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Risky Business: Agricultural Development and Environmental Consequences in Indonesia and Ecuador

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Abstract

This article looks at the effects of agricultural development and its relation to deforestation and soil erosion in Indonesia and Ecuador. Indonesia's rainforests are some of the most biodiverse and species rich areas on earth, but it has the third highest level of endangered and at-risk species in the world. Ecuador is currently the country with the highest number of at-risk species. Live-stock and agricultural production are central to the economies of both Indonesia and Ecuador. Indonesia's economy has changed from rural to urban in recent years, however around 30 percent of Indonesian land area is used for agriculture purpose. Although recent economic developments may have worked in reducing poverty, both Indonesia and Ecuador still suffer from high rates of rural poverty and low agricultural productivity. This paper examines how agricultural developments have led to deforestation and land degradation, destroying biodiversity, and how these countries are implementing new sustainable development policies.

I. Introduction

Indonesia and Ecuador are both extremely biodiverse countries, both are listed as one of the 17 "megadiverse" countries on earth.[1] Ecuador hosts more biodiversity per square km than any other country and Indonesia has been cited as the most species rich country on earth spread out over its 18,000 islands. Indonesia is the sixth largest producer of greenhouse gas emissions due to deforestation to make way for its palm oil and paper plantations Both countries are largely affected by fragmentation, deforestation, pollution, soil erosion, and species extinction. Both governments, historically plagued by political corruption and land disputes, only recently began conservation initiatives due to international pressure. These conservation initiatives and sustainable agricultural development policies are aimed at increasing agricultural productivity for poor rural farmers who suffer the most from large plantations encroaching on their land. Many have been ineffective as both the Ecuadorian and Indonesian government still struggles with enforcement of laws and political corruption.

[1] See https://www.rankred.com/top-10-megadiverse-countries-in-the-world/.

This article looks at agricultural production and its relation to environmental issues such as deforestation, soil degradation, and endangered species in both Indonesia and Ecuador, and will look at sustainable agricultural solutions. This article excludes urban centers and urban growth in both Ecuador and Indonesia and focuses only on rural areas and their contribution to agricultural growth and the ways in which they are affected by deforestation from large plantation companies.

Following this introduction, the next section reviews some of the prominent literature on agricultural development and environmental challenges in Ecuador and Indonesia. The third section provides some socio-economic background for both countries. Section IV discusses first the importance of agriculture specific to each country, then the issues of deforestation, soil erosion, and mangrove and peatland depletion, and lastly, the existing sustainable agricultural and conservation initiatives in each country. The last section provides some conclusions.

II. Literature Review

There is an extensive amount of literature on agricultural productivity and small farming in Indonesia and Ecuador, as well as the extent of the destruction in each country from companies such as palm oil growers, who cause deforestation and desertification. Even though some of these studies were written years ago, they are still useful in understanding the causes of Ecuador and Indonesian land degradation.

Southgate and Whitaker (1992) discuss the causes and conditions of soil and coastal erosion and deforestation in Ecuador. According to the authors, the causes of Ecuador's environmental degradation are inadequate property rights and government policies, government interference in market forces, and poor investment in research. The authors look specifically at areas of Ecuador that have experienced rapid agricultural colonization resulting in deforestation, such as lowland Ecuador. Lastly, they discuss maricultural development in Ecuador, specifically the once booming shrimp industry, which has caused the displacement of mangrove swamps and overfishing.

Feintrenie, Laurène, Schwarze, Stefan and Levang (2010) discuss lading (rice cultivation), agroforests, and agricultural intensification and expansion in Indonesia. The study looks at the transformation of forests and agroforest to monoculture plantations focusing on three regions in Indonesia and small farmers' land use decisions and conservation efforts in those areas. The authors concluded that economic factors such as commodity prices determined by the international market drive agricultural intensification and monoculture plantations, specifically rubber, palm oil and cocoa are more profitable than traditional agroforests and rice cultivation.

Austin, Mosnier, Pirker, McCullum, Fritz and Kasibhatla (2017) analyze the extent of deforestation in Indonesia that is due to oil palm plantations and evaluate the impact of the zero-deforestation commitments of some Indonesian companies. They specifically focused on deforestation in forests of Sumatra, Kalimantan, and Papua, which are where oil palm plantations are located, and offered the solution of future expansion into lands without deforestation. They found that while oil palm driven deforestation increased in Kalimantan and Papua, however overall the percent of plantations replacing forests decreased from 2010-2015. Oil palm plantations are increasingly expanding into non-forested lands making zero-deforestation commitments by palm oil growers and companies not as important in decreasing deforestation in some regions of Indonesia such as Sumatra.

