

Forests and Fauna in Jeopardy: Deforestation and Resource Depletion in Brazil and Indonesia

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Abstract

This article looks at the effect that deforestation and the depletion of critical resources has on the ecosystems and thus the life of animals, plants, and people of Brazil and Indonesia. Though the two countries are very different in terms of geography, Indonesia is an archipelago while Brazil is a part of the continent of South America, both countries are known for being extremely rich in their varieties of species of wildlife, both of the plant and the animal variety. This article examines the evolution of deforestation and resource depletion in Brazil and Indonesia and outlines some of the key implications.

I. Introduction

Deforestation and the depletion of natural resources more generally, have become important issues facing the world today, especially as they are connected to global climate change. In 2004, 17.3 percent of the global greenhouse gas emission, which is the source of the current warming of the planet, has been allocated to deforestation and the decay of biomass.¹ Brazil and Indonesia are two countries with extreme rates of deforestation, which contributes not only to global climate change but also to a local loss of biodiversity. The loss of biodiversity refers not only to deforestation, but the overall economic as well as environmental impacts, which run in tandem with one another surrounding the presence of animal habitats, presence of diverse plant life, and the existence of a variety of non-renewable natural resources.

Following this introduction, the next section provides a brief review of the literature. The subsequent section provides some empirical background on the population sizes and socioeconomic developments of Brazil and Indonesia. The discussion section will focus mostly on examining the available data for deforestation, freshwater withdrawal, and natural resources depletion. The last section provides some conclusions.

¹ Intergovernmental Panel on Climate Change (IPCC) (2007), Figure SPM.3., p. 5.

II. Literature Review

Given the many negative side effects deforestation has, including the loss of habitat for millions of species, the more recent linkage of deforestation to driving climate change resulted in a large and growing literature. In addition to the many global assessment studies, there by now also many country-specific studies, including for Brazil and Indonesia. There also is a great diversity in the level of analysis, ranging from non-technical summaries, mostly provided by environmental non-governmental organizations (NGOs), to highly scientific assessments by scholars at universities and research centers. The following summaries address a variety of issues related to the loss of forests and biodiversity in Brazil and Indonesia.

- Balch (2015) examines the devastating forest fires in Indonesia, which started in July 2015 and have been called a crime against humanity. He inspects how the fires started, what damage they are causing, who is to blame, and what needs to be done. He states that forest fires have become a seasonal phenomenon in Indonesia, with the root of the problem being the practice of forest clearance known as slash and burn, where land is set on fire as a cheaper way to clear it for new planting. Balch also provides some estimates for the human as well economic costs, referring for example to estimates by the Indonesian government, which suggest that the financial costs could be as high as \$47 billion.
- Glaeser and Glaser (2010) is an academic journal article that addresses how the Indonesian government is trying to approach the issue of climate change. They examine the importance of managing the coastlines because Indonesia is entirely made up of islands that produce a great amount of agricultural products for the rest of the world. They make clear that it is important to focus on solutions that prevent further negative impacts on the economy, citizens, and biodiversity.
- Gullison et al. (2007) address the different policies associated with deforestation problems as well as the positive incentives to protect the forests, particularly those in the Amazon rainforest and the forests on the islands of Indonesia. The authors refer to the fact that global warming has put a huge burden on not only the earth but particularly the areas of the world that are covered with tropical rainforest vegetation. For example, Indonesia faces a huge future danger effecting the economic state of the country due to the growing ozone hole over the islands. This will decrease the agricultural production of the once agriculturally rich archipelago.
- Perz et al. (2008) examine the prospects for environmental governance in the Amazon with regards to road building, land use and climate Change. They the give and take relationship, with giving more people access to natural resources in the forest, but splitting up the vegetation as a result adding to the decline of the rainforest ecosystem and then affecting the population adversely. The authors bring to light that new NGOs as well as other governmental institutions are attempting to find alternate plans to balance resource need and a stable economic state with the importance of preserving the ecosystem and biodiversity at the same time.
- Portela et al. (2008) examine the idea of market-based mechanisms for forest conservation and climate change. They address the importance that the forests of the world play, particularly the bio-diversely rich ones, such as the Amazon rainforest, for the general

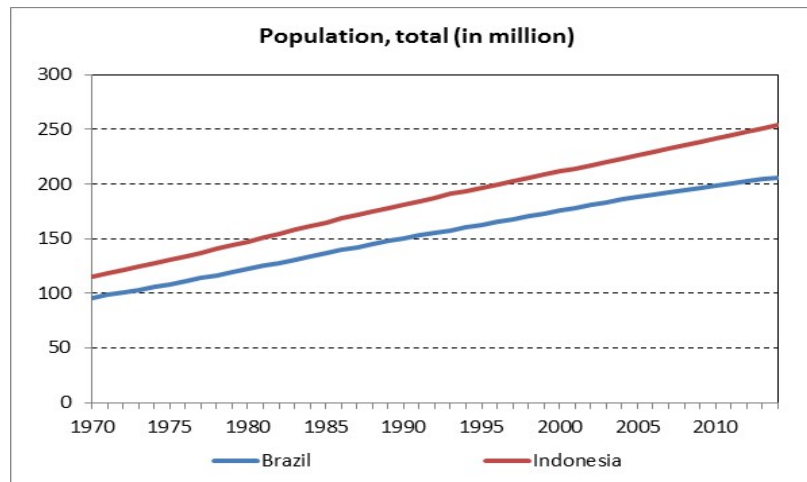
health and maintenance of the world as an ecosystem. They come to the conclusion that these forests are extremely important because they control both, the amount of greenhouse gases that are in our environment and the air we breathe as these forests are the lungs of the earth. They also conclude (p. 12) that “market systems fail to provide incentives for conserving ecosystem services.”

