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Evaluating the Role of Natural Resources, and Financial Development on Ecological Footprint in Pakistan: An ARDL Approach

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ABSTRACT

The role of economic growth, natural resources and financial development on ecological footprints in Pakistan. Data is applied between 1980 and 2021. Using ARDL bounds testing cointegration approach, the result signifies that the financial development, and natural resources have statistically significant with ecologic footprint. however, the economic growth has positive effect on ecologic footprint. Natural resources, economic expansion, and financial development were shown to be the driving forces behind the increase in ecological footprint because they all have a positive and significant influence on it. In long period, Pakistan data also supported the actuality of the Ecofriendly Kuznets Curve theory. Hence, the situation is advised to raise public mindfulness of the implementation of defensible applies in everyday lifespan and the routine of environmental technology that offer the greatest efficacy and the tiniest volume of environmental damage in business and household actions. Ultimately, based on the research findings, a thorough policy framework was suggested, which would enable the Pakistan economy to achieve the Sustainable Development Goals.

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1. Introduction

The reduction of environmental pollution is currently one of the main goals of a global civilization. Stability between financial development and global environmental conservation is a difficulty for both industrialized and developing nations (Hassan, Xia, Khan, & Shah, 2019). The majority of research have concluded that CO_2 emissions are the key cause of rising environmental squalor and that greenhouse gases raise global temperatures. The most urgent global issue in recent years has been environmental deterioration, which previously was only a low priority issue (Altaf, Awan, & Rehman, 2023; Ilyas-Lecturer, Awan, Kanwal-Lecturer, & Banaras, 2023). The usage of terrestrial and water for producing all human-distributed capitals and eradicating surplus waste created by the population was the first clear evidence of the biological

footprint in the 1990s. According to research (Al-Mulali, Weng-Wai, Sheau-Ting, & Mohammed, 2015; Galli et al., 2012), the ecological footprint is a complete degree of environmental deprivation (M. Rahman & Sciara, 2022). The ecological footprint supports to focus effects that production and ingestion have on atmosphere, both directly and indirectly Ulucak and Bilgili (2018) Using "Environmental Kuznets Curve" (EKC) theory, association among ecological degradation (ED) and economic growth (EG) was examined Li et al. (2022); Rehman, Ali, Idrees, Ali, and Zulfiqar (2022), In light of this theory, EKC hypothesis asserts that ED and economic activity form an inverted U-shaped link (Beyene & Kotosz, 2019). Moreover, there is an increase in ED during the initial phases of EG, but only to a specific level. At greater economic growth levels, this trend reverses, and environmental conditions begin to improve. If this hypothesis is correct, economic growth would not be regarded as endangering the environment, contrary to common belief (Dawood, ur Rehman, Majeed, & Idress, 2023; Stern, 2004).

Two proxies are typically used to assess environmental degradation: carbon dioxide CO_2 and ecological footprint (ECF) emissions of CO_2. The latter proxy, however, is a poor predictor Zafar et al. (2019), scarcely captures how human activities have affected the natural ecology Ahmed and Wang (2019), because it only accounts for a small percentage of the conservational destruction affected by excessive energy usage (Destek & Sarkodie, 2019a; Ozturk, Al-Mulali, & Saboori, 2016; Uddin, Salahuddin, Alam, & Gow, 2017). The latter however, denotes the strain that a particular population is placing on atmosphere (Wackernagel & Rees, 1998). The strain that human actions are placing on the ecosystem is what causes it (Uddin et al., 2017). Several researches have used the environmental imprint as a stand-in for ecological degradation (ED) due to its comprehensiveness in capturing the impact on production and consumption e.g (Hafiza et al., 2022; Zulfiqar et al., 2022).

Numerous researches have been showed to inspect the impacts of various Economic and social operations on ECF, encompassing globalization, human capital, natural resources (NR) Zafar et al. (2019), exploration Ozturk et al. (2016), globalization Ahmed, Wang, Mahmood, Hafeez, and Ali (2019), and monetary advancement (Godil, Sharif, Rafique, & Jermsittiparsert, 2020). The connection between society and nature is generally recognized, and as a result, there is a connection between community and ecological well-being. Thus, it is crucial to maintain the pair natural environment and economy (Katircioglu, Gokmenoglu, & Eren, 2018; Shahid, Muhammed, Abbasi, Gurmani, & ur Rahman, 2022). ED stands for environmental depletion or environmental degradation (Bais et al., 2018). There are a number of causes for this depletion of natural resources, but manmade activities that seriously endanger the survival of the natural environment are the main culprits (Ahmed et al., 2019). According to M. Rahman and Sciara (2022), use surpasses the NR's production capability, creating a significant problem for everyone on earth (Allahrakha, Sheikh, & ur Rahman, 2023). The crucial mismatch between supply and demand is causing resource depletion, greenhouse gas buildup, and the destruction of the earth's bio capacity. Long-standing debates have surrounded the plentiful stock of (NR) and environmental impact (Johnsson, Kjärstad, & Rootzén, 2019). This connection clarifies how EG first brings to industrial development, which hastens the abstraction and use of (NR), which in return rises the ecological footprint (Baloch, Zhang, Iqbal, & Iqbal, 2019).

