waste disposal and industrial activities can contribute to environmental degradation, including air, water, and soil pollution, which can have serious impacts on the health and well-being of people living in these areas (5).

Likewise, unequal access to green spaces and clean environments can worsen the impact of environmental degradation on marginalised communities. Industries focusing on low-income areas for waste disposal can contribute to environmental degradation, which can, in turn, affect the health and well-being of the impoverished. Conversely, low-income countries may lack the financial resources and infrastructure to invest in sustainable environmental practices, perpetuating the cycle of degradation.

This study addresses the following research questions: 1) Is there any correlation between poverty, income inequality, and environmental degradation in low-income countries? This study aims to investigate the relationship between poverty, income inequality, and environmental degradation in low-income countries.

The rest of the research article is organised as follows. Section 2 describes the summary of the literature review. Section 3 portrays the variables, methodology, and sources of data. Section 4 details the empirical results and discussion. Section 5 contributes concluding remarks, policy recommendations, and study limitations.

2 Literature Review

2.1 Poverty and Environmental Degradation

As the literature identifies, various approaches relate to poverty and environmental degradation. Poverty is considered the main factor of environmental degradation, particularly in low-income countries, even though the relationship is multi-complex and currently involved in a debate among scholars. This is due to poverty contributing significantly to the high levels of carbon emission and excessive use of land and resources that deteriorate the environment. This is supported by a study that found a two-way causal relationship between poverty and the environment (9). (10) agreed that poverty, high population, and inadequate environmental regulation and management in low-income countries worsen the environmental quality.

While a study by (11) highlighted that rich and poor people are responsible for contributing to pollution, the poor are affected more as they act as both agents and victims of this issue. Similar findings found that farmers who are not poor and those who are moderately poor are the ones who are more involved in activities that are recognised locally as harmful to the environment. The former group contributes more than the latter. Conversely, the adoption of land management measures that enhance the quality of the land is rather limited among the most impoverished farmers (12). The research findings by (13) indicate a positive relationship between poverty and the growth in carbon emissions and ecological footprint over the entire panel. Limited studies are conducted regarding this issue, yet the majority agree that poverty consistently contributes to environmental degradation.

Another study done by (14) indicates a direct correlation between environmental deterioration and economic growth, and with poverty, for both variables. Considering some socio-economic variables that may serve as explanatory factors for their environmental influence is advisable.

2.2 Income Inequality and Environmental Degradation

There are various studies, but limited studies have been done on the linkage between income inequality and environmental degradation. A study by (15) found that income inequality was statistically significant and positively related to environmental quality. It is suggested that intervention programs be implemented to escalate income levels and improve the quality of life among rural residents. The findings by (16) indicate a unidirectional relationship where income disparity has a causal effect on environmental degradation, whereas environmental degradation does not cause income inequality. Although economic disparity contributes to environmental deterioration, there are additional elements that contribute to the occurrence of income inequality. Environmental deterioration is exacerbated by income disparity, per capita gross domestic product (GDP), and industrial structure. Income inequality is adversely affected by environmental degradation, education, and per capita GDP, while the environmental protection budget and taxation exacerbate it.

The empirical results demonstrate a positive correlation between income inequality with carbon emissions and ecological footprint over the entire panel. However, when the panel is divided into groups, the findings suggest that economic disparity reduces carbon emissions and ecological footprint in the high-income group but increases both in the middle-income group (13).

3 Method

The Driscoll–Kraay standard errors coefficient is employed in this study to determine further the relationship between environmental degradation and control variables in low-income countries (2). The estimator represents a non-parametric method that offers a more dynamic and broader time dimension and applies to unbalanced and balanced datasets since it can handle missing values effectively (Baloch et al., 2020). Data for low-income countries are generally very limited; therefore, the D-K standard error coefficient estimator would help address this downside.

This study will use panel data from 23 low-income countries covering 2000 to 2022. According to the World Bank Database, the total number of low-income countries is 26. Due to the nonavailability of a big percentage of data in 3 countries[2], they were dropped from the observation. The database is unbalanced and with quite a few missing values. Therefore, the test for heteroscedasticity is done using the Breusch-Pagan tests.