Barrowclough, Stehouwer, Alwang, Gallagher, Mosquera and Dominguez (2016) study conservation agricultural techniques for small-scale farmers in Ecuador's highlands. Authors

collected data for five years in Bolivar Province, Ecuador in the Sierra region where they compared crop yields and cost of production for farmers using both conventional agricultural farming practices and conservation agricultural practices. In the five-year study, authors found that conservation agriculture yielded more crops, was less expensive, and protected soil from erosion. Economic benefits and protection from soil erosion made conservation agriculture attractive to small farmers, however it has largely not been adopted due to uncertainty and risk aversion.

Pan, Carr, Barbieri, Bilsborrow and Suchindran (2007) focus on deforestation in the Ecuadorian Amazon. The authors collected data from migrant colonist farm plots and found that an increasing population size significantly increased deforestation and an increase in population density increased agricultural expansion. They also found that farms further from urban centers had a lower rate of forest clearing. Their study also showed that forest clearing was necessary to claim the land and to grow subsistence crops, and overtime the land cleared was used to grow cash crops such as coffee.

III. Socio-Economic Background

Indonesia is the largest economy in Southeast Asia and the 10th largest economy in terms of purchasing power parity in the world. It is the fourth most populous country in the world. Indonesia is a lower middle-income country, who's national poverty rate has fallen to 11.3 percent in 2014, though rural poverty was with 14.2 percent for the same year nearly 3 percentage points higher. Indonesia has seen great improvements in poverty reduction mostly due to infrastructure development and nonfarm economic growth since the Asian Financial Crisis of 1997. However, Indonesia still faces challenges due to slow job creation, poor quality of schools and health clinics, and a high maternal mortality rate.[2]

Ecuador, which is an upper middle-income country, is one of the smaller countries of South America, but still the eighth largest economy in Latin America. It hosts a diverse range of climate and ecosystems. Ecuador's poverty rate has decreased drastically since 2000 and in 2014 the national poverty rate was 22.5 percent, however rural poverty in the same year was 35.3 percent. Hence, poverty is much worse in rural areas, where the oil industry encroaches on native lands. Agricultural intensification causing soil degradation and land scarcity and the destruction of mangrove swamps along the coast have also increased poverty.

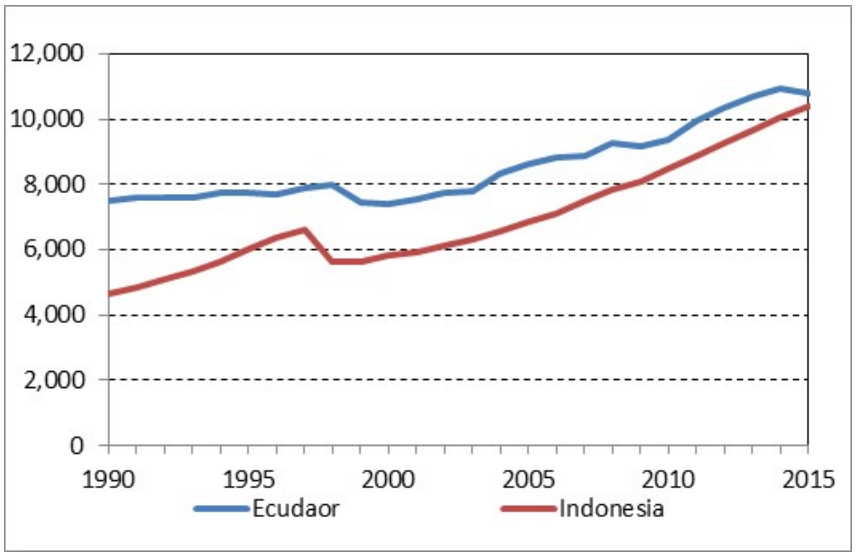
As shown in Figure 1, for both countries, GDP per capita has overall increased from 1990 to 2015. However, Ecuador's GDP experienced a drop in 1999, due to a financial crisis after global oil prices dropped in 1997-1998. Since 2000, Ecuador's GDP per capita rose, though fluctuations in international oil prices and natural disasters have affected GDP per capita negatively in some years. Like most other East Asian countries, Indonesia also experienced a financial crisis in 1997 but recovered in 1999 with economic and governmental reforms supported by international organization like the World Bank and the International Monetary Fund (IMF).

