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Executive Summary: Indonesia and Climate Change

Working Paper on Current Status and Policies

DFID Department for International Development

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Preface

This summary paper is based on an assignment from DFID and the World Bank, in consultation with the State Ministry of Environment in Indonesia, to compile data and information that reflects the most updated state of knowledge of Climate Change in Indonesia.

The document is a synthesis of existing information, does not present new data and is not necessarily based on official Government of Indonesia statistics. It does not serve as an official publication from the State Ministry of Environment, nor does it represent the views of DFID or the World Bank. Rather it is a professional desk review of existing published information, and including two specialist consultation events, commissioned from the consultant, PT. Pelangi Energi Abadi Citra Enviro (PEACE).

The full final report will be available by the end of March 2007.

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EXECUTIVE SUMMARY

Deforestation, peatland degradation, and forest fires have put Indonesia among the top three largest emitters of greenhouse gases in the world. Emissions resulting from deforestation and forest fires are five times those from non-forestry emissions. Emissions from energy and industrial sectors are relatively small, but are growing very rapidly.

At the same time, Indonesia stands to experience significant losses with climate change. Being an archipelago, Indonesia is very vulnerable to the impacts of climate change. Prolonged droughts, increased frequency in extreme weather events, and heavy rainfall leading to big floods, are a few examples of the impacts of climate change. The inundation of some parts of the country, for instance Jakarta Bay, has come to pass; Indonesia's rich biodiversity is also at risk. In turn, this may lead to harmful effects on agriculture, fishery and forestry, resulting in threats to food security and livelihoods.

Indonesia will host the 13th Conference of the Parties to the United Nations Framework Convention on Climate Change, which serves as the Third Meeting of the Parties to the Kyoto Protocol in Bali, December 4-13, 2007. This report has been prepared as an input to the COP/MOP, on the occasion of Sir Nicholas Stern's visit to Indonesia. The report discusses emissions, impacts, and policy constraints faced by Indonesia to cope with climate change.

