

The Economic Impact of Deforestation on the Ecosystems: A Case of Indonesia

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Abstract

This paper analyses the determinants, impacts, and policy responses associated with deforestation in Indonesia, a globally significant tropical forest economy experiencing rapid land-use change. Using a narrative synthesis of empirical literature and secondary data sources, the study examines the principal drivers of forest loss, their environmental and socioeconomic consequences, and the effectiveness of alternative policy responses. The review finds that deforestation is driven by the interaction between proximate drivers, including agricultural expansion, logging, mining, infrastructure development, and forest fires, and underlying drivers such as weak governance, insecure property rights, corruption, decentralized decision-making, and policy incentives that favor forest conversion. Land-use change has been further reinforced by government programmes, including transmigration schemes and large-scale agricultural development initiatives, which have increased the economic attractiveness of converting forests to alternative land uses. The paper analyses deforestation through an environmental economics framework based on land-rent differentials and market failures. Land rent refers to the net economic return from a particular land use, while forest rent and agricultural rent represent the returns from maintaining forests and converting them to agricultural production, respectively. Deforestation becomes more likely when agricultural rents exceed forest rents, while environmental externalities such as carbon emissions, biodiversity loss, and health damage associated with peatland and forest fires remain inadequately reflected in market prices. The analysis highlights the role of fiscal policies, regulatory institutions, and governance quality in shaping land-use decisions and influencing deforestation outcomes. From a policy perspective, the findings suggest that an integrated mix of fiscal instruments, strengthened enforcement, land-use zoning regulations, and expansion of protected areas can reduce pressures on forests by increasing forest rents, reducing incentives for conversion, and internalizing environmental externalities. Effective mitigation ultimately requires aligning local economic in-

centives with national environmental objectives while strengthening institutional capacity, transparency, and accountability in forest governance.

Keywords

Deforestation, Indonesia, Forest Degradation, Land Use Change, Agricultural Expansion, Palm Oil, Climate Change, Biodiversity Loss, Environmental Policy, Taxation, Protected Areas, Sustainable Forest Management, Governance, Carbon Emissions

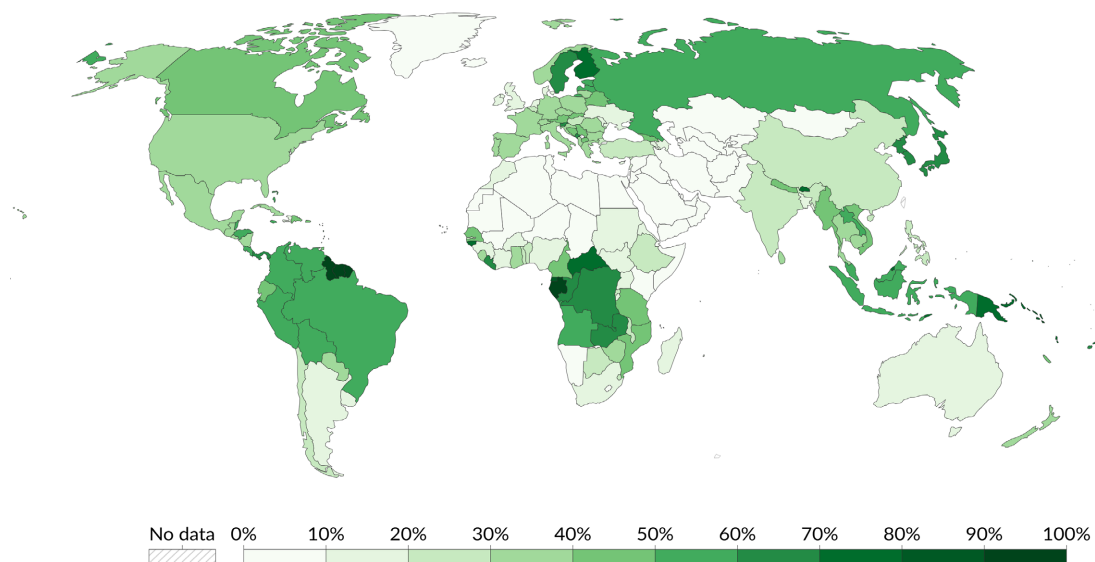
1. Introduction

Deforestation, according to National Geographic (2018), refers to the large-scale removal of forests, a process that can significantly degrade land quality, reduce biodiversity, and disrupt ecological systems. Forests are among the most important natural resources on Earth, providing vital ecosystem services such as carbon sequestration, climate regulation, water cycle maintenance, and habitat for wildlife. Globally, forests cover approximately 30% of the world's land area [1]. As shown in **Figure 1**, forest resources are unevenly distributed across the globe. Countries in South America, Central Africa, Southeast Asia, and Northern Europe exhibit

Share of land covered by forest, 2025

Forest area includes land with natural or planted groups of trees at least five meters tall, excluding those in agricultural systems.