There are three main variables e.g. natural resources, economic growth and technology advancements significantly change the ecological impact Awan, Rahman, Ali, and Zafar (2023); Fatima, Jamshed, Tariq, and Rahman (2023), Modern gear may be used in the extraction process thanks to a technical advancement, reducing environmental damage. Financial development is seen as being a crucial component in order to acquire this cutting-edge technology. For the same reason, one of the key variables in the current study's analysis was financial development. Shahbaz, Solarin, Mahmood, and Arouri (2013) believe that financial development (FD) recovers atmosphere of the state due to developments in research work and technical progress (Shahzadi, Ali, Ghafoor, & Rahman, 2023). The idea that financial growth enhances economic efficiency and increases opportunity to adopt cutting-edge technology to lessen environmental impact is supported by (Visigalli et al., 2021). Yet, only a small number of investigations e.g. Baloch, Mahmood, and Zhang

(2019); Y. Zhang and Zhang (2018) identified FD is just one among the factors contributing. By reducing the costs involved with utilizing financial information, creating contracts, and conducting transactions, innovative markets for finance, intermediaries, and contracts can be created Javaid, Noor, Hassan Iftikhar, Rahman, and Ali (2023), The creation and growth of financial institutions, markets, and tools are therefore involved Bank (2020); IGI (2020) nonetheless, this has a number of negative repercussions scheduled the situation Mukhtar et al. (2023) All buying or construction of a huge structure, equipment, automobile impacts the atmosphere since these things require energy to produce (Nawaz, Rahman, Zafar, & Ghaffar, 2023). Hence, by way of a outcome of monetary development, financiers prefer to invest in equipment and plant settings that require a lot of energy to function, which results in spread of pollution and CO_2 into atmosphere (Pata, 2018).

Pakistan began its path towards sustainable growth Awan, Shahid, Rahman, and Baig (2023) in the 1990s, and since then, it has undertaken a number of measures to realize its 2025 vision for sustainable development (Arslan, Kanwal, Kazmi, & Rahman, 2023; Tabassum, Rahman, Zafar, & Ghaffar, 2023). In 2009, On the basis of three important concepts, a new monetary system (NMS) was created: high income, inclusiveness, and sustainability, which correspond to the economy, society, and environment aspects of the SDGs (Asad, 2019; Awan, Arslan, & Hussain, 2023). Now in effect is its eleventh Term from 2016 to 2020.

Pakistan stays working for better both the situation socioeconomic situation and the state of the environment. According to the Khalid, Sharma, and Dubey (2020), Pakistan's SDGs index score improved overall from 53.11% in 2015 to 63.49% in 2020, a 19.5% rise from the baseline in 2015. It's a composite score here. Sector accomplishments exist in varying degrees. Pakistan is ranked 125th out of 163 countries (Zhao et al., 2023). Pakistan’s every individual consumption is 4.2 universal hectares, that is higher than the worldwide middling and should remain between 1.7 and 2.4 global hectares. 2 It exhibits borrowing. earth's natural resources. Figure 1 shows Pakistan’s biocapacity and ecological impact between 1961 and 2017. It appears that Pakistan has a negative net reserve situation (Qadri & Shi, 2023). The amount of consumption exceeds the planet's ability to meet all of the demands of humanity.

First and foremost, it was crucial to determine how variables like Interactions between NR, financial development, and EG Pakistan's ecological footprint because, by way of far as the writers are aware, none of these factors have ever been investigated in relation to Pakistan (Dawood et al., 2023; Shahzadi, Sheikh, Sadiq, & Rahman, 2023). Second, to learn more about the opposing viewpoints of different experts on what can produce ecological footprint and whether any of the elements might also aid to lessen the impact of ecological footprint brought on by other causes. Last but not least, our attempt makes use of a unique strategy that has never been used to these variables with regard to Pakistan: dynamic simulated ARDL (Ahmad, Riaz, Rahman, & Hafiza, 2023; Zahra, Nasir, Rahman, & Idress, 2023).

