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Natural Resource Rents-Environmental Degradation Nexus: Empirical Insights from Pakistan

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ABSTRACT

The study aim was to inspect the nexus between natural resource rents (NRR) on environmental degradation (CO_2) and used the data from 1976 to 2024 of Pakistan and ARDL procedures for estimation. The GDPpc, and FD have optimistic effects on CO_2. Yet, the NRR, URBP and HK have negative and substantial effects on CO_2 in the long run (LR). Moreover, in the short run (SR), the FD has optimistic and noteworthy effects on environmental degradation only. Furthermore, ECM value is negative and noteworthy, which shows that the speed of alteration from SR to LR by 52% and the LR cointegration. Moreover, there exists one way causality running from CO_2 to GDPpc, CO_2 to FD, NRR to URBP, FD to URBP, HK to FD, and HK to URBP, However, there is a Feedback causality between CO_2 and URBP. Consequently, this study determined that the total natural resource rent meaningfully reduces the CO_2 in LR while having no effect on CO_2 in the short run. Based on the findings, this study indorsed that the government of Pakistan and all resource rich developing countries use natural resources rents efficiently for sustainable development and focus on renewable energy consumption to enhance production and increase economic growth. Furthermore, use the efficient way of natural resources for economic growth as well as reduce the CO_2 emissions.

Background of the Study

Natural resources (NR) refer to all of the items that humans utilize on a daily basis that come straight from nature. In other words, NR is everything nature provides for human consumption. For example, the Earth naturally creates a number of NRs that are valuable to people in a variety of ways, such as water, soil, and various sorts of energy (Kumar *et al.*, 2022). Food and energy are the most valuable natural resources. meal fulfills hunger and provides energy for transportation, meal preparation, and seeking heat and cold. Everything we eat comes from either animals or plants, whether it's dairy, vegetarian, or non-vegetarian. Furthermore, we employed electricity to power a variety of activities and machinery (Ekka *et al.*, 2023). Natural resources are categorized into two categories: renewable natural resources (RNR) and nonrenewable natural resources (NRNR). The RNR are created using an appropriate method. Nonrenewable natural resources are limitless and available to utilize without the need for a method (Zameer *et al.*, 2020). People all across the world have a big difficulty in terms of uninterrupted access to energy supplies. Most human activities include machines, which demand infinite energy but have a finite supply (Mondal & Palit, 2022). Many countries are now attempting to shift their demands to renewable energy (REC) due to various benefits. The most major advantage is low CO2 emissions and environmental friendliness. The REC decreases the GHG and has no significant effect on climate change and also reduces the utilization of natural resources (NR) (Azam *et al.*, 2023). However, the supply of nonrenewable energy consumption (NREC) such as fossil fuels is limitless, but it degrades environmental quality (EnvQ) and increases the usage of natural resources (Mensah, 2019).

Natural resource rents are critical to prosperity, especially for rising nations aiming for better development rankings. Such expanding nations trust largely on the abuse of their national currency to enhance their GDPpc (Xue *et al.*, 2021). A country with plentiful natural resources would see significantly faster economic growth and development. Because NR determines a country's production, exports, and output, they are important for both consumption and production (Guan *et al.*, 2021). Similarly, Ibrahim and Ajide (2021) find that NRRs have had a significant impact. NR are not always negative for the EnvQ; nonetheless, the mining process might be detrimental. Since humans tacit the value of natural resources for economic success, a number of environmental issues have emerged. Climate change is today's most important environmental issue. Human exploitation of nonrenewable natural resources, such as minerals, natural gas, and crude oil (Bürgin, 2015). Even though NR are vital, their misuse harms the ecosystem (Burger, 2008; Frankel & Rose, 2005). Similarly, Anwar *et al.* (2019); Raza and Shah (2018), CO_2 continue to cause considerable harm environmental. This debate indicates that the bond between NR and environmental quality (EnvQ) cannot be ignored.

