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Does Ecotourism Really Benefit the Environment? A Trend Analysis of Forest Cover Loss in Indonesia

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Abstract: Ecotourism is widely promoted as a sustainable tourism model that harmonizes environmental conservation with local community benefits. Indonesia, celebrated for its extraordinary biodiversity, has long adopted ecotourism as a strategy to safeguard its natural ecosystems. Despite this, evidence of its environmental impact at a national scale remains sparse. This study bridges this gap by examining forest loss trends from 2014 to 2023 across ecotourism sites in Indonesia to assess whether ecotourism contributes to forest protection. The analysis reveals that most ecotourism sites exhibit no significant reduction in forest loss, with some even experiencing accelerated deforestation. While a few sites demonstrate positive outcomes, these successes are rare and insufficient to indicate widespread environmental benefits. The findings call into question whether the ecotourism model, in its current form, is an effective conservation strategy. A reevaluation of its use is imperative, along with critical reflection on whether ecotourism is genuinely suited to addressing Indonesia's deforestation challenges. This study underscores the need for alternative or complementary approaches to conservation, as well as a robust examination of ecotourism's limitations and potential within the broader context of sustainable development.

Keywords: ecotourism; forest conservation; deforestation trends; sustainable tourism; biodiversity protection; Indonesia; conservation strategies; environmental impact

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1. Introduction

Recent studies underscore the complex dynamics of global forest loss, particularly in tropical regions where biodiversity and carbon storage are critical. While protected areas tend to have lower deforestation rates compared to unprotected lands, they remain vulnerable to threats such as agricultural encroachment, illegal logging, and infrastructure expansion [1,2]. Fire is a major contributor to global forest loss, accounting for 38% of total loss between 2003 and 2018, with significant regional variations, particularly in tropical forests where both natural and anthropogenic fires exacerbate deforestation [3].

In Indonesia, the drivers of forest loss reflect these global trends, with plantations and smallholder agriculture being primary contributors from 2012 to 2019 [4]. Despite this, the overall rate of deforestation in Indonesia has shown a gradual decline since 2012, attributed in part to strengthened policies and international conservation initiatives. However, forest loss in the region remains sensitive to non-market factors such as climate anomalies and policy shifts, as seen in other tropical countries like Brazil and the Democratic Republic of Congo [5,6]. These dynamics highlight the urgent need for adaptive and region-specific strategies to mitigate forest loss effectively.

In response to this environmental crisis, ecotourism has emerged as a potential solution that balances conservation with economic growth. Ecotourism is rooted in the principles of

sustainable development, aiming to protect biodiversity while providing economic benefits to local communities [7]. Recognizing its potential, Indonesia has implemented policies to promote ecotourism as an alternative to extractive industries. Theoretically, ecotourism offers a pathway to forest conservation by creating financial incentives to protect natural landscapes and fostering environmentally responsible visitor behavior [8]. Despite these promises, the actual environmental impact of ecotourism remains underexplored, especially in the Indonesian context. Evidence on whether ecotourism effectively curbs deforestation or merely shifts environmental pressures to other areas is sparse and inconsistent [9].

This study addresses the critical knowledge gap by examining the relationship between ecotourism and forest cover changes in Indonesia. Through a combination of temporal and spatial analyses, it investigates whether ecotourism sites experience less deforestation compared to non-ecotourism areas. Additionally, this study seeks to identify specific ecotourism practices, such as visitor management strategies and waste disposal systems, that contribute to positive environmental outcomes. By exploring the conditions under which ecotourism succeeds or fails in promoting forest conservation, this research aims to provide evidence-based insights for policymakers and stakeholders.

Ultimately, this research will contribute to a growing body of knowledge on sustainable tourism and environmental conservation, offering practical recommendations for enhancing the effectiveness of ecotourism in Indonesia. It aspires to bridge the gap between ecotourism theory and practice, fostering a sustainable future for Indonesia's invaluable forests and the diverse life they support.

2. Literature Review

2.1. Global Perspective on Ecotourism Outcomes

Globally, ecotourism has been recognized as a tool for both conservation and sustainable development, with mixed success in achieving its environmental objectives [10]. In Kenya, challenges such as marketing limitations, security concerns, and a lack of innovative strategies have impeded efforts to strengthen stakeholder linkages in ecotourism development [11]. A case study from Italy's Monviso Transboundary Biosphere Reserve highlighted that while ecotourism facilitated stakeholder cooperation, its impact was constrained by negative public perceptions, potentially stemming from insufficient environmental education initiatives [12]. In Costa Rica, the Lapa Rios Eco-lodge showcased the dual benefits of ecotourism by supporting both community livelihoods and ecological restoration, evidenced by notable reforestation achievements [13]. Nonetheless, another investigation in Costa Rica presented a more complex picture, indicating that while ecotourism had some conservation benefits, legal frameworks were perceived to have a stronger role in curbing deforestation and wildlife exploitation [14].

However, several success stories provide optimism. In Costa Rica, ecotourism has supported biodiversity conservation by funding protected areas and promoting sustainable land-use practices, demonstrating the compatibility of tourism and ecological preservation when properly managed [15]. Community-based ecotourism initiatives in Kenya have empowered local populations to engage in wildlife conservation, reducing habitat loss and poaching [16]. In New Zealand, community-led ecological restoration initiatives have incorporated ecotourism as a mechanism to support conservation financing and environmental education, although their financial sustainability through tourism varies by location [17]. Comparable outcomes have been observed in Langkawi, Malaysia, where participatory ecotourism has contributed to the conservation of limestone forests by offering immersive, experiential learning opportunities [18]. The case of the Dadia-Lefkimi-Soufli Forest Reserve in Greece illustrates how WWF Greece employed ecotourism as a dual-purpose tool—supporting raptor conservation while addressing local socio-economic needs [19].

Global case studies reveal that ecotourism's environmental benefits are not guaranteed and often depend on governance, community involvement, and education. Despite its potential, outcomes remain mixed, with many initiatives falling short of their conservation goals. These inconsistencies highlight the need for context-specific evaluation. This study responds to that need by examining whether ecotourism in Indonesia delivers on its environmental promises through an analysis of forest cover trends around ecotourism sites.

2.2. Ecotourism Benefits to the Environment in Indonesia

Building on global evidence that ecotourism can lead to both positive and negative environmental outcomes, Indonesia presents a similarly complex picture. Negative impacts often arise from exceeding the carrying capacity of ecotourism sites, causing ecosystem distress and habitat degradation [20]. Specific cases include pollution and habitat disturbances in regions such as the Tangkoko Dua Sudara Nature Reserve, where unchecked tourism has disrupted wildlife behavior [21]. Additionally, the opening of land for tourism or agriculture near ecotourism hotspots has contributed to ecosystem imbalance, as observed in Taman Wisata Alam Telogo Warno Telogo Pengilon [22].

However, positive environmental effects are also evident. Revenue from ecotourism has directly funded conservation efforts, aligning local community empowerment with sustainable development [23]. Initiatives in Bali, such as Tukad Bindu, highlight how ecotourism can mitigate negative impacts by promoting environmental awareness and responsible tourism behaviors [24]. Comprehensive management planning, as demonstrated in Indonesia's national parks, has led to improved forest management and biodiversity protection [25]. Furthermore, community-based ecotourism models in rural areas have increased local environmental awareness and sustainable waste management practices, underscoring the role of education in fostering pro-conservation values [26].

Despite these findings, it is noteworthy that most studies on the environmental effects of ecotourism in Indonesia focus on localized case studies, with limited understanding of nationwide impacts. In contrast to international research that has begun to evaluate ecotourism's cumulative or landscape-scale effects, Indonesia still lacks a comprehensive assessment. This study addresses that gap by using geospatial data to evaluate forest cover loss across ecotourism sites nationwide, offering an evidence-based understanding of whether ecotourism in Indonesia aligns with its environmental promise.

2.3. Methodological Approaches to Assessing Ecotourism

Understanding the environmental impacts of ecotourism requires the application of diverse and context-sensitive research methodologies. Case studies have been a cornerstone of ecotourism research, offering in-depth analyses of specific destinations to capture localized complexities and dynamics. For example, Chaplin & Brabyn (2013) used remote sensing and a Geographic Information System (GIS) to examine forest cover changes in the Annapurna Conservation Area, revealing how proximity to tourism villages influenced deforestation patterns [27]. Surveys and interviews are also valuable tools, providing qualitative and quantitative insights into the perceptions and experiences of stakeholders, including tourists, local communities, and park officials [15].

However, at the nationwide scale, conducting interviews and surveys can be logistically challenging and resource-intensive, especially in Indonesia, where the implementation of the One Map Policy (OMP) has revealed substantial barriers related to manual data collection, institutional fragmentation, and inconsistent spatial datasets [28,29]. Therefore, advanced technological approaches, such as remote sensing, are the most feasible alternative. Remote sensing and GIS enable the monitoring of land-use changes, forest cover, and ecological indicators across vast areas, offering a macroscopic view of ecotourism's

environmental impacts. For instance, Brandt et al. (2019) used counterfactual analyses combined with satellite imagery to assess forest loss across multiple ecotourism hubs in the Himalayan region, demonstrating the effectiveness of such methods in large-scale studies [30].

