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Terrorism, Freshwater, and Environmental Pollution: Evidence of Afghanistan, Burkina Faso, Iraq, Arab Republic of Egypt, Cameroon, Mali, Mozambique, Niger, Nigeria, Somalia, Syrian Arab Republic, and Pakistan

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Abstract: Nowadays, the world is facing many important problems, including terrorism, drinking-water supply problems, and environmental pollution, which have strong impacts on the sustainable development. In this paper, the cointegration between drinking water, terrorism, economic growth, energy consumption, and environmental pollution was explored in Afghanistan, Burkina Faso, Iraq, Arab Republic of Egypt, Cameroon, Mali, Mozambique, Niger, Nigeria, Somalia, Syrian Arab Republic, and Pakistan in the period of 2000–2020 by using the panel Fourier bootstrapping auto regressive distributed lag (PFBARDL) test, and then the direction of causality between the selected variables was determined. The PFBARDL test determined evidence of cointegration among the selected variables. The causality test found evidence of unidirectional causality from terrorism to drinking water and environmental pollution.

Keywords: causality; Fourier; drinking water; panel; panel Fourier bootstrapping ARDL; sustainability; terrorism

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1. Introduction

Nowadays, the world is facing many important problems, including environmental pollution, drinking water supply problems, and terrorism, which have strong impacts on the sustainable development [1]. Especially, environmental pollution is an important problem across the world. Sustainability science strives to understand the relationship between society and nature and to embrace one or several of the three supports of sustainability: economic prosperity, social justice, and environmental quality [1]. In the context of sustainability, in recent years, renewable investments increased, but the quantity of renewable investments required for decarbonization was not sufficient. Moreover, in recent years, air pollution under the influence of dangerous pollutants such as CO_2, NOx, and GHG has become a major threat worldwide. According to the International Energy Agency (IEA), CO_2 emissions throughout the world rose by 33.1 billion tons in 2018, which is approximately 145% above the pre-industrial levels [2,3]. Moreover, the CO_2 growth rate from 2015 to 2016 was the largest from the last 30 years, and the CO_2 concentration rate was the highest from the last 800,000 years [4].

Many papers have investigated the causes of carbon dioxide, and some factors have come to the fore. The general consensus was seen as industrialization. In this study, as well as industrialization, another factor, terrorism, will be emphasized, as it is equally important. Terrorism is one of the primary causes of environmental damage and drinking water supply problems. It causes an increase of CO_2 emissions throughout the world, and terrorist attacks have an adverse impact on the drinking water supply, land, etc.

Some papers have highlighted the relationship between economic growth and terrorism. According to the results of these papers, terrorism and economic growth play a key role in determining the level of a sustainable environment [5,6]. Terrestrial conflict, terrorist camps and bases, training operations, and CO_2 releases due to energy usage are just some of the environmental impacts inflicted by terrorism [6]. Metal contamination is a prominent source of pollution, according to [7–9]. Furthermore, terrorists' chemical weapons of mass destruction have a negative impact on the environment. Terrorists use various non-renewable energies, as well as numerous chemicals and heavy metals (iron, copper, steel, and depleted uranium) [6]. In addition to the consumption of crucial elements such as copper and zinc, metals contain hazardous elements such as lead (Pb) and cadmium. The use of these elements will cause a drinking water supply problem because it can cause water pollution and water shortages.

Drinking water is the most important natural resource in the world. Since there is no substitute for water, water resources and systems are appealing targets. On the other hand, water supplies can be targeted by terrorists [10]. Terrorist organizations destabilize countries through violent and coercive behaviors, which include using water resources as a target, a weapon, a leveraging tool, and a nation-building strategy, as well as using water resources as an incentive for violent responses. Drinking water is regarded as a key resource in the field of security studies, particularly on the topic of environment and security [11]. Water is also a critical resource targeted by terrorists to threaten communities and weaken states. Besides, water as a political or military objective or tool has a lengthy history [12,13]. Water system attacks date back 4500 years [14]. Often, marginalized groups made threats or attacks on water systems [15].

