Bulletin of Business and Economics, 13(3), 703-718
https://bbejournal.com
https://doi.org/10.61506/01.00569

Natural Disasters, Foreign Development Assistance and Economic Growth in South Asian Countries

Muhammad Ramzan Sheikh[1], Mahnoor Sayal[2], Sabira Dilawar[3], Sidra Ilyas[4], Asad Abbas[5]

Abstract

Disasters caused by nature are natural occurrences. Due to global climate change, natural disasters become more frequent and destructive. Natural disasters disproportionately impact developing countries, resulting in significant economic and human casualties. We have utilized panel data from five selected South Asian nations (Pakistan, India, Nepal, Bangladesh, and Sri Lanka) spanning from 1971 to 2020 and applied the Panel ARDL and Causality test. This study examines whether foreign development assistance has a positive and statistically significant effect on economic growth. Natural disasters have a statistically significant and negative effect on economic growth. The results of the causality test indicate that each variable influences the others. Natural disasters have a detrimental effect on economic growth, which is mitigated by foreign development assistance. Government officials and planners may find some policy implications in this study.

Keywords: Net official development assistance, Natural disasters, Gross Domestic Product Growth, Trade, Broad money, government final consumption expenditure

1. Introduction

Catastrophic natural occurrences are not new. Ten years ago, natural disasters impacted an estimated two hundred and fifty million individuals (Benali and Feki, 2020). Tsunamis, volcanic eruptions, floods, hurricanes, droughts, and earthquakes are examples of natural calamities that induce economic disruptions. According to the Malaysian National Security Council, natural disasters are "unexpected incidents that are complex in nature and result in loss of lives and property" (Shaari et al, 2016). Economic losses caused by natural disasters are proportional to the frequency, duration, and intensity of the disasters, which have significant social and economic implications. (1921, Cavallo). In general, economic operations are severely impacted by natural disasters; fatalities and human and material losses result from such catastrophes (Faiben et al, 2019; Iqbal & Shahzad, 2020; Senturk & Ali, 2021). Variables such as economic structure, per capita income, population density, and level of development influence the destruction and damage caused by natural disasters (Benali and Feki, 2020; Machove, 2022). However, numerous studies have found that trade openness, effectiveness of institutions, and qualifications can mitigate the economic impact of natural disasters (Noy, 2009; Nwezeaku, 2018; Olay, 2021). Natural disasters thus impede the convergence of nations towards a condition of consistent progress by causing losses in both human lives and money. CRED (2010) estimates that during the 1970s, over seven million disasters were documented, resulting in damages of nearly two trillion dollars and the loss of life involving approximately two and a half million individuals (Shabanam,2014). Various studies have demonstrated that natural catastrophes can have a beneficial or negative effect on economic growth (Cunado and Ferreia, 2014; Rasmussen, 2004; Strobl, 2010, 2012; Audi et al., 2023). However, in the near term, natural disasters have been found to hinder economic growth (Oliveira,2017). Tragically, natural catastrophes mostly impact the economies and health systems of emerging and low-income nations, where they inflict damage upon costly infrastructure (Udwig et al, 2007). Foreign development assistance contributions are reduced as a result of natural disasters, according to a number of studies (Ahmad, 2018; Chen and Singh, 2020; Audi et al., 2023).

Foreign aid and development assistance are significant contributors to the economic expansion of underdeveloped nations. Economic help that is offered by one country to another country is either in the form of humanitarian aid or paying the military spending is called foreign aid (Hossain, 2014; Hossain, 2014; Iqbal & Raza, 2018; Ashiq & Akhlaque, 2019). Technical assistance, products, services, or food may all constitute forms of support. Interest-bearing loans and grants are the two categories of assistance. There are two overarching classifications of aid: multilateral aid and bilateral aid. Bilateral aid consists of assistance that is delivered directly to recipient nations. Multilateral assistance is not delivered directly but rather via international organizations (Hossain, 2014). Thus, the conclusions of previous studies examining the impact of foreign development assistance on growth are contentious. The growth-promoting effects of foreign development assistance are supported by an abundance of studies. Livery and McGill (2003). By bolstering savings, investment, and capital stock, foreign development assistance significantly influences economic expansion (Hjertholm et al., 1998; Mahmood & Aslam, 2018). (Blankson, 2015). Numerous studies have produced contradictory findings; for example, Murphy (2006) and Duc (2006), among others, have documented the adverse effects of foreign aid on economic growth. Knock (2000) and Braulgam and Knack include them (2004). Foreign development assistance has been found to have a positive impact on economic growth, according to additional research (Trap, 2000; Papanek (1972). Foreign development assistance contributes to the enhancement of domestic savings, the reduction of the foreign exchange deficit, and the provision of access to cutting-edge technologies (Hatemi and Jrandoust, 2005; Shahzadi & Ahmad, 2018). Therefore, since research on the relationship between foreign aid and growth is inconclusive, no conclusion can be derived from prior studies (Fasanya and Onakoya, 2012; Khan & Ahmad, 2018; Raiz & Zulfaqir, 2019; Audi et al., 2022).

2. Literature Review

The summary of the studies pertaining to economic growth, government development assistance, and natural disasters is provided in Table 1.

[1] Professor of Economics, School of Economics, Bahauddin Zakariya University Multan, Pakistan, ramzansheikh@bzu.edu.pk
[2] MPhil Student, School of Economics, Bahuddin Zakariya University, Multan, Pakistan, mahnoorsayal414@gmail.com
[3] Lecturer in Economics, Department of Economics, The Women University Multan, Pakistan, sabira.6113@wum.edu.pk
[4] Assistant Professor, School of Economics, Bahauddin Zakariya University Multan, Pakistan, sidrailyas@bzu.edu.pk
[5] Lecturer in Economics, Department of Economics, COMSATS University Islamabad Vehari Campus, Pakistan, asad@cuivehari.edu.pk

Table 1: Summary of the Studies

Reference(s)	Period	Country	Methodology	Main Results
		Studies on Natural Disasters and Economic Growth		
Guo et al (2015)	1985-2011	China	GLS (Generalized Least Square), robust standard error, Akaike Info Criterion (AIC), and autocorrelation.	Metrological disasters (+) Geological disasters (no impact) Investment (+) Education (+) State-owned business (-)
M shaari et al (2016)	1960-2013	Malaysia	ARDL (Autoregressive Distributive Lag), Error correction model (ECM), Phillips Perron (PP) test, Kwiatkowski-Phillips-Schmidt-Shin test (KPSS)	Effected area (+) Frequency of flood (+) The magnitude of the affected area had more impact on growth There is a relationship between growth and flood
E. Mu and Chen (2016)	1990-2012	US	Difference-in-difference model	Natural disasters had a long-term negative effect on income.
Yeiw et al (2018)	1960-2014	Bangladesh	Autoregressive Distributive Lags model (ARDL)	Population (+) Capital stocks (+) Trade (+) Natural disasters (-) in the long run
Nida et al (2018)	1977-2015	Pakistan	ARDL, and Granger causality test	Natural disasters distorted economic growth.
Lima and Barbosa (2018)	2005-1010	Brazil	Difference-in-difference model	The author found that the direct effect of flood recovered after two years but an indirect effect existed.
S. Mohan et al (2018)	1970-2011	21 Caribbean Countries	Vector autoregressive model	Investment (+) Exports (-) Imports (+) Private consumption (-) Govt consumption (+) The overall impact was ambiguous, not a conclusion.
Fabian et al (2019)	1992-2013	All over the world	Growth model, Robustness regressed level equations	Earthquake energy had a negative impact on light growth.
De Oliveira (2019)	2002-2011	Brazil	Generalized Method of moments (GMM)	Flood and droughts had a negative effect on agriculture growth, only floods had a negative effect on service growth, and the industrial sector was not affected
Zhang and managi (2020)	1960-2014	Pacific small island states	Vector Autoregressive model and Bivariate autoregressive model	Natural disasters put a negative impact on the economic development of pacific small island states and this effect is reduced by financial development
Fatouros and sun (2020)	1990-2017	110 countries	Pure nonparametric regression analysis	Growth was not affected by earth-quack, growth was affected by the combination of natural disasters.
Benali and Feki (2020)	1990-2017	20	ARDL bond testing approach	Developing countries had more suffered from natural disasters.
Sseruyange and Klomp (2021)	1995-2010	80 developing countries	applied OLS-FE model and Hausman test.	Natural disasters had negative effects on the growth rate and this effect was reduced by microfinance institutions.
Cavallo et al (2021)	1970-2019	All countries	Event study methodology	Natural disasters had a negative impact on the economic growth of poor countries.
Diaz and Larroulet (2021)	1970-2010	90 counties	Standard growth regression	Natural disasters had a negative impact on growth but institutional factors decreased the negative impact of disasters
		Studies on Economic Growth and Natural Disasters		
Toya and Skidmore (2006)	1960-2003	151 countries	Ordinary Least Square (OLS) and heteroskedasticity consistent error test.	Per capita income (-) Educational attainment (-) trade openness (-)

