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Green Energy Strategies and Their Effect on Natural Resource Sustainability in Pakistan

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Abstract

This study explores the impact of green energy strategies on natural resource sustainability in Pakistan, utilizing data from 1999 to 2022 and applying the ARDL estimation technique. The primary focus is on understanding how renewable energy consumption and production influence natural resource rents. Empirical results indicate a complex relationship: renewable energy consumption is negatively correlated with natural resource rents, suggesting that increased consumption of renewable energy may reduce the exploitation of natural resources. Conversely, renewable energy production shows a positive correlation with natural resource rents, implying that boosting renewable energy production can enhance the value derived from natural resources. These findings underscore the dual role of renewable energy in promoting sustainability. On the consumption side, a shift towards renewables can alleviate pressure on natural resources, fostering long-term ecological balance. On the production side, investing in renewable energy infrastructure appears to complement the efficient use of natural resources, potentially increasing economic rents. Policymakers should encourage renewable energy consumption through incentives and subsidies, reducing dependence on non-renewable resources and mitigating environmental degradation.

Keywords: Green Energy Strategies, Natural Resource Sustainability, ARDL

1. Introduction

This is the most crucial measure to take now to ensure a balanced and sustainable future. It promotes the use of recyclable energy resources and helps to safeguard the world from the depletion of natural resources (Purnomo et al., 2020). Using other resources, such as hydropower, wind power, and solar electricity, ensures the safety and long-term use of natural resources. The natural resources in our environment are being used inappropriately without any thought of their depletion, so in this context, green energy is the best source of obtaining energy such as obtaining energy from the waste of plants and their debris, it also refers to the usage of animal wastes and crops remains for the usage of generating energy for daily use, if we fail to take proper measures on using the green energy along with natural resources then soon, we have to face the serious depletion of natural resources which may create great hurdles in future and may cause a devastating energy crisis (Hussain et al., 2021; Majeed et al., 2021; Farhadi & Zaho, 2024). So, in the best of mankind using other sources and methods of obtaining energy such as green energy is the need of today which makes our energy reservoir safe and allows us to use it in the coming time. So natural resources such as coal, oil, or petroleum are non-renewable sources of energy and are obtained from the earth's crust in limited amounts besides this limited amount mankind is wasting these resources without any concern for the energy crisis and excess usage of this not only causes depletion, but it is also the source of pollution. Using green energy is the most effective method to tackle pollution problems and make the environment mankind friendly and this may also be the source of disposing of the wastes used in making energy. So, in that way, land pollution can also vanish through this method (Esen & Bayrak, 2017; Filippidis et al., 2021; Ullah & Ali, 2024). On the other hand, using animals and plant wastes for the manufacturing of energy is also a cheap way of obtaining energy. So, the impact of using green energy is very positive for our environment and also for our energy reservoirs, and the consumption of energy through these resources makes the natural resources sustainable and, in that way, it is the key to saving us from the depletion of natural resources and also to deal with many important challenges (Le, 2020; Roussel & Ali, 2024).

On the other side, if we talk about how green energy is utilized, it is utilized in the waythat we dispose of the plants and animal wastes in a tanker or closed things so that gas is produced which is used to run the turbines and that how these turbines generate electricity fordomestic use and that how cheap source energy which also resolve the problem of pollution and reduce the hurdles for the development and production (Hassan et al., 2019; Tawari, 2024). On the other hand, by using hydropower plants, we can also obtain energy by using turbines in the dams which run the generators and cheap energy is obtained. So, using cheap and natural resources may be promoted to end the fear of any difficulty in the future related to the depletion of fossil-based resources (M. M. Asghar et al., 2020; Esen & Bayrak, 2017; Le, 2020; Rehman & Ahmad, 2024). This may also demand innovation in machinery and techniques to obtain energy from green resources which lead to more and more energy and a more sustainable environment with no pollution and energy crisis.Measures are being taken in this regard to improve the steps to recycle natural resources and obtain energy for them which may prove very beneficial to the environment and increase the sustainability of natural resources (Aurmaghan et al., 2022; Purnomo et al., 2020; Xue et al., 2021). These resources provide superior substitutes for conventional energy sources, contributing to the mitigation of climate change, Carbon emissions reductions and environmental sustainability advancements. In addition to being the greatest and most efficient means to address smog-related problems, it has the potential to completely transform society. The transition to green energy and consumption habits has an impact on natural resource sustainability, both positively and negatively (M. Asghar et al., 2022). It decreases environmental degradation and lessens dependency on finite fossil fuels, but it also presents difficulties including resource-intensive infrastructure production and land use implications. Long-term environmental sustainability depends on striking a balance between these variables through effective resource management, waste reduction, and sustainable consumption habits (Imam, 2022). Green energy sources are sunlight, wind, and, water providing us with practical sustainability for energy. Green and Renewable energy may still need to play a significant role in our environmental impact.