Water infrastructure can be targeted directly, or water can be poisoned by intentionally introducing poison or disease-causing chemicals. Some critical water infrastructure, such as dams, reservoirs, and pipelines, are open to the public at various points, and they could be hacked by computer systems [14]. Terrorists can disrupt and contaminate the water system in a variety of ways, from biological and chemical weapons to physical attacks on water businesses, treatment plants, reservoirs, and dams [16–19].

In the literature, some papers discussed one side of these relationships, such as the relationship among real GDP, terrorism, and environment pollution [5,6], and some other papers discussed the effects of water terrorism [12,16,20,21]. This paper does not discuss the effects of water terrorism, but aims to determine the relationship between terrorism, environmental pollution, energy consumption, real GDP, and drinking water. For this aim, the direction of causality was explored and the cointegration among real GDP, terrorism, environmental pollution, and drinking water supply problems was tested for a sample of countries that consists of Afghanistan, Burkina Faso, Iraq, Arab Republic of Egypt, Cameroon, Mali, Mozambique, Niger, Nigeria, Somalia, Syrian Arab Republic, and Pakistan in the period of 2000–2020 by using panel bootstrapping Fourier Autoregressive Distributed Lag (ARDL) and panel Granger causality tests. The countries were selected according to the Global Terrorism Index and the Environmental Performance Index. The selected countries were those that have high levels of environmental pollution and terrorist attacks. The selected countries are among the countries with the highest number of terrorist attacks in the world (discussed in following table).

The reason for the selection of an econometric methodology is the necessity of determining (if it exists) the cointegration under nonlinearity and structural breaks. The panel bootstrapping Fourier ARDL (PFBARDL) model was utilized to determine the existence of cointegration among the variables. The panel Fourier Granger causality tests were applied to evaluate the direction of causalities. These tests have the advantage that the date, the number, and the form of the break do not affect the power of the estimation.

Benarjee et al. [22] suggested that ADL based on the Fourier method is effective in case of the existence of nonlinear breaks. However, the employment of nonlinear methods, such as Nonlinear Autoregressive Distributed Lag(NARDL), Markov-Switching Vector Auto Regression(MSVAR), Threshold Autoregressive Distributed Lag(TARDL), and Logistic Smooth Transition Autoregressive ARDL(LSTARARDL), could lead to various econometric problems in the estimation if the samples cover relatively short periods. In the presence of breaks and if the analysis period is short, the Fourier method provides significant improvement in modeling since the approach does not assume a specific functional form, in addition to assuming exact frequencies and requiring a priori knowledge regarding the dates of the breaks. Benarjee et al. [22] suggested that ADL based on the Fourier method is effective in case of the existence of nonlinear breaks. In this paper, we employed the Bootstrapping Autoregressive Distributed Lag with the Fourier method. The motivation for employing the Bootstrapping Autoregressive Distributed Lag(BARDL) with the Fourier method is that the BARDL permits for endogeneity and feedback and the BARDL with the Fourier method can effectively eliminate the degenerate cases.

The paper was designed as follows. The literature review is outlined in Section 2. The relationship between terrorism, economic growth, water resources, and environmental pollution is demonstrated in Section 3. In Section 4, the econometric methodology is presented, and Section 5 explains the data and the empirical model. Section 6 outlines the results and the conclusion is provided in Section 7.

2. Literature

2.1. Water and Terrorism

Water supplies and water distribution systems represent potential targets for terrorist activity, as discussed in [17]. Foran and Brosnan [23] believe that terrorists' use of bioweapons pose a significant threat to drinking water. Several pathogens and biological toxins have been weaponized, are potentially resistant to disinfection by chlorination, and are stable for relatively long periods in water. By contaminating water supplies at the source or in the distribution and storage system, terrorists can make use of an efficient water connection system to strike fear and panic into homes and offices. To this end, between 1748 and 2006, [16] identify 52 acts of water terrorism. Ping [24] discusses the urgency of water terrorism by showing how the drinking water system can be and has been attacked. Francis [25] explored the deliberate targeting of water resources by governments to cause harm to other nations or persons, as well as the vulnerability of freshwater ecosystems to the effects of warfare.

Some studies [26–28] examined the relationships between terrorism financing and wildlife trafficking, as well as the availability of natural resources and terrorism incidents. Berrebi and Ostwald [29] also studied whether natural disasters and other extreme weather events may incite terrorism in the world's major cities.

