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Analysis of Foreign Aid Effectiveness for School Education Improvement and Economic Growth of Nepal

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Abstract

Background: Nepal is struggling to improve its education system due to financial deficiency, social disparities, and political instability. The government relies heavily on international aid for education improvement. Nepal's education system shows foreign aid's potential and limitations in sustainable development. Foreign aid, GDP per capita, and government spending affect Nepalese youth literacy and gross enrollment rates. This aims to examine the aid effectiveness in school enrollment and GDP growth in Nepal.

Methods: This study has employed an econometric approach based on ARDL and Granger causality tests. Model I focuses on youth literacy rates as a measure of educational outcomes, while Model II examines gross enrollment ratios to assess access to education.

Results: The results reveal a significant long-term role of foreign aid in improving literacy outcomes, whereas GDP per capita emerges as a critical determinant of enrollment. Granger causality tests highlight bidirectional relationships, showing how literacy improvements influence foreign aid allocation and GDP growth. The findings underscore the importance of aligning aid strategies with local priorities and enhancing the efficiency of public spending to achieve sustained educational improvements.

Conclusion: This study contributes to human capital theory by exploring the interplay between education and economic development, emphasizing the need for targeted, sustainable interventions. Future research should focus on the role of institutional quality and demographic disparities in shaping education outcomes.

Novelty: This study offers a comprehensive analysis of aid efficacy and its congruence with local requirements by incorporating perspectives from local educators, students, policymakers, and donor organizations.

Keywords: aid effectiveness, school education, enrollment ratio, ARDL model, funds deficiency

JEL Classification: F35, I25, H52, C22

Introduction

Foreign aid has played a vital role in bridging the educational deficits in developing countries by supplying the necessary resources for, even, better access, quality as well as institutional capacity (Riddell & Niño-Zarazúa, 2016; Michaelowa & Weber, 2006). Nepal, which is a developing nation with considerable socio-economic issues, has gotten enormous aid to reform its educational system particularly school infrastructure, and best teacher training and, at the same time, expand enrollment programs (Heyneman & Lee, 2016).

The effect of the assistance, however, is different in terms of governance, allocation, and efficiency of local needs (Samoff, 2007). The study by Birchler and Michaelowa (2016) indicates that despite the fact that foreign aid increases access, it still fails to be constant in the case of educational quality. The persistent disparities in enrollment and literacy levels in Nepal bring to light the fact that the interventions of education cannot be sustained in the long run

and thus warranting a close examination of the relationship between foreign aid and educational outcomes.

Notwithstanding the many years of foreign aid invested in the Nepalese education sector, the country is still experiencing challenges such as uneven resource distribution, weak institutions, and the rural-urban gap concerning literacy and enrollment rates (Mishra & Aithal, 2021). Although the aid program has made a considerable effort to broaden educational access, its impact on solving the actual core problems as well as the risk of over-reliance on external financing is still due for scrutiny (Michaelowa, 2004; d'Aiglepierre & Wagner, 2013).

Research findings demonstrate that even though enrollment rates have been surging, the literacy outcomes are progressing more slowly due to systemic issues such as the shortage of trained teachers and poor facilities in the countryside (Riddell & Niño-Zarazúa, 2016). Moreover, the congruence of donor priorities with the local demands is frequently ineffective, thus the superiority and efficiency of the aid programs are limited (Samoff, 2007). It has been aimed in this research to examine the long-term consequences of the foreign aid on the youth literacy and enrollment rates, which consequently would reflect the needed policy changes and more effective utilization of aids.

This study aims to assess the impact of foreign aid, government expenditure, and GDP per capita on youth literacy rates and gross enrollment ratios in Nepal. It further seeks to provide evidence-based recommendations to optimize aid allocation for improving access and quality in education. This study contributes to the existing body of literature by bridging theoretical insights with empirical data to assess the effectiveness of foreign aid in Nepal's education sector. Drawing on studies such as Birchler and Michaelowa (2016) and Colclough and De (2010), it highlights the critical need for targeted, sustainable interventions that address both enrollment and literacy challenges.

By focusing on youth literacy and gross enrollment metrics, this study underscores the importance of aligning aid strategies with local socio-economic contexts to foster sustainable educational development. Insights from this research aim to guide policymakers and donors in designing interventions that enhance aid effectiveness, ensuring long-term benefits for Nepal’s education system.

Literature Review

Foreign aid has long been recognized as a critical resource for addressing educational challenges in developing countries. Foreign aid has played a pivotal role in shaping education systems in developing countries, but its effectiveness is often mediated by domestic institutional capacity and governance. Adegboye and Osobase (2021) emphasized that in Sub-Saharan Africa, robust institutional frameworks are critical for translating aid into meaningful educational outcomes, a challenge echoed in many developing regions. Similarly, Kamguia et al. (2022) argue that while foreign aid contributes to development, it can sometimes impede economic complexity, underscoring the need for strategic alignment between aid and local priorities. Shaturaev (2021) highlights disparities in public education systems in Indonesia and

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Uzbekistan, pointing to the role of governance and policy in determining educational success, which remains a crucial factor in evaluating aid effectiveness.

Studies such as Riddell and Niño-Zarazúa (2016) and Michaelowa and Weber (2006) underscored the role of aid in improving access, particularly in expanding school enrollment and infrastructure development. Birchler and Michaelowa (2016) highlighted the dual focus of aid on increasing primary education coverage and enhancing quality, though achieving both objectives simultaneously often proves challenging. Heyneman and Lee (2016) argued that international organizations have historically shaped education systems through funding and policy influence, yet the effectiveness of such aid depends significantly on local governance structures and institutional capacity. In Nepal, aid has facilitated enrollment growth, but its impact on quality outcomes like literacy has been less pronounced, as seen in Mishra and Aithal's (2021) analysis of foreign aid flows.

The effectiveness of foreign aid in improving educational outcomes is a recurring debate in the literature. Michaelowa (2004) and d'Aiglepierre and Wagner (2013) argued that while aid often contributes to improving access, its impact on quality metrics like literacy and teacher training remains inconsistent. Samoff (2007) critiques the systemic inefficiencies of aid programs, noting that misaligned donor priorities and local needs often lead to suboptimal outcomes.

