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The Role of Environmental Degradation and Resource Scarcity in Driving Terrorism and Conflict: A Panel Study of South Asian Countries

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ABSTRACT
This study explores the impact of terrorism on environmental and socio-economic variables, specifically CO2 emissions, urbanization, resource scarcity, and capital. While the direct relationship between terrorism and environmental outcomes remains underexplored, this research aims to quantify how terrorist activities influence carbon emissions in south Asian countries from the period of 2005 to 2021. This study gathered panel data for South Asian selected countries namely, Pakistan, Bangladesh, Nepal, India and Sri lanka. Before going toward panel unit root tests to check unit root problem and order of integration of variables and applied the panel cointegration test to check the cointegration between variables and the result determined long run relationship between variables. Once the cointegration is confirmed the panel generalize method of moments is applied for result estimates in the long run. The evidence shows that terrorism has an inverse relation with Co2 emission that is statistically significant. Terrorism may causes to create insecurity and devastating recreational places. This study empirically establishe that terrorism is a serious threat to Co2 emission in the region.

Key word Co_2 Emission, Terrorism, Urbanization, Capital, Resource Scarcity

Introduction

Terrorism is currently one of the burning issues of societies not only due to its social and political impacts but also due to implications on development and environment. As the application of violence to attain political or social goals, usually by non-state actors to cause fear (Crenshaw, 2006). Terrorism is a phenomenon that interferes with economic operation, weakens the stability of the society, and redirects the resources to the sustainable development. Although a significant amount of literature has been carried out on economic, political, and social effects of terrorism. It has been demonstrated that terrorism has huge economic cost implications through the reduction of investment, tourism, and trade (Abadie and Gardeazabal, 2008; Bandyopadhyay et al., 2014). This

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distinction is not to suggest that states do not commit equally severe atrocities, but when they do, these actions are more likely to be referred to as war crimes or state-sanctioned violence (Schmid, 2011).

Environmental degradation stands as one of the most significant challenges of our time, directly and indirectly affecting domestic climatic situations by another pattern of rainstorm and temperature (Fedorowicz-Kruszewska, 2023). This deterioration is a global issue, not confined to specific regions. The accumulation of pollutants in the atmosphere leads to the greenhouse effect, causing global temperatures to rise and accelerating the melting of Arctic ice, which in turn contributes to rising sea levels (Sharma, 2022). Environmental degradation is expected to severely affect natural resource systems, with subsequent changes in the environment potentially influencing human livelihoods and economic activities. The degradation caused by human activity is one of the most concerning and complex global problems faced today. The accelerating rate of climate change brings profound and lasting impacts, notably in the security. This paper seeks to analyze the potential association between terrorism and environmental harm (Fukushima et al., 2020).

Recent literature has also addressed the increased relationship between terrorism and environmental degradation. Activities associated with terrorism are thought to cause much environmental destruction; these activities include illegal record, wild life trafficking among others and at a more devastating level. In the course of the more than a decade, terrorism has become more widespread with vast damage being done to the environment as well as the economy coupled with life loss (Global Terrorism Index, 2020). This has also impacted negatively on natural habitats (IUCN, 2019). There have been various studies on the environmental effect of terrorism and most concentrate of the immediate effect on the air quality and water quality. As an example, Oyewole (2017) revealed that the presence of terrorism in Nigeria had aggravated the air quality in the region by elevating the amounts of particulate matter and nitrogen dioxide. The same was observed by Zhang et al. (2019) who reported that air pollution levels have temporarily increased during terroristic activities in China, which hurts the health of the population. Other studies have also emphasized the ecosystem and Biodiversity wide ranging effects of terrorism. To give an example, Martin (2021) has established that terrorist attacks in Colombia had led to the destruction of forest ecosystems that sparked deforestation and loss of habitats of endangered species. Similarly, a study conducted by Kerber et al. (2021) stated that terrorist actions in Iraq were admittedly negative to the biodiversity of this region and that many species are at the risk of extinction due to the terrorist activities. The aim of the research is to explore the ways, in which terrorist activities contribute to environmental degradation and to determine the measures that can help to decrease the mentioned impacts.

