Causality Analysis between Poverty and Environment: A Case Study of Pakistan's Coastal Belt

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Abstract

The current study explores the impact of poverty on environmental degradation and impact of environment on poverty in the Coastal Belt of Pakistan. Poverty is measured by using headcount ratio measure. While environmental proxies used in this study are fossil fuel energy consumption from fossil fuel (FFEC), combustible waste and renewable (CRW), and carbon dioxide emission from the use of liquid fuel (CELF). The study indicates a strong long-run correlation between poverty and environmental degradation. This relationship has been investigated by using Augmented Dicky-Fuller, co-integration as well as Granger causality tests. Pakistan's secondary data from 1971 to 2018 on poverty and environmental variables have been used for analysis purposes. The results of the study indicate that poverty contributes to environmental degradation and results in lowering the pace of economic growth and development. Moreover, environmental degradation also is a cause of poverty and may affect economic development adversely. The present study predicts the evidence of a bi-directional relationship between environmental factors and poverty in Pakistan.

***Keywords*:** *Poverty, Environment, Coastal Belt of Pakistan*

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1. Introduction

The poverty–environment nexus has been widely discussed in the literature. However, insufficient approaches have been used to show the relationship between environmental proxies and poverty. These approaches have failed to differentiate between hypotheses i.e., (1) environmental factors affects poverty; (2) poverty affects environmental factors: (3) both variable have a bi-directional relationship; (4) Both variables are causality independent (but highly correlated). Environmental degradation and poverty are widely discussed areas in academic circles. Research indicated that environmental degradation affects poor and increases their poverty level 1[1]. There are different factors i.e., owing to migration and job scarcity that compel the poor to live with inadequate services. The poor's savings and productivity reduces due to the health hazards that are the result of natural disasters such as

the earthquake, flood, etc. On the other hand, the environment is polluted by poor by illegal removal of wastes and wastewater due to inadequate services[2].

Developmental organizations have also noted that improper use of natural resources results in poverty and poverty causes the environment to degrade. Environmental degradation adversely affects the sources of poor's earnings. The dependency of poor on natural resources is a reason of their vulnerability to environmental degradation[3]. The poor have less alternative resources and are least

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[3] World Bank. World Development Indicators (WDI) 2009 CD-ROM. Washington: The World Bank 2009

capable of handling environmental issues[4]. Nowadays, poverty and environmental conditions are not plausible in Pakistan and both are rising adversely, especially within the coastal regions of Pakistan. In rural areas income of poor mainly depends on agriculture, therefore, in these areas poverty and environmental degradation is high. Out ofthea total population in Pakistan, nearly 37% live in urban area,s and remaining 67% live in rural areas. 31.95% of the rural population are living below the line of poverty[5].

The rural areas, the availability of basic needs, i.e. potable water, education, sanitation, and healthcare is not sufficient. Moreover in Pakistan, the problems of high infant mortality, low life expectancy, and malnutrition are very high[6]. In rural areas, access to land and productive assets is highly skewed and unequal which creates differences in earning opportunities and increased poverty. Moreover, in barani (rain fed) areas, yield potentials, and crop production is very low[7]. Environmental degradation is also increasing due current pattern of water consumption. The agricultural productivity also reduces by losses of earth fertility due to soil erosion, salinity, and inefficiencies in water allocation[8] . Pakistan is bearing heavy losses due to environmental degradation. The above discussion shows that there is a

[4] Yusuf, A.A. Poverty and environmental degradation: searching for theoretical linkages. Working paper in Economics and Development Studies No. 200403. Bandung, Indonesia: Center for Economics and Development Studies, Department of Economics, Padjadjaran University Jalan Cimandiri No. 6. 2004 https://ideas.repec.org/p/unp/wpaper/200403.html

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[8] Ibid.

strong relationship between poverty and environmental proxies such as FFEC, CRW, and CELF.

The rest of the paper is organized as follows; the next section summarizes the review of the literature. The following section consists of the sample and methodology, while the third section discusses the results of the study. The last section concludes the study.