Manufacturing requires a number of minerals and resources (Bayat *et al.*, 2021). Limited NR emerge in an economy when resources are scarce; those that strive survive while the others perish because to an absence of NR. Developed countries have an abundance of NR (Agus, 2020). A flourishing economy accompaniment when a country has an abundance of NRs that can be used for production. Furthermore, all natural resources, biotic and abiotic, are interrelated. Natural resource-rich nations and slow-growing countries are commonly impoverished due to unequal resource distribution. The NR curse theory explains this behaviour. Nations with higher NR may be less developed than those with lower NR due to inefficient resource allocation (Zuo *et al.*, 2023). NRR meaningfully contribute to CO_2 in Pakistan. Still, Huang *et al.* (2023), NRR causes a rise in CO_2, which contribute to environmental damage. Also, Wani *et al.* (2024) claim that NRR upsurges sources of energy for manufacturing, which is a key contributor to Pakistan's environmental deterioration, such as the usage of fossil-fuels. Correspondingly, Shah *et al.* (2022) said that LR negative environmental consequences are directly proportionate to the extent of FD, URBP, and rent harvesting of NR.

In the case of Pakistan, the raw material for growth might be NRs, when managed properly, can be critical to economic development but can also have negative environmental consequences (Batool & Mohsin, 2024). The main use of NR use of NR in energy generation, has been shown to damage soils (Ganda, 2022). Furthermore, NRR contribute significantly to environmental exploitation in Pakistan (Kiran & Gardezi, 2024). NR exhaustion, extraction, processing, and removal degrade the environment and have an impact on ecological-systems by falling environmental quality (EnvQ) (Zhang *et al.*, 2022). NR, otherwise, seek to improve EnvQ by reprocessing waste and falling GHG (Zucca *et al.*, 2022). Although agri-land, grazing land, and forests (most imperative natural resources) minimize the amount of carbon dioxide emission (Amor *et al.*, 2022). Though augmented NRR boost ecological footprint (Zucca *et al.*, 2022).

Besides, Sarkodie and Strezov (2018) used the data of five European countries and found that NRR has a positive effect on CO_2, which is harmful to nature. These countries are abundant NRR are working to decrease their imports of impure energy. They identified that NRR reduces the CO_2 in these countries and their communities with rich NRR may reduce the NREC imports and help to decrease in CO_2. Similarly, Sun *et al.* (2020) used the BRICS countries data and found that NRR has negligible effect on CO_2. Correspondingly, Ansari (2022) conducted study in five provinces of China and found that NRR are closely related to CO_2

Xinjiang, Gansu, and Shaanxi) while insignificant in the case of Ningxia Provinces. Marle *et al.* (2022) shows that the NRR improve the EnvQ and reduces the CO_2 and other gases. The NRR has made major contributions to the economy, particularly in the mining, energy, and agriculture sectors. However, Pakistan confronts significant environmental issues as a result of poor natural resource management (Ahsan, 2024).

Countries create environmental regulations to encourage long-term growth and ecological sustainability. Besides, political institutions have a substantial role in the establishment and execution regulations (Ahmed *et al.*, 2022). Many businesses rely on natural resources for production, and both production and consumption can have an impact on the EnvQ. Poor EnvQ affects human well-being as well as economic activity. Finding the right of these objectives is crucial for every government (Arslan *et al.*, 2022). The NRR issue is not a recent problem (Rashad *et al.*, 2022). Speciously, certain NRR are employed for their development, particularly in poor countries such as Pakistan. However, it also implies a greater exhibition of environmental harm, such as growing CO_2 and other associated consequences (Kiran & Gardezi, 2024). Natural resource rents are a significant part of Pakistan's economy. Though NRR have been linked to environmental deterioration, there has been no clear study of these rents in connection to the aforementioned gaps, particularly the interaction among resources, GDPpc, and CO_2 (Aziz & Afridi, 2024). Besides, the relationship between NRR and EnvQ is extremely complicated, with inconsistent results. Some scholars argue that NRRs have a positive impact on EnvQ (Hussain *et al.*, 2020; Joshua *et al.*, 2020; Shen *et al.*, 2021; Wang *et al.*, 2020), while others argue that they have a negative impact (Khan *et al.*, 2021; Li *et al.*, 2019; Lorente *et al.*, 2018). Resultantly, this study will be look into the complicated subject of whether NRR promote or worsen EnvQ in Pakistan.

