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Original Research

Economic Growth and Forest Cover Dynamics in Ethiopia: A Time Series Analysis (1992-2021)

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Abstract

This study investigates the relationship between economic growth and forest cover dynamics in Ethiopia using annual time-series data from 1992 to 2021 obtained from the World Development Indicators database. Pre- and post-estimation tests were conducted, and a multiple regression model was employed for data analysis. The findings reveal a statistically significant inverse relationship between economic expansion and forest cover. A 1% increase in growth of GDP per capita is associated with a 577 km² decline in forest cover (p = 0.002). Inflation is also negatively associated with forest cover, while extreme heat events, measured by a variable heat index (>35°), also exert the most substantial adverse effect on forest cover. Unit root tests confirm that all variables are stationary at the level, supporting the robustness of the results. These findings imply that Ethiopia's agriculture-driven economic growth accelerates the conversion of forests to farmland, contributing to soil erosion, waterbody siltation, and declining agricultural productivity. Strengthening Ethiopia's Climate-Resilient Green Economy Strategy, expanding reforestation programs, incentivizing agroforestry, and diversifying the economy beyond resource-dependent sectors are recommended.

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INTRODUCTION

Globally, forests cover approximately 31% of the Earth's total land area, yet deforestation remains a pressing issue driven mainly by population growth and agricultural expansion. Between 2010 and 2020, global forest coverage decreased by 1.2%, particularly in South America and Africa, resulting in an estimated USD 6.3 trillion loss in ecosystem services in 2016, equivalent to 8.3% of global GDP (UN, 2021; Sutton et al., 2016). These figures highlight the significant environmental and economic consequences of land degradation, especially in developing countries.

Ethiopia, one of the countries most vulnerable to climate variability shocks, faces growing threats to its water resources, agriculture, infrastructure, forests, and public health due to environmental degradation and biodiversity loss (World Bank, 2024). Establishing an empirical link between forest depletion and economic growth remains challenging because of diverse geo-climatic factors and data limitations (Cuaresma et al., 2017).

In Ethiopia, land degradation—including poor land use, deforestation, overgrazing, population pressure, and climate change leads to the loss of roughly 92,000 hectares of forest and 2 billion tonnes of fertile soil annually (FAO, 2024). With over 120 million people, Ethiopia is mainly rural, with urbanization limited to about 23%, concentrated primarily in Addis Ababa (World Bank, 2024). Forests are central to Ethiopia's Climate Resilient Green Economy strategy due to their role in carbon sequestration and climate resilience. The Green Legacy Initiative has markedly increased forest cover from 17.2% in 2019 to nearly 23.6% in 2025, planting over 7 billion seedlings annually with high survival rates averaging 88% (Ethiopian Forestry Development Authority, 2025). Despite these successes, challenges remain, including limited post-planting care, insufficient community ownership, and weak tree tenure systems (Gifawesen et al., 2020).

Deforestation in Ethiopia continues to be driven by logging, agricultural expansion, and energy demand, with wood fuels such as firewood and charcoal contributing significantly to forest degradation (Sisay & Gitima, 2020; Zeleke & Vidal, 2020). Although rapid economic growth has occurred, natural resource rents from forestry declined from 15.8% of GDP in 2010 to 5.1% in 2020, primarily due to farmland expansion (AFDB, 2023).

The Environmental Kuznets Curve (EKC) hypothesis states that there is an inverted U-shaped relationship between environmental degradation and economic growth, implying that at early stages of development, ecological degradation worsens, but beyond a certain income level, it begins to improve. In the context of Sub-Saharan Africa, studies revisiting the EKC show mixed results. For instance, research focusing on deforestation and greenhouse gas emissions from agriculture in Sub-Saharan African countries found evidence of the EKC only for agricultural emissions but not necessarily for deforestation rates (Rudel, 2013). Other investigations also confirm the EKC relationship, where deforestation initially rises with economic growth but declines as countries surpass certain development thresholds. Factors such as population density, trade openness, and macroeconomic policies significantly influence these environmental outcomes (Stern, 2012).