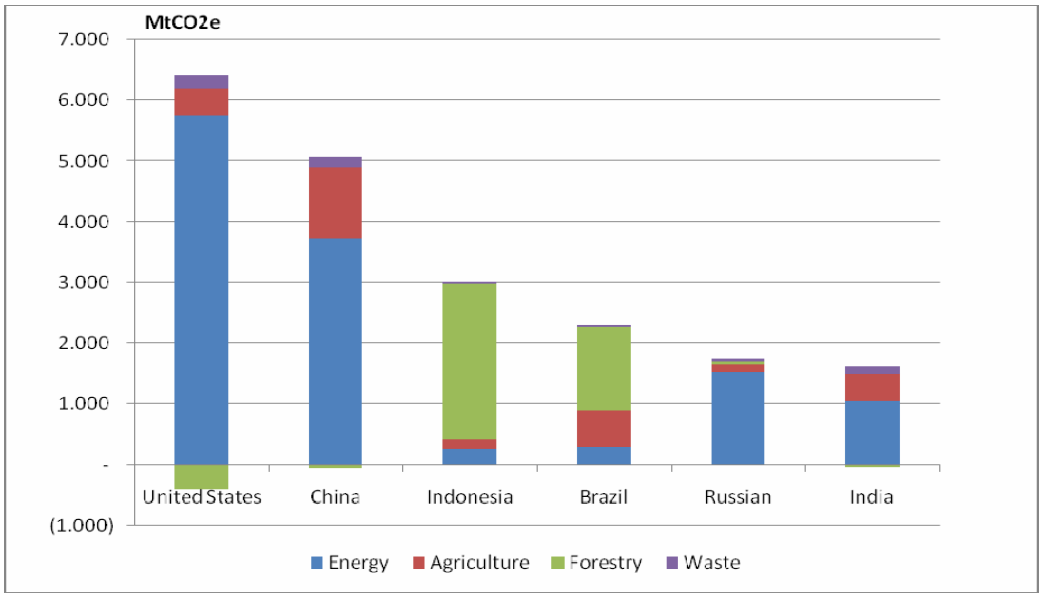
Emissions

Indonesia is among the top three GHG emitters in the world due to land use change and deforestation. Indonesia has become one of the three largest emitters of greenhouse gases in the world (see Table & Figure 1). This is largely due to the significant release of carbon dioxide from deforestation. Yearly emissions in Indonesia from energy, agriculture and waste all together are around 451 million tons of carbon dioxide equivalent ($MtCO_2e$). Yet land-use change and forestry (LUCF) alone is estimated to release about 2,563 $MtCO_2e$ – mostly from deforestation, as estimated by the IPCC (Houghton 2003, cited in Baumert *et al*. 2005). While data on the emissions from different sources does vary between studies, the overall conclusion is the same. Indonesia is a major emitter of GHGs.

Table & Figure 1: GHG emissions summary ($MtCO_2e$) [1]

Emissions sources	United States	China	Indonesia	Brazil	Russia	India
Energy[2]	5,752	3,720	275	303	1,527	1,051
Agriculture[3]	442	1,171	141	598	118	442
Forestry[4]	(403)	(47)	2,563	1,372	54	(40)
Waste[5]	213	174	35	43	46	124
Total	**6,005**	**5,017**	**3,014**	**2,316**	**1,745**	**1,577**

Note: (1) The table excludes EU from the comparison as EU comprises 25 countries. If EU as a block enters the calculation, Indonesia stands 4th, and the ranking are US, EU, China and Indonesia. (2) The data for energy emissions are from 2003. The energy data used IEA's 2005 annual statistics except for Indonesia where PIE 2005 statistics are used. (3) The data for agriculture emissions are from 2005, from US EPA 2006. Biomass combustion is included in the calculation. (4) The data for forestry (LULUCF) emissions are from 2000, from Houghton 2005. (5) The data for waste emissions are from 2005, from US EPA 2006.



Indonesia is host to vast forested areas. About 24 billion tons of carbon stock (BtC) are stored in vegetation and soil, and 80% of this (about 19 BtC) is stored in the standing forest (State Ministry of Environment, 2003). But out of the 108 million ha of forest area, almost half is in poor and degraded conditions (Departemen Kehutanan RI, 2006). Land use change and deforestation, estimated at 2 million hectares (ha) per year (World Bank 2000) results in the release of a large amount of Indonesia's carbon reservoir. Indeed, the emissions from LULUCF, notably deforestation, account for 83% of the yearly emissions of greenhouse gases in Indonesia, and 34% of global LULUCF emissions.

Deforestation and land conversion are the largest sources of emissions. The largest carbon dioxide emissions in the forestry sector, about three-quarters (75%), come from deforestation and land conversion, followed by forest-related energy consumption (23%), and the remainder is from forest-related industrial processes (2%). Forest fires are the main contributor of deforestation and land conversion, accounting for 57% of total deforestation and land conversion. In the 1997 forest fires alone, it is estimated that between 3,000 and 9,000 $MtCO_2e$ were released to the atmosphere (Page *et al*. 2002). On average, around 1,400 Mt are released during the annual burning season and 600 Mt are released each year from decomposition of dry peat (Wetlands International n.d.). Global warming will likely cause a vicious cycle by drying up the rainforest and peat swamps, thus increasing the risks of even more intense fires.

Emissions from the energy sector are small but are growing very rapidly. Emissions from non-forestry sectors are small, in absolute and per capita terms, but are growing very rapidly. Current emissions from the energy sector, about 275 $MtCO_2e$, account for 9% of the country's total emissions. But these emissions from industry, power generation, and the transport sector are growing very rapidly in the wake of industrialization and economic growth. It is expected that, with current governmental policies that promote the expansion of fossil fuels and the high barriers to clean and renewable sources of energy, the trend is that emissions from energy sector will continue to demonstrate a strong growth, tripling in the next 25 years from about 275 $MtCO_2e$ in 2003 to about 716 $MtCO_2e$ in 2030. Improvement in energy intensity of the economy, about 2% between 2000 and 2004, has been offset by strong economic growth as a whole. On a per capita basis, greenhouse gas emissions in Indonesia have grown 150% since the 1980s, or 67% since 1990 (World Resources Institute 2007).