- Weisse and Petersen (2015) provide a scientific blog of the World Resource Institute (WRI), examining Brazil’s and Indonesia’s struggle to reduce deforestation. They report that both, Brazil and Indonesia have made significant efforts to reduce deforestation in recent years, but that both saw an uptick in tree cover loss in 2014, according to new data on Global Forest Watch from the University of Maryland and Google. Brazil’s rate of tree cover loss increased by more than 16 percent between 2013 and 2014, while Indonesia’s rose by 30 percent during the same time period.

III. Empirical Background

Indonesia and Brazil are, respectively, the world’s fourth and fifth most populous countries. The following graph gives a depiction of the total population of the two countries from 1970 to 2014. As of 1970, Brazil’s population was 96.0 million, while that of Indonesia was 114.8 million. Both countries had doubled their populations by 2007 (that is, within 37 years), and by 2014, Brazil’s population reached 206.1 million, while that of Indonesia reached 254.5 million. Though both countries’ population growth rates declined over time, Indonesia’s annual population growth rate was and continues to be slightly higher than that of Brazil. Brazil’s average annual population growth rate from 1970-2014 was 1.75 percent, while that of Indonesia was 1.83 percent. Given that Brazil has a far larger land area than Indonesia, Brazil’s population density was with 24.7 people per sq. km of land area less than a fifth of Indonesia’s (which stood at 140.5 people per sq. km of land area).

Figure 1: Total Population (in millions), 1970-2014

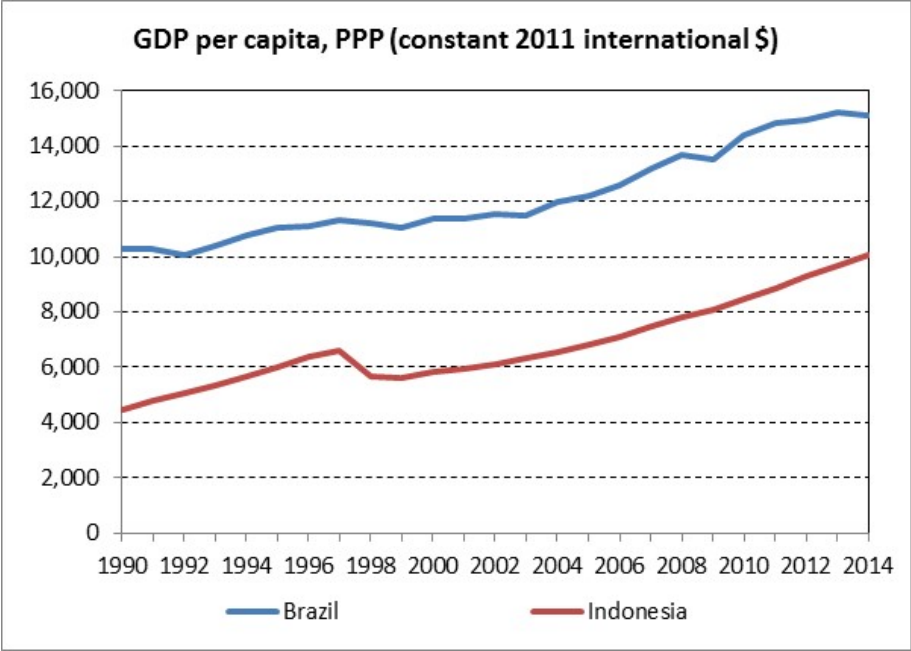


Source: Created by author based on World Bank (2015).

Figure 2 shows the evolution of Gross Domestic Product (GDP) per capita adjusted for purchasing power parity (PPP) of Brazil and Indonesia. As it can be seen, Brazil’s GDP per capita is considerably higher than that of Indonesia. However, Indonesia’s GDP per capita has grown faster

during the last 25 years than that of Brazil, despite the sharp decline Indonesia experienced during the Asian financial crisis that began in July 1997. While Brazil’s GDP growth rate was impacted by the 2008 world financial crisis, there has been no visible impact on Indonesia’s GDP per capita. As of 2014, Brazil’s GDP per capita was with PPP\$15,110 slightly less than 1.5 times its 1990 level, while Indonesia’s GDP per capita was with PPP\$10,033 slightly more than 2.2 times its 1990 level. Despite these overall very positive trends, we should keep in mind that GDP per capita does not take into account the loss of forests, the degradation of biodiversity, and the depletion of natural resources.

