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INSTITUTIONAL QUALITY AND GREEN GROWTH NEXUS IN NEPAL: EVIDENCE FROM COINTEGRATION ANALYSIS WITH A STRUCTURAL BREAK

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ABSTRACT

The greening economy is a growing body of research in recent academia. Experiencing green growth is the precondition of sustainable development and can be promoted by maintaining quality institutions, this paper attempts to examine the relationship between institutional quality and green growth in Nepal. This study employs Gregory-Hansen cointegration with structural break test and residual-based Engle-Granger cointegration test with a time series spanning from 1996 to 2021 to examine the association among variables. After the cointegration test, this study applies ordinary least squares (OLS) for long-run and error correction mechanisms (ECM) for short-run dynamics with a break dummy series referencing 2005. The results revealed that there was a long-run association among variables with the existence of structural breaks. The OLS and ECM highlighted the negative impact of institutional quality on green growth in Nepal. Similarly, financial development negatively and trade openness positively impacted green growth in both the short and long run. On the flip side, findings indicated that electricity access could not influence green growth significantly in Nepal. Overall findings thus demonstrate the existing institutional quality may not be sufficient to promote green growth in Nepal. Moreover, the findings offer insights for policymakers to enhance institutional quality, promote green finance and technology, encourage green agriculture and indigenous techniques, and adopt renewable energy to support

green growth, enforce environmental standards, and mitigate carbon emissions for sustainable economic development in Nepal.

Keywords*:* green economy, regime shifts, climate change, green finance, sustainable development

JEL classification*:* D02, F43, H11, O43, O44, Q01, Q54

INTRODUCTION

Green growth refers to the expansion of economic activities both in the short and long term while preserving natural resources. For example, according to the Organization for Economic Cooperation and Development (OECD, 2011) green growth means achieving higher economic growth and development while safeguarding natural resources which is essential for human well-being. The ideology of green economic growth emerged as a key focus at the Rio+20 conference on sustainable development in 2012 and it was a major element in the final document (United Nations Sustainable Development, 2012) which concurrently highlighted the green economy and sustained economic growth. Since then, green growth has emerged as a leading approach in response to the escalating warning about climate change and environmental degradation (Dale *et al.,* 2016). Further, many sustainable development goals (SDGs) are related to accomplishing green development which suggests that environmental conservation and economic expansion go in the same and flourishing direction (Osabohien *et al.,* 2023). However, the concurrent evidence suggests that there exists a directly proportionate relationship between economic growth and environmental degradation specifically in developing nations (Scott *et al.,* 2013).

Development today is pursued in the face of interrelated crises involving climate change, economic challenges, and enduring poverty (Elliott, 2013). Institutional quality thus surpasses the present development paradigm thereby greening the economy. Nepal is a landlocked country located in highly rugged and mountainous terrain facing complex development challenges due to recurring natural disasters, including those related to climate variability and change, which form a key barrier to social and economic development in Nepal; despite these challenges, Nepal aspires to make notable economic progress and be an active player in the outside world on climate change (Global Green Growth Institute, 2017). Global warming and climate change are already causing increased floods, heat stress on labor and crop productivity, and excluding the marginalized

and women from the development stream requiring policy action to excel in Nepal's human development and growth. For instance, in August 2024 a glacial lake burst in the Mount Everest region displacing hundreds of people and climate change is further inflaming the risk (Khadka, 2024). Additionally, the country aims to create a climate-resilient society and attain socioeconomic prosperity by committing to SDGs (Raihan & Tuspekova, 2022).

As such to cope with climate change and sustainability green growth can play a vital role. For instance (Baniya *et al.,* 2021) state that the idea of a green growth model is emerging as a prominent option to the orthodox growth model and is becoming increasingly popular in the global development space. The World Bank (WB), the Organization for Economic Cooperation and Development (OECD), and the Green Growth Knowledge Platform have generated some significant reports on how theoretical advancements in green growth can be effectively implemented into practice (Hellegatte *et al.,* 2011). Thus, considering the significance of green growth, the inquiry of how to attain green growth has motivated numerous scholars to investigate this area (Chan *et al.,* 2016).