Emissions from agriculture and waste are small. Emissions from the agriculture and waste sectors are very small and insignificant globally, coming mainly from rice production. The sector is the main contribution of methane (CH_4) and nitrous oxide (N_2O) emissions. Seventy% (70%) of the emissions from the agriculture sector are generated by rice cultivation. Albeit small, greenhouse gas emissions from the Indonesian waste sector in 2000 ranged from 32 – 60 $MtCO_2e$. This ranks Indonesia as the sixth largest emitter in the waste sector (USEPA 2006).

Impacts

Indonesia will experience modest temperature increase. Annual mean temperature in Indonesia has been observed as increasing by around 0.3 degrees Celsius (^oC) since 1990 and has occurred in all seasons of the year, relatively consistent if not slightly lower than the expectation of the warming trend due to climate change. The 1990s

was the warmest decade and a 1998 increase of almost 1°C (above the 1961 – 1990 average) made it the country's warmest year in the century (Climatic Research Unit 2006).

In 2020, it is projected that mean temperature will increase somewhere between 0.36 to 0.47°C compared to 2000, with the highest temperatures potentially occurring in the islands of Kalimantan and the southeastern part of the Moluccas. Figure 2, below, shows the distribution of the changes throughout the country by 2020 (Susandi 2007).

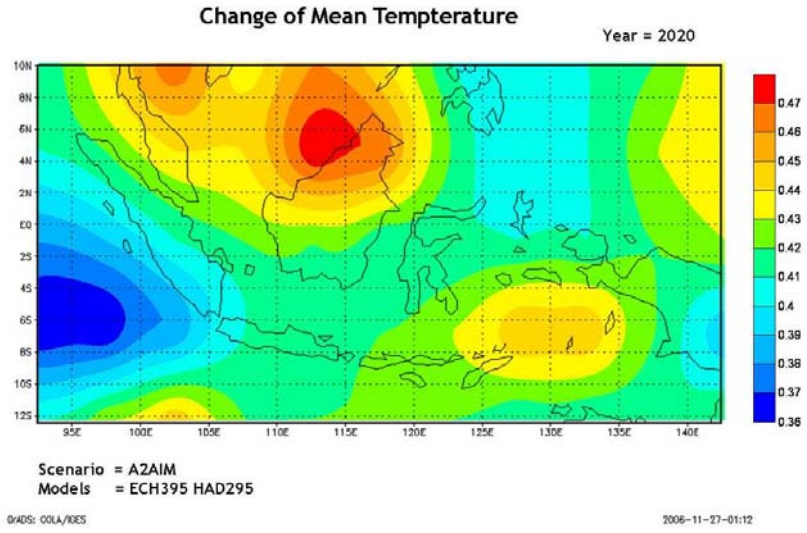


Figure 2. Change of Annual Temperature in 2020 (Susandi, 2007)

Indonesia will experience more intense rainfall. Climate change is predicted to result in 2% to 3% more rainfall per year in Indonesia (Ratag 2001 in Susandi 2007). As Figure 3 shows, the entire country will experience more rainfall, with the largest change being in the Moluccas. The increased rainfall is expected to continue and, due to climate change, result in a shorter rainy season (fewer number of rainy days in a year), with significant increase in the risk of flooding.

