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DOES CONSERVING FORESTS REDUCE POVERTY? MICROECONOMIC EVIDENCE FROM THE GUAYAS PROVINCE, ECUADOR

Hugo Donoso Reinoso^{1*} and Jenniffer Maxi Murillo²

¹Universidad Estatal de Milagro (UNEMI). Email: hdonosor@unemi.edu.ec

²Unidad Educativa Juan Ezequiel Vargas - MINEDEC. Email: maximurillo1978@hotmail.com

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Corresponding Author: Hugo Donoso Reinoso

(hdonosor@unemi.edu.ec)

ABSTRACT

The relationship between environmental conservation and social well-being remains a topic of debate in the scientific literature, especially in developing countries where poverty and pressure on natural resources coexist. This study empirically analyzes the relationship between forest cover and the probability of poverty at the individual level in the province of Guayas, Ecuador, integrating socioeconomic microdata from the National Survey of Employment, Unemployment, and Underemployment (ENEMDU 2023) with territorial information on forest cover from MapBiomias. Using a weighted Logit model with robust standard errors grouped by canton, the study assesses whether a greater forest cover is associated with better living conditions for the population. The results show that forest cover does not have a statistically significant effect on the probability of poverty, once demographic, educational, and productive integration characteristics are controlled for. In contrast, the sector of economic activity and other structural socioeconomic factors emerge as the main determinants of well-being. These findings suggest that environmental conservation, while fundamental to ecological sustainability, does not automatically translate into socioeconomic improvements without economic and institutional mechanisms to transform natural capital into real productive opportunities. The study provides relevant empirical evidence for the contemporary debate on poverty and the environment, highlighting the need for integrated public policies that link forest protection with territorial development strategies, productive inclusion, and a green economy. In this sense, the research contributes to a more realistic and critical understanding of the limitations and potential of forest conservation as a poverty reduction tool.

KEYWORDS: Poverty, Forest Cover, Environmental Economics, Territorial Development.

INTRODUCTION

The relationship between poverty (as a research variable and social condition) and forest area (as a variable and factor related to nature and the environment) is an aspect that is gaining relevance within a global context concerned with climate stability, biodiversity, ecosystem services, and economic activities linked to the green economy. At the same time, societies express the expectation that this environmental transition will translate into tangible improvements in well-being. The relationship between forests and poverty is bidirectional, meaning that an increase in forest area does not automatically imply a reduction in poverty levels. Rather, economic mechanisms or tools that link opportunities with nature-based capital are necessary (Wunder, 2001; Angelsen & Wunder, 2003).

The global debate has focused on achieving the Sustainable Development Goals, particularly SDG 15, which is linked to reforestation and the need for society to achieve targets for recovering and creating more green areas on the planet (United Nations, 2025). Evidence has also been presented that deforestation generates economic and financial costs, meaning that forest loss is not solely an ecological problem, but also affects irrigation, productivity, and the overall macroeconomic environment (Almeida et al., 2024). From a climate perspective, recent research suggests that forest loss has been strongly influenced by forest fires and the expansion of land use for agriculture, variables that impact and exert pressure on population groups with high socioeconomic vulnerability (World Resources Institute, 2025).

This issue presents two contrasting contemporary empirical approaches linked to the dialectical relationship between environment, economy, and benefit. One approach considers that forests can contribute to poverty reduction because they generate: provision of subsistence, employment, and income (related to primary timber and non-timber forest products), shock absorption, and resilience building through natural resources. Recent analyses strengthen this position, identifying pathways through which forest areas could contribute to sustainable poverty reduction, considering as a fundamental condition that the benefits depend on access, markets, and institutional frameworks (Wang, 2023). Meanwhile, global comparative evidence suggests that environmental income is a key element of rural livelihoods, carrying greater relative weight for lower-income families, while emphasizing that it does not, in itself, guarantee a solution to poverty (Angelsen et al., 2014; Vedeld et

al., 2007).

The second perspective argues that environmental stewardship does not necessarily lead to improvements in living conditions, especially given the informal nature of the local economy, its low productivity, and limited green supply chains. Recent research shows mixed results and trade-offs: in some areas, conservation is associated with social improvements, while in others, no benefits are observed, or even distributive tensions are recorded (Auliz-Ortiz et al., 2023). Furthermore, studies linking forest regeneration/ plantations to short-term poverty reduction highlight the structural problems inherent in this relationship. This imposes limitations and necessitates studies that measure the impact both quantitatively and qualitatively. Therefore, this perspective concludes that increasing the tree cover ratio does not automatically translate into improved socio-ecological sustainability (den Braber et al., 2024).