Our World
in Data



Data source: Food and Agriculture Organization of the United Nations and historical sources
OurWorldinData.org/forests-and-deforestation | CC BY

Figure 1. Global distribution of forest area as a percentage of total land area by country. Darker shades of green indicate a higher proportion of forest cover, while lighter shades represent lower levels of forest coverage. The map illustrates the unequal distribution of global forest resources, with particularly high concentrations found in South America, Central Africa, Southeast Asia, and Northern Europe.

relatively high levels of forest cover, whereas arid and heavily urbanized regions tend to have much lower forest coverage. The darker shades on the map represent countries with a greater proportion of forested land, highlighting the global significance of forest-rich regions for environmental sustainability and climate stability.

Despite the critical ecological and economic benefits forests provide, they continue to disappear at an alarming rate. The Food and Agriculture Organization (FAO) estimates that approximately 7.3 million hectares of forest are lost annually worldwide [2]. This loss is driven primarily by anthropogenic activities, including agricultural expansion, infrastructure development, commercial logging, mining, and the extraction of wood for fuel and industrial purposes [3]. Among the countries facing significant deforestation pressures, Indonesia has emerged as one of the most affected, due to rapid land-use change associated with palm oil cultivation, logging, mining, and other development activities. Given Indonesia's extensive tropical forests and their importance for global biodiversity and climate regulation, understanding the drivers of deforestation and identifying effective policy responses is of particular importance. Therefore, this paper examines the problem of deforestation in Indonesia and explores the policy instruments that can be employed to mitigate and control forest loss.

Economic Framework

This paper analyses deforestation through a land rent framework commonly used in environmental economics. Land rent refers to the net economic return obtained from a particular land use. Forest rent represents the returns generated from maintaining forests through sustainable timber production, ecosystem services, or conservation-related benefits. Agricultural rent refers to the returns generated when forestland is converted into agricultural uses such as oil palm or pulpwood plantations. Deforestation occurs when expected agricultural rent exceeds forest rent. This process is often reinforced by policy distortions and market failures. In addition, externalities arise when forest conversion imposes costs, such as carbon emissions, biodiversity loss, and public health impacts, that are not fully reflected in market prices. The policy instruments discussed later in the paper are evaluated according to their ability to alter relative rents or internalize environmental externalities.

2. Methods

This study adopts a narrative literature review supported by secondary data analysis. Academic articles, institutional reports, and policy documents relating to deforestation in Indonesia were identified through targeted searches of Google Scholar, Scopus, Web of Science, FAO publications, CIFOR reports, World Resources Institute publications, government documents, and international environmental agency databases. Sources were selected based on four criteria: 1) relevance to Indonesian deforestation, 2) empirical evidence on drivers, impacts, or policy responses, 3)

publication by peer-reviewed journals or reputable institutions, and 4) availability of quantitative or policy-related findings.

The screening process excluded sources that lacked methodological transparency, duplicated findings already represented in the review, or focused primarily on regions outside Indonesia. Evidence from the selected studies was synthesized thematically and organized into three analytical categories: drivers of deforestation, environmental and socioeconomic impacts, and policy responses. Secondary statistics were used descriptively to illustrate trends and support the discussion rather than to conduct a formal meta-analysis. The objective was to identify recurring patterns in the literature and assess how economic incentives, governance conditions, and public policies influence forest conversion decisions.

3. Extent of Deforestation in Indonesia

Indonesia's forests are among the most magnificent in the world. According to [4], the country's forests rank only third, after those of Brazil and the Democratic Republic of Congo, in terms of extent. Indonesia has different types of forests, each of which boasts a rich biodiversity. Some of the major types of forests in the country include savannah grasslands, seasonal monsoon forests, alpine forests, non-dipterocarp lowland forests, mangrove forests and evergreen lowland dipterocarp forests [4]. Indonesia is home to some of the world's largest mangrove forests, estimated to cover more than 10.5 million acres (4.25 hectares) in the early 90 s [4].

Although Indonesia still retains vast forest resources, it has experienced some of the highest rates of deforestation in the world. According to the United Nations, Indonesia lost more than 760,000 acres (307,561 hectares) of forest annually between 2000 and 2005 [5]. The rate of forest loss accelerated further between 2006 and 2010, reaching approximately 1.7 million acres per year [5]. Similarly, [6] estimate that Indonesia lost more than 6.02 million hectares of primary forest between 2000 and 2012, with forest loss increasing by approximately 47,600 hectares each year. In 2012 alone, Indonesia lost around 840,000 hectares of primary forest, substantially exceeding Brazil's loss of 460,000 hectares during the same period [6].

Figure 2 illustrates annual forest loss estimates in Indonesia between 2000 and 2012 based on two different datasets: Hansen *et al.*'s satellite-based analysis and Indonesia's Ministry of Forestry records. Both datasets indicate a long-term upward trend in forest loss, although the Hansen estimates consistently report higher levels of deforestation than the official government statistics after the mid-2000s. The divergence becomes particularly pronounced after 2006, with the Hansen dataset showing forest loss exceeding 1.5 million hectares in several years and reaching more than 2 million hectares in 2011-2012. The figure, therefore, highlights not only the severity of deforestation in Indonesia but also the challenges associated with accurately monitoring and reporting forest loss. Nevertheless, both sources clearly demonstrate that deforestation intensified during the study period, posing significant threats to biodiversity, ecosystem services, carbon storage, and

sustainable development.

