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Indonesia: A Vulnerable Country in the Face of Climate Change

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Abstract

This article reviews the causes of Indonesia's high greenhouse gas releases, the impacts climate change has on the country, and the effects of climate change. It shows that deforestation, forest fires and the degradation of peat land have been the main causes for Indonesia being the world's third largest emitter of greenhouse gases. It summarizes some of the main impacts climate change has in Indonesia, which include, but are not limited to: temperature increase, intense rainfall, sea level rise, and a threat to food security. It examines the effects climate change has on (i) Indonesia's economy and poor people, (ii) human health, and (iii) Indonesia's environment and biodiversity.

I. Introduction

Climate change in Indonesia is receiving a lot of attention as the country is the world's third largest emitter of greenhouse gases, which are the root causes of the current global climate change. While Indonesia is opulently endowed with lush natural resources, the environmental degradation is continuing at a fast rate, and unlike in most industrialized countries, Indonesia's greenhouse gas emissions are mostly the result of forest fires and environmental degradation. As a country extremely vulnerable to climate change, Indonesia must adapt to these various environmental pressures. Indonesia has also become a frontrunner in the international limelight due to the country's eagerness to reduce greenhouse emissions by roughly 26 percent (World Bank, 2010).

Climate change in Indonesia not only has implications for the country's environment, it also immensely affects its people and development. Indonesia's economy has been growing at a fast pace over the last two decades due to good economic policy and political stability (see Ministry of Environment, Republic of Indonesia, 1999). However, climate change makes the task of development for poor countries an even harder challenge. The shocks of climate change are already harshly felt in Indonesia, with additional droughts,

heat waves, and floods. Hence, if these effects continue to increase in Indonesia, it will pose as an even greater threat to the country's development challenge.

Climate change in Indonesia has also gotten the world's attention when the Government of Indonesia hosted the United Nations Climate Change Conference in Bali in December 2007. The Conference gathered some 10,000 participants to discuss solutions to Indonesia's as well as global climate change concerns. The conference culminated in the adoption of the Bali Road Map, a variety of decisions and programs that will reach toward a safer climate future. [1]

The remainder of this article is structured as follows. The next section provides a brief literature review, summarizing the main country-specific publications on this topic, while the third section will present some empirical background. The fourth, fifth, and sixth sections discuss, respectively, the causes of Indonesia's high greenhouse gas releases, the impacts climate change has on the country, and the effects climate change has on Indonesia's economy, human health, and the environment. The last section provides some conclusions.

II. Brief Literature Review

Due to Indonesia's standing as the world's third largest emitter of green house gases, there has been an abundance of studies and reports concerning the current status and policies of climate change in Indonesia. The research includes the causes of Indonesia's high release of green house gases and the effects these emissions have on the nation's social and economic development.

There are various news articles that cover the effects that climate change has in Indonesia, such as the increase of natural disasters in the country. One of the more recent such reports has been posted by the Integrated Regional Information Networks (IRIN) in October 2009, stating that there has been an increase in the number and severity of disasters occurring in Indonesia. The news article reports specifically of more intense typhoons, droughts, forest fires, and floods that will take place in Indonesia due to climate change. Another article by Williamson (2007), posted at the BBC News website, explains how the poor population in Indonesia is uneducated about climate change. The farmers who tend the rice fields are currently confused about the irregularity of the harvests. Parto, a Java rice field farmer, states that "The harvests have become irregular (...) normally we harvest two to three times a year, but it depends on the weather. We need to wait for the right conditions, but now that's become unpredictable."[2] A local woman said that the people in Indonesia who are tending the rice farms do not talk about climate change.

The World Bank has provided numerous summaries and reports on the status and implications of climate change in Indonesia. These reports explain why Indonesia's emission of greenhouse gases is so high and the impacts the increasing emissions have in Indonesia. Sari, Maulidya, Butarbutar, Sari and Rusmantoro (2007) provide an overview of the background and key climate change issues facing the country. They also include

[1] See http://unfccc.int/meetings/cop_13/items/4049txt.php for further details and reports.
[2] Williamson, Lucy (2007).

some analysis on the effects of climate change on the country's future development. The World Bank (2009) report details Indonesia's rising policy and priorities that will help the country mitigate climate change. The 2009 report, entitled "Mainstreaming Climate Change for Sustainability", summarizes Indonesia's key climate change concerns, including more intense rainfall and a rise in sea level. The report outlines various aspects of life influenced in Indonesia by climate change, such as food security, water resources, health, farming life, and forest and marine biodiversity. The report also explains the implications that climate change will have on Indonesia's economic growth as deforestation will decrease the country's potential for development.

Along with various studies discussing the causes and effects of Indonesia's high release of greenhouse gases, there is also an abundance of articles concerning the suggested solutions and programs that will help the vulnerable country combat climate change. There is also literature on sector-specific programs that will aid in combating Indonesia's increase in greenhouse gas emissions. For example, the United States Agency for International Development (USAID, 2008) has proposed various solutions to the climate change issues in the country, such as a sustainable forest and biodiversity management and reducing energy emissions. Most of these suggestions are not new. For example, the report of the Indonesian Ministry of Environment (1999) covered the efforts of the United Nations Framework Convention on Climate Change (UNFCCC) to aid Indonesia with its main climate change concerns. The report includes a detailed outline of the general programmatic and policy steps that must be taken by the Government of Indonesia to combat the issue of climate change. The report also discussed goals that must be accomplished in each of the following areas: energy, transportation, forestry, agriculture, waste, coastal resources, public health, and international cooperation.