This work makes a significant contribution to the current literature. Like, used inimitable mixture of the variables first time for Pakistan and updated data from 1979 to 2024. This study will use the updated estimation techniques based the data behavior to overcome the endogeneity issues to provide the authentic results. Therefore, these results will be beneficial for the policy makers in case of Pakistan and others emerging countries to improve the sustainable development. Therefore, this study was conducted to examine the effect of natural resource rents on environmental degradation in Pakistan.

Theoretical Background

Ecological modernization theory (EMT) was established on the idea of retrogressive approaches to environmental difficulties faced by companies. However, significant improvements in economic development diminish the NRR while gradually deteriorating environmental quality as a result of insufficient environmental restrictions (Spaargaren & Mol, 1992). The scale consequence is an increase in output levels that happens without any improvements in technology. Economic development, for example, tends to reduce EnvQ since greater manufacturing requires more raw materials, which drives GDPpc while also emitting pollutants (Zübeyde *et al.*, 2020). Furthermore, depending on the building industry, effect mimics pollution from industrial activities. Emerging countries frequently experience structural transformation. Furthermore, if the structural shift is significant enough, the compositional effect may mitigate GDPpc (Destek & Sarkodie, 2019). The technological influence encourages increased productivity and breakthroughs are mostly intended to combat environmental degradation (Dogan & Seker, 2016). Huber (2000) initially suggested the EMT, which is based on ideas about how modern technologically advanced nations deal with environmental issues. Rapid production and development not only deplete the existing natural resource pool, but also create ongoing CO_2 due to inadequate environmental regulations and fading EnvQ (Bekun *et al.*, 2019). EMT believe that technical advancements may enable countries achieve LR GDPpc while without materially reducing EnvQ.

Empirical Literature

Hassan *et al.* (2019) employ an autoregressive distributive lag model to evaluate the effect of GDPpc and NR on Pakistan's ecological footprint (EF) in LR. The empirical outcomes demonstration that NR have an optimistic inspiration on an EF that CO_2 and confirmed the environmental Kuznets hypothesis (EKC). NR and the EF have a bidirectional causal bond, biocapacity and EF. Similarly, Ahmad *et al.* (2020) used data from 1984-2016, and show a consistent, long-term link between EF, NRR, technological advancements, and GDPpc. Moreover, NRR and economic expansion enhance and extend EF, whilst technical improvements assist to mitigate the environmental deterioration caused by these phenomena. Kwakwa *et al.* (2020) used data period 1971-2013 of Ghana and discovered that wealth, URBP, and NRR all contribute to environmental concerns, which include increased carbon emissions and EC. Yet, TO has been shown to cut CO_2. Similarly, Xue *et al.* (2021) intend inspiration of NR misuse and GLOB on EnvQ in South Asian countries (1991-2018) and found that in LR an optimistic link among NRR and GHG. Similarly, Aladejare (2022) used the data of five richest African nations from 1990-2019 and utilized OLS, GLS and AMG. The study's findings revealed that NRRs have a major contribution to CO_2. Moreover, GDPpc has no significant impact on CO_2, HK considerably degrades CO_2.