One of the ways to achieve green economic growth is to have efficient and effective institutional quality (Ahmed *et al.,* 2022; Karim *et al.,* 2022). The institutional quality includes the set of rules and regulations, and their enforcement capability and well-established institutions stimulate economic activities while protecting the environment (Salman *et al.,* 2019). Institutional factors like government regulations, the rule of law, and political stability among others are believed to significantly impact the effectiveness of environmental policies to safeguard the environment (Karim *et al.,* 2022). However, it is contingent on how efficient these institutions are in enforcing such policies (Bhattacharya *et al.,* 2017).

There are ample previous studies linking the impact of institutional quality and economic growth (Campos *et al.,* 2020). However, there is a lack of studies on the impact of institutional quality on green economic growth (Ahmed *et al.,* 2022). Moreover, few studies have considered the multifaceted impact and examined the effect of institutional quality on green economic growth especially in the case of Nepal. Moreover, the implication of the study will offer insight to the policymakers to enhance institutional quality, promote green finance and technology, encourage green agriculture and indigenous techniques, and adopt renewable energy to support green

growth, enforce environmental standards, and mitigate carbon emissions for sustainable economic development in Nepal.

Thus, this paper examined the relationship between institutional quality and green growth to contribute to the extant literature. We empirically examined relevant Nepalese data from 1996 to 2021. Our study introduces two key innovations. First by examining Nepal, we highlight the often-overlooked research area on the influence of institutional quality on green growth in the developing country. Second, we analyzed the relative significance of the Nepalese institutional quality and its indicators for green growth which provides a reference for improving institutional quality and its influence and promoting green growth in Nepal. Finally, the paper is divided into four additional sections except the introduction, namely, literature review, materials and method, results and discussion, and conclusion and implication.

LITERATURE REVIEW

The concept of green growth has become a significant policy approach in addressing climate change and environmental degradation. According to the green growth theory, ongoing economic growth can be aligned with the planet's ecological health, as advancements in technology and resource substitution are expected to enable the decoupling of GDP growth from resource consumption and carbon emissions. This notion is currently reflected in both national and international policies, including sustainable development goals (Hickel & Kallis, 2019).

A revision of standard growth theory identifies the contribution made to growth by investment in natural capital and the correction of a variety of market failures. Solow's Growth theory, theory of comparative advantage and long waves of capitalism emphasize the importance of technological innovation in generating growth (Jacobs, 2013). These theoretical concepts relating to green growth are supportive of empirical review.

As we examined the previous literature review, institutional quality influences on the country's ecological preservation and socioeconomic improvement. Cherniwchan (2012) developed a simple two-sector model of neoclassical growth and environment in a small open economy to examine how industrialization affects environment and green growth. The study found that the process of industrialization is a significant determinant of observed change. Pan *et al.* (2019) investigated how industrial structure and

energy consumption patterns influence the green economy using a vector auto-regression model and findings revealed that the impact of China's industrial structure and energy consumption on green economic growth is short-lived, typically lasting around four years.

Kim (2006) found that the environmental impact of industrialization in East Asia suggests the region is not on a path to sustainability, and the current rate of economic growth is unsustainable for the environment. Likewise, Mahmood (2022), explored the effects of economic indicators such as industrialization, urbanization, economic growth and trade openness on pollution emission in Gulf Cooperation Council (GCC) and found that trade openness and economic growth are helping the GCC region to follow the track of green and circular economies. Industrialization and urbanization accelerate emissions in the long run however no harm could in the short run.

Degbedji *et al.* (2024) explored the influence of institutions on green economic growth in the West African Economic and Monetary Union (WAEMU) countries, aiming to contribute to the sustainable development goal of good health and well-being, and found that the impact of institutional quality varies across countries and positively affects green economic growth. Furthermore, Zakaria and Bibi (2019) conducted an empirical evaluation of how institutions shape environmental quality in South Asian Economies and found a favorable effect. Ali *et al.* (2019) found that quality institutions contribute positively to improving environmental quality and economic growth. Likewise, Gani (2011) analyzed the data from developing countries and found that corruption control is one of the components of institutional quality and it helps to increase economic growth. Ahmed *et al.* (2022) explained the role of institutional quality financial development in green economic growth and concluded that institutional quality and financial development improve long-term economic growth.