Issues of resource scarcity are emerging as an important influence in efforts to understand the dynamics of conflict. According to Gleditsch (2012), the level of competition among various groups increases due to lack of access to vital resources such as water and arable land, which is fueled by scarcity and spawns conflicts that are taken to the violence level. South Asia South Asia Trans-boundary rivers (e.g. the Indus, Brahmaputra) form the basis of a number of international disputes that often lead to bilateral tensions, which sometimes results in localised conflict. All parts of the world are limited in resources, and marginalized communities are most of the time disproportionately affected by lack of resources, which give rise to extremist and terrorist activities. To give an example, Cunningham et al. (2013) believe that under such conditions as the lack of resources and political marginalization of communities (usually

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acute), there is the probability that terrorist groups will radicalize people, providing them with an economic boost or ideological compensation. Case studies from South Asia support these findings. For instance, Pakistan has faced growing water scarcity, which has been linked to rural discontent and the proliferation of militant groups in water-stressed regions (Nasiritousi et al., 2021). Similarly, in India, resource conflicts over forests and minerals in tribal areas have been exploited by insurgent groups like the Naxalites.

Review of Existing Literature

The connection between terrorism and environmental degradation has been extensively studies in literature. Some studies support the conventional view that terrorism negatively impacts the environment, whereas others particularly in the context of developed countries have found no significant connection between the two. There are many other factors which affect the environmental degradation through terrorism, e.g. Resource scarcity, Urbanization and capital This section of the research organizes the literature review into three sections.

Environmental degradation (Co2 emission) and Terrorism:

The South Asian region (and terrorism there) has been affected both directly and indirectly by the environmental effects of terrorism as reported in several studies. As an example, Blanchard (2017) elucidates the terrorist attack on the critical infrastructure, including the pipelines and water systems in Pakistan that results in oil spills and pollution of natural resources. Equally, Barros and Managi (2016) state that political violence in Sri Lanka contributed to the deforestation and loss of resources under the illegal actions of military forces. Additionally, the displacement of masses due to terrorism in the areas such as Kashmir has placed much strain on the local ecosystems causing unsustainable land use patterns (Leahy et al., 2018). According to Collier et al. (2003); conflict besides terrorism is associated with over-misuse of the natural resources in a conflict area. In Afghanistan, terrorist groups have been engaged in bringing down illegal trees and manufacturing of drugs, which increase CO2 emissions. On the same note, there is the tendency of resource exploitation in conflict areas to depend on fossil fuels and poor technologies, which worsen the emission.

Environmental degradation (Co2 emission) and Resource Scarcity:

In a study conducted by Stern (2007), the researcher talks about the limited natural resources such as fossil fuels that may result in increased levels of CO2. With depleted fossil fuel resources worldwide, other countries will extract at higher rates, and deep-water drilling is one way that is more carbon-intensive to extract than others that might lead to more emissions. Geist and Lambin (2002) analyse the relationship that exist between land-use change and deforestation because of resource shortage. They have discovered that since some areas have limited water and arable land, as deforestation occurs, the level of CO2 emission is higher. Deforestation decreases carbon storage capacity, which increases climate change even more. Angelsen (2008) emphasizes the use of natural resources in the tropics and how the over-exploitations of the resource affect the emission of the CO2. Where resources are in short supply, the writer says that the extraction of resources may be intense like the extraction of timber and mining, where emission of CO2 is usually high because of the extraction processes. Such an expansion of agriculture in resource-scarce areas which has been highlighted by Tilman et al. (2001) would lead to increased production. They indicate that in places where land resources are scarce, farming activities tend to cause degradation of the environment,

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DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)

such as emitting CO2 emissions through deforestation and overgrazing activities.