Sicen *et al.* (2022) used the data of BRICS economies between 1995-2018 and indicated that NRR help to lessen CO_2 emissions, but oil rents, and forest, considerably increase CO_2 emissions. Similarly, Zuo *et al.* (2022) utilized data from 1991-2018 of BRI and revealed that NRRs have a considerable detrimental influence on EnvQ, even when technological developments can help lessen the EF. Furthermore, NRR and technological improvements has a negative influence on the EF. Moreover, Ganda (2022) used the data of BRICS economies from 1990-2019 and panel GLS methods and discovered a U-shaped connection between GDPpc and CO_2. Besides, NRR, EC, and HK all have a considerable positive association with CO_2. Zhang *et al.* (2022) employed CS-ARDL for estimation (1990-2020). They found that NRR, increases CO_2. Likewise, excessive energy use and GDPpc are robust contribute to environmental damage. Arslan *et al.* (2022) used data from 1970 to 2016 and indicated that NR promote EnvQ while lowering economic development in China. Moreover, Rashad *et al.* (2022) used data from 1975-2020 of Pakistan and RLS regression outcomes exhibited that NRR and GDPpc augmented GHG.

Hossain *et al.* (2023) ARDL methodologies (1970-2018) and demonstrate that GDPpc have different but significant effects on EnvQ, and we prove the presence of a EKC in India, with CO_2. NRR, energy use, and URBP all have an optimistic correlation with long-term environmental impact. The GDPpc and NRR has an optimistic impact on CO_2 as well as on environmental footprint. Sibanda *et al.* (2023) used data 1994-2020 and the GMM technique, demonstration that NRR are positively related with CO_2 and related to EKC, which asserts that CO_2 accelerates during the early segments of developing country GDPpc.

Hacıimamoğlu and Cengiz (2024) used data from 1990–2018 in ASEAN-5 nations. They corroborate the EKC hypothesis and reveal that RECs and NRRs reduce CO_2. Moreover, Shang, Samour*, et al.* (2025) used data between 2004-2018 and found that trusting on REC helps to improve CO_2. They found a positive bond between FD and CO_2, while, NRR has a harmful impact on ecological quality. Moreover, Ahmed *et al.* (2025) used FMOLS in MENA nations and found that GLOB, investment, NRR, oil revenue, and technical breakthroughs all contribute to a decrease in environmental sustainability by increasing CO_2. Chen and Usman (2025) used the data of China between 1973-2019 and indicated that NNR and energy usage increase CO_2, energy lessening, and consumption, but forest rents are inversely linked with NRR. Guan *et al.* (2025) used data of 60 nations from 1996-2018 and Quantile ARDL for estmation. Their findings demonstrated that in the selected economies, more NRR, stronger financial growth, and bigger sharing in the global value chain all had a favorable impact on environmental deterioration. Qian and Chen (2025) seek to investigate the influence of NRR on GDPpc in G-7 nations. Their findings using the panel ARDL technique show that NRR all have a negative long-term impact on green development. Furthermore, oil rent has a good influence on long-term green development, but mineral rent has no impact. According to Shuayb *et al.* (2025), used dataset of the top ten NR-rich African nations from 1990-2021 and employed CS-ARDL method for estimation. Their findings show that economic expansion, energy intensity, and natural resource rents increase environmental harm, but REC and rule of law reduce it. Shang, Akhtar*, et al.* (2025) used Malaysia's data from 1990-2022 and NARDL for estmation and found GHG will eventually gain greatly from an increase in mineral and oil rent.

Summary of Literature

Although NRRs have been linked to environmental deterioration, there has been no clear study of these NRR in link to the aforementioned gaps, particularly the interaction between resources and GDPpc (Aziz & Afridi, 2024). Besides, the relationship between NRR and EnvQ is extremely complicated, with inconsistent results. Some scholars argue that NRRs have a positive impact on EnvQ (Asif & Ghaffar, 2025; Hussain *et al.*, 2020; Joshua *et al.*, 2020; Shen *et al.*, 2021; Wang *et al.*, 2025; Wang *et al.*, 2020), while, another group of scholars argue that they have a negative impact (Khan *et al.*, 2021; Li *et al.*, 2019; Lorente *et al.*, 2018). The present research demonstrates that the relationship between natural resource rent and environmental deterioration is unclear. Furthermore, previous research employed a variety of approaches, data types, and time periods. This study also employed a novel grouping of factors, an updated data period, and procedures to get strong results.