In Indonesia, where ecotourism sites are dispersed across a geographically diverse archipelago, adopting remote sensing and GIS as primary methodologies is highly relevant. These technologies not only overcome logistical barriers but also enable consistent, replicable analysis across different regions and time periods. In this study, we employ GIS-based spatial analysis of forest loss around ecotourism areas to investigate whether ecotourism leads to measurable environmental benefits at the national level.

3. Materials and Methods

To investigate whether ecotourism contributes to forest conservation, we conducted a nationwide spatial analysis of forest cover change around ecotourism sites in Indonesia using GIS and remote sensing data. The analysis included calculating annual forest cover loss from 2014 to 2023 at multiple buffer distances around ecotourism locations, comparing trends to national averages and matched control sites in protected areas. This approach allowed us to assess ecotourism impact towards the environment in a consistent, scalable, and regionally comparable manner.

3.1. Study Area

This study adopted a nationwide approach, encompassing established ecotourism sites situated across the terrestrial area of Indonesia. Indonesia is geographically located in 95° E–141° E and 6° N to 11° S, across 17,504 islands [31]. The nation consists of 38 provinces, and this research groups those provinces into five main regions based on the main islands: (1) Jawa, Bali & Nusa Tenggara (2) Sumatera, (3) Kalimantan, (4) Sulawesi, and (5) Maluku & Papua. In this research we use the Level 1 (country) administrative boundaries as the study boundaries, as seen in Figure 1.

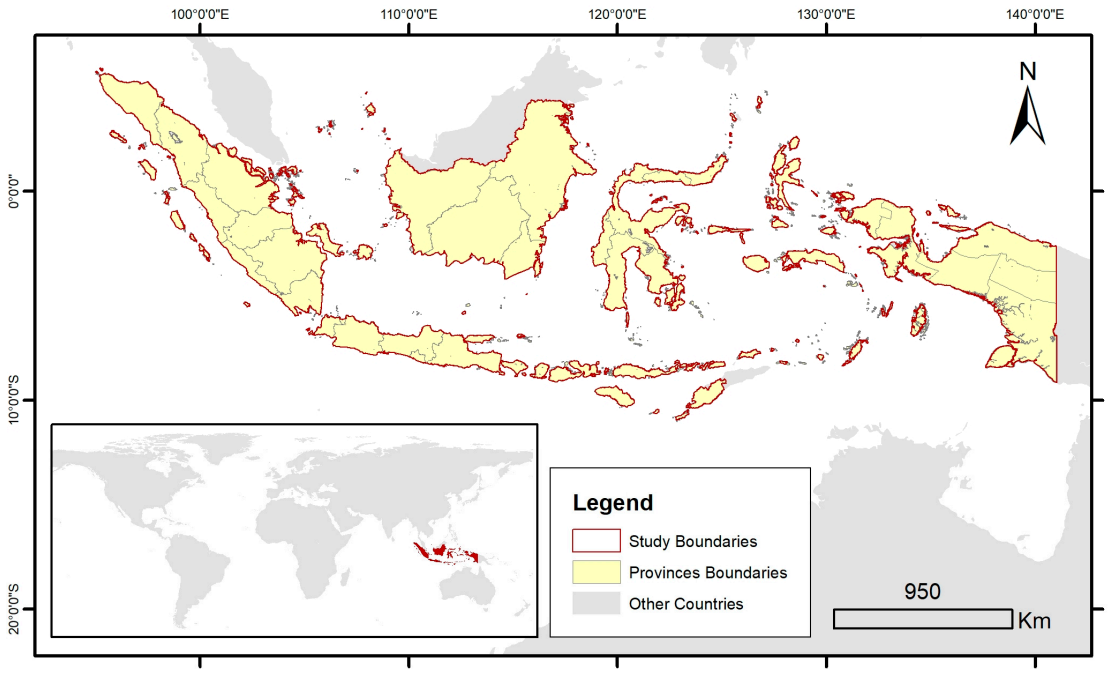


Figure 1. Map of Indonesia as the study area.

3.2. Forest Cover Calculation on Ecotourism Sites

Annual forest cover in this study was estimated based on the Hansen Global Forest Change data [32]. The Hansen Global Forest Change (GFC) is a publicly available dataset, providing results of time series analysis of Landsat images in characterizing global forest extent and changes from 2000 and updated annually with the latest for 2023. This dataset has been widely used to calculate regional forest loss, which fits the scale for this research with accuracy of more than 80%, especially for the nationwide-scale approach [33]. Annual forest cover from the period 2014–2023 was acquired from the Google Earth Engine (GEE) catalog based on each year of the GFC version, combining the bands of "treecover2000", representing tree canopy cover for the year 2000, and "loss", representing forest loss during the GFC's version period. Tree canopy cover is defined as canopy closure for all vegetation taller than 5 m in height [34]. The overall research flow can be seen in Figure 2.

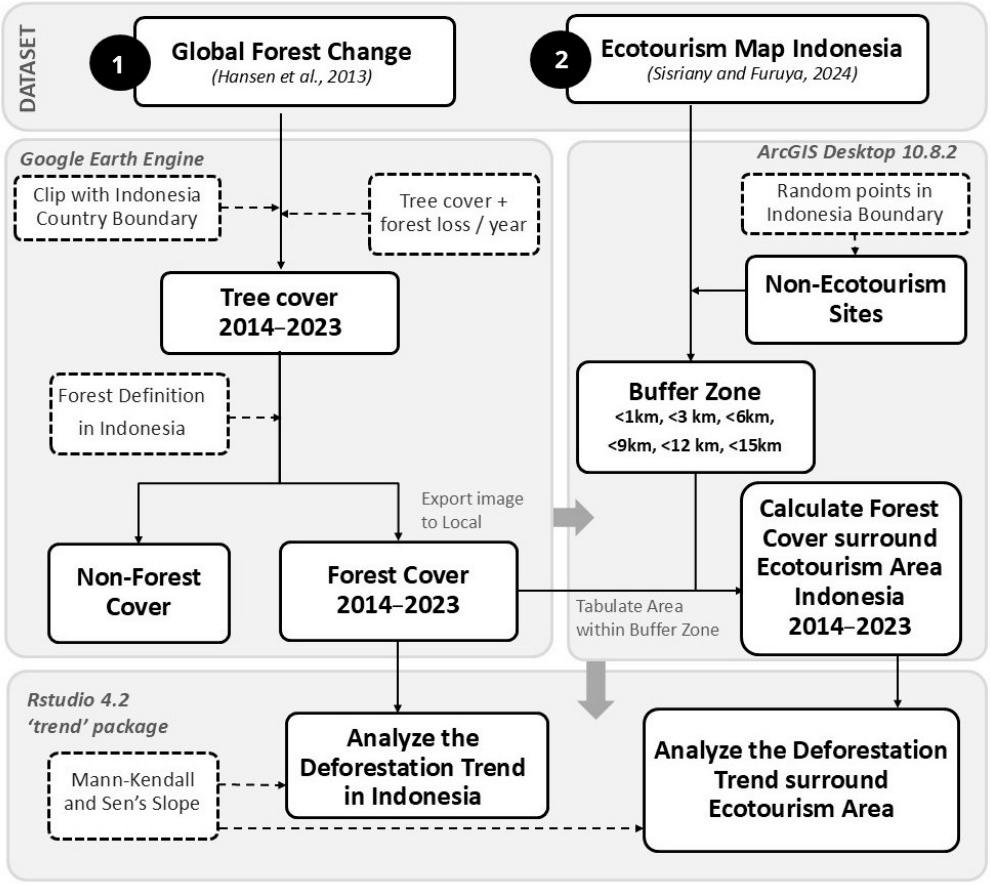


Figure 2. Flow of research methods and Datasets [32,35].

The GFC dataset was then clipped by the Indonesia boundaries. Forest cover was selected based on the forest threshold value in Indonesia as follows: a minimum tree height of 5 m; a canopy cover of at least 30%; and a contiguous block of forest land of 5 hectares or more [36].

The process of data acquisition for the selection of Indonesia forest cover based on the definitions was performed in GEE, and data were then exported to ESRI ArcMap.

The second dataset for this research is the Ecotourism Map of Indonesia derived from the author's prior research [35], which was chosen considering it is the most recently updated and has complete distribution data of ecotourism sites in Indonesia. The Ecotourism Map of Indonesia dataset is also publicly accessible, providing geographical locations of ecotourism sites in Indonesia developed based on the Google Places API and consisting of

172 identified ecotourism sites. For the purpose of this analysis, 152 sites were selected and processed based on the availability of forest cover data. Sites without relevant forest cover—such as those located on beaches—were excluded. To assess the impact of ecotourism on forest cover, we calculated forest cover at each ecotourism location. The analysis included multiple buffer zones to capture the influence of ecotourism at varying distances from the sites. Specifically, buffer zones of 1 km, 3 km, 6 km, 9 km, 12 km, and 15 km were used. The forest cover of each buffer area was calculated using the tabulate area tools with the WGS 1984 World Mercator projection system in ESRI ArcMap. Annual forest cover of Indonesia from 2014 to 2023 was also calculated to compare the forest loss between the national level and ecotourism site level.

3.3. Counterfactual Analysis of Forest Loss

This study incorporated a counterfactual approach based on the quasi-experimental design to determine the impact of ecotourism on forest loss. The counterfactual approach assesses the effectiveness of the interventions by comparing its factual states, in the presence of the intervention, with its counterfactual states, in the absence of intervention [37]. The application of counterfactual analysis has been used in assessing impacts in conservation [38], ecosystem services [39], and ecotourism [30].