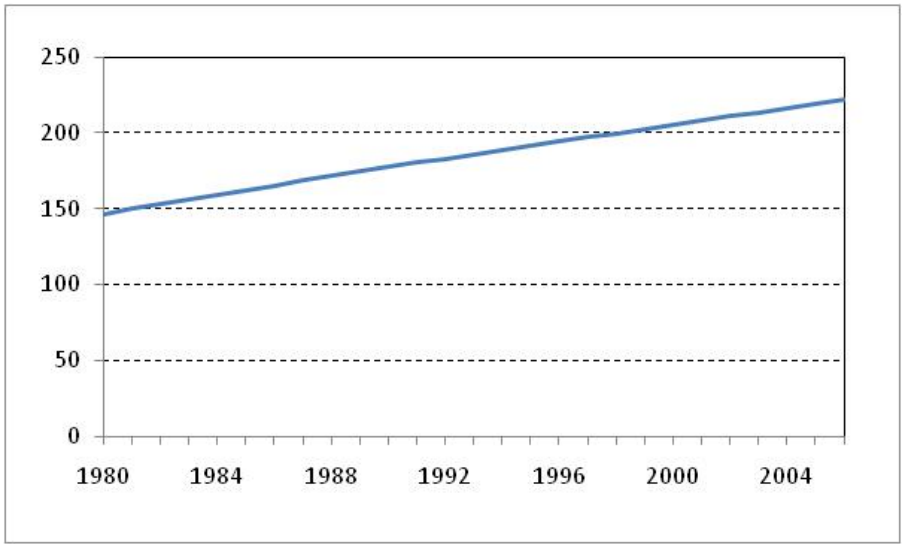
III. Empirical Background

Indonesia is the world's largest archipelago, consisting of 17,000 islands and spanning across two biogeographic regions – the Indolalayan and Australasian (World Bank, 2010). Indonesia is home to the world's richest biological diversity of plant and animal life on the entire planet (USAID, 2008). The country has the highest marine diversity in the world, and the second largest area of rainforest (USAID, 2008). However, along with the rich array of biological assortment in Indonesia, the country's emission of greenhouse gases is also severely increasing (USAID, 2008).

Figure 1 depicts the increasing population in Indonesia, growing from slightly less than 150 million in 1980 to over 220 million in 2006, while Figure 2 shows Indonesia's deforestation. In 1990, Indonesia's forest covered close to 65 percent of the total land area. By 2006, forests covered only 48 percent of the total land area. The charts provide the background for Indonesia's growing pressures of population demands, which combined with insufficient environmental management, pose problems for both Indonesia's people and economy. For example, air pollution has cost the Indonesian economy approximately $400 million per year (World Bank, 2010). Due to the fact that the poor of Indonesia are more vulnerable, they are more affected by these costs. Thus, climate change is not only a

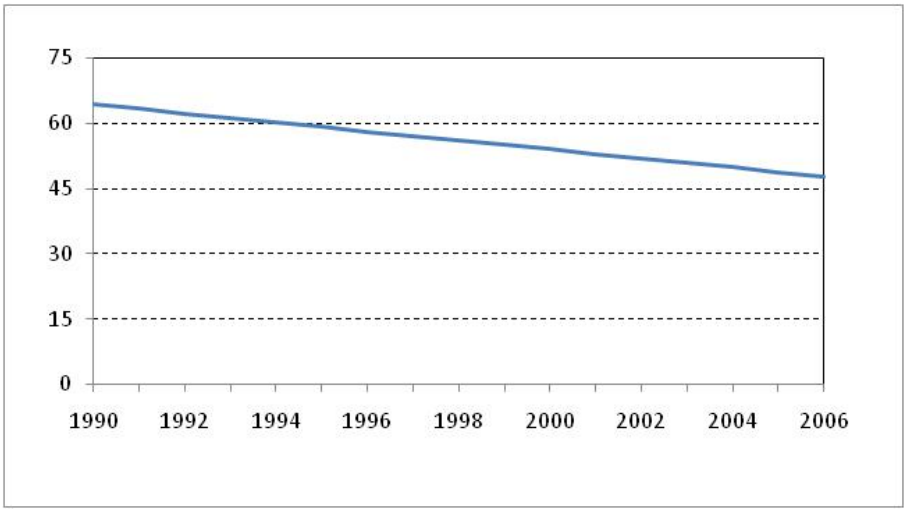
threat to environmental issues in Indonesia, but it also greatly impacts the country's development, especially for the poor population present in the country.

Figure 1: Evolution of Indonesian Population (in millions), 1980-2006



Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom.