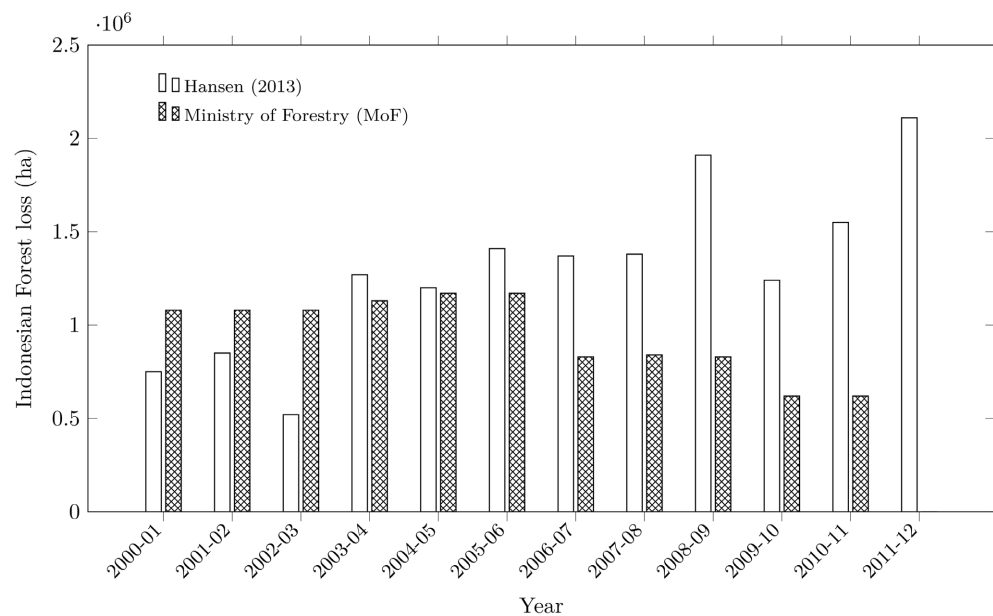


Figure 2. Annual forest loss estimates in Indonesia between 2000 and 2012, comparing Hansen *et al.*'s satellite-based estimates with data reported by Indonesia's Ministry of Forestry. The figure indicates an overall increase in forest loss over the study period, with satellite-derived estimates suggesting substantially higher levels of deforestation after 2006. Source: Adapted from [7].

4. Causes of Deforestation

The causes of deforestation can be divided into proximate drivers and underlying drivers. Proximate drivers are the direct land-use activities that immediately remove forest cover, including agricultural expansion, logging, mining, infrastructure development, and forest fires. Underlying drivers are the institutional, economic, and political factors that shape incentives for these activities, including weak governance, insecure land tenure, corruption, decentralisation, population pressures, land market dynamics, and public policies that favour forest conversion. Understanding the interaction between these two levels of causation is essential for designing effective policy responses [8].

Forest destruction in Indonesia occurs for various reasons. Some of the main reasons for the destruction of forests in Indonesia include the extraction of raw materials for furniture, household tools, building materials, and fuel. Companies and farmers also cut or burn forest trees to create new land for farming, fields, or to construct buildings such as housing complexes and office buildings [4]. Another reason for deforestation is the construction of infrastructure such as ports, airports, and roads. Indonesia, as a country, is made up of 17,500 islands, many of which remain remote due to a lack of necessary infrastructure. To construct roads and other infrastructure, the government must clear sections of protected forests or conservation areas.

The two largest contributors to degradation in Indonesia are the pulp and paper

industries. These industries account for the greatest loss in wood fiber and oil palm plantations [9]. Between 2000 and 2015, approximately 3.1 million hectares of primary forest, an area almost the size of Switzerland, were converted to wood fiber and palm oil plantations. Of this total area, 1.5 million ha were converted to oil palm plantations.

Another reason for deforestation in Indonesia is mining. Indonesia has large mineral reserves, including gold, copper, tin, and coal, and ranks second in tin output worldwide [10]. The country also has abundant supplies of natural gas, silver, petroleum, bauxite and nickel. Most mining takes place in forested areas, and miners typically must clear forest cover and lay the land bare as they work. The decentralization of coal mining to the district level has led to a massive boom in the coal sector and substantial destruction of conservation forests. The situation has been worsened by the fact that Indonesia, through a 2009 presidential decree, expressly permits underground mining in forests [11]. Corruption has also been linked to deforestation in Indonesia, with officials demanding and receiving billions of dollars in exchange for providing mining, forestry, and plantation leases. As noted by [12], decentralization has made it easier for local officials to trade coal and mineral concessions for political favours or cash without the sanction of the national government or environmental authorities.