In a nutshell, the study concludes from the review that most of the reviews are associated with industrialization, good governance, and green economic growth separately. As per our knowledge, only a few studies were found on panel studies, incorporating institutional quality and green growth, and very limited country-specific studies about it. On the other hand, with our knowledge, only limited studies were found but these were based on document studies, and other than time series studies whatever we have been exploring. Based on two empirical studies on panel data including Degbedji *et al.* (2024) and Ahmed *et al.* (2022), this paper attempts to fill

the empirical gap and sufficiently uncover issues in the Nepalese context by employing time series data with different cointegration methods and ECM techniques to explore institutional quality and green growth nexus in Nepal.

MATERIALS AND METHOD

Data and Variables of Interest

This study attempts to evaluate the institutional quality and green growth nexus in Nepal. The data were collected from the World Development Index (WDI) and the World Governance Indicators (WGI) of the open databank of the World Bank (https://databank.worldbank.org/source/world-development-indicators#), spanning from 1996 to 2021 as per the availability of data. Following the prior empirical studies (Ahmed *et al.,* 2022; Degbedji *et al.,* 2024; Sohag *et al.,* 2019;), the study computed green growth as the difference between annual GDP growth plus government expenditure on education and summation of CO2 emission, fossil fuel energy consumption, net forest depletion, and net energy depletion; and was taken as dependent variables. On the other hand, institutional quality, a predictor, was measured as an index by accompanying six domains of governance indicators—corruption control, rule of law, regulatory quality, political stability, and government effectiveness—by principal component analysis (PCA), following the Degbedji *et al.* (2024), Khan *et al.* (2020), and Panthi and Devkota (2023). The description of the outcome variable and other regressors are presented in Table 1.

Model Specification and Econometric Procedures

This study employed the cointegration analysis with structural breaks and finally estimated the error correction model with breaks. The study applied a linear interpolating technique to fill the missing data in a time series. The study was based on the following general functional specifications in the context of Nepal, following the empirical panel studies by Ahmed *et al.* (2022) and Degbedji *et al.* (2024)

$$GG = f(IQ, FD, EC, TO)$$

Before executing the break cointegration and error correction model, the study inspected unit root in the time series. The study applied the augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979, 1981) and the Phillips and Perron (1988) tests to confirm the order of integration in the series.

Table 1

Descriptions of Variables of Interest

Variables	Proxies	Description	Sources
GG	Green growth	Computation as: GG = GDP + EE – CO2 – FEC – NFD – NED Here GDP = GDP (% annual growth), CO2 = CO2 emissions (% of total fuel combustion), EE = Government expenditure on education (% of GDP), FEC = Fossil fuel energy consumption (% of total), NFD = Net forest depletion (% of GNI), NED = Net energy depletion (% of GNI)	WDI
IQ	Institutional quality	Principle components of control of corruption, regulatory quality, voice and accountability, rule of law, political stability and absence of violence, and government effectiveness, ranging index ranging -2.5 to +2.5	WGI
FD	Financial development	Domestic credit to private sector by banks (% of GDP)	WDI
EC	Electricity consumption	Access to electricity (% of population)	WDI
TO	Trade openness	Total trade (% of GDP)	

Gregory and Hansen Cointegration with Structural Break Test

As per the intended outcome of the study, this paper utilized Gregory-Hensen (GH) cointegration tests for structural breaks. Gregory and Hansen (1996) proposed three test statistics—ADF, Z_t, and Z_α—to test no cointegration against the alternative hypothesis of having cointegration, allowing a prospective regime shift. Gregory and Hansen (1996) used the standard cointegration model without structural change for the observed data is y, = (y_{1t}, y_{2t}).

$$Y_{1t} = \mu + \alpha^T Y_{2t} + e_{t;} \qquad t = 1, 2, \ldots, n$$

In the GH model, structural change can be represented by shifts or changes in the intercept (μ) or slope (α), making it helpful to introduce a dummy variable for modeling these changes (Gregory & Hansen, 1996).

$$\phi_{t\tau} = t \leq [n\tau], 1 \text{ if } t > [n\tau],$$

Where τ(0, 1) denotes the dummy for the relative timing of the change point. Gregory and Hansen (1996) suggested three cointegration models—level shift (C), level shift with trend (C/T), and regime shift (C/S)—with structural changes, allowing dummy variables as estimated in the following three equations respectively. In these models, μ_1 and μ_2 indicate the intercept before and after shift respectively.