Society is increasingly seeking options, models, and tools that consider the environment as a factor of social impact. Payments for Ecosystem Services (PES) have been promoted as a means to reconcile conservation and well-being. It is important to note that various PES program models are characterized by heterogeneous effects on environmental and socioeconomic outcomes (Le et al., 2024). Empirical evidence, depending on the context (area, region), documents that some PES programs can reduce deforestation without significantly reducing poverty; moreover, the opposite effect has been observed – increased poverty despite reduced deforestation. This raises concerns about potential distributional frictions and the need for complementary employment and productive inclusion policies (Villalobos et al., 2023).

In Latin American countries, the environment is a key issue due to the presence of forests and jungles crucial for global climate stability. However, poverty and social inequality are also significant factors in the region's analysis. Regional reports indicate that poverty remains at considerable levels, largely due to structural factors related to access to opportunities and social conditions (CAF, 2023; World Bank, 2024). Furthermore, the interaction between climate vulnerability and poverty – especially among children and youth – reinforces the understanding that sustainability must be seen as an integrated socio-environmental agenda (UNICEF, 2023/2024). Within this framework, recent studies on forest transition in the region have explored how economic growth, sectoral changes, and policies influence deforestation/regeneration trajectories, highlighting

the centrality of the economic component in forest dynamics (Caravaggio, 2022).

In Ecuador, the debate is especially relevant due to the coexistence of (i) pressures on forests and land cover changes, and (ii) challenges related to poverty and productive diversification. Public dashboards indicate recent natural forest loss and help contextualize the magnitude of the problem in the country (Global Forest Watch, n.d.). Regional monitoring analyses also report fluctuations in forest loss in recent years in the western Amazon, highlighting that the dynamics are constantly changing and sensitive to political and economic factors (MAAP, 2024). In specific ecosystems within the country, the relevance of fragmentation and land cover changes has also been documented, reinforcing the importance of studies that connect environmental changes with socioeconomic implications (Rivas et al., 2021). On the social front, recent World Bank assessments warn of stagnation and persistent challenges related to poverty, emphasizing that structural vulnerabilities and climate risks condition social and economic performance (World Bank, 2024).

In this context, the contribution of this research is justified by a specific gap: the discussion of forests and poverty is frequently based on aggregate data or indirect inferences, while the most useful evidence for public policy requires observing how well-being is distributed across the territory. Therefore, this study adopts a micro-territorial approach that integrates socioeconomic microdata with environmental information at the cantonal level, allowing each individual to be assigned a territorial indicator of forest cover and its association with the probability of poverty to be estimated. This strategy aligns with widely cited recommendations in the literature regarding the precision of the thematic axis of the forest-well-being relationship and the recognition of territorial and institutional heterogeneity (Angelsen & Wunder, 2003; Wunder, 2001). This research contrasts and tests the hypothesis that “a greater environmental condition of the territory (referring to greater forest cover) does not, in itself, guarantee better living conditions for the population (referring to overcoming poverty levels), if it is not accompanied by economic and institutional mechanisms that convert ecological value into opportunities (employment, income, productivity and access to assets).

1. METHODOLOGY

1.1. Method

Research Approach, Type and Design

The study adopts a quantitative approach, with a non-experimental, cross-sectional design (2023) and an explanatory scope. The objective is to empirically analyze the relationship between a territorial environmental indicator—forest cover—and an individual socioeconomic outcome—poverty—from the perspective of environmental economics and territorial development.

The research is situated within the theoretical framework of ecological economics, particularly in the discussion on the disconnect between environmental conservation and socioeconomic well-being when mechanisms for the economic valuation of ecosystem services are lacking. RStudio software was used for both data processing and the generation of the econometric model. RStudio software was used for both data processing and the generation of the econometric model.

Area of Study and Unit of Análisis

The study area corresponds to the province of Guayas, Ecuador. The primary unit of analysis is the individual, obtained from ENEMDU microdata.

Each individual is assigned aggregated environmental information at the level of their canton of residence, allowing for implicit multilevel análisis:

- Micro level: individual and household characteristics.
- Macro-territorial level: cantonal forest cover.

1.2. Participants

National Survey of Employment, Unemployment and Underemployment (ENEMDU):

The 2023 National Survey of Households (ENEMDU) (INEC), which contains nationally representative socioeconomic information, was used as the annual population database. Demographic, educational, territorial, and labor variables were employed, as well as the sample expansion factor (fexp).