Eco-terrorism is described in [30,31] as the use of violence by non-state actors to advance environmental causes and to impede or halt the exploitation of natural resources. According to [32–34], environmental terrorism primarily targets natural resources. Environmental terrorism, according to the author, is more effective than either a typical conventional weapon attack or a weapons of mass destruction attack on civilian targets. Gleick [12] is especially interested in the relationship between terrorism and freshwater. Gleick believes that it is impossible to determine the genuine danger of water-related terrorism. Veilleux and Dinar [10] study the interaction of the larger areas of terrorism and environmental security in the context of water-related terrorism. They identified the terrorist organizations with the highest number of incidents and the transboundary water basins most vulnerable to water-related terrorism. Clark and Hakim [35] explored the effect of a contamination event in a water system on the people, the community, and the businesses. Maiolo and Pantusa [36] discussed the link between the freshwater supply and counterterrorism and they suggested the Infrastructure Vulnerability Index for freshwater. Al Amin [14] examines a segment of Nigeria's energy source, hydropower, in the context of the country's current security crisis in the north. The research investigated Nigeria's hydroelectric asset and analyzed its vulnerability to insurgent attacks, particularly those perpetrated by the Boko Haram terrorist group, which dominated the study area.

2.2. Terrorism and Environmental Pollution

Grossman and Krueger [35] tested the relationship between economic development and environmental damage via the Environmental Kuznets Curve (EKC) approach and they found negative impacts of economic development on the environment. Many papers analyzed the relationship between environmental pollution and industrial production following the work of [35], who showed that the economic development tends to accelerate environmental pollution problems once a certain GDP per capita level is reached. Many papers discussed this relation for many countries again and again.

From the perspective of terrorism, the authors of [36] analyzed the relationship between tourism and terrorism for Spain by using the Vector Autoregression (VAR) model for 1970–1999. Enders et al. [37] analyzed the relationship between the tourism and terrorist attacks in Spain, Austria, and Italy during 1974–1988. Following these papers, some papers analyzed the effects of terrorism on macroeconomic variables [38]. Tavares [39] found that terrorist actions in a country have an influence on the growth of the country, and the authors of [40] investigated the impacts of terrorist attacks for 177 countries during 1968–2000 and determined the negative effects of terrorist attacks on economic growth. Mirza and Verdier [41] showed that terrorism has a negative effect on the economic performance of countries. Gaibulloev and Sandler [42], in Asia in the period of 1970–2004, explored the relationship between economic growth and terrorism. Especially in the developing countries, the impact is stronger than in developed countries. Gries et al. [43], for seven western countries from 1950 to 2004, determined terrorism to reduce the economic growth since the accumulation and allocation of resources are impacted by terrorist attacks. By using panel cointegration tests and Granger causality tests, the authors of [6] investigated the relationship between economic growth, foreign direct investments (FDI), terrorism, energy consumption, and environmental pollution for Thailand, Yemen, Iraq, Syria, Somalia, Nigeria, Pakistan, Afghanistan, and the Philippines from 1975 to 2017. As a result of the causality findings, there is evidence of a unidirectional causality relationship between terrorism and CO_2 emissions. From 1975 to 2017, the authors of [5] analyzed the relationship between pollution, terrorism, FDI inflow, economic growth, and energy consumption in Israel, Turkey, India, and China. The findings indicated that there is evidence of unidirectional causality from terrorism, energy use, and foreign direct investment to environmental damage.

3. Data and Definitions of the Variables

The annual data used in this study: environmental pollution (co), terrorism (t), energy consumption (c), the drinking water supply problem (w), and real GDP (y), covered the 2000–2020 period for Afghanistan, Burkina Faso, Iraq, Arab Republic of Egypt, Cameroon, Mali, Mozambique, Niger, Nigeria, Somalia, Syrian Arab Republic, and Pakistan. CO_2 emissions was used as a proxy for environmental pollution.

For the analyzed countries, real GDP (2005 US$), energy consumption, drinking water, and CO_2 emissions were obtained from the World Bank, CEIC, and country sources. Energy consumption was measured in quadrillion Btu. Drinking water was measured as people using at least basic drinking water services (% of population). Terrorism data cover the number of deaths from terrorist attacks. The University of Maryland's Global Terrorism Database was used, which includes information on terrorist events around the world. Terrorism data cover the number of deaths from terrorist attacks. The University of Maryland's Global Terrorism Database was used, which includes information on terrorist events around the world.