3.1 A Test for heteroscedasticity.

For this purpose, this study used the Breusch–Pagan test (BP) for heteroskedasticity. For the BP test, the null assumes homoskedasticity. Therefore, based on the result obtained below, p_value > 0.05 (0.3608); means failure to reject the null, and it is safe to conclude that there may not be heteroskedasticity.

Table 1. Breusch–Pagan test (BP) for heteroskedasticity

Assumption: Normal error terms
Variable: Fitted values of lnCo2
H0: Constant variance
chi2(1) = 0.84
Prob > chi2 = 0.3608

3.2 Variables

Variables included in the study are as follows. Carbon dioxide (CO2) emissions are the variable used by (7,13,16,17). CO2 emissions are a direct result of burning fossil

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fuels and manufacturing cement. This includes the consumption of solid, liquid, gas fuels, and gas flaring- extracted from the World Bank National Account Database. Another variable is poverty used by (9,10). The national poverty headcount ratio directly measures the percentage of the population living below the national poverty line. National estimates are calculated using population-weighted subgroup estimates from household surveys. In economies where EU-SILC data is used, the reported year is the income reference year, the year before the survey year- extracted from the World Bank, ld Bank, Poverty and Inequality Platform. The following variable is the Gini coefficient, used by (14,16–18). The Gini coefficient measures income inequality on a scale of 0 to 1. Higher values indicate a greater level of inequality. The data relates to income after taxes and benefits or consumption per capita. These coefficients are extracted from the World Income Inequality Database (WIID)(19).

Forest Area is also another variable used by (2). The term forest area refers to land containing natural or planted stands of trees at least 5 meters tall, whether used for production. This definition excludes tree stands within agricultural production systems (such as fruit plantations and agroforestry systems) and trees in urban parks and gardens, based on the Food and Agriculture Organization through the World Bank Database. GDP per capita – used by (16,18). GDP per capita is the gross domestic product divided by the midyear population. It is calculated without deductions for asset depreciation or natural resources depletion. The data is in constant 2015 USD, extracted from the World Bank National Account Database. The last variable used is PM2.5 air pollution. The term population-weighted exposure to ambient PM2.5 pollution describes the average level of exposure of a nation's population to fine particles measuring less than 2.5 microns in aerodynamic diameter. These particles can deeply penetrate the respiratory tract and lead to severe health issues. Exposure is determined by considering the mean annual concentrations of PM2.5 and weighting them based on the population in urban and rural areas. The efforts to reduce air pollution have heavily relied on the widespread use of air pollution control devices (APCDs). However, it is important to note that the operation of these devices depends significantly on electricity, resulting in substantial indirect CO2 emissions. It is crucial to acknowledge that the extent of CO2 emissions caused by these actions is still underestimated.

The descriptive statistics that were generated especially for the variables that were used in this paper are summarised in Table 2 which can be found below.

Table 2. Descriptive Analysis

Variables	Obs	Mean	Std.Dev	Min	Max
Co2 Emission	483	0.256712	0.4723411	0.0217895	3.098697
GDP per capita	510	727.4905	493.8454	255.1003	2547.64
Forest Area	494	24.60339	22.68094	0.8425673	85.36794
Air Pollution	376	44.74503	13.79019	17.23831	87.52219
Poverty	87	50.68506	14.23271	19.7	82.3

Headcount Gini	89	40.35783	5.601244	26.6	56.2

4 Result and Analysis

The Driscoll–Kraay standard errors coefficient is employed in this study to determine further the relationship between environmental degradation and control variables in low-income countries. Table 3 shows the findings obtained when the data is estimated by using Stata MP17.

Table 3. Driscoll - Kraay Regression Estimator

Variable	**Coefficient - D–K standard error estimates**
Constant	-1.077381* (1.597579)
Forest Land	.2144867*** (0.0402155)
Air Pollution	.2430275* (.1340816)
Poverty	.3395614** (.1429356)
Gini	-1.208075*** (3036001)
GDP Per Capita	.0171110 *** (.0005877)
R2	0.6172
Group	23
Observation	483

*Notes: Coefficients report using D-K Standard Error Estimates. Standard errors in parentheses. *, ** and *** show level of significance at 10%, 5% and 1% respectively.*