The land-use transition theory complements this by explaining the shifts in land use from natural ecosystems to agricultural and urban uses as economies evolve. In Sub-Saharan Africa, deforestation is often driven by the expansion of agricultural land and population pressures, reflecting early stages of land-use transition. Empirical studies show that higher population density exacerbates deforestation, while policy interventions promoting family planning and protected areas can help moderate this trend (Angelsen & Kaimowitz, 1999). Overall, empirical evidence from the region suggests that addressing deforestation requires not only economic growth but also integrated policy measures that consider demographic, institutional, and trade factors alongside land-use dynamics framed within theories like EKC and land-use transition (Stern, 2012).

Statement of the Problem

Ethiopian forests remain economically significant. Forestry contributes up to 12.9% of Ethiopia's GDP when non-market benefits are included (UNEP, 2016). Carbon trading has also provided revenues, with Ethiopia earning around USD 70 million by 2025 through afforestation and clean energy projects (FAO, 2025). Institutional measures, including the establishment of a national ecosystem restoration fund and forest stewardship standards, aim to strengthen sustainable forest management (FAO, 2025).

Despite progress, inequality persists, with rural communities benefiting less from national economic growth (World Bank, 2024). Environmental shocks, including recurring droughts, exacerbate these disparities. Ethiopia's 10-Year Development Plan (2020/21–2029/30) seeks to sustain economic progress while promoting private-sector-led growth.

While expansions in agriculture, infrastructure, and urbanization have boosted the country's GDP, they have simultaneously placed increasing pressure on natural resources, particularly forests. Most existing studies examine either economic growth or environmental degradation in isolation, offering a limited understanding of their long-term interplay (Miheretu & Yimer, 2017; UNEP, 2016). Additionally, localized studies using remote sensing techniques have not sufficiently linked forest loss to broader macroeconomic indicators, leaving the dynamic relationship between national-level forest cover and economic growth largely unexplored. Without a comprehensive analysis of how economic growth and forest cover influence each other over time, policy interventions risk being ineffective. This study aims to address this research gap by examining the dynamic interaction between economic growth and forest cover in Ethiopia, providing evidence to support policies that promote both economic development and environmental sustainability.

Research questions

This research is expected to answer the following research questions:

1. How do macroeconomic factors, particularly growth of GDP per capita and inflation, influence forest cover in the study area?
2. Does forest cover have a significant feedback effect on economic growth?

MATERIALS AND METHODS

Ethiopia, located in the Horn of Africa, shares borders with six countries and is renowned for its rich biodiversity, ranking as the fifth-largest floral country in tropical Africa (Tadesse et al., 2024). The nation boasts over 6,500 vascular plant species, including 625 endemic plant species and 669 near-endemic species, along with one endemic plant genus. Despite this diversity, for the period between 1985 and 2017, the proportion of area covered decreased by 60.57 ha (12.7%) (Fasika et al., 2019). However, through initiatives like the Green Legacy Initiative, Ethiopia has made notable progress in reforestation, increasing forest cover to 23.6% by 2023 from 17.2% in 2019.

The Green Legacy Initiative aligns with global sustainability goals such as the 2030 Agenda and SDG 2 (food security), contributing to climate action and promoting sustainable agriculture. In 2022 alone, over 500 million trees were planted, including high-value crops like avocados, mangoes, apples, and papayas, which support food self-sufficiency and economic growth. Additionally, Ethiopia has planned to restore 15 million hectares of land by 2030 under the AFR100 Initiative.

Despite these efforts, deforestation remains driven by agricultural expansion, demand for firewood, and urbanization. Forest degradation is exacerbated by climate change and variability impacts such as rainfall fluctuations, rising temperatures, and shifting precipitation patterns. These factors threaten ecosystems and reduce forests' carbon sequestration potential.

Economically, forests contribute approximately 12.86% of Ethiopia's GDP through direct and indirect benefits such as honey production, bamboo harvesting, and non-timber products. The sector supports millions of livelihoods while playing a significant role in Ethiopia's Climate Resilient Green Growth Strategy. To sustain these contributions and combat deforestation, Ethiopia must continue strengthening afforestation programs, promoting agroforestry practices, and integrating climate adaptation strategies into forest management policies.

This study employs a quantitative research design utilizing secondary time series data that was obtained from the World Development Indicators (WDI) database, as it provides consistent, long-term, and comparable time series data across countries. The research aims to analyse macroeconomic variables affecting forest cover measured by square kilometers. By examining annual data spanning multiple years, the study seeks to identify trends and causal relationships between environmental changes and economic performance.