This research study begins by outlining the research gap and then provides some background information on the topic. After referencing relevant studies, the third part discusses research technique. The next parts, titled data analysis, conclusion, and recommendations, respectively.

2. Literature Review

Due to careless consumption, ambitious consumption, competitive expansionism, and social habits, Mother Nature is suffering devastating consequences (Shrinkhal, 2019; Wackernagel & Rees, 1998). The sharp increase in conservation deprivation and associated worries prompt academics to look into the phenomena by taking into account several aspects that might contribute to the deterioration of this sustainable condition Usman, Rahman, Shafique, Sadiq, and Idrees (2023), Hence, several investigations in industrialized, undeveloped, and least developed countries have been carried out. Scholars attempted to

evaluate the EKC theory Arslan et al. (2023); Kanwal, Khalid, and Alam (2023), which posits an inverted U-shaped nexus connecting ED and other economic activity. This helpful idea encapsulates the popularity of this notion, and numerous studies have also backed this opinion. Later on, nevertheless, a number of investigations also produced contradictory findings (Chaudhary, Nasir, ur Rahman, & Sheikh, 2023). The EKC hypothesis was found to be sensitive to the country's geographic location, time period, data accessibility, and application of econometric methodology (Dogan, Taspinar, & Gokmenoglu, 2019). From 1977 through 2013, Destek and Sarkodie (2019b) examined the Environmental Kuznets Curve theory in eleven newly developed countries. The connection between the variables was investigated using an Augmented Mean Group estimator (Usman et al., 2023). Four nations, namely Mexico, the South Africa, Singapore, and Philippines, agreed with the Environmental Kuznets Curve theory, while the remaining nations had a U-shaped nexus. The EKC theory was supported by Charfeddine and Mrabet (2017) investigation on the relationship between 15 MENA countries' actual GDP and environmental impact countries. The study also conducted by Ashfaq, Zafar, Zahid, and Khan (2023) regarding oil price shocks drive corruption, is also the main issue that deteriorates the environment and increase corruption and carbon dioxide emission (Ilyas, Banaras, Javaid, & Rahman, 2023; Nawaz et al., 2023).

According to J. Wang and Dong (2019), although the amount of ED was relatively lower in Sub-Saharan nations, environmental degradation was sparked by expanding urbanization, economic expansion, and energy consumption. Using an enhanced mean group estimator, from 1990 to 2004, panel data for 14 Sub-Saharan nations were examined. The Environmental Kuznets Curve theory was supported in entirely 3 income groups by Ulucak and Bilgili (2018), The ECF showed that GDP had a favorable effect. Over the years 1970 to 2014, Hassan et al. (2019) examined the Ecological footprint, in Pakistan. It was shown that while economic expansion initially causes the ECF to increase, over time it really improves the environment. The EKC theory was confirmed in Pakistan as a result.

Using spatial econometric methods, Y. Wang, Kang, Wu, and Xiao (2013) investigated how economic expansion affected the ECF in 150 different nations. In these 150 nations there is no statistically significant association among the variables was found, rendering to the outcomes. In contrast, Caviglia-Harris, Chambers, and Kahn (2009) survey of 146 countries, including Pakistan, failed to uncover any empirical support for the EKC theory. Moreover, Hervieux and Darné (2013) worked to support the EKC theory in seven Latin American nations. The results were established using a time series analysis of data collected from 1961 to 2007. Although the theory of EKC was not verified, there was a positive linear relationship among economic growth and ECF.

While Bagliani, Bravo, and Dalmazzone (2008) investigated the EKC theory while adopting economic development measures in 141 nations and Ecological footprint keen on consideration, they found no evidence to support it. Mrabet and Alsamara (2017) investigated the CO_2 and ECF emissions in Doha from 1980 to 2011. EKC was not verified for CO_2 emission, but it was found to be corresponding to the ecological footprint substitute for environmental deterioration. Financial development, real GDP, and other variables were taken into consideration in the study.