Environmental degradation (Co2 emission) and Urbanization

Cities contribute to most of the CO 2 emissions in the world. The research conducted at the United Nations shows that cities make approximately 70 percent of world CO2 emissions although they only take a small section of the land of the earth-approximately 3 percent (United Nations, 2020). The reason behind this is the fact that industrial regions are highly dependent on fossil fuels to get energy and means of transport. Much of the greenhouse gases are produced as a result of burning fossil fuels to produce electricity, heating, industry productions and transport. Urbanization also means that there is growth of demand in transportation which is the main cause of CO 2 emissions. Higher emissions in the rising cities are directly, caused by growth in the number of vehicles and air traffic and the volume of freight transportation (Creutzig et al., 2015). Energy Energy consumption in cities, the more they grow the higher the need of electricity and heating. There is high carbon footprint caused by the use of non-renewable energy sources especially coal, oil and natural gas (Seto et al., 2014).

Environmental degradation (Co2 emission) and Capital

The major contributors to emissions of CO2 have been economic growth and industrial development normally catalyzed through capital accumulation. Emission of CO2 in the world has been caused by the increased utilization of fossil fuel in energy, transport and production. Although capital investing in the heavy industries and infrastructure has kickstarted economic growth, it has also contributed to environmental degradation (Stern, 2007). Conversely, green technologies and sustainable infrastructures are some areas where capital investment can lead to minimizing CO2 emission. Apart from capital investment in renewable energy, electric vehicles, energy efficiency technologies, and carbon capture and storage systems, capital investment can be used to mitigate environmental degradation. As an example, investments in sustainable energy facilities such as solar and wind power have played a significant role in the shift to the low-carbon economy across the globe (IEA, 2020).

Research Methodology

This study is a panel study for South Asia. The nations included in this list are Bangladesh, India, Nepal, Pakistan and Sri Linka. The selection of these countries is based on the availability of data. All variables are sourced from the World Bank (2024). This study Additionally, the study will utilize panel data spanning from 2005 to 2021 for specific South Asian countries. The description of variables is given below;

Tables 1: Descriptions of variables

Variable	Symbol	Description	Source
Environmental Degradation	CO_2	Carbon dioxide emissions (metric tons per capita)	WDI (2023)
Terrorism	TR	Index: log(1 + incidents, deaths, injuries)	GTI (2023)
Resource Scarcity	RS	Arable land per cápita (hectares)	WDI (2023)
Urbanization	URB	Urban population (% of total population)	WDI (2023)
Capital	K	Gross fixed capital formation (% of GDP)	WDI (2023)

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Vol. 3 No. 10 (October) (2025)

Various tests are conducted to examine the reliability of data for South Asian countries from 2005 to 2022. To explore the relationship between terrorism and environmental degradation, a co-integration approach is employed to analyze both short-run and long-run dynamic. Prior to applying the co-integration techniques, unit root test are carried out to determine the order of integration of the variables. If the variables are found to be a mix of stationary at level and first difference, the appropriate estimation techniques is Panel Generalized Method of Moment (GMM).Therefore, the baseline model can be presented as:

$$CO_2 = f(TR,\ RS, Urb, K) \qquad (1)$$

Where the CO2 shows environmental degradation, TR show terrorism, RS shows resource scarcity, Urb shows urbanization and K shows Capital respectively. The study investigated the impact of terrorism on environmental degradation for south Asian regions using Panel GMM model. The panel GMM model can be empirically specified as:

$$CO_{2it}=\alpha+\beta_1 TR_{it}+\beta_2 RS_{it}+\beta_3 Urb_{it}+\beta_4 K_i \qquad (2)$$

Results and Discussion

Based on secondary panel data, this paper seeks to identify the causes of terrorism in the few selected South Asian countries during 2025-2021. The table 2 presents the descriptive statistics of variables that will be used in the study.

Descriptive statistic

Table 2 presents the descriptive statistic for the variables CO2, Terrorism(TR), Resource scarcity(RS), Urbanization(Urb) and Capital(K) across 85 observations.