				The financial sector (-) With natural disaster impact
Jharudin et al. (2009)	1985, 1995, 2005	73 countries	Heteroskedasticity constant standard error test	Income was negatively related to the impact of natural disasters; Wealthier nation minimizes disaster risk.
Schumacher and strobl (2011)	1980-2004	181	Tobit estimation, heteroscedasticity, correlation test, and robustness test	Population density (+) Geographical size (+ Inverted U shapes the association between economic loss and economic development(wealth)
Songwathanaa (2017)	1990-2017	Across the country (168) countries.	Pooled OLS	The finding of this study was a negative relationship between natural disaster loss and education level, and a positive relationship between the number of urban population and disaster loss.
George et al. (2021)	1960-2018	SAARC countries	Panel regression, housman test, Breusch-Pagon larange multiplier test	A positive relationship between urban population, population density, and natural disasters and a negative relationship between GDP and natural disasters.
Studies on Foreign Development Assistance or ODA and Economic Growth				
Hatemi-J and Ikandoust (2005)	1974-1996	Developing countries Botswana, Ethiopia, India, Kenya, Sri Lanka, and Tanzania oping countries were	panel co-integration test, Dickey-Fuller test, and panel root test	Foreign aid (+)
Feeny (2005)	1965-1999	Papua New Guinea	Autoregressive Distributive Lags (ARDL) approach	Investment had no impact Trade (+) Labor force (-) Govt index (-) Aid (+) only when the country is under the SAP program
Upadhyaya et al (2007)	1993-2002	Czech Republic, Estonia, Hungary, Latvia, Poland, and Lithuania	Error Correction Method (ECM)	Labor (-) Capital (+) Foreign direct investment (+) Foreign aid (-) Lagged value (+)
Tadesse (2011)	1970-2019	Ethiopia	multivariate co-integration technique	Foreign aid (+) in the long run Rainfall (-) Aid squared (+)
Javid and Qayyum (2011)	1960-2008	Pakistan	Autoregressive Distributive Lags (ARDL) cointegration test	Trade (+) Inflation (-) budget deficit (-) Foreign aid (-) Aid policies (+)
Fason and Onakoya (2012)	1970-2010	Nigeria	unit root test, Augmented Dickey-Fuller test, and Johansen co-integration test	Foreign aid (+) Inflation rate (-) Population growth (-)
Kolawole (2013)	1980-2011	Nigeria	Augmented Fuller Test, Granger Causality test, and Error Correction Method	Exports (+) Imports (-) Foreign direct investment (-) Official development assistance (no impact)
Hossain (2014)	1980-2012	Bangladesh	Poled least square estimation	Labor force (+) Capital stock (+) Inflation rate (-)

				Foreign aid (+)
Mbah and Amassoma (2014)	1981-2012	Nigeria	Augmented Dickey-Fuller (ADF) test, Philips-perron test (PP), Ordinary Least Square (OLS), and Johanson cointegration test	Investment (+) Exports (+) Imports (-) Aid (-)
Alemu and Lee (2015)	1995-2010	Africa	Dynamic Generalized Methods of Moments (GMM)	Foreign aid (+) in case of low-income countries, foreign aid (-) in case of middle-income countries, FDI (+) in the middle-income of African countries, FDI (-) in low-income countries of Africa
Mohapatra et al (2016)	1970-2014	India	Autoregressive Distributive Lags bond test approach (ARDL)	Trade openness (+) Investment (+) Official development assistance (+) Govt expenditure (+) Inflation rate (-)
Ramadhan et al (2016)	1992-2014	Tanzania	Error Correction Model (ECM) Augmented Dickey-Fuller test and Phillips Perron Ordinary Least Square test	Foreign investment (+) ODA (-) Exports (-) External debt (-)
Aghoutane and Karim (2017)	1981-2014	Morocco	Vector Error Correction Model (VECM)	Exports (+) Investment (+) ODA (+) in the short run. ODA (-) in the long run
Khan and Ahmed (2017)	1972-2006	Pakistan	Autoregressive Distributive Lags Model (ARDL)	Domestic investment (+) Exports (+) Imports (-) Foreign direct investment (+) Foreign aid (-) Project aid (+) Non-project aid (-) Foreign aid was a curse in Pakistan.
Hussain et al (2018)	1991-2014	SAARC COUNTRIES (India, Pakistan, Bangladesh, Sri Lanka)	Pooled OLS and fixed effect or random effect model	Initial GDP (-) Aid (-) Population growth rate (+) Inflation rate (-) Education (+) Gross capital formation (+)
Sothan (2018)	1980-2014	Cambodia	Autoregressive Distributive Lags Model (ARDL) bond	Investment (+) in the long run Trade openness (+) in the short and long run Foreign aid (+) in the short-run Foreign aid (-) in the long run
Mustafa et al (2019)	1980-2015	Sudan	Autoregressive Distributive Lags (ARDL) bond	ODA (+) Exports (+) Privatization (+) Human capital (+) Financial credit (+)
Azam and Feng (2021)	1985-2018	37 developing countries	fixed effect and robust least-squares estimations	Foreign aid had a positive effect on the lower middle-income countries, and a negative effect on low-income and upper-middle-income countries.
Golder et al (2021)	1989-2018	Bangladesh	Autoregressive Distributive Lags (ARDL) technique	Domestic investment (+) Trade openness (+) Foreign aid (+)

3. Model Specification

Functional and econometric forms of the models are described in this section. The models are outlined as follows:
Model 1: Impact of natural disasters, foreign development assistance, and growth (without interaction terms)
The growth model is represented by its functional form.

$$GDPG = f(LFPR, GFCF, SSE, NDI, ND2, NODA, GFCE, M2, TRADE) \quad (1)$$

The growth model is represented in econometric form as:

$$GDPG_{it} = \varphi_0 + \varphi_1 LFPR_{it} + \varphi_2 GFCF_{it} + \varphi_3 SSE_{it} + \varphi_4 ND1_{it} + \varphi_5 ND2_{it} + \varphi_6 NODA_{it} + \varphi_7 GFCE_{it} + \varphi_8 M2_{it} + \varphi_9 TRADE_{it} + \varepsilon_{it} \quad (2)$$

Model 2: Effects of Natural Disasters, Foreign Development Assistance, and Growth with Interaction Terms
The growth model is represented by its functional form.

$$GDPG = f(LFPR, GFCF, SSE, NDI, ND2, NODA, GFCE, M2, TRADE, ND1*NODA, ND2*NODA) \quad (3)$$

The growth model is represented in econometric form as:

$$GDPG_{it} = \varphi_0 + \varphi_1 LFPR_{it} + \varphi_2 GFCF_{it} + \varphi_3 SSE_{it} + \varphi_4 ND1_{it} + \varphi_5 ND2_{it} + \varphi_6 NODA_{it} + \varphi_7 GFCE_{it} + \varphi_8 M2_{it} + \varphi_9 TRADE_{it} + \varphi_{10} ND1_{it} * NODA_{it} + \varphi_{11} ND2_{it} * NODA_{it} + \varepsilon_{it} \quad (4)$$

Where:
GDP= GDP growth (annual %)
LFPR= Labor force participation rate, total (% of total population ages 15+)
GFCE= Gross fixed capital formation (% of GDP)
SSE= School enrollment, secondary (% gross)
ND1=Natural Disaster Dummy 1 IF(AND(ND>=0.1, ND<=0.2),1,0)
ND2= Natural Disaster Dummy 2 IF((ND>0.2),1,0)
NODA= Net official development assistance and official aid received (% of GDP)
GFCE= General government final consumption expenditure (% of GDP)
M2= Broad money (% of GDP)
TRADE= Trade (% of GDP)
ND1*NODA= Natural Disasters Dummy 1*Net Official Development Assistance
ND2*NODA= Natural Disasters Dummy 2*Net Official Development Assistance
Natural Disaster Dummy 1
Natural catastrophes dummy 1 is calculated by dividing the total number of impacted individuals by the population. The conditions for generating the dummy of natural catastrophes are as follows: if the value of the total affected person per capita is larger than 0.1 or less than 0.2, assign 1; otherwise, it is regarded as zero. Depict natural calamities with a modest intensity in dummy 1.

$$Natural\ Disasters\ Dummy1 = \frac{Total\ Affected\ Persons}{Population} \quad (5)$$

Condition is if (0.1 ≤ND1≤O.2) = 1 otherwise 0
Natural Disaster Dummy 2

Table 2: Variables: Description and Sources

Variable	Description	Source
	Dependent Variable	
GDPG	GDP growth (annual %)	WDI
	Explanatory Variables	
LFPR	Total labour force participation rate as a percentage of the total population aged 15 and above ILO estimate based on a model	
GFCF	Investment in fixed assets as a percentage of Gross Domestic Product (GDP)	WDI
SSE	Gross secondary school enrolment rate	
ND1	Natural Disaster Dummy 1	
ND2	Natural Disaster Dummy 2	
NODA	Net official development assistance and official aid received as a percentage of GDP	
GFCE	Government final consumption expenditure as a percentage of Gross Domestic Product (GDP)	WDI
M2	Percentage of broad money in relation to GDP	
TRADE	Trade as a percentage of Gross Domestic Product (GDP)	

To generate natural disaster, dummy 2, divide the total number of impacted individuals by the population. In order to produce a dummy set representing natural disasters, the following conditions are applied to the data: assign 1 if the total number of impacted individuals per capita exceeds 0.2; otherwise, the set is regarded as zero. Natural catastrophes dummy 2 illustrates the severity of natural disasters.

$$Natural\ Disasters\ Dummy\ 2 = \frac{Total\ Affected\ Persons}{Population} \quad (6)$$

Condition is if (ND2 ≥ 0.2) =1 otherwise 0

The following countries are included in our analysis:

1. Pakistan
2. India
3. Nepal
4. Bangladesh
5. Sri Lanka

The information pertaining to each country's variables was obtained from WDI. Table 2 provides a summary of the variable names and descriptions, as well as the sources from which the data were obtained.