Figure 2: GDP per capita (constant 2011 international \$), 1990-2014

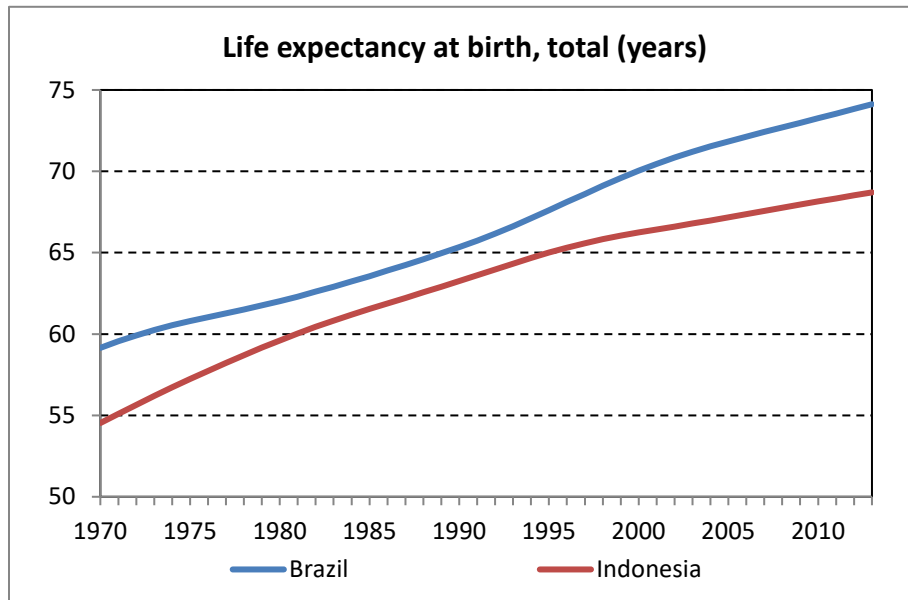


Source: Created by author based on World Bank (2015).

Figure 3 shows that like GDP per capita, Brazil’s life expectancy at birth is also higher than that of Indonesia. As of 1970, Brazil’s life expectancy was 4.6 years higher than that of Indonesia. From 1970 until 1986, the difference between Brazil’s and Indonesia’s life expectancy had become smaller, reaching a minimum of only 2 years in 1986. Since 1986, the difference between Brazil’s and Indonesia’s life expectancy increased continuously. As of 2013, Brazil’s life expectancy was 5.4 years higher than that of Indonesia.

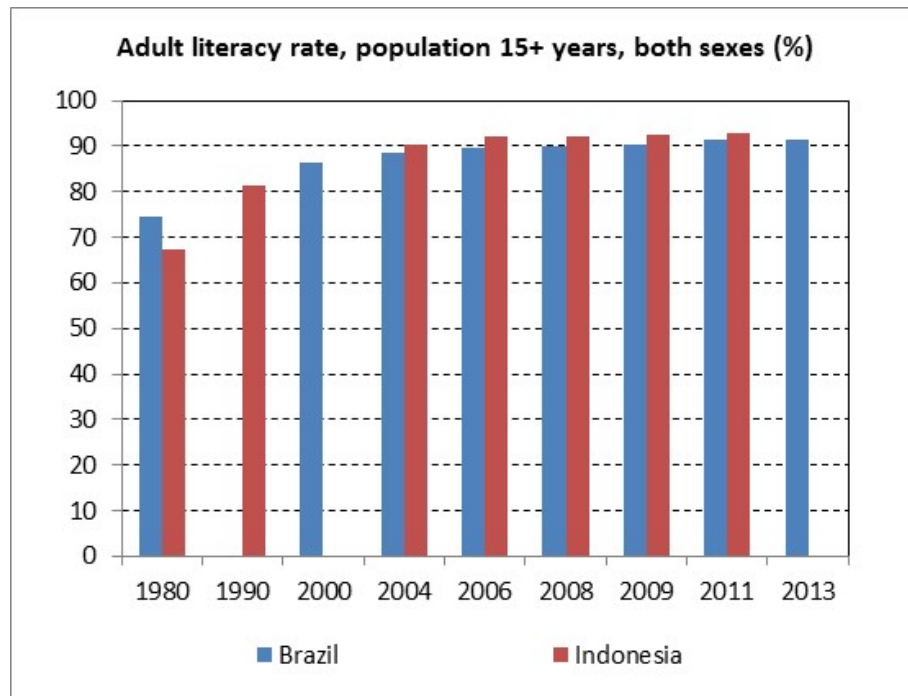
Figure 4 displays the adult literacy rate for Brazil and Indonesia. It is interesting to note while Brazil had a considerably higher literacy rate than Indonesia in 1980, Indonesia has more than caught up with Brazil by 2004, and seems to have remained the slightly higher literacy rates ever since. This clearly does not shed a good light on Brazil’s education system, despite that Brazil has a higher GDP per capita and a higher life expectancy than Indonesia.