Studies in South Asia, such as Dash et al. (2024), highlighted how aid contributes to capital formation in education but often fails to address systemic issues like regional disparities and inequitable resource allocation. In Nepal, despite significant foreign aid inflows, rural and marginalized communities continue to face barriers to accessing quality education, emphasizing the need for targeted interventions. Foreign aid's effectiveness in education is closely tied to economic factors such as GDP growth and public expenditure. Birchler and Michaelowa (2016) note that aid works best when combined with robust domestic investments in education. Colclough and De (2010) illustrate how aid in India has supported education reforms but also highlight the critical role of economic growth in sustaining these reforms.

Maruta et al. (2020) emphasize that institutional quality significantly influences how aid impacts economic growth and, by extension, education systems. In Nepal, studies by Kharel et al. (2024) highlighted the interplay between remittances, GDP, and school enrollment, suggesting that aid must align with broader economic policies to maximize its impact. The misalignment between donor priorities and local education needs remains a key barrier to aid effectiveness. Samoff (2007) and d'Aiglepierre and Wagner (2013) emphasized that donors often prioritize metrics like enrollment over long-term quality improvements, creating gaps in addressing systemic issues such as teacher training or curriculum development.

Alam and Mohanty (2023) advocate for integrating modern tools like big data analytics to better understand local needs and optimize resource allocation. In Nepal, Mishra and Aithal (2021) argue that the dependency on external aid has sometimes diverted focus from building sustainable domestic education systems. To overcome these challenges, Dash et al. (2024) recommend a collaborative approach involving donors, governments, and local communities. The literature provides valuable insights into designing effective education aid programs.

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Maruta et al. (2020) and Kharel et al. (2024) highlight the importance of economic and institutional factors in enhancing aid effectiveness, suggesting that countries like Nepal must strengthen governance and public finance systems to maximize returns on aid. Acharya et al. (2024b) further emphasize leveraging remittances and domestic resources alongside foreign aid to create a sustainable education system.

Moving forward, aligning donor strategies with national education goals and employing data-driven approaches to decision-making are critical for achieving long-term progress in Nepal's education sector. This literature review synthesizes key findings from diverse studies, offering a comprehensive understanding of the opportunities and challenges associated with foreign aid in education. It highlights the critical need for targeted, aligned, and data-driven strategies to ensure aid effectiveness in improving both access and quality in education systems.

Research Methods

The use of two models is justified to capture different dimensions of school education improvement:

Model I: Youth Literacy Rate (LNYLR)

This model focuses on youth literacy rates as the dependent variable, capturing the broader educational outcomes in terms of literacy skills acquired by the population aged 15–24 years. This measure reflects the cumulative impact of educational interventions and economic factors on the development of foundational literacy.

Model II: Gross Enrollment Ratio (LNGER)

The second model examines gross enrollment ratios as the dependent variable, which directly measures access to education by reflecting the proportion of children enrolled in primary and secondary schools. This indicator helps evaluate how foreign aid, economic growth, and government expenditure influence school participation rates.

The two models collectively provide a holistic view of the education sector by analyzing both access (enrollment) and outcomes (literacy), enabling policymakers to design interventions targeting specific areas of improvement. The research utilizes 33 sets of annual time-series data spanning the period from 1991 to 2023. The study aims to explore both short-term and long-term relationships between the variables through advanced econometric modeling techniques. The data analysis and interpretation are conducted using EViews version 12, a robust statistical software for time-series econometrics.

Econometric Models

Model I: Youth Literacy Rate (LNYLR)

The relationship between youth literacy and its contributing factors is modeled as follows:

$$YLR_t = f(FA_t, GDP_t, GEE_t) \quad \ldots\ldots(1)$$

To establish linear relationships among the variables, logarithmic transformations are applied. This facilitates the calculation of elasticities, providing a clearer understanding of how changes in independent variables influence the dependent variable.

$$LNYLR_t = \alpha+\beta_1 LNFA_t+\beta_2 LNGDP_t+\beta_3 LNGEE_t+\epsilon_t \quad \ldots\ldots(2)$$

Where,

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LNYLR : Logarithm of Youth Literacy Rate (15–24 years, %)
LNFA : Logarithm of Foreign Aid (in million NPR)
LNGDP : Logarithm of Per Capita GDP (USD)
LNGEE : Logarithm of Government Expenditure on Education as % of GDP
ϵt : Error term
βi : Coefficients measuring the elasticities of the independent variables.

Model II: Gross Enrollment Ratio (LNGER)

The relationship between gross enrollment ratio and its contributing factors is modeled as follows:

$GER_t = f(FA_t, GDP_t, GEE_t)$ ……(3)

To establish a linear relationship among the variables, logarithmic transformations are applied to both sides of the equation (3).

$LNGER_t = \alpha+\beta_1 LNFA_t+\beta_2 LNGDP_t+\beta_3 LNGEE_t+\epsilon_t$ ……. (4)

Where,

LNGER : Logarithm of Gross Enrollment Ratio (% for primary and secondary levels)
LNFA : Logarithm of Foreign Aid (in million NPR)
LNGDP : Logarithm of Per Capita GDP (USD)
LNGEE : Logarithm of Government Expenditure on Education as % of GDP
ϵt : Error term
βi : Coefficients measuring the elasticities of the independent variables.

Sources of Data

This research employs both descriptive and analytical methods, relying exclusively on secondary data. The study utilizes data from reputable sources to ensure accuracy and reliability in the analysis of school education improvement in Nepal.