4. Methodology: Panel ARDL

Below are the Unrestricted Error Correction models (UECMS) used to analyze the effects of natural catastrophes and Official Development Assistance (ODA) on GDP growth.

$$\begin{aligned}\Delta(GDPG)_{it} &= \lambda + \kappa_1 (GDPG)_{it-1} + \kappa_2 (LFPR)_{it-1} + \kappa_3 (GFCF)_{it-1} + \kappa_4 (SSE)_{it-1} \\ &+ \kappa_5 (NODA)_{it-1} + \kappa_6 (GFCE)_{it-1} + \kappa_7 (M2)_{it-1} + \kappa_8 (TRADE)_{it-1} \\ &+ \kappa_9 (ND1) + \kappa_{10} (ND2) + \kappa_{11} (ND1 * NODA) + \kappa_{12} (ND2 * NODA) \\ &+ \sum_{i=1}^{k_1} \delta_{1i} \Delta(GDPG)_{it-i} + \sum_{i=0}^{k_2} \sigma_{2i} \Delta(LFPR)_{it-i} + \sum_{i=0}^{k_3} \sigma_{3i} \Delta(GFCF)_{it-i} \\ &+ \sum_{i=0}^{k_4} \sigma_{4i} \Delta(SSE)_{it-i} + \sum_{i=0}^{k_5} \sigma_{5i} \Delta(NODA)_{it-i} + \sum_{i=0}^{k_6} \sigma_{4i} \Delta(GFCE)_{it-i} \\ & \sum_{i=0}^{k_7} \sigma_{4i} \Delta(M2)_{it-i} + \sum_{i=0}^{\kappa_8} \sigma_{4i} \Delta(TRADE)_{it-i} + \sum_{i=0}^{k_9} \sigma_{5i} \Delta(ND1 * NODA)_{it-i} \\ & \sum_{i=0}^{\kappa_{10}} \sigma_{10i} \Delta(ND1 * NODA)_{it-i} + \varepsilon_{it} \quad (7)\end{aligned}$$

The parameters associated with long-term multipliers, (for i= 1,2, 3…...p1, p2, p3……) are VAR coefficients of the ARDL models. is the white noise error and is the first difference operator. If the long-run relationship exists then the long-run parameters can be defined or estimated as the following equation for South Asian countries.

Equation (8) parameters linked to the summing sign indicate the long-term relationship of parameters.

$$\begin{aligned}GDPG_{it} &= \lambda + \sum_{i=1}^{k_1} \delta_{1i} (GDPG)_{it-i} + \sum_{i=0}^{k_2} \delta_{2i} (LFPR)_{it-i} + \sum_{i=0}^{k_3} \delta_{3i} (GFCF)_{it-i} + \sum_{i=0}^{k_4} \delta_{4i} (SSE)_{it-i} \\ & \sum_{i=0}^{k_6} \delta_{6i} (NODA)_{it-i} + \sum_{i=0}^{k_7} \delta_{7i} (GFCE)_{it-i} + \sum_{i=0}^{k_8} \delta_{8i} (M2)_{it-i} \\ &+ \sum_{i=0}^{k_9} \delta_{9i} (TRADE)_{it-i} + \sum_{i=0}^{k_9} \delta_{9i} (ND1 * NODA)_{it-i} + \sum_{i=0}^{k_{10}} \delta_{10i} (ND1 * NODA)_{it-i} + \varepsilon_{it} \quad (8)\end{aligned}$$

Short-term outcomes can be determined by calculating equation (9)

$$\begin{aligned}\Delta GDPG_{it} &= \rho + \sum_{i=1}^{k_1} \chi_{1i} \Delta(LFPR)_{it-i} + \sum_{i=0}^{k_2} \chi_{2i} \Delta(GFCF)_{it-i} + \sum_{i=0}^{k_3} \chi_{3i} \Delta(SSE)_{it-i} \\ &+ \sum_{i=0}^{k_4} \chi_{4i} \Delta(NODA)_{it-i} + \sum_{i=0}^{k_5} \chi_{5i} \Delta(GFCE)_{it-i} + \sum_{i=0}^{k_6} \chi_{6i} \Delta(M2)_{it-i} + \\ &+ \sum_{i=0}^{K_7} \chi_{7i} \Delta(TRADE)_{it-i} + \sum_{i=0}^{k_8} \chi_{8i} \Delta(ND1 * NODA)_{it-i} + \sum_{i=0}^{k_9} \chi_{9i} \Delta(ND2 * NODA)_{it-i} \\ &+ \omega ECM_{it-1} + \varepsilon_{it} \quad (9)\end{aligned}$$

In the Error Correction Model (ECM), the parameters associated with the summation sign represent the short-run coefficient and parameters that indicate the rate of adaptations required to reach long-run equilibrium in both equations. In order to attain long-run equilibrium, the coefficient of adjustment must be either negative or economically significant.

Direction of causation between variables is specified by causality. The Granger causality test establishes many outcomes, including null effects, bivariate effects, and univariate effects. Listed below are the corresponding econometric formulations of Granger causality.

$$GDPG_t = \sum_{i=1}^{n} \alpha_i ND1_{t-i} + \sum_{j=1}^{n} \beta_j GDPG_{t-j} + \mu_{1t}$$

$$ND1_t = \sum_{i=1}^{n} \lambda_i ND1_{t-1} + \sum_{j=1}^{n} \delta_j GDPG_{t-j} + \mu_{2t} \quad (10)$$

Equation (10) shows that GDPG causes ND1, and the second equation represents that ND1 causes GDPG.

$$GDPG_t = \sum_{i=1}^{n} \alpha_i ND2_{t-i} + \sum_{j=1}^{n} \beta_j GDPG_{t-j} + \mu_{1t}$$

$$ND2_t = \sum_{i=1}^{n} \lambda_i ND2_{t-1} + \sum_{j=1}^{n} \delta_j GDPG_{t-j} + \mu_{2t} \quad (11)$$

Equation (11) represents that GDPG causes ND2, and the second equation shows that ND2 causes GDPG.

$$GDPG_t = \sum_{i=1}^{n} \alpha_i NODA_{t-i} + \sum_{j=1}^{n} \beta_j GDPG_{t-j} + \mu_{1t}$$

$$NODA_t = \sum_{i=1}^{n} \lambda_i NODA_{t-1} + \sum_{j=1}^{n} \delta_j GDPG_{t-j} + \mu_{2t} \quad (12)$$

Equation (12) shows that GDPG causes NODA, in the second equation represents that NODA causes GDPG.

5. Results and Discussion

In this section, we will explain the results.

5.1. Unit Root Analysis

The outcomes of the unit root test, which utilized the LLC, IPS, ADF Fisher, and PP Fisher methods, are presented in Table 3. The outcomes of variables are evaluated subsequent to modifying the equation's parameters. One equation includes an intercept but no trend, another equation includes both an intercept and a trend, and the third equation includes neither an intercept nor a trend. The variable GDPG was analyzed initially, and all tests produced statistically significant results, including tests with an intercept and no trend, an intercept and trend, and no intercept. Stationarity is present at integration order I (1). The LFPR exhibits non-stationarity at the order of integration zero, with only two significant findings (intercept and no trend term) observed among the majority of results. GFCF is non-stationary at the order of integration zero, as all test results, save for one from the test of the equation with intercept and trend, indicate that the variable is non-stationary and unimportant. The NODA is a stationarity order of integration one. Most findings show statistical significance and stationarity, except for two tests on the equation with an intercept and no trend, which show insignificance. GFCE has a non-stationary order of integration of 1. Most findings show insignificance and non-stationarity, except for three cases with no trend and one case with a trend but insignificance or stationarity in the equation. M2 shows the level of integration with non-stationarity, as all test results show insignificance and non-stationarity. SSE represents a first-order non-stationary integration, as shown by all results pointing to non-stationarity and insignificance. Trade is characterized by non-stationarity with an order of integration of one. Most results show non-stationarity and insignificance, except for three results showing an intercept and no trend, and one result showing stationarity and significance with intercept and trend terms.

5.2. Long Run Analysis

Subsequently, the long-run coefficients of the ARDL model for the nations comprising South Asia—India, Pakistan, Sri Lanka, Bangladesh, and Nepal—must be determined. Table 4 displays the outcomes of the long-run coefficient estimation. Two models are regressed; the outcomes of one model's regression without the interaction term are described in Table 4, while the results of the second model's regression with the interaction term are shown in Table 5.

5.2.1. Long-term Analysis of Natural Disasters, Foreign Development Assistance and Growth (Without Considering Interaction Terms)

Table 4 summarizes the results of estimating the long-run coefficient without interaction terms. The model's Gross Domestic Product growth rate (GDPRG) is determined by nine independent variables: Labour force participation rate (LFPR), Gross fixed capital formation (GFCF), secondary school enrolment (SSE), Natural Disasters Dummy variable 1 (ND1), Natural Disasters Dummy variable 2 (ND2), Nett Official Development Assistance (NODA), General Government Final Consumption Expenditure (GFCE), broad money (M2), and trade.