To quantify the relationship between economic growth and forest cover dynamics in Ethiopia for the period 1992-2021, a multiple linear regression model was employed following Gujarati & Porter (2009).

The model is specified as:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \mu_i$$

Y_t is forest cover (km²), X_{1t} is growth of GDP per capita(%), X_{2t} is inflation rate (%), X_{3t} is heat index (>35°C), and μi is the error term.

RESULTS AND DISCUSSION

Results

Descriptive results

As shown in Table 1, between 1992 and 2021, Ethiopia's average forest cover was 180921.25 square kilometers, while the country's average economic growth rate was 4.292%. Inflation, calculated based on annual consumer prices, averaged 10.66% with a standard deviation of 11.021%. Additionally, the mean Heat Index (> 35°C), which accounts for the combined effects of air temperature and humidity, indicated that Ethiopia experienced an average of 3.287 Heat Index > 35°C during this period. Trend analyses of these variables are illustrated in Figure 1, providing insights into the spatiotemporal dynamics of forest cover and its relationship with economic and climatic factors over the study period.

Table 1

Descriptive statistics

Variable	Observation	Mean	Std. Dev.	Minimum	Maximum
Forest Cover (km²)	30	180921.25	7349.118	169955	202562.41
Growth of GDP per capita	30	4.29	5.216	-12.314	10.357
Inflation	30	10.665	11.021	-8.484	44.357
Heat Index (> 35°)	29	3.287	0.707	2.31	5.05

Source: Calculated from World Development Indicators Database (2024)

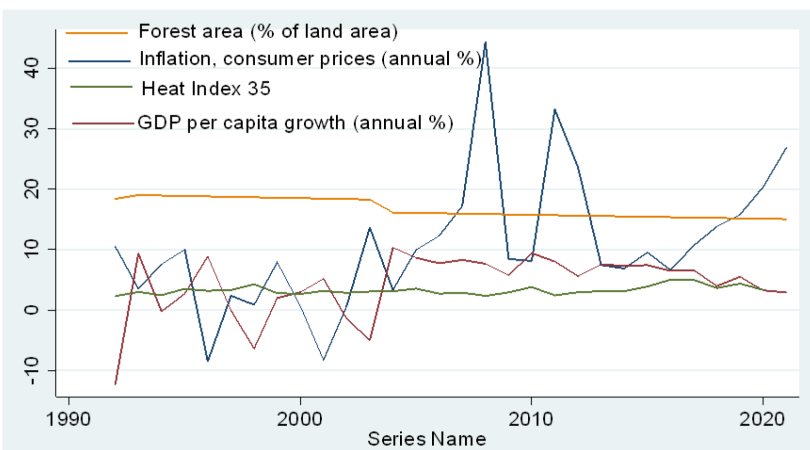

Figure 1. *The relation among forest, inflation, economic growth, and heat index*

The correlation analysis conducted in this study examined the relationships between all variables in the dataset, with statistical significance evaluated using hypothesis testing. Table 2 details the p-values associated with these correlations, revealing that all three independent variables (economic growth, inflation, and heat index (> 35°C) exhibited statistically significant correlations with forest cover at the 5% significance level. Specifically, the p-values for these variables were less than 0.05, confirming that the observed associations between these factors and forest cover are unlikely to be due to chance. This statistical validation strengthens the regression model's findings, which identified these variables as key drivers of deforestation in Ethiopia.

Table 2

Partial and semi-partial correlations of forest cover

Variable	Partial Corr.	Semi-partial Corr.	Partial Corr.^{2}	Semi-partial Corr.^{2}	Significance Value
Growth of GDP per capita	-0.571	-0.416	0.326	0.173	0.002
Inflation	-0.563	-0.408	0.317	0.166	0.002
Heat Index (>35)	-0.637	-0.495	0.406	0.245	0.000

Source: Calculated from World Development Indicators Database (2024)