Table 1. *Variables, Abbreviations, Units, and Data Sources Used in Research*

Variable Name	Abbreviation	Unit	Source
Youth Literacy Rate	LNYLR	Logarithm of Youth Literacy Rate (%)	WDI,2024
Gross Enrollment Ratio	LNGER	Logarithm of GER (%)	WDI, 2024
Foreign Aid	LNFA	Logarithm of Foreign Aid (in Million NPR)	QEB, 2024
Per Capita GDP	LNGDP	Logarithm of Per Capita GDP (USD)	QEB, 2024
Government Expenditure on Education	LNGEE	Logarithm of % of GDP	WDI, 2024

Table 1 displays the data for these variables were obtained from the World Development Indicators (2024) and Quaterly Economic Bulitein of Nepal Rastra Bank, April 2024 database, ensuring a comprehensive understanding of the economic context influencing school education improvement in Nepal.

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Econometric Method

This study employs a comprehensive econometric methodology to analyse the factors affecting school education improvement in Nepal using time series data.

Stationery Test

Time series econometric techniques largely depend on the assumption that the variables are stationary. To ensure this, it is essential to examine the stationarity properties of each series. The unit root test helps determine the order of integration for the time series. For the Autoregressive Distributed Lag (ARDL) model to be applicable, the time series must be integrated at either I(0) or I(1). Therefore, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are utilized in this study to identify the order of integration of the variables (Kharel et al., 2024, Acharya et al.2024a & Khatri et al., 2024).

ARDL Model

The Engle-Granger and Johansen models are commonly referenced for co-integration tests 1(Poudel et al., 2024). These traditional methods necessitate that variables are stationary at I(1) while non-stationary at I(0) (Pesaran et al., 2001). In contrast, the ARDL bounds test, proposed by Pesaran and Shin (1995) and further refined by Pesaran et al. (2001), accommodates non-stationary series at different levels, allowing for co-integration testing without prior knowledge of the degree of integration. The ARDL approach offers several advantages:

Simplicity: It allows for verification of co-integration after determining the appropriate lag length.

Flexibility: It does not require preliminary unit root testing, making it suitable for variables that are I(0) or I(1), but not I(2).

Efficiency: It remains effective even with small or limited sample sizes.

ARDL Bounds Test

The ARDL bounds test is employed to identify long-run relationships between the independent and dependent variables, offering distinct advantages over traditional co-integration tests (Poudel, 2022). This method assesses whether the data are integrated at order zero, I(0), or order one, I(1). Once the order of integration is established, an Error Correction Model (ECM) is utilized for further analysis.

Error Correction Model (ECM)

The error correction representation of the ARDL model captures the co-integration among variables and is analyzed through the ECM. The coefficients of the lagged values are used to examine short-run dynamics, providing insights into how deviations from long-run equilibrium are corrected over time (Baltagi, 2008).

Granger Causality Test

To assess the relationships between the variables, the Pairwise Granger Causality Test is employed. This test evaluates whether past values of one variable (x) can predict future values of another variable (y), considering the past values of y. Specifically, the methodology involves regressing y on its own lagged values alongside the lagged values of x. The null hypothesis posits that the coefficients of the lagged values of x are jointly zero. A rejection of this null

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hypothesis indicates that x does indeed Granger-cause y, thereby establishing a predictive relationship between the variables.

Justification for Econometric Approach

The combination of two models and the ARDL framework allows for a comprehensive analysis of school education improvement in Nepal by:

1. **Capturing Distinct Outcomes**: By separately analyzing literacy and enrollment, the study addresses both access and quality dimensions of education.
2. **Accommodating Mixed Integration**: The ARDL model effectively handles the mixed stationarity of time-series data, ensuring robust estimation.
3. **Providing Policy Insights**: The models highlight which factors have the greatest impact on improving education outcomes, enabling targeted interventions.

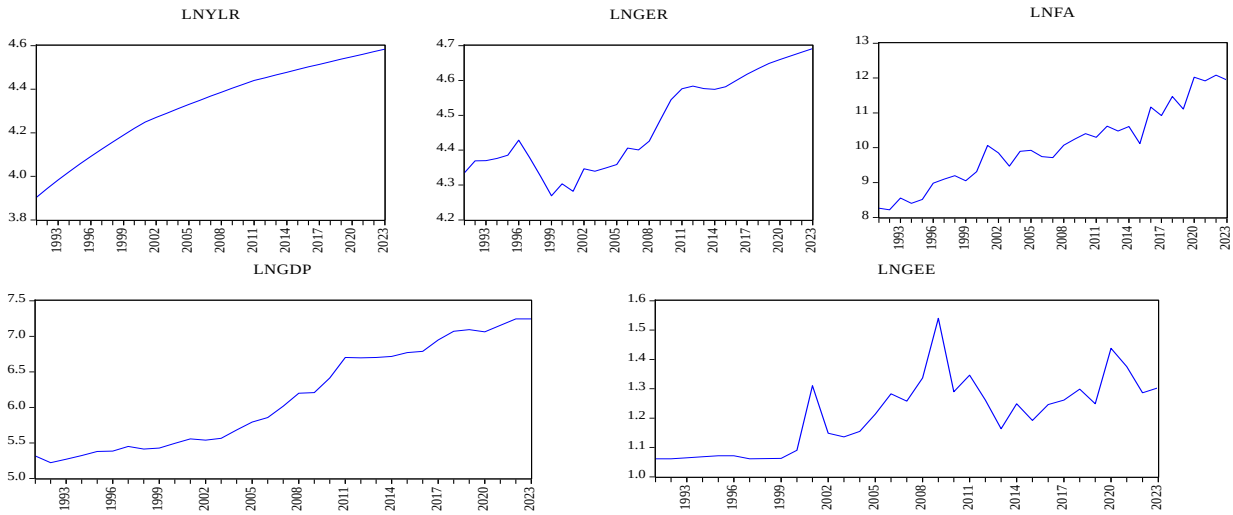
This dual-model approach ensures a nuanced understanding of the role of foreign aid, GDP, and government expenditure on both access (enrollment) and outcomes (literacy) in Nepal's education system.

Data Analysis and Results

4.1 Trends in Key Variables for the Analysis of School Education Improvement in Nepal (1991–2023)

The trends in the key variables under analysis, which include youth literacy rate, gross enrollment ratio, foreign aid, per capita GDP, and government expenditure on education. These variables represent critical drivers of school education improvement in Nepal over the study period from 1991 to 2023.