The labour force participation rate serves as the initial explanatory variable (LFPR). The contribution of labour to manufacturing is critical. A statistically substantial positive correlation exists between labour force participation and GDP growth, as seen by the positive sign of the coefficient of labour force participation rate. Hence, the labour force exerts a favorable influence on the rate of growth of the gross domestic product. The production function's determining factor is the labour force. One plausible explanation for this phenomenon is that an increase in labour force participation results in a corresponding rise in labour productivity, which promotes economic expansion. As labour force participation rises, there is a concomitant increase in employed individuals and productivity. This productivity surge subsequently exerts a beneficial influence on economic growth. Increasing the number of qualified and professional workers also contributes to economic expansion by fostering more effective technological application. Our findings are consistent with neoclassical theories of economic growth, which emphasize the contribution of labour and capital productivity to economic expansion. Our results correspond to the (Hossain, 2014; Shaari et al, 2016; Nasir, 2019; Solow, 1995). Additionally, this research demonstrates the favorable correlation between the labour force participation rate and GDP growth.

Table 3: Results of Panel Unit Root Tests

Variable	Intercept				Intercept and Trend				None			
	LLC Test	IPS Test	ADF-Fisher Chi-Square	PP-Fisher Chi-Square	LLC Test	IPS Test	ADF-Fisher Chi-Square	PP-Fisher Chi-Square	LLC Test	ADF-Fisher Chi-Square	PP-Fisher Chi-Square	Result
GDPG	-6.0267	-9.1612	94.0098	105.803	-7.0673	-9.9218	113.354	102.834	-3.1909	22.3522	36.1247	I(1)
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0007)	(0.0134)	(0.0001)	
LFPR	-0.4371	-0.8860	18.1636	22.3309	-0.3805	0.13677	11.1405	17.6319	-0.2104	4.87568	4.68603	I(0)
	(0.3310)	(0.1878)	(0.0523)	(0.0135)	(0.3518)	(0.5544)	(0.3467)	(0.0615)	(0.4166)	(0.8993)	(0.9111)	
GFCF	-0.6356	-0.4916	14.8295	9.33760	-0.5612	-0.7419	16.6058	9.39826	1.88924	2.02807	2.03298	I(0)
	(0.2625)	(0.3115)	(0.1384)	(0.5004)	(0.2873)	(0.2291)	(0.0836)	(0.4948)	(0.9706)	(0.9961)	(0.9961)	
NODA	5.15660	-12.204	129.551	178.320	7.77303	-11.907	124.497	577.622	-12.381	215.892	515.206	I(1)
	(1.0000)	(0.0000)	(0.0000)	(0.0000)	(1.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
GFCE	-0.2310	-1.6762	16.8594	20.4904	0.40525	-0.9808	12.6468	19.2856	0.49247	4.14913	3.77132	I(1)
	(0.4086)	(0.0468)	(0.0775)	(0.0249)	(0.6574)	(0.1633)	(0.2441)	(0.0368)	(0.6888)	(0.9404)	(0.9571)	
M2	2.75168	4.66711	1.64426	0.80226	-0.3435	0.03407	15.1612	5.39661	4.42452	0.67420	0.18825	I(1)
	(0.9970)	(1.0000)	(0.9984)	(0.9999)	(0.3656)	(0.5136)	(0.1263)	(0.8632	(1.0000)	(1.0000)	(1.0000)	
SSE	3.42404	5.31301	0.54970	0.72151	1.55069	1.57171	3.33379	3.80203	5.70435	0.11734	0.07139	I(1)
	(0.9997)	(1.0000)	(1.0000)	(1.0000)	(0.9395)	(0.9420)	(0.9724)	(0.9558)	(1.0000)	(1.0000)	(1.0000)	
TRADE	-1.5326	-1.7093	22.8885	14.5637	-0.6854	-0.5415	16.4855	7.70985	0.12505	3.74797	3.59829	I(1)
	(0.0627)	(0.0437)	(0.0112)	(0.1488)	(0.2465)	(0.2941)	(0.0866)	(0.6572)	(0.5498)	(0.9580)	(0.9637)	

Table 4: Panel ARDL Results of Natural Disasters, Foreign Development Assistance, and Growth (Excluding interaction terms)

Dependent Variable: D(GDPG)

Selected Model: ARDL(1, Fixed)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LFPR	0.0187	0.0058	3.1971	0.0017
GFCF	0.1105	0.0680	1.6245	0.1056
SSE	0.1985	0.0596	3.3308	0.0010
ND1	-0.2840	0.1245	-2.2804	0.0238
ND2	-0.6218	0.2574	-2.4155	0.0168
NODA	0.0107	0.0017	6.2107	0.0000
GFCE	0.2471	0.0397	6.2252	0.0000
M2	0.0387	0.0126	3.0743	0.0024
TRADE	0.2022	0.1012	1.9983	0.0471
C	0.0102	0.0017	5.9744	0.0000

Gross fixed capital formation constitutes a significant proportion of the nation's savings. Consequently, Gross Fixed Capital Formation plays a critical role in fostering economic expansion. The positive sign of the coefficient for the second explanatory variable, Gross Fixed Capital Formation (GFCF), indicates a significant positive association between GFCF and GDP growth at the ten percent level. This result is consistent with the Harrod Domer model, which states that the saving ratio and investment are positively correlated with economic growth or the growth of national income. The positive indication is due to the fact that investment constitutes the primary source of capital formation. Consequently, increased investment and capital facilitate the implementation of cutting-edge technology in manufacturing, resulting in heightened productivity and economic progress. Therefore, a rise in the supply of investments might facilitate the introduction of new production factors, enhance output, and stimulate GDP growth. This discovery aligns with Say's Law, which states that "supply generates demand." Guo et al. (2015), M Shaari et al. (2016), Yeiw et al. (2018), Upadhyaya et al. (2007), Mbah and Amassoma (2014), Kolawole (2013), Hossain (2014), Hussain et al. (2018), Ali & Ahmad (2016), Azam and Feng (2014), Audi et al., (2022) all concur with our findings (2021). Furthermore, the favourable influence of capital production on GDP growth is elucidated in these studies.

Enrollment in secondary schools constitutes the education variable. Thus, schooling enhanced the labour force's competencies and understanding in regards to utilizing cutting-edge technologies. It will stimulate economic expansion. Secondary school enrollment (SSE), the third explanatory variable, exhibits a positive sign and demonstrates substantial statistical significance. Consequently, secondary school enrollment influences the GDP growth rate in a positive manner. Potential factors contributing to this correlation include the correlation between higher levels of education and enhanced skills and abilities, which subsequently result in increased production. And further rationale for this correlation is that Secondary School Enrollment (SSE) serves as a metric for human capital, which in turn determines the economy's proficiency in managing production elements. This results in advancements as well. Thus, it is impossible to attain economic growth in the absence of human capital. The enduring growth increase is attributable to the caliber of education. An increase in the number of years that individuals spend in school leads to a corresponding improvement in their skill set, hence stimulating economic growth. Our findings are consistent with those of Mustafa et al. (2019), Hussain et al. (2018), Alemu and Lee, and Azam and Feng (2021). (2015). Moreover, this research demonstrates that SSE positively affects GDP growth.

Dummy 1 (ND1), the fourth explanatory variable, is derived from the proportion of the total number of affected individuals to the population. The low severity of damages is illustrated by natural disaster dummy 1. As a result, natural disasters have an adverse effect on GDP growth, as indicated by the negative sign and statistically significant results of the coefficient of natural 1. A potential cause for the adverse consequences is the labour force being impacted by natural catastrophes; such labour forces contribute little to GDP growth and experience a decline in productivity. The export sector experiences a decline in output subsequent to calamities, which in turn may have an adverse impact on GDP growth. Harm to the labour force, which includes fatalities, injuries, and disabilities, is one of the two forms of damage caused by natural disasters. Physical capital loss constitutes the second category of damages, including infrastructure and home damage. Thus, as a consequence of these damages, savings are diminished, and investment falls, which ultimately slows the expansion of the gross domestic product. Yeiw et al. (2018); Fomby et al. (2009); Sseruyang and Klomp (2021); Shabnam (2014); Noy and Vu (2010); Fabian et al. (2019); Strobl (2011); Cavallo et al. (2004) have all reported results consistent with our own (2021). The adverse consequences of natural disasters are also illustrated in these research.

As determined by dividing the number of affected individuals by the population, Natural Disasters Dummy 2 (ND2) becomes the fifth explanatory variable. Natural disasters have a detrimental effect on GDP growth, as indicated by the negative coefficient of Natural Disasters Dummy 2 (ND2), which has a value of 0.6218. Due to the extreme severity of this natural disaster, it has resulted in a greater amount of devastation. Thus, the impact of the fictitious natural disasters on GDP growth is greater. Potential factors contributing to this phenomenon include the increased magnitude of physical and human destruction inflicted by natural disasters. Therefore, as the severity of natural disasters increases, a greater number of individuals are impacted, and the labour force experiences a decline in productivity and GDP growth. Zhaang and Managi (2020); Oreggia et al. (2010); Hochrainer (2009); Vu and Hammes (2020); Mu and Chen (2010) are in agreement with our findings (2016).