Some indigenous and local communities in Indonesia practise shifting cultivation or rotational farming systems [13]. However, these activities generally occur on a relatively small scale compared with commercial agriculture, industrial plantations, logging, and mining operations. In many cases, traditional shifting cultivation includes fallow periods that allow partial forest regeneration and therefore differs from permanent forest conversion. The environmental effects of such practices are also influenced by population pressures, land tenure arrangements, and restrictions on access to customary land. Consequently, while shifting cultivation may contribute to localised forest loss, it should not be regarded as a primary national driver of deforestation in Indonesia [13].

Forest fires represent both a direct cause of forest degradation and a mechanism frequently used for land clearing. In Indonesia, many fire events are closely linked to peatland drainage, agricultural expansion, and weak enforcement of land-use regulations [14]. One forest fire on the Island of Borneo destroyed close to 25,500 km² of forest in 1983 (Siscawati 1998). Between 1997 and 1999, many Indonesian islands experienced massive forest fires, with the most affected areas being Kalimantan, Irian Jaya, Sumatra, Java, and Sulawesi. Because of these fires, millions of hectares of forest land went up in flames.

Indonesian government policies touching on land and agriculture have been blamed for the high level of deforestation in the country [8]. For one, the government, through its transmigration program, has greatly contributed to deforestation in Indonesia. The program, aimed at addressing poverty and high population density in areas such as Java Island, has led to the transfer of large numbers of people to other places, including Sulawesi, Sumatra, Papua, and Kalimantan [15].

The relocation of people to new places has meant that forests must be cleared up to create space for housing. Although the government currently allocates two hectares of land per family head, this space is inadequate considering that families grow over time and grown-up children need land for their own development.

The government of Indonesia has also implemented the One Million Rice Fields Project, a programme that aims to convert one million hectares of peat forest into rice fields [14]. This project has resulted in the extensive destruction of Indonesia's peat forests. Currently, the government has plans to convert tens of millions of acres of rainforest into pulp and oil palm plantations over the next ten years Rainforest Action Network (2018), a factor that may continue to contribute to forest loss if implemented.

Indonesian regulations allow selective logging of trees inside concession areas and generally prohibit forest clearing. According to [9], a substantial proportion of forest loss between 2000 and 2015 occurred within concession areas. This finding highlights the important role of licensed land-use activities in shaping deforestation patterns across Indonesia. Outside concession areas, licence holders may harvest trees. In these areas, excessive timber harvesting is often followed by conversion of cleared land to oil palm plantations by smallholders and commercial operators [9]. Between 2000 and 2015, close to 3.6 million ha of original forest, an area approximately three times the size of New York City, was lost.

Indonesian regulations allow selective logging of trees inside concession areas and generally prohibit forest clearing. According to [9], a substantial proportion of forest loss between 2000 and 2015 occurred within concession areas. **Figure 3** further illustrates the distribution of natural forest loss across different land-use

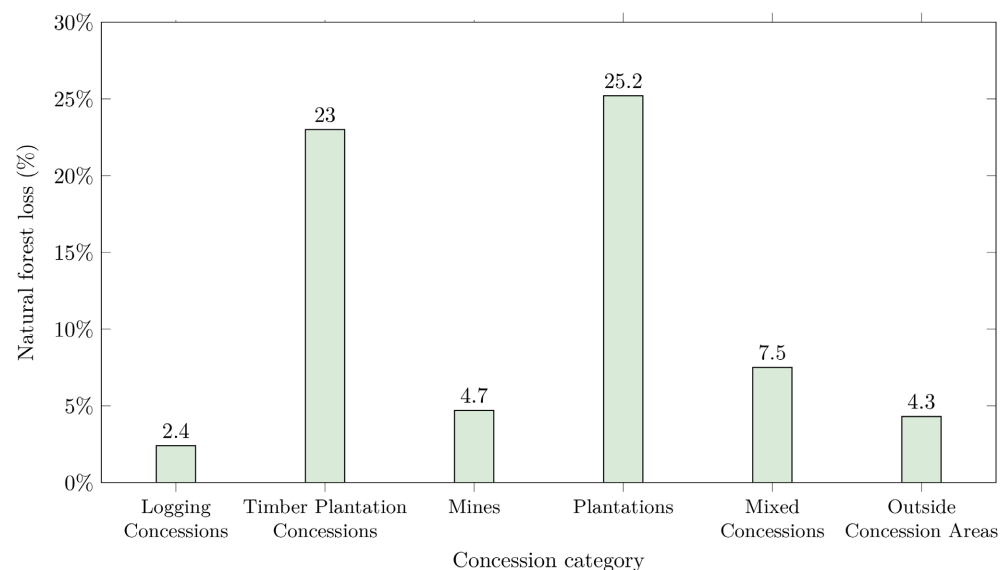


Figure 3. Natural forest loss by land use category in Indonesian concession and non-concession areas, 2009-2013. Plantation areas (25.2%) and timber plantation concessions (23.0%) accounted for the largest shares of forest loss, followed by mixed concessions (7.5%) and mining activities (4.7%). The categories shown account for 67.1% of observed forest loss. Source: Forest Watch Indonesia (2014), reproduced by [16].