Forest cover data:

Territorial statistics from MapBiomass Ecuador were used, specifically the file with coverage by canton, from which the variable corresponding to the year 2023 (y2023) was extracted and interpreted as hectares of forest cover.

1.3. Procedure

Data Construction and Preparation

Geographic Filtering

The sample was restricted to individuals residing in the province of Guayas (INEC province code = 9). Construction of the Cantonal Identifier
The ENEMDU database did not directly contain the standard cantonal code, so it was derived from the city variable using:

$$\text{Canton_code}_i = \left\lfloor \frac{\text{ciudad}_i}{100} \right\rfloor$$

It was then formatted to four digits (0901, 0919, 0924). Preparation of the forest database
From the MapBiomass file, the following columns were identified:

territory_level_2: province
 territory_level_3: canton
 y2023: forest cover (ha)
 Guayas was filtered out, and the following

variable was created

$$\text{forest_ha_2023}_c$$

The names of the cantons were standardized (uppercase, no accents, no double spaces), and a dictionary of equivalences was created for cantons with special spellings.

Database Merging

The merging was performed using a left join by canton_code, assigning each individual the forest cover of the corresponding canton. Records without a match were removed.

Construction of the final analytical database

Only the necessary variables were selected, and observations with missing values were removed, resulting in the final model_data database.

1.4. Data Analysis

Definition of Variables

Table 1: Definition Of Model Variables.

Variable	Type	Description	Code	Source
pobre	Dependiente	Condición de pobreza del individuo	1 = pobre, 0 = no pobre	ENEMDU
forest_ha_2023	Independiente principal	Cobertura forestal cantonal (ha)	Continua	MapBiomass
p03	Control	Edad del individuo	Años	ENEMDU
p02	Control	Sexo	1 = hombre, 2 = mujer	ENEMDU
nnivins	Control	Nivel educativo	Factor categórico	ENEMDU
area	Control	Área de residencia	1 = urbana, 2 = rural	ENEMDU
rama1	Control	Rama de actividad económica	Factor categórico	ENEMDU
fexp	Peso	Factor de expansión muestral	Numérico	ENEMDU

Note: The Table Specifies the Types of Variables Used, Encoding in Rstudio, And Data Source.

Econometric Specification

A weighted Logit model was estimated, of the form:

$$\text{Pr}(\text{pobre}_i = 1 | X_i Z_c) = \Lambda(\beta_0 + \beta_1 \text{forest}_{ha_c, 2023} + \gamma' X_i + \delta' W_i)$$

Where:

$\Lambda(\cdot)$ = represents the function

X_i = represents individual variables (age, sex, education)

W_i = represents territorial and occupational variables (area, branch)

c = indicates the canton of residence of the individual

Robust Inference

Since the environmental variable is common to all individuals in the same canton, robust standard errors grouped by canton were estimated, correcting for within-group dependence:

$$\widehat{\text{Var}}(\hat{\beta}) = \text{vcovCL}(\text{clúster} = \text{cantón})$$

Model Diagnostics

The following tests were applied:

- Multicollinearity: VIF (all < 2, no issues).
- Pseudo-R²: McFadden.
- ROC/AUC: discriminatory capacity.
- Confusion matrix: sensitivity and specificity.
- Hosmer-Lemeshow: goodness of fit (with limitations in large samples).

Diagram

The design allows for the evaluation of association, not strict causality. Forest cover is an aggregate territorial variable, while poverty is individual, which may generate unobserved intra-cantonal heterogeneity. Nevertheless, the approach is consistent with environmental economics studies that combine microdata with contextual variables.

The methodological strategy combines socioeconomic microdata with territorial environmental information, allowing for an empirical evaluation of whether forest conservation translates into improvements in economic well-being in the absence of institutional mechanisms for ecological valuation.

2. RESULTS

2.1. Results of the Logit Model

Table 2 presents the estimated coefficients of the

weighted Logit model, using the individual's poverty status as the dependent variable. Robust standard errors are reported, grouped by canton, allowing for consistent inference regarding intra-territorial dependence.

Table 2: Results of the Weighted Logit Model with Robust Errors by Canton.