The goal of this analysis is to see if a similar trend of forest loss would appear if ecotourism existed or not. In this study, the control units (non-ecotourism sites in protected areas) and treatment units (ecotourism sites in protected areas) were matched to observe the forest sites if they were not subjected to ecotourism. Treatment units consisted of forest cover in the multiple buffer zones of the ecotourism sites in Indonesia. The central points of control units were randomly generated outside the ecotourism site zones, but within Indonesia's protected area there were six control units in each region, as mentioned in the study area section. The forest cover surrounding the central point of each control unit was calculated within the same buffer zones as the treatment units: 1 km, 3 km, 6 km, 9 km, 12 km, and 15 km. The datasets consist of forest cover and ecotourism sites, along with additional control points, which can be seen on the map in Figure 3.

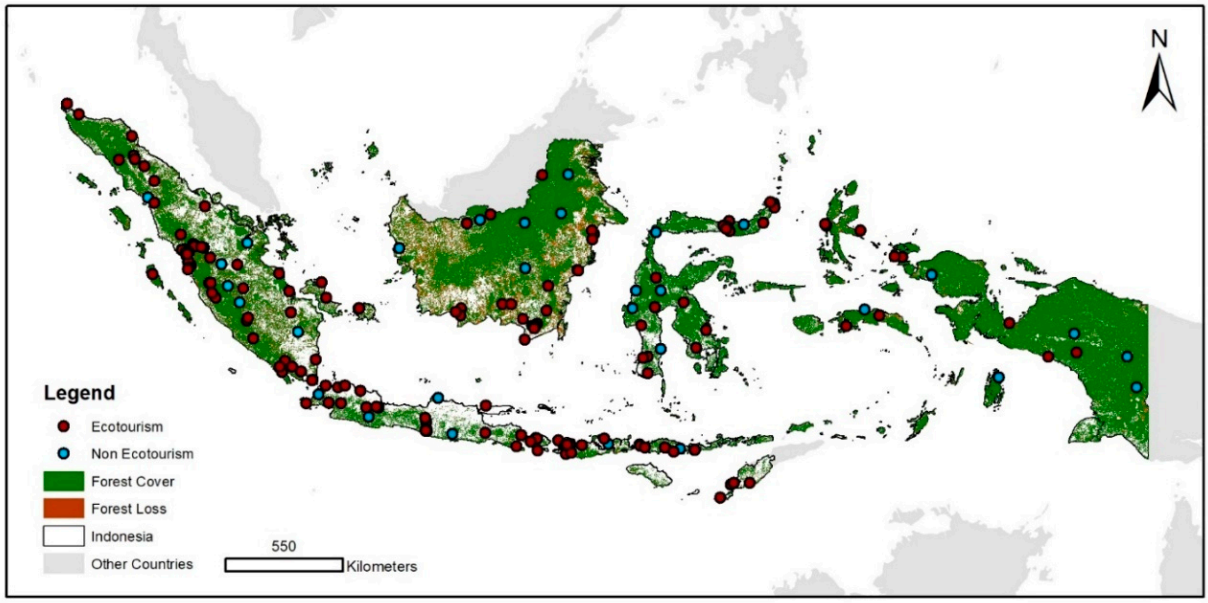


Figure 3. Forest cover and forest loss in Indonesia [32] and ecotourism in Indonesia [35].

3.4. Trend Analysis of Forest Loss Change

Forest loss was calculated from the results of the Hansen GFC Forest cover calculations. The forest loss in the proximity areas of ecotourism sites, non-ecotourism sites, and nationwide was all calculated with the same formula as

$$\boldsymbol{FL_{Y1} = FC_{Yn} - FC_{Y(n-1)}} \quad (1)$$

where $\boldsymbol{FL_{Yn}}$ is the forest loss at the year of $\boldsymbol{n}$, $\boldsymbol{FC}$ is the forest cover at the year of $\boldsymbol{n}$, and $\boldsymbol{FC_{Y(n-1)}}$ is the forest cover in the previous year ($\boldsymbol{n-1}$). Since the data extracted from the Hansen GFC excluded the forest gain, the formula was straightforward and calculated the forest loss from the subtraction of forest cover of the current year and previous year. The calculation of forest loss was conducted in Microsoft Excel.

This research used the combination of the Mann–Kendall test and Sen's slope estimator to analyze the trend of forest loss surrounding ecotourism sites, non-ecotourism sites (control units), and national forest loss for the period of 2015–2023. The combination of the Mann–Kendall test and Sen's slope estimator has been widely applied in forest cover trend analysis [40,41] and other studies such as climate change [42]. The Mann–Kendall test is a non-parametric statistical test that was used to evaluate significant changes over time series data due to its low requirements for the sample and insensitivity to outliers, and because it does not assume a normal distribution. However, this test alone cannot be used since it only judges the significance and identifies the monotonic upward and downward trend. Sen's slope estimator was used to provide additional information about the slope of the trends [43].

Both Mann–Kendall and Sen's slope analysis was performed using the "trend" package in RStudio ver. 3.6 [44]. In total, 1.097 trend analyses of forest loss were performed, including 152 ecotourism sites and 30 non-ecotourism sites (in six different proximity areas), and forest loss in the five regions within Indonesia. The interpretation of trend analysis uses Kendall's tau value and *p*-value, and Sen's slope value was used to identify the forest loss trend (Table 1).

Table 1. Forest loss trend Interpretation.

Kendall's Tau (τ)	*p*-Value	Sen's Slope (b)	Loss Trend
$\tau > 0$	≤ 0.05	$b > 0$	Significant increase
$\tau > 0$	>0.05	$b > 0$	Slight increase
$\tau < 0$	≤ 0.05	$b < 0$	Significant decrease
$\tau < 0$	>0.05	$b < 0$	Slight decrease
$\tau = 0$	-	$b = 0$	No trend

3.5. Statistical Analysis

All statistical analyses were conducted using R version 4.4.2 to explore relationships between forest loss trends and key factors, as well as to compare differences across ecotourism sites, non-ecotourism sites, and national forest loss rates. Pearson's Chi-squared test and Fisher's exact test were used to assess associations between forest loss trends and categorical variables, such as distance to ecotourism sites, conservation area status, and region. The Chi-squared test is as follows:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} \quad (2)$$

where O_i is the observed frequency and E_i is the expected frequency. Fisher's exact test was applied for small sample sizes. The Wilcoxon rank sum test was used to compare

forest loss trends between ecotourism and non-ecotourism sites, while the Mann–Whitney U test evaluated regional differences. Both are non-parametric tests suitable for non-normal distributions.

A paired *t*-test compared forest loss trends at ecotourism sites with the national forest loss rate. The Shapiro–Wilk test was performed beforehand to assess data normality:

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \overline{x})^2} \quad (3)$$

where $x_{(i)}$ is the ordered data and $\overline{x}$ is the mean. Non-parametric alternatives were considered if normality was violated. This approach combined robust parametric and non-parametric methods to accommodate varying data distributions, ensuring reliable insights into ecotourism's impact on forest loss.

4. Results

The calculation from 2014 to 2023 shows that Indonesia has lost an estimated 13.04 million hectares (Mha) of forest cover, from the total of 139.53 Mha in 2014 to 126.49 Mha in 2023. This means the forest cover remained approximately 66.57% of the total Indonesia land area of 190.02 Mha. This overall estimation corresponds to other forest cover research that calculates Indonesia forest cover as having a similar tree cover threshold (>30%) in 2020 of around 138 Mha [45].

The impact of ecotourism on forest loss varies across different sites in Indonesia, as shown in Figure 4. Out of the 152 ecotourism sites analyzed, 47 sites (30.92%) exhibited significant trends of forest loss, while the majority, 105 sites (69.08%), showed no significant forest loss trends. Among the sites with significant trends, 36 sites (23.68% of the total) demonstrated a decreasing trend in forest loss, 10 sites (6.58%) showed an increasing trend, and 1 site (0.66%) exhibited both increasing and decreasing trends in different areas. The trends were distributed across various distances, with decreases most commonly observed at 9 km (24.19%) and 15 km (22.58%), while increases were concentrated at 3 km (27.78%) and 9 km (27.78%). The full breakdown of trends by distance is presented in Table 2.