2. Literature Review

Poverty and environment nexus is the most burning issue in current writings on sustainable development. Many research studies have been conducted on how poverty and environment affect each other? Some suggest that vicious circle of poverty affects the environment. The studies which presented the belongings of poverty on environment recommended that poverty influences environment due to the over-population; moreover, poor's have more children than non-poor. The overpopulation results in degradation of environment i.e., land, forest, river, lakes, and fisheries. For achieving this goal, there must be a reallocation of resources toward the poorer sector of society. Political determination can play an important role in achieving the goal of poverty reduction and environmental betterment.

2.1. Poverty and Environmental Degradation

Research shows that poverty is one of the most important causes of environmental pollution, which is affecting environment very badly[9]. In order to understand the complex links between environment and poverty, it is necessary to differentiate between direct and indirect reasons for environmental degradation. The direct causes are easily recognizable in the field, behind them there may be a long sequence of indirect causes. In rural and urban areas, the effects of

[9] Carter, Michael R., and Christopher B. Barrett. "The Economics of Poverty Traps and Persistent Poverty: An Asset-Based Approach." *Journal of Development Studies*, vol. 42, no. 2, Feb. 2006, pp. 178–199, 10.1080/00220380500405261.

environmental degradation on poor are stronger than their well-being from their limited assets and greater dependence on common resources for livelihoods. The stock of wealth including natural, human, physical, and social capital has also been considered by the economist for eradication of poverty[10].

Research also suggests that the industrial sector is more responsible for environmental problems than service sector[11]. Industrial production can be used as an indicator of pollution in developing nations. Moreover, wastewater is thrown into canals and rivers without treatment[12]. Urban population is also another determinant of water pollution. Researchers have also identified that factors responsible for water, noise, and pollution are mostly based in urban areas[13]. Researchers also suggested that the means of vehicle transportation, like buses, motorcycles, cars etc., are in use more intensively in cities as compared to rural areas[14]. Moreover, the transportation of food items from rural areas to urban areas also contributes to air pollution in urban areas. Research pointed that the population growth along with the change in lifestyle and modern

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technologies has also put effects on sewage. Moreover, human activities also affect water quality[15].

2.2. Deforestation, Agricultural Environment and Water availability

The poor people mostly contingent upon natural resources have fewer alternative resources, have a low ability to manage environmental risk, and consequently are more defenseless to environmental degradation[1617]. The classic Malthusian theory introduced the demographic pressure on forest lands. This theory suggests that an increase in population density results in deforestation[18]. Research concluded that there is an association between rural poverty (headcount ratio) and environmental measures i.e., electricity consumption for agriculture and water availability[19]. There is a stable and unidirectional association in the agricultural environment and poverty in the framework of Pakistan. The study also proposes that only a particular equation/conventional view is not enough to measure the strong association. Therefore, simultaneous equations can be formulated for the long-term relationship.

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Many research findings indicated that the issue of deforestation is closely related to poverty due to the habitation of poor people near a forested area. The relationship between poverty and forests was examined by using occasion studies in different countries such as Malawi, Indonesia, Brazil, Vietnam, etc[20]. Similar findings of a strong link between forests and the location of the rural poor have also been identified by researchers in India, Nicaraguaand China[21][22][23]. These studies only provide information regarding where the poor most likely to live, and are unable to explain the reasons of this close association of poor with forests. The reasons of deforestation can be seen from two perspectives i.e., demographic and economic.

Environmental degradation associated with different factors such as industrial pollution, urbanization, sewage pollution, toxic waste disposal problems, forests degradation as well as more alarming political unwillingness in developing countries like Pakistan. Previously, it was assessed the association between environmental degradation and air pollution and used Co_2 emissions as a measure of environmental degradation[24]. Moreover, research estimated the relationship of poverty with environmental degradation in terms of the

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agricultural environment, water availability, and electric consumption for agriculture[25]. The current study, to the best of my knowledge, is the first systematic measurable study about relationships between poverty and environmental degradation in relation to environmental proxies such as fossil fuel energy consumption (% of total energy), Co_2 emission from liquid fuel (% of total), combustible renewable and waste (in terms of oil equivalents).