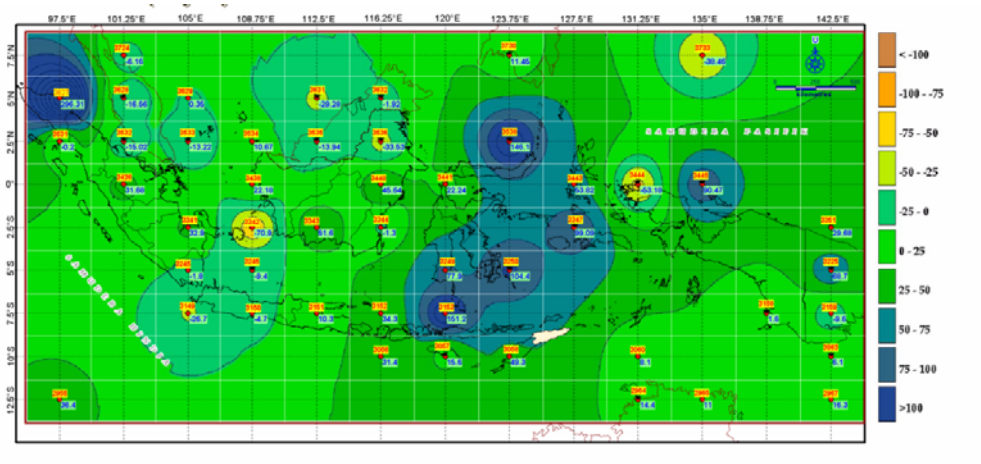


Figure 3. The Average Change of Precipitation Pattern 1900-2000 September-October-November (in mm/100 years (Ratag, 2007)

Food security in Indonesia will be threatened by climate change. Perhaps the largest concern for Indonesia with regards to the impacts of climate change is the risk of decreased food security. Climate change will alter precipitation, evaporation, run-off water and soil moisture; hence will have effects on agriculture and thus food security. The droughts caused by the 1997 El Nino event affected 426,000 hectares of rice. Important income-generating non-food crops such as coffee, cocoa and rubber were also affected (FAO, 1996). Projected changes in crop yields in Asia could vary between -22% to +28% by the end of the century in the event of a doubling of atmospheric carbon dioxide concentrations (Reilly and John 1996). A model simulating the impacts of climate change on crops (Goddard Institute of Space Studies, UK Meteorological Office) shows a decrease of crop harvest in West and East Java. Climate change will likely reduce soil fertility by 2% to 8%, resulting in projected decreases of rice yield by 4% per year, soybean by 10%, and maize by 50% (Amin, 2004).

Sea level rise will inundate productive coastal zones. Climate change will also increase the average sea level due to increased volume of the sea water and the melting of polar ice caps. The mean sea level in the Jakarta Bay will increase as high as 0.57 centimeters (cm) per year. The average depth of inundated area varies between 0.28 and 4.17 in 2050 (Meliana 2005 in Susandi 2007). This coupled with the land surface decline as high as 0.8 cm per year, as observed in the Jakarta Bay, can have a tremendous impact on urban productivity and infrastructure (Priambodo 2005). Also, in rural districts such as Krawang and Subang, a 95% reduction in local rice supply (down 300,000 tons) is estimated as a result of inundation of the coastal

zone. In the same districts, maize output would be reduced by 10,000 tons, about half of this due to inundation.

Sea level rise will reduce farming and coastal livelihoods. Sea-level rise would also be likely to affect fish and prawn production. In the Krawang and Subang districts, the loss is estimated at over 7,000 tons and 4,000 tons, respectively (valued at over US$ 0.5 million). In the lower Citarum Basin, sea-level rise could result in the inundation of about 26,000 ha of ponds and 10,000 ha of crop land. This could result in the loss of 15,000 tons of fish, shrimp and prawns output, and about 940,000 tons of rice production.

The overall effect would be to reduce potential average income. The estimated reduction of yield would cost the rice farmer US$ 10 to US$ 17 annually, the soybean farmer US$ 22 to US $72 and the maize (corn) farmer US$ 25 to US $130 annually. It is estimated that the decrease in yield would cause, in the Subang District alone, about 43,000 farm laborers to lose their jobs. In addition, more than 81,000 farmers would have to look for other sources of income due to the inundation of their rice fields or prawn and fish farms due to sea-level rise (Parry & Nih, 1992).