Figure 2: Indonesia's deforestation (forests as percent of total land area), 1990-2006

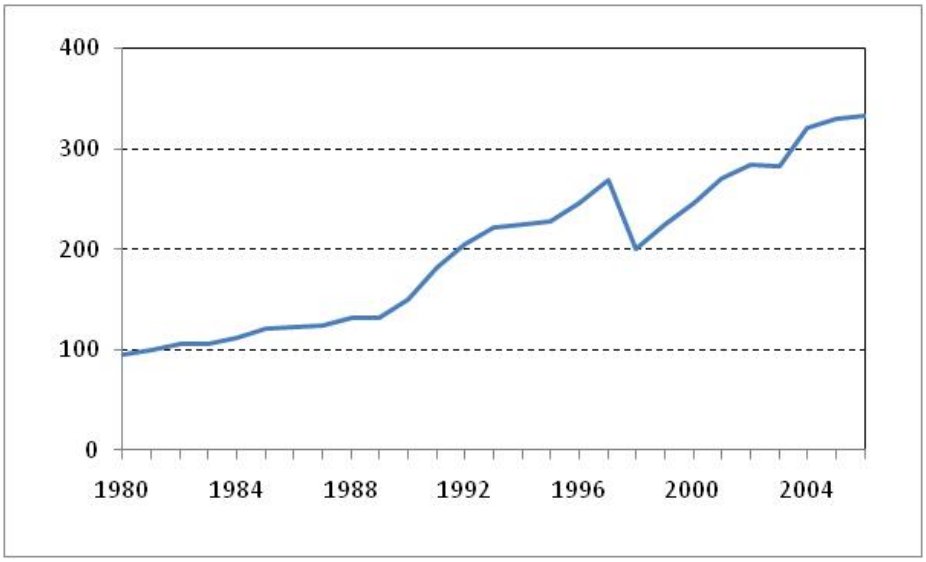


Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom.

The next three figures show Indonesia's CO_2 emissions from 1980-2006, respectively in millions of metric tons, in metric tons per capita, and in kg per 2000 US$ of GDP. Figure 3 shows that Indonesia's CO_2 emissions have increased drastically from 95 million metric tons in 1980 to about 330 million metric tons in 2006. As Figures 4 shows, Indonesia's

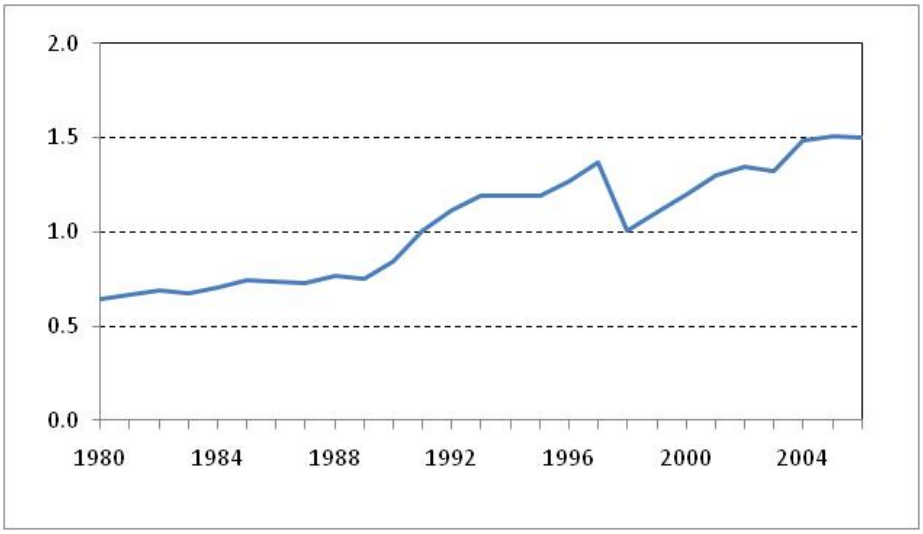
CO_2 emissions have typically grown faster than Indonesia's population, though there seems to have been some stabilization in per capita CO_2 emissions since 2004. Finally, Figure 5 shows that CO_2 emissions per unit of GDP (measured in constant US$ of year 2000) have overall remained stable, despite some ups and downs in some specific years.

Figure 3: Indonesia's CO_2 Emissions (millions of metric tons) from 1980-2006



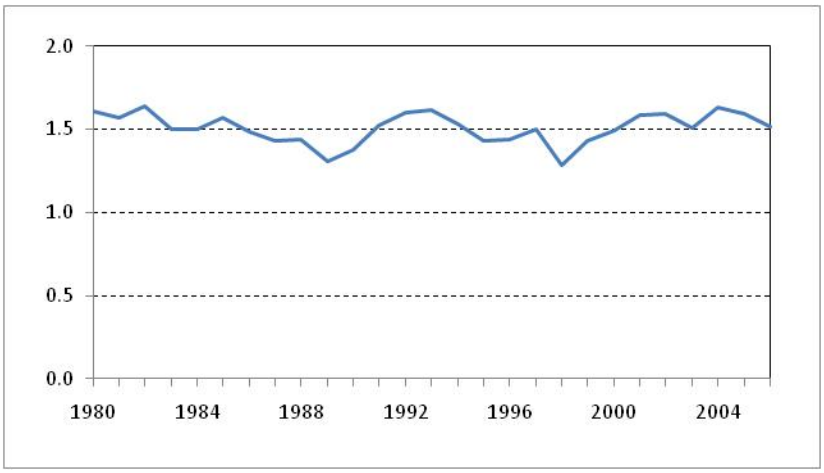
Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom, updated with the latest information available on the World Bank data website as of May 2010.