Despite the limited availability of data, Figure 2 shows that literacy rates of both Ecuador and Indonesia were increasing and reached respectively, 94.5 percent and 95.4 percent in 2015. Hence, despite Ecuador's higher GDP per capita throughout recent history (i.e., since 1990), literacy rates have been higher in Indonesia, though only marginally (about one percent) currently, though by about 8 percent in 2009. On the other hand, in 1990, Ecuador had a considerably higher literacy

[2] This and the next paragraph is based on information provided by World Bank (2017).

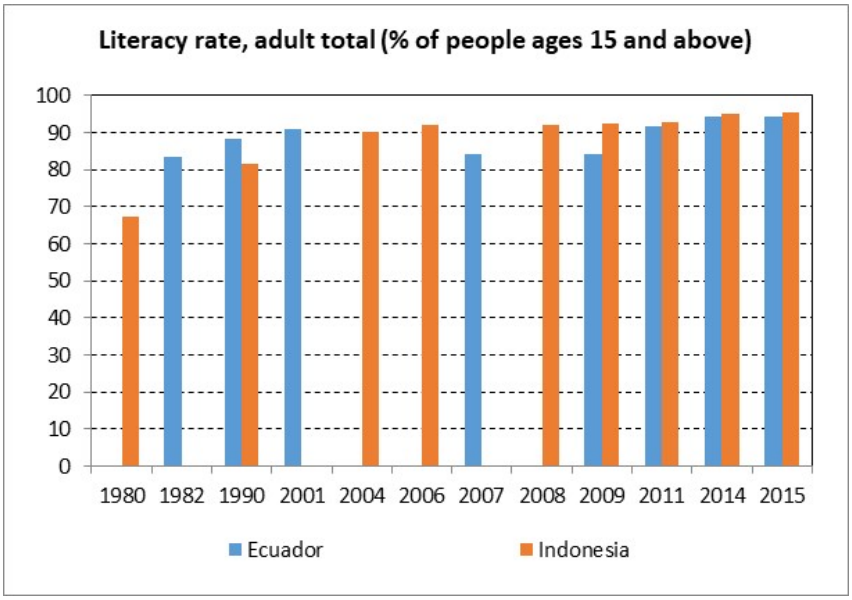
rate than Indonesia. In 2015, the gender gap in adult literacy was 1.9 percentage points in Ecuador, while it was 3.2 percentage points in Indonesia. In 2015, government spending on education was 4.9 percent of GDP for Ecuador and 3.6 percent of GDP for Indonesia, which is interesting as Ecuador still has lower literacy rates than Indonesia.

Figure 1: GDP per capita, PPP (constant 2011 international $) in Ecuador and Indonesia



Source: Created by author based on World Bank (2017).

Figure 2: Adult Literacy in Ecuador and Indonesia (all available years)

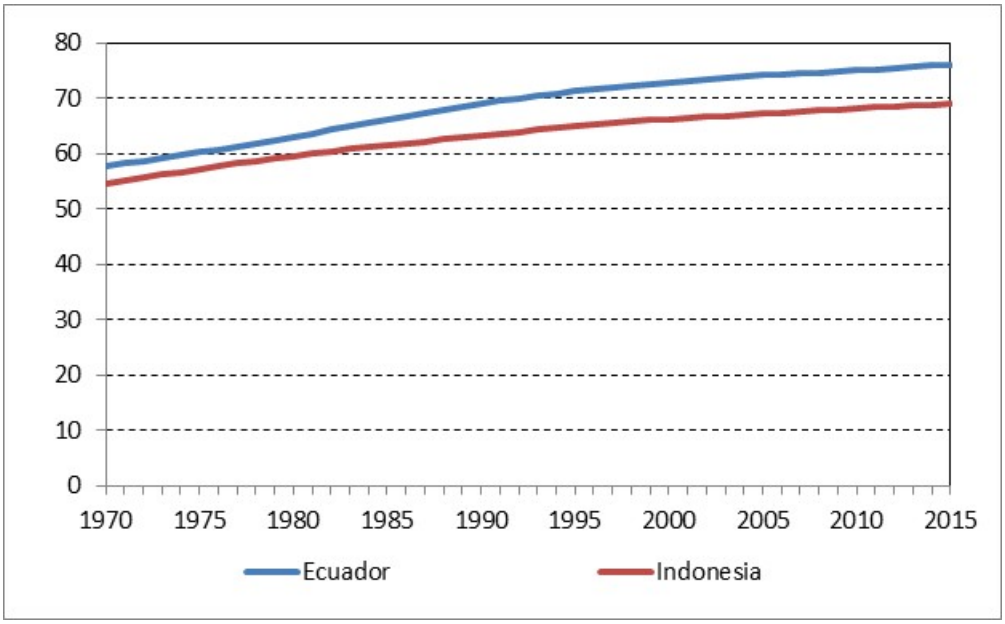


Source: Created by author based on World Bank (2017).