The data were logged (ln) to minimize skewness, and therefore all variables were measured in logarithms.

In this paper, the countries were selected according to two different indexes: the Global Terrorism Index [44] and the Global Environmental Index [45,46] (see Table 1).

Table 1. Scores of the countries.

Countries	GTI Ranks	GTI Scores	EPI Ranks	EPI Scores
Afghanistan	1	9.109	81	43.60
Iraq	2	8.511	169	27.80
Somalia	3	8.398	-	-
Burkina Faso	4	8.270	127	35.50
Syrian Arab Republic	5	8.250	-	-
Nigeria	6	8.233	162	28.30
Mali	7	8.152	159	28.50
Niger	8	7.856	110	37.70
Pakistan	9	7.825	176	24.60
Cameroon	10	7.432	153	30.20
Mozambique	11	7.432	144	31.70
Arab Republic of Egypt	12	6.932	127	35.50

IEP [46] ranks 180 countries on 24 performance indicators. The numbers in parentheses show the rank within 180 countries for [46].

For example, Nigeria, that suffered intense terrorist attacks, witnessed the largest increase in deaths caused by terrorist attacks across the world. Terrorist attacks are much more lethal in the selected countries than in any other countries. Accordingly, Nigeria showed the largest increase in the death rate due to terrorism in 2014, with 7512 deaths [21]. The economic cost of terrorism increased by approximately 61% in 2014 and it reached its highest level since 2000. This means a 61% rise from the previous year and a 10-fold rise since 2000. On the other hand, according to the 2022 GTI [22], terrorism remains a serious threat, with sub-Saharan Africa accounting for 48% of the total global deaths from terrorism. Terrorism deaths in Niger more than doubled in 2020, rising to 588. Deaths attributed to Islamic extremist groups such as Islamic State in West Africa (ISWA), Jama'at Nasr al-Islam wal Muslimin (JNIM), Boko Haram, and Al-Shabaab recorded deaths as far south as Mozambique, with 43% occurring in the Sahel. For Syria and Iraq, terrorism was shifted to the Sahel, with deaths from terrorism rising ten times in the region since 2007. The Sahel has became the new epicenter of terrorism. As differentiation from other countries, Mozambique had the largest drop in terrorism deaths, falling by 82% to 93. The decrease in Boko Haram's activities contributed to Nigeria recording the second largest reduction in deaths from terrorism in 2021, with the number falling by 47% to 448. According to the IEP [46], it was measured how far these countries are to establishing environmental policy goals. Low scores show that there are low domestic sustainability struggles. These countries are under-developed and developing countries, and they have more serious environmental damage than developed countries.

4. Econometric Methodology

The econometric methodology was applied in two stages. In the first stage of the study, the panel Fourier bootstrapping ARDL method was applied, and in the second stage, the panel Fourier causality test.

4.1. Panel Fourier Bootstrapping ARDL Method

McNown et al. [47] showed the advantages of the BARDL method. However, the BARDL method has a disadvantage. This method recommends the use of dummy variables to control structural breakage. The dummy variable depends on the exact and correct location of the structural break in advance. The FBARDL method was used to eliminate these challenges. Solarin [48] employed bootstrap autoregressive distributive lag with

Fourier terms, the authors of [3,49] used the Fourier BARDL method, and the authors of [50] employed the panel Fourier BARDL method.

By using the panel Fourier bootstrapping ARDL (PFBARDL) test, the authors of [51,52] tested the possibility of a nonlinear trend since nonlinearity causes weak inferences.