Figure 4: Indonesia's CO_2 Emissions (metric tons per capita) from 1980-2006



Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom, updated with the latest information available on the World Bank data website as of May 2010.

Figure 5: Indonesia's CO_2 Emissions (kg per 2000 US$ of GDP) from 1980-2006



Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom, updated with the latest information available on the World Bank data website as of May 2010.

IV. Causes for Indonesia's High Greenhouse Gas (GHG) Emissions

According to the World Bank (2010), deforestation, forest fires, and degradation of peat land have placed Indonesia as the world's third largest emitter of greenhouse gases. The emissions resulting from forest fires and degradation are five times greater than those ensuing from non-forestry emissions. According to Sari, Maulidya, Butarbutar, Sari and Rusmantoro (2007), the yearly emissions from Indonesia in agriculture, waste, and energy total approximately 451 million tons of carbon dioxide.

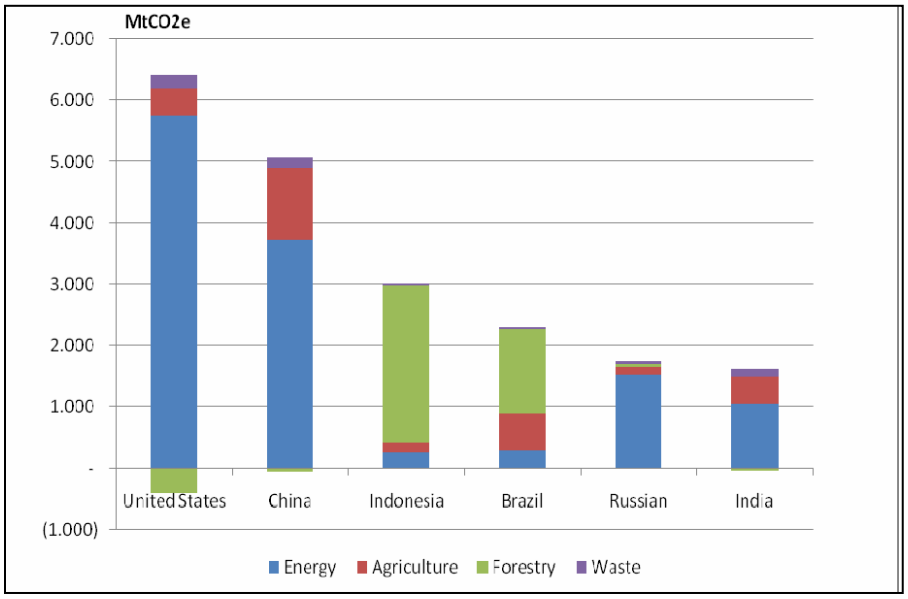
In 1994, the main sources of CO_2 emissions in Indonesia were from the forestry and energy sectors, which contributed for about 98 percent of the total CO_2 emissions for that year. The forestry sector's CO_2 emissions resulted primarily from the burning of biomass during grassland and forest conversion activities (Ministry of Environment, Republic of Indonesia (1999). The following table and figure show the sources of emission for Indonesia and other countries for year 2003.

Table 1: GHG Emissions of Selected Countries by Source (in Mt CO_2e)

Emission Sources	United States	China	Indonesia	Brazil	Russia	India
Energy	5,752	3,720	275	303	1,527	1,051
Agriculture	442	1,171	141	598	118	442
Forestry	-403	-47	2,563	1,372	54	-40
Waste	213	174	35	43	46	124
Total	**6,005**	**5,017**	**3,014**	**2,316**	**1,745**	**1,577**

Source: Sari, Maulidya, Butarbutar, Sari and Rusmantoro (2007), Table 1, p. 2.

Figure 6: GHG Emissions of Selected Countries by Source (in Mt CO_2e)



Source: Sari, Maulidya, Butarbutar, Sari and Rusmantoro (2007), Figure 1, p. 2.

As Table 1 and Figure 6 illustrate, Indonesia is the world's third greatest emitter of greenhouse gases. The table and figure also depict that the main contributor to Indonesia's high release of greenhouse gases is due to forestry. Forestry accounts for approximately 2,563 million tons (Mt) of CO_2-equivlent green house gases (CO_2e), the highest in the world coming from forestry. Indonesia contains a multitude of vast forested areas, and approximately 24 billion tons of carbon stock (BtC) are stored in the vegetation and soil, and 80 percent of this is stored in forests (World Bank, 2007). The conversion of land and deforestation, which the World Bank estimates at around 2 million hectares per year, results in the emission of a significant amount of Indonesia's carbon reservoir (World Bank, 2007). The deforestation emissions from the so-called Land Use, Land-Use Change and Forestry (LULUCF) sector account for about 83 percent of the yearly releases of greenhouse gases in Indonesia, and approximately 34 percent of global LULUCF emissions (World Bank, 2007).