Al-Mulali, Saboori, and Ozturk (2015) analyzed 93 nations in order to assess the EKC hypothesis in various income group countries. Panel Data were collected between 1980 and 2008. Due to the early stages of their growth, low-income and lower-middle-income countries did not exhibit EKC hypothesis. Moreover, it was discovered being lower-income nations, financial growth had little to no impact on ECF, however, it was discovered that the EKC hypothesis was accurate, and FD had a detrimental effect on the ECF. It should be noted that Pakistan was categorized as an upper-middle income country (Baloch, Mahmood, et al., 2019).

GDP and financial development, Charfeddine and Mrabet (2017) analyses figures generated by Doha, Qatar during the years 1970 to 2015 using the Markov switching analysis model. Findings indicated a favorable relationship between financial development and ECF along with an ECF-real GDP link that is strongly U-shaped. Visigalli et al. (2021) investigated how economic growth from 1986 to 2018 affected ECF in Turkey. About Saudi Arabia, Xu et al. (2018) asserted that FD damages the environment. According to Mrabet and Alsamara (2017), ECF and economic growth in Qatar are favorably associated. Moreover, Charfeddine and Mrabet (2017) found that activities related to financial development have an increased ecological impact.

Majeed and Mazhar (2019), on the other hand, assessed an analysis of 131 countries ECFs and the impact of FD from 1971 to 2017. According to Baloch, Zhang, et al. (2019), financial development reduces the ecological footprint, which is another conclusion that they endorse. Additional research by Uddin et al. (2017) on 27 republics with CO_2 emissions showed the economic growth lessens ecological impact.

Nature's demand has multiplied in recent years and outpaced the planet's ability to provide it Ulucak and Khan (2020). Due to a shortage of land regeneration capability, countries currently face an issue known as the bio capacity gap. Reduction of natural resources might be slow down then the rebirth process may start if they are utilized responsibly, but if they are exploited carelessly, a reduction in bio capacity may cause the ECF to rise. From 1992 to 2016, the BRICS countries were examined by Ulucak and Khan (2020). It has been discovered that using natural resources sustainably slows down environmental deterioration. EKC for the BRICS nations was therefore validated.

According to Sobrinho (2005), some economists believe that free trade leads to environmental gain (EG), which prevents the environment from degrading as a result of rising wages. On the other hand, some economists contend that this increase in earnings brought about by free trade amplifies consumption, which in turn puts pressure on natural resources through production. In industrialized countries, the manufacture procedure be contingent on outdated energy bases similar oil, gas, and coal. Demand for NR rises as economic development accelerates, increasing ecological imprint (Panayotou, 1993).

The impact of natural resources and EG on Pakistan's ECF from 1970 to 2014 was examined by Hassan et al. (2019). The findings show that using NR has large beneficial effects on the ECF, indicating that relying too many on natural resources degrades environmental quality. According to Sarkodie (2018), human activities including mining, agriculture, and deforestation cause environmental deterioration. Human ECF has increased by about 190% over the past 50 years; this increase suggests that there is an unbalanced link among people and the environment. Countries are using extra resources than the world can replenish, later it may be said that humanity are previously reliant on the environment (GFN 2020). Ahmed, Asghar, Malik, and Nawaz (2020) examined the relationship from 1970 to 2016 between natural resources and ECF in China together with other factors. The authors investigated how NR increases the likelihood of ECF with economic growth. Ulucak and Khan (2020) take into account the use of renewable resources and natural resources to determine the factors that influence ECF. urbanization, energy, and BRICS countries from 1992 to 2016. According to the findings, natural resources significantly harm the ECF. the ECF effected from 1980 to 2019 by Natural resources in the Iran were examined by Hatami, Sayehmiri, and Ebrahimi (2021). Natural resources and ECF were shown to have an indirect relationship (Jahanger, Usman, Murshed, Mahmood, & Balsalobre-Lorente, 2022). Among Asian nations, an inverted U-shaped association was seen that supports the Environmental Kuznets Curve concept. This suggests that natural resources contribute to bettering the environment in Asian countries.

Thus, it may be said that natural resources appear to produce a variety of outcomes in various nations since it is pretty obvious that the manner in which they are extracted and managed determines whether they have good or bad consequences.

3. Data & Methodology

This study uses time series data to look at the effects of natural resources, economic growth, and financial development from 1980 to 2021 on ecological footprints. Data has been extracted using the world development indicator (WDI) As in many studies like (Awan, Rahman, et al., 2023; Kanwal, Khalid, et al., 2023; S. Younas, Shoukat, Awan, & Arslan, 2023). In this study we have used Autoregressive Distribution Lag Model (ARDL). Ecological footprint is our dependent variable and financial development, natural resources and economic growth are our independent variable.