Methodology

The data was together from World Development Indicators (2026) from 1976-2024 of Pakistan

Table 1: Descriptions of Variables

S.No	Variables Detail	Mark
1.	Carbon dioxide (CO_2) emissions per capita (t CO2e/capita)	CO_{2t}
2.	GDP per capita growth (annual %)	$GDPpc_t$

S.No	Variables Detail	Mark
3.	NRR (% of GDP)	NRR_t
4.	Domestic credit to private sector (% of GDP)	FD_t
5.	Urban population growth (annual %)	$URBP_t$
6.	School enrollment, secondary (% gross)	HK_t

Specification of the Model

This study used the succeeding adapted model, from the studies by Azam *et al.* (2022) and Arslan *et al.* (2022).

$$CO_2 = f(NRR, GDPpc, FD, HK, URBP) \quad \text{(1)}$$

$$CO_{2_t} = \beta_0 + \beta_1 GDPpc_t + \beta_2 FD_t + \beta_3 NRR_t + \beta_4 HK_t + \beta_5 URBP_t + \mu_t \quad \text{(2)}$$

Estimation Strategy

One of the most crucial duties in the analysis is to assess the data's stationarity. This is significant when selecting estimating strategies. This study employed the Augmented Dickey Fuller (ADF) test, developed by Dickey and Fuller (1981), to examine the order of integration.

Estimation Technique

This study chooses ARDL estimate strategies based on data behavior. Unlike other estimation techniques, which have strict assumptions and bias outcomes, this study used the ARDL estimation techniques, which are better suited for each order of data and automatically resolve endogeneity and homogeneity issues, making the results more reliable than other techniques. The main purpose of ARDL approaches is to estimate both the SR and LR coefficients. Now, this study gives the model ARDL forms.

$$CO_{2_t} = \beta_0 + \sum_{i=1}^{n} \beta_{1i} CO_{2_{t-i}} + \sum_{i=0}^{n} \beta_{2i} GDPpc_{t-i} + \sum_{i=0}^{n} \beta_{3i} FD_{t-i} + \sum_{i=0}^{n} \beta_{4i} NRR_{t-i} + \sum_{i=0}^{n} \beta_{5i} HK_{t-i} + \sum_{i=0}^{n} \beta_{6i} URBP_{t-i} + \mu_t \quad \text{(3)}$$

$$\Delta CO_{2_t} = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta CO_{2_{t-i}} + \sum_{i=0}^{n} \beta_{2i} \Delta GDPpc_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta FD_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta NRR_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta HK_{t-i} + \sum_{i=0}^{n} \beta_{6i} \Delta URBP_{t-i} + \gamma_1 GDPpc_t + \gamma_2 FD_t + \gamma_3 NRR_t + \gamma_4 HK_t + \gamma_5 URBP_t + \varepsilon_t \quad \text{(4)}$$

Results and Discussions

Table 2 extant that the series human capital has the uppermost mean and standard deviation (S.D.) while the CO_2 has the bottommost S.D. and mean.

Table 2: Descriptive Statics

Variables	CO_{2t}	$GDPpc_t$	NRR_t	FD_t	$URBP_t$	HK_t
Mean	0.6700	1.9512	1.9450	20.7993	3.4351	25.6030
Median	0.7031	1.8388	1.4492	22.2704	3.3827	23.0913
Max	0.9658	5.8040	9.3295	29.7861	5.2586	48.2805
Min	0.3142	-3.0389	0.7400	11.4661	2.0182	15.2170

S.D.	0.1916	2.0157	1.4703	4.7860	0.8407	8.5028
Skewness	-0.4229	-0.2185	3.1649	-0.2928	0.2712	0.7554
Kurtosis	2.0876	2.6553	14.9043	1.8191	2.2720	2.5991
Jarque-Bera (JB)	3.1605	0.6323	371.1357*	3.5473	1.6827	4.9887
p-value (JB)	0.2059	0.7289	0.0000	0.1697	0.4311	0.0825

*Note: * significant at 1%.*

Table 3 shows the correlation results among the variables, the NRR and HK are negatively while the rest of the variables are positively correlated with CO_2. Moreover, the rest of the variables is positively correlated with each other.