Within the forestry sector, the largest amount of carbon dioxide emissions arise from deforestation and land conversion, which account for 75 percent. Forest-related energy consumption accounts for 23 percent of carbon dioxide emissions, and the remaining 2 percent occurs from forest-related industrial processes. The main cause of the high emission from deforestation and land conversion are forest fires, which account for 57 percent of the total emissions. For example, in 1997 it was estimated that forest fires caused the emission of between 3,000 and 9,000 Mt CO_2e into the atmosphere. The likely cause of this vicious cycle of the drying up of peat swamps and rainforest is global warming, thus increasing the risk of more intense forest fires (see Sari, Maulidya, Butarbutar, Sari and Rusmantoro, 2007).

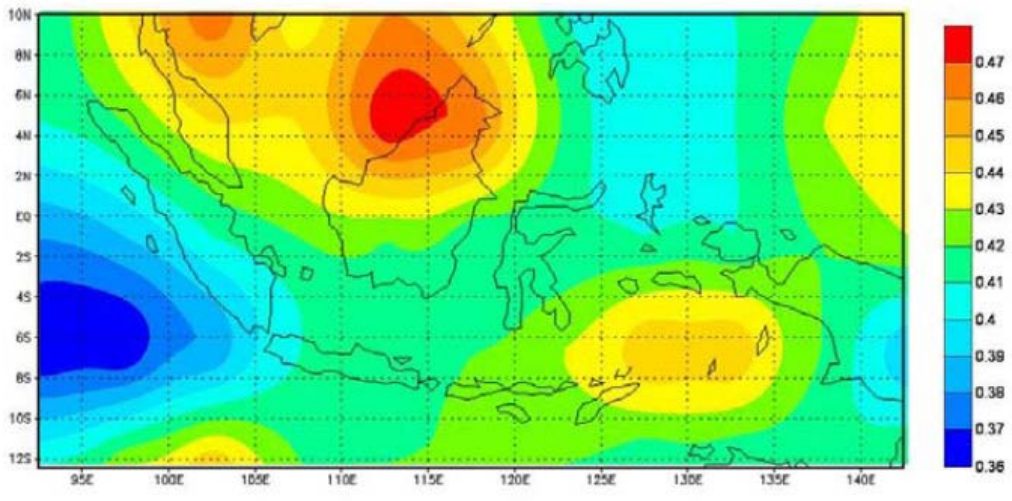
The key issues that contribute to Indonesia's deforestation include the following: weak political accountability; policies favoring large-scale commercial businesses over small and medium size; distorted incentives for timber transport and prices; ineffective legal foundation for protecting the poor land-users; the undervaluation of forest assets; and corruption (World Bank, 2007). These underlying issues impact the landscape of Indonesia, thus contributing to the country's high greenhouse gas emissions.

Even though the emissions from the energy sector in Indonesia are small, they are growing at a rapid pace. The current emissions from the energy sector accounted for 9 percent of Indonesia's total emissions. As a result of economic growth and industrialization, the emissions from industry, transport, and power generation are also increasing. It is expected that these emissions will continue to grow and actually triple in the next few years, increasing from 275 Mt CO_2e in 2003 to approximately 716 Mt CO_2e in 2030.

V. Impacts of Climate Change

Due to the rise of the greenhouse gas emissions in Indonesia, the impacts of climate change will be heavily felt by the country. The influence of observed climate changes is already an event in Indonesia, and the impacts will continue to worsen due to further human-caused climate change (Case, Ardiansyah and Spector, 2007, p. 5). The impacts of climate change in Indonesia include, but are not limited to: temperature increase, intense rainfall, a rise in sea-level, and a threat to food security. The increase in GHG emissions will also continue to affect the "natural" climate variability, thus leading to more intense weather events (Case, Ardiansyah and Spector, 2007, p. 8).

Figure 7: Projected Change of Mean Temperature in 2020

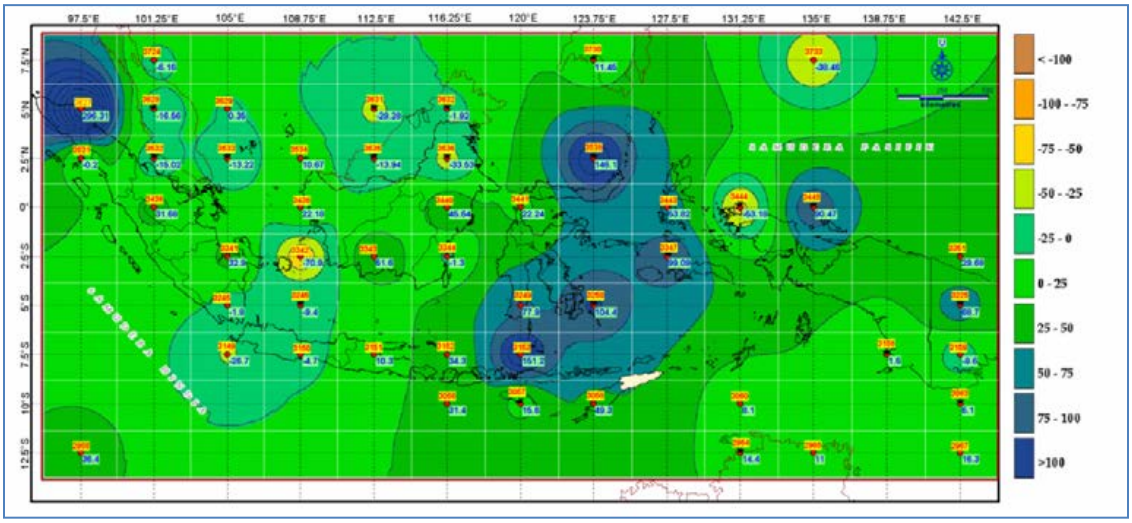


Source: Sari, Maulidya, Butarbutar, Sari and Rusmantoro (2007), Figure 2, p. 4 (referring to a study by Susandi, 2007).

