

# Sustainable Forests in Bali Factors That Affect It (Semi Log Model Analysis)

Putu Krisna Adwitya Sanjaya<sup>1,\*</sup> I Komang Arthana<sup>2</sup>

<sup>1</sup> Management Study Program, Hindu University of Indonesia, Denpasar, Indonesia

<sup>2</sup> Accounting Study Program, Nusa Cendana University, Kupang, Indonesia

\*Corresponding author. Email: [krisnasanjaya@unhi.ac.id](mailto:krisnasanjaya@unhi.ac.id)

## ABSTRACT

On the island of Bali, efforts to conserve forests have been around for a long time through the tradition of Wanakerti and *Tumpek Bubuh*, namely rituals of respecting forests and plants which are implicitly an implementation of environmental preservation and are also part of local wisdom. This is considered insufficient considering that the condition of forest areas in Bali is experiencing distortion. This study aims to determine the simultaneous and partial effects of the factors that affect forest sustainability. By using data from the 1993-2020 period analyzed with the semi-log model approach, it is known that simultaneously GRDP, population, and decentralization have a significant effect on forest preservation during the analysis period, while the decentralization factor does not partially affect forest sustainability. Forest is an integrated ecosystem containing biological natural resources, dominated by trees in their natural relationship with their environment. Therefore, forest management must rely on three pillars, namely the local economy, ecology, and socio-culture which also need to be considered to achieve sustainable forest management and utilization.

**Keywords:** *Forest Sustainability, Gross Regional Domestic Product, Population, Decentralization*

## 1. INTRODUCTION

Biological resources in which there is flora, the fauna has an attachment to nature and its environment that becomes a unified ecosystem called forests [1]. As a unit of biological resource ecosystems, forest function hydrology, ecosystem conservation vehicles from natural resources, and serve as the world's lungs to preserve forests. Forestry conditions on the island of Bali today undergo considerable distortions resulting from reduced forest cover and increased critical land area; it will undoubtedly affect climate change, reduced water discharge upstream that will threaten the lives of living things. Forest damage is also caused by land transfer, human negligence, causing forest fires, and also massive illegal logging [2] for the sake of mere economic interests without putting forward the concept of sustainable economic development.

Sustainable economic development is a fair concept for reducing environmental damage without sacrificing socially equitable economic development [3]. For a handful of individuals, sustainable development correlates with economic growth and how to seek efforts to improve the economy in the long run without killing

off nature. The rate of gross regional domestic product and the per capita income of the inhabitants in a region are often used indicators to determine its economic state [4]. The increasing rate of economic growth, as well as the demographic aspects of the population, can be said to be a threat and also pressure on the utilization of natural resources [5]. With the dispersion of the region's population, it is expected that the availability of necessities ranging from the most basic to the most advanced will only increase. The decentralization of the area can be said to be a double-edged knife, on the one hand, it can bring the decision-making process closer to the community, but on the other hand, it will be a serious threat to forest sustainability if the hypothesis of the spirit of decentralization of the area is not able to be actualized consequently [6].

As one of the potential development and welfare of the community and also forest living creatures must be maintained sustainability [7]. On the island of Bali related to environmental rescue efforts have been inherited since time immemorial by the ancestors. This is evident from the existence of upakara *tumpek bubuh*, the concept of palemahan in the teachings of Tri Hita Karana, and also Wanakerti, which is the preservation of forests

that are part of the concept of *Sad Kerthi*. This is insufficient in light of the status of Bali's forests. Disruptions in security, reductions in forest area, and expansion of critical land in forest areas, as well as the signalmen development of socioeconomic indicators, have all had an effect on Bali's forest sustainability level.