A statistically significant positive sign is shown for the sixth explanatory variable, Net Official Development Assistance (NODA). As a result, Official Development Assistance influences GDP growth positivistically. The efficacy and efficiency of foreign aid utilisation account for this favourable consequence. Both directly and indirectly, official development assistance stimulates economic expansion. Thus, aid-induced increases in foreign investment and human capital development contribute indirectly to the direct increase in economic growth, which is attributed to aid-induced increases in physical capital. Foreign direct investment and national income increase concurrently as a result of aid. The government raised its consumption as a result of the aid's beneficial influence, which subsequently stimulated economic expansion. The findings are consistent with the studies conducted by Aghoutane and Karim (2017), Fason and Onakoya (2012), Hatemi-J and Ikandoust (2005), Hossain (2014), and Mustafa et al (2019). The studies also demonstrate the beneficial effects of Official Development Assistance on GDP growth[6].

Fiscal policy is implemented through the General Government Final Consumption Expenditure (GFCE). Government spending thus stimulate economic expansion. The seventh explanatory variable, General Government Final Consumption Expenditure (GFCE), exhibits statistically significant results and possesses a positive sign. This indicates that final government consumption expenditures contribute positively to GDP growth. An upsurge in final consumer expenditure of the general government results in a corresponding expansion of the GDP. Consistent with the growth hypothesis of Keynesian economists, which posits that rising government spending stimulates economic expansion, these results support this notion. Because government expenditures significantly contribute to economic stability. Thus, according to the Keynesian theory of standard effective demand, an expansion of government expenditure stimulates aggregate demand and consequently economic expansion. This favourable outcome can be attributed to the government's expenditure on physical and social development, which concurrently stimulates economic expansion. Consequently, increased government expenditure on health and education results in heightened worker productivity and output. Government spending on infrastructure, such as roads and communications, which reduces production costs and stimulates investment, is an additional factor contributing to this phenomenon. Barro, Shafuda (2015), Vu Le and Suruga (2005), and our findings are consistent (1990). In addition, these studies demonstrate that government expenditure stimulates GDP growth.

Monetary policy significantly influences the expansion of the economy, given that M2 is the monetary policy variable. Statistically significant results are indicated by the positive coefficient of the eighth explanatory variable, broad money (M2). This illustrates how wide money positively affects GDP growth. The positive influence of broad money on GDP growth can be attributed to the fact that an expansion in money supply, or broad money M2, results in a short-term decline in interest rates. Consequently, an increased demand for borrowing funds from banks is stimulated, leading to a greater influx of consumers and investors. This stimulates investment and contributes to the expansion of the GDP. In accordance with the structural model method, which investigated the monetary transmission mechanism via the asset price mechanism, an augmentation in money supply leads to a corresponding rise in financial wealth and consumption. Consequently, this led to a rise in production.

The government, in response to increases in the money supply, also opts to decrease market prices. Nizhegorodtsev and Goridki (2015); Chaitipa et al. (2015); Mohammad et al. align with our findings (2009).

Trade is essential for economic expansion; when exports rise, domestic productivity rises as well. Subsequently, commerce is critical to economic expansion. Statistically significant and favourable indications may be found for the coefficient associated with the ninth explanatory variable, trade. Trade has a beneficial effect on GDP growth, as seen by this positive coefficient. Trade openness leads to the introduction of new and advanced technologies, which enhance labour productivity and reduce development costs. Trade enhances access to cutting-edge technologies and opens up opportunities in international markets. Trade incentivizes the workforce to enhance economic growth by advancing technologies and engaging in research and development. Possible factors for this beneficial influence include the expansion of goods and services production and the rise in exports due to trade. This results in a

[6] Several studies have identified the adverse effect of Nett Official Development Assistance on GDP growth. Upadhyaya et al (2007), Sothan (2018), Ramadhan et al (2016), Mbah and Amassoma (2014), Hussain et al (2018), Aghoutane and Karim (2017). The negative impact is caused by inadequate fiscal and monetary policies, weak financial institutions, or a preference for self-reliance and utilising their own resources. Aid just leads to an increase in government spending and does not encourage capital formation.

beneficial effect on GDP expansion. As exports rise, national revenue increases and GDP growth improves. The findings align with the studies conducted by Aghoutane and Karim (2017), Alemu and Lee (2015), Azam and Feng (2021), Feeny (2005), Javid and Qayyum (2011), Kolawole (2013), Mohapatra et al (2016), Sothan (2018), and Guo et al (2015). The studies demonstrate the beneficial influence of trade on GDP growth.

5.2.2. Long-term Outcomes of Natural Disasters, Foreign Development Aid, and Growth (With an Interaction Term)

The outcomes of Table 5, which contains the interaction term in the model, are summarized in this section. Statistically insignificant are the positive coefficient results for the first explanatory variable, labour force participation rate. This model has a greater magnitude for the coefficient representing labour force participation. Thus, the Labor Force Participation Rate has a greater effect on GDP growth when interaction terms are held.

Significant and positive trends are seen in the coefficient of the second explanatory variable, Gross Fixed Capital Formation. The coefficient of Gross Fixed Capital Formation is less in the model with the interaction term compared to the model without it.

Table 5: Panel ARDL Results of Natural Disasters, Foreign Development Assistance, and Growth (With Interaction Term)

Dependent Variable: D(GDPG)
Selected Model: ARDL(2, Fixed)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LFPR	0.2673	0.1808	1.4788	0.1411
GFCF	0.0010	0.0005	2.1967	0.0290
SSE	0.2333	0.0902	2.5869	0.0105
ND1	-0.0102	0.0041	-2.4986	0.0134
ND2	-0.0609	0.0327	-1.8661	0.0638
NODA	0.1111	0.0419	2.6557	0.0085
GFCE	0.2471	0.0397	6.2252	0.0000
M2	0.0010	0.0005	2.1967	0.0290
TRADE	0.2512	0.0358	7.0136	0.0000
ND1* NODA	0.1196	0.0431	2.7771	0.0061
ND2* NODA	0.0011	0.0004	2.7093	0.0075
C	0.0370	0.0121	3.0644	0.0024

Results are positive and statistically significant for the coefficient of third-secondary school enrollment. An interaction term increases the magnitude of secondary school enrollment. This model therefore has a greater SSE impact. GDP growth is more significantly influenced by secondary school enrollment. A negative sign and statistically significant results are observed in the coefficient of Natural Disasters Dummy One (ND1). However, the interaction term is greater in magnitude than the coefficient for Natural Disasters Dummy 1. There are also statistically significant negative results for the coefficient of Natural Disasters Dummy 2 (ND2). The interaction term, however, has a greater magnitude than ND2. The magnitude of natural disasters is consequently diminished due to the interaction terms.

Statistically significant and positive results are observed in the coefficient of Net Official Development Assistance (NODA). This model exhibits a greater magnitude of the NODA coefficient. This model attributes greater efficacy to net official development assistance in impacting GDP growth. Positive and statistically significant results characterise the Gross Final Consumption Expenditure (GFCE) coefficient. In the absence of interactions, the magnitude of Government Final Consumption Expenditure (GFCE) remains unchanged. Significantly and positively, the coefficient of broad money M2 is observed. However, the size of M2 is greater under this hypothesis. The results of the trade coefficient are statistically significant and positive. In this approach, the magnitude of transaction is also greater. Trade is therefore more efficient when interaction terms are utilised.

The first interaction term, ND1*NODA, is taken to mean that Natural Disasters (ND1) have a statistically significant positive effect on GDP growth relative to the average value of Net Official Development Assistance (NODA). One plausible explanation for this phenomenon is that Net Official Development Assistance (NODA) serves to alleviate the adverse consequences of natural calamities. The significance of the second interaction term, ND2*NODA, is attributed to the positive and statistically significant effects of Natural Disasters Dummy 2 (ND2) on the average value of Net Official Development Assistance (NODA). Public Development Assistance has the potential to mitigate the severity of natural disasters (ODA). Thus, assistance mitigates the adverse effects of natural catastrophes.

5.3. Error Correction Analysis

The short-run relationship between variables is to be analyzed following a discussion of the outcomes of the long-run relationship. Error Correction Results are useful for evaluating short-term outcomes (ECM). The accuracy with which the model's equilibrium is restored is denoted by the Error Correction Method (ECM). The rate at which a variable approaches steady-state is denoted by the coefficient of the Error Correction Term. Denoting statistical significance with a negative sign is the value that the coefficient should possess. Summarized in Table 6 are the short-term outcomes excluding interaction terms.

The coefficient without interaction term in Table 6 has a value of -1.1342, while its corresponding probability is 0.00. Consequently, the variable's coefficient exhibits a negative sign and is deemed statistically significant. Remedial action will be taken to restore the variable to its long-run equilibrium state. Short-term adjustment occurs at a rapid rate, and the system rapidly approaches steady states.