3. Material and Methods

We are going to find out the bi-directional relationship between poverty and environment. The general function included in this study is;

Environment = f (poverty)

Poverty = f (environment)

In the study, we used secondary time series annual data for the sample period of 1971-2018. For this study, the data were obtained from World Bank. Rural poverty measured by using official poverty line of 2450 calories per adult equivalent per day. The poverty has been measured by headcount ratio (PHCR) and the environmental proxies used in this study were energy consumption from fossil fuel (FFEC), Combustible waste and renewable (CRW), and carbon dioxide emission from the liquid-used fuel (CELF). The following regression equation has been used to measure the relationship between poverty and environment.

$$\text{Log (PHCR)} = a_1 + a_2 \log (\text{FFEC}) + \mu \quad (1)$$

$$\text{Log (FFEC)} = b_1 + b_2 \log (\text{PHCR}) + \mu \quad (2)$$

$$\text{Log (PHCR)} = c_1 + c_2 \log (\text{CRW}) + \mu \quad (3)$$

[25] Zaman, Khalid, et al. "Bivariate Cointegration between Poverty and Environment: A Case Study of Pakistan (1980–2009)." *Journal of Environmental Planning and Management*, vol. 53, no. 8, 12 Oct. 2010, pp. 977–989, 10.1080/09640568.2010.495537. Accessed 5 Apr. 2020.

$$\text{Log (CRW)} = d_1 + d_2 \log (\text{PHCR}) + \mu \quad (4)$$

$$\text{Log (P HCR)} = e_1 + e_2 \log (\text{CELF}) + \mu \quad (5)$$

$$\text{Log (CELF)} = f_1 + f_2 \log (\text{PHCR}) + \mu \quad (6)$$

Where:

FFEC represents fossil fuel energy consumption (% of total)

CRW represents combustible renewable and waste (metric tons of oil equivalents)

CELF represents Co_2 emission from liquid fuel (% of total)

PHCR represents poverty measured by headcount ratio

4. Results and Discussion

4.1. Testing the Stationarity of the Poverty and Environment Time Series

For measuring stationarity of all variables in the study, Augmented Dicky-Fuller test (ADF) was used. The results obtained for poverty (PHCR) and environmental proxies i.e., PHCR, ECELF, ECRW, and EFFEC were shown in the Tables 1.

Table 1. Augmented Dicky-Fuller test on the levels and on the first difference for stationarity of data for PHCR variable (1971-2018)

Variables	Level	First Difference	Critical values			Decision
			1%	5%	10%	
PHCR	-2.591127	-3.890416	-2.650	- 1.953	-1.609	I(1)
ECELF	-1.406660	-3.776113	-2.650	- 1.953	-1.609	I(1)
ECRW	-0.666251	-7.094880	-2.650	- 1.953	-1.609	I(1)
EFFEC	-0.305562	-5.870687	-2.650	- 1.953	-1.609	I(1)

Note: Null hypothesis about the time series data variables was that the series contains unit root, or non-stationary. The MacKinnon critical values have been used to accept or reject null hypothesis. SIC criteria ranging from lag-zero to lag-two have been used for the selection of lag length.

The results indicated that all the variables are non-stationary at levels and stationary at the first difference. Moreover, all variables have order one integration i.e., I (1).

4.2. Testing co-integration between PHCR and CELF

The co-integration test is applied to measure the long-run relationship between poverty and environmental variable Co_2 emission from liquid fuel (CELF). The results will indicate whether there is any existence of a relationship between both variables. The results for regression and ADF test for residual manifested in (Table 2 and Table 3) respectively. The results indicated that residual has order one integration i.e., it is stationary at first difference. This implies the presence of the long-run correlation (co-integration) between these variables.