Level shift (C): $Y_{1t} = \mu_1 + \mu_2\phi_{t\tau} + \alpha^T Y_{2t} + e_{t;}$ $t = 1, 2, \ldots, n$

Level shift with trend (C/T): $Y_{1t} = \mu_1 + \mu_2\phi_{t\tau} + \beta t + \alpha^T Y_{2t} + e_{t;}$ $t = 1, 2, \ldots, n$

Regime shift (C/S): $Y_{1t} = \mu_1 + \mu_2\phi_{t\tau} + \alpha_1{}^T Y_{2t} + \alpha_2{}^T Y_{2t} + e_{t;}$ $t = 1, 2, \ldots, n$

The GH cointegration tests for structural breaks thus confirmed the existence of structural breaks in the series and offered an insight to build a dummy variable ($\phi_{t\tau} = D_t$) which was used to further estimate of long-run and error correction model (ECM) as a regressor.

Residual-Based Cointegration Test

This study applied Engle and Granger (1987) two-step (EG) residual cointegration methods to examine the cointegration between institutional quality and green growth in Nepal. If the time series is stationary after the first differencing, the cointegration test of the residual series of linear ordinary least squares (OLS) can be applied for the long-run association between variables of interest via the ordinary unit root process (Engle & Granger, 1987).

The long-run OLS estimation was based on the following equations.

$$GG_t = \phi_0 + \phi_1 IQ_t + \phi_2 FD_t + \phi_3 EC_t + \phi_4 TO_t + D_t + \epsilon_t$$

For the EG two-step cointegration, the unit root test for the residual or error of the long-run estimation was employed with the null of no cointegration against the alternative hypothesis of cointegration or long-run relationship. In the aftermath of the cointegration test, the short-run estimation was obtained by OLS of differencing variables with lagged value error correction representation(residual) as an error correction model (ECM).

$$\Delta GG_t = \phi_0 + \phi_1 \Delta IQ_t + \phi_2 \Delta FD_t + \phi_3 \Delta EC_t + \phi_4 \Delta TO_t + \Delta D_t + ECT_{t-1}$$

RESULTS AND DISCUSSION

Statistical Summary of Variables of Interest

The statistical summary of the variables under study provides a great outlook on the nature, distribution, central value, variations, skewness, and tailedness of the distribution of the time series. Table 2 shows the negative green growth with slightly higher variations from the mean with fat-tailed distribution in Nepal. Similarly, institutional quality was a mix of both positive and negative indexes, varying relatively low with thin-tailed distribution in Nepal. Financial development and trade openness, however, were similar sets of distribution where the former was more varied from its mean value. Additionally, electricity consumption, indicating access to electricity, spans from 17% to 93% approximately during the study periods.

Table 2

Statistical Summary of Variables of Interest

	Green growth (*GG*)	Institutional quality (*IQ*)	Electricity consumption (*EC*)	Financial development (*FD*)	Trade openness (*TO*)
Mean	-9.780950	-7.69E-09	58.16511	47.69178	47.29119
Median	-6.431012	-0.230956	57.65000	47.20930	46.01055
Maximum	-0.329134	1.989176	93.90000	103.5260	64.03550
Minimum	-36.73446	-1.449113	17.90000	22.50920	36.29680
Std. Dev.	9.836321	1.000001	26.33985	22.53418	6.455461
Skewness	-1.487889	0.799438	-0.125558	0.761468	0.815890
Kurtosis	4.198363	2.656873	1.565247	2.707182	3.336982