3.1. Model Specification

In the time series equation displayed lower, 0 denotes the constant span and 1 to 3 are the coefficients of the independent variables, which, respectively, stand for EG, FD, and NR.

$$ECO = \beta_0 + \beta_1 EG + \beta_2 FD + \beta_3 NR + u_t \quad (1)$$

Where, ECF = Ecological footprints, Ecological footprint index (EFI) is deliberate principal component analysis (PCA) on a panel. It is formed with three selected indicators of Ecological footprints (Agriculture, forestry, and fishing, value added, Arable land and Permanent cropland), EG= Economic Growth index (EG) is principal component analysis on a panel (PCA). It is molded through four selected indicators of Economic Growth (GDP growth). FD =Financial Development index (FD) is determined by Principal component analysis on a panel (PCA). It is formed with three chosen indicators of Financial Development (Insurance and financial services, Net financial account and Net certified growth assistance acknowledged), and NR=Natural resources which is measured as Total natural resources rents (% of GDP).

World Development Indicators provided the yearly time series data. online data base for Pakistan over the time period between 1980 and 2021.

Table 1
List of Selected Variables with Details is as Under

Symbols	Variables	Measurement	Data Resources
ECF	Ecological footprints	Agriculture, forestry, and fishing, value added (annual % growth)	WDI
EG	Economic Growth	Arable land (% of land area)	WDI
		Permanent cropland (% of land area)	
		GDP growth (annual %)	
		General government final consumption expenditure (annual % growth)	
FD	Financial Development	Imports of goods and services (annual % growth)	WDI
		Exports of goods and services (annual % growth)	
		Insurance and financial services (% of commercial service exports)	
		Net financial account (BOP, current US$)	
		Net official development assistance received (current US$)	
NR	Natural Resources	Total natural resources rents (% of GDP)	WDI

3.2. Co-Integration Technique:

The cointegration method remained used to assess the long-term correlation between the variables, which are likewise referred to as F-statistics. The computed F-statistics' value, which determines whether co integration is present or not among the studied variables, has a major effect on the variables' long-term nexus. if the F-statistics value that was calculated is lower than the value at the lower bound, there is no cointegration; and if the computed F-statistics value is intermediate between the values of the upper and lower bounds, there is no co integration (Pesaran, Shin, & Smith, 2001). The two ensuing theories are applied in order to look into the cointegration relationship between the variables:

$$H_0: \partial_1 = \partial_2 = \partial_3 = \partial_4 = 0 \quad (2)$$
$$H_1: \partial_1 \neq \partial_2 \neq \partial_3 \neq \partial_4 \neq 0 \quad (3)$$

In the event that the first two hypotheses support the presence of a long-run nexus, the following calculation examines the short- and long-term relationships between the research variables.

$$\Delta ECO_t = \partial_0 + \partial_1 ECO_{t-1} + \partial_2 EG_{t-1} + \partial_3 FD_{t-1} + \partial_4 NR_{t-1} + \sum_{i=1}^{q} \beta_1 \Delta ECO_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta EG_{t-1} + \sum_{i=1}^{q} \beta_3 \Delta FD_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta NR_{t-1} + \epsilon_t \quad (4)$$

In the following equation, the ecological footprint change operators are represented by ECO, and t 1 indicates that SIC is the optimum lag option. In comparison to other lag selection criteria, Ivanov and Kilian (2005) demonstrated that SIC is more accurate for a relatively smaller sample size. The elements analyzed in the aforementioned equation are numbered ∂1 to ∂5 and β1 to β5, respectively.

The long-term application of the dynamic ARDL simulation model and short-run findings is the following stage.

3.3. ARDL simulations:

Initial investigators by M. K. Khan, Teng, and Khan (2019); L. Zhang et al. (2021) also used the lively ARDL (DARDL) simulation model. To examine both the short- and long-term associations Among the factors under investigation, Jordan and Philips (2018) proposed using the ARDL simulation model. The implementation of this special DARDL simulation model addressed the short-run and long-run nexus among the study variables lacking in the regular ARDL model. The DARDL simulation model maintains constant values for other independent variables may automatically analyze, pretend, and conjecture graphs using optimistic and adverse differences in the independent variables (Jordan & Philips, 2018; Sarkodie & Strezov, 2019). If the variables have an association with cointegration under examination, the DARDL simulation model can be applied. This research study fully satisfies the the DARDL simulation model's criteria. Five thousand in total runs are performed for the dynamic ARDL simulation model in the direction of restrictions utilizing the multivariate usual scatterings (Jordan & Philips, 2018).