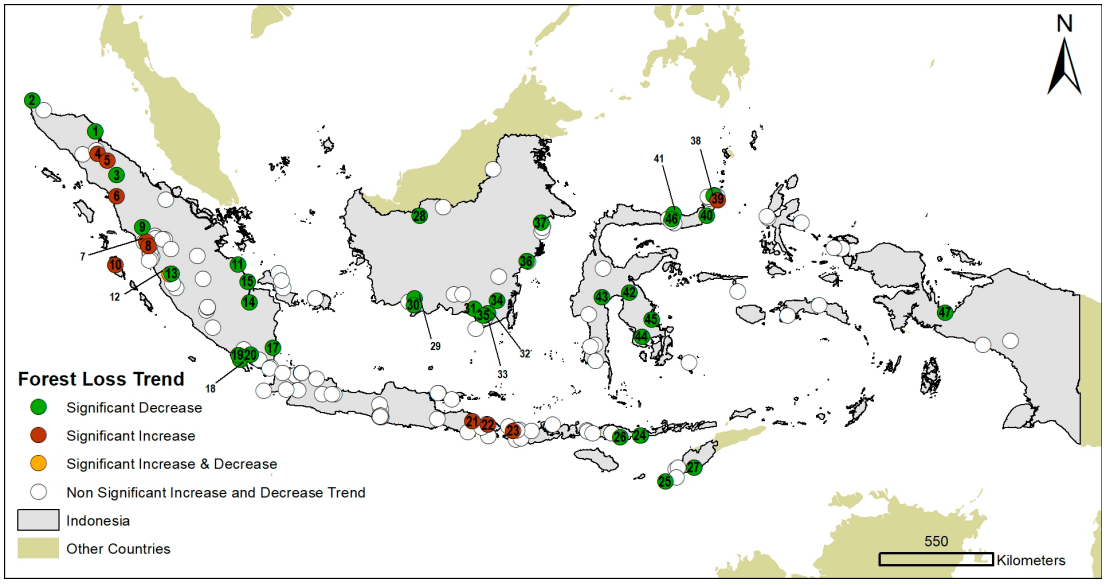


Figure 4. Map of detected significant forest loss trends on ecotourism sites. Each number in this map represents an ecotourism site; see Appendix A for the detailed list.

Table 2. Frequency of forest loss trends based on distance to ecotourism sites.

Loss Trend	1 km	3 km	6 km	9 km	12 km	15 km	Ratio
Significant increase	1	4	3	4	0	3	1.6%
Slight increase	34	45	48	40	54	53	30.0%
Significant decrease	2	7	14	15	13	12	6.9%
Slight decrease	60	71	69	74	75	73	46.3%
No trend	7	6	9	10	6	7	4.9%
NA	48	19	9	9	4	4	10.2%

Some sites are notable for their positive impacts, while others result in negative consequences. Tanjung Puting National Park demonstrates decreasing forest loss trends in four out of six observed proximity areas: 6 km, 9 km, 12 km, and 15 km. In contrast, Bat Cave in Bukit Lawang highlights a troubling increase in forest loss, showing a significant rise in forest loss trends in three proximity areas: 3 km, 6 km, and 9 km. Meanwhile, Kerinci Seblat National Park exhibits mixed trends, with both increases (at 3 km) and decreases (at 9 km) in forest loss observed across its surroundings. These three sites are among those with significant impacts on forest loss. A more detailed list of other locations including site names, coordinates, and conservation area types, is provided in Appendix A.

Additionally, 10.2% of sites were categorized as "NA" in the analysis. This classification does not indicate insufficient data but instead reflects cases where no change in forest cover was observed over the ten-year period, rendering trend analysis unnecessary for these sites. Therefore, in the following sections, "NA" sites will be excluded.

4.1. Forest Loss Trends by Distance, Conservation Area, and Region

The relationship between forest loss trends and various key variables, including distance to ecotourism sites, conservation area status, and region, was assessed using Pearson's Chi-squared test and Fisher's exact test. The results are summarized in Table 3.

Table 3. Statistical associations between forest loss trends and key variables.

No	Variables	Pearson's Chi-Squared Test		Fisher's Exact Test	Interpretation
		x-Squared	*p*-Value	*p*-Value	
1	Distance to Ecotourism	18.282	0.553	0.427	No association
2	Conservation Area	43.795	0.042 *	0.011 *	Moderate association
3	Region	72.611	0.0004998 ***	0.0004998 ***	Very strong association

* $p < 0.05$; *** $p < 0.001$.

The analysis revealed no significant association between forest loss trends and the distance to ecotourism sites. Pearson's Chi-squared test returned a test statistic of $X^2 = 18.282$ with a *p*-value of 0.5537, while Fisher's exact test yielded a *p*-value of 0.4273. These results suggest that proximity to ecotourism does not have a noticeable impact on forest loss trends. Therefore, no further exploration of the impact of the distance to ecotourism was undertaken.

Meanwhile, the statistical tests demonstrated a highly significant association between forest loss trends and region ($X^2 = 72.611$, *p*-value < 0.0005 for both Pearson's Chi-squared and Fisher's exact tests). These results suggest that regional differences significantly influence forest loss trends, reflecting the varying environmental, socio-economic, and policy contexts across regions.

As shown in Figure 5, significant decreases and increases in forest loss are distributed unevenly across regions, with Sumatera and Sulawesi exhibiting the most dynamic trends. The regions display varied patterns of significant forest loss. Sumatera exhibits the highest number of significant trends, with 21 areas (7%) showing significant decreases and 10 areas (3%) showing significant increases in forest loss. This highlights Sumatera as a hotspot for dynamic forest loss trends that require targeted interventions.

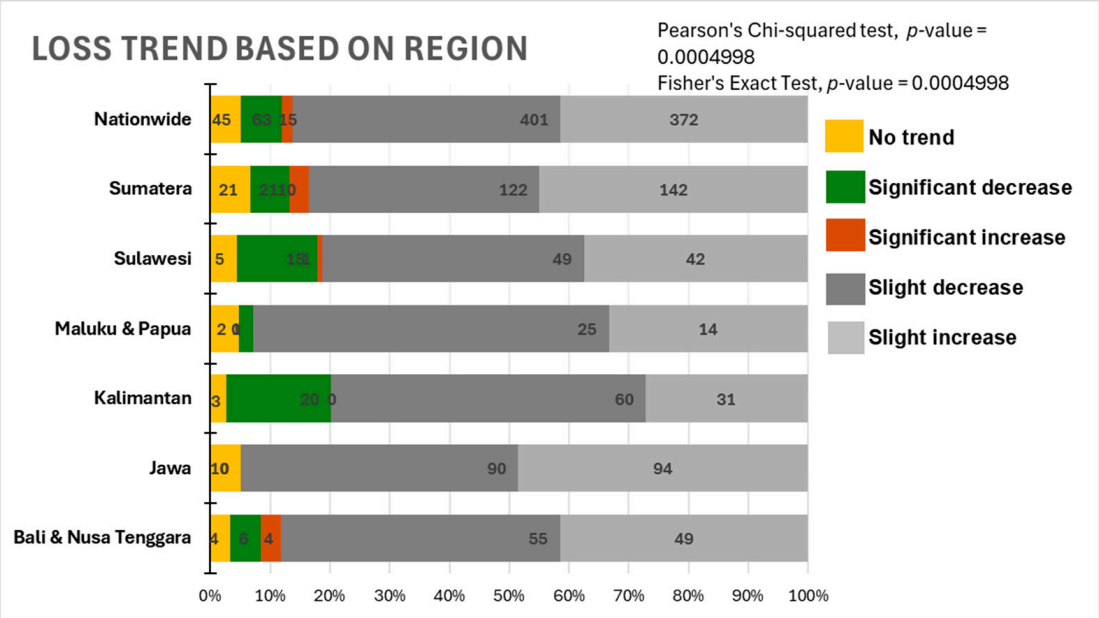


Figure 5. Proportions of forest loss trends surrounding the ecotourism sites across regions.

Sulawesi also displays notable significant trends, with 15 areas (8%) showing significant decreases and 1 area (<1%) showing significant increases. This suggests a slightly stronger emphasis on recovery in some parts of the region. In Kalimantan, 20 areas (10%) demonstrate significant decreases, while no significant increases are observed, indicating a clear trend toward forest recovery in parts of the region.

Regions such as Bali and Nusa Tenggara, Jawa, and Maluku and Papua exhibit negligible significant trends. Bali and Nusa Tenggara show only six areas (5%) with significant decreases, while Jawa and Maluku and Papua exhibit no significant increases or decreases, reflecting more stable forest conditions.

These results underscore the need for region-specific conservation strategies. Sumatera and Sulawesi, with both significant increases and decreases, present a complex dynamic that warrants closer monitoring and targeted interventions. In contrast, Kalimantan's trend toward significant decreases highlights progress in forest recovery, which can serve as a model for other regions.

The relationship between conservation area types and forest loss trends is depicted in Figure 6. Fisher's exact test ($p = 0.011$) and Pearson's Chi-squared test ($p = 0.042$) reveal a statistically significant association between conservation area type and forest loss trends, particularly in the categories of "Significant increase" and "Significant decrease."

Protected Forests exhibited notable performance, with only 6% of sites experiencing a "Significant increase" in forest loss, while 9% showed a "Significant decrease". Similarly, National Parks demonstrated relatively strong results, with 8% of sites experiencing a "Significant decrease", compared to 2% with a "Significant increase". These areas appeared more successful in mitigating forest loss compared to other conservation types.