Figure 1

Green Growth and Institutional Quality Index of Nepal From 1996 to 2021

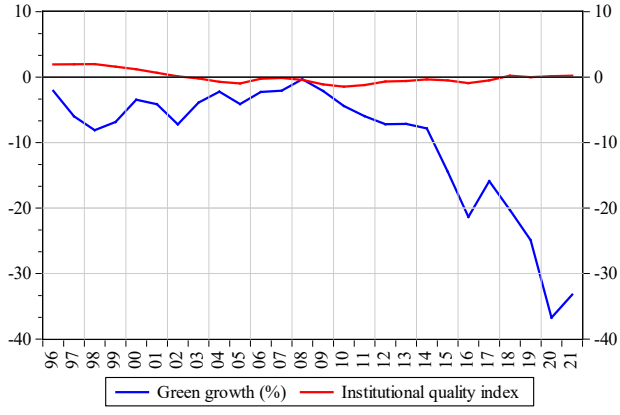


Figure 2 shows the trend of growth of green and institutional quality in Nepal from 1996 to 2021, indicating deteriorating green growth and institutional quality in Nepal. The green growth gradually fell until 2005, then fluctuated, and recently from 2018, it has been pretty improving. Conversely, institutional quality fluctuated upward until 2008, thereafter, it jumped downward till the date. Nepal experienced so many political, social, and administrative reformations after the global financial crisis 2007-09. With the political shift in Nepal, the corruption index rose and other institutional distress rose significantly. Nepal has been facing several challenges to improve institutional quality as Shrestha (2019) reported that major challenges in combating corruption in Nepal include poor enforcement of rules, weak oversight institutions, increasing impunity due to insufficient legal actions, widespread bribery in business operations, and corruption cases often remaining unpunished. Thus, these findings offer an insight into having structural breaks in the time series of the variables of interest during the study periods.

Table 3

Results of ADF and PP Unit Root Tests

Variables	Augmented Dickey-Fuller test (ADF)				Phillips–Perron test (PP)				Order of integration
	At level		At Δ		At level		At Δ		
	C	C & T	C	C & T	C	C & T	C	C & T	
GG	1.067	1.830	0.269	-6.285***	0.814	-0.484	-4.747***	-10.513***	I(1)
IQ	-2.505	-1.524	-3.400**	-4.580***	-2.032	-0.866	-3.122**	-3.969**	I(1)
EC	-3.760**	-0.130	-0.047	0.494	-0.973	-2.452	-8.811***	-9.610***	I(1)
FD	1.674	-1.041	-3.160**	-3.621**	1.674	-0.568	-3.160**	-3.625**	I(1)
TO	-3.289**	-3.170	-5.685***	-6.057***	-2.091	-2.171	-5.516***	-10.394***	I(1)

Note: C = with constant; C & T = with constant and trend; Δ = first difference; * indicates significant at 10%; **significant at 5%; and *** significant at 1%.

Stationarity of the Time Series

This study employed ADF and PP traditional unit roots (URs) to test whether a series is stationary or not stationary. The study examines the linear relationship between institutional quality and green growth in Nepal. Thus, unit root tests are a precondition to execute this model. It is observed that in the AR(1) model $y_t = \alpha+\rho y_t-1 + v_t$, y_t, a series, is nonstationary if $\rho = 1$ and stationary if $|\rho| < 1$(Hill *et al.,* 2018). Table 3 demonstrates the ADF and PP URs results. The ADF and PP URs results indicated that all variables

under study were stationary with first differencing. Pesaran (2015) states that a process (y_t) is termed difference stationary, or an integrated process if it can be transformed into a covariance stationary process by differencing *d* times, where *d* is the order of integration denoted as $y_t \sim I(d)$. Thus, ADF and PP URs tests implied the I(1) order of integration of all series that allows us to apply EG cointegration and GH cointegration with structural breaks.

Gregory-Hensen Cointegration with Structural Breaks

This study employed GH cointegration which allows a structural break. There are three GH test statistics and the study considered only two models, C and C/T, having null of no cointegration with structural break against the alternative hypothesis of cointegration between variables of interest allowing structural break. Table 4 reports the findings of GH test statistics.

Table 4

Gregory-Hensen Cointegration with Structural Breaks

Model	Gregory-Hensen test	Test statistics	Breakpoint	Break date
Level	ADF	-7.00***	10	2005
	Z_t	-5.54*	11	2006
	Z_α	-29.01	11	2006
Level and trend	ADF	-8.29***	10	2005
	Z_t	-5.29	11	2006
	Z_α	-28.01	11	2006

Note: * indicates significant at 10%; **significant at 5%; and *** significant at 1%.