categories between 2009 and 2013. The largest shares of forest loss occurred in plantation areas (25.2%) and timber plantation concessions (23.0%), highlighting the significant role of industrial agriculture and plantation development in driving deforestation. Forest loss was also associated with mixed concessions (7.5%) and mining activities (4.7%), while logging concessions accounted for a relatively small share (2.4%). These findings demonstrate that much of Indonesia's deforestation is linked to legally authorized land-use change rather than illegal logging alone. Outside concession areas, license holders may harvest trees, and excessive timber extraction is often followed by conversion of cleared land to oil palm plantations by smallholders and commercial operators [9]. Between 2000 and 2015, close to 3.6 million hectares of original forest, an area approximately three times the size of New York City, was lost.

Impacts of Deforestation

Indonesia is infamous for having one of the highest rates of deforestation globally. Today, the country retains less than half of its original forest cover. Statistics from the World Conservation Monitoring Centre indicate that Indonesia is home to approximately 3305 known species of mammals, birds, reptiles, and amphibians [6]. Around 30% of these species are endemic, meaning that they occur nowhere else in the world, while approximately 10% are currently threatened [6]. Indonesia also contains about 29,370 vascular plant species, nearly 60% of which are endemic [6]. As illustrated in **Figure 4**, Indonesia ranks among the countries with the highest numbers of threatened species globally, reflecting both its exceptional

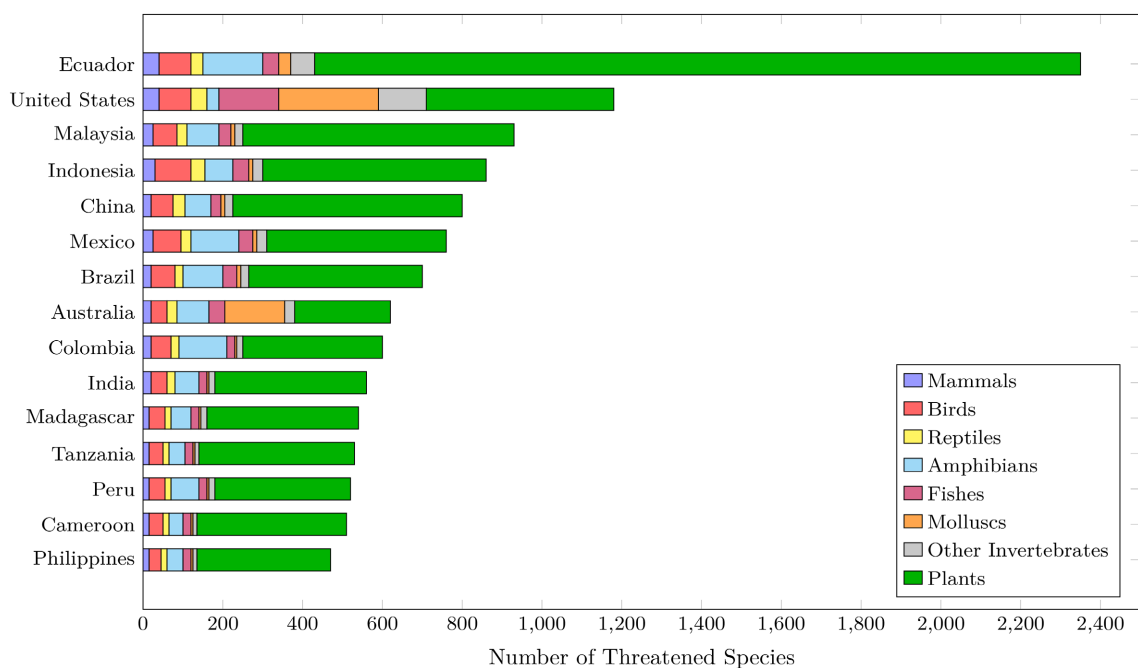


Figure 4. Countries with the highest numbers of threatened species across major taxonomic groups. Indonesia ranks among the world's most biodiversity-rich countries and also among those with the greatest numbers of threatened species, highlighting the conservation consequences of continued forest loss. Source: Adapted from [6].

biodiversity and the increasing pressures placed upon its ecosystems. Deforestation and habitat fragmentation have contributed significantly to biodiversity loss, leading to the extinction of species such as the Javan tiger and placing others, including the orangutan, at severe risk of extinction [17]. The continued destruction of Indonesia's forests therefore poses a major threat to both national and global biodiversity conservation efforts.

Indonesia ranks third worldwide in greenhouse gas emissions, behind China and the United States. About 85% of the country's greenhouse gas emissions originate from forest degradation and deforestation [5]. According to [18], deforestation associated with Indonesia's palm oil industry accounted for between two and nine per cent of all emissions from tropical land-use change between 2000 and 2010. **Figure 5** highlights Indonesia's position among the world's major greenhouse gas emitters. Despite having a smaller industrial sector than many developed economies, Indonesia contributes substantially to global emissions because of forest clearance, peatland degradation, and land-use change. As a direct consequence of deforestation, Southeast Asia is expected to face increasing climate-related challenges, including flooding, typhoons, heat stress, climate-related diseases, and droughts that may reduce agricultural productivity and threaten local livelihoods. The disruption of the hydrological cycle resulting from large-scale forest loss may also transform previously forested regions into drier landscapes, negatively affecting ecosystems and human well-being [18].