As a result of climate change, Indonesia will experience a modest temperature increase. Since 1990, the annual mean temperature in Indonesia has increased around 0.3 degrees Celsius, and has occurred during all of the yearly seasons. In the year 2020, it is expected that the mean temperature in Indonesia will have increased by 0.36 to 0.47 degrees Celsius, with the highest temperatures increase projected to occur in the Kalimantan islands and the Moluccas; see Figure 7 above.

Indonesia will also experience more intense rainfall due to the impact of climate change. Climate change is predicted to result in about 2 percent to 3 percent more rainfall in Indonesia each year (see Sari, Maulidya, Butarbutar, Sari and Rusmantoro, 2007). As Figure 8 illustrates, the entire country will experience more rainfall with a considerably large change in the Moluccas. The amplified rainfall is expected to persist and result in a shorter rainy season, with a substantial increase in the risk of floods. For example, the Jakarta flood in February 2007 affected 80 districts and caused traffic chaos paralyzing the affected cities. In the flood more than 70,000 houses had water levels ranging from 5-10 cm, and an estimated 420,000 to 440,000 people were displaced from their homes (Case, Ardiansyah and Spector, 2007, pp. 4-5).

Figure 8: The Average Change of Precipitation Pattern 1900-2000
(for September-November, in mm/100 years)



Source: Sari, Maulidya, Butarbutar, Sari and Rusmantoro (2007), Figure 3, p. 5 (referring to a study by Ratag, 2007).

Climate change will also increase the average sea level as a result of the increased volume of warmer water and the melting of polar ice caps. The mean sea level in the Jakarta Bay will rise as much as 0.57 centimeters (cm) annually and the land surface will decline as high as 0.8 cm per year. In Indonesia, the combination of rising sea-levels and land

subsidence will move the coastline inland, which will cause an increase risk of flooding.[3] A study published in 2007 by Indonesia's Institute for Technology in Bandung (referred to in ADB, 2009), illustrated that with a sea level rise of 0.25, 0.57, and 1.00 cm per year, the total area of north Jakarta that will be affected by inundation in the year 2050 would be about 40, 45, and 90 square km (ADB, 2009). If land subsidence continues these sea risings are expected to increase further.

Even a moderate sea-level rise will conclude in significant socio-economic and physical impacts because much of Indonesia's population, infrastructure, and fertile agricultural lands are located in low-lying coastal areas.[4] Approximately 60 percent of Indonesians live in low-lying coastal cities such as Jakarta and Surabaya, and thus these people will strongly be impacted by the sea level rise. The sea-level rise, along with the observed sinking in the Jakarta Bay region, will have massive influences on infrastructure and businesses (Case, Ardiansyah and Spector, 2007, p. 3).

The rise will also reduce coastal livelihoods and farming. The sea-level rise will most likely affect the production of both fish and prawn, with an estimated loss of over 7,000 tons, worth over 0.5 million US dollars, in the Krawang and Subang districts. The Citarum Basin is also expected to experience a loss of 15,000 tons of fish, shrimp, and prawns yield. The overall effect of this sea-level rise will result in the reduction of potential average income. For example, it is predicted that in the Subang region alone, 43,000 farm laborers will lose their jobs. Also, more than 81,000 farmers will have to seek other sources of income due to the flooding of farms from rising sea-levels (Sari, Maulidya, Butarbutar, Sari and Rusmantoro, 2007).

Climate change will also pose a threat to food security in Indonesia. One of the major concerns for Indonesia is the risk of a reduced food security due to climate change. Climate change will affect evaporation, precipitation, and run-off soil moisture and water, hence affecting agriculture and food security. As previously discussed, the sea-level rise will also cause the flooding of more rice and fish farms, thus affecting farmers' food production. For example, the 1997 El Nino droughts affected approximately 426,000 hectares of rice. A model that simulated the impacts of climate change on crops at the Goddard Institute of Space Studies in the United Kingdom depicted a decrease of crop harvest in East and West Java. Along with these effects, climate change will also lower soil fertility by 2 to 8 percent, which will result in the estimated decrease of rice yields by 4 percent per year and maize by 50 percent per year (Sari, Maulidya, Butarbutar, Sari and Rusmantoro, 2007).