Previous research has been conducted by [8] , [9], and [10], which have linked economic growth to forestry with the findings that all three have had positive influences. Research has been conducted by [5] and [11], which implies that one of the causes of deforestation is the explosion of the population. But so far, there is still minimal research that includes economic, social, and regional decentralization policies in one study. Thus, this study collaborates on economic determinants (GRDP), social demographics, and decentralization policies towards forest sustainability on the Island of the Gods of Bali so that these findings can provide a heterogeneous paradigm on the study of sustainability of forest conservation as part of the lungs of the world.

Scientific research on the long-term viability of the forest should be conducted as a basis for policy development, divorcing the sawala from environmental rationale. To answer the following questions, we conducted this study: (1) Is the sustainability of Bali Province's forests affected by factors such as GDP, population, and decentralization? (2) What effect do GDP, population, and partial decentralization have on the long-term viability of Bali Province's forests? Aims of this study are to examine the impact of GDP, population, and decentralization on forest sustainability in Bali Province, either concurrently or in part.

**2. METHOD**

The study uses secondary data from 1993 through 2020. The research is based on data available in 1993, with 2020 being the latest year for which data is available. This study uses both primary and secondary data. This study included preliminary data from key agencies and structured interviews with informants such the Central Bureau of Statistics, Environment Office, Forest Service, and Greenpeace Bali. Secondarily, the Bali Provincial Forest Service offers statistics on forest area, forest damage, population, and Gross Regional Domestic Revenue from Bali's Central Statistics Agency.

This study looked at applying econometrics models with semilogous techniques on forest sustainability with the influence of each of the explanatory changes using the Eviews ten software application [12]. Before testing the ordinary least square (OLS) regression model is conducted then first conducted a test of the stationer time series data with stationary test followed by basic assumption tests including multicollinearity, heteroskedasticity, and autocorrelation tests so that the model used meets the rules of Best Linear Unbiased Estimator [13]. Data analysis techniques used are linear

regression analysis with the semi-log method used to know the influence of free variables on bound variables; the form is as follows.

$$\text{Ln}Y_i = \beta_0 + \beta_1 \text{LX}_{1i} + \beta_2 \text{X}_{2i} + \beta_3 \text{DX}_{3i} + e_i \quad (1)$$

Information:

- $\text{Ln}Y_i$  = Forest Sustainability
- $X_{1i}$  = Gross Regional Domestic Product
- $X_{2i}$  = Population
- $\text{DX}_{3i}$  = Regional Decentralization
- $\beta_1, \beta_2, \beta_3$  = Regression Coefficient
- $\beta_0$  = Intercept
- $e_i$  = Approximate Error or error term
- $i$  = Observation to -  $i$

**3. RESULT AND DISSUCION**

**3.1 Stationarity Test of Data**

In order to get a sense of the data that will be used in the study, stationary tests are employed to find out what kind of data it is and how much variance it has. This stationary test uses the Dickey-Fuller method of the root unit test. This test can be met if the Augmented Dickey-Fuller (ADF) value is smaller than McKinnon's critical value level of 0.05.

**Table 1.** Result of Stationarity Dickey-Fuller Unit Root Test

Variables	ADF Value	McKinnon Critical Value			Description
		1%	5%	10%	
Forest Sustainability (Ln <sub>v</sub> )	-2,271	-3,698	-2,976	-2,627	Stasioner ordo (0)
GRDP (X <sub>1</sub> )	-4,564	-3,711	-2,981	-2,629	Stasioner ordo (1)
Population (X <sub>2</sub> )	-4,581	-3,711	-2,981	-2,629	Stasioner ordo (1)
Decentralization (D <sub>i</sub> )	-5,099	-3,711	-2,981	-2,629	Stationer ordo (0)

Source: Data Analysis Result (2021)

**3.2 Multicollinearity Test**

Multicollinearity tests are conducted to determine the correlation between free variables. The Klein test method is used to measure the data, which compares lower case letters to each other (correlation between each free variable). If the value of  $R^2 y X_1, X_2 \text{Ln} > r^2 y X_1 X_2 D_i$ , then it can be said in the model does not occur multicollinearity.