Table 6: Panel ARDL Results of Natural Disasters, Foreign Development Assistance, and Growth (Excluding interaction terms)

	Dependent Variable: D(GDPG) Selected Model: ARDL(1, Fixed)			
COINTEQ01	-1.1342	0.1280	-8.8621	0.0000
D(LFPR)	0.2310	0.0745	3.1005	0.0022
D(GFCF)	-0.0024	0.0011	-2.1101	0.0363
D(SSE)	0.0091	0.0054	1.6771	0.0953
D(ND1)	0.1215	0.3867	0.3142	0.7537
D(ND2)	-1.1430	0.1219	-9.3780	0.0000
D(NODA)	0.0038	0.0025	1.4860	0.1391
D(GFCE)	0.0817	0.2943	0.2776	0.7816
D(M2)	0.1696	0.1424	1.1910	0.2353
D(TRADE)	0.0018	0.0103	0.1700	0.8652
C	0.3166	0.7226	0.4382	0.6618
@TREND	0.0867	0.0381	2.2740	0.0242

The results of incorporating the interaction term into the model are now being discussed. The interaction term-containing short-run outcomes of the variables are presented in Table 7. The interaction term yields a coefficient of –1.1709 for the variable. The coefficient possesses a negative sign and is statistically significant as well. The magnitude of the speed of adjustment toward equilibrium increases at a faster rate when the interaction term is accounted for.

Table 7: Panel ARDL Results of Natural Disasters, Foreign Development Assistance, and Growth (Including Interaction Terms)

	Dependent Variable: D(GDPG) Selected Model: ARDL(2, Fixed)			
COINTEQ01	-1.1709	0.1596	-7.3353	0.0000
D(LFPR)	-0.4732	0.5332	-0.8874	0.3761
D(GFCF)	-0.0001	0.0000	-2.7401	0.0068
D(SSE)	-0.1868	0.2662	-0.7018	0.4838
D(ND1)	-0.0004	0.0063	-0.0714	0.9432
D(ND2)	0.0157	0.0109	1.4317	0.1541
D(NODA)	-0.0387	0.0126	-3.0743	0.0024
D(GFCE)	0.0246	0.0130	1.8823	0.0610
D(M2)	-0.0102	0.0017	-5.9744	0.0000
D(TRADE)	0.2519	0.0363	6.9344	0.0000
D(ND1*NODA)	0.0037	0.0094	0.3907	0.6964
D(ND2*NODA)	-0.0501	0.0122	-4.1186	0.0001
C	0.0366	0.0122	2.9924	0.0031

The short-term imbalance will be rectified over time. The model with interaction terms converges more rapidly towards steady states.

5.4. Panel Causality Analysis

The direction of causality between the variables is next looked into. Therefore, the first step in a causality analysis is to determine the lag. There are several methods for figuring out the lag. There are numerous methods available for selecting a lag variable; nevertheless, Table 8 lists the six most widely used methods.

These are Final Prediction Error (FPE), Akaike Information Criterion (AIC), and Schwarz Information Criterion (SIC), Hann and Quinn Information Criterion (HQ). The lag is determined by selecting the minimum value from the values of HQ, SC, AIC, and FPE. The LR technique identifies the highest value as the ideal lag. Table 9 displays panel causality analysis results. According to the LogL technique, there is no optimal lag. However, the LR method and Final Prediction Error (FPE) both indicate that the ideal lag is 3. The Akaike Information Criterion (AIC) indicates a lag of 3, the Schwarz Information Criterion (SIC) suggests a lag of 1, and the Hannan-Quinn Information Criterion (HQ) points to a lag of 1. SC and HQ indicate a lag of 1, while LR, FPE, and AIC suggest a lag of 3. More criteria support lag 3. Therefore, lag 3 is the most effective in our findings.

Table 8: Panel Causality Analysis (VAR Lag Order Selection Criteria) of Natural Disasters, Foreign Development Assistance, and Economic Growth

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5105.317	NA	1.60e+16	48.66016	48.72391	48.68593
1	-4938.119	326.4329	3.78e+15	47.22019	47.53896*	47.34905*
2	-4922.455	29.98647	3.79e+15	47.22338	47.79717	47.45534
3	-4901.024	40.20774*	3.60e+15*	47.17166*	48.00047	47.50672
4	-4889.063	21.98701	3.75e+15	47.21012	48.29394	47.64827
5	-4880.528	15.36297	4.03e+15	47.28121	48.62006	47.82246
6	-4865.708	26.11091	4.08e+15	47.29246	48.88632	47.93679
7	-4852.845	22.17381	4.22e+15	47.32233	49.17121	48.06976
8	-4848.645	7.079272	4.73e+15	47.43471	49.53861	48.28524

5.4.1. Pairwise Granger Causality Tests

This analysis determines the results based on the probability value of pairwise causality, which investigates the pairwise causes between variables. It can be concluded that the null hypothesis is rejected based on the statistical significance of the probability value of the first pair of variables (ND1 and GDPG) in Table 9. GDPG is therefore caused by ND1.

GDPG and ND1 are the remaining pair variables; the null hypothesis is denied on the grounds that the probability value of this pair is significant. Consequently, GDPG induces ND1. Bivariate causality is established by the discovery that both pairings are causing one another. A pairwise Granger causality test is illustrated in Table 9. We reject the null hypothesis and conclude that ND2 is the causal factor of GDPD based on the significant probability value of the second pair, which consists of two variables: ND2 and GDPG. With GDPG and ND2 constituting the other pair, the null hypothesis is rejected due to the significance of the probability value. The relationship between GDPD and ND2 can be described as bivariate causality, as both variables are influencing one another.

Table 9: Pairwise Granger Causality Tests of Natural Disasters, Foreign Development Assistance and Economic Growth

Null Hypothesis:	Obs	F-Statistic	Prob.
ND1 ↛ GDPG	240	0.43608	0.0471
GDPG ↛ ND1	240	0.36505	0.0946
ND2 ↛ GDPG	240	2.70060	0.0692
GDPG ↛ ND2	240	5.87676	0.0032
NODA ↛GDPG	240	2.40510	0.0925
GDPG ↛NODA	240	0.01382	0.0863
ND2 ↛ ND1	240	0.59868	0.0504
ND1 ↛ ND2	240	0.43007	0.0510
NODA↛ND1	240	0.97770	0.0777
ND1 ↛NODA	240	0.46970	0.0258
NODA ↛ND2	240	0.96386	0.0829
ND2 ↛ NODA	240	0.94447	0.0904

The variables NODA and GDPG form a statistically significant pair, leading to the rejection of the null hypothesis and indicating that NODA causes GDPG. The alternate pair of variables in this association consists of NODA and GDPG. Given the statistically substantial probability value of this association, which rejects the null hypothesis, it can be inferred that NODA is caused by GDPG. NODA and GDPG exhibit bivariate causality. The fourth combination consists of two variables labelled ND2 and ND1. The probability value is statistically significant, leading to the rejection of the null hypothesis. Thus, ND2 causes ND2. The alternate pair comprises ND1 and ND2, with their corresponding probability values being statistically significant. ND2 and ND1 are causally connected in a bivariate manner because each variable influences the other.

NODA and ND1 constitute the fifth dyad of the variable, and their probability value is deemed to be statistically significant. In conclusion, the null hypothesis is refuted and ND1 is caused by NODA. The opposite pair, ND1 and NODA, also demonstrates statistically significant outcomes, thus rejecting the null hypothesis. Bivariate causality exists between NODA and ND1. Among the six pairings, two variables (NODA and ND2) are present; this pair's probability value is deemed to be statistically significant. Thus, NODA induces ND2. ND2 is an additional pair of this variable, and the NODA probability value is noteworthy. Therefore, bivariate causality exists, as both variables influence one another.

6. Conclusions and Policy Implications

The present study investigates the correlations that exist among economic growth, foreign assistance, and natural disasters. The primary objective of this research endeavor is to determine the correlation between foreign development assistance, natural disasters, and economic growth. In order to conduct an empirical examination of the relationship between foreign development assistance, economic growth, natural disasters, and Pakistan, India, Nepal, Bangladesh, and Sri Lanka, this study employs panel data from 1971 to 2020 and utilises the panel ARDL test on the selected five south Asian nations. This study also employs panel unit root tests, including the Levin-Lin Chu test, LM-Pesaran and Shin test, Augmented Dickey-Fuller test (ADF), Fisher Chi-Square test, and

Phillips Peran Test (PPT). These tests verify the stationarity of all significant variables. The Error Correction Method (ECM) is utilised to analyse the short-run impact, while the Panel ARDL test is utilised to determine the long-run results.

This research focuses on analysing natural disasters, Foreign Development Assistance (FDA), and economic growth as the primary factors. The dependent variable in this relationship is economic growth, as measured by the Gross Domestic Product Growth (GDPG). The independent variables are Official Development Assistance (ODA) and natural disasters. The study estimates the Labour Force Participation Rate (LFPR), Gross Fixed Capital Formation (GFCF), Secondary School Enrolment (SSE), Government Final Consumption Expenditures (GFCE), Trade, and M2 as explanatory variables. In order to quantify the impact of natural disasters, the ratio of Total Affected Persons (TAP) is utilised. Consequently, the ratio of the total number of affected individuals is used to construct two dummies: Natural Disasters Dummy 1 (ND1) and Natural Disasters Dummy 2 (ND2). The two models are regressed in this research. One model, denoted as ODA*ND1 and ODA*ND2, is regressed without interaction terms, while the other model incorporates an interaction term.