Table 3: Correlation Outcomes

Variables	**CO_{2t}**	**$GDPpc_t$**	**NRR_t**	**FD_t**	**$URBP_t$**	**HK_t**
CO_{2t}	1					
$GDPpc_t$	0.1664	1				
NRR_t	-0.3404	0.0849	1			
FD_t	0.6726	0.0904	0.0457	1		
$URBP_t$	0.8951	0.1087	0.2089	0.7668	1	
HK_t	-0.8342	0.1615	0.2342	0.8359	0.8113	1

Unit Root (UR) Test Outcomes

Table 4 extant the ADF test results, which shows that the GDPpc and NRR series are stationary at level only. Consequently, the ARDL techniques is more suitable for this data to estimate the coefficient.

Table 4: UR test Results

Variables	**At Level**		**1st Difference**		**Decision**
	t-statistics	**p-value**	**t-statistics**	**p-value**	**(Stationary)**
CO_{2t}	-1.8133	0.3698	-5.7958*	0.0000	1st Difference
$GDPpc_t$	-5.8094*	0.0000	----	----	At level
NRR_t	-3.9148**	0.0039	----	----	-do-
FD_t	-0.7665	0.8194	-6.4779*	0.0000	1st Difference
$URBP_t$	-1.0081	0.7412	-3.9840*	0.0039	-do-
HK_t	3.2673	1.0000	-5.9823*	0.0000	-do-

*Note: * and ** significant at 1% and 5%.*

Regression Outcomes

Table 5 extant the ARDL outcomes, in the long run (LR), which demonstrates that GDPpc has optimistic and noteworthy effect on CO_2. A percent upsurge in GDPpc will increase the CO_2 on average by 0.01 percent. The outcomes are same with Hussain *et al.* (2020); Wang *et al.* (2020) while opposing Alvarado and Toledo (2017). Yet, the NRR has a negative and substantial effect on CO_2. A percent increase in NRR will decrease the CO_2 on average by 0.03 percent. The results are in line with Balsalobre-Lorente *et al.*

(2018), Li *et al.* (2019) and Khan *et al.* (2021) while opposing Wang *et al.* (2020), Udi *et al.* (2020), Hussain *et al.* (2020) and Shen *et al.* (2021). Yet, the FD has an optimistic and significant effect on environmental degradation. A % upsurge in FD will increase the CO_2 on average by 0.0020 percent. Though, the URBP has a negative and substantial effect on environmental degradation. A % increase in URBP will decrease the CO_2 on average by 0.14 percent. Yet, the HK has negative effect on CO_2. A % upsurge in HK will decrease the CO_2 on average by 0.01 percent. Moreover, in *SR*, the FD has an optimistic and notable effects on CO_2 only. A % upsurge in FD will upsurge the CO_2 on average by 0.001 percent. Furthermore, ECM value is negative and significance, which shows that the speed of tuning from SR-LR by 52% and the LR cointegration.

Table 5: ARDL Outcomes

Variable	***Coefficient***	***Std. Error***	***t-Statistic***	***p-value***
Long Run (LR) Outcomes				
$GDPpc_t$	0.0051**	0.0025	2.0637	0.0484
NRR_t	-0.0347*	0.0122	-2.8479	0.0082
FD_t	0.0021**	0.0009	2.3682	0.0250
$URBP_t$	-0.1363**	0.0627	-2.1726	0.0384
HK_t	-0.0055**	0.0021	-2.6161	0.0142
C	0.4107*	0.0352	11.6556	0.0000
Short Run (SR) Outcomes				
$D(GDPpc_t)$	0.0011	0.0016	0.6626	0.5114
$D(NRR_t)$	-0.0012	0.0032	-0.3551	0.7243
$D(FD_t)$	0.0056*	0.0020	2.7366	0.0092
$D(URBP_t)$	0.0329	0.0208	1.5873	0.1203
$D(HK_t)$	-0.0024	0.0016	-1.4959	0.1425
ECM_{t-1}	-0.5206*	0.0799	-6.5178	0.0000
C	0.0150	0.0041	3.6535	0.0007
F-Bounds Test	***H_0: No levels relationship***			
Test Statistic	***Value***	***Signif.***	***I(o)***	***I(1)***
F-statistic	6.1821*	10%	2.08	3.00
k	5	5%	2.39	3.38
		2.5%	2.70	3.73
		1%	3.06	4.15