$$\Delta ECO_t = \delta_0 ECO_{t-1} + \beta_1 EG_t + \delta_1 \Delta EG_{t-1} + \beta_2 FD_t + \delta_2 \Delta FD_{t-1} + \beta_3 NR_t + \delta_3 \Delta NR_{t-1} + \varphi ECT_{t-1} + \in_t \quad (5)$$

The rate of recovery from the disequilibrium in the previously mentioned DARDL simulation model is evaluated using the phrase "error correction" (ECT), where indicates the short- and long-term coefficients. The stationarity of each variable utilized in this study was examined using a variety of unit root tests. The variables must first be assessed for combination and stationarity at the level and (1) in order to investigate the data using a novel dynamic ARDL technique.

4. Descriptive Analysis of the Variables

Table 2 offers descriptive information for the variables from 1980 to 2021. Means are included in the summary statistics, medians, maximums, and minimums of each series.

Table 2
Descriptive Statistics

	ECO	FD	NR	EG
Mean	-2.38E-09	3.81E-08	1.323154	1.67E-08
Median	0.109172	0.284707	1.142871	-0.008380
Maximum	1.241606	1.616794	2.617278	4.197657
Minimum	-1.847322	-3.203553	0.729306	-1.644310
Std. Dev.	1.000007	1.000002	0.543013	1.000001
Skewness	-0.321628	-1.595149	0.924970	1.638320
Kurtosis	1.607044	5.628350	2.583201	8.650413
Jarque-Bera	4.119686	29.90091	6.293001	74.66118
Probability	0.127474	0.000000	0.043002	0.000000

4.1. Unit Root Test

In order to explore the data using a unique dynamic ARDL technique, the variables must first be evaluated for integration and stationarity at level (1). Table 3 employs 2 various unit root tests, such as the tests for Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP), which validate the application of the dynamic ARDL approach and demonstrate Because at the majority of levels, stationary and integrated variables are present (1).

Table 3
Unit Root

		At Level			
		With Intercept		With Trend & Intercept	
Variables		Statistics	P-Value	Statistics	P-Value
ECO	ADF	-2.215409	0.2041	-0.186926	0.9913
	PP	-1.942811	0.3101	-0.602820	0.9735
EG	ADF	-7.823325	0.0000	-7.797474	0.0000
	PP	-7.768822	0.0000	-7.752688	0.0000
FD	ADF	-7.752688	0.0000	-2.650061	0.0915
	PP	-2.575139	0.1062	-3.233217	0.0923
NR	ADF	-1.906573	0.3262	-1.915390	0.6284
	PP	-1.906573	0.3262	-1.915390	0.6284

		At 1st Difference			
		With Intercept		With Trend & Intercept	
Variables		Statistics	P-Value	Statistics	P-Value
ECO	ADF	-4.391771	0.0012	-4.641247	0.0032
	PP	-4.356772	0.0013	-4.661453	0.0030
EG	ADF	-7.684425	0.0000	-7.571326	0.0000
	PP	-30.11506	0.0001	-29.40792	0.0000
FD	ADF	-6.183429	0.0000	-6.124128	0.0001
	PP	-8.409258	0.0000	-10.44514	0.0000
NR	ADF	-6.197273	0.0000	-6.202668	0.0000
	PP	-6.302511	0.0000	-6.450199	0.0000

Table 4 lists the VAR criteria for choosing lag lengths. The simulated ARDL method gives investigators the freedom to select the lag durations for dependent and independent variables. The amount and frequency of the data, including its quarterly, monthly, or annual format, also

affect this choice. There are various information criteria available, including Final Prediction Error (FPE), Likelihood Ratio (LR), Akaike (AIC), Hannah Quinn (HQ), and Schwarz (SIC). AIC lag 1 in this study displays the lowest value when compared to HQ and SC. Because of this, the researchers used AIC for lag selection.

Table 4
Lag Length Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-181.0469	NA	0.155380	9.489585	9.660206	9.550802
1	-76.45933	182.3578*	0.00166*	4.946632*	5.799741*	5.25272*
2	-62.45697	21.54208	0.001895	5.049076	6.584671	5.600034
3	-54.68758	10.35919	0.003106	5.471158	7.689240	6.266987

Additionally, the long-term nexus is carefully examined using the ARDL model (Altaf et al., 2023). To accomplish this, Pesaran et al. (2001) devised the cointegration test utilizing the ARDL bound process. Since F-statistics values are greater than I (0) at the 5% and 10% levels of significance, Table 4 clearly shows that all of the study's variables are cointegrated.