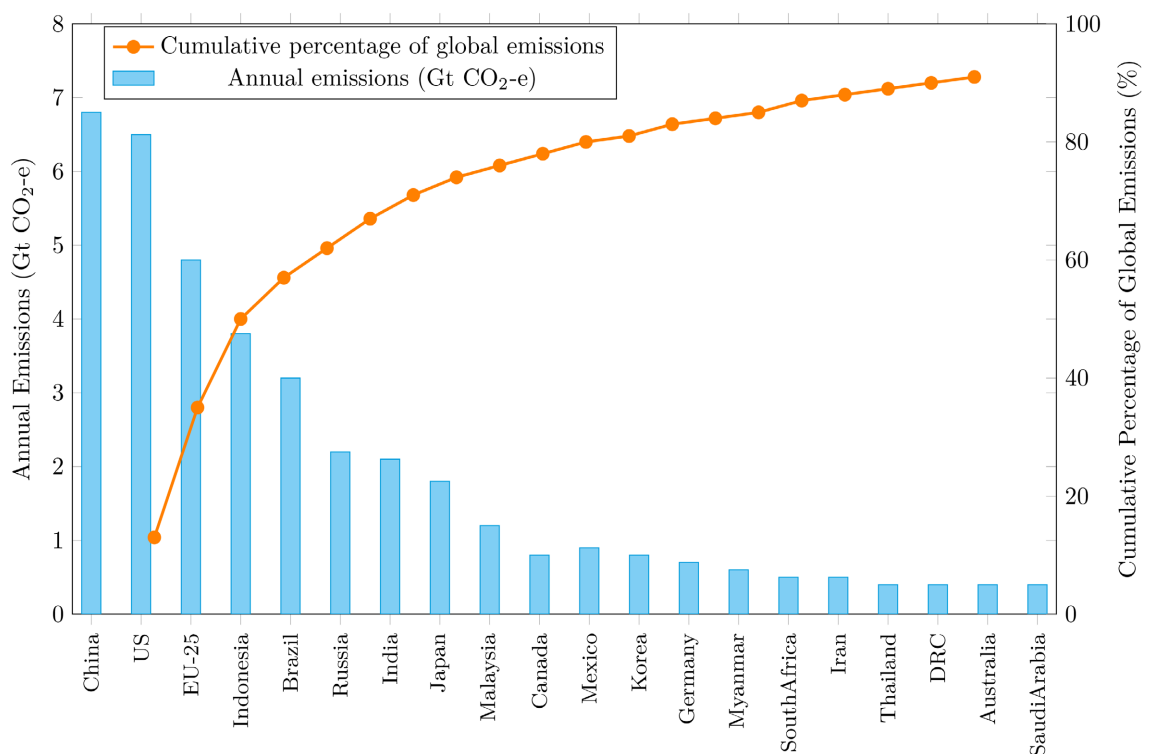


Figure 5. Comparative greenhouse gas emissions among major global emitters. Indonesia is shown as one of the world's largest contributors to greenhouse gas emissions, largely due to land-use change, deforestation, and peatland degradation. Source: Adapted from [5].

Forest fires occurring in Indonesia's forests have ecological, economic, and socio-cultural impacts at the local, regional, and global levels. It is estimated that the carbon dioxide emitted by Indonesian forest fires in 1997 was equivalent to the annual emissions produced by Europe as a whole [14]. Ecologically, such fires have resulted in permanent changes in vegetation cover, as forest ecosystems are replaced by less diverse vegetation types. In Kalimantan, for example, alang-alang grasslands have replaced dipterocarp forests in many areas following repeated burning. Forest fires have also contributed to the destruction of biodiversity and the degradation of wildlife habitats.

In many fire-affected forests, populations of tree and animal species have declined significantly. Wildlife movement patterns have also been disrupted as feeding grounds, breeding areas, and habitats are destroyed [14]. Forest fires in Indonesia have caused substantial losses across the plantation, health, tourism, hospitality, and transportation sectors. These fires release large quantities of harmful gases and particulate matter into the atmosphere, creating severe public health challenges. Dense haze resulting from forest fires has contributed to respiratory illnesses, transportation disruptions, and accidents involving boats and aircraft. In September 1997, for example, an aircraft carrying 222 passengers crashed near North Sumatra Airport after the pilot became disoriented by thick smoke from surrounding forest fires [14]. Economic losses from the 1997 fires were estimated at between US\$3.5 billion and US\$7 billion, with substantial damage to forest resources and biodiversity [14]. Together with ongoing deforestation, forest fires have contributed to air pollution, acid rain, increased drought frequency, and global climate change.