**Table 2.** Multicollinearity Test Result

Item	R <sup>2</sup>	r <sup>2</sup>
Regression	0,961	
Auxiliary X1		0,938
Auxiliary X2		0,880
Auxiliary Di		0,841

Source: Data Analysis Result (2021)

### 3.3 Heteroscedasticity Test

Heteroskedastisitas tests are conducted to determine whether there is a variable mismatch in a model analyzed using glejser tests. This test combines the significance of probability value with a significance of 0.05; if the probability value is greater than the significance of 0.05, then in the model, it is said not to contain heteroscedasticity problems.

**Table 3.** Heteroscedasticity Test Result

Variable	Probability Values	Assumptions of Heteroscedasticity
GRDP (X1)	0,092	It didn't happen
Population (X2)	0,098	It didn't happen
Decentralization (Di)	0,091	It didn't happen

Source: Data Analysis Result (2021)

### 3.4 Autocorrelation Test

This test was conducted to see if there is a correlation between the past and the present, using the Breusch-Godfrey method serial correlation Lagrange multiplier obtained obs\* R Square value of 0.070, which is greater than the real level of 0.05 then concluded the model in this study does not contain autocorrelation problems.

### 3.5 Results of Multiple Linear Regression Estimation OLS Semilog model

The regression model in this study was used to show how free variables (X<sub>1</sub>, X<sub>2</sub>, D<sub>i</sub>) affect bound (LnY) variables both simultaneously and partially.

From table 4 under can be obtained multiple linear regression equation models as follows, with the equation of the regression:

$$LnY_i = 5,817 + -(3,630 X_{1i}) + (-7,050 X_{2i}) + 0,007DX_{3i} + e_i \quad (2)$$

**Table 4.** Linear Regression Test Results of OLS Semilog Model

Variables	Coefficient	T Statistic	Significance
GRDP (X1)	3,630	4,164	0,000
Population (X2)	-7,050	6,409	0,000
Decentralization (Di)	0,007	0,170	0,866
Constanta = 5,817		F statistic = 198,480	
R <sup>2</sup> = 0,916		Sig = 0,000	

Source: Data Analysis Result (2021)

The value of R Square of 0.961 or 96.1 percent of the variable Gross Regional Domestic Product (GRDP), population and decentralization policy affect forest sustainability in Bali Province. The remaining 3.9 percent is impacted by non-research model variables. The F test was obtained at 198,480, much greater than the F table (198,480 > 3.03), which means H<sub>0</sub> was rejected, and H1 was accepted. Based on the F test, it can be concluded that GRDP, population, and decentralization policies have a simultaneous effect on forest sustainability with a confidence rate of 95 percent. The t-test is performed to see how each free variable affects the partially bound variable.

The result of t statistical testing in this study is that in GRDP (H<sub>1</sub>) the forest sustainability is greater than the table t (4,164 > 1,703) with a significance value smaller than the actual level of α (0.000 < 0.005.). In this study, the beta regression coefficient in PDRB variables was found to be 3,630. GRDP has a positive and large impact on forest sustainability, which supports the hypothesis (H1). This condition occurs because the economic growth of Bali implied in the GRDP is balanced with environmental conservation efforts and also forests where the realization through the program nangun sad kerthi loka Bali which this concept and vision contain meaning to preserve the nature of Bali and its contents to realize a prosperous and happy Balinese krama life at a time lan niskala. This research is in line with study conducted by [7] , [14], and [8]. The success of environmentally sound development requires enabling policy [15].

The results of the t-test statistics in this study found that the population value (H<sub>2</sub>) for forest sustainability was greater than the table t value (6,409 > 1,703), and the probability value was smaller than the actual level of 5 percent. The value of the beta regression coefficient in population variables has a negative value of 7,050. In this study, H2 is accepted, indicating that human population growth has a detrimental effect on the long-term viability

of forest ecosystems. This situation occurs because, with the increasing population growth or even uncontrollable, this will be a kind of challenge as well as a threat to the sustainability of forests in Bali especially Bali is an island that is a broadly small territory of 5.636,66 Km<sup>2</sup> or only 0.29 percent of the total area of Indonesia. The rapid increase in population growth in a certain period will cause the need for new land will also increase, and not to deny that forest areas can also be used as the primary target. The findings of this study are in line with studies conducted by [16], [17], [4], and [18].