Figure 1. *Trends in Key Variables for the Analysis of School Education Improvement in Nepal*



Source: *Results from data analysis*

Figure 1 illustrates the trends in key variables influencing school education improvement in Nepal from 1991 to 2023. The logarithm of youth literacy rate (LNYLR) shows a steady upward trajectory, reflecting consistent improvements in literacy outcomes. Similarly, the logarithm of gross enrollment ratio (LNGER) exhibits fluctuations in earlier years, followed by a sustained upward trend, indicating enhanced access to

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education. Foreign aid (LNFA) steadily increases, with peaks corresponding to significant international support periods, such as post-disaster recovery efforts.

Per capita GDP (LNGDP) shows a consistent rise, reflecting economic growth and increased resources for education. However, government expenditure on education as a percentage of GDP (LNGEE) demonstrates variability, with peaks in critical years of heightened policy focus or fiscal adjustments. These trends collectively highlight the interplay of economic, financial, and policy factors in shaping educational outcomes in Nepal, underscoring the relevance of analyzing both short-term dynamics and long-term relationships.

Descriptive Statistics

The descriptive statistics provide a summary of the key variables used in the analysis, including the youth literacy rate (LNYLR), gross enrollment ratio (LNGER), foreign aid (LNFA), per capita GDP (LNGDP), and government expenditure on education as a percentage of GDP (LNGEE). These statistics highlight the central tendencies, dispersion, and distributional characteristics of the data over the study period.

Table 2. *Descriptive Statistics of Key Variables*

	LNYLR	LNGER	LNFA	LNGDP	LNGEE
Mean	4.3255	4.4720	10.0531	6.1418	1.2125
Median	4.3678	4.4259	10.0630	6.0163	1.2462
Maximum	4.5833	4.6916	12.0831	7.2435	1.5398
Minimum	3.9041	4.2689	8.2195	5.2213	1.0613
Std. Dev.	0.1995	0.1359	1.1194	0.7158	0.1246
Skewness	-0.5831	0.2136	0.1811	0.2024	0.4472
Kurtosis	2.1954	1.5271	2.2234	1.4337	2.7029
Observations	33	33	33	33	33

Source: *Results from data analysis*

Table 2 depicts the mean values indicate the average levels of the variables, with the logarithm of youth literacy rate (LNYLR) averaging 4.33 and gross enrollment ratio (LNGER) at 4.47, reflecting steady improvements in education over time. Foreign aid (LNFA) has the highest mean of 10.05, emphasizing its significant role in the education sector, while government expenditure on education (LNGEE) shows a mean of 1.21. The standard deviations reveal variability, with LNFA and LNGDP exhibiting relatively higher variation, reflecting fluctuations in foreign aid inflows and economic growth. The Skewness and Kurtosis values suggest that most variables have near-normal distributions, with slight asymmetry observed for LNYLR and LNGEE. Overall, the statistics capture the dynamic trends and variations in key economic and education-related factors, providing a robust foundation for further econometric analysis.

Table 3. *Correlation Analysis*

Correlation (Probability)	LNYLR	LNGER	LNFA	LNGDP	LNGEE
LNYLR	1.0000				
LNGER	0.8100	1.0000			
	0.0000				
LNFA	0.9429	0.8497	1.0000		
	0.0000	0.0000			
LNGDP	0.9278	0.9559	0.9326	1.0000	

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	0.0000	0.0000	0.0000		
LNGEE	0.7629	0.6113	0.7574	0.7051	1.0000
	0.0000	0.0002	0.0000	0.0000	

Source: *Results from data analysis*

Table 3 presents the correlation analysis among key variables influencing school education improvement in Nepal, including youth literacy rate (LNYLR), gross enrollment ratio (LNGER), foreign aid (LNFA), GDP per capita (LNGDP), and government expenditure on education (LNGEE). The results reveal strong positive correlations between LNYLR and LNGER (0.81), LNFA (0.94), and LNGDP (0.93), highlighting the significant role of school enrollment, foreign aid, and economic growth in improving literacy outcomes. Similarly, LNGER exhibits high correlations with LNGDP (0.96) and LNFA (0.85), indicating that economic prosperity and foreign assistance are critical for expanding access to education.

Foreign aid demonstrates consistently strong correlations with all variables, emphasizing its pivotal role in enhancing both enrollment and literacy rates. While LNGEE shows moderate correlations with LNYLR (0.76) and LNGER (0.61), its impact appears less pronounced compared to GDP and foreign aid, suggesting potential inefficiencies in public spending. Overall, the analysis underscores the interconnectedness of economic growth, foreign aid, and public expenditure in driving school education outcomes, emphasizing the need for strategic policy interventions to maximize their impact.

Unit Root Testing

To implement the bounds testing approach, it is essential that the time series data is integrated at either order zero (I(0)) or order one (I(1)). Consequently, unit root tests are conducted to ascertain the order of integration. This study employs the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to evaluate the stationarity of the following variables: Labor Force Participation Rate (LFPR), GDP growth rate (GDPGR), inflation rate (CPI), population growth rate (PGR), urban population growth rate (UPGR), personal remittances (% of GDP) (REMGR), foreign direct investment (% of GDP) (FDIGR), and the Trade Openness Index (TOI).