Figure 3: Life Expectancy at birth (years), 1970-2013



Source: Created by author based on World Bank (2015).

Figure 4: Adult Literacy Rates (percent) for Brazil and Indonesia (all available data)



Source: Created by author based on World Bank (2015).

IV. Discussion

As shown in Figure 5, Brazil and Indonesia contain the most significant amounts of the world's tropical rain forests. It has been estimated that more than half of the world's currently known biotic species are indigenous to tropical rainforests, with many millions of species of plants, insects and microorganisms still undiscovered in tropical rainforests.² Furthermore, in addition to tropical rain forest, Brazil has nearly 5 million square kilometer (sq. km) of non-tropic rainforest, which is one of the most biologically diverse regions of the world, containing over a million species of plants and animals.³

Figure 5: World Map of Tropical Forests



Source: Koppen_World_Map_Hi-Res.png: M. C. Peel, B. L. Finlayson, and T. A. McMahon (University of Melbourne), derivative work: Me ne frego (talk) - Koppen_World_Map_Hi-Res.png, CC BY-SA 3.0, available at: <https://commons.wikimedia.org/w/index.php?curid=14798010>.

For Indonesia and Brazil, which are among the most bio-diverse countries in the world, the threat resulting from deforestation, freshwater withdrawals, and resource depletion more generally is very high. Furthermore, the impact of deforestation in Brazil and Indonesia is not only limited to within the boundaries of these two countries themselves. The effects span far beyond and into the rest of the world. This discussion section will focus on some key issues related to deforestation, freshwater withdrawals, the broader issue of resource depletion, and the subsequent risk to biodiversity.

² Newman (2000).

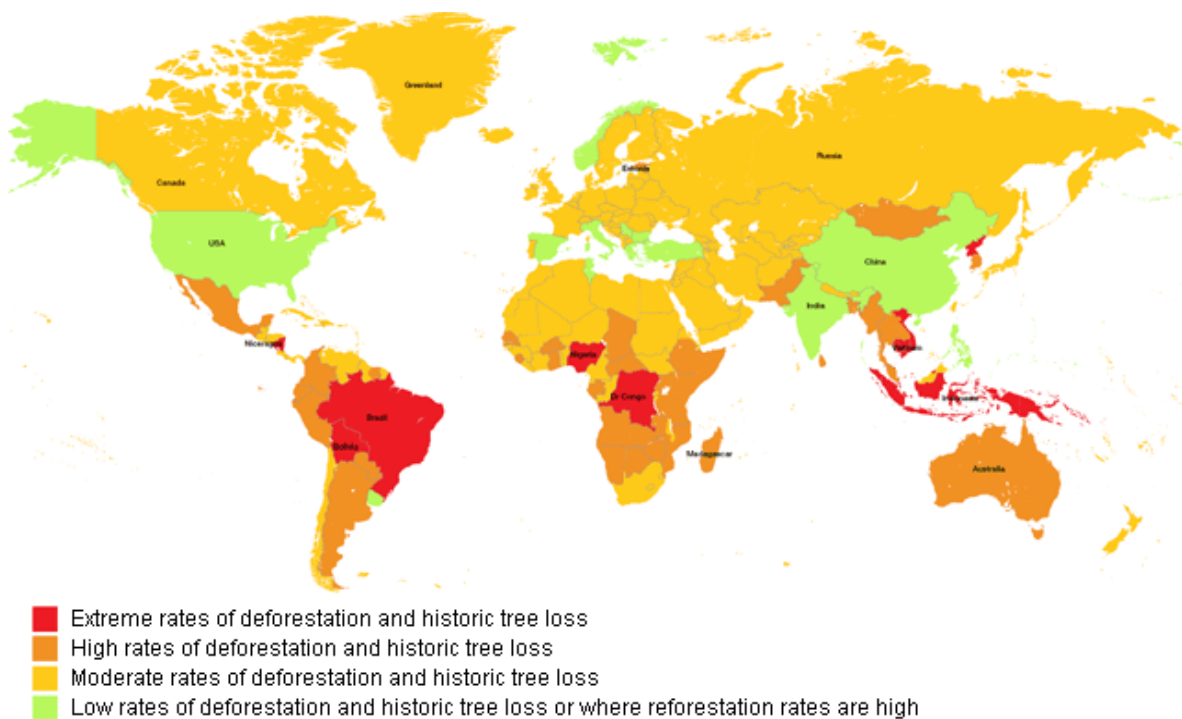
³ World Tree Trust (2013b).

IV.1. Deforestation

As was detailed in the Introduction above, deforestation and the decay of biomass accounted for 17.3 percent of the global greenhouse gas emission in 2004, and given that Brazil and Indonesia are estimated to account for approximately 55 percent of the world's deforestation,⁴ it can be estimated that nearly 10 percent of the global greenhouse gas emissions is coming from Brazil's and Indonesia's deforestation. Excluding greenhouse gas emissions resulting from deforestation, Brazil and Indonesia contributed, respectively, only 1.27 percent and 1.62 percent of the global carbon dioxide emissions stemming from the burning of fossil fuels, the manufacture of cement, and the carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

As shown in Figure 6, Brazil and Indonesia are both countries with extreme rates of deforestation and historic tree loss. The countries that are affected by extreme deforestation in addition to Brazil and Indonesia include Bolivia, the Democratic Republic of Congo (DRC), Nicaragua, Nigeria, North Korea, and Vietnam.