Econometric results

Unit Root Test

In time series analysis, conducting both pre- and post-estimation tests is mandatory. Accordingly, stationarity tests were performed, and the results obtained are shown in Table 3. Since the null hypothesis assumes the presence of a unit root, that is, α=1, the p-value obtained should be less than the statistically significant level (say 0.05) in order to reject the null hypothesis (Gujarati & Porter, 2009). To ensure the reliability of the data that were used in this study, a Dickey-Fuller test was carried out to check whether the key variables -forest cover, growth of GDP per capita, inflation rate, and the heat index (> 35°C)—were stationary. This is important because time series data must be stationary, meaning their statistical properties do not change over time, for applying a valid econometric analysis. As stated in Table 3, we reject the null hypothesis because the test statistic of all four variables is more negative than the critical value. For instance, forest cover had a test statistic of -3.604 with a p-value of 0.0057; growth of GDP per capita was even stronger at -5.905 with a p-value of 0.0000, while inflation and the heat index(> 35°C) also met the criteria for stationarity.

Table 3

Dickey-Fuller test for unit root test

Variables	Test statistic	MacKinnon's approximate p-value for Z(t)	Decision
Forest Cover	-3.604	0.0057	stationary
Growth of GDP per capita	-5.905	0.0000	stationary
Inflation	-3.293	0.0152	stationary
heat index (>35°C)*	-3.403	0.0108	stationary

Dickey-Fuller Interpolated Dickey-Fuller critical values are 1% critical value = -3.730, 5% critical value = -2.992, 10% critical value = -2.626, and Number of observations = 29. Note: Heat Index (> 35) is the total count of days per year where the daily mean Heat Index rose above 35°C.*

These findings confirm that the data are solid and suitable for the next steps of the analysis, giving us a strong foundation for exploring the relationship between the growth of GDP per capita and the level of deforestation in Ethiopia.

Regression analysis with time series data can be used to forecast the future values of the dependent variable when the data fulfill classical linear regression model assumptions. Ensuring that the model meets the classical regression model assumption helps the model to predict the future values of the dependent variable based on the values of the independent variables with confidence. It is important to note that the accuracy of the forecast depends on the quality of the data, the appropriateness of the model, and the validity of the assumptions.

Table 4

Results of Multiple Linear Regressions

Independent variables	Coef.	St. Err.	t-value
Growth of GDP per capita	-577.23***	193.8	-2.98
Inflation rate	-282.89***	81.443	-3.47
heat index (>35°C)	-5241.91***	877.046	-5.98
Constant term	203894.73***	3544.33	57.53

*Note: *** indicates that the variable is statistically significant at p<0.01. Source: calculated from data from World Development Indicators Database (2024)*

The mean of the dependent variable is 181,299.393 with a standard deviation of 7,176.029. The model explains 64.2% of the variation in the dependent variable (R-squared = 0.642), based on 29 observations. The overall model is statistically significant ($F = 17.670$, $p < 0.001$).

The results of the multiple linear regression analysis reported in Table 4 demonstrate statistically significant relationships between forest cover and three key variables: growth of GDP per capita, inflation rate, and heat index (>35°C) over the 1992–2021 periods. The model explains 64.2% of the variation in forest cover (R-squared = 0.642), with an F-test statistic of 17.670 ($p = 0.000$), confirming its robustness. For every increase in growth of GDP per capita, forest cover declines by 577.23 km^2 ($p = 0.006$), highlighting the trade-off between economic expansion and environmental conservation. Similarly, a 1% rise in inflation correlates with a 282.89 km^2 loss of forest cover ($p = 0.002$), likely due to increased reliance on forest resources during economic instability. Most strikingly, each additional heat index (>35°C) results in a 5,241.91 km^2 decline in forest cover ($p = 0.000$), emphasizing the compounding effects of climate stressors. The constant term (203,894.73 km^2) represents baseline forest cover when all independent variables are zero. These findings align with Ethiopia's observed deforestation patterns, where agricultural expansion, inflation-driven resource substitution, and climate extremes collectively threaten forest ecosystems. The model's validity is further reinforced by earlier diagnostic tests confirming stationarity, absence of multicollinearity, and no omitted variable bias, ensuring reliable conclusions about these critical drivers of deforestation.

Multicollinearity test

Multicollinearity is a situation in which two or more explanatory variables in the model are correlated with each other. This is problematic as it results in a violation of the assumption of classical linear regression analysis. The presence of multicollinearity can increase the variance of the regression coefficients, making them unstable and difficult to interpret the values of those coefficients. In order to check whether our model has a multicollinearity problem or not, the variance inflation factors (VIF) method was used (Gujarati & Porter, 2009).