The panel Fourier bootstrap ARDL model is stated as [50]:

$$\Delta y_{it} = c_i + \sum_{k=1}^{p} \gamma_{ij} \Delta y_{i,t-j} + \sum_{k=0}^{q-1} k_{ij} \Delta x_{i,t-j} + \delta_{1i} y_{i,t-1} + \delta_{2i} x_{i,t-1} + \gamma_{10} \sin\left(\frac{2\pi nt}{T}\right) + \gamma_{11} \cos\left(\frac{2\pi nt}{T}\right) + \varepsilon_{it} \quad (1)$$

$$\delta_{1i} = -(1 - \sum_{j=1}^{q} \lambda_{ij}), \delta_{2i} = \sum_{j=0}^{q} \varpi_{ij}, \gamma_{ij} = -\sum_{m=j+1}^{p} \lambda_{im}, \mu_{ij} = -\sum_{m=j+1}^{q} \varpi_{im}. \quad (2)$$

where γ_{10}, γ_{11} represent the amplitude and the displacement of the frequency and n is the frequency of the Fourier. ϖ_{ij} and λ_{ij} are $k \times 1$ vectors for the explanatory variables, respectively. In the tests of the null hypothesis, $H_0 : \delta_{1i} = \delta_{2i} = 0$ reveals significant information regarding the long-term relationships among the variables.

McNown et al. [53] presented supplemental tests to complement the F and t-tests in [54] for the ARDL test. The use of three tests is required in their technique to determine the presence of any of the non-cointegration, cointegration, or degenerate instances. According to [53], the two degenerate situations can be evaluated as follows:

McNown et al. [53] demonstrated that rejection of three null hypotheses is required for cointegration between A and B.

$$\begin{array}{l} \text{Case1 : FtestFor} H_0 : \delta_1 = \delta_2 = 0 \text{against} H_1 : \ any\ \delta_1,\ \delta_2 \neq 0. \\ \text{Case2 : } t\text{testfor} H_0 : \ \delta_1 = 0 \text{against} H_1 : \ \delta_1 \neq 0. \\ \text{Case3 : FtestFor} H_0 : \ \delta_2 = 0 \text{against} H_1 : \ \delta_2 \neq 0. \end{array} \quad (3)$$

4.2. Panel Fourier Causality Test

The models were rewritten for Granger causality [50] as:

$$\Delta y_{it} = \lambda_1 + \sum_{k=1}^{m} \alpha_{1ik} \Delta y_{it-k} + \sum_{k=1}^{m} \beta_{1ik} \Delta x_{it-k} + \gamma_{10i} \sin\left(\frac{2\pi nt}{T}\right) + \gamma_{11i} \cos\left(\frac{2\pi nt}{T}\right) + \zeta_{1i} ecm_{it-1} + \varepsilon_{1it} \quad (4)$$

$$\Delta x_{it} = \lambda_2 + \sum_{k=1}^{m} \alpha_{2ik} \Delta y_{it-k} + \sum_{k=1}^{m} \beta_{2ik} \Delta x_{it-k} + \gamma_{20i} \sin\left(\frac{2\pi nt}{T}\right) + \gamma_{21i} \cos\left(\frac{2\pi nt}{T}\right) + \zeta_{2i} ecm_{it-1} + \varepsilon_{2it} \quad (5)$$

where ecm_{t-1} is the error-correcting term (ecm) and ζ is a parameter indicating the speed of adjustment to the equilibrium level after a shock. Granger non-causalities are tested under the null hypotheses of $H_0 : \alpha_{ik} = 0$, $H_0 : \beta_{ik} = 0$, against the alternatives $H_1 : \alpha_{ik} \neq 0$ and $H_1 : \beta_{ik} \neq 0$ in Equations (4) and (5) for all i.

4.3. Empirical Results

The econometric application was carried out in five steps in this paper:

1. We used descriptive statistics tests. Then, the cross-sectional dependence test was applied.
2. For the confirmatory analysis, Im Pesaran Shin test (IPS) [55] and Cross-sectionally augmented IPS (CIPS) tests were preferred.
3. PFBARDL, Pedroni, and Kao tests were used to determine the evidence of cointegration.
4. The long-term coefficients were determined by using Pedroni's Full Modified Ordinary Least Square (FMOLS) and Ordinary Least-Squares (OLS) methods. These coefficients were compared to those obtained using the PFBARDL method.
5. Finally, the direction of the causality was determined by using panel Fourier causality and the results of causality were compared to those obtained by using Dumitrescu–Hurlin causality tests.

5. Descriptive Statistics

Table 2 shows the results of the descriptive statistics tests. The 't' and 'w' variables were negatively skewed, but the co, c, and y variables had a positive skewness.

Table 2. Descriptive statistics results.