Table 4. *Unit Root Test Results*

UNIT ROOT TEST TABLE (PP)						
At Level		**LNYLR**	**LNGER**	**LNFA**	**LNGDP**	**LNGEE**
With Constant	t-Statistic	-19.4443***	-0.0152	-0.3580	0.5242	-2.2517
With Constant & Trend	t-Statistic	-5.8935***	-1.7195	-4.4329***	-2.4884	-3.5591**
Without Constant & Trend	t-Statistic	5.3185	1.9930	5.0641	4.1899	0.3901
At First Difference		d(LNYLR)	d(LNGER)	d(LNFA)	d(LNGDP)	d(LNGEE)
With Constant	t-Statistic	-2.4470	-4.6234***	-24.2352***	-4.8392***	-8.5188***
With Constant & Trend	t-Statistic	-1.1170	-4.6658***	-23.7202***	-4.6937***	-8.3949***
Without Constant & Trend	t-Statistic	-4.8543***	-4.3155***	-8.0034***	-3.1848***	-8.2593***
UNIT ROOT TEST TABLE (ADF)						
At Level		**LNYLR**	**LNGER**	**LNFA**	**LNGDP**	**LNGEE**
With Constant	t-Statistic	-2.3411	0.0872	0.4367	0.5757	-2.3777
With Constant & Trend	t-Statistic	-2.9973	-2.4633	-4.4329	-2.4726	-3.5594**
Without Constant & Trend	t-Statistic	0.5502	2.1556	4.2798	4.3833	0.4866
At First Difference		d(LNYLR)	d(LNGER)	d(LNFA)	d(LNGDP)	d(LNGEE)
With Constant	t-Statistic	-2.0907	-4.5886***	-6.0321***	-4.8310***	-8.0874***

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With Constant & Trend	t-Statistic	-1.1815	-4.7035***	-5.9740***	-4.6773***	-7.9707***
Without Constant & Trend	t-Statistic	-3.8457***	-4.2508***	-1.1488	-1.2265	-8.1399***

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%

Source: *Results from data analysis*

Table 4 presents the results of unit root tests (Phillips-Perron and Augmented Dickey-Fuller) to assess the stationarity of the variables under analysis: youth literacy rate (LNYLR), gross enrollment ratio (LNGER), foreign aid (LNFA), per capita GDP (LNGDP), and government expenditure on education (LNGEE). At the level, LNYLR is stationary under the Phillips-Perron test with constant and constant + trend, indicating its long-term stability and alignment with structural educational policies. LNFA shows partial stationarity with constant + trend, reflecting consistent foreign aid inflows linked to Nepal's development needs.

However, variables such as LNGER, LNGDP, and LNGEE are non-stationary at level, suggesting that school enrollment, economic growth, and government spending are influenced by persistent shocks and long-term trends rather than immediate fluctuations. This necessitates differencing to analyze short-term changes effectively. At first difference, all variables achieve stationarity, with significance at the 1% level under both tests, validating their use in dynamic econometric models such as ARDL.

This study highlights that enrollment, foreign aid, GDP, and government expenditure respond significantly to short-term policy changes, economic conditions, and external shocks. The stationarity of LNYLR and LNFA at the level underscores the long-term consistency of education outcomes and foreign aid, whereas the first-difference stationarity of LNGDP and LNGEE reflects the cumulative nature of economic growth and fiscal adjustments. These findings emphasize the importance of balancing long-term stability with short-term responsiveness in policy design to achieve sustained improvements in Nepal's education sector.

ARDL Long Run Form and Bounds Test

Within the ARDL framework, the co-integrating equation outlines the long-term relationship among the variables being studied. This equation is established when co-integration is detected, signifying that the variables share a common stochastic trend (Poudel, 2023). The hypotheses for the co-integration test are as follows: H0, stating that there is no co-integrating equation, and H1, asserting the existence of a co-integrating equation. To further investigate these long-term relationships, the ARDL Long Run Form and Bounds Test are performed in Table 5.

Table 5. *ARDL Bounds Test Results*

Model	**I**	**II**
Computed F- Statistics	930.7482	4.4684
5% Critical Value(Actual Sample Size)		
Value in Lower Bound	3.164	3.164
Value in Upper Bound	4.194	4.194

Source*: Results from data analysis*

Table presents the ARDL Bounds Test results for Model I (dependent variable: youth literacy rate, LNYLR) and Model II (dependent variable: gross enrollment ratio, LNGER). For Model I, the computed F-statistic (930.7482) significantly exceeds the upper bound critical value (4.194), confirming strong evidence of

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cointegration and a stable long-run relationship between youth literacy and its explanatory variables-foreign aid, GDP per capita, and government expenditure on education.

Similarly, for Model II, the computed F-statistic (4.468) is also greater than the upper bound critical value, indicating the presence of a long-run relationship between the gross enrollment ratio and the explanatory variables. These results suggest that both literacy and enrollment are influenced by sustained changes in economic and financial factors, emphasizing the importance of consistent long-term investments and policy interventions to achieve lasting improvements in education outcomes in Nepal.

Table 6. *Short run Coefficients*

Model	Variable	Coefficient	Std. Error	t-Statistic	Prob.
I	D(LNGDP)	0.0086	0.0032	2.7194	0.0117
	D(LNGEE)	0.0035	0.0029	1.1947	0.2434
	CointEq(-1)*	-0.0632	0.0008	-73.4734	<0.0000
II	D(LNGEE)	0.0521	0.0467	1.1175	0.2740
	CointEq(-1)*	-0.1863	0.0367	-5.0773	<0.0000

Source: *Results from data analysis*

Table 6 highlights the short-run dynamics of the two models: Model I (youth literacy rate, LNYLR) and Model II (gross enrollment ratio, LNGER). In Model I, GDP per capita (D(LNGDP)) has a significant short-run positive effect on youth literacy, with a coefficient of 0.008574 (p = 0.0117), indicating that economic growth directly supports immediate improvements in literacy. However, government expenditure on education (D(LNGEE)) shows an insignificant short-run effect (p = 0.2434), suggesting that public spending often requires time to translate into structural improvements like better teacher quality or school infrastructure. The error correction term (CointEq (-1)) of -0.0632 signifies a slow adjustment speed, with only 6.3% of deviations corrected annually, reflecting the systemic and long-term nature of literacy development.

In Model II, government expenditure (D(LNGEE)) similarly has a positive but insignificant short-run impact (p = 0.2740) on enrollment, which may stem from delays in implementing enrollment-focused programs or inefficiencies in resource allocation. The error correction term (CointEq(-1)) of -0.1862 indicates a faster adjustment speed than in Model I, with 18.6% of deviations corrected annually, highlighting the responsiveness of enrollment rates to short-term interventions. These results suggest that while enrollment can be effectively influenced by immediate measures such as financial incentives or school campaigns, literacy improvements require sustained, long-term investments in education systems and infrastructure. Policymakers must adopt a dual approach- short-term policies to address enrollment challenges and long-term strategies for literacy enhancement.