Table 2. Empirical findings of the model – CELF (1971–2018)

Dependent variable: log [Corbin Dioxide Emission from Liquid Fuel (CELF)]	
Constant	-0.259 (-0.775)*
Log (PHCR)	-1.856 (-2.423)*
AR(1)	0.770 (5.337)*
R-square	0.802
Adjusted R-square	0.781
Durbin-Watson statistics	2.103
F-statistics	45.125
Probability (F-statistics)	0.0000*
Number of observations	48

Note: The values of t-statistics are shown in parentheses. The * sign indicates the 1% level of significance.

Table 3. Augmented Dickey-Fuller (ADF) test for residuals – CELF

Residual Integration	Level	Critical values			Decision	Integration Order
		1%	5%	10%		
Residual	-4.150	-2.650	-1.953	-1.609	Stationary at level	I(1)

ECM is applied to capture the short-run disequilibrium phenomenon and long-term stability between variables. Table 4 indicates that the results of the model are significant at 5% level. The findings revealed long-run convergence of variables because the adjustment parameter (p) has a negative value. It means that 35.4% of the disequilibrium in CELF arises due to PHCR is corrected every year. This indicates a stable and long-term relationship between PHCR and CELF. Granger causality test has used up to four lags to check the causal relationships between PHCR and CELF. The results of the

Table 4. Empirical findings for Error Correction (EC) Model – CELF

Dependent variable: log (CELF)]	
Constant	-0.346 (-1.570)
Log (PHCR)	-1.259 (-1.541)**
p	-0.354 (-2.243)**
R-square	0.740
Adjusted R-square	0.707
Durbin-Watson statistics	1.951
F-statistics	5.657
Probability (F-statistics)	0.042**
Number of observations	48

Note: The values of t-statistics are shown in parentheses. The ** sign indicates the 5% level of significance.

Granger causality test are presented in table 5. The findings indicate that null hypothesis "PHCR does not Granger cause to CELF" has been rejected. Moreover, another null hypothesis of CELF causes PHCR has also been rejected. This finding revealed the presence of a bidirectional relationship between PHCR and CELF. It supports the conventional hypothesis of a bidirectional relationship between poverty and environment.

Table 5. Causality results – CELF

Years (Lagged)	Null hypothesis	Decision
1	log (PHCR) does not granger cause log (CELF)	Rejected
	log (CELF) does not granger cause log (PHCR)	Rejected
2	log (PHCR) does not granger cause log (CELF)	Accepted
	log (CELF) does not granger cause log (PHCR)	Accepted
3	log (PHCR) does not granger cause log (CELF)	Accepted
	log (CELF) does not granger cause log (PHCR)	Accepted
4	log (PHCR) does not granger cause log (CELF)	Accepted
	log (CELF) does not granger cause log (PHCR)	Accepted

4.3. Testing co-integration between PHCR and CRW

The co-integration test is applied to measure the long-run relationship between poverty and environmental variable Co_2 emission from liquid fuel (CELF). The results of the test would indicate whether there is any relationship between these two variables. Table 6 and Table 7) indicated the results for regression and ADF test for residual respectively. The results indicated that residual has order one integration i.e., it is stationary at first difference. This implies the presence of the long-run correlation (co-integration) between these variables.

Table 6. Empirical findings of the model – CRW (1971-2018)

Dependent variable: log [Corbin Dioxide Emission from Liquid Fuel (CRW)]	
Constant	8.259 (0.875)*
Log (PHCR)	15.046 (0.123)*
AR(1)	0.670 (6.437)*
R-square	0.702
Adjusted R-square	0.681
Durbin-Watson statistics	1.903
F-statistics	38.225
Probability (F-statistics)	0.0000*
Number of observations	48

Note: The values of t-statistics are shown in parentheses. The * sign indicates the 1% level of significance

Table 7. Augmented Dickey-Fuller test for the residuals – CRW

Residual Integration	Level	critical values			Decision	Integration Order
		1%	5%	10%		
Residual	-4.550	-2.650	- 1.953	-1.609	Stationary at level	I(1)

ECM is applied to capture the short-run disequilibrium phenomenon and long-term stability between variables. Table 8 indicates that the results of the model are significant at 5% level. The findings reveal a long-run convergence of variables because the adjustment parameter (p) has a negative value. It means that 49.9% of the disequilibrium in CRW arises due to PHCR being corrected every year. This indicates a stable and long-term relationship between PHCR and CRW. Granger causality test has used up to four lags to check the causal relationships between PHCR and CRW. The findings indicate (Table 9) that null hypothesis "PHCR does not granger cause to CRW" has been rejected at lag one. Moreover, another null hypothesis of CRW causes PHCR has also been rejected at lag 3. This finding

reveals the presence of a bidirectional relationship between PHCR and CRW.