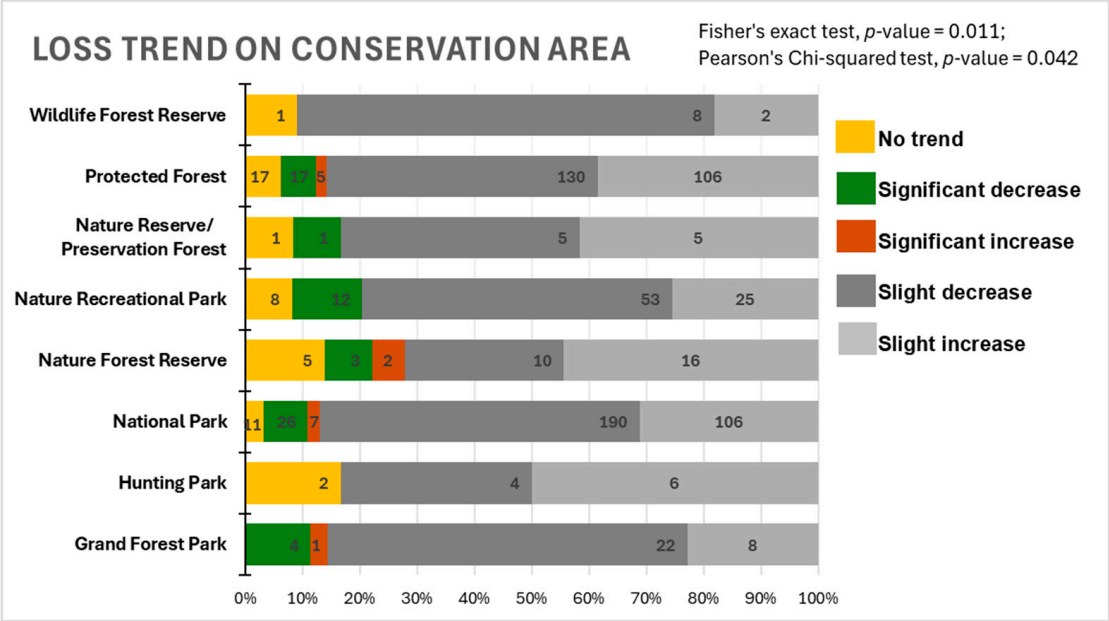


Figure 6. Proportions of forest loss trends surrounding the ecotourism sites in conservation areas.

Conversely, Grand Forest Parks and Hunting Parks showed poor performance, with 11% and 17% of their areas, respectively, categorized under "Significant increase" in forest loss, and no areas recorded as having a "Significant decrease". Wildlife Forest Reserves followed a similar trend, with 9% experiencing a "Significant increase" and no significant reductions observed.

In Nature Recreational Parks and Nature Reserves and Nature Preservation Forests, the presence of "Significant decrease" trends (8% and 14%, respectively) suggests moderate success in mitigating forest loss, although they still reported smaller proportions of "Significant increase" trends (6% and 8%, respectively). Overall, while some conservation areas, such as National Parks and Protected Forests, demonstrate relative success in reducing forest loss, others, such as Grand Forest Parks and Hunting Parks, appear less effective in achieving conservation goals.

4.2. Counterfactual Analysis of Ecotourism Sites and Non-Ecotourism Sites

A Wilcoxon rank sum test was conducted to evaluate differences in forest loss trends (Mann–Kendall's tau) between sites with ecotourism intervention and those without (non-ecotourism). Negative values of Mann–Kendall's tau indicate a positive environmental impact (reduced forest loss), whereas positive values indicate a negative environmental impact (increased forest loss). The results showed no significant difference in forest loss trends between the two site types across all regions ($W = 278{,}034$, $p = 0.5812$). This finding suggests that, overall, ecotourism intervention does not have a statistically significant effect on forest loss trends.

To explore potential regional differences, Mann–Whitney U tests were also conducted for each region. The results demonstrated that forest loss trends did not significantly differ between ecotourism and non-ecotourism sites in most regions (Table 4). In addition, the boxplot (Figure 7) provides a visual comparison of forest loss trends (Mann–Kendall Tau) between ecotourism and non-ecotourism sites across regions. Negative values indicate reduced forest loss (positive environmental impact), while positive values suggest increased forest loss (negative environmental impact).

Table 4. Wilcoxon rank sum test results for ecotourism and non-ecotourism.

Region	*p*-Value	Interpretation
Kalimantan	0.0021 *	Significant difference
Jawa, Bali and Nusa Tenggara	0.933	No significant difference
Maluku and Papua	0.7612	No significant difference
Sulawesi	0.8564	No significant difference
Sumatera	0.2843	No significant difference
All (Nationwide)	0.5812	No significant difference

* $p < 0.05$.

For instance, in Jawa, Bali, and Nusa Tenggara, there was no significant difference ($p = 0.933$), indicating similar forest loss trends in sites with and without intervention. Similarly, in Maluku and Papua ($p = 0.761$), Sulawesi ($p = 0.856$), and Sumatera ($p = 0.284$), the forest loss trends were comparable regardless of the presence of ecotourism intervention.

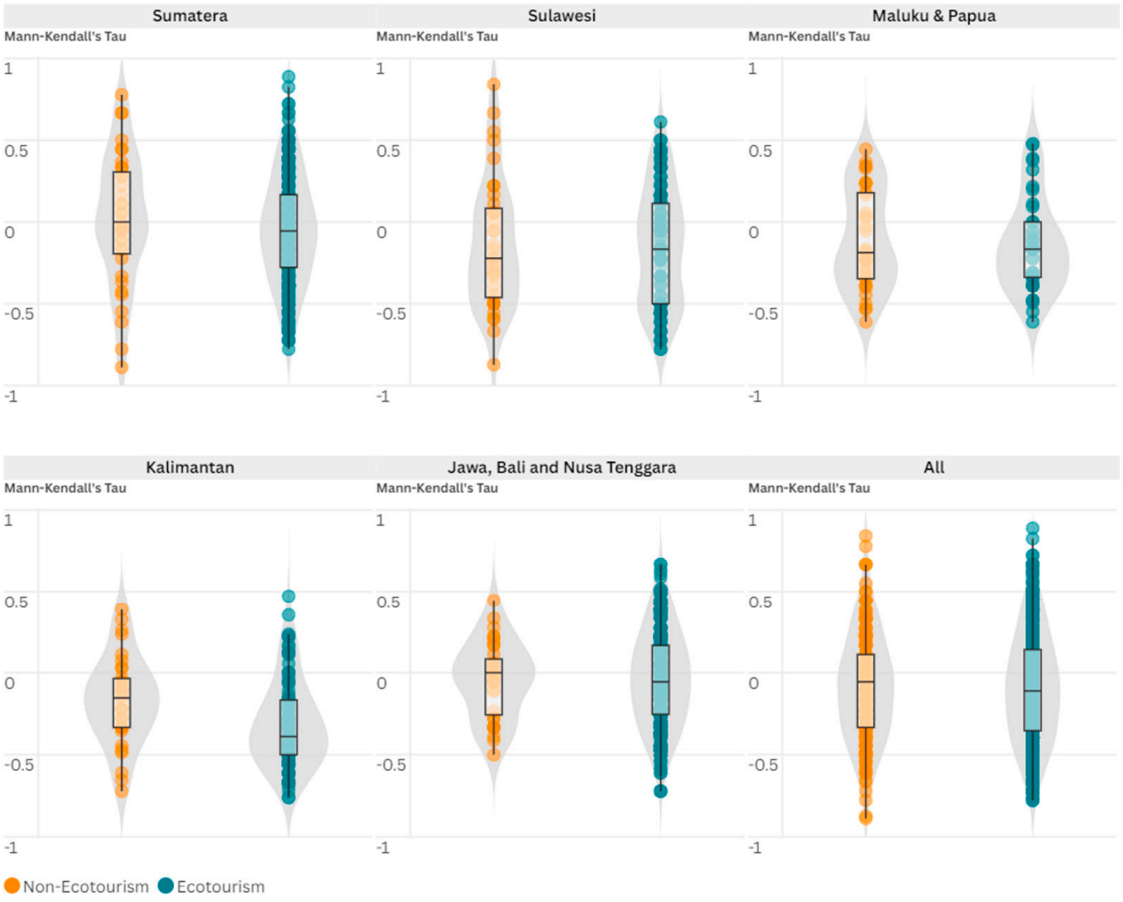


Figure 7. Comparison of forest loss trends surrounding ecotourism and non-ecotourism.

However, a significant difference was observed in Kalimantan ($p = 0.002$), where forest loss trends differed between ecotourism and non-ecotourism sites. This result suggests that the presence of ecotourism intervention in Kalimantan is associated with distinct forest loss trends compared to sites without such intervention

The boxplot figure shows Kalimantan as the sole region with a statistically significant difference between ecotourism and non-ecotourism sites, evident from the visibly distinct boxplot medians and reduced spread of ecotourism sites. In Kalimantan, the median Mann–Kendall Tau for non-ecotourism sites is higher than that for ecotourism sites, suggesting greater forest loss trends in non-ecotourism areas. This may indicate the potential

effectiveness of ecotourism in mitigating forest loss, though further analysis is needed to confirm causation.

In other regions, overlapping distributions support the statistical results having no significant differences. This consistency strengthens the conclusion that ecotourism interventions generally do not significantly alter forest loss trends nationwide.

4.3. Comparison of Ecotourism Sites with National Forest Loss Trends

Forest loss trends were analyzed at both regional and national levels using the Mann–Kendall (τ) test and Sen's slope estimation, as shown in Table 5. The nationwide trends over the last ten years have shown a significant decrease. At the regional level, significant decreases in forest cover were observed in Maluku and Papua, and Sulawesi. These regions demonstrated consistent and substantial declines in forest cover over time. In contrast, Kalimantan, Sumatera, Jawa, Bali, and Nusa Tenggara exhibited slight decreases in forest cover, but these trends were not statistically significant.