VI. Effects of Climate Change on Indonesia

Climate change in Indonesia greatly affects many aspects of the country, including Indonesia's economy, poor population, human health, and the environment. Indonesia has been identified as one of the most vulnerable Asian countries in the face of climate change. Vulnerability studies have illustrated that the economically productive areas of Bali, Java, Sumatra, and Papua are particularly vulnerable to the effects of climate change (World

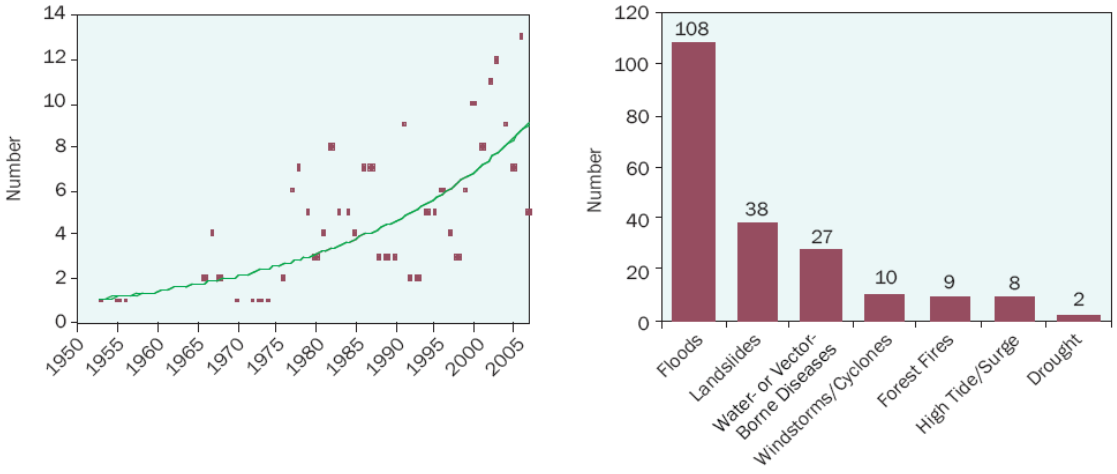
[3] ADB (2009).
[4] Case, Ardiansyah, Spector (2007), p. 5.

Bank, 2009). The poor communities that live on the coast and those dependent on agriculture will greatly be affected by droughts, sea-level-rises, floods, and landslides (World Bank, 2010). Despite these hazards, the annual benefit of adopting measures to combat climate change is likely to exceed its expected costs by the year 2050 (World Bank, 2010). Thus, adopting methods and policies to mitigate climate change now will promote the potential development of Indonesia and help to preserve the country's rich biodiversity.

VI.1. Effects on the Economy and the Poor

Even though the Indonesian economy has grown rapidly during the last two decades, with GDP growth averaging over 7 percent annually (Ministry of Environment, Republic of Indonesia (1999), if climate change is not adequately addressed it will have severe consequences on economic development and the reduction of poverty (Asian Development Bank (ADB), 2009). The ADB predicted that climate change will cost Indonesia approximately between 2.5 percent and 7 percent of GDP by the end of this century (World Bank, 2009). The greatest impacts of climate change will be experienced by the poorest people in the country, especially those who live in areas vulnerable to flooding, landslides, and drought. Figure 9 below depicts the various climate-related disasters by their type that have occurred in Indonesia from 1950 to 2005.

Figure 9: Number of Climate-Related Hazard Occurrences in Indonesia (1950-2005)



Source: Asian Development Bank (ADB) (2009), Figure 3.4, p. 29 (referring to a study by Boer and Perdinan, 2008).

As the graph illustrates, Indonesia has experienced an affluent amount of floods, mostly due to climate change. The poor population in Indonesia is going to be the hardest hit by climate disasters. The poor lack the assets and flexibility to handle the impacts that climate change have on productivity and the devastations caused by natural disasters and extreme weather conditions. As it was discussed earlier, climate change will increase the rise in the sea-level, which will increase floods and simultaneously affect those people who are

dependent on agriculture and fisheries. Climate change and the induced sea-level rise are going to drastically effect the agricultural sector in Indonesia, and in turn those poor dependent on the sector (ADB, 2009). Climate change brings about the loss of arable lands due to the advancing of sea level, and poor people lack the ability and the means to find other land in order to continue production.

VI.2. Human Health

Human health in Indonesia will be both directly affected by climate change, through deaths from floods and other disasters, and also indirectly affected due to increased infections and diseases. The more frequent prolonged heat waves, extreme weather, floods, and droughts caused by climate change will also lead to increased injury, sickness, and mortality (Case, Ardiansyah and Spector, 2007, p. 9). The direct affects – higher temperatures, sea-level rising, and frequent floods and heat waves – will lead to more injury and deaths.

The indirect effects of climate change include more widespread and extensive vector-borne diseases, such as malaria and dengue. Climate change will also lead to an expansion of water-borne diseases, such as diarrhea, infectious diseases, and poor nutrition due to a disruption in food production. This increase in infections and disease is linked to the threat to food security previously discussed in the section concerning the impacts of climate change on Indonesia. For example, if more and more people become sick, they will not be able to continue working on the rice and fish farms, and thus food production will decrease (see Case, Ardiansyah and Spector, 2007, p. 9).