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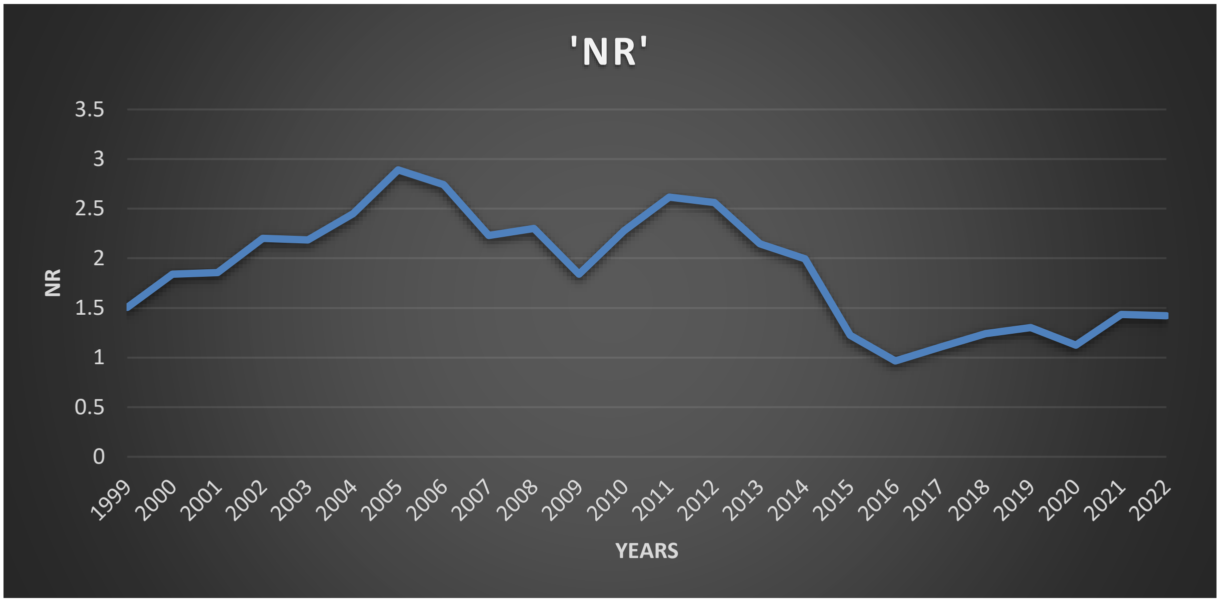
Figure 1