The results confirmed that the ADF test statistics in both C and C/T models were significant at a 1% significance level with the presence of common break data 2005, indicating there was cointegration and long-run association between the variables evidencing a structural break. However, other statistics were not significant, and without experiencing of a structural break. In the periphery of 2005, Nepal experienced a massive confrontation between three powerhouses—the monarchy, the parliamentary parties, and the Maoists (Boquérat, 2006). The global price movement created severe inflationary pressure in the economy via oil price hikes; and since 2005, value-added tax (VA) rose from 10% to 13% pressurized the whole economic performance in Nepal (Nepal Rastra Bank [NRB], 2006; NRB, 2007). To some extent, these particular incidents may be significant to

evidence of the specific structural break point in Nepal. The study generated a new dummy series (D_t) assigning 0 for before-change data and 1 for after-change data. This study introduced the dummy variable as a regressor to estimate the short- and long-run relationship between institutional quality and green growth. Initially, to validate the long-run cointegration, the EG residual-based cointegration was also employed to confirm the long-run relationship among variables.

Engle-Granger Cointegration with Break Dummy

Before EG cointegration, the OLS model with break dummy was estimated and the results were robust statistically which was presented in Table 5. The residual series obtained from the OLS was used to test the EG cointegration with traditional URs tests for null of residual having unit root (no cointegration) against alternative hypothesis of having no unit root or cointegration among variables. The EG test statistic ($t_{statistic}$ = 4.407794, p = 0.0001) showed initial cointegration among variables at 1% level of significance. However, this p-value is not sufficiently reliable and the critical value, C(p,T), based on MacKinnon (2010) can be obtained by using the formula: $C(p,T) = \beta_\infty + \beta_1 T^{-1} + \beta_2 T^{-2} + \beta_3 T^{-3}$. The asymptotic critical value for cointegration for m = N = 5 at 10% = -4.13 is less than $t_{statistic}$ of ADF residual unit root confirming that there was cointegration among variables of interest at 10% level of significance. However, GH cointegration test showed the cointegration with structural breaks between variables in the estimated model.

Both GH and EG cointegration tests confirmed the long-run association between institutional quality and green growth. This result were consistent with the previous studies (Ahmed *et al.,* 2022; Degbedji *et al.,* 2024). It is quite logical that institutional quality perceptions may promote sustainable economic activities by mitigating carbon emission standards and being cautious about resource depletion in the long run. Concerning electricity consumption, financial development, trade openness, and structural break, good governance, rule of law, lower corruption perception, regulatory quality, and political stability may ensure the green growth level in Nepal in the long run. Institutional quality was thus able to enhance green financial development, alternative energy innovation, green technology policy enactment, and environmental risk awareness and resilience, thereby improving green growth.

Short- and Long-run Dynamics

After cointegration tests, this paper employed the OLS and error correction models to examine the short- and long-run relationship between institutional quality and green growth in Nepal. The OLS results of Table 5 show the long-run relationship between green growth and institutional quality in Nepal. The OLS results were statistically robust. R^2 indicated the approximately 86% variance in dependent variables can explained by regressors. Similarly, statistically significant F-statistics showed that the overall model was best fitted and well-predicted. Moreover, DW statistics is 1.532225 for long-run, indicating the model was free from autocorrelation. Furthermore, the long-run estimation was free from serial correlation and heteroskedasticity; and the residual was normally distributed. On the other hand, a positive and significant dummy variable offered an insight that a structural break and break model was suitable for the long-run analysis which had a positive impact on green growth.

The long-run estimation: $GG_t = -10.15 - 4.32\text{IQ}_t - 0.13EC_t + 0.37FD_t + 0.42TO_t + 8.51D_t$

ECM estimations: $\Delta GG_t = - 0.09 - 4.16\Delta\text{IQ}_t + 0.04\Delta EC_t - 0.34\Delta FD_t + 0.72\Delta TO_t - 1.30\Delta D_t - 0.85\Delta ECT_{t-1}$

The long-run (Table 5) and short-run (Table 6) results indicated a negative impact of institutional quality (IQ) on green growth (GG) in Nepal. This result was different from the many empirical studies (Ahmed *et al.,* 2022; Jiang *et al.,* 2023; Teklie & Yağmur, 2024; Yang *et al.,* 2024) and consistent with some empirical findings (Appiah *et al.,* 2024; Degbedji *et al.,* 2024). These empirical studies evidenced the positive and negative effects of institutional quality and green growth. When one point deteriorates the institutional quality index in Nepal thus it may reduce green growth by 4.32% in the long run and 4.16% in the short run. Lack of green awareness, low institutional quality level, higher corruption, impunity of political crimes and rent-seeking behavior, lack of motivation to use and innovate green technology, political instability, low administrative quality, lack of environmental shocking resilience policies, low regulatory quality, lack of precise sustainable growth commitment, and low level of law administration may hamper the green growth benchmark in Nepal.