In the table above, all results are obtained with a log form of the data for all variables to make the data less affected by outliers (20). All the variables selection and their signs are consistent with the literature except for forest land. Based on the results, as expected, the higher the poverty rate in low-income countries, the more environmental degradation will occur. An increase of 1% of the poverty rate will cause the degradation of the environment to rise by 0.341%. This result is supported by many other previous research. Poverty is acknowledged as a significant contributing factor to environmental degradation, particularly in the presence of poverty, along with high population growth and inadequate environmental policies, which place considerable strain on available resources. This strain bates the degradation of ecological quality, leading to a range of complex and interconnected environmental challenges (10). (9),

(21), and (27) established that poverty contributes to excessive CO2 emissions and land degradation because impoverished communities often rely on unsustainable use of environmental resources for survival.

For income inequality, the finding shows a trade-off between the income gap and environmental degradation. It is not a favourite coefficient sign for this variable, but much previous research also agreed with this finding. A study by (22), for the pre-economic liberalisation periods from 1981 – 1991 stated that the relationship between Co2 emission and income inequality was already negative in India. Another study by (23) found that imposing a policy that can lead to increased inequality will reduce emissions, as in Germany. (24) also discovered that higher inequality could significantly decrease CO2 emissions, and (25) demonstrated that increased inequality among households reduces overall environmental deprivation. However, this finding contradicts the studies done by (16) and (15), which show a positive relationship between inequality and environmental degradation.

For GDP per capita, as stated in the table above, the result of GDP per capita is significantly positive with the dependent variable. The emission of CO2 will rise by 0.171% due to a percentage rise in GDP per capita. Based on the empirical evidence, it can be concluded that ongoing economic development is meant to help reduce poverty, but at the expense of environmental pollution. These findings are particularly relevant for low-income countries, where the focus on economic growth often disregards the potential negative impacts on the environment. The result is in line with (26) for the case in India and (4) for Asian countries. The result for the other two control variables showed two potential issues. The first one is that forest area is significant to the study, but the coefficient sign is not as expected. The underlying rationale for this pertains to suspected multicollinearity issues. Instrumental variable (IV) estimation is conventionally employed to mitigate the bias stemming from the correlation between an explanatory variable and the error. However, given the lack of focus on causality within this study, this matter will be addressed in future investigations. For air pollution, the result is barely significant at a 10% level. We believe we should use data on the usage of APCDs instead of air pollution since the relationship between both might be indirect compared to between APCDs and Co2 emissions.

5 Conclusion

In conclusion, this study employs the Driscoll-Kraay standard errors coefficient method to investigate the correlation between environmental degradation and control variables in low-income countries. The analysis is based on panel data gathered from 23 low-income countries, spanning 2000 to 2022. This approach allows for a thorough examination of the dynamics between environmental degradation and various influencing factors within the context of low-income countries over a substantial timeframe. The empirical evidence presented in this study demonstrates a significant correlation between poverty, income inequality, and environmental degradation. Specifically, it is observed that higher levels of poverty are associated with increased environmental degradation. This finding suggests that impoverished populations, due

to limited access to resources and opportunities, may engage in practices that exacerbate environmental harm as they struggle to meet their basic needs.

Furthermore, the study uncovers a nuanced relationship between income inequality and environmental degradation. The results indicate a trade-off between the income gap and environmental health, implying that in contexts where income disparity is more pronounced, the adverse environmental impacts may be mitigated or exacerbated depending on various socio-economic dynamics. The study highlights the intricate interactions between socio-economic variables and environmental effects in low-income nations. As essential elements of environmental sustainability plans, the findings emphasise the pressing need for policies that address poverty and economic disparity. Reducing environmental deterioration and promoting a more sustainable and equitable future are possible outcomes of low-income countries addressing these socio-economic concerns. Breaking the cycle of poverty, inequality, and environmental degradation can be achieved primarily by empowering people to participate in sustainable natural resource management, supporting renewable energy, and ensuring access to education. The study has a few limitations. It is best to proceed cautiously when interpreting the estimates because they appear hazy and do not explicitly demonstrate cause and effect. Collecting a more comprehensive set of data on inequality over an extended period and in a wider range of nations is also necessary to maximize the additional variance in the study. We ought to examine the dependent variable in greater detail rather than merely utilising CO2 emissions as a proxy for economics.

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