The results of the t-test statistics in this study found that the value of decentralized variables (H<sub>3</sub>) to forest sustainability is greater than the table t value (0.170 < 1,703), and the probability value of 0.866 is greater than the real level of 5 percent (0.05). The beta regression coefficient value in decentralized variables has a positive value of 0.007, so in this study, decentralization has no influence on forest sustainability, as hypothesized by hypothesis (H<sub>3</sub>), which was found to be false. This study supports research conducted by [6], [19] and [20]. This condition is due to the impact of decentralization of forestry policy in regional decentralization, which has not shown the results as expected. Granting authority to local governments has resulted in the emergence of stigma and a shift in mindset. Increasing provincial revenues is a top priority when they are given significant responsibility for managing their areas without sufficient funding from the central government to finance their activities.

#### 4. CONCLUSIONS AND SUGGESTIONS

Statistical testing shows that the variables of GRDP, population, and decentralization of the area have a significant effect on forest sustainability. Partially found the fact that GDP and population significantly influenced. At the same time, the decentralization of the region does not affect the sustainability of forests in Bali; vague definitions of administrative authority and understanding that has not been the same between the central government, local governments towards decentralization tend to be still a stumbling block to the implementation of regional forestry development [14].

To ensure the long-term well-being of all communities, both present and future, forests must be managed, safeguarded and utilized sustainably. Future research may add other variables that affect forest sustainability, such as green GRDP, local wisdom. In addition, it can also modify the variables of regional decentralization as moderation variables to forest sustainability because in essence, the concept of decentralization will provide new hopes and opportunities for local governments to maximize the potential of their forest areas to be managed and can also determine the direction of forest management itself by its interests and needs.

#### ACKNOWLEDGMENTS

The highest appreciation goes to the leaders of The Hindu University of Indonesia, Widya Kerthi Education Foundation, Nusa Cendana University, colleagues, and everyone who has made a valuable contribution to this research, as well as their critical comments to this article.

#### REFERENCES

- [1] P. K. A. Sanjaya, "Hutan Lestari: Aspek Sosial Ekonomi yang Mempengaruhinya." UNHI Press, 2020.
- [2] I. A. Swasrina and A. Putera, "Kilas Balik 2019 : Bila Hutan Kintamani Beralih Fungsi, Bali Terancam Krisis Air," *Bali Post*, Bangli, 2019.
- [3] P. Campos, A. Alvarez, B. Mesa, L. Oviedo, and A. Caparr, "Forest Policy and Economics Linking standard Economic Account for Forestry and ecosystem accounting : Total forest incomes and environmental assets in publicly-owned conifer farms in Andalusia-Spain," vol. 128, no. August 2020, pp. 26–28, 2021, doi: 10.1016/j.forpol.2021.102482.
- [4] P. K. A. Sanjaya, N. L. A. A. Wulandari, N. K. Sumadi, and I. A. W. Sugianingrat, "Accelerating Regional Economic Development through Tourism: The development of 'Alas Kedaton' as a spiritual tourism destination," 2019.
- [5] N. Hosonuma *et al.*, "An assessment of deforestation and forest degradation drivers in developing countries," *Environ. Res. Lett.*, vol. 7, no. 4, 2012, doi: 10.1088/1748-9326/7/4/044009.
- [6] Sanjaya, *Hutan Lestari:Aspek Sosial Ekonomi yang Mempengaruhinya*, 1st ed. Denpasar Bali: Unhi Press, 2020.
- [7] Edward B. Barbier, "The Evolution of Economic Views on Natural Resource Scarcity," *Rev. Environ. Econ. Policy*, vol. 15, no. 1, pp. 22–44, 2021, [Online]. Available: <https://www.journals.uchicago.edu/doi/10.1086/712926>.
- [8] Emmanuel Paradis, "Forest gains and losses in Southeast Asia over 27 years: The slow convergence towards reforestation," *For. Policy Econ.*, vol. 120, no. 102332, 2021, doi: doi.org/10.1016/j.forpol.2020.102332.
- [9] E. K. Krisna Sanjaya, Urmila Dewi, "Forest Steadiness in the Perspective of Macroeconomics: Distributed Lag Analysis," in *Community, Ecology and Religion: Interdisciplinary and Civic Engagements towards Sustainable Living*, 2020, pp. 46–53.
- [10] D. Qiao, S. Ke, X. Zhang, and Q. Feng, "Impact of marketization process on China's forestry economic growth – based on the statistical yearbook data from 1978 to 2016," *For. Econ. Rev.*, vol. 2, no. 1, pp. 43–60, 2020, doi: 10.1108/fer-02-2020-0002.