On the other hand, electricity consumption (CE) did not significantly influence the green growth in Nepal. This result was similar to some countries' cases studied by Degbedji *et al.* (2024). This result offers insight

into the current level of electrical technology and its adaptation seems to be insufficient to promote green growth in Nepal. The current measures are inadequate for green growth, as Baniya *et al.* (2021), necessitating a greater share of renewable energy and reduced energy and material consumption to achieve sustainability goals and for greening growth. Similarly, financial development negatively impacted green growth in both the short- and long-run in Nepal. The result was consistent with Cao *et al.* (2022) and Degbedji *et al.* (2024) and contrary to Ahmed *et al.* (2022), Saleem *et al.* (2022), and Arzova & Şahin (2024). These empirical results suggested that green finance and environmental quality investment can improve green growth, however, in Nepal, such types of concern and financing mechanisms are not practiced yet. To mitigate optimal green growth in Nepal, in the era of climate change, as concluded by Ngo *et al.* (2022), sustainable infrastructure investments are vital for economies heavily reliant on non-renewable energy sources and facing high climate risk. Thus, Mahat *et al.* (2019) revealed that Nepal is well-equipped with institutional frameworks, climate policies, and mitigation strategies to address climate change and promote a low-carbon, equitable society, but it needs additional technical and financial resources. Similarly, an empirical study of Nepal by Gajurel *et al.* (2023) found that institutional quality and financial development impeded human capital development which can be a catalyst for economic growth and eco-friendly innovation and adaptation, may be delaying green growth in Nepal.

Table 5

Long-run Dynamics: OLS Results of Green Growth

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IQ_t	-4.322383	1.613866	-2.678279	0.0144
EC_t	-0.134937	0.103651	-1.301838	0.2078
FD_t	-0.369379	0.090262	-4.092320	0.0006
TO_t	0.428717	0.240664	1.781392	0.0900
D_t	8.506783	3.516839	2.418872	0.0252
C	-10.15263	12.62834	-0.803956	0.4309
R-squared	0.868451	Akaike info criterion		5.803982
Adjusted R-squared	0.835564	Schwarz criterion		6.094312
S.E. of regression	3.988701	Durbin-Watson statistic		1.532225
F-statistic	26.40692	Heteroskedasticity BPG (χ^2)		4.478197
				(0.4828)
Prob(F-statistic)	0.000000	Residual normality (JB)		2.194133
				(0.333849)
		Serial Correlation LM (χ^2)		5.501276
				(0.0639)

Moreover, trade openness (TO) has a positive impact on green growth in Nepal, showing significance at the 10% level in the long run and 1% in the short run, consistent with findings from Jiang *et al.* (2023). This effect may be attributed to the production and import of environmentally friendly products. In Nepal's context, this can be linked to an economy centered on agro- and green farming, the production and export of primary goods, the import of electrical products, and increasing awareness of environmental harm from carbon emissions and climate change, which collectively contribute to green productivity.

Table 6

Error Correction Mechanism (ECM): Short-run Dynamics

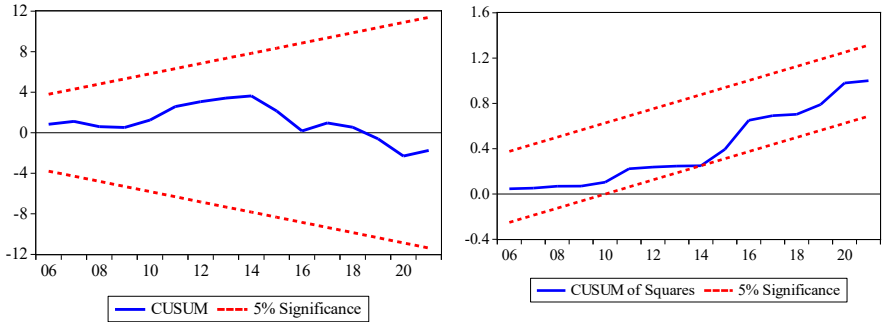
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔIQ	-4.160506	1.883734	-2.208649	0.0404
ΔEC	0.043523	0.140137	0.310578	0.7597
ΔTO	0.721634	0.178836	4.035178	0.0008
ΔFD	-0.344626	0.126446	-2.725471	0.0139
ΔD_t	-1.302729	3.257119	-0.399964	0.6939
ECT(-1)	-0.849040	0.231235	-3.671757	0.0017
C	-0.090699	0.821611	-0.110392	0.9133
R-squared	0.530511	Akaike info criterion		5.295386
Adjusted R-squared	0.374015	Schwarz criterion		5.636671
S.E. of regression	3.043495	Durbin-Watson stat		1.619415
F-statistic	3.389927	Heteroskedasticity BPG (χ^2)		1.819717 (0.4026)
Prob(F-statistic)	0.020435	Residual normality (JB)		0.696360 (0.705972)
		Ramsey RESET (LR)		0.717308 (0.3970)
		Serial Correlation LM (χ^2)		4.695345 (0.5834)