Table 5

Variance Inflation Factor

Variables	VIF	1/VIF
Heat Index (>35°C)	1.09	0.917
Inflation rate	1.086	0.921
Growth of GDP per capita	1.053	0.95
Mean	1.076	0.929

Source: Calculated from the World Development Indicators Database (2024)

As a rule of thumb, values between 5 and 10 suggest potential concern, while values above 10 indicate a serious problem that requires attention. As reported in Table 5, the model is free from multicollinearity issues. In this analysis, the VIF values for all variables were well below the critical threshold. Specifically, the Heat Index(>35°C) had a VIF of 1.09, the inflation rate was 1.086, and the growth of GDP per capita stood at 1.053 -each indicating only minimal correlation with the other variables. The average VIF across all variables was 1.076, suggesting strong model stability. Additionally, the reciprocal VIF values (1/VIF), ranging from 0.917 to 0.95, further confirm that multicollinearity is not a concern. These results give confidence that the regression coefficients are reliable, and that growth of GDP per capita, inflation, and the heat index independently contribute to explaining the pattern of deforestation in Ethiopia.

Heteroscedasticity test

In regression analysis, when residuals are more scattered with an increase in the level of the independent variable, there is a heteroskedasticity problem. Formally, it is tested by using the Breusch-Pagan test. In our study, the Breusch-Pagan test showed that the p-value is 0.5451, which is greater than 0.05; therefore, we fail to reject the null hypothesis. This result clearly indicates that the data is homoscedastic and concludes that the model does not suffer from a heteroskedasticity problem.

Omitted variable test

The omitted variable bias test is usually used to determine whether any important explanatory variables have been excluded from the regression model. Excluding relevant variables can distort the results and lead to incorrect conclusions. The omitted variable test produced a p-value of 0.2814, which is greater than the conventional threshold p-value of 0.05. This means we fail to reject the null hypothesis that there is no omitted variable from the model, suggesting that the model is correctly specified and does not suffer from omitted variable bias. In other words, the variables included in the model are sufficient to explain the behavior of the dependent variable, and the model provides reliable results.

Normality test

In our study, we used the Shapiro-Wilk test to see if the residuals from our regression model were normally distributed. This is important because normal residuals make the results more reliable. The normality test results gave us a statistic of 0.978 and a p-value of 0.782, which is quite high. This means the residuals do not show any signs of straying from normality. The z-score of -0.781 also confirms that any differences from normal are minor and not statistically significant. Knowing this helps us trust that the connections we found between forest cover and factors like economic growth, inflation, and extreme heat are accurate and not thrown off by any unusual patterns in the data.

Significant variables

Growth of GDP per capita

This variable has a negative coefficient (= -577.23) and is statistically significant at a 1% significance level (P value = 0.006). Other factors remain constant; a 1% point increase per year reduces forest cover by 577.23 square kilometers between 1992 and 2021. The probable justification might be that Ethiopian economic growth is mainly driven by the agricultural sector. The growth of agricultural sectors is usually accompanied by the expansion of agricultural land by cutting down trees and natural forests. This result is consistent with the analysis of Ajanaku and Collins (2021) which suggests that the level of deforestation is very high in countries with low income per capita and tends to be negative in countries with high income per capita because developed countries record high afforestation and reforestation rates. However, it contradicts the findings of Assa (2020) and Adem et al (2020) which stated as the economy grows sustainably over time, it can support measures that protect or restore forests, improve vegetation cover or enhance overall environmental conditions.

Inflation rate

This variable has a negative coefficient (=-282.89) and is statistically significant at a significance level less than 1% (P-value = 0.002). Other factors remain constant; an increase in the inflation rate by 1% reduces forest cover by 282.89 square kilometers between 1992 and 2021.

Heat index (>35)

This variable has a negative coefficient (= -5241.91) and is statistically significant at less than a 1% significance level (P-value = 0.000). The heat index (>35°C) measures the total average number of days per year where the daily mean heat index is >35°C, representing extremely hot days. The regression shows that, holding growth of GDP per capita and inflation constant, each additional extremely hot day per annum is associated with a decrease of ~5,242 km² of forest cover per year. Expressed in relative terms, this corresponds to a ~2.9% reduction in total forest cover, which is substantial given that the average number of such days in Ethiopia is only about 3.2873 days per year.