- [11] B. A. Margono *et al.*, “Mapping and monitoring deforestation and forest degradation in Sumatra (Indonesia) using Landsat time series data sets from 1990 to 2010,” *Environ. Res. Lett.*, vol. 7, no. 3, pp. 2000–2010, 2012, doi: 10.1088/1748-9326/7/3/034010.
- [12] J. Hausman and H. L. Y. L. C. Palmer, “Errors in the Dependent Variable of Quantile Regression Models,” *Econometrica*, vol. 89, no. 2, pp. 849–873, 2021, doi: <https://doi.org/10.3982/ECTA14667>.
- [13] S. Arora, M. a. Little, and P. E. Mcsharry, “Nonlinear and nonparametric modeling approaches for probabilistic forecasting of the US gross national product,” *Stud. Nonlinear Dyn. Econom.*, vol. 17, no. 4, pp. 395–420, 2013, doi: 10.1515/snde-2012-0029.
- [14] P. Krisna, “Social economy indicator on constructing forest sustainability in Bali,” *e3-Revista Econ. Empres. e Empreendedores na CPLP*, vol. 6, no. 1, pp. 56–68, 2020.
- [15] Nurrochmat, D. R., Darusman, D. and M. Ekayani, *Kebijakan Pembangunan Kehutanan dan Lingkungan : Teori dan Implementasi*, 2nd ed. Bogor: PT Penerbit IPB Press, 2017.
- [16] Krister P. Andersson, S. M. Smith, and L. J. Alston Amy, “Wealth and the distribution of benefits from tropical forests: Implications for REDD+,” *Land use policy*, vol. 72, pp. 510–522, 2018, doi: <https://doi.org/10.1016/j.landusepol.2018.01.012>.
- [17] P. D. Noah Goyke, “Twenty-five years of increasing inequality among family Forest landowners in the United States,” *For. Policy Econ.*, vol. 122, no. 102332, 2021, doi: <https://doi.org/10.1016/j.forpol.2020.102334>.
- [18] R. K. Bannor, M. A. F. Ros-Tonen, P. O. Mensah, M. Derkyi, and V. F. Nassah, “Entrepreneurial behaviour among non-timber forest product-growing farmers in Ghana: An analysis in support of a reforestation policy,” *For. Policy Econ.*, vol. 122, no. July 2020, p. 102331, 2021, doi: 10.1016/j.forpol.2020.102331.
- [19] M. A. Omala and L. M. Aglanu, “Power dynamics in forest governance decentralization: the case of Kenya,” *Int. For. Rev.*, vol. 22, no. 2, pp. 225–240, 2020.
- [20] L. Secco, M. Favero, M. Masiero, and D. M. Pettenella, “Failures of political decentralization in promoting network governance in the forest sector: Observations from Italy,” *Land use policy*, vol. 62, pp. 79–100, 2017.