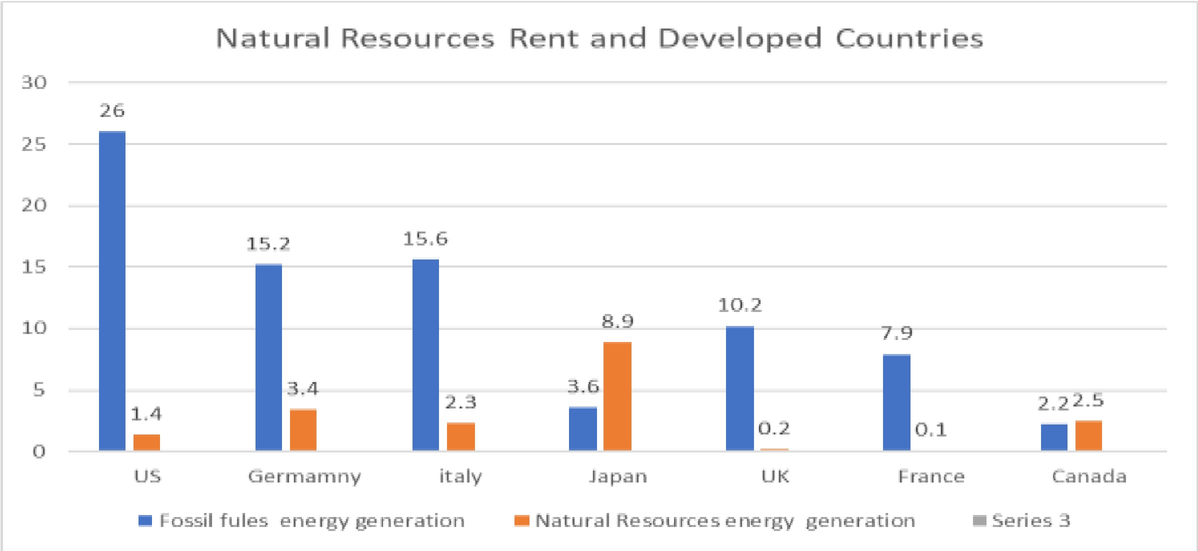


Natural Resources in Pakistan

In recent years, we need to change consumption habits that affect natural resource conservation and management in industrial countries. Sustainable energy and consumption patterns have a huge impact on the countries 'Sustainability Landscape' Solar, wind, and water energy all produce less carbon emissions than fossil fuels. The use of green energy has a positive impact on the environment, and climate, and protects our natural resources (Segerson et al., 1991; Ze et al., 2023; Audi et al., 2024). The green energy sources not only contribute to air and water pollution but also lead to ecosystem degradation. Developed countries are increasingly adopting minimized waste generation while maximizing green energy efficiency. This approach enhances Long–term environmental sustainability. Renewable energy infrastructure energy-saving technologies and environmental to help us to grow the economy. The Variegation of energy sources as a result of technological advances the economic growth in industrialized countries Click or tap here to enter text. (Hass.

Green energy is generated from natural resources such as wind, water, and sunlight. So, it's no harm to the environment. To solve these problems, governments, corporations, and civil society must work together in renewable energy research and development. Now, in recent years the global world has a critical need to uplift the promotion of sustainable energy sources and consumption habits for the environmental challenges. This will lead us to the various effects of green energy and consumption and natural resources sustainability (Aurmaghan et al., 2022).

Figure 2



Here, the graph shows the linkages and relationship between natural resource rents and economic development. Government and Policymakers should work together on the potential of natural resources for Long-term growth in developed countries.

2. Literature Review

Concerns about resource depletion, environmental harm, and climate change have brought sustainable consumerism and the use of renewable energy back to the forefront The aim of this literature review is to provide an extensive recent study on how green energy strategies and their effect on natural resource sustainability. Various researchers have been convinced that renewable energy sources such as wind, hydro, sunlight, and geothermal power can reduce dependence on fossil fuels (Amri, 2019; Ito, 2017; Ivanovski et al., 2021; Saudi et al., 2019; Shafiei & Salim, 2014; Shahbaz et al., 2020; Viana Espinosa de Oliveira & Moutinho, 2022).

According to Arnaut and Lidman (2021), renewable energy technology development can critically lower greenhouse gas emitted air and water pollution In addition renewable energy sources are improving air and water quality having positive effects on public health. According toTopcu and Tugcu (2020), the dilation of renewable energy infrastructure like wind turbines and solar farms may have an impact on land use, biodiversity, and ecosystem services. However, it is necessary to examine how renewable energy systems will affect the environment and their whole life cycle, abstraction, manufacturing processes, and disposal.

Green energy sources dignify sustainable consumption patterns and amend energy efficiency to achieve natural resource sustainability. Research by Zaghdoudi (2017), emphasizes the importance of reducing energy demand through policy interventions, technological innovations, and lifestyle changes. For example, beginning steps such as efficient buildings, and transportation systems and reducing the impact of resource consumption and environmental (Rafindadi & Usman, 2019).