The warming of ocean water will affect marine biodiversity. Climate change will subject Indonesia's ocean water to an increase in temperature of 0.2 to 2.5 ^{o}C. The 50,000 km^2 of coral reefs in Indonesia, about 18% of the world's total, are already in dire straits. The El Nino event in 1997 – 1998 alone was estimated to have caused coral bleaching to 16% of the world's coral reef. In a 2000 survey, only 6% of Indonesia's coral reefs are in excellent condition, 24% in good condition, and the remaining 70% are in fair to poor condition (Johns Hopkins University 2003). A survey in the Bali Barat National Park found that a majority of coral reefs were in poor condition. More than half of the degradation was due to coral bleaching. This puts the Bali Barat National Park as a catastrophically-affected site (Wilkinson, 2000 in Setiasih,et.al, 2006). In Pari island, in the Thousand Islands National Park, 50 – 60% of the coral reefs were found bleached in 1997 (Irdez 1998 in Setianingsih 2006).

Climate change will intensify water- and vector- borne diseases. In the late 1990s, El Nino and La Nina were associated with outbreaks of malaria, dengue and plague. Malaria has spread to high elevations where it was detected for the first time as high as 2103 m in the highlands of Irian Jaya in 1997 (Climate Hotmap). In 2004, it appeared that a more virulent strain of the potentially deadly dengue fever virus may have emerged. Dengue fever has been spreading faster and killing more victims than in past years.

Extreme temperatures can also cause other health problems. For example, people with heart dysfunction may be vulnerable to hot climates as they need extra energy to keep the body cool during hot weather. High temperatures can also lead to heat

exhaustion and certain respiratory problems. The concentration of ozone at ground level may also increase as a result of higher air temperatures, causing lung tissue damage.

The links between climate change and these diseases and health problems is poorly researched. The IPCC's Fourth Assessment Report (2007) stated that there is too little data to reliably confirm perceptions of an increase in extreme weather events, which may be due to increased reporting. However, perhaps as a forewarning of what is to come, the rise in the number of dengue fever cases during the rainy seasons in Indonesia, particularly in Java, could have been partially caused by warmer climates. Research has confirmed that warmer temperature has led to mutation of the dengue virus, making cases more difficult to handle, thus leading to an increase in fatalities. Malaria had also spread to high elevations, and for the first time it was detected as high as 2103 m in the highlands of Irian Jaya in 1997.

Impacts will be uneven across the country, but are likely to result in significant economic damage and loss of livelihoods. For example, the economic impacts of forest fires are estimated to cost an annual US$ 9 billion from droughts and fires (Applegate *et al*. 2002) and US$ 4 billion from haze related costs (IDRC 2003).

There is no proven evidence yet that intense and more frequent El Nino and La Nina events are caused by or are causing climate change. But these events can be a good proxy for looking at the damage that could occur due to climate change. The rare events could become the norm as the world will get permanently warmer.

Policy and capacity constraints

Indonesia signed the Kyoto Protocol in 1998 and ratified it in 2004 through Law No. 17/2004. Since then, a lot has happened, notably in the field of the clean development mechanism (CDM), although less so in the other fields.

Forestry policies and legislation are good, but implementation and enforcement are weak. There are many good policies and legislations that favor sustainable forest management in Indonesia. Unfortunately, the capacity of the government to implement and enforce laws is weak. For example, through Presidential Instruction No. 4/2005, Indonesia codifies and reinforces the commitment to fight forest crime. The decree directs eighteen agencies to cooperate in the control of illegal logging and the prosecution of forest crimes, including the Coordinating Ministry of Political and Security Affairs, the Ministry of Forestry, the National Police, and financial sector regulators. An order of the Ministry of Home Affairs has called for cooperation at the district government level and has prohibited further grants of logging concessions at that level. Officials from Police and Prosecutors Office have been stationed at the Ministry of Forestry, but there is still a need for more detailed plans,

budgets, information sharing arrangements and standard protocols (World Bank, 2006).