Figure 6: Rates of Deforestation and Historic Tree Loss

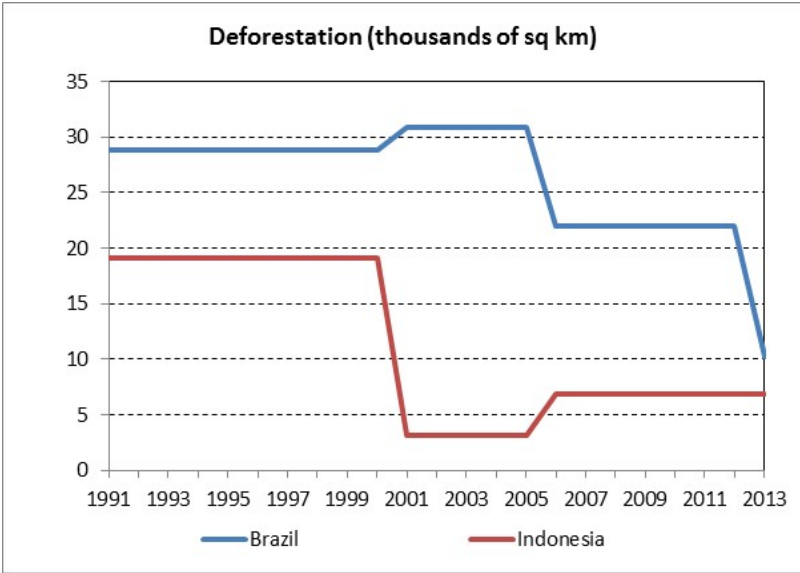


Source: World Tree Trust (2013).

Figure 7 shows the annual deforestation in thousands of square kilometer in Brazil and Indonesia from 1991 to 2012, which seems overall of a declining trend. Figure 7 also shows that Brazil destroys more forest areas than Indonesia, despite having a smaller population than Indonesia.

⁴ World Tree Trust (2013a).

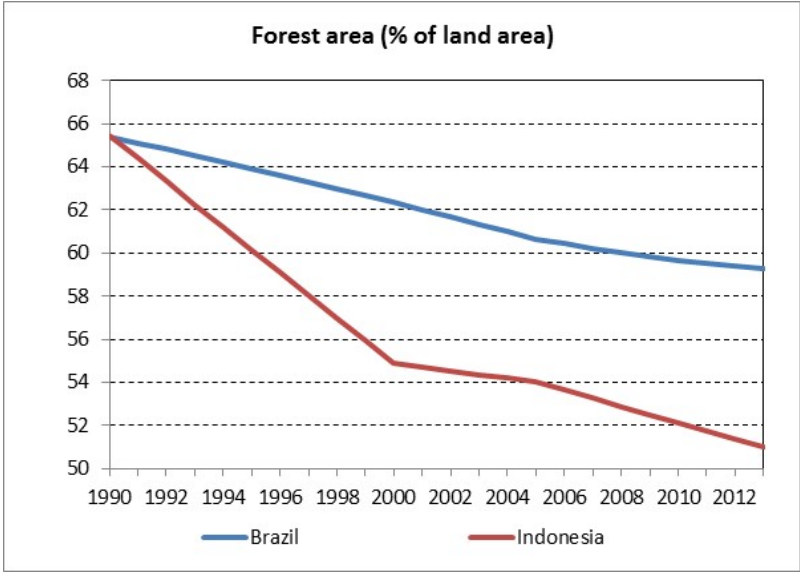
Figure 7: Deforestation (thousands of square kilometer) in Brazil and Indonesia, 1991-2013



Source: Created by author based on World Bank (2015).

On the other hand, taking into account that Brazil has far more forests than Indonesia, Figure 8 shows that Indonesia is depleting its forest at higher percentage rates than Brazil. In 1990, forests constituted 65.4 percent of each country’s land area. However, due to deforestation, by 2013, forests accounted for 59.3 percent of total land area in Brazil, while in Indonesia, forests accounted for only 51.0 percent of total land area.