Ze et al. (2023) stated that there is a complex link between consumption patterns, natural resource sustainability, and energy. Sustainable Energy future provides a complete picture of the problems and opportunities in economics, sociology, and engineering. Green energy embrace and sustainable consumption habits have improved the natural resources sustainability, Government, society and corporations have a vital role in supporting behavior can change more sustainable energy system and believe that natural resources are provided for future generation

The literature, here discusses the difference between green energy systems such as solar, biomass, wind geothermal, and ocean wave energy. Study by Esen and Bayrak (2017) indicate that renewable energy sources need global energy to reduce greenhouse gas emitting. Sustainable alternatives to fossil fuels by utilizing renewable resources found in the 'Earth 's interior' such as sunlight, water, and wind, green energy technologies evidence of the value of innovation in lowering costs and accelerating adoption comes from studies on developments, such as energy storage system, wind turbine design, and enhanced solar cell efficiency(Chen et al., 2023).

The abstraction and use of natural resources can have major environmental effects on habitat, water pollution, and greenhouse gas emitting (Majeed et al., 2021). According toOlunuga (2022), Sustainable resource management strategies exclude environmental decline and secure natural resources. However, research on the "resource curse of plenty" emphasizes the difficulty of managing natural resource plenty sustainably. Countries that have abundant in natural resources are more liable to environmentally declined ecosystems and adequate supervision (Muhammad & Khan, 2021). Governance settles how natural resources are assigned and managed within the country.

3. Data and Methodology

3.1. Data

Table 1: Data Description

Abb	Variables	Measurements	Source
NR	Natural Resource Rent	Natural resource rent, percentage of GDP	WDI
RENP	Renewable Energy Production	Renewable electricity production percentage of electricity production total	WDI
RENC	Renewable Energy Consumption	Renewable energy consumption percentage of energy Consumption total	WDI
CRW	Combustible Renewables and Waste	Combustible renewables and waste percentage of totalenergy	WDI
EG	Economic Growth	GDP growth percentage annual	WDI
POP	Population Growth	Population growth percentage annual	WDI
AGRI	Agriculture	Agriculture, fishing, and forestry, value-added percentage of GDP	WDI

3.2. Model Specification

3.2.1. Economic Model.

NR= f (REC, REP, CRW, POP, AGRI)…………………………… ………………………… (1)

Natural resources are the dependent variable in the economic model, with GDP growth, population growth, combustible renewables and waste, renewable energy generation, consumption, agriculture, forestry, and fisheries acting as independent variables.

3.2.2. Econometric Model

Our model's long-term link between the variables was investigated using a bound test. We assessed the long-term association between the research variables using the ARDL bound test form based on our theory.

$$NR_t = \beta_1 + \beta_2 REC_t + \beta_3 REP_t + \beta_4 CRW_t + \beta_5 EG_t + \beta_6 POP_t + \beta_7 AGRI + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

After taking log from equ (1) and (2)

$$lnNR_t = \beta_1 + \beta 2lnREC_t + \beta 3lnREP_t + \beta 4lnCRW_t + \beta_5 lnEG_t + \beta_6 lnPOP + \beta_7 ln AGRI + \mu_t \ldots (3)$$

3.3. ARDL Bound Test

$$\Delta NR_t = \alpha_1 + \alpha_2 NR_{t-i} + \alpha_3 REC_{t-i} + \alpha_4 REP_{t-i} + \alpha_5 CRW_{t-i} + \alpha_6 EG_{t-i} + \alpha_7 Pop_{t-i}$$

$$+ \alpha_8 ADRI_{t-i} + \sum\beta_1 \Delta NR_{t-i} + \sum\beta_2 \Delta RECt_{-i} + \sum\beta_3 \Delta REP_{t-i} + \sum\beta_4 \Delta CRW_{t-i} +$$

$\sum\beta_5 \Delta \quad EG_{t-i} + \quad \sum\beta_6 \Delta \quad Pop_{t-i} + \sum\beta_7 \Delta \quad AGRI_{t-i} + \mu_t$……………………………..……… (4)

In Eq. 2, Δ represents the first difference, Natural Resources is NR, Renewable energy consumption is REC, Renewable energy production is REP, Combustible renewables is CRW and waste, GDP growth is GR, Population growth is POP and Agriculture, forestry, and fishing is AGRI.