The residual term ECT(-1) was negative and statistically significant, indicating the long-run causation of institutional quality on green growth and conversing back in the long run if any disturbance or shocks in the short run. The ECM estimation (Table 6) was also statistically robust. R^2 indicates that approximately 53% of variations in GG were explained by IQ, and the model was passed from the coefficient diagnostic and stability tests, thereby robust and statistically fitted. CUSUM and CUSUM of square (Figure 2) also revealed that the ECM model was stable. On the other hand, ECM inferred the same results as directed by OLS. The IQ, a targeted variable, had a negative effect on GG. Moreover, there was a positive impact of

EC on GG but not significant, and as a long-run result, FD harmed GG. However, the dummy variable was not significant in the ECM mechanism.

Figure 2

CUSUM and CUSUM of Squares Plot



CONCLUSION AND IMPLICATION

This paper examines the institutional quality and green growth nexus by using secondary data ranging from 1996 to 2021. Employing GH cointegration for a structural break and EG residual-based cointegration, this paper estimated the long-run (OLS) as well as ECM with a break dummy series. The GH cointegration confirmed cointegration with a break in 2005 and the long-run association between institutional quality and green growth in Nepal. In line with this GH cointegration, residual-based EG cointegration also confirmed the cointegration among variables.

The overall results highlighted that institutional quality and financial development negatively influenced green growth but it positively influenced by trade openness in the short run and long run. On the flip side, electricity consumption did not significantly affect green growth in the short and long run. The study's findings revealed that institutional quality negatively impacted green growth in Nepal, implying institutional quality impeded green growth and wasn't sufficient to mitigate the carbon emissions and resource depletion for greening growth, as well as unable to offer safety nets measures to overcome the vulnerability of greenhouse challenges and massive resources depletion. On the other hand, financial development, according to the study, was not sufficient to finance green industries and did not more attention to environmental improvement. Green finance was missing which may hinder the green growth in Nepal. The study also offered insight into the trade openness significantly impacted green growth

in Nepal. Green agricultural practices and adaptation of manual techniques to produce and trade goods may enhance the environmental qualities in Nepal, thereby improving green growth in the short and long run.

Conversely, electricity access did not significant impact on green growth in Nepal. The reason behind this may be that electricity is only used for lighting purposes and not for other alternative uses to reduce carbon emissions. Low industrialization and sophistication may preserve the environmental quality and alternative applications of electricity may substitute the eco-friendly techniques resulting in green growth improvement in Nepal in the future. Eventually, institutional quality was not able to promote green finance and alternative uses of electricity, producing severe effects on green growth in Nepal.

This study has some crucial implications. Negative effects of institutional quality appeals that we have to revisit the institutional performance in Nepal. Particularly, the government should work on maintaining the rule of law, controlling corruption, enhancing regulatory quality, promoting government effectiveness, stabilizing political violence, and enabling voice and accountability to enact environmental quality measures and institutional commitments for green growth effectively and efficiently. On this ground, the government can promote green finance through financial intermediaries. Another crucial implication is that policymakers should prioritize green agriculture and renewable mechanization to enhance green growth in the future.

This study used a limited year of observations due to the availability of the data and only covered some macroeconomic variables to examine the institutional quality and green growth nexus. Moreover, the study interpolated some missing values and applied an error correction mechanism for anticipated results. Future researchers thus can fill the data gap, and methodological gap with other causal processes, and consider other intervening variables with alternative proxies to infer a robust and valid conclusion.

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