As shown in Figure 3, life expectancy has steadily increased for both countries. In 2015, it was 76 years for Ecuador and 69 years for Indonesia. In the same year, maternal mortality for Indonesia was relatively high at 126 deaths per 100,000 live births, while it was relatively low (64 deaths per

100,000 live births) in Ecuador. In 2015, Ecuador's population growth rate was 1.51 percent, while that of Indonesia was 1.21 percent. While both countries are currently experiencing rapid urbanization, 36 percent of Ecuador's population still lived in rural areas in 2015, while in Indonesia, the rural population accounted for 46 percent in the same year.

Figure 3: Life Expectancy (at birth, years) in Ecuador and Indonesia, 1070-2015



Source: Created by author based on World Bank (2017).

IV. Discussion

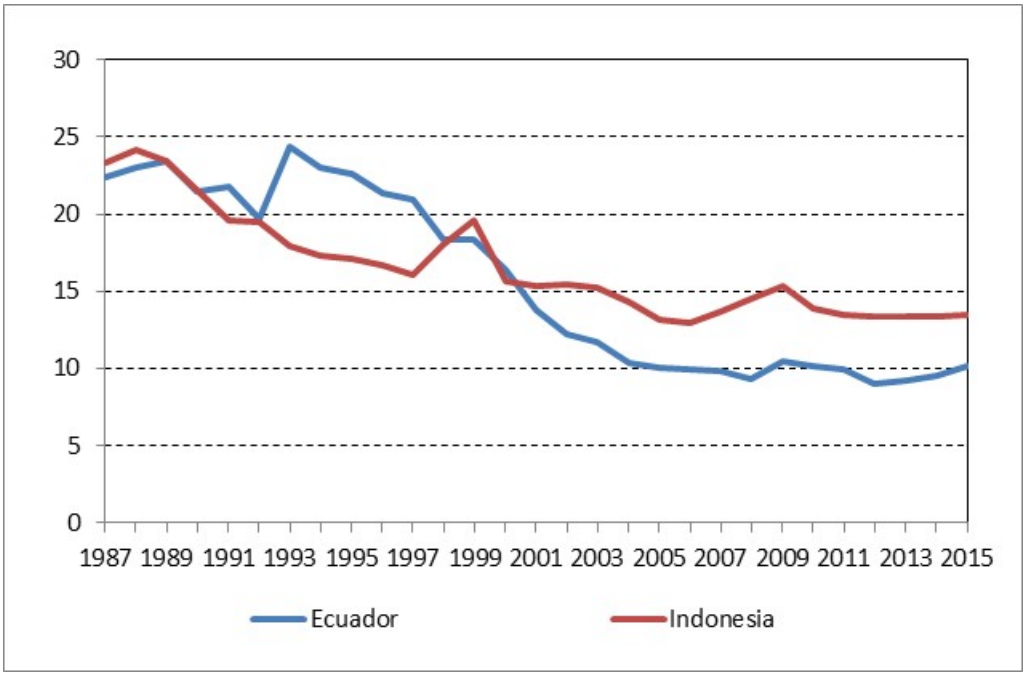
IV.1. Agriculture in Indonesia and Ecuador

Central to understanding Indonesia's agricultural development policies is knowing that Indonesia has been a transforming country since the 1970s and is projected to become urbanized soon. At this point, being a transforming country, means that although agriculture is no longer a main source of GDP growth, poverty remains to be mostly rural. As shown in Figure 4, the share of agriculture in GDP shows a clearly downward trend. In 2015, it accounted for 13.5 percent of GDP in 2015 (while industry accounted for 40.0 percent and services accounts for 46.5 percent of GDP).[3]

Even though 64 percent of Ecuador's population live now in cities, given that urban poverty is far lower than rural poverty, most of Ecuador's poor people (2.05 million) still live in rural areas (compared to the 1.66 million urban poor). Even though agriculture accounts currently (2015) for only 6.5 percent of GDP (industry makes up 33.8 percent and services make up 59.7 percent of GDP), agriculture is still the main source of livelihood for rural communities. [4]

[3] World Bank (2017).
[4] The data in this paragraph is based or calculated by author based on World Bank (2017).