Many people in Indonesia will also experience enlarged respiratory effects as a result of increased burning and air pollution. Numerous studies have also observed the association between climate-related factors – severe floods, droughts, and warming temperatures – with diarrheal diseases such as malaria, hepatitis, cholera, and dengue fever (Case, Ardiansyah and Spector, 2007). The rise in sea levels, precipitation changes, and increased flooding may also degrade the quality of freshwater and potentially contaminate drinking water. Thus, water-borne disease will become more common in the region.

Once again, the poor in Indonesia are going to be the most impacted by the threat to human health posed by climate change. Many of the region's poor live in coastal areas, and most of the small farmers and fisherman are too poor to acquire access to sufficient health services. Thus, the poor lack a safety net to protect them against the threats that climate change causes.

VI.3. Environment and Biodiversity

Along with affecting the Indonesian economy, poor population, and human health, climate change also threatens the country's environment and biodiversity. The precipitation changes, land-use change, and temperature increases over the past 20 years have increased the amount and intensity of forest fires and burned areas in Southeast Asia (Case, Ardiansyah and Spector, 2007). For example, the 1997-1998 El Nino prompted the burning of 9.7 million hectare of forests and cost Indonesia approximately US$9 billion. During the El Nino event, over 2 million hectares of peat swamp forests were burned. The burning of peat swamps directly contributes to climate change because these swamps can hold

around 30 times more carbon than tropical rainforests. Thus, forest fires and land-use change can release this stored carbon into the atmosphere, thus causing increased warming and added fires (Case, Ardiansyah and Spector, 2007).

Climate change poses a particular threat to coral reefs, such as those in western Indonesia. The warming of the sea surface temperatures can lead to the extensive destruction of the coral reefs, and thus a loss of biodiversity. Indonesia's marine turtle populations may also be impacted by sea-level rising, increasing extreme weather conditions, and warming temperatures (Case, Ardiansyah and Spector, 2007). Because Indonesia contains many of the world's most endangered species, such as the Sumatran and Bornean Orangutan, the country's biodiversity is especially placed at risk by climate change.

Climate change in Indonesia will also have drastic effects on the orangutans. Orangutans are especially dependent on their forest habitat for survival, as the trees and vines produce their main source of food. Orangutans need a habitat with trees that produce nutrient-rich fruits, and the numbers of trees that yield fruit vary with the season. For example, in the Indonesian peat swamps, there are at least 40 species of trees that produce fruit during wet season and 60 during the dry season.

However, warming temperatures and precipitation changes will affect the phenology of fruit trees, and thus have negative impacts on orangutans. A longer dry season will reduce the amount of fruit and thus limit female reproduction, as they cannot conceive orangutan babies during a time with limited food resources. The fires from the El Nino event alone eliminated 1,000 out of 40,000 total orangutans (i.e., 2.5 percent) in the single year of 1997. It is estimated that severe El Nino events, such as those in 1997-1998, would kill an average of 3.5 percent of orangutans per episode, while less severe episodes would kill around 1 percent (Case, Ardiansyah and Spector, 2007, p. 8).

VII. Conclusion

Indonesia is the world's third largest emitter of greenhouse gases. Indonesia is also extremely vulnerable to the effects of climate change. Climate change will impact many aspects of Indonesia, including its economy, poor populace, human health, and the environment. Indonesia faces the challenge of forming effective and appropriate strategies to adapt to the effects of climate change by building resilience and resistance. Action must take place at all levels, from the national and local to the international.

Even though Indonesia signed the Kyoto Protocol in 1998 and ratified the doctrine in 2004, there are still necessary steps that must be taken by the Indonesian government to face the climate change struggle (World Bank, 2007). Indonesia's forestry policies and legislation are good; however, the endorsement and implementation of these policies must become stronger. Currently, the government's enforcement of these laws is very weak.

According to a report by the Indonesian Ministry of Environment (1999), the Indonesian government must take steps in each of the following sectors in order to combat the effects and impacts of climate change: energy, agriculture, forestry, and coastal resources.

- In the energy sector, Indonesia must promote the use and development of renewable energy, such as through tax incentives. The Indonesia government must also

encourage the public to adopt energy efficiency and conservation through public campaigns and economic incentives. It is also necessary to endorse efficient and clean energy use for both commercial and industrial sectors, as various technologies, such as clean production, are available to boost the efficiency of these sectors.

- In order to speed innovation, the Indonesian government must focus on improving the technology and transfer of information to the farmer. It is also important to strengthen the research that is done on the development of more sustainable agricultural practices. The government must also promote innovative and improved agricultural practices that release the least amount of greenhouse gases into the atmosphere.
- One of the main steps that the Indonesian government must take in order to handle the effects of climate change is to prevent forest fires in areas that are prone to such fires. Forestry is the main cause of Indonesia's high greenhouse gas emission, and thus it must be the country's primary concern. The government must provide land grants to universities for forestry research and also replenish the forests in rural areas and replant trees in urban areas.
- The coastal areas are greatly affected by climate change due to the rise in sea-level, and thus the Indonesian government must prepare long term adaptation strategies to these effects. It is also important that the government promotes the rehabilitation planning and management of coral reefs. The government should also seek to continue strengthening water resource management to promote water availability in the event that it becomes contaminated by pollutants.

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