According to the findings of our research, natural disasters have a statistically significant and adverse effect on economic growth. Natural disasters dummy 1 (ND1) exhibit a negative but comparatively insignificant effect on economic growth due to its representation of low intensity natural disasters, whereas ND2 demonstrates statistically significant negative effects attributable to higher intensity natural disasters. The findings from the model incorporating interaction terms (ODA*ND1 and ODA*ND2) indicate that natural disasters have a positive effect on the average value of ODA. This model thereby converts the adverse consequences of natural disasters into favourable outcomes associated with Official Development Assistance (ODA). Selected countries in South Asia experience a positive and statistically significant effect of Official Development Assistance (ODA) on their economic growth. In accordance with these findings, Official Development Assistance (ODA) also mitigates the adverse effects of natural disasters. Furthermore, trade, M2, labour force participation, gross fixed capital formation, and secondary school enrolment all contribute in a positive manner to the acceleration of economic growth. Consequently, this study concludes that natural disasters have an adverse effect on economic growth, resulting in a decline in growth. One possible explanation for this adverse effect is that natural disasters have an effect on the labour force, which contributes little to GDP growth and experiences a decline in productivity. Following calamities, there is a decline in domestic productivity, which in turn hampers exports and potentially curtails GDP growth. This adverse effect is the result of disaster-related losses of tangible capital, including infrastructure and residential property. Consequently, the aggregate impact of these detriments is a reduction in savings, which in turn leads to a decline in investment and ultimately impedes GDP growth. In addition to stimulating economic development, Official Development Assistance (ODA) mitigates the adverse effects of natural disasters. ODA's positive effects are attributable to the efficient and effective administration of foreign assistance. Economic growth is stimulated both directly and indirectly by official development assistance. The direct stimulus to economic growth is therefore the augmentation of physical capital facilitated by aid, while the indirect effect stems from the aid's capacity to enhance human capital and stimulate foreign investment. Additionally, aid promotes domestic reserves and investment, which contribute to an increase in national income. In addition, the causal analysis of important variables is examined in this study. Therefore, bivariate causality is predicted by the results of causality, which indicate that all variables are causing one another. The findings of this research indicate that economic growth is adversely affected by natural disasters, while Official Development Assistance (ODA) functions to stimulate economic growth while mitigating the adverse effects of natural disasters.

The findings of our research have significant implications for enhancing the efficacy of official development assistance and foreign development assistance while mitigating the adverse effects of natural disasters.

- Economic growth is positively impacted by Official Development Assistance, as demonstrated by our findings. Policymakers may therefore direct their attention towards public institutions that play a critical role in effectively channelling Official Development Assistance (ODA). This could involve increasing the allocation of ODA towards production and development through the enhancement of human capital, mitigating the risk of disasters, bolstering monitoring of ODA-funded projects, minimising resource wastage and loss, and promoting efficient utilisation.
- Policymakers may prioritise securing foreign aid in various other guises that concurrently stimulate economic development, including establishing diplomatic relations with donor nations that do not impose any preconditions on the recipient nation.
- To increase the beneficial effects of Official Development Assistance (ODA), the budget deficit must be reduced by the planner.
- Foreign Direct Investment (FDI) and other forms of stable and sustainable external financing resources may be prioritised by the government. Portfolio investment and export expansion.
- In order to stimulate economic development, investment and capital stocks may be increased by the planners.
- In addition to prioritising foreign aid, policymakers might also be advised to enhance investment and export activities.
- Our findings demonstrate that natural calamities have a detrimental effect on economic expansion. Due to the fact that natural disasters are natural phenomena, the government may organize immediate precautions and disaster relief in an effort to minimise their destructive and loss-causing effects. In order to reduce the risk of natural disasters, the government must ensure that institutions implement an effective response strategy that includes recovery operations, reconstruction efforts, and emergency responses. This adverse effect is mitigated through enhanced governance.
- It may be necessary for policymakers to augment the national income in order to finance direct disaster mitigation efforts and reduce the frequency of natural disasters.
- It is imperative that international meteorological institutions deliver precise weather forecasts in order to mitigate the detrimental effects of natural disasters.
- To reduce the risk of natural disasters, the government may implement a warming system or early disaster forecasting.
- Increasing investments in infrastructure and structural development, such as the construction of hospitals and schools that will provide shelter during disasters, may be considered by the planners.

- Since economic development significantly contributes to the mitigation of natural disasters, policymakers must prioritise its expansion.
- As education plays a pivotal role in stimulating economic expansion, the government may consider augmenting its investment in this sector.
- Policymakers have the ability to enhance the knowledge and competencies of the labour force in order to stimulate economic expansion.
- Investment plays a pivotal role in stimulating economic expansion. Thus, planners may prioritize increasing savings, which subsequently fuels increased investment activity.
- Fiscal policy is critical for both avoiding natural disasters and fostering economic expansion. Therefore, policymakers must increase government expenditure on health, education, and other sectors, as well as government intervention.
- In order to concentrate on monetary policy, the government might enhance financial development.

References

Aghoutane, K., & Karim, M. (2017). The impact of foreign aid on economic growth in Morocco: econometric analysis using VECM. *International Journal of Economics and Finance*, 9(5), 87.

Ahmad, S. (2018). Credit Scoring: Assessing Creditworthiness and Its Implications for Borrowers and Lenders. *Journal of Business and Economic Options*, *1*(2), 44-51.

Alemu, A. M., & Lee, J. S. (2015). Foreign aid on economic growth in Africa: a comparison of low and middle-income countries. *South African Journal of Economic and Management Sciences*, 18(4), 449-462.

Ali, A., & Ahmed, F. (2016). Impact of Government borrowing on financial development (a case study of Pakistan). *Bulletin of Business and Economics (BBE)*, *5*(3), 135-143.

Ashiq, R., & Akhlaque, S. (2019). Interest Rate Dynamics and External Debt Accumulation: Empirical Evidence from Pakistan. *Journal of Business and Economic Options*, *2*(3), 142-151.

Audi, M., Ali, A., & Hamadeh, H. F. (2022). Nexus Among Innovations, Financial Development and Economic Growth in Developing Countries. *Journal of Applied Economic Sciences*, *17*(4).

Audi, M., Ehsan, R., & Ali, A. (2023). *Does Globalization Promote Financial Integration in South Asian Economies? Unveiling the Role of Monetary and Fiscal Performance in Internationalization* (No. 119365). University Library of Munich, Germany.

Audi, M., Poulin, M., & Ali, A. (2023). Determinants of Human Wellbeing and its Prospect Under the Role of Financial Inclusion in South Asian Countries. *Journal of Applied Economic Sciences*, *18*(4).

Azam, M., & Feng, Y. (2021). Does foreign aid stimulate economic growth in developing countries? Further evidence in both aggregate and disaggregated samples. *Quality & Quantity*, 1-24.

Bagdigen, M., & Cetintas, H. (2004). Causality between public expenditure and economic growth: The Turkish case. *Journal of Economic and Social research*, 6(1), 53-72.

Baig, N., Khan, S., Gilal, N. G., & Qayyum, D. (2018). Do natural disasters cause economic growth? An ARDL bound testing approach. An ARDL Bound Testing Approach (April 3, 2018). Baig, N., Khan, S., Gilal, NG, & Qayyum, A, 5-20.

Barro, R. J. (1990). Government spending in a simple model of endogeneous growth. *Journal of political economy*, 98(5, Part 2), S103-S125.

Benali, N., & Feki, R. (2020). The Relationship Between Natural Disasters, Education, Ict And Economic Growth: Empirical Evidence From ARDL Bounds Testing Approach. *Journal of Economic Development*, 45(4).

Callen, T. (2008). Back to basics: what is gross domestic product? *Finance & Development*, 45(004).

Cavallo, E. A., Becerra, O., & Acevedo, L. (2021). The impact of natural disasters on economic growth (No. IDB-WP-1257). IDB Working Paper Series.

Chaitip, P., Chokethaworn, K., Chaiboonsri, C., & Khounkhalax, M. (2015). Money supply influencing on economic growth-wide phenomena of AEC open region. *Procedia Economics and Finance*, 24, 108-115.

Chen, H., & Singh, B. (2020). Effectiveness of Foreign Development Assistance in Mitigating Natural Disasters' Impact: Case Study of Pacific Island Countries.

Cunado, J., & Ferreira, S. (2011). The macroeconomic impacts of natural disasters: New evidence from floods (No. 321-2016-10928).

Cunado, J., & Ferreira, S. (2014). The macroeconomic impacts of natural disasters: The case of floods. *Land economics*, 90(1), 149-168.

de Oliveira, V. H. (2019). Natural disasters and economic growth in Northeast Brazil: evidence from municipal economies of the Ceará State. *Environment and Development Economics*, 24(3), 271-293.

Diaz, D. A., & Larroulet, C. (2021). Impact of Institutions in the Aftermath of Natural Disasters. *Cato Journal*, 41(1), 65-79.

Fabian, M., Lessmann, C., & Sofke, T. (2019). Natural disasters and regional development–the case of earthquakes. *Environment and Development Economics*, 24(5), 479-505.

Fasanya, I. O., & Onakoya, A. B. (2012). Does foreign aid accelerate economic growth? An empirical analysis for Nigeria. *International journal of economics and financial issues*, 2(4), 423-431.

Fatouros, N., & Sun, Y. (2020). Natural Disasters and Economic Growth: A Semiparametric Smooth Coefficient Model Approach. *Journal of Risk and Financial Management*, 13(12), 320.

Feeny, S. (2005). The impact of foreign aid on economic growth in Papua New Guinea. *Journal of development Studies*, 41(6), 1092-1117.