Figure 4: Share of Agriculture in GDP in Ecuador and Indonesia, 1987-2015



Source: Created by author based on World Bank (2017).

In 2015, Indonesia accounted for 53.3 percent of world palm oil production.[5] It also is a major producer and exporter of rice, coffee, rubber, and cocoa. Rice provides the main source of income for small farmers, and employs 7.1 percent of the total workforce in the agricultural sector.[6] Agricultural productivity growth has been slow in Indonesia, however the Indonesian Government along with the World Banks has developed a rural development strategy which includes strengthening property rights to land and reducing soil degradation, among other things. Agricultural productivity has also increased from agricultural mechanization. Developing environmentally sustainable techniques is important to the issue of productivity growth.

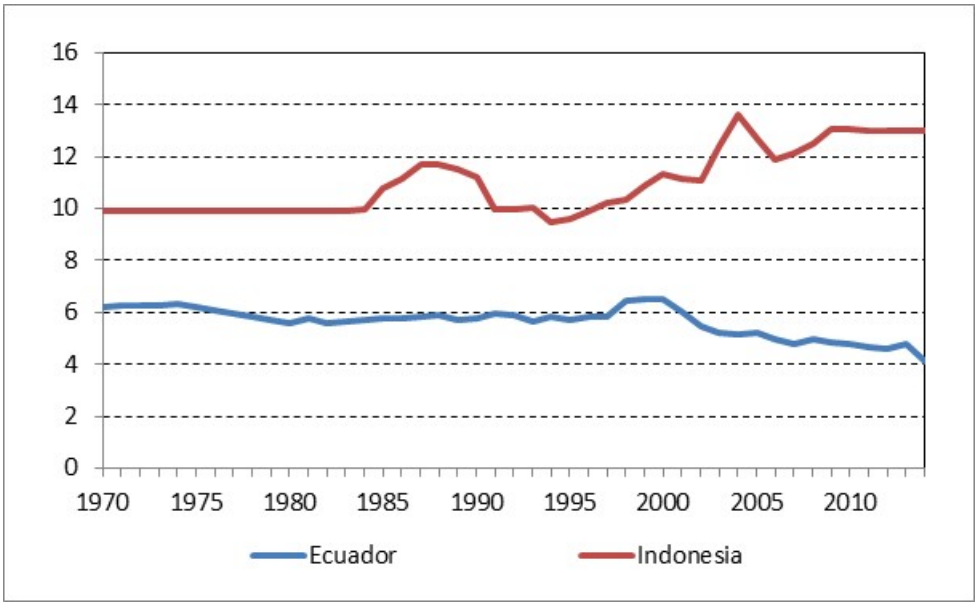
The large diversity of climates in different regions of Ecuador allow for cultivation of different agricultural goods. Large-scale production of cash crops exists in the coastal regions where coffee, palm oil, bananas, sugar, and rice are produced for export. Oil is Ecuador's largest export and main industry, accounting for 40 percent of exports. Ecuador's banana production is also important as Ecuador exports more bananas than any other country. Fishing and shrimp production in the coastal lowlands is also a main source of economic growth in Ecuador. Ecuador is the seventh largest producer of cacao, and around 90 percent of cacao is produced by smallholder farmers. Ecuador has the highest deforestation rates in Latin America and 50 percent of the land is affected by soil erosion.[7]

[5] https://www.slideshare.net/GreenPalmOil/2015-global-palm-oil-production-by-country.
[6] Barichello and Patunru (2009).
[7] This paragraph is based on information posted at: http://www.new-ag.info/en/country/profile.php?a=2741.

IV.2. Deforestation

Figure 5 shows the percent of land area in Ecuador and Indonesia that is capable of being plowed and used for crops. The graph shoes that in Ecuador this land is decreasing while in Indonesia it is still increasing (largely due to deforestation, which more than compensates for the arable land lost due to a variety of reasons, including salination). In Ecuador, the western two-thirds of the country does not have much land sustainable for agricultural production and most of the lands already being used for crop production are the ones that are most suitable. However, the majority Ecuador's increased crop production is from agricultural expansion into land that has limited agricultural potential, instead of increased agricultural productivity.

Figure 5: Arable Share (as percent of total land area) Ecuador and Indonesia, 1970-2014



Source: Created by author based on World Bank (2017).