3.4. ARDL MODEL

3.4.1. Long Run Equation

The long-run level connection between variables is calculated using the ARDL bounds testing approach to cointegration, from which error correction is derived. The Autoregressive Distributed Lag Model (ARDL) Bounds testing method works effectively for discovering level connections whether the underlying time series attribute is wholly I(0), entirely I(1), or co-integrated.

$NR_t = \gamma_1 + \sum\gamma_2 \ NR_{t-i} + \sum\gamma_3 \ REC_{t-i} + \sum \gamma_4 \ REP_{t-i} + \sum\gamma_5 \ CRW_{t-i} + \sum\gamma_6 EG_{t-i} + \sum\gamma_7 \ POP_{t-i} + \sum\gamma_8 \ AGRI_{t-i} + \mu_t$……………………………………..………………………………..……… (5)

In the following equation," ɤ" reflects the long-run variation in the study variables. The information criterion was used to choose relevant lags.

3.4.2. Short Run Equation

The short-run ARDL model applied the following error-correcting methodology:

$NR_t = \beta_1 + \sum\beta_2 \Delta NR_{t-i} + \sum\beta_3 \Delta RECt_{-i} + \sum\beta_4 \Delta REP_{t-i} + \sum\beta_5 \Delta CRW_{t-i} + \sum\beta_6 \Delta EG_{t-i} + \sum\beta_7 \Delta POP_{t-i} + \sum\beta_8 \Delta AGRI_{t-i} + \mu_t$……………………………………………………………………………..(6)

4. Result and Discussion

4.1. Descriptive Analysis

Table 2: Descriptive Statistics

	LNR	LRENEC	LRENEP	LCRW	LGDP	LPOP	LAGRI
Mean	0.324118	3.829365	20.92554	3.579766	1.539475	0.405745	3.110702
Median	0.264980	3.826029	21.01904	3.579060	1.488992	0.429766	3.106912
Maximum	0.763696	3.914819	21.62003	3.612932	1.883098	0.638293	3.165795
Minimum	-0.035284	3.740048	19.79945	3.547655	0.915345	0.185696	3.029064
Std. Dev.	0.259408	0.058106	0.575631	0.022010	0.301825	0.153668	0.043280
Skewness	0.559167	-0.131669	-0.651357	0.091883	-0.709607	0.189978	-0.468513
Kurtosis	2.326814	1.841068	2.621191	1.895470	3.125833	1.919115	2.470559
Jarque-Bera	0.638944	0.529677	0.690210	0.470158	0.761250	0.492255	0.434371
Probability	0.726532	0.767330	0.708146	0.790508	0.683434	0.781823	0.804781

In this study, the connection between the independent and dependent variables was assessed using the ARDL technique. To determine the stationarity of each variable and the pattern of integrating the pertinent variables, use the unit root test. Regressions with nonstationary variables may yield unreliable findings. The initial difference and the level were used to calculate each variable's stationarity. Nothing has changed, according to our statistics. In dynamic ARDL simulations, variables can only be employed that are stationed at I(0) or I(I). Table 1.

4.2. Correlation Matrix

Table 3: Correlation matrix

	LNR	LRENEC	LRENEP	LCRW	LGDP	LPOP	LAGRI
LNR	1						
LRENEC	0.6540	1					
LRENEP	-0.5042	0.0427	1				
LCRW	-0.3883	0.2238	0.9634	1			
LGDP	-0.2471	-0.1090	0.1213	0.1262	1		
LPOP	0.3713	0.7154	0.5316	0.6907	-0.04251	1	
LAGRI	0.5806	0.4110	-0.6671	-0.5875	0.2951	-0.1608	1

The findings of the correlation matrix analysis are shown in Table 3, which shows the correlations between the constructs but does not explore their significance. According to the findings, there is a positive correlation between NR and Pop, EG, CRW, REP, REC, and AGRI.

4.3. Unit root test

Table 4 indicates that the autoregressive distributed lag model (ARDL) lets you allows the independent and dependent variables to have different delays selected. The outcomes of numerous lag selection criterion tests are displayed in the table below.