Descriptive Statistics	CO_2	C	Y	T	W
Mean	1.395252	1.0075	4.665195	2.576063	1.838436
Std. Dev.	0.293419	0.255401	0.594076	1.101034	0.137764
Skewness	0.340281	0.423847	0.170735	−0.710841	−0.583402
Kurtosis	2.092095	2.306816	1.745824	2.334072	2.297026
Jarque–Bera	12.39176	7.275595	8.26200	18.72217	17.86020

5.1. The Results of Panel Unit Root Tests

To explore cross-sectional dependence (Table 3), four different tests were applied. If the results of all tests point to the same inference, the results will be accepted as true. According to the test results, a decision about using the first-generation or second-generation unit rot tests will be made. To avoid inconsistency, IPS and CIPS tests were applied.

Table 3. Cross-sectional dependence tests.

Tests	CO	Y	t	W	C
Breusch–Pagan LM	469.003	765.58	421.81	1143.39	297.51
Pesaran scaled LM	38.89	66.70	33.92	102.72	22.53
Bias-corrected scaled LM	38.86	66.69	33.915	102.71	22.52
Pesaran CD	14.54	17.45	18.88	21.58	12.38

The results of the IPS and CIPS panel unit root tests for the series y, t, w, co, and c are shown in Table 4. The unit root statistics for the level and first difference series of the selected variables are also supplied in Table 4. According to the results of the panel unit root tests, the variables were characterized as an I(1) process.

Table 4. Panel unit root test.

Level	IPS	CIPS	First Differences	IPS	CIPS	Decision
y	1.714	1.05	dy	−12.25	−13.88	I(1)
t	1.446	1.45	dt	−10.89	−12.85	I(1)
w	−0.76	−0.76	dfdi	−9.92	−10.78	I(1)
co	−1.31	−0.85	dco	−15.8	−16.96	I(1)
c	1.982	−1.56	dc	−20.63	−28.12	I(1)

5.2. Panel Cointegration Results

Three different panel cointegration tests, Kao, Pedroni, and FBARDL tests, were applied. The results of Kao and Pedroni's cointegration tests are presented in Tables 5 and 6, respectively. Pedroni and Kao's tests show the possibility of a long-term relationship. The results reported that the existence of cointegration between variables was determined.

Table 5. Kao's test results.

DF_Rho Test	DF_t_Rho Test	DF_Rho_Star Test	DF_t_Rho_Star Test
−5.65	−8.77	−10.67	−3.674

Table 6. Pedroni's cointegration test results.

Panel Statistics (within)		Group Statistics (between)	
Panel variance (*v;* Variance ratio)	5.45		
Panel ρ statistics (Panel Rho statistic)	−5.81	Group ρ (Rho statistic)	−4.58
Panel PP statistic	−10.16	Group PP statistic	−5.893
Panel ADF	−10.197	Group PP (parametric)	−5.774

In Table 7, the model selection for the PFBARDL method is shown.

Table 7. The results of the panel ARDL bounds testing cointegration models.

Dependent Variable/ Independent Variable	F	F *	F_{indep}	F^*_{indep}	t	T *	Cointegration Status	
(y/co, c, w, t)	17.51	14.28	13.89	9.16	-4.82	-4.22	Cointegration	Jarque–Bera: 2.84 Ramsey RESET: 0.25 ARCH method: 1.07 Q-statistics: 1.00
(c/co, y, w, t)	9.15	8.64	3.14	4.44	−3.94	−3.22	Degenerate 1	
(co/y, c, w, t)	13.92	12.87	10.65	10.61	−3.57	−4.44	Degenerate 2	
(t/y, c, co, w)	3.78	3.96	2.16	1.43	−3.01	−2.12	No-cointegration	
(w/y, c, co, t)	4.19	3.82	7.55	6.44	−3.88	−4.11	Degenerate 2	

When economic growth was used as a dependent variable, evidence of cointegration was discovered. However, terrorism was identified as a dependent variable, and evidence of no-cointegration was discovered. Water, energy consumption, and CO_2 emissions were identified as dependent variables, and evidence of degenerate states was discovered.