Table 5
ARDL Bound Test

Test Statistic	Value	Signif.	I (0)	I (1)
F-statistic	6.54288	10%	2.72	3.77
K	3	5%	3.23	4.35
		2.5%	3.69	4.89
		1%	4.29	5.61

An essential phase in the analytical process is the diagnostic test. The results of three diagnostic tests are shown in Table 5. The test's insignificant result demonstrates that autocorrelation does not exist in the model being studied. The Breusch-Pagan-Godfrey test also shows that heteroscedasticity is not a problem. The Ramsey RESET test confirms that the exemplary is being used properly, whereas the Jarque-Bera test establishes the normality of the estimated model.

Table 6
Diagnostics Tests

Test	χ2 (p value)	Results
Breusch-Pagan-Godfrey	0.5425	No heteroscedasticity issue
Ramsey RESET Test	0.0630	Model is specified correctly
Jarque-Bera Test	0.2756	Estimated residuals are normal

4.2. ARDL, Short Run and Long Run Simulations

The following pioneering researchers also used the dynamic ARDL (DARDL) simulation model: Jordan and Philips (2018); M. I. Khan, Teng, and Khan (2020); L. Zhang et al. (2021) proposed using the ARDL simulation model to look at the short- and long-term relationships between the research variables. Optimistic and unfavorable disparities in the independent variables are used by the NARDL simulation approach to automatically evaluate, imagine, and predict graphs while maintaining the same levels of other independent components (Jordan & Philips, 2018; Sarkodie & Strezov, 2019). If there is a cointegration association between the variables under study, the DARDL simulation model may be applied. The DARDL simulation model's prerequisites are all met by this study. The dynamic ARDL simulation model runs 5000 simulations for the parameter vector using the multivariate normal distributions (Jordan & Philips, 2018).

Owing to the concern of synchronized effect of entirely independent variables, the dynamic stimulated ARDL model proposed by Jordan and Philips (2018) is extra fit than the conventional one in the situation of the multivariate equation. For bivariate models, the traditional ARDL technique is usually appropriate . This method resolves this conundrum by analyzing and estimating the effect of the regress or on the regress and while maintaining all other independent variables constant.Thease findings are in align with the (Awan, Bibi, Bano, & Shoukat, 2023).

Table 7
Dynamic ARDL, Short Run and Long Run Estimations

Variables	Coefficient	Std. Error	t-Statistic	Prob.
ECT	-0.321277	0.130110	-2.469268	0.0295
EG	-0.117249	0.033006	-3.552352	0.0040
EG_{t-1}	-0.065437	0.026468	-2.472277	0.0294
FD	0.088981	0.036152	2.461273	0.0300
FD_{t-1}	0.082770	0.036709	2.254761	0.0436
NR	0.435637	0.112646	3.867293	0.0022
NR_{t-1}	0.176619	0.088126	2.004172	0.0682
Cons	-0.321277	0.130110	-2.469268	0.0295
R-squared			0.993587	
F (9, 28) 10.48			Prob > F 0.0000	
Simulations			1125	
Time period			33	
Long Run Coefficients				
EG	0.839215	1.176310	0.713431	0.4882
FD	3.130887	0.572267	5.471020	0.0001
NR	2.986543	0.488310	6.116081	0.0000

The ECT, which indicates the rate of rectification in Table 8, is undesirable and substantial as needed. Additionally, FD has a beneficial and considerable influence on ECF in Pakistan over the long and short terms. According to the study's findings, a 1% increase in FD enhances Pakistan's ECO by 0.08277% in the short term and by 0.0889% in the long term. Baloch, Mahmood, et al. (2019); Godil et al. (2020); Mrabet and Alsamara (2017) all validate the findings. According to S. u. Rahman, Chaudhry, Meo, Sheikh, and Idrees (2022); Shahzadi, Sheikh, et al. (2023); Ullah, ur Rahman, and Rehman (2023) , the financial sector may play a crucial role because it offers funding for the use of eco-friendly expertise in novel ventures as well as to established enterprises to replace antiquated equipment (Kanwal, Tayyab, & Idrees, 2023).