Ninety-five percent of the coastal regions of Ecuador have already been deforested. The Ecuadorian Amazon is one of the most biodiverse areas in the world with thousands of species of plants and trees and hundreds of species of mammals and reptiles. According to a news report by the Green Commodities Programme (2017), more than 99 percent of the once forested land in the Ecuadorian Amazon is now used for agriculture, typically palm oil, coffee, or cocoa plantations. Deforestation of Ecuador's Amazon region began during the 1970s oil boom and increased with agricultural expansion and illegal logging. Deforestation of the Amazon was due to a lack of fertile land in the western two-thirds of Ecuador, causing agricultural colonization in the Oriente[8] and Amazon. Additionally, all of Ecuador's oil reserves are located in the Amazon.[9]

[8] The Oriente is a region of eastern Ecuador, comprising the eastern slopes of the Ecuadorian Andes and the lowland areas of rainforest in the Amazon basin.
[9] Goldman (2017).

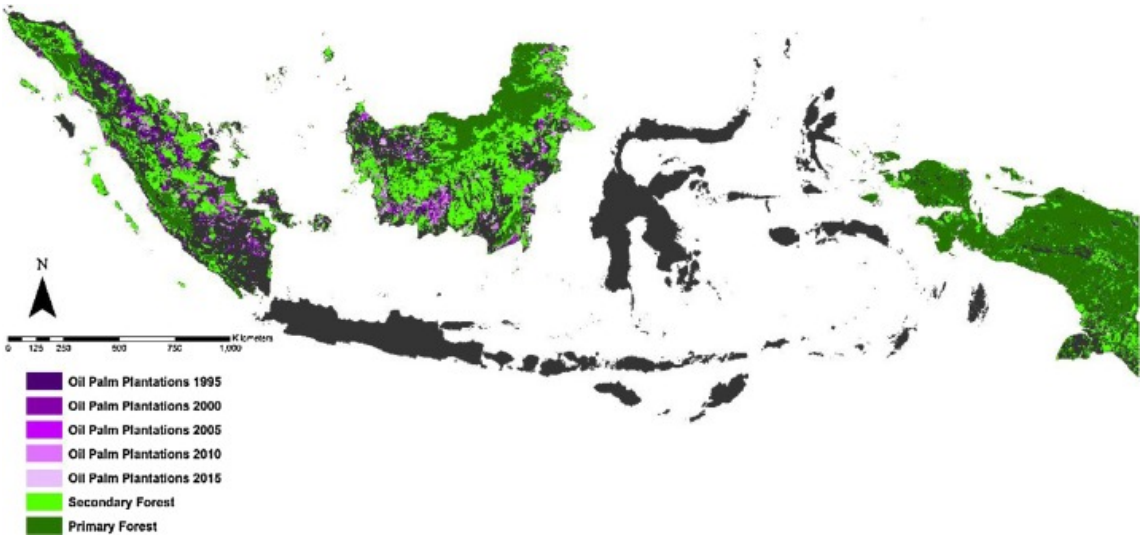
The government of Ecuador has plans to achieve a net zero deforestation by 2020 by providing financial incentives for conservation and recognizing the rights of indigenous people.[10] However, in 2016 they started extracting oil from Yasuni National Park. Yasuni is one of the most biodiverse ecosystems on the planet hosting a variety of species that are endemic to Ecuador, however it also is on top of 20 percent of Ecuador's untapped oil reserves.[11] Currently protected areas are underfunded and do not consult or involve local tribes in their policy negotiations. Many mining and oil companies go unchecked in their encroachment on indigenous land or protected areas.

Indonesia suffers from a very similar situation. Indonesia contains the world's third largest rainforest. With only 1 percent of the world's land area, it contains 10 percent of the earth's plant species, 12 percent of mammal species, and 17 percent of all known bird species. A third of all its native mammals are threatened. The Sumatran Tiger, the only surviving species of Indonesian tiger, is listed as endangered due to deforestation. Sumatran orangutans are listed as critically endangered by the International Union for Conservation of Nature (IUCN) red list,[12] as 60 percent of their forest habitat was lost between 1985 and 2007. The biggest threat to their habitat are oil palm plantations that cover hundreds of square kilometers. A spatial land-use plan ratified in 2013 by the government of the Aceh province allows Sumatran orangutan habitat to be converted to plantations.[13] Sumatran elephants have also become endangered due to loss of habitat and fragmentation by palm oil industries.