5. Policy Instrument Options

As noted by the Commission of the European Communities [19] Commission of the European Communities (2008), forest conservation remains a priority on the international political agenda. Several organizations and processes are committed towards reducing deforestation and promoting sustainable forest management. Some of these processes and organizations include the Food and Agriculture Organization (FAO), the United Nations Forum on Forests (UNFF), the International Tropical Timber Organization (ITTO), and the UN Convention on Biological Diversity (CBD), among many others [19]. At the national and local levels, several policy options are available for environmental agencies to implement to combat deforestation and promote sustainable forest use.

One policy instrument that governments can use to reduce or prevent deforestation is taxation [20]. A government may impose income taxes, property taxes or their equivalents, and severance taxes to generate revenue as well as to control production or consumption. In many countries, income tax is primarily applied to generate government revenue and is therefore applied equitably across all activities. In other words, all activities bear the same tax burden, as a proportion of profits or income. However, in some countries, provisions do not apply equally to

all productive activities. In some nations, for example, taxes on capital gains are relatively lower than other income [20]. The severity and the way property taxes are applied can stimulate or discourage deforestation.

Another option that environmental agencies can apply to control deforestation is to give incentives. By providing incentives such as free seedlings, technical assistance to forest managers, and financial aid, governments and local authorities can encourage the planting of trees. Such incentives provide cost savings for those who manage forests [20]. Even so, such incentives are practical where the government has adequate financial and technical resources and can therefore afford to offer them.

Yet another option for environmental agencies to control deforestation is to apply regulations. Governments have often imposed regulations to govern or limit activities in and around forests. Governments can, for example, require permits for tree harvesting, even on private land, to limit felling. Restrictions on the shipment of timber across geographic or political boundaries, restrictions on clear cuts, and regulations on selective logging, carbon payments, forest certification, water quality guidelines, and the protection of endangered habitats have also been implemented to reduce deforestation and encourage sustainable forest management [20].

Reducing agricultural rent is another way to reduce deforestation (Angelsen 2015). This involves heavily taxing export crops, neglecting rural roads, and providing no support to smallholders. These policies are often in conflict with the objectives of increasing agricultural production and reducing poverty. Policies aimed at reducing agricultural rents are likely to be politically controversial and are often associated with negative side effects. By reducing agricultural rent, people will tend to seek other better employment opportunities off farm, thereby reducing agricultural activities and deforestation [21]. On the other hand, instituting policies to increase forest rents by limiting the supply of forest products in the wake of high demand for such products can help stabilize forest cover [8]. To increase forest rent, taxation, the promotion of new technologies, and marketing arrangements that affect forest product prices can be applied. Increasing forest rent, however, only works if land users capture a share of the land.

Another way to reduce deforestation is to create protected areas [8] [21]. Forest protected areas such as parks, national forests, extractive reserves and indigenous lands offer a degree of protection to forests. Studies have shown that, for example, in protected areas in the Amazon, significantly less deforestation occurs [8].

6. Policy Options Applicable to Indonesia

From a land rent perspective, policy instruments influence deforestation by either increasing forest rent (the returns from maintaining forests), reducing agricultural rent (the returns from converting forests to alternative land uses), or internalizing the environmental externalities associated with forest conversion [21], [8]. Consequently, the effectiveness of any policy depends on its ability to alter the

relative economic incentives facing land users.

Indonesia can apply a mix of taxation and changes to land use policies to control deforestation. Regarding taxation, Indonesia should consider lowering its income tax rate for forest related activities. Investing in timber as a capital asset has positive effects when the capital gains tax rate is lower, as timber held for long periods appreciates [20]. According to Russakoff (1985), a study conducted in the U.S. suggested that favorable treatment of capital gains resulted in 20% of the country's forest industry's after-tax profits in 1984 [20]. Lowering capital gains tax rates can therefore act as an incentive to encourage investment in favored activities, such as forestry, and to discourage investment in non-favored activities, such as agriculture. Within the economic framework adopted in this paper, favorable tax treatment for forestry increases forest rent relative to agricultural rent, thereby reducing the incentive to convert forest land to alternative uses [8] [20].

Property taxes are typically calculated based on the value of each property, as determined by expert assessments. These taxes are often assessed annually, based on the property's highest and best use. Considering that timber takes several years to be harvested, it is more likely to accumulate annual property taxes by the time it is harvested, this time bias going against forest management and making forestry unfavorable [20]. The application of property taxes on firms may lead them to cut forests and exit to avoid paying property taxes, leaving large parcels of cut-over land, as happened in the U.S. in the 1920s [20]. To avoid such situations, policymakers in Indonesia may opt to design local tax systems so that property tax is paid only once (during harvest) or to lower it in favor of forest lands. Such reforms would increase the expected returns from retaining forests and therefore raise forest rents, making long-term forest management more economically attractive [20].