Variable	Coefficient	Error robusto	Estadístico z	p-valor
Constante	-9.90e+14	8.64e+14	-1.15	0.252
Cobertura forestal (ha)	-1.49e+08	1.14e+09	-0.13	0.896
Edad	6.71e+12	8.77e+12	0.77	0.444
Sexo	9.10e+13	1.23e+14	0.74	0.460
Educación (nivel)	—	—	—	>0.60
Área (urbano/rural)	-3.86e+14	3.33e+14	-1.16	0.247
Rama agrícola	-1.42e+15	1.51e+14	-9.38	0.000
Rama manufactura	-5.90e+14	2.10e+14	-2.81	0.005
Rama servicios	-1.40e+15	2.28e+14	-6.12	0.000
Rama construcción	-2.12e+15	1.62e+14	-13.07	0.000

It is important to note that the magnitude of some estimated coefficients is influenced by the original scale of the variables included in the model. In particular, the forest cover indicator is measured in hectares at the cantonal level, which involves large numerical values. As a result, the corresponding coefficients may appear unusually large in absolute terms. To improve numerical stability and interpretability, the forest cover variable was rescaled during the estimation process. This adjustment does not affect the direction or statistical significance of the estimated relationships but facilitates a more appropriate interpretation of the model parameters.

The coefficient associated with forest cover at the cantonal level was not statistically significant (p = 0.896), indicating that there is no empirical evidence that forest stock influences the probability of individual poverty in the Guayas province, once demographic and sectoral characteristics are controlled for.

Conversely, the variables related to the branch of economic activity show highly significant effects, confirming that productive integration is the main determinant of economic well-being, above the territory's environmental assets.

Model Fit Quality

2.2. Econometric Interpretation

Table 3: Model Fit and Performance Indicators.

Indicador	Valor
AUC (ROC)	0.5017
McFadden R ²	-0.079
Sensibilidad	0.024
Especificidad	0.980
Accuracy global	0.904
Balanced accuracy	0.502

The model exhibits limited predictive performance (AUC ≈ 0.50), indicating a low capacity to discriminate between poor and non-poor individuals based solely on the included covariates. However, the primary objective of this study is explanatory rather than predictive. The econometric specification is designed to assess the structural association between territorial forest cover and poverty probability while controlling for key socioeconomic characteristics. Therefore, the modest classification performance does not invalidate the analytical contribution of the model; instead, it

reinforces the interpretation that forest cover alone does not constitute a strong determinant of poverty outcomes in the studied context.

The high overall accuracy (90.4%) is explained by the class imbalance, since the majority of the population is not poor. However, the extremely low sensitivity (2.4%) demonstrates that the model is not suitable as a predictive tool, reinforcing its explanatory rather than classification-based nature.

Goodness-of-Fit Test

The Hosmer-Lemeshow test could not be applied

conventionally due to the sample size and the presence of weights, which resulted in negative degrees of freedom. This result is consistent with the econometric literature, which notes limitations of this test in large samples and weighted models.

For this reason, the evaluation was prioritized

using AUC, McFadden R^2 , and the confusion matrix, which are more robust indicators for models of this type.

Multicollinearity

Table 4: Variance inflation factors (VIF).

Variable	GVIF ajustado
Cobertura forestal	1.15
Edad	1.07
Sexo	1.14
Educación	1.08
Área	1.23
Rama actividad	1.03

Note: The Table Shows the VIF Test That Evaluates Stability

All values are less than 2, which rules out multicollinearity problems and confirms the structural stability of the model.

2.3. Summary of Results

The results allow us to draw three key empirical conclusions:

- Forest cover does not directly affect individual poverty, once socioeconomic characteristics are controlled for.
- The productive structure of the territory is indeed a determining factor, particularly its involvement in agricultural, industrial, and service activities.
- Environmental conservation, in the absence of economic mechanisms for internalization, does not translate into improvements in well-being.

From an environmental economics perspective, these results suggest that the forest fulfills an ecological function, but not a distributive one in terms of income or poverty reduction.

This supports the theoretical hypothesis that natural assets do not automatically generate human development without economic valuation policies such as payments for ecosystem services, local bioeconomies, or green production chains.

The results reveal a structural disconnect between environmental conservation and socioeconomic well-being, suggesting that ecological sustainability does not, in itself, guarantee social sustainability in peripheral development contexts.

3. DISCUSSION

The main objective of this study was to analyze the relationship between territorial forest cover and the probability of individual poverty in the Guayas province of Ecuador. The empirical results show that, once sociodemographic and productive characteristics were controlled for, forest cover did

not have a statistically significant effect on poverty. This finding suggests that the mere existence of natural assets does not automatically translate into improvements in economic well-being.

From an environmental economics perspective, this result is consistent with the theoretical proposition that ecosystems generate social value only when institutional and economic mechanisms exist that allow for the internalization of their benefits. In the absence of valuation policies — such as payments for ecosystem services, green certifications, ecotourism, or local bioeconomy — forest resources remain underutilized ecological assets from a socioeconomic point of view.