Table 8. Empirical findings of Error Correction Model – CRW

Dependent variable: log (CRW)]	
Constant	49.292 (1.047)
Log (PHCR)	77.266 (-1.541)**
p	-0.499 (-3.401)**
R-square	0.440
Adjusted R-square	0.370
Durbin-Watson statistics	2.081
F-statistics	9.657
Probability (F-statistics)	0.000**
Number of observations	48

Note: The values of t-statistics are shown in parentheses. The ** sign indicates the 5% level of significance.

Table 9. Causality results – CRW

Lagged years	Null hypothesis	Decision
1	log (PHCR) does not granger cause log (CRW)	Rejected
	log (CRW) does not granger cause log (PHCR)	Accepted
2	log (PHCR) does not granger cause log (CRW)	Accepted
	log (CRW) does not granger cause log (PHCR)	Accepted
3	log (PHCR) does not granger cause log (CRW)	Accepted
	log (CRW) does not granger cause log (PHCR)	Rejected
4	log (HCR) does not granger cause log (CRW)	Accepted
	log (CRW) does not granger cause log (PHCR)	Accepted

4.4. Testing co-integration between PHCR and FFEC

The co-integration test is applied to measure the long-run relationship between poverty and environmental variable Co_2 emission from liquid fuel (CELF). The results of the test would indicate whether there is any relationship between these two variables. Table 10 and Table 11 indicated the results for regression and ADF test for residual respectively. The results indicated that residual has order one

integration i.e., it is stationary at first difference. This implies the presence of the long run correlation (co-integration) between these variables.

Table 10. Empirical findings of the model – FFEC (1971–2018)

Dependent variable: log [Corbin Dioxide Emission from Liquid Fuel (FFEC)]	
Constant	0.671(4.443)*
Log (PHCR)	0.151(2.343)*
AR(1)	0.692(3.435)*
R-square	0.672
Adjusted R-square	0.621
Durbin-Watson statistics	2.182
F-statistics	40.335
Probability (F-statistics)	0.0000*
Number of observations	48

Note: The values of t-statistics are shown in parentheses. The * sign indicates the 1% level of significance.

Table 11. Augmented Dickey-Fuller test for the residuals – FFEC

Residual Integration	Level	critical values			Decision	Integration Order
		1%	5%	10%		
Residual	-4.081	-2.650	- 1.953	-1.609	Stationary at level	I(1)

ECM is applied to capture the short-run disequilibrium phenomenon and long-term stability between variables. Table 12 indicates that the results of the model are significant at 5% level. The findings reveal long-run convergence of variables because the adjustment parameter (p) has a negative value. It means that 30.5% of the disequilibrium in FFEC arises due to PHCR is corrected every year. This indicates a stable and long-term relationship between PHCR and FFEC. Granger causality test has used up to four lags to check the causal relationships between PHCR and FFEC. The results of the

granger causality test indicated that null hypothesis "PHCR does not granger cause to FFEC" has been rejected at lag 2 (Table 13). Moreover, another null hypothesis of FFEC causes PHCR has also been rejected at lag 2. This finding reveals the presence of a bidirectional relationship between PHCR and FFEC.

Table 12. Empirical findings of Error Correction Model – FFEC

Dependent variable: log (FFEC)]	
Constant	0.696 (-1.220)
Log (PHCR)	1.116 (0.331)**
p	-0.305 (-0.199)**
R-square	0.560
Adjusted R-square	0.527
Durbin-Watson statistics	1.991
F-statistics	7.552
Probability (F-statistics)	0.042**
Number of observations	48

Note: The values of t-statistics are shown in parentheses. The ** sign indicates the 5% level of significance.