Furthermore, as indicated in Table 6, the ARIMA regression results suggest that all three predictors - growth of GDP per capita, inflation, and extreme heat events - have a significant negative impact on forest cover in Ethiopia. Specifically, increases in growth of GDP per capita and inflation are associated with declines in forest area, suggesting that both economic expansion and economic instability contribute to deforestation. Moreover, extreme temperature events, measured by a heat index (>35°C), also significantly reduce forest cover, highlighting the sensitivity of forests to climate-related stress. The constant term is positive and highly significant, indicating a substantial baseline forest cover, while the sigma value reflects the variation explained by the model. Overall, these findings emphasize that both economic and climatic factors play a critical role in forest loss, underscoring the need for policies that integrate the growth of GDP per capita and environmental sustainability.

Table 6

ARIMA regression of predictors of forest cover

Variables	Coefficient	Standard Error	t-value
Growth of GDP per capita	-577.234***	140.803	-4.10
Inflation	-282.889***	82.243	-3.44
heat index (>35°C)	-5241.908***	1892.849	-2.77
Constant	203894.73***	6145.88	33.18
Sigma	4217.814***	708.132	5.96
Mean-dependent variable	181299.393	Standard deviation of the dependent variable	7176.029
Number of observations	29	Chi-square	46.639
Prob > chi²	0.000	Akaike criteria (AIC)	576.429

*Note: *** indicates that the variable is statistically significant at p<0.01.Source: Calculated from the World Development Indicators Database (2024)*

Vector autoregression (VAR) and the Granger causality test

The results of the vector autoregression (VAR) model reveal important dynamics between forest cover and macroeconomic variables. Results of the VAR model are indicated in Table 7, and for the forest cover equation, the coefficient of its first lag is positive and highly significant, displaying strong persistence of forest cover over time. Growth of GDP per capita also exerts a significant positive influence on forest cover, suggesting that improvements in economic performance are associated with better forest outcomes, possibly through enhanced investment in conservation or reduced reliance on deforestation for livelihoods. The positive coefficient in the VAR model may capture short-to-medium term dynamics, where periods of economic improvement could lead to increased investment in conservation programs, such as the Green Legacy Initiative, or reduce the immediate pressure on forests by providing alternative livelihoods and energy sources. Inflation, on the other hand, shows a negative and weakly significant effect, implying that rising prices may increase pressure on forest resources. The heat index, which was included as a proxy for climatic stress, does not display a statistically significant effect on the forest cover. In contrast, the growth of GDP per capita equation shows that none of the lagged explanatory variables, including forest cover, is statistically significant.

Table 7

Vector autoregression (VAR) model result

Dependent variables	Independent variables	Coef.	Std. Err.
Forest cover	Forest cover (lag 1)	0.823***	0.064
	Growth of GDP per capita (lag 1)	152.869**	68.189
	Inflation rate	-60.893*	32.497
	heat index (>35°C)	-690.174	518.418
	Constant term	33200.48**	13049.780
Growth of GDP per capita	Forest cover (lag 1)	-0.00016590	.000177
	Growth of GDP per capita (lag 1)	-0.045	0.188
	Inflation rate	0.021	0.090
	heat index (>35°C)	-0.672	1.429
	Constant term	37.295	35.978

*Note: ***, ** & * indicate that the variable is statistically significant at p<0.01, p<0.05, and p<0.1, respectively. Source: Calculated from the World Development Indicators Database (2024)*

Table 7 suggests that while economic growth influences forest cover, forest cover and the other macroeconomic variables considered do not significantly explain the variations in the development of GDP per capita within the system. Overall, the findings highlight a unidirectional relationship in which economic growth contributes to changes in forest cover, but forest cover does not exert a significant feedback effect on economic growth.