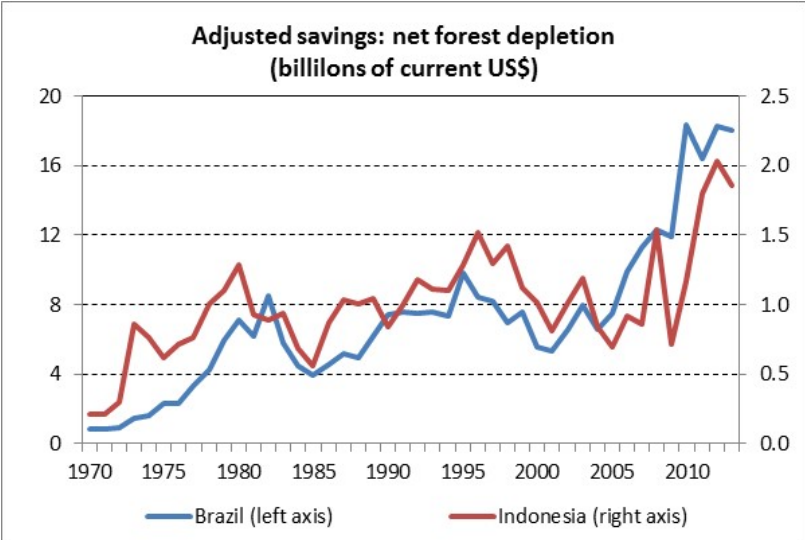
Figure 8: Forest Area (as percent of land area) in Brazil and Indonesia, 1990-2013



Source: Created by author based on World Bank (2015).

Figure 9 shows the net forest depletion in current U.S. dollar. It should be stressed that this figure does not show the monetary loss of deforestation. Net forest depletion is defined to measure the monetary value of actually realized timber sales from deforestation, it does not assign any value to the deforestation via burning trees to the ground.⁵ As pointed out in World Tree Trust (2013), in both Brazil and Indonesia, most of the deforestation is happening via burning trees to the ground. In other words, the loss of forests via burning trees is not included in the calculation of net forest depletion. On the other hand, the burning of trees emits vast amounts of carbon dioxide into the atmosphere, which implies an additional negative factor of deforestation. We still provide Figure 9 as it shows the monetary value Brazil and Indonesia gain from logging, which has dramatically increased for both countries, though it is about ten times higher in Brazil than in Indonesia.

Figure 9: Adjusted Savings: Net Forest Depletion (billions of current US\$), 1970-2013



Source: Created by author based on World Bank (2015).

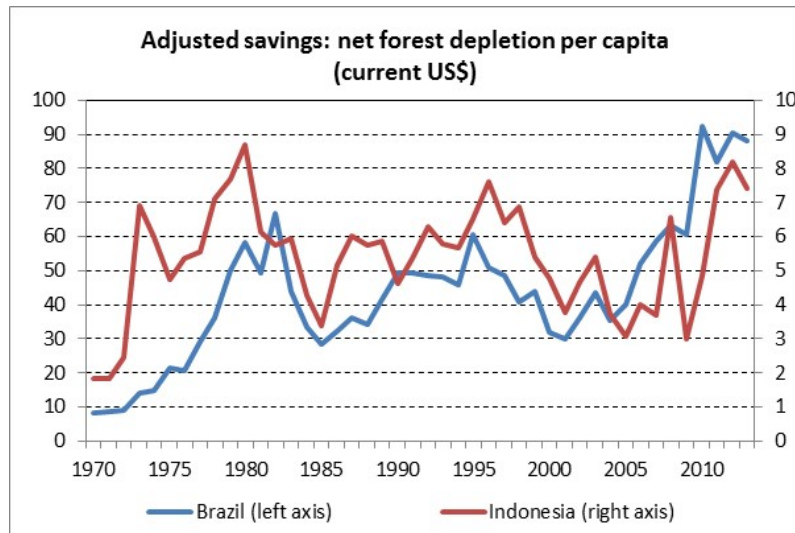
Figure 10 shows the trends in net forest depletion in per capita terms, which show a very similar picture in terms of trends, and once again, the level of per capita net forest depletion is about ten times higher in Brazil than Indonesia. Here too, it is important to keep in mind that net forest depletion measures only the revenues a country gets from timber sales coming from deforestation, which is a small fraction of the total deforestation.

In Brazil, the average per capita revenue from lumber sales from deforestation has increased from about current US\$8 in 1970 to current US\$88 in 2013. In Indonesia, the average per capita revenue from lumber sales from deforestation has increased from current US\$1.82 in 1970 to current US\$7.40 in 2013. In other words, keeping inflation in mind, that is, given that US\$1.00 in 1970 had the same buying power as US\$6.09 in 2013,⁶ these per capita revenues have actually declined for Indonesia, though they have slightly increased in the case of Brazil.

⁵ World Bank (2015).

⁶ Calculated by the author based on U.S. inflation data provided by World Bank (2015).