5.3. Long-Term Coefficients

Table 8 displays the long-term coefficient estimates. PFBARDL, FMOLS, and OLS results showed that c, w, terrorism, and CO_2 emissions have statistically significant effects on economic growth. In the OLS, FMOLS, and PFBARDL methodologies, a 1% rise in the drinking water increases the economic growth by 13%, 38%, and 18%, respectively. In the OLS, FMOLS, and PFBARDL methods, a 1% rise in terrorism reduced the economic growth by 25%, 40%, and 28%, respectively. The negative effects of terrorist attacks on economic growth were highlighted by some papers. The authors of [40] found similar results for 177 countries, the authors of [56,57] for developed and developing countries, the authors of [58] for Pakistan, the authors of [6] for Afghanistan, Iraq, Nigeria, Pakistan, The Philippines, Syria, Somalia, Thailand, and Yemen, and the authors of [5] for China, India, Israel, and Turkey.

Table 8. FMOLS, DOLS, OLS, and PMG results.

Dependent Variable: y						
Variables	**OLS**		**FMOLS**		**PFBARDL**	
	Coefficient	t	Coefficient	t	Coefficient	t
lc	0.332979	9.684104	0.072643	2.1143	0.374	2.125
lw	0.138482	4.222339	0.387407	1.885	0.18602	10.32565
lco	0.0169597	2.157204	0.001985	2.053101	0.0190947	2.492193
lt	−0.25593	1.75619	−0.40125	2.344869	−0.2818	3.435183
dc					1.6798	3.169
dw					−0.3589	2.13
dco					0.058314	2.55
dt					−0.404114	1.85
ecm					−0.153038	3.26
Fourier 1					0.000992	2.0167
Fourier 2					−0.00018	2.0072
R2	0.65		0.77		0.66	
Adjusted R2	0.62		0.71		0.59	

The coefficient of ECM was calculated to be −0.153038. Fourier 1 and 2 were determined as 0.000992 and −0.00018, respectively.

5.4. Causality Results

Tables 9 and 10 evaluate the Granger causality results. The results of Dumitrescu–Hurlin panel causality and panel Fourier Granger causality tests were found to be similar. The only difference between these two tests is the direction of the causality between water and CO_2 emissions. For this result, theoretically and expectantly, PFBARDL results were more accurate.

Table 9. The results of the Fourier causality test.

Δc→ ΔCO **Δco→ Δc**	**Δy→ Δco** **Δco→ Δy**	**Δt → Δco** **Δco → Δt**	**Δw → Δco** **Δco → Δw**	**Δy→ Δc** **Δc→ Δy**
3.04817 0.1493	12.647 0.35275	2.275 0.305	0.6089 8.648	0.1176 2.3755
Causality Direction				
c → co	y → co	t → co	co → w	c → y
Δt → Δc Δc → Δt	Δw → Δc Δc → Δw	Δt → Δy Δy → Δt	Δw → Δy Δy → Δw	Δw → Δt Δt → Δw
2.3585 1.5956	4.9548 8.6312	2.33685 0.1766	6.2843 1.784	0.1772 2.1728
Causality Direction				
t → c	↔	t → y	w → y	t → w

In this table, the symbol → shows the direction of causality and ↔ describes bidirectional causality.

Table 10. Results of the Dumitrescu–Hurlin panel causality tests.

$\Delta c \rightarrow \Delta CO$ $\Delta co \rightarrow \Delta c$	$\Delta y \rightarrow \Delta co$ $\Delta co \rightarrow \Delta y$	$\Delta t \rightarrow \Delta co$ $\Delta co \rightarrow \Delta t$	$\Delta w \rightarrow \Delta co$ $\Delta co \rightarrow \Delta w$	$\Delta y \rightarrow \Delta c$ $\Delta c \rightarrow \Delta y$
		${W^{hnc}}_{N,T}$		
8.2693 1.5844	9.0907 1.5039	8.65417 0.3215	0.634 6.546	0.246 8.123
		Causality Direction		
$c \rightarrow co$	$y \rightarrow co$	$t \rightarrow co$	$co \rightarrow w$	$c \rightarrow y$
$\Delta t \rightarrow \Delta c$ $\Delta c \rightarrow \Delta t$	$\Delta w \rightarrow \Delta c$ $\Delta c \rightarrow \Delta w$	$\Delta t \rightarrow \Delta y$ $\Delta y \rightarrow \Delta t$	$\Delta w \rightarrow \Delta y$ $\Delta y \rightarrow \Delta w$	$\Delta w \rightarrow \Delta t$ $\Delta t \rightarrow \Delta w$
		${W^{hnc}}_{N,T}$		
8.246 1.263	13.436 1.4759	10.1036 1.563	24.8806 2.0823	1.718 9.9845
		Causality Direction		
$t \rightarrow c$	$w \rightarrow c$	$t \rightarrow y$	$w \rightarrow y$	$t \rightarrow w$