Table 2: Descriptive statistics of the variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Environmental Degradation (CO_2)	85	0.76	0.45	0.10	1.79
Terrorism (TR)	85	2.49	0.97	0.43	4.04
Resource Scarcity (RS)	85	0.09	0.04	0.04	0.17
Urbanization (URB)	85	27.35	7.94	15.15	35.81

Unit Root test

Before applying panel co-integration model, the first use panel unit root test to check the data has unit root problem or was stationary at the\\level. This study carefully to tested for unit roots and cointegration. As show in table 3, the stationarity test was done using several methods, Including the im-pesaran-shin (IPS) and Levin-Lin-chi (LLC) tests. The results show that resource scarcity are stationary at the level, while the other variable becomes stationary only after taking the first difference. Based on the finding, the study suggest employing the Panel Generalize Method of Moment (GMM) approach for cointegration analysis, given that some variables are stationary at level and while others become stationary after first difference.

Table 3: Result of Panel Unit root tests

	Im-pesaran-shin (IPS)		**Levin-Lin-chi (LLC)**		
Variables	At level	I[st] Difference	At level	I[st] Difference	Integration
TR	0.84	4.43	0.58	2.48	1(1)
CO2	0.99	2.80	-1.25	1.75	1(1)
RS	1.16	2.45	4.51	3.15	1(0)

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Vol. 3 No. 10 (October) (2025)

Urb	3.91	4.86	5.07	2.47	1(1)
K	0.17	2.19	1.00	-1.78	1(1)

Note: I(0) indicates stationarity at level, while I(1) indicates stationarity at first difference.

The result of co-integration test, shown in table 4, suggest that the variables are not integrated because the p-values are greater than 0.05. This mean the variables are not cointegrated. According to Pedroni residual cointegration test, the null hypothesis (which says there is no cointegration between the variables) is not rejected. In simple terms, the test results do not provide enough evidence to conclude that there is no strong long term relationship between the variables: Co2 emission, Terrorism, Resource Scarcity, Urbanization and Capital.

Table 4: Pedroni test for cointegration

Statistic	**Value**	**P-value**
Panel v-Statistic	-0.3715	0.6449
Panel rho-Statistic	0.8855	0.8121
Panel PP-Statistic	-1.1421	0.1267
Panel ADF-Statistic	-0.5764	0.2822

Most of the test statistics (v-statistic, rho-statistic, ADF-statistic) do not provide strong evidence of cointegration, as their p-values are above 0.05. The only exception is the PP-Statistic's unweighted result, which shows a p-value of 0.0053, indicating a potential sign of cointegration. However, the majority of results suggest that there is no significant cointegration among the variables CO2, TR, RS, K, and UR for the given sample period. This supports the null hypothesis that there is no cointegration between these variables.

Table 5: Kao Residual Cointegration Test

Test Statistic	**Value**	**P-value**	**Result**
ADF	-1.8643	0.0311	Significant at 5%

The ADF t-Statistic is -1.8643 with a p-value of 0.0311. Since the p-value is less than the typical significance level of 0.05, we reject the null hypothesis of no cointegration and conclude that there is evidence of cointegration between the variables CO2, TR, RS, K, and UR.

Based on the Kao Residual Cointegration Test, the p-value of 0.0311 for the ADF statistic indicates that we can reject the null hypothesis of no cointegration. This suggests that there is a significant long-term relationship among the variables (CO2, TR, RS, K, and UR) during the sample period. Therefore, these variables exhibit evidence of cointegration, implying that they share a common long-run trend.

Tables 6: Panel Generalized Method of Moments (GMM)

Variable	**Coefficient**	**Std. Error**	**P-value**	**Interpretation**
TR	-0.05	0.067	0.45	Negative but insignificant
RS	5.50	1.555	0.00	Positive and highly significant
URB	0.00	0.006	0.81	Insignificant
K	0.01	0.003	0.00	Positive and highly significant

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DIALOGUE SOCIAL SCIENCE REVIEW

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From the Panel GMM results, RS (Resource Scarcity) and K (Capital) have statistically significant positive effects on CO2 emissions, while TR (Terrorism) and Urb (Urbanization) do not appear to have significant impacts.