Table 8

Granger causality test

Equation	Excluded	chi²	df	Prob > chi²	Decision
Forest cover	Growth of GDP per capita	5.0259	1	0.025	GDP per capita growth Granger-causes changes in forest cover.
Forest cover	ALL	5.0259	1	0.025	
Growth of GDP per capita	Forest cover	0.87831	1	0.349	Forest cover does not Granger-cause the growth of GDP per capita.
Growth of GDP per capita	ALL	0.87831	1	0.349	

*Note: *** indicates that the variable is statistically significant at p<0.01. Source: Calculated from the World Development Indicators Database (2024)*

From a policy perspective, this implies that fostering sustainable economic growth can play a vital role in supporting forest conservation if appropriate policies are in place to channel growth induced benefits into environmental protection (Table 8). At the same time, the coefficient of inflation is negative and shows that forest cover underscores the importance of stable macroeconomic management to reduce pressures on natural resources. Policymakers should therefore integrate forest management strategies into broader economic planning to ensure that growth is not achieved at the expense of environmental sustainability.

Discussions

The empirical analysis demonstrates that Ethiopia's forest cover between 1992 and 2021 is significantly and negatively influenced by the growth of GDP per capita, inflation, and the heat index (> 35 °C). Together, these variables explain over 64% of the year-to-year variation in forest area, and both OLS and ARIMA specifications confirm their robustness. In particular, each 1% increase in growth of GDP per capita is associated with a loss of approximately 577 km² of forest, and each 1% rise in inflation with roughly 283 km² of forest loss. Diagnostic tests for multicollinearity (mean VIF = 1.076), heteroskedasticity (Breusch–Pagan p = 0.545), omitted-variable bias (RESET p = 0.281), and normality of residuals (Shapiro–Wilk p = 0.782) all confirm that the model assumptions hold, lending confidence to these results.

These findings underscore a challenging trade-off: while economic growth is urgently needed for poverty reduction, without green-growth safeguards, it can accelerate forest clearance. Likewise, macroeconomic instability as proxied by inflation appears to drive rural households toward greater forest-resource extraction. Finally, climate stress in the form of prolonged extreme-heat events severely undermines forest health and regeneration. Collectively, these pressures threaten Ethiopia's forest-based ecosystem services, carbon stocks, and long-term climate resilience. These findings support the argument of Stern (2004), who discussed the environmental consequences of economic growth and emphasized that without sustainable policies, growth often leads to increased deforestation and ecological degradation.

CONCLUSIONS

Deforestation has severe and often irreversible consequences, affecting soil health, water resources, climate stability, biodiversity, and human well-being. Forests act as natural carbon sinks, and their removal releases stored carbon dioxide into the atmosphere repeatedly, exacerbating global warming. This study aimed to explore the relationship between economic growth and forest cover in Ethiopia from 1992 to 2021 using data from the World Development Indicators database. Descriptive statistics and multiple linear regression analysis were employed for data analysis, supported by pre- and post-estimation tests, including stationarity, heteroscedasticity, multicollinearity, omitted variable bias, and normality tests. The results confirmed that the model is free from statistical issues. The findings revealed that a 1% increase in the growth of GDP per capita results in a reduction of forest cover by 577.23 square kilometers. Similarly, a 1% rise in inflation reduces forest cover by 282.89 square kilometers, while an additional heat index (>35°C) leads to a loss of 5241.91 square kilometers of forest cover. These results highlight the detrimental impact of economic growth, inflation, and climate stressors on Ethiopia's forests.

Recommendations

Based on these findings, several recommendations were proposed.

First, Ethiopia should prioritize non-agricultural sectors for economic growth to reduce pressure on forest areas. They may strengthen afforestation programs, conserve natural forests, and implement soil conservation practices.

Second, addressing inflation requires aggregate demand management strategies that include command-and-control methods and market mechanisms to stabilize prices while promoting agroforestry practices.

These measures are essential for mitigating deforestation and ensuring sustainable economic growth while preserving Ethiopia's critical forest resources.

CRediT Authorship Contribution Statement

Gemechu Mulatu: Conceptualization, Data Collection, Model Development, Analysis & Writing Original Draft. **Keno Talila:** Data Analysis & Model Validation, Review & Editing.

Declaration of Competing Interest

The authors declare that there is no conflict of interest.

Ethical approval

Not applicable

Data Availability

Data are available on the World Development Indicators Database. https://databank.worldbank.org/reports.aspx?source=World-Development-Indicators

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