Table 4: Unit Root Test

	ADF		PP	
Variables	Level	1st Diff	Level	1st Diff
NR	-1.265856	-4.024711**	-1.464247	-4.024711**
RENEC	-2.223466	-3.029190*	-1.679275	-3.029190
RENEP	-10.27753	-0.594603	-4.083961*	-8.328163***
CRW	-2.829592*	-3.509547*	-1.308364	-3.122317*
GDP	-2.834426*	-5.689136***	-2.912548*	-5.649912***
POP	-2.672732*	-2.767586^{8}	-1.574932	-2.517816
AGRI	-3.408713^{8}	-2.925455^{8}	-2.234270	-2.925455^{8}

4.4. Bound Test of ARDL Model

Table 5

Bound Test		Null Hypothesis: No levels of relationship		
Statistic	Value	Significant	I(0)	I(1)
		10 percent	1.87	2.83
F-stats	8.666565	5 percent	2.37	3.26
		2.5 percent	2.44	3.59
		1 percent	2.77	3.76

The F-statistic values are displayed in Table 4. Cointegration is tested using F-statistics. The estimated F-statistics value is greater than the upper limits value for the significance levels of 10%, 5%, and 2.5%, suggesting cointegration of the study variable.

4.5. ADRL Long-Term Results

Table 6: Long-Run Results

Variables	Coefficients	Std. Error	t-Statistics	Probability
LRENEC	-2.471329	1.119613	-2.207306	0.0547
LRENEP	0.080221	0.019139	4.191504	0.0023
LCRW	0.887729	1.380239	0.643170	0.5362
LGDP	0.134823	0.049181	2.741353	0.0228
LPOP	1.353677	0.318282	4.253076	0.0021
LAGRI	1.425981	0.420297	3.392793	0.0080
C	3.904065	3.015870	1.294507	0.2277

4.6. ARDL Short Run Results

Table 7: Short Run Results

Variables	Coefficients	Std. Error	t-Statistic	Probability
LRENEC	-1.053413	0.282440	-3.729684	0.0047
LRENEP	0.569170	0.203092	2.802520	0.0206
LCRW	0.084506	0.025643	3.295534	0.0093
LGDP	0.109404	0.042392	2.580763	0.0364
LPOP	-0.433149	0.480237	-0.901948	0.3906
LAGRI	0.658360	0.317421	2.074089	0.0768
CointEq(-1)*	-0.451952	0.109641	-4.122111	0.0008

Tables show the ARDL model's long-run and short-run findings. The coefficient of renewable energy consumption, which is 2.4713 significantly, explains that a one percent increase in renewable energy consumption will increase the natural resources by 2.4713 present in the long run and short run because the impact of using green energy is very positive for our environment and also for our energy reservoirs and the consumption of energy through these resources makes the natural resources sustainable. Some previous researchers are line with our findings (Gardezi & Chaudhry, 2022; Kasperowicz et al., 2020; Topcu & Tugcu, 2020; Viana Espinosa de Oliveira & Moutinho, 2022; Wei et al., 2022). The coefficient of renewable energy production, that is 0.0802, significantly explain that one percent increase in renewable energy production will increase the natural resources by 0.0802 present in the long run and short run natural resource wealth can be conducive to renewable energy production. Some past studies found similar findings (Alvarado et al., 2021; Ivanovski et al., 2021). The coefficient of combustible renewables and trash, 0.8877, strongly explains that a one percent growth in renewable energy output will increase natural resources by 0.8877. The findings show the existence of long-run linkages between combustible renewables and waste, as well as aggregate renewables and waste, as well as aggregate wealth and ecological proxies (Sumrin et al., 2021; S. Yang, 2020). Furthermore, our empirical results for the production function model show that combustible renewables and trash have a large positive effect on natural resources. The coefficient of GDP growth, which is 0.1348, strongly explains that a one percent rise in GDP growth will increase the natural resources by 0.1348. The share of GDP in mining has a robust positive correlation with economic growth. Several past researchers found similar findings such as (Farooq et al., 2020; Gardezi & Chaudhry, 2022; Kisswani, 2017; Magazzino, 2018; Munir et al., 2023; Zaib, Ali Gardezi, et al., 2023). The coefficient of population growth, which is 1.3536 significantly, explains that a one percent increase in population growth will increase the natural resources by 1.3536. Few previous researchers found similar findings like (Ali Gardezi et al., 2024; Curran & Mahutga, 2018; Dong et al., 2018; Farooq et al., 2022; Immurana et al., 2021; W. Yang & Kanavos, 2012; Zaib, Rafique, et al., 2023). The agriculture coefficient, which is 1.4259, explains that a one-percent increase in population growth will increase natural resources by 1.4259. Some past researchers regress agriculture on natural resources and found similar results (Aurmaghan et al., 2022; Awunyo-Vitor & Sackey, 2018; Naraghi et al., 2021).