Table 7 highlights the long-run coefficients for Model I (youth literacy rate, LNYLR) and Model II (gross enrollment ratio, LNGER), analyzing the effects of foreign aid (LNFA), GDP per capita (LNGDP), and government expenditure on education (LNGEE). In Model I, foreign aid has a positive and statistically significant impact on youth literacy (coefficient = 0.0347, p = 0.0207), indicating that targeted aid interventions can effectively improve literacy outcomes by addressing systemic challenges such as infrastructure and teacher quality.

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Long Run Coefficients

Table 7. *Long Run Coefficients*

Levels Equation	Case 2: Restricted Constant and No Trend				
Model	**Variable**	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
I	LNFA	0.0347	0.0140	2.4691	0.0207
	LNGDP	0.0162	0.0211	0.7674	0.4500
	LNGEE	-0.0390	0.0766	-0.5091	0.6151
	C	4.2423	0.1611	26.3289	0.0000
II	LNFA	-0.0883	0.0809	-1.0919	0.2849
	LNGDP	0.2184	0.0986	2.2142	0.0358
	LNGEE	0.9423	0.9159	1.0288	0.3130
	C	2.9293	0.4948	5.9201	0.0000

Source: *Results from data analysis*

However, GDP per capita and government expenditure on education show insignificant relationships, suggesting that while economic growth enhances general well-being, its direct influence on literacy requires complementary policies targeting access and equity. The insignificant effect of public spending highlights inefficiencies in allocation, underscoring the need for reforms to prioritize literacy-specific programs. The significant constant term suggests that non-economic factors, such as cultural attitudes or demographic trends, play a crucial role in literacy outcomes.

For Model II, GDP per capita significantly boosts enrollment (coefficient = 0.2184, p = 0.0358), reflecting how economic growth reduces financial barriers and enables greater access to education. However, foreign aid and government expenditure on education exhibit statistically insignificant effects on enrollment, with foreign aid showing a negative coefficient (-0.0883). This indicates that while aid may support quality improvements, it does not directly translate into increased enrollment, possibly due to inefficiencies or a lack of focus on access-related interventions.

Similarly, the positive but insignificant effect of public spending suggests a need to address allocation inefficiencies and ensure investments target high-impact areas such as financial aid, outreach programs, and infrastructure in underserved regions. The significant constant term again highlights the importance of non-economic factors, such as demographic policies or social norms, emphasizing the need for holistic approaches that integrate economic investments with structural and cultural interventions to improve both literacy and enrollment sustainably.

The Wald test

Table 8. *Wald Test*

Model	Test Statistic	Value	df	Probability
I	F-statistic	2.4613	(5, 25)	0.0605
	Chi-square	12.3066	5	0.0308
II	F-statistic	113.6619	(4, 26)	0.0000
	Chi-square	454.6474	4	0.0000

Source: *Results from data analysis*

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Table 8 presents the Wald Test results for Models I (youth literacy rate, LNYLR) and II (gross enrollment ratio, LNGER), evaluating the joint significance of explanatory variables (foreign aid, GDP per capita, and government expenditure). For Model I, the marginally significant F-statistic (p = 0.0605) and significant Chi-square (p = 0.0308) indicate that the variables collectively influence literacy, though their individual impacts may vary. This suggests that while foreign aid plays a critical role, GDP and government spending may have weaker or indirect effects, requiring targeted strategies to improve literacy outcomes.

In contrast, Model II shows highly significant F-statistic (p = 0.0000) and Chi-square (p = 0.0000), reflecting the strong joint impact of the variables on enrollment. These findings highlight that enrollment is more directly influenced by economic and financial interventions, such as subsidies or infrastructure investments, while literacy requires long-term structural reforms. Policymakers must adopt a balanced approach, combining short-term measures for increasing enrollment with sustained investments to address literacy challenges.

Granger Causality Test

Table 9. *Granger Causality Test Results*

Model	Null Hypothesis:	Obs	F-Statistic	Prob.
I	LNYLR →LNFA	32	7.5992	0.0100
	LNYLR →LNGDP	32	7.4747	0.0106
	LNYLR →LNGEE	32	7.9809	0.0085
	LNGDP →LNFA	32	7.4280	0.0108
	LNGEE →LNGDP	32	5.9219	0.0213
	LNGDP →LNGEE	32	3.8206	0.0603
II	LNGDP →LNGER	32	6.4419	0.0168
	LNGEE →LNGER	32	13.8115	0.0009
	LNGEE →LNGDP	32	5.9219	0.0213
	LNGDP →LNGEE	32	3.8206	0.0603
	LNGDP →LNFA	32	7.4280	0.0108

Source: *Results from data analysis*

Table 9 presents the Granger Causality Test results, highlighting significant interdependencies among the variables in Models I (youth literacy rate, LNYLR) and II (gross enrollment ratio, LNGER). In Model I, literacy (LNYLR) Granger-causes changes in foreign aid (LNFA), GDP (LNGDP), and government expenditure on education (LNGEE), indicates that progress in literacy influences donor decisions, economic growth, and public spending priorities. These findings align with the human capital theory, as improved literacy enhances labor productivity, driving economic growth and motivating increased investment in education.

Additionally, government spending on education Granger-causes GDP growth, reflecting the critical role of educational investments in fostering long-term economic development. The interdependencies among independent variables, such as LNGDP influencing LNFA, suggest that economic performance guides donor funding decisions. In Model II, GDP (LNGDP) and government expenditure on education (LNGEE) significantly Granger-cause enrollment

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(LNGER), emphasizing the importance of economic growth and public spending in improving school access. Government spending has the strongest impact on enrollment, underscoring the importance of well-targeted investments in infrastructure, teacher training, and financial aid programs to enhance school participation.