In this table, the symbol $\rightarrow$ shows the direction of causality, and $\leftrightarrow$ describes bidirectional causality. Only ${W^{hnc}}_{N,T}$ results were exhibited. When the test statistics in Table 10 are compared to the bootstrap critical values of Dumitrescu and Hurlin (2012), it is observed that these test statistics are significant.

The results of the causality tests were as follows:

1. There was bidirectional causality between water and energy consumption in Panel fourier Granger causality method, and unidirectional causality form water to energy consumption in Dumitrescu–Hurlin panel causality test.
2. Evidence of unidirectional causality existed from energy consumption to real GDP, as well as from terrorism to CO_2 emissions and from terrorism to energy consumption.
3. Evidence of unidirectional causality from terrorism to drinking water and from terrorism to economic growth was found.

The causality results between C and CO_2 emissions are consistent with the findings of [5,6,59]. Policies implemented to reduce CO_2 emissions can adversely affect economic development. The result between terror and CO_2 emission is similar to that in [5,60].

6. Discussion and Policy Implications

Terrorism had a strong explanatory power in economic development, drinking water supply, and CO_2 emissions, according to the causality findings. There was unidirectional causality from terrorism to energy consumption, from terrorism to CO_2 emissions, and from terrorism to freshwater. Terrorism is a Granger cause of environmental pollution, drinking water supply problems, and energy consumption. On the other hand, terrorist attacks, energy consumption, and economic growth are C, which pollute the environment. And environmental pollution is Granger cause of drinking water. Evidence of unidirectional causality from CO_2 emissions to drinking water was found.

As a result of terrorist attacks, these countries suffered dramatic changes, such as environmental pollution, a lack of adequate drinking water and freshwater, and problem of economic development.

Terrorism, production technology, and a lack of environmental awareness are three major factors contributing to increased pollution and drinking water supply problems in the countries studied. Policymakers must choose between economic growth and the use of energy sources that have significant environmental consequences and must prefer to implement policies to support CO_2 emissions' reductions and drinking water and freshwater supply problems.

Moreover, the terrorism problem leads to economic in addition to social and political problems. Terrorism slows economic development and growth in certain countries by diverting resources away from more productive initiatives. Terrorist attacks result in reduced investment and increased government spending. This condition is related to government spending crowding in and investment crowding out. Policies to reduce the tendency toward terrorism in these countries must be determined. These countries must assume the leading role against terrorist threats.

7. Conclusions

The panel cointegration methods (PFBARDL, Pedroni, and Kao) and causality approaches (panel Fourier causality and Dumitrescu–Hurlin) were used in this paper to examine cointegration and causality between CO_2 emissions, economic growth, energy consumption, drinking water, and terrorism in Afghanistan, Burkina Faso, Iraq, Arab Republic of Egypt, Cameroon, Mali, Mozambique, Niger, Nigeria, Somalia, Syrian Arab Republic, and Pakistan from 2000 to 2020.

According to the findings of this study, because pollution and terrorism in these countries continue to rise, the causality between CO_2 emissions, energy consumption, the drinking water problem, terrorism, and economic growth showed that economic development, CO_2 emissions, and the drinking water problem will not decline in the foreseeable future.

Policies must be centered on economic development, which has the ability to help reduce the danger of terrorism. Governments need to raise awareness among water professionals about the role they may play in conserving present and future water infrastructure. Governments must develop a better understanding of security threats to water systems and must explore "How can the water supply be protected from a terrorist attack?"

This paper explored the cointegration and causality between CO_2 emissions, economic growth, energy consumption, the drinking water supply problem, and terrorism, but excluded the relationship between water wars and terrorism. We hope that future studies will improve the literature by including this topic.

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