Indonesia as the world's largest producer of palm oil and produced 36,000,000 metric tons in 2016, a number that is growing rapidly.[14] The goal of the Indonesian Palm Oil Association is to produce 40 million tons per year by 2020.[15] The total area of palm oil plantations in Indonesia is around 11.9 million hectares and is expected to reach 13 million hectares by 2020.[16] Small farmers manage about a quarter of Indonesian palm oil plantations. Switching from other agricultural products such as coffee or cocoa to palm oil as it is in high international demand and is thus more profitable is common for small farmers. It is estimated that small farmers will manage around 60 percent of Indonesia's total oil palm plantations by 2030. Big private plantations produce over half of Indonesia's palm oil. In October of 2015, there were massive forest fires in Sumatra and Kalimantan, where all of Indonesian palm oil is produced, resulting from slash and burn clearing techniques that destroyed around 2.6 million hectares of land.[17]

[10] Green Commodities Programme (2017).
[11] https://www.rainforest-rescue.org/news/1462/scientists-identify-ecuador-s-yasuni-national-park-as-one-of-the-most-biodiverse-places-on-earth.
[12] https://www.iucn.org/theme/species/our-work/iucn-red-list-threatened-species.
[13] Kuhn (2015).
[14] https://www.worldatlas.com/articles/top-palm-oil-producing-countries-in-the-world.html.
[15] Indonesia Investment (2017).
[16] Indonesia Investment (2017).
[17] https://www.theguardian.com/sustainable-business/2015/nov/11/indonesia-forest-fires-explained-haze-palm-oil-timber-burning.

Figure 6: Oil Palm Plantations from 1995-2015



Source: Figure 1 of Austin, Mosnier, Pirker, Mccallum, Fritz, and Kasibhatla (2017), based on Government of Indonesia, Ministry of Environment and Forestry.

In 2016, Indonesian President Joko Widodo issued a five-year temporary stop on clearing land for new oil palm plantations, although the effectiveness of it has been dubious. Widodo wants to increase productivity of already existing oil palm plantations by reforestation and using more efficient farming techniques and technologies.[18] The Indonesia Sustainable Palm Oil System was adopted by the Indonesian Government and the Ministry of Agriculture to reduce greenhouse gas emissions and to focus on sustainable practices in palm oil production. However, many small farmers do not have the resources or the training to practice sustainable farming. Similarly, in Ecuador, smaller farmers are subject to higher interest rates than larger farmers and are last to sell their products to the government at a reasonable price. They are not willing to invest in conservation tactics.

In both Ecuador and Indonesia, land disputes with locals and lack of clarity regarding land ownership have worsened deforestation. Companies often buy local land for low prices and leave them landless and without resources on which local communities depend. Indigenous communities are often not recognized as owning the land they live on. Hence, there is no protection of those lands or the livelihoods of indigenous communities. The Indonesian government also allows transfer of public forests to private lands which results in clearing for agricultural production and plantations.[19]

IV.3. Soil Degradation

Almost 50 percent of Ecuador is susceptible to erosion and desertification affects much of the Western side of the country.[20] Soil erosion decreases land productivity, and small-scale farming in the Andean region has been a main cause of this degradation. Under Ecuador's Land Reform

[18] Indonesia Investment (2017).
[19] Fay, Sirait and Kusworo (2000).
[20] http://www.new-ag.info/en/country/profile.php?a=2741.

Law, these rocky lands are considered idle and can be agriculturally colonized. Small farmers are not inclined to practice sustainable farming techniques and instead abandon their crop land when it has become unusable, and colonize other land for agriculture. Abandoned land is common in the Sierra agricultural region as soil has become almost totally degraded.[21] The Andes Mountains are the region with the most soil degradation (with 70 percent affected by soil erosion). [22] The main type of cultivation in these area is corn.

Similar to Ecuador, Indonesian small farmers without incentive or access to technologies for sustainable farming degrade soil and then simply clear a new forest for agriculture land. Both increased flooding and decline in agricultural production as well as contamination of local water supplies are results of soil erosion from deforestation. In order to maintain productivity, agroforestry is encouraged to rehabilitate degraded lands. Several different agroforestry systems have been established and practiced for a long time in local communities in Indonesia, specifically in the eastern dry areas. Small farmers are often hesitant to adopt sustainable agricultural practices due to risk of failure, cost, and lack of education. However, land degradation keeps communities poor and malnourished with low agricultural productivity. Dry climate in eastern Indonesia also contribute to soil degradation, however it is worsened by over exploitation of the land.