The feedback loop between LNGDP and LNGEE further demonstrates the symbiotic relationship between economic growth and education investment, where economic prosperity increases public resources for education, and educational improvements contribute to sustained economic growth. These findings highlight the need for integrated policies that harness these dynamics, combining targeted educational investments with inclusive economic growth strategies to achieve long-term educational and economic progress.

Diagnostics and Stability Tests

Diagnostics and stability tests are essential for validating model assumptions, detecting issues, assessing parameter stability, ensuring robustness, improving model specification, and avoiding invalid inferences. They are integral to credible and accurate econometric analysis, ensuring that findings and recommendations are based on sound and reliable models.

Table 10. *Diagnostics and Stability Tests*

	Model -I		***Model-II***	
Diagnostics	**Statistics**	**p-value**	**Statistics**	**p-value**
Normality(J-B)	1.1166	0.5722	0.2754	0.8714
Serial Correlation $\chi^2(2)$	12.4321	0.0020	0.6322	0.7290
B-P-G Test(Scaled explained SS)	6.6778	0.3517	7.3125	0.1984
Ramsey RESET(F_{STAT})	2.0401	0.1661	949382	0.3392
CUSUM Test	Stable		Stable	
CUSUM of Square Test	Stable		Stable	

Source: *Results from data analysis*

Table 10 presents diagnostic and stability test results for Models I (youth literacy rate, LNYLR) and II (gross enrollment ratio, LNGER). The normality test (Jarque-Bera) confirms that residuals are normally distributed for both models, ensuring unbiased and consistent parameter estimates, which are essential for reliable policy analysis (See Figure 2 & Figure 3). Heteroscedasticity tests (Breusch-Pagan-Godfrey) indicate no evidence of non-constant variance in residuals, confirming the robustness of the models for forecasting (See Table 13 & Table 14). Similarly, the Ramsey RESET test reveals no functional form misspecification in either model, suggesting that the relationships among variables are adequately captured (See Table 15 & Table 16).

However, Model I exhibits serial correlation ($p = 0.0020$), indicating potential inefficiencies in capturing all relevant dynamics affecting literacy, while Model II does not ($p = 0.7290$), making it more reliable for immediate policy applications (See Table 11 & Table 12). The stability tests (CUSUM and CUSUM of Squares) confirm that both models remain stable over the sample period, ensuring consistent relationships between the dependent and independent variables (See Figure 4 & Figure 5).

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This stability makes Model II particularly suitable for designing and evaluating policies to improve enrollment rates, as its results are reliable for both short-term and long-term planning. In contrast, the presence of serial correlation in Model I suggests that the dynamics influencing literacy, such as cultural or demographic factors, might not be fully accounted for. To improve Model I, policymakers and researchers should consider incorporating additional explanatory variables to enhance its predictive power. These results emphasize the need for continuous refinement of econometric models to ensure their accuracy and relevance in guiding education policies and resource allocation.

Discussions

This study provides a comprehensive analysis of the impact of foreign aid, GDP per capita, and government expenditure on youth literacy rates and gross enrollment ratios in Nepal. Consistent with Riddell and Niño-Zarazúa (2016), the findings affirm the significant role of foreign aid in improving long-term literacy outcomes through targeted interventions such as infrastructure development and teacher training. However, short-term impacts of foreign aid on literacy remain limited, echoing concerns raised by Michaelowa (2004) regarding inefficiencies in aid allocation.

Similarly, GDP per capita significantly influences enrollment rates, aligning with Birchler and Michaelowa (2016) has assertion that economic growth reduces financial barriers to education. Yet, its impact on literacy is less pronounced, contrasting with findings by Colclough and De (2010), who emphasize the role of economic growth in enhancing both access and quality. Moreover, consistent with Samoff (2007), this study highlights that government expenditure has limited impact on educational outcomes, pointing to inefficiencies in resource utilization.

The Granger causality results reveal significant interdependencies among literacy, GDP, and foreign aid. This study uniquely demonstrates that literacy improvements influence donor decisions, emphasizing the reciprocal relationship between educational outcomes and foreign aid flows. Furthermore, similar to d'Aiglepierre and Wagner (2013), the findings show that aid primarily supports enrollment growth, often at the expense of structural quality improvements. While enrollment responds quickly to short-term policies, as seen in Dash et al. (2024), literacy requires sustained, systemic investments. These findings reaffirm the importance of aligning foreign aid strategies with local priorities, as suggested by Alam and Mohanty (2023), and highlight the need for integrated policies that address both access and quality challenges in Nepal's education sector.

Conclusion

This study critically examines the impact of foreign aid, GDP per capita, and government expenditure on youth literacy rates and gross enrollment ratios in Nepal. The findings underscore the long-term significance of foreign aid in improving literacy outcomes, though its short-term effects remain limited due to inefficiencies in allocation. GDP per capita emerges as a significant determinant of enrollment, reinforcing the role of economic growth in reducing financial barriers to education. However, the limited impact of government expenditure highlights inefficiencies in resource utilization and a need for better-targeted investments.

These results align with the human capital theory, which posits that investments in education enhance productivity and economic development, while also extending its application by exploring the reciprocal effects of educational outcomes on economic factors like foreign aid allocation. The findings have critical policy implications for improving aid effectiveness and resource utilization in Nepal's education sector. First, targeted interventions should prioritize both access (enrollment) and quality (literacy) to achieve balanced outcomes. This requires better alignment between donor priorities and local educational needs, as evidenced by the reciprocal relationship between literacy improvements and foreign aid inflows.

Second, GDP growth should be leveraged to fund sustainable education programs, reducing dependency on external aid over time. Finally, inefficiencies in government expenditure must be addressed by improving accountability, equity in resource distribution, and investments in high-impact areas such as teacher training and curriculum development. These steps can ensure that aid and domestic resources work synergistically to enhance educational outcomes.