4.7. Variance Inflation Factors

Table 8: VIF

Variables	Coefficients Variances	Uncentered VIF	Centered VIF
LRENEC	1.674912	18904.02	3.425929
LRENEP	0.000429	101.1207	4.846921
LCRW	1.484196	14306.21	1.648496
LGDP	0.009960	15.80783	1.281406
LPOP	0.131822	51.02860	6.544622
LAGRI	0.579970	4257.110	1.656175
C	17.89866	13572.40	NA

VIF test is used to determine whether multicollinearity exists among the independent variables or not. Multicollinearity occurs when there is a correlation between two or more independent variables. The reliability of the predictor variables is strongly correlated with their multicollinearity. Multicollinearity is present in the data since the centered VIF value is less than 10.

4.8. Diagnostic tests

Table 9: Diagnostic tests

Different tests	Prob-Values	Results
Heteroscedasticity (Bruesch-pagan-Godfrey)	0.53	Data is free from the heteroscedasticity Problem
Heteroscedasticity (Harvey)	0.605	Data is free from the heteroscedasticity Problem
Serial correlation/Autocorrelation (Breusch-Godfrey Serial correlation LM test)	0.1769	Data is free from the Problem of Autocorrelation
Ramsey RESET Test	0.364	Our model is correctly Specified.

Figure 2: Normality test

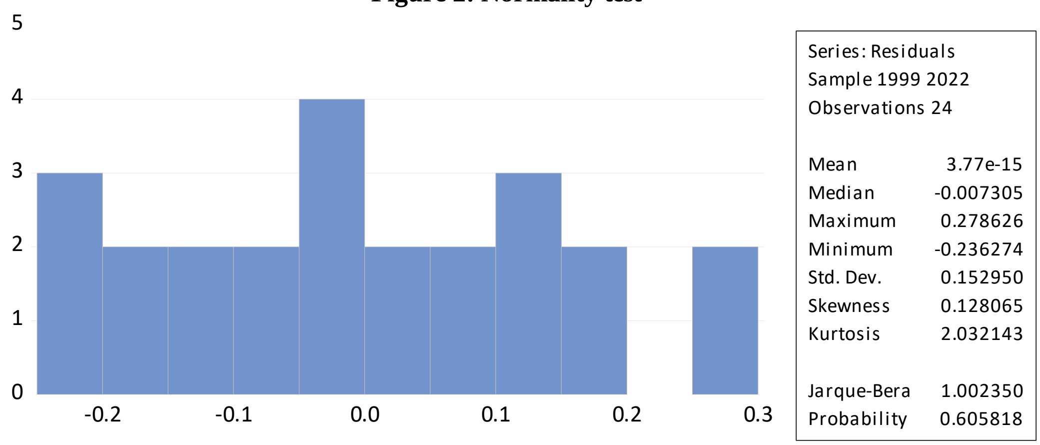
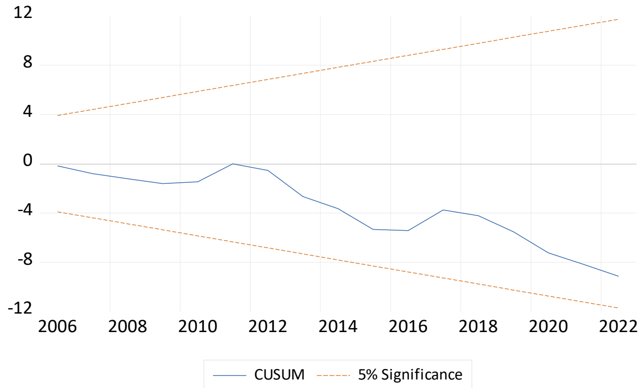
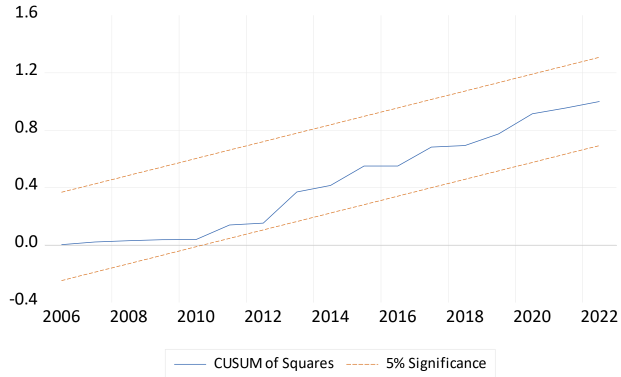