The policy to expand biofuel production is still risky and problematic. Indonesia is progressing towards expanding biofuel production, both for domestic use in order to reduce oil consumption, and for export due to meet strong demand, especially in Europe. Bioethanol is currently produced using mainly sugar and cassava as feedstocks, whereas biodiesel is developed using crude-palm oil (CPO), stearin (the non-edible byproducts of CPO), Jatropha curcas, and others.

In 2009, biodiesel from oil palm in Indonesia is projected to reach 700 million liters, or 2% of diesel consumption, requiring about 200,000 ha of oil palm plantations. Demand for biodiesel is expected to increase in 2025, when it reaches 4,700 million liters, or 5% of total diesel consumption. This will need 1.4 million hectares of oil palm plantations – about 2.5 times the area of the island of Bali. Jatropha curcas can grow in degraded lands and promises a good potential to reforest the degraded areas, while at the same time providing livelihoods to the poor living near degraded areas and reducing the use of petro-diesel.

However, the risks of deforestation – and to some extent land use conflicts with biofuels – have not been thoroughly assessed. Historically, oil-palm production in Indonesia has been a major driver of deforestation.

The policy to rapidly expand the use of coal will increase emissions further. Indonesia greenhouse gas emissions from coal burning by the year 2025 will be 20 times higher than in 2005 or 1.3 times higher than all energy sector emissions for the same year (Hutapea, 2007). The decision to rapidly expand coal-fired power generation (by 10,000 MW in Java alone) may increase these emissions even further.

Renewable energy sources are underdeveloped, with barriers but few incentives. At the same time, there are barriers but few incentives in Indonesia for the development of renewable energy. Development of renewable energy has slowed if not halted. While energy policies may call for development of renewable sources, supporting instruments, such as fiscal and financial incentives, have not been fully developed. Table 1 shows the small amount of renewable energy actually utilized compared to the potential. This is very different from China and India, where policies to foster development of renewable sources have been strongly implemented.

Table 1. Indonesian Renewable Energy Potential Compared to Installed Capacity (DGEEU, 2006)

Renewable Sources	Potential		Installed Capacity	
Hydro	75,67	GW	4,200	MW
Geothermal	27	GW	807	MW
Mini/micro hydro	500	GW	84	MW
Biomass	49,81	GW	445	MW
Solar	4,8	kWh/m²/day	8	MW
Wind	3-6	m/s	0,6	MW

The only improvement may have occurred in energy conservation. Energy pricing policy -- that gradually removed subsidies from electricity and fuel – has helped increase conservation of energy. Energy intensity has also been constantly reduced over time.

Indonesia has not yet been able to take advantage of the opportunities in the Clean Development Mechanism. Indonesia has at least 235 $MtCO_2e$ of emissions reduction potential that can be developed as CDM projects, ranging from reduction of gas flaring in large oil and gas facilities, to development of geothermal and other clean and renewable energy sources, to production of biogas from agriculture and animal waste.

However, at present only 11 projects have received approval from the Designated National CDM Authority (DNA). Of these, eight have been registered by the Executive Board of CDM with a potential to produce 13 $MtCO_2e$. From the registered projects, most are renewable and waste management projects (UNEP Risoe 2007). Compared with the potential, this is not significant.

Indonesia is not yet adequately preparing for adaptation to future climate events. The importance of adaptation to climate change has already been acknowledged in the country's Mid-Term National Development Plan. Chapter 32 of the Plan mentions that Indonesia shall "improve national capacity in adapting climate change issues into development aspects".

Currently, a draft of the National Strategy on Adaptation has been completed. The draft contains a compilation of research activities, identification of adaptation issues that need to revised and expanded with implementation experience of UNFCCC methodology. At present, the Ministry of Environment is finalizing the strategy in time for the COP13 meeting. Other Ministries have yet to follow through by implementing recommendations, resulting in weak preparedness for adaptation to future climate events