This study contributes to the existing literature by exploring the bidirectional relationship between educational outcomes and economic variables, particularly foreign aid. Additionally, it provides new insights into the differential impacts of GDP and government expenditure on enrollment and literacy, emphasizing the importance of targeted and context-specific policy interventions. Future studies should explore the impact of foreign aid on education in greater depth by incorporating demographic factors such as gender and rural-urban disparities.

Authors Contribution

Dr.Bisna Acharya: Dr. Acharya has the contribution on conceptualization, writing review and editing and formal analysis.

***Omkar Poudel*:** Mr.Poudel has contributed in data curation, research methodology, formal analysis and writing original draft.

Pradeep Acharya: Mr. Acharya has supported in data modeling and analysis and project management.

Dr.Khom Raj Kharel: Dr.Kharel has supported in conceptualization, formal analysis and original writing and editing the final manuscript.

Dr. Suman Kharel: Dr. Kharel has contributed in review and editing, project administration and data curation.

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Annexes

Table 11. Serial Correlation Test for Model-I

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	7.306292	Prob. F(2,23)	0.0035
Obs*R-squared	12.43208	Prob. Chi-Square(2)	0.0020

Table 12. *Serial Correlation Test for Model II*

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.241867	Prob. F(2,24)	0.7871
Obs*R-squared	0.632236	Prob. Chi-Square(2)	0.7290

Table 13. *Heteroskedasticity Test: Breusch-Pagan-Godfrey for Model* I

F-statistic	3.411919	Prob. F(6,25)	0.0134
Obs*R-squared	14.40657	Prob. Chi-Square(6)	0.0254
Scaled explained SS	6.677804	Prob. Chi-Square(6)	0.3517

Table 14. *Heteroskedasticity Test: Breusch-Pagan-Godfrey for Model II*

F-statistic	2.239793	Prob. F(5,26)	0.0804
Obs*R-squared	9.633786	Prob. Chi-Square(5)	0.0863
Scaled explained SS	7.312475	Prob. Chi-Square(5)	0.1984

Table 15. *Ramsey RESET Test for Model I*

	Value	**df**	**Probability**
t-statistic	1.428309	24	0.1661
F-statistic	2.040067	(1, 24)	0.1661
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	5.51E-06	1	5.51E-06
Restricted SSR	7.04E-05	25	2.82E-06
Unrestricted SSR	6.49E-05	24	2.70E-06

Table 16. *Ramsey RESET Test for Model II*

	Value	**df**	**Probability**
t-statistic	0.974363	25	0.3392
F-statistic	0.949382	(1, 25)	0.3392
F-test summary:			
	Sum of Sq.	**df**	**Mean Squares**
Test SSR	0.000597	1	0.000597
Restricted SSR	0.016317	26	0.000628
Unrestricted SSR	0.015720	25	0.000629

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Figure 2. *CUSUM Test for Model I*

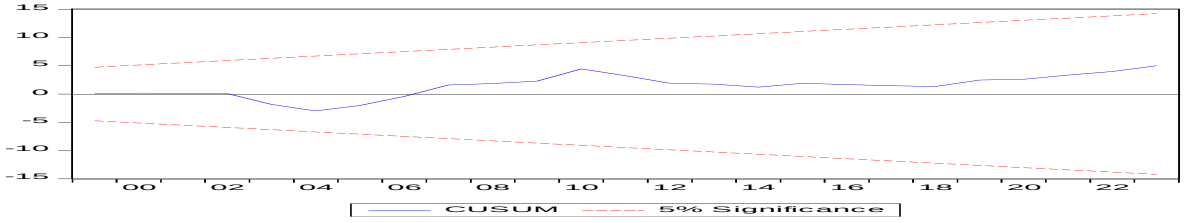

Figure 3. *CUSUM Test for Model II*

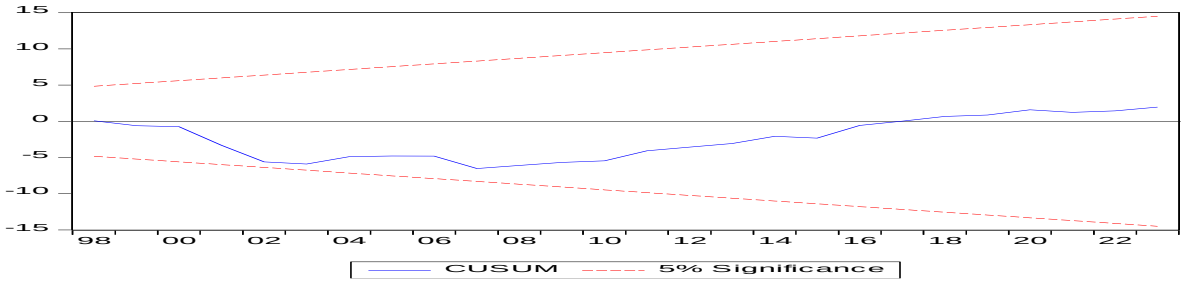

Figure 4. *CUSUM of Squares Test for Model I*

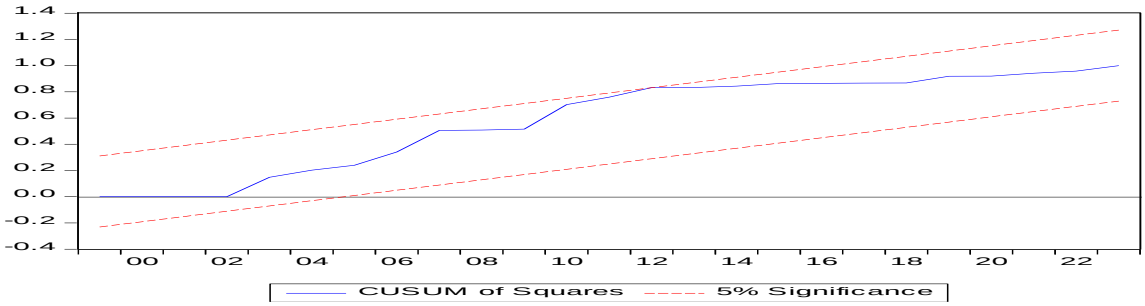

Figure 5. *CUSUM of Squares Test for Model II*