Table 5. Regional and nationwide forest loss trends in Indonesia.

Region	Mann–Kendall		Sen Slope	Forest Loss Trend [1]
	Tau (τ)	*p*-Value		
Kalimantan	−0.5	0.0763	−10,361.7	Slight decrease
Maluku and Papua	−0.67	0.0164 *	−14,649.7	Significant decrease
Sulawesi	−0.56	0.0476 *	−33,173.5	Significant decrease
Sumatera	−0.5	0.0763	−381.211	Slight decrease
Jawa, Bali and Nusa Tenggara	−0.056	0.9169	−117,824	Slight decrease
Nationwide	−0.56	0.0476 *	−117,824	Significant decrease

* $p < 0.05$; [1] Forest Loss Trend category is refer to Table 1

To evaluate the effectiveness of ecotourism interventions in mitigating forest loss, forest loss trends (Mann–Kendall's tau mean value) surrounding the ecotourism sites were compared to the overall forest loss trends across five regions (Mann–Kendall's tau value), as shown on Figure 8.

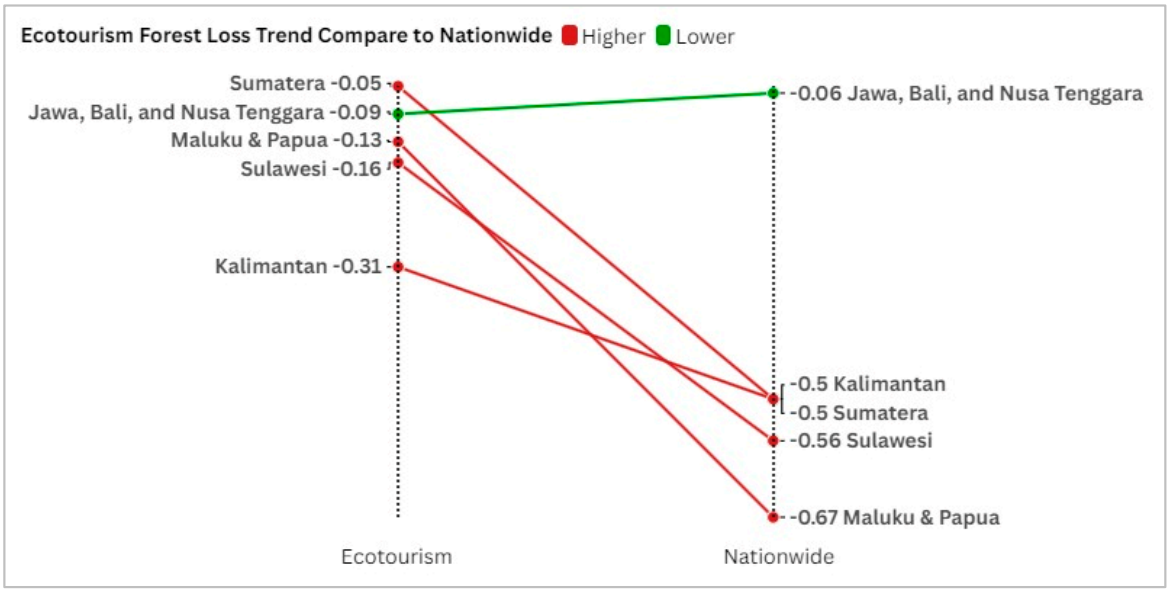


Figure 8. Comparison of forest loss trends in ecotourism and nationwide based on Mann–Kendall's tau value.

A paired *t*-test was performed to assess whether ecotourism sites exhibited significantly different trends. The paired *t*-test indicated a significant difference between the two groups ($t = 2.96$, df = 4, $p = 0.042$), with ecotourism sites exhibiting higher forest loss trends (mean difference = 0.307, 95%, confidence interval: 0.019 to 0.596). A Shapiro–Wilk test confirmed that the differences were normally distributed (W = 0.92, $p = 0.533$), validating the *t*-test assumptions.

These results suggest that the areas surrounding ecotourism sites experience much higher forest loss trends compared to national benchmarks (see red lines on Figure 8), warranting further investigation into site-specific factors that may influence this outcome.

5. Discussion

5.1. Ecotourism Impact on Forest Loss in Indonesia

The findings revealed that the majority of ecotourism sites (69.08%) showed no significant trends in forest loss, raising questions about the effectiveness of ecotourism as a conservation strategy. While 23.68% of sites demonstrated positive outcomes with decreasing forest loss trends, the presence of increasing forest loss trends at 6.58% of sites highlights the potential for negative environmental impacts. These results challenge the assumption that ecotourism inherently benefits forest conservation, especially given the lack of significant differences in forest loss trends between ecotourism and non-ecotourism sites across most regions. The exception of Kalimantan, where ecotourism sites perform better than non-ecotourism sites, underscores the importance of strong governance, community engagement, and site-specific management [46,47].

Additionally, comparisons of forest loss trends between ecotourism sites and non-ecotourism sites, as well as with national and regional averages, suggest that ecotourism has not been effective in reducing forest loss. The analysis shows no significant differences in forest loss rates between ecotourism and non-ecotourism areas, indicating that ecotourism interventions are not achieving their intended conservation outcomes. Furthermore, national forest loss trends demonstrate a significant overall decline, with forest loss rates at the national level being notably lower than those in areas surrounding ecotourism sites. This disparity implies that broader national forest conservation efforts, likely involving more comprehensive strategies and stronger governance, are more effective in curbing deforestation than localized ecotourism initiatives. The ecotourism effects on forest loss are visualized in Figure 9. Figure 9 summarizes the overarching trends emerging from our empirical analysis. While provincial and regional policies likely mediate some of the observed outcomes, this study emphasizes data-driven generalizations rather than case-specific policy comparisons, which will be better addressed in future policy-oriented research.

If ecotourism does not actively mitigate deforestation or enhance forest protection at most sites, its environmental claims must be critically reconsidered. The overuse of the term "eco" in tourism risks becoming a tool for marketing rather than a genuine commitment to sustainability, a problem increasingly recognized globally. For instance, in China, ecotourism ventures often prioritize profit over conservation, undermining the ecological goals they claim to support [48]. Similarly, in Kenya and Ghana, "eco" branding has been criticized for masking unsustainable practices, leading to calls for stricter oversight and accountability in the sector [49,50]. In Vietnam, rapid growth in ecotourism has outpaced conservation planning, resulting in significant ecological degradation despite claims of environmental stewardship [51].

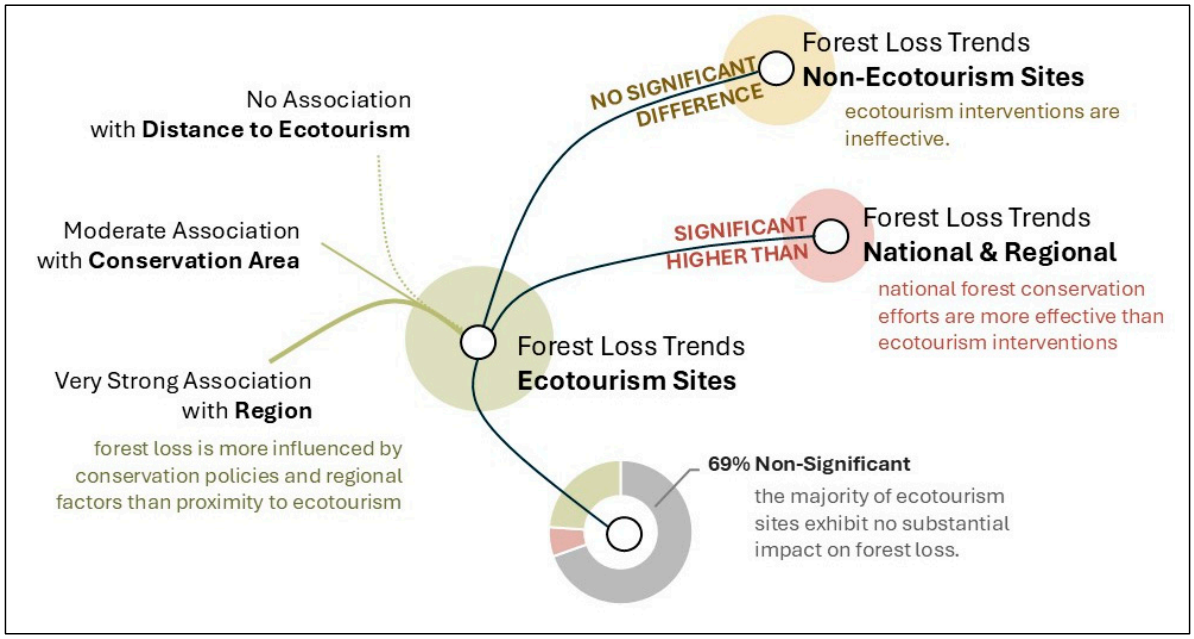


Figure 9. Ecotourism effects on forest loss in Indonesia.