Severance royalties or taxes are normally charged on mature trees at the time they are harvested. Raising severance fees generally increases incentives for illegal logging, as people try to avoid paying them [20]. At the same time, high severance fees serve as a disincentive for legal harvests. In Indonesia, the government raised the severance fee in 1999 owing to external pressure. As a result of this move, illegal logging increased, and revenue collection from logging declined. To reduce illegal logging and encourage legal commercial activities, Indonesia should consider lowering its severance tax. By reducing incentives for illegal activities and supporting legal forest management, an appropriately designed severance tax system can help maintain forest rents while reducing losses associated with weak enforcement [20].

Indonesia has already categorized many of its forests as protected areas. By establishing protected areas, the country has managed to control deforestation to a limited extent. The country has also, so far, implemented permit requirements for tree harvesting, selective logging regulations, and regulations to protect endangered habitats. The gains the country should make by these measures, however, remain unrealized due to poor implementation of laws and regulations governing

protected areas and corruption among officials. Protected areas directly restrict the conversion of forest land and therefore reduce the opportunity to capture agricultural rents from alternative land uses. In addition, they help preserve ecosystem services whose benefits are often not reflected in market prices, thereby addressing negative environmental externalities associated with deforestation [8] [21].

Taking this into consideration, the environmental agency in Indonesia should work with the national government to change the country's land use policy. So far, the land use policy has mainly focused on reducing poverty, producing more food, and creating wealth, as evidenced by the One Million Rice Fields Project, the transmigration program, and other similar projects. Many of these policies unintentionally increased agricultural rents by making forest conversion more profitable than forest conservation [8] [21]. As a result, economic incentives have frequently favored land clearing rather than sustainable forest management.

The agency should institute a policy limiting the amount of forest land that can be converted to other uses within a specified period. For example, this policy may state that no more than 100,000 ha of forest land may be converted to other uses within a period of five decades. Such a policy, if properly implemented, will no doubt limit the destruction of forests within short periods. From an economic perspective, land-use restrictions alter the relative returns to competing land uses and can therefore reduce equilibrium deforestation rates. Combined with taxation, enforcement, and protected-area policies, such measures contribute to the internalization of environmental externalities and support more sustainable forest management outcomes [8] [21].

7. Conclusions

This paper has examined deforestation in Indonesia through a synthesis of empirical literature and secondary data sources, using an environmental economics perspective to analyse the factors driving forest loss and the policy options available to address it. The review highlights that deforestation is driven by the interaction between proximate drivers, including agricultural expansion, logging, mining, infrastructure development, and forest fires, and underlying drivers such as weak governance, corruption, land market incentives, and policy distortions that favour forest conversion.

The analysis demonstrates that agricultural expansion, particularly for oil palm and pulpwood production, remains one of the most significant drivers of forest loss. While activities such as mining, logging, and infrastructure development contribute directly to deforestation, their effects are often reinforced by institutional weaknesses and inadequate enforcement of environmental regulations. Forest fires further exacerbate forest loss, functioning both as a mechanism for land clearing and as a consequence of peatland drainage, land-use change, and weak governance.

The economic framework developed in this paper suggests that deforestation

occurs when the expected returns from converting forest land exceeds the returns from maintaining forest cover. In this context, public policies play a critical role in shaping land-use decisions by influencing agricultural rents, forest rents, and the extent to which environmental externalities are incorporated into economic decision making. The evidence reviewed suggests that some historical land-use policies, including transmigration schemes and large-scale agricultural development programmes, have unintentionally increased incentives for forest conversion.

The impacts of deforestation extend far beyond the loss of forest cover. Biodiversity decline, greenhouse gas emissions, degradation of ecosystem services, adverse health effects associated with forest fires, and risks to local livelihoods all impose substantial social and economic costs. Many of these costs represent environmental externalities that are not fully reflected in market prices, resulting in continued pressure on forest resources.

Addressing deforestation in Indonesia therefore requires an integrated policy approach that combines fiscal instruments, land-use regulation, protected areas, and stronger institutional enforcement. Policies that increase forest rents, reduce excessive incentives for forest conversion, and internalise environmental externalities are likely to be more effective in reducing long-run deforestation. At the same time, improvements in governance, transparency, and land tenure security are essential to ensure that policy interventions achieve their intended outcomes. Ultimately, balancing economic development objectives with environmental sustainability remains a central challenge for Indonesia, and successful forest conservation will depend on aligning economic incentives with long-term ecosystem protection.

8. Future Research

Several areas for further research emerge from this analysis. First, there is a need for more empirical studies examining the effectiveness of policy instruments in practice, particularly taxation and land use reforms, where evidence remains limited. Second, the role of institutional quality requires deeper investigation, especially in relation to governance, corruption, and decentralisation, which strongly influence deforestation outcomes.

Third, future research should explore the economic trade offs between agricultural expansion, resource extraction, and forest conservation, with greater focus on long-term sustainability. Finally, more attention should be given to community based and indigenous land management systems, which remain underexplored but may provide more effective and locally grounded solutions for sustainable forest use.

Conflicts of Interest

The authors, Edeo Kalo and Mahamed Hussein, declare that they have no conflicts of interest regarding the publication of this paper.

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