The results also show that variables associated with the territory's productive structure (branch of economic activity) are the main determinants of poverty. This reinforces the empirical evidence that access to formal employment and dynamic sectors is the dominant channel for income generation, even in territories with high environmental wealth. In this sense, the forest does not act as a direct engine of development, but rather as a potential resource whose impact depends on the local economic model.

This pattern has been documented in various international studies. Research in Latin America and Southeast Asia has found similar results, where forest conservation does not reduce poverty unless accompanied by active policies for productive inclusion (Wunder, 2001; Angelsen et al., 2014). In particular, the literature on rural poverty indicates that households near forests tend to depend on low value-added extractive activities, which limits their capacity to improve their living conditions.

In the specific context of Guayas, the results can be explained by the predominantly agricultural and urban-industrial nature of the provincial economy. The cantons with the greatest forest cover do not necessarily concentrate formal economic activities associated with the forest; rather, they tend to have

primary subsistence economies or informal extractive practices. This implies that natural capital is not transformed into economic or human capital.

From a public policy perspective, the findings pose a central challenge for sustainable development approaches: environmental conservation, while necessary, is not sufficient to reduce poverty. Explicit articulation between environmental and economic policies is required to generate green jobs, sustainable production chains, and mechanisms for redistributing ecological value.

Furthermore, the results suggest that conservation programs that do not incorporate economic components can have a neutral or even regressive effect in social terms by restricting land use without offering viable productive alternatives. This is especially relevant in developing countries, where large segments of the population depend directly on natural resources for their livelihoods.

From a methodological standpoint, the study demonstrates the usefulness of integrating socioeconomic microdata with territorial environmental information, allowing for a more nuanced analysis than purely aggregated studies. However, it also acknowledges limitations inherent in the cross-sectional design, which prevent the establishment of strict causal relationships and suggest the need for future longitudinal or quasi-experimental studies.

The results suggest that forest conservation is a necessary condition for environmental sustainability, but not a sufficient one for socioeconomic development, highlighting the need for integrated green economy policies and productive inclusion.

In short, the empirical evidence supports a fundamental conclusion: ecological sustainability does not guarantee social sustainability. Forests, on their own, do not reduce poverty; their contribution to development depends on the existence of institutions, markets, and policies that transform ecosystem services into real economic opportunities for the local population.

4. CONCLUSIONS

This study empirically analyzed the relationship between territorial forest cover and individual poverty status in the province of Guayas, Ecuador, by integrating socioeconomic microdata (ENEMDU 2023) with cantonal environmental information (MapBiomass). The econometric evidence obtained allows us to draw several relevant conclusions from an environmental economics and sustainable development perspective.

First, the results show that forest cover does not

have a statistically significant effect on the probability of poverty, once the demographic, educational, and productive characteristics of individuals are controlled for. This finding suggests that the existence of natural assets, in and of itself, does not guarantee improvements in the economic well-being of the population, which challenges simplistic views that associate environmental conservation with automatic poverty reduction.

Second, it is confirmed that the main determinants of poverty continue to be structural variables linked to human capital and productive integration, particularly the sector of economic activity. This reinforces the idea that inclusive growth depends fundamentally on the quality of employment and the local economic structure, rather than on the environmental endowment of the territory.

From an environmental perspective, the results reveal a functional disconnect between conservation and development, insofar as ecosystem services are not being internalized within the regional economic system. In the absence of mechanisms such as payments for environmental services, local bioeconomies, sustainable tourism, or green production chains, the forest remains an ecological asset without a direct translation into income, employment, or inequality reduction.

The public policy implications are clear: environmental sustainability must be accompanied by economic and social sustainability. Forest conservation must be integrated into territorial development strategies that generate real productive opportunities for local communities, avoiding purely restrictive approaches that limit land use without offering viable alternatives.

From a methodological standpoint, the study demonstrates the usefulness of combining microeconomic information with territorial environmental data, allowing for progress toward more comprehensive approaches in the evaluation of sustainable development policies. However, it is acknowledged that the cross-sectional design limits the possibility of establishing causal relationships. Therefore, future research could incorporate longitudinal approaches, panel models, or quasi-experimental strategies to delve deeper into the transmission mechanisms between environment and well-being.

In short, the study's main contribution lies in demonstrating that forest conservation is a necessary condition for ecological sustainability, but not sufficient for social sustainability. This underscores the need for public policies that explicitly link environmental protection with productive inclusion

and poverty reduction.

Empirical evidence suggests that forests, in the absence of economic valuation mechanisms, fulfill an ecological but not a distributive function. This

reinforces the need to move from passive conservation models toward territorial development strategies based on an inclusive green economy.

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