5.2. Regional Variation in Ecotourism's Effectiveness

The observed regional variances in forest loss trends underscore the critical need for tailored conservation strategies that consider environmental, socio-economic, and governance differences. Sumatera, identified as a hotspot for dynamic forest loss trends, exemplifies the dual challenges and opportunities in addressing deforestation. Previous studies suggest that Sumatera's high deforestation rates are driven by agricultural expansion, infrastructure development, and weak enforcement of conservation policies [46]. While areas showing recovery indicate some success of localized interventions, these efforts must be scaled and strengthened through integrated land-use planning and stricter governance [52]. Sulawesi's recovery trends, with limited increases in forest loss, align with findings that community-based conservation initiatives and ecotourism programs can foster forest regeneration when paired with effective local governance [53,54].

Kalimantan's encouraging recovery trends, with no significant increases in forest loss, may reflect the success of conservation-focused policies and partnerships between national park authorities and local stakeholders. The region's progress mirrors findings from other tropical regions where strategic governance and community engagement have led to forest recovery [55,56]. Counterfactual analysis further supports Kalimantan's excellence in ecotourism-driven conservation. It is the only region where forest loss trends around ecotourism sites are significantly lower than those around non-ecotourism sites. This suggests that ecotourism in Kalimantan effectively mitigates deforestation, potentially through its alignment with community-based management and the enforcement of land-use regulations [57,58].

While Kalimantan's success in mitigating deforestation through ecotourism is evident in quantitative trends, a closer qualitative lens reveals an important dimension: it is not the volume but the governance quality of ecotourism that appears to drive conservation outcomes. Kalimantan hosts relatively fewer ecotourism sites than Sumatra, yet these initiatives are often better integrated with local governance and conservation frameworks. This controlled scale may facilitate closer monitoring, stronger community ownership, and adherence to the principles of genuine ecotourism. In contrast, the rapid expansion of ecotourism in Sumatra presents greater challenges in ensuring ecological integrity and accountability. Without stringent oversight, the risk of "greenwashing"—where tourism is

framed as eco-friendly but fails to deliver real conservation value—may undermine efforts. Thus, future conservation strategies should not only scale ecotourism but also prioritize quality, governance, and alignment with local ecological contexts.

Meanwhile, the stability observed in regions like Bali and Nusa Tenggara, Jawa, and Maluku and Papua suggests the absence of significant pressures but also highlights potential underutilization of ecotourism as a conservation tool. For Jawa and Bali specifically, this stability is likely influenced by their high population densities and the limited availability of remaining forests. Most of the forests in these regions are confined to protected landscapes, reducing the opportunity for further forest loss simply because so little forest area remains [9,59]. These findings align with previous research emphasizing how population pressures and urbanization leave small, fragmented forest patches that are less prone to new deforestation but require sustained management to prevent degradation [60,61]. Urbanization often limits deforestation directly but increases indirect pressures on biodiversity through habitat fragmentation and resource demand [62]. In such contexts, ecotourism's role should focus on maintaining these protected areas while enhancing public awareness and support for broader conservation initiatives [63].

These regional differences highlight the necessity of adaptive and context-specific conservation approaches. Kalimantan's success demonstrates the potential of ecotourism interventions to deliver measurable conservation benefits, emphasizing the importance of governance, community participation, and consistent monitoring. By understanding why these interventions succeed in Kalimantan, policymakers can adapt similar strategies as those of Sumatera and Sulawesi to counteract their dynamic forest loss trends and of stable regions to reinforce resilience against emerging threats. Integrating ecotourism with broader socio-economic and policy frameworks will be pivotal to ensuring Indonesia's long-term forest preservation.

5.3. Conservation Area Types and Forest Loss Trends Around Ecotourism Areas

Protected Forests and National Parks emerge as relatively effective in mitigating forest loss near ecotourism sites. This effectiveness likely stems from stricter regulations and enforcement mechanisms, coupled with enhanced ecological protection policies designed to support biodiversity and landscape conservation [64,65]. National Parks, in particular, benefit from strong international and national frameworks such as UNESCO World Heritage designations and Indonesia's Strategic Plan for National Parks that provide additional funding and monitoring resources. Despite positive trends in some areas, certain ecotourism sites within Protected Forests and National Parks exhibit significant increases in forest loss, raising serious concerns about localized management failures. These negative trends may be driven by factors such as inadequate enforcement of conservation policies, unregulated tourism infrastructure development, and illegal logging activities within or near ecotourism zones [66]. Furthermore, the issue extends beyond ecotourism-specific areas, as National Parks in Indonesia overall experienced a forest loss of 1.07% between 2012 and 2017, reflecting broader challenges in conservation management [67].

Conversely, conservation types like Grand Forest Parks, Hunting Parks, and Wildlife Forest Reserves show limited effectiveness. Unlike National Parks and Protected Forests, these areas often prioritize other objectives—such as recreation, hunting, or specific wildlife protection—over forest conservation [68]. Additionally, many of these areas face overlapping land-use pressures, limited resources, and weak governance, which exacerbate deforestation risks near ecotourism sites [69,70]. This lack of focus on forest protection limits their ability to leverage ecotourism as a tool for sustainable conservation.

While some areas benefit from enhanced ecotourism initiatives that foster community engagement and ecological monitoring, others remain vulnerable to pressures like illegal land use and tourism-driven deforestation [71]. Strengthening ecotourism policies in these areas, alongside improved resource allocation and governance, could reduce variability and amplify positive conservation impacts [72].

5.4. Site-Specific Ecotourism Strategies and Their Correlation to Forest Conservation

The varied impacts of ecotourism on forest conservation at Tanjung Puting National Park, Bat Cave in Bukit Lawang, and Kerinci Seblat National Park highlight the complex interplay between ecotourism strategies, conservation area types, and regional contexts. These cases offer critical insights into how site-specific approaches influence forest loss trends and underscore the necessity for tailored interventions.

Tanjung Puting National Park exemplifies a successful integration of ecotourism and conservation. Located within a National Park—a conservation type prioritized for strict biodiversity protection—Tanjung Puting benefits from policies that align ecotourism with conservation objectives. Activities like guided wildlife tours, particularly focused on orangutan habitats, and traditional boating engage visitors while emphasizing ecological stewardship [73]. The park's decreasing forest loss trends in most proximity areas suggest that its model of leveraging ecotourism as a funding source for conservation, alongside community-based initiatives, is effective. Additionally, government support and public–private partnerships have strengthened enforcement and infrastructure planning, reducing deforestation risks.

Conversely, Bat Cave in Bukit Lawang, situated in Gunung Leuser National Park, highlights the challenges of poorly managed ecotourism. While categorized as a National Park, this site lacks structured ecotourism programs that prioritize forest conservation. Instead, tourism primarily revolves around recreational activities like cave exploration, which often lack conservation-oriented frameworks [74]. The observed increases in forest loss in multiple proximity areas suggest that unregulated infrastructure expansion and tourism activities may be exacerbating habitat degradation. Limited enforcement, coupled with the absence of sustainable tourism planning, underscores the urgent need for structured interventions that align tourism activities with conservation goals [75].

Kerinci Seblat National Park presents a nuanced case with both positive and negative impacts on forest loss. The park's mixed trends—forest loss increases near some proximity areas and decreases near others—indicate that outcomes are heavily influenced by local governance and land-use pressures [76]. Ecotourism strategies here emphasize trekking and wildlife viewing, often in partnership with local communities. However, the park's vulnerability to infrastructure projects, such as the Trans-Sumatra Highway, complicates its conservation outcomes [77]. Strengthening collaborative management frameworks between local stakeholders and national park authorities could mitigate these challenges.

5.5. Implication to Ecotourism Planning and Policy

To address the issue highlighted by this study, ecotourism planning must prioritize site suitability assessments, ensuring ecological sensitivity and conservation objectives guide development. Strengthening governance, as seen in Kalimantan, is essential for reducing forest loss and enforcing sustainable practices [47,53]. Where conservation goals cannot be achieved, alternative tourism models—such as cultural tourism, rural tourism, village tourism, agrotourism, and recreation—should be considered to avoid the overuse of the ecotourism concept [78–80].

Policymakers play a critical role in supporting this shift. They should integrate measurable conservation targets into ecotourism projects, including reforestation initiatives, community-based conservation, and biodiversity monitoring. These targets must be incorporated into national and regional tourism policies to ensure alignment with broader sustainability goals. Independent certification programs and regular impact assessments are critical for ensuring accountability and distinguishing genuine conservation efforts from superficial "eco" branding [48,63]. Moreover, governments should consider offering incentives for ecotourism operators that demonstrate measurable environmental benefits, while enforcing stricter regulations for those that fail to meet conservation standards. By diversifying tourism models and enhancing accountability, ecotourism can contribute more effectively to forest preservation while avoiding misuse as a mere marketing tool. Strengthening the policy framework will help ensure ecotourism serves as a genuine mechanism for conservation, not just economic development.

5.6. Limitation and Future Studies

While this study provides valuable insights into the relationship between ecotourism and forest loss in Indonesia, several limitations warrant attention. Firstly, the analysis relies heavily on remote sensing and GIS-based forest cover data, which, while robust for tracking land-use changes, do not account for qualitative nuances such as local governance structures, community participation, or specific management practices at individual ecotourism sites. These factors are critical in shaping conservation outcomes but remain beyond the scope of this study.