The EG statistics for Pakistan show that a 1% rise in EG increases the ECO by 0.06543% in the near run and by 0.11724% in the long run. The ECO is increased by 0.4356% in the long term and by 0.1766% in the short term for every 1% increase in NR., according to the NR statistics for Pakistan. As a result, an increase in NR will degrade nature's gifts by aggravating the negative consequences on the ecosystem Ulucak and Khan (2020) discovered the same result.

Furthermore, N. Younas, Idrees, and Rahman (2021) noted that EG increases the need for NR, which in chance increases ecological destruction, with regard to Pakistan. Ahmed et al. (2020) found that NR improves the ECO in China. The increasing impact of NR on the ECO, according to Ahmed et al. (2020), shows that NR is not mined and used in an acceptable and maintainable custom. Tools from the past that consume needless amounts of NR improve ECO. In long run, the finding exhibited that the natural resources, and financial development have positive connection with ECO, while the economic growth has positive and insignificant association with ECO. These positive relations are aligned with previous studies of (Shafique, Rahman, Khizar, & Zulfiqar, 2021).

5. Conclusion and Policy Implications

The study aims to explore the relationship between ecological footprints and natural resources, financial development, and economic progress. Information is used from 1980 to 2021. Growth in finances, the environment, and natural resources are found to positively and significantly correlate, according to the results of the ARDL cointegration technique Winarsi, Prihatiningtyas, Wahyuni, Fitriana, and Rahman (2023), In contrast, there is a long-term positive correlation between economic expansion and environmental impact (S. Rahman & Idrees, 2019; Usman et al., 2023). The fact that Pakistan's economic growth square is negative indicates that the EKC hypothesis holds true in that nation. The goal of rapid economic expansion by emerging nations is putting them at risk for serious environmental problems such as deterioration, massive amounts of solid and industrial waste, and issues with the water, air, and soil (Ulucak & Khan, 2020). Hence, a paradigm change is already taking place as a result of the global focus on sustainable financial development. The United Nations' (UN) 2030 vision tackles global conservation issues as well as other Goals that are connected to them (such as life on land, climate action, etc.) (S. Rahman & Idrees, 2019). Governmental agencies, the United Nations, scholars, and all other decision-makers have been paying close attention to environmental deterioration. It is believed that politicians should reevaluate green activities in order to reduce environmental harm. In order to determine the causes of the rising environmental degradation, this study used the ARDL method to assess the effects of financial development, the improvement of natural resources, and commercial growth on ECF. It also sought to determine if the EKC hypothesis was present in Pakistan.

Natural resources show a dynamic part in the Pakistan frugality, which is rich in natural resources. Yet, ongoing extraction and use are lowering environmental standards. According to Balsalobre-Lorente, Shahbaz, Roubaud, and Farhani (2018), countries with a wealth of natural resources may be able to slow down environmental deterioration by limiting imports and fossil fuel usage. Similar to this, by the impose of sustainable administrative techniques reduction of natural resource may be slowed down and enhancing source output and consumption, so allowing the resources to replenish and restore themselves (Merino-Saum, Baldi, Gunderson, & Oberle, 2018). Reevaluating the strategies and realigning the does through defensible expansion is therefore advised. Only once the general populace has received educated can sustainable practices be put into place. Hence, authorities have to think about utilizing a variety of media to promote the requirement for supportable performs in the use of natural resources. Also, it is advised to avoid employing antiquated technologies and machinery types in home and commercial settings and to utilize modern technologies, appliances, and equipment that give optimal efficiency. So, sectors that provide financing ought to be further developed (Awan, ul Hasnain, & Arshad, 2023).

A sustainable financial development method must be swapped for the traditional approach. Establishing laws that support green initiatives and enable the purchase of efficient technology with simple financing options will also be a wise move. To achieve sustainable growth, it would be beneficial to capitalize on industries that have environmentally friendly observes and impose duties on those that harm the atmosphere via incompetent and morbid activities. Also, research and development must be supported financially in order to reinvent present management and manufacturing techniques. The public has to be made more aware of the necessity to adopt sustainable behaviors. It is suggested that the general people embrace sustainable behaviors on a daily basis.

Authors' Contribution

Rana Israr Ahmad: Initiated the core idea of performed data analysis and drafting.
Sharafat Ali: Provided guidance for data analysis, reviewed, supervised.
Hafiz M. Rizwan Khan: Reviewed and revised overall quality and writeup of the manuscript.
Sadia Idrees: Provided guidelines for empirical analysis.

Conflict of Interests/Disclosures

The authors declared no potential conflict of interest w.r.t the research, authorship and/or publication of this article.

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