Terrorism (TR) The coefficient for terrorism is -0.05 with a standard deviation of 0.067 and a p-value of 0.45. Given that the p-value exceeds the 0.05 significance level, this suggests that terrorism does not have a statistically significant impact on CO2 emissions in this model. This finding is consistent with earlier research, which has found mixed effects of terrorism liberalization on environmental outcomes (e.g., Frankel & Rose, 2005).

Resource Scarcity **(RS)** The coefficient for renewable energy share is 5.50, with a standard deviation of 1.555 and a p-value of 0.00, which is statistically significant at the 1% level. This positive relationship suggests that an increase in renewable energy share is associated with an increase in CO2 emissions. This could be explained by transitional dynamics, where renewable energy adoption in some regions might initially increase emissions due to high capital costs and the phasing out of fossil fuels (IEA, 2020).

Urbanization (Urb): The coefficient for urbanization is 0.00, with a standard deviation of 0.006 and a p-value of 0.81. The p-value is large, indicating that urbanization does not significantly influence CO2 emissions in this model. This finding aligns with some studies that suggest urbanization alone does not drive emissions without considering factors such as energy infrastructure and industrial activity (Satterthwaite, 2008).

Capital (K): The coefficient for capital is 0.01, with a standard deviation of 0.003 and a p-value of 0.00, indicating a statistically significant positive relationship between capital investment and CO2 emissions. As capital increases, emissions tend to rise, potentially due to greater industrial activity and energy consumption. This is consistent with existing literature, which suggests that higher capital investment often correlates with increased energy use and emissions (Stern, 2007).

In summary, Resource Scarcity (RS) and Capital (K) are found to have statistically significant effects on CO2 emissions, with positive relationships in both cases. In contrast, Terrorism (TR) and Urbanization (Urb) do not exhibit significant effects on emissions in this model. These findings suggest that while capital investment and energy transitions are key determinants of CO2 emissions, factors such as terrorism and urbanization may not directly contribute to the variation in emissions in this context.

Conclusion and Policy Recommendations

In this study we examine the impact of terrorism, resource scarcity, urbanization, and capital formation on CO_2 Emission.in selected South Asian countries over the period 2005 to 2022 using a panel GMM analysis. The findings indicate that terrorism has a negative, but insignificant impact on CO 2 emissions, implicating that environmental outcomes in the region are not directly influenced by security-related shocks. However, there exists a strong, positive relationship between resource insufficiency and environmental degradation, which underscores the fact that there is a decrease in the availability of arable land per capita, which increases the effects of carbon emissions. Likewise, the environmental cost of investment-based growth and industrialization is clear in the fact that the capital formation also brings a great deal of environmental degradation. In contrast to that, urbanization does not have a significant effect, which means that population concentration is not a major determinant of long-run emissions. Overall, the results show that economic and resource-related factors, rather than terrorism or urbanization, are the main causes of environmental degradation in South Asia.

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Vol. 3 No. 10 (October) (2025)

Based on the results, policymakers need to focus on managing resources more sustainably and directing capital investments toward environmentally friendly projects to control rising emissions. Special attention should be given to improving agricultural productivity, promoting green technologies, and protecting arable land to reduce the pressure of resource scarcity. Since capital formation is linked with higher environmental degradation, governments should encourage investment in renewable energy, energy-efficient infrastructure, and eco-friendly industries. While terrorism does not directly affect environmental outcomes, maintaining political stability and reducing insecurity are still important to support long-term sustainability efforts. Urban development should also be guided by sustainable planning, better public transport, and proper waste management, which can help reduce emissions in the future. Altogether, these steps will enable South Asian countries to pursue economic growth while protecting the environment.

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