Secondly, this study focuses exclusively on environmental outcomes, particularly forest loss, without examining other dimensions of ecotourism, such as socio-economic and cultural impacts. While forest conservation is a vital goal, ecotourism's success is also measured by its ability to provide economic benefits to local communities and preserve cultural heritage. Neglecting these dimensions limits the holistic understanding of its overall effectiveness. Lastly, the temporal scope of this study may not fully capture long-term ecological and policy shifts that influence forest loss trends. Future research should integrate longitudinal data with interviews and participatory approaches to enrich the findings.

Acknowledging these limitations underscores the need for multidisciplinary studies that incorporate both quantitative and qualitative methodologies, enabling a more comprehensive understanding of ecotourism's role in achieving its core benefits, especially for the environment.

6. Conclusions

This study demonstrates that most ecotourism sites in Indonesia exhibit no significant differences in forest loss trends compared to non-ecotourism sites, showing no substantial impact on deforestation. Alarmingly, some sites even experience higher forest loss rates than national and regional averages. These findings underscore the ineffectiveness of ecotourism in reducing forest loss and highlight that forest loss is more strongly influenced by regional conservation policies and broader socio-environmental factors than proximity to ecotourism activities. While certain ecotourism hubs have shown positive outcomes, these cases remain exceptions rather than the rule, suggesting that ecotourism, as currently practiced, does not consistently deliver its intended environmental benefits.

Future research should extend beyond forest cover analysis to evaluate the economic and social dimensions of ecotourism. Investigations into how ecotourism influences local livelihoods, community empowerment, and cultural preservation could provide a more comprehensive assessment of its sustainability. Moreover, studies should explore the role of governance, policy frameworks, and financial incentives in driving successful conservation outcomes. Specific attention should be paid to the mechanisms by which conservation areas with robust regional policies have achieved reduced forest loss, offering potential models for replication. Finally, integrating advanced technologies such as remote sensing with participatory approaches like stakeholder interviews could bridge the gap between ecological data and community-based insights, ultimately enhancing ecotourism's alignment with conservation and sustainability goals.

In addition, ecotourism holds untapped potential as a public environmental education tool. Future initiatives could leverage ecotourism experiences to raise awareness about conservation, promote pro-environmental behaviors, and foster public engagement in addressing broader challenges such as biodiversity loss and the climate crisis.

This research serves as a pivotal foundation for rethinking Indonesia's ecotourism strategies. To maximize environmental and socio-economic benefits, future initiatives must prioritize adaptive management practices, align local and national policies, and foster collaborations between government, communities, and conservation organizations.

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Data Availability Statement: This study utilized publicly available datasets: the ecotourism spatial dataset from Sisriany and Furuya (2024) (https://doi.org/10.3390/land13030370) and the global forest cover change data from Hansen et al. (2013) (https://doi.org/10.1126/science.1244693). Summary results, including forest loss trend analyses, are provided in Appendix A. More detailed datasets and processed outputs supporting these findings are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. List of detected significant forest loss trends at ecotourism sites.

No	Province	Name	Latitude	Longitude	Conservation Area	Distance Significant Detected	Significant Trend
Sumatera							
1	Aceh	Wisata Hutan Mangrove Kota Langsa	4.521636	98.0162	Protected Forest	3 km	Decrease
2	Aceh	Teupin Layeu	5.871526	95.25749	Nature Recreational Park	12 km	Decrease
3	North Sumatera	Toba Caldera Resort	2.6075849	98.94648	Protected Forest	6 km, 15 km	Decrease
4	North Sumatera	Bat Cave Bukit Lawang	3.535454	98.11727	National Park	3 km, 6 km, 9 km	Increase
5	North Sumatera	Air Terjun Sikulikap	3.2454292	98.53399	National Park	3 km	Increase
6	North Sumatera	Air Terjun Sipitu-Pitu	1.686052	98.94605	Protected Forest	1 km	Increase
7	West Sumatera	Lawang Adventure Park	−0.280778	100.2416	Protected Forest	6 km, 9 km	Increase
8	West Sumatera	Lembah Anai Waterfall	−0.483611	100.3384	Nature Forest Reserve	15 km	Increase
9	West Sumatera	Objek Wisata Taman Suaka Alam Rimbo Panti	0.3463983	100.06914	Nature Recreational Park	3 km, 9 km, 15 km	Decrease
10	West Sumatera	Siberut Island National Park	−1.317489	98.88916	National Park	6 km	Increase
11	Jambi	Berbak National Park	−1.286865	104.2396	National Park	9 km, 15 km	Decrease
12	West Sumatera	Kerinci Seblat National Park	−1.70422	101.26899	National Park	3 km, 9 km	Both
13	Jambi	Air Terjun Telun Berasap	−1.689885	101.3397	National Park	15 km	Decrease
14	South Sumatera	Puntikayu Amusement Palembang	−2.943726	104.7283	Nature Recreational Park	12 km, 15 km	Decrease
15	South Sumatera	Taman Nasional Sembilang	−2.035627	104.6593	National Park	15 km	Decrease
16	Lampung	Camp Ground Danau Lebar Suoh	−5.247633	104.2706	National Park	6 km	Decrease
17	Lampung	Way Kambas National Park	−4.927576	105.7769	National Park	12 km	Decrease
18	Lampung	Taman Nasional Bukit Barisan Selatan	−5.448473	104.3516	National Park	6 km, 9 km	Decrease
19	Lampung	Nirwana Keramikan	−5.237233	104.2593	National Park	6 km	Decrease
20	Lampung	Wana Wisata Tanjung Harapan	−5.224397	104.7919	Protected Forest	3 km, 6 km	Decrease
Bali & Nusa Tenggara							
21	Bali	West Bali National Park	−8.127611	114.4753	National Park	15 km	Increase
22	Bali	Bali Botanical Garden	−8.276122	115.1542	Protected Forest	3 km, 9 km	Increase
23	West Nusa Tenggara	Air Terjun Tibu Bunter	−8.536218	116.2599	Grand Forest Park	15 km	Increase
24	East Nusa Tenggara	Kelimutu National Park	−8.741548	121.7936	National Park	15 km	Decrease

Table A1. *Cont.*

No	Province	Name	Latitude	Longitude	Conservation Area	Distance Significant Detected	Significant Trend
Bali & Nusa Tenggara							
25	East Nusa Tenggara	Pantai Litianak	−10.75517	122.8999	Protected Forest	15 km	Decrease
26	East Nusa Tenggara	Wolokoro Ecotourism	−8.81706	120.9341	Nature Forest Reserve	6 km, 9 km, 12 km	Decrease
27	East Nusa Tenggara	Taman Wisata Alam Menipo	−10.14851	124.1491	Nature Recreational Park	15 km	Decrease
Kalimantan							
28	West Kalimantan	Sentarum Lake National Park	0.8303082	112.1769	National Park	9 km, 12 km	Decrease
29	Central Kalimantan	Camp Leakey	−2.760856	111.9448	National Park	15 km	Decrease
30	Central Kalimantan	Taman Nasional Tanjung Puting	−3.055015	111.9184	National Park	6 km, 9 km, 12 km, 15 km	Decrease
31	South Kalimantan	Taman Wisata Alam Pulau Bakut	−3.215241	114.5576	Nature Recreational Park	6 km, 9 km, 12 km	Decrease
32	South Kalimantan	Jeram Alam Roh Tujuh Belas	−3.419173	115.1415	Grand Forest Park	3 km, 6 km, 9 km	Decrease
33	South Kalimantan	Bukit Matang Kaladan	−3.525424	115.0094	Grand Forest Park	9 km	Decrease
34	South Kalimantan	Mandin Mangapan	−2.860428	115.5502	Protected Forest	6 km, 9 km, 12 km	Decrease
35	South Kalimantan	Taman Hutan Raya Sultan Adam	−3.519414	114.9501	Nature Reserve and Nature Preservation Forest	1 km	Decrease
36	Central Kalimantan	Hutan Lindung Sei Wain	−1.145255	116.8397	Protected Forest	1 km	Decrease
37	East Kalimantan	Wisata Alam Prevab Tnkutai	0.5315004	117.4653	National Park	3 km	Decrease
Sulawesi							
38	North Sulawesi	Ekowisata Mangrove Desa Bahoi	1.7180899	125.02	Protected Forest	12 km	Decrease
39	North Sulawesi	Tangkoko Batuangus Nature Reserve	1.5082463	125.1882	Nature Forest Reserve	9 km	Increase
40	North Sulawesi	Pantai Lakban Ratatotok	0.8492183	124.7087	Protected Forest	12 km	Decrease
41	North Sulawesi	Obyek Wisata Pantai Batu Pinagut	0.9202904	123.2694	Protected Forest	12 km	Decrease
42	South Sulawesi	Ide Beach	−2.51529	121.3423	Nature Recreational Park	9 km, 15 km	Decrease
43	South Sulawesi	Air Terjun Sarambu Ala	−2.704501	120.1323	Protected Forest	3 km, 6 km, 9 km	Decrease
44	Southeast Sulawesi	Taman Nasional Rawa Aopa Watumohai	−4.438332	121.8733	National Park	6 km, 9 km, 12 km	Decrease
45	Southeast Sulawesi	Air Panas Wawolesea	−3.696262	122.3033	Protected Forest	12 km	Decrease
46	Gorontalo	Ilomata River Camp	0.6988795	123.1824	National Park	3 km, 6 km, 9 km	Decrease
Maluku & Papua							
47	Papua	Pantai Wagi	−3.380823	135.1236	National Park	6 km	Decrease

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