George, B., Banerjee, S., & Kumar, R. (2021). Determinants of Impact of Natural Disaster in SAARC Countries with Special Reference to India. *Economic Research Guardian*, 11(1), 64-77.
Golder, U., Sheikh, M., & Sultana, F. (2021). The Relationship Between Foreign Aid and Economic Growth: Empirical Evidence from Bangladesh. *Journal of Asian Finance, Economics and Business*.
Guo, J., Liu, H., Wu, X., Gu, J., Song, S., & Tang, Y. (2015). Natural disasters, economic growth and sustainable development in china—an empirical study using provincial panel data. *Sustainability*, 7(12), 16783-16800.
Gupta, K.L., Islam M.A. (1983), ―Foreign Capital, Savings and Growth—An International Cross-Section Study‖, Reidel Publishing Company: Dordrecht.
Hochrainer, S. (2006). Macroeconomic risk management against natural disasters. Wiesbaden: German University Press.
Hochrainer, S. (2009). Assessing the macroeconomic impacts of natural disasters: are there any? World Bank policy research working paper, (4968).
Hossain, B. (2014). The effect of foreign aid on the economic growth of Bangladesh. *Journal of Economics and Development Studies*, 2(2), 93-105.
Husein, J. G. (1998). Essays on the impact of foreign aid on economic growth and development: The case of Jordan. Utah State University.
Hussain, A., Tariq, M., Qadir, F., & Saeed, I. U. (2018). Foreign Aid and Economic Growth Nexus: A comparative study of Pakistan with four SAARC countries. *Journal of the Research Society of Pakistan*, 55(1).
Hyndman, D., & Hyndman, D. (2016). Natural hazards and disasters. Cengage Learning.
Iqbal, K., & Raza, A. (2018). Impact of Foreign Exchange Rate Volatility on Money Demand in Pakistan: An Empirical Analysis. *Journal of Policy Options*, *1*(3), 74-83.
Iqbal, Y., & Shahzad, M. (2020). Analyzing the Nexus Between Economic Development and Money Monetization: Evidence from Pakistan. *Journal of Business and Economic Options*, *3*(3), 111-119.
Irandoust, A. H. J. M., & Hatemi, A. (2005). Foreign aid and economic growth: new evidence from panel cointegration. *Journal of economic development*, 30(1), 71-80.
jaharudin, p., habibullah, m. s., & baharom, a. economic impact of natural disasters and economic condition: a cross-sectional analysis
Javid, M., & Qayyum, A. (2011). Foreign aid and growth nexus in Pakistan: The role of macroeconomic policies. Working Papers & Research Reports, 2011.
Khan, M. A., & Ahmed, A. (2007). Foreign aid—blessing or curse: Evidence from Pakistan. *The Pakistan Development Review*, 215-240.
Khan, R. I. A., & Ahmad, K. (2018). Revitalizing the Pakistan Textile Industry: Challenges and Opportunities. *Journal of Policy Options*, *1*(1), 14-19.
Kolawole, B. O. (2013). Foreign assistance and economic growth in Nigeria: The two-gap model framework. *American international journal of contemporary research*, 3(10), 153-160.
Kumar, D. (2018). Exploring the Impact of Remittances on Human Development: Insights from Developing Countries. *Journal of Policy Options*, *1*(4), 104-111.
Lima, R. C. D. A., & Barbosa, A. V. B. (2019). Natural disasters, economic growth, and spatial spillovers: Evidence from a flash flood in Brazil. *Papers in Regional Science*, 98(2), 905-924.
Machove, M. (2022). Multiscale Asset Pricing: Integrating Wavelet Analysis and High Order Moments into the Fama-French Model. *Journal of Business and Economic Options*, *5*(1), 8-15.
Mahmood, H., & Aslam, M. (2018). Impact of Plastic Money Adoption on Consumer Purchasing Habits: A Study in Pakistan. *Journal of Policy Options*, *1*(1), 28-33.
Mbah, S., & Amassoma, D. (2014). The linkage between foreign aid and economic growth in Nigeria. *International Journal of Economic Practices and Theories*, 4(6), 1007-1017.
Meor Shaari, M. S., Abd Karim, M. Z., & Hasan Basri, B. (2016). Flood disaster and GDP growth in Malaysia. *European Journal of Business and Social Sciences*, 4(10), 27-40.
Mohan, P. S., Ouattara, B., & Strobl, E. (2018). Decomposing the macroeconomic effects of natural disasters: A national income accounting perspective. *Ecological economics*, 146, 1-9.
Mohapatra, G., Giri, A. K., & Sehrawat, M. (2016). Foreign aid, macroeconomic policies and economic growth nexus in India: An ARDL bounds testing approach. *Theoretical & Applied Economics*, 23(4).
Morris, M. D. (1978). A physical quality of life index. *Urban Ecology*, 3(3), 225-240.
Mu, J. E., & Chen, Y. (2016). Impacts of large natural disasters on regional income. *Natural Hazards*, 83(3), 1485-1503.
Murphy R.G., Tresp N.G. (2006). Government Policy and the Effectiveness of Foreign Aid. Department of Economics, Botson College.
Mustafa, M. E., Elshakh, M. M., & Ebaidalla, E. M. (2019). Does Foreign Aid Promote Economic Growth in Sudan? Evidence from ARDL Bounds Testing Analysis. *Journal of Economic Cooperation & Development*, 40(3).
Nasir, M. (2019). Navigating Economic Challenges: Opportunities and Challenges for Emerging Entrepreneurs. *Journal of Policy Options*, *2*(3), 75-82.
Nizhegorodtsev, R., & Goridko, N. (2015). The impact of money supply on economic growth: theory, experience, modelling. *Handbook on the Economics, Finance and Management Outlooks*, 3, 66-72.
Noy, I., & Vu, T. B. (2010). The economics of natural disasters in a developing country: The case of Vietnam. *Journal of Asian Economics*, 21(4), 345-354.

Nwezeaku, N. C. (2018). Analyzing the Impact of Public Expenditure on Economic Development: Evidence from Nigeria. *Journal of Business and Economic Options*, *1*(4), 99-105.

Oulay, S. (2021). Road Access and Rural Development: Insights from Laos. *Journal of Business and Economic Options*, *4*(4), 9-16.

Papanek, G.F. (1972). The Effect of Aid and Other Resource Transfers on Savings and Growth in Less Developed Countries. *Economic Journal*, 82(327), 934–50.

Raiz, Q., & Zulfaqir, B. (2019). Interconnectedness between Gender Inequality and Income Inequality: Implications for Pakistan's Economy. *Journal of Policy Options*, *2*(3), 66-74.

Ramadhan, A. A., Jian, Z. H., Pacific, Y. K. T., & Abeid, A. R. (2016). Impact of Foreign Aid on Tanzania Economic Growth-Time Series Approach. *Academy of Social Science Journal*, 1(6), 89-94.

Salih, M. A. R. (2012). The relationship between economic growth and Government expenditure: Evidence from Sudan. *International Business Research*, 5(8), 40.

Schumacher, I., & Strobl, E. (2011). Economic development and losses due to natural disasters: The role of hazard exposure. *Ecological Economics*, 72, 97-105

Senturk, I., & Ali, A. (2021). Effectiveness of Monetary Policy Channels: Insights from Four Emerging Economies. *Journal of Business and Economic Options*, *4*(3), 1-9.

Shahzadi, R., & Ahmad, J. (2018). Examining Global Media Influence: Understanding the Impact on Pakistani Culture. *Journal of Policy Options*, *1*(4), 97-103.

Shimada, G. O. (2012). The macroeconomic impacts of natural disasters: A case study of Japan. *J. Grad. Sch. Asia Pac. Stud*, 24(10), 121-137.

Sothan, S. (2018). Foreign aid and economic growth: evidence from Cambodia. *The Journal of International Trade & Economic Development*, 27(2), 168-183.

Sseruyange, J., & Klomp, J. (2021). Natural disasters and economic growth: The mitigating role of microfinance institutions. *Sustainability*, 13(9), 5055.

Strobl, E. (2011). The economic growth impact of hurricanes: Evidence from US coastal counties. *Review of Economics and Statistics*, 93(2), 575-589.

Taban, S. (2010). An examination of the government spending and economic growth nexus for Turkey using the bound test approach. *International Research Journal of Finance and Economics*, 48(1), 184-193.

Tadesse, T. (2011). Foreign aid and economic growth in Ethiopia: A cointegration analysis. *The economic research guardian*, 1(2), 88-108.

Toya, H., & Skidmore, M. (2007). Economic development and the impacts of natural disasters. *Economics letters*, 94(1), 20-25.

Upadhyaya, K. P., Pradhal, G., Dhakal, D., & Bhandari, R. (2007). Foreign aid, FDI and economic growth in East European countries.

Vu Le, M., & Suruga, T. (2005). Foreign direct investment, public expenditure and economic growth: the empirical evidence for the period 1970–2001. *Applied economics letters*, 12(1), 45-49.

Vu, T. B., & Hammes, D. (2010). Dustbowls and high water, the economic impact of natural disasters in China. *Asia-Pacific Journal of Social Sciences*, 1, 122-132.

Yiew, T. H., Kalimuthu, K. V., Lee, C. Y., Cheah, S. P., & Foo, C. C. (2018). Do Natural Disasters Affect Economic Growth In Bangladesh? *International Journal of Business and Society*, 19(3), 781-792

Zhang, D., & Managi, S. (2020). Financial development, natural disasters, and economics of the Pacific small island states. *Economic Analysis and Policy*, 66, 168-181