Table 13. Causality results – CELF

Lagged years	Null hypothesis	Decision
1	log (PHCR) does not granger cause log (FFEC)	Accepted
	log (FFEC) does not granger cause log (PHCR)	Accepted
2	log (PHCR) does not granger cause log (FFEC)	Rejected
	log (FFEC) does not granger cause log (PHCR)	Rejected
3	log (PHCR) does not granger cause log (FFEC)	Accepted
	log (FFEC) does not granger cause log (PHCR)	Accepted
4	log (PHCR) does not granger cause log (FFEC)	Accepted
	log (FFEC) does not granger cause log (PHCR)	Accepted

5. Conclusions

The present study investigates the long-run correlation between environmental degradation and poverty in the coastal regions of Pakistan. The environmental degradation was measured by energy consumption from fossil fuel, Co_2 emissions from liquid fuel, combustible renewable, and wastes while the poverty level was estimated by headcount ratio. The study revealed a bidirectional relationship between environmental degradation and poverty in Pakistan. It means that the causal relationship between environmental degradation and poverty works in both directions. That is, natural environmental degradation leads to increased poverty and a rise in poverty level may affect the environment negatively.

There is a bidirectional relationship between Co_2 emission from liquid fuel and poverty in Pakistan. Poverty is the main cause of high population growth in Pakistan. With the increase in population, the need for the liquid fuel has also increased. The poverty is the cause of higher consumption of liquid fuel and the use of liquid fuel generates Co_2 in the air that is the main cause of air pollution. The higher rate of use of liquid fuel has also increased the emission of Co_2 in the air, resulting extreme air pollution. The emission of Co_2 in the air is damaging the ozone layer and increasing the heat in the weather whereas, the rise in the heat level is creating global warming. The global warming is affecting the production of agricultural products adversely and creates uncertainty in the weather. The recent floods in Pakistan are a result global change in weather conditions. The floods affected the poor very much and created different types of problems for them. The poor people affected by floods have lost their scarce resources. Moreover, they faced health hazards and their earning ability and living standards have affected.

The energy produced in Pakistan is mostly from fossil fuel such as oil, gas and coal. This increasing use of energy producing

resources also creates environmental problems such as air pollution. Because the increasing use of fossil fuel also increased the emission of greenhouse gases in the air; causing damaging of the ozone layer and generating global warming. Moreover, the greenhouse gases are also creating health problems for poor people in Pakistan. This health damage and global warming have increased the severity of poverty level. On the other hand, the economic growth has inequality in Pakistan. Because the rich people have got more benefits of economic growth than poor people and it has widened the gap between poor and rich. This unequal distribution of wealth has also increased the use of energy resources. Because rich people have more income from economic growth, therefore, they mostly use energy to provide sources for their luxurious lifestyle.

6. Policy Proposals

1. There is a need to reduce poverty and environmental improvement by policymakers in Pakistan. Because the policies are only made for environmental conservation. The policies for poverty alleviation might also be not fruitful for poverty reduction in Pakistan.

2. The government of Pakistan should also devise policies for the proper dumping of industrial and municipal wastes because unsafe dumping is creating health problems in the country. Moreover, the regulations and procedures for the use of these wastes for the purpose of energy production must also be formulated to minimize the chances of environmental degradation.

3. Industrial units must be established in unpopulated areas to minimize the effects of industrial waste. The people could also be safe from health hazards generated due to the unsafe dumping of industrial wastes.

4. Environmental conservation policies must be developed and implemented by policymakers without political influence for the improvement of the environment in the country. This will reduce health problems for people in Pakistan.

5. There must be policies for reducing the emissions of greenhouse gases in the air. For this purpose, policymakers must encourage the use of energy resources that produces less air pollution. It means environment-friendly energy resources must be used.

6. The policies must be devised for equal distribution of benefits of economic growth among the poor and rich. This will be helpful for reducing poverty and also be helpful in reducing fossil fuel consumption by rich people for their luxurious lifestyles.

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