Table 4 displays the findings from many diagnostic statistics. To evaluate the model's consistency, diagnostic data were used. The chosen model has no problems with serial correlation, according to the findings of the Breusch-Godfrey LM test. The results of the ARCH and Breusch-Pagan-Godfrey tests, which were used to look for heteroscedasticity, indicate that there are no problems with heteroscedasticity in the model. the. The model was tested using the Ramsey RESET test, and the results show that it is accurately described. The model's residual is normally distributed, according to Jarque-Bera's findings.

Figure: 3





COSUM Test **COSUM of Squares Test**

The CUSUM and CUSUM of Squares tests are displayed in the graphs below. Apply CUSUM and CUSUM of squares to verify the stability of the coefficients. The fact that the blue lines in both photos are below the crucial lines indicates that the coefficients are stable at the 5% significance level. The models' reliability is shown by the graphs above.

5. Conclusion and Policy Recommendation

In conclusion, the exam Considering the impact of green energy adoption on consumption, an assessment of natural resources rent shows considerable potential but major limitations. The transition towards renewable energy sources presents a positive trajectory, reducing reliance on finite natural resources and mitigating environmental degradation associated with fossil fuel consumption. This shift not only diversifies the energy portfolio but also fosters economic growth, job creation, and technological innovation. However, this transformation is not without limitations. Data constraints, methodological challenges, and complex interactions among variables pose significant hurdles in accurately assessing the full extent of the impact. Moreover, temporal dynamics and contextual factors further complicate the analysis, emphasizing the need for ongoing research and nuanced policy interventions. Nonetheless, with careful consideration of these complexities and informed decision-making, the pursuit of green energy solutions holds immense promise in promoting sustainable development, preserving natural resources, and securing a resilient future for generations to come. Limitation are despite the compelling insights gained from investigating Several restrictions should be acknowledged when considering the impact of green energy adoption on consumption and exploration of natural resources rent. Foremost among these constraints is the inherent challenge of obtaining comprehensive and accurate data. The availability and reliability of data regarding energy consumption patterns, natural resource extraction rates, and the revenues generated from natural resource rent can vary significantly across regions and industries. Moreover, methodological hurdles, such as measurement errors and sample biases, may introduce uncertainties into the analysis, potentially undermining the robustness of the findings. Additionally, the intricate interplay of various factors, including technological advancements, policy dynamics, and market fluctuations, introduces complexity to the research landscape. The evolving nature of these dynamics necessitates a nuanced understanding that may not be fully captured within the scope of the study. Furthermore, contextual factors, such as cultural norms, institutional frameworks, and socio-economic disparities, can further complicate the interpretation of results, limiting the generalizability of findings across different contexts Considering these limits, identifying and addressing these issues can help to inform future studies efforts, allowing for a more full understanding of the complicated interaction between green energy adoption, consumption exploration, and natural resource rent.

In conclusion, the transition towards green energy and sustainable consumption is essential for ensuring the long-term sustainability of developed countries. By reducing carbon emissions, conserving finite resources, promoting circular economy principles, enhancing energy security, stimulating innovation, and addressing socio-economic disparities, green energy, and consumption practices contribute to the preservation and responsible management of natural resources. However, realizing these benefits requires collaborative efforts and innovative solutions to overcome existing barriers and accelerate the shift toward a more sustainable future.

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