IV.4. Wetlands

Indonesia has 23 percent of all mangrove ecosystems in the world and they are the most carbon-dense forests in the tropics. Indonesia has the fastest rate of mangrove destruction in the world, accounting for 6 percent of the total annual forest lost despite making up less than 2 percent of the country's total forest area.[23] Mangroves are converted into shrimp ponds in Sumatra or agricultural land in Java. Mangroves provide both food and income to local communities and their water supplies are also affected by oil spills and pollution of mangroves. Similarly, Indonesian carbon rich Peatlands, the largest in the world, are being destroyed to make way for industrial palm oil and timber plantations. Recent efforts at restoration, such as the 2016 Peatland Restoration Agency aimed at restoring 2 million hectares in five years, have been mostly ineffective due to lack of enforcement of laws and outdated, poor quality peatland maps that do not allow for management and conservation.[24]

Ecuador is the world's third largest producer of whiteleg shrimp which are produced in large ponds in the coastal mangroves, specifically the regions of Guaya, El Oro, Manabi, and Esmeraldas.[25] Estimates of mangrove loss range from 20 percent to 50 percent of the coastline. The loss of both ecological services and everyday livelihood services of mangroves is detrimental to local communities. Wood is used to build houses as well as for fuel, and some plants are cut down because they have medicinal value. A lack of secure property rights in much of the coast of Ecuador allows for unrestricted access and resource depletion.

IV.5. Sustainable Initiatives

According to the Agriculture Sustainability Institute (2018) at the University of California at Davis: "Practitioners of sustainable agriculture seek to integrate three main objectives into their

[21] Barrowclough et al. (2016).
[22] http://www.new-ag.info/en/country/profile.php?a=2741.
[23] Center for International Forestry Research (2015).
[24] Seymour and Samadhi (2018).
[25] Vega and Beillard (2015).

work: a healthy environment, economic profitability, and social and economic equity." Ecuador's government has been hesitant to adopt sustainable measures due to how dependent their economy is on oil production, and small farmers have also been hesitant due to a lack of education and no support from the government. National conservation programs to protect forests have fallen off due to lack of government funding, and the Ministry of the Environment cannot actively enforce deforestation laws and stop unsustainable and illegal practices such as slash and burn from occurring. The key to increasing agricultural productivity in Ecuador without agricultural expansion by deforestation is the introduction of higher yielding crop varieties and encouraging small farmers to adopt agricultural technologies.

Indonesian rehabilitation and conservation policies have cited the rural poor living in and around these forests as key actors in sustainable agricultural development that would also help them move out of poverty. Empowering these local communities has been the approach of government and non-government organizations in Indonesia. The focus has largely been on market-based conservation strategies, including incentives to get companies to become sustainably certified. Pressure has pushed companies in Indonesia to commit to zero-deforestation, however there is often inadequate support and oversight to enforce zero-deforestation production. One Indonesian NGO called Sawit Watch is promoting increased productivity of home gardens and alternative crops to diminish local's dependency on palm oil. Producing rubber has also become an alternative for local communities because it is less labor-intensive and its price is not dominated by large companies.[26]

V. Conclusion

There is a clear link to rural poverty and unsustainable agricultural practices. The poorest areas of Ecuador are the areas that depend largely on agriculture, specifically indigenous people in the Amazon region and rural highlands. In Indonesia, the poorest regions are in Java and Sumatra, which is where the majority of mangrove deforestation and oil palm production occurs. It is no surprise that the people living in these rural areas also suffer from high rates of malnutrition. Although migrating to urban areas may seem like the only solution out of unemployment and poverty, if these governments invested more in small farmers and encouraged sustainable agricultural practices it would alleviate their poverty. Agriculture is important to rural communities not only as a source of income but also as a way to eat and produce for themselves.

To governments, commodity values of exports are often seen as more important than the value of ecological services. The rainforests and mangroves of Indonesia and Ecuador offer natural services such as protection from soil erosion, water sanitation, medicinal plants, and rich soil that is important in aiding against climate change. Their destruction and the loss of hundreds of species endemic to these areas cannot be undone. Although Indonesia plans to cut carbon emissions by 29 percent by 2030, previous failed initiatives have shown that the government has no interest in curbing palm oil production as their economy is so dependent on it. Similarly, in Ecuador, a new fervor for protecting Ecuador's biodiversity seems not as important as the wealth that comes from oil exports. Ecotourism is a more environmentally conscious and still highly profitable venture for both Indonesia and Ecuador, however it is unlikely that either government will stop production of their most profitable industries.

[26] This paragraph is based on Friends of the Earth, LifeMosaic and Sawit Watch (2008).

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