*Note: * and ** significant at 1% and 5%.*

Granger Causality Results

Table 6 extant the causality among variables, which demonstrations that there are exist one way causality running from CO_2 to GDPpc, CO_2 to FD, NRR to URBP, FD to URBP, HK to FD, and HK to URBP, However, no causality exist between CO_2 and NRR, CO_2 and HK, NRR and GDPpc, FD and GDPpc, URBP and GDPpc, HK and GDPpc, FD and NRR, and HK and NRR. However, there is exist Feedback causality between CO_2 and URBP.

Table 6: Pairwise Granger Causality Tests

Variables	CO_{2t}	$GDPpc_t$	NRR_t	FD_t	$URBP_t$	HK_t
CO_{2t}	---	2.9404***	0.1598	3.7757**	6.6220*	1.2167
		(0.0638)	(0.8529)	(0.0310)	(0.0032)	(0.3064)
$GDPpc_t$	0.6565	----	0.8073	1.6027	1.2004	0.4628
	(0.5239)		(0.4528)	(0.2134)	(0.3112)	(0.6327)
NRR_t	01616	1.7452	----	0.8252	5.4085*	0.0315
	(0.8513)	(0.1870)		(0.4451)	(0.0081)	(0.9690)
FD_t	0.5557	0.9347	0.5520	----	3.1476***	0.5655
	(0.5778)	(0.4007)	(0.5799)		(0.0532)	(0.5724)
$URBP_t$	4.5661**	0.1932	0.8632	1.4732	----	1.5544
	(0.0161)	(0.8251)	(0.4291)	(0.2408)		(0.2232)
HK_t	0.0710	1.2686	0.0040	3.7132**	2.9603***	----
	(0.9316)	(0.2918)	(0.9961)	(0.0327)	(0.0627)	

*Note: *, ** and *** significant at 1%, 5% and 10%.*

Conclusion

Natural resource rents are an important aspect of Pakistan's economy. Granting NNR have been connected to CO_2, there has been no comprehensive examination of these NRRs in link to the aforementioned gaps, notably the interplay between resources, GDP per capita, and the environment. As a result, this study examines the relationship between natural resource rents and environmental deterioration, using Pakistani data from 1976 to 2024 using ARDL estimating methodologies. This study discovered that, in LR, GDPpc and FD had positive and significant effects on CO2. However, the NRR, URBP, and HK have a detrimental and considerable impact on environmental deterioration. Furthermore, in the short term (SR), the FD has positive and significant impacts on CO2, but the remaining factors have minimal effects on CO2. Furthermore, the ECM value is negative and considerable, indicating a 52% increase in the rate of change from SR to LR and LR cointegration. Furthermore, there is one-way causation from CO2 to GDPpc, CO2 to FD, NRR to URBP, FD to URBP, HK to FD, and HK to URBP. However, there is also feedback causality between CO2 and URBP. As a result, this study showed that total natural resource rent decreases CO2 in the long run but has no effect on CO2 in the short term.

Recommendations

- Pakistan, like other resource-rich developing countries, effectively utilizes natural resources for sustainable development.
- Pakistan and other countries should prioritize renewable energy to boost production and economic growth.
- Maximize the use of natural resources for economic expansion while reducing CO2 emissions.
- To encourage economic growth, Pakistan's government should implement innovative CO2 emission reduction strategies.

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