Figure 10: Adjusted Savings: Net Forest Depletion per capita (current US\$), 1970-2013

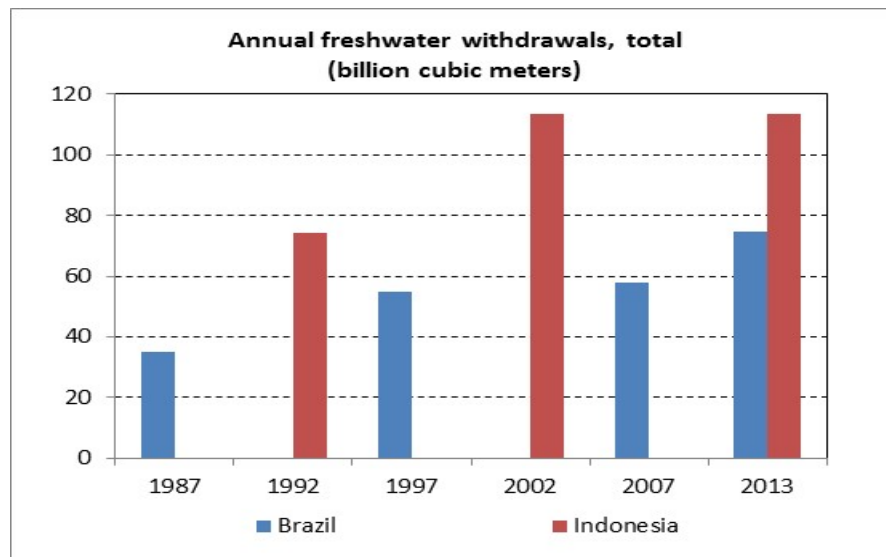


Source: Created by author based on World Bank (2015).

IV.2. Freshwater Withdrawal

Given that annual freshwater withdrawals amount currently (2013 data) to only 1.3 percent of total internal resources in Brazil and to 5.6 percent of total internal resources in Indonesia, freshwater withdrawals are no serious concern in neither Brazil nor in Indonesia. Still, Figure 11 provides some useful information on long-term trends, despite the sparse data available.

Figure 11: Annual freshwater withdrawals, total (billion cubic meters), all available years



Source: Created by author based on World Bank (2015).

IV.3. Natural Resource Depletion

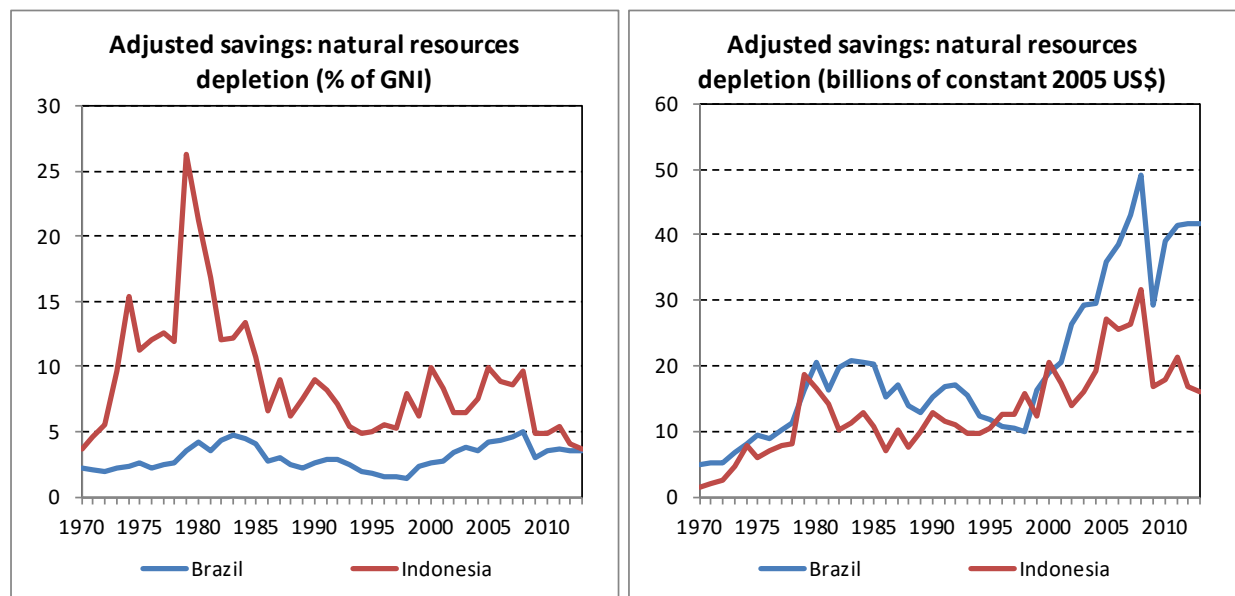
The topic of natural resource depletion is an important one to keep in mind when talking about ecosystem depletion and loss of biodiversity. Figures 12 and 13 show the depletion of natural resources that took place in Indonesia and Brazil from 1970 through 2012, respectively as percent of gross national income (GNI), and in billions of constant 2005 U.S. dollars. It is once again very important to keep in mind how this variable is defined.

Adjusted savings: natural resource depletion is defined as the sum of net forest depletion, energy depletion, and mineral depletion.

- We already stressed the possibly misleading definition of net forest depletion above.
- With regards to energy depletion, this is defined as the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas.
- And finally, mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.

Despite these imperfections in the definition of natural resource depletion, some data is better than no data. Anyway, comparing Figures 12 and 13 clearly shows that while Brazil's as well as Indonesia's natural resource depletion has been at about the same level in 1970 as in 2013, expressed in billions of constant 2005 US\$, both countries' natural resource depletion has increased significantly over time, even though the latest trends seem to be declining.

Figures 12 and 13: Adjusted Savings: Natural Resource Depletion, 1970-2013
(as percent of GNI and in billions of constant 2005 US\$)



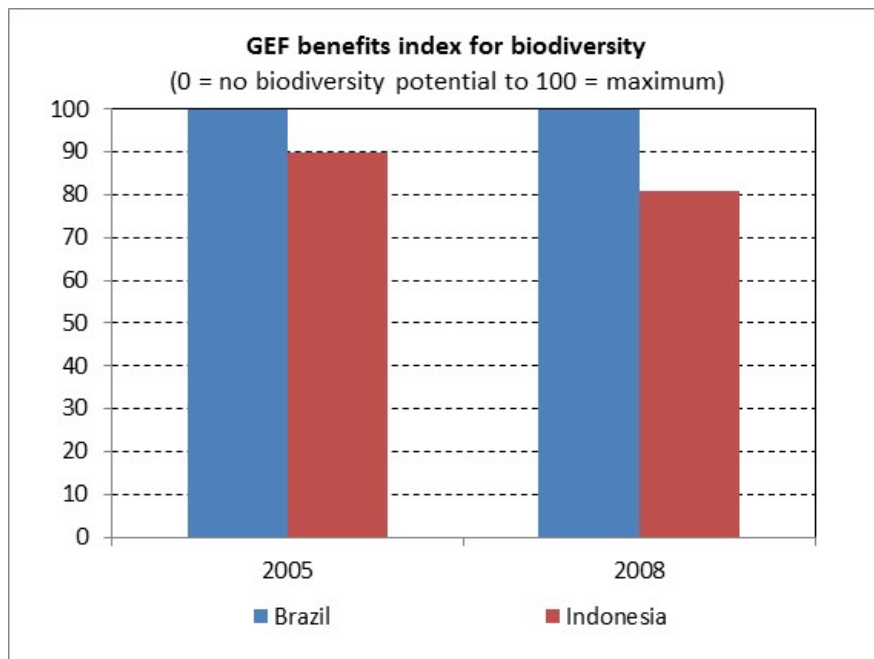
Source: Created by author based on World Bank (2015).

IV.4. Biodiversity at Risk

Figure 14 shows the Global Environmental Facility's Benefits Index for Biodiversity for 2005 and 2008 (which are the only two years this data is available). As provided by the World Bank (2015), the "Global Environment Facility's (GEF) benefits index for biodiversity is a comprehensive indicator of national biodiversity status and is used to guide its biodiversity priorities. For each country the biodiversity indicator incorporates the best available and comparable information in four relevant dimensions: represented species, threatened species, represented ecoregions, and threatened ecoregions. To combine these dimensions into one measure, the indicator uses dimensional weights that reflect the consensus of conservation scientists at the GEF, and International Union for Conservation of Nature (IUCN), WWF International, and other nongovernmental organizations."

While the data is scarce and a bit outdated, it is still interesting to see that Brazil's index has remained at the maximum of 100 percent, while Indonesia's index has deteriorated by 9 percentage points within only three years. If that trend continued, Indonesia's index would be only at around 50 by 2020. This is obviously not only a huge threat to Indonesia, but to the world's biodiversity.

Figures 14: Benefits Index for Biodiversity of the Global Environmental Facility (GEF)
(0 = no biodiversity potential to 100 = maximum biodiversity potential)



Source: Created by author based on World Bank (2015).

V. Conclusion

This article examined Brazil's and Indonesia's deforestation, freshwater withdrawal, natural resource depletion, and benefits index for biodiversity, all based on the data available by the World Bank (2015). It showed that even though Brazil's and Indonesia's deforestation has been on an

overall declining trend (in terms of the number of square kilometer getting deforested), both countries' forests continue to decline as a percentage of total land area. In 2013, forests accounted for 59.3 percent of total land area in Brazil, and for only 51 percent in Indonesia. The fact that most of this deforestation is carried out by burning trees to the ground implies that in addition to the negative effect deforestation has on forests serving as a carbon sink, burning the trees also releases huge amounts of greenhouse gases. And finally, deforestation via burning trees to the ground is not even accounted for in the various measures for adjusted savings. While both countries' freshwater withdrawals are not a major issue of concern at this point, the overall natural resource depletion, which amounts to billions of U.S. dollar on an annual basis in each country is alarming. We have also shown that Indonesia's biodiversity has been reduced by 9 percentage points within only three years.

Brazil and Indonesia had been chosen as they are known to be hotspots for biodiversity. Their biodiversity is not only an issue within these countries borders, but an issue of global concern and global consequences. The trees, water sources, and other natural resources are precious to our world ecosystem in addition to the ecosystem of their own specific country environment. We are already starting to experience negative side effects in various parts of our lives. Whatever we do to the environment has the ability to come back and adversely affect us. Like Newton's law states, every action has an equal and opposite reaction. We can and need to do more to protect the remaining forests, not only for the sake of conserving the world's biodiversity, but ultimately to determine our own destiny.

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