Climate Change in Indonesia

Climate Change Guide

What is climate change?

How does climate change affect us?

What can we do against climate change?

Marion Künzler

Bread for all

December 2010

BREAD FOR ALL

mission 21
protestant mission basel

Publisher

Brot für alle - Pain pour le prochain - Bread for All
Development Organization of the Swiss Protestant Community of Churches
Monbijoustrasse 29
Postfach 5621
CH-3001 Bern
Switzerland
Tel. +41 31 380 65 65
Fax +41 31 380 65 64
E-mail bfa@bfa-ppp.ch

Picture Front Side

Destruction of forest to make way for plantations, largely for products like paper and palm oil, which are transported worldwide and used to make chocolate, toothpaste and so-called 'climate-friendly' biofuels in Indonesia.
Source: http://weblog.greenpeace.org/climate/2009/10/climate_defenders_camp.html, Accessed 10 January 2011.

Text

Marion Künzler, climate expert, *Bread for All*

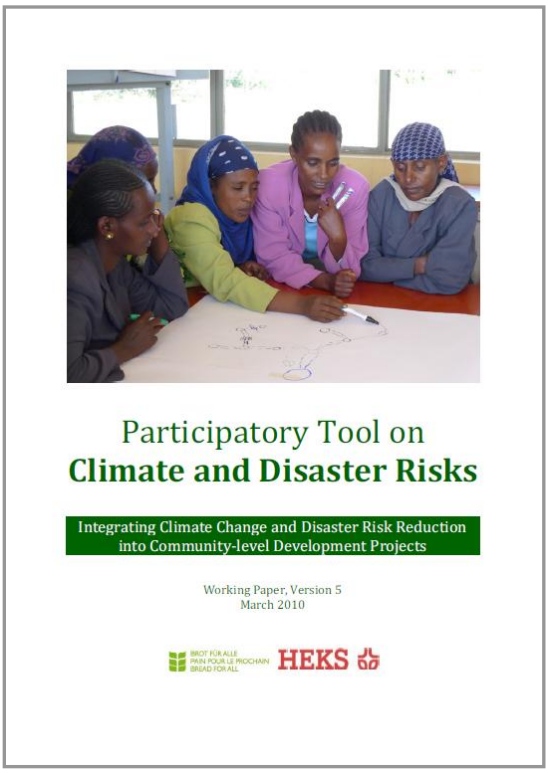
Bread for All is the development organization of the Swiss Protestant Community of Churches. The organization supports 400 development projects and programs in 57 countries in Africa, Asia, and Latin America. In addition, its development policy has the goal of creating fairer international socioeconomic structures, maintaining creation, and bringing peace.

Mission 21 works in 17 countries with 57 partner churches and organizations, a beacon of hope in the spirit of the Gospel. Around the world mission 21 assists in 100 projects, fighting against poverty, promoting health, improving the position of women, resolving conflicts peacefully and educating people in theology and the church. In Switzerland mission 21 organizes meetings, exchanges and research in the sensitive field of missionary work and developmental cooperation.

Contents

1 Introduction

Climate change is one of the largest problems humanity faces today. Communities in Indonesia suffer now and in the future from the impacts of this global phenomenon, even though people in Indonesia have contributed very little to causing climate change.



The first step in order to be able to cope with the adverse effects of climate change is to know about climate change and its impacts. Thus, this guide aims at providing basic information on climate change, its causes, and how it affects us. Furthermore, this guide can also be used to analyze the climate context with tools such as the *Climate and Disaster Risk Tool (CLiDR*) developed by *HEKS* and *Bread for all*.

2 What is Climate Change?

Climate change refers to changes in the Earth's climate that are persistent and often large scale. These changes can be caused by either natural processes or they can be caused by human activities. In the reminder of this guide, climate change will refer to changes that are man-made unless noted otherwise.

Different human activities affect the climate including energy production from combustion of fossil fuel, coal, and wood and land-use changes. The mechanism by which these activities affect the global climate is called the greenhouse effect.

The Earth receives energy from the Sun in form of visible light and loses energy in the form of invisible, thermal radiation (heat) to space (see Figure 1). Greenhouse gases block some of the infrared radiation from escaping to space, thus heating the atmosphere and the surface of the Earth. One can think of greenhouse gases as a blanket that you use during the night to keep the body from cooling. Adding greenhouse gases to the atmosphere corresponds to using a thicker blanket, with the consequence that your body heats up.

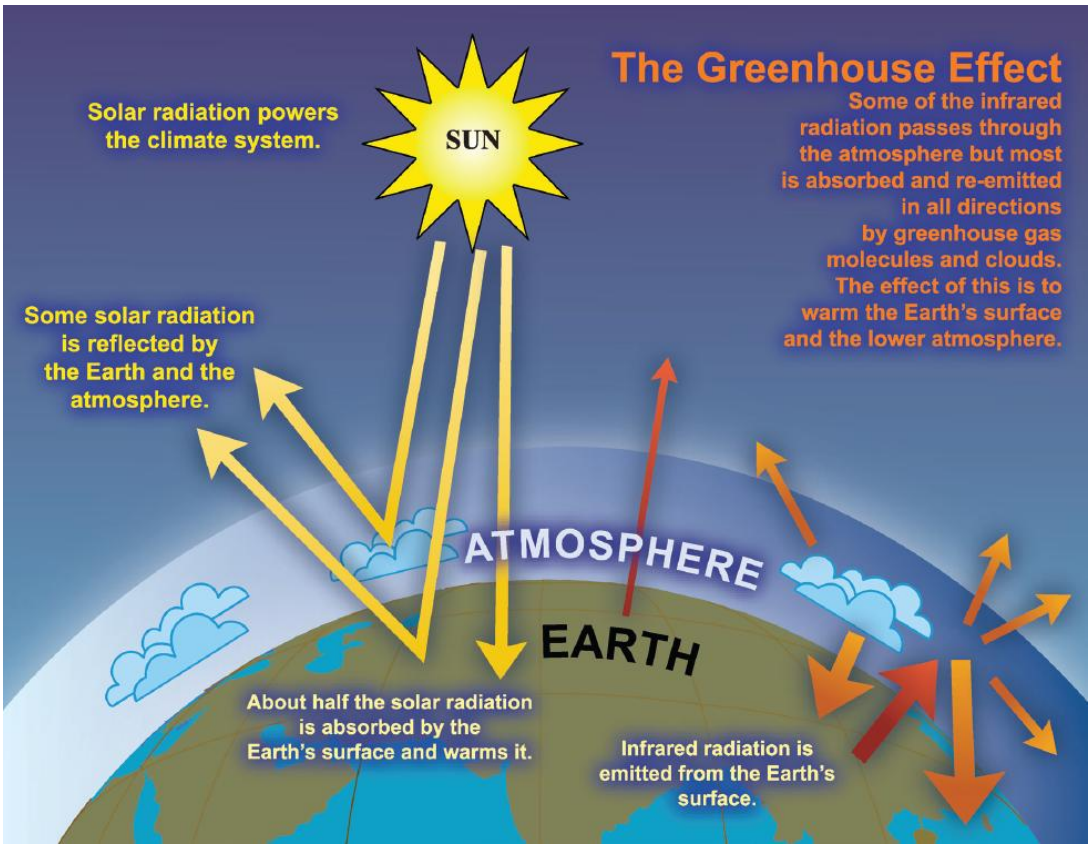


Figure 1: An idealized model of the greenhouse effect (IPCC, 2007)

The most important greenhouse gas is water vapour, which occurs naturally. Without water vapour in the atmosphere, the Earth would be completely frozen. Other important greenhouse gases are carbon dioxide, methane, and nitrous oxide. Human activities such as combustion of fossil fuels, deforestation (carbon dioxide), and agricultural activities (methane and nitrous oxide) add greenhouse gases to the atmosphere, where these gases spread out globally, accumulate, and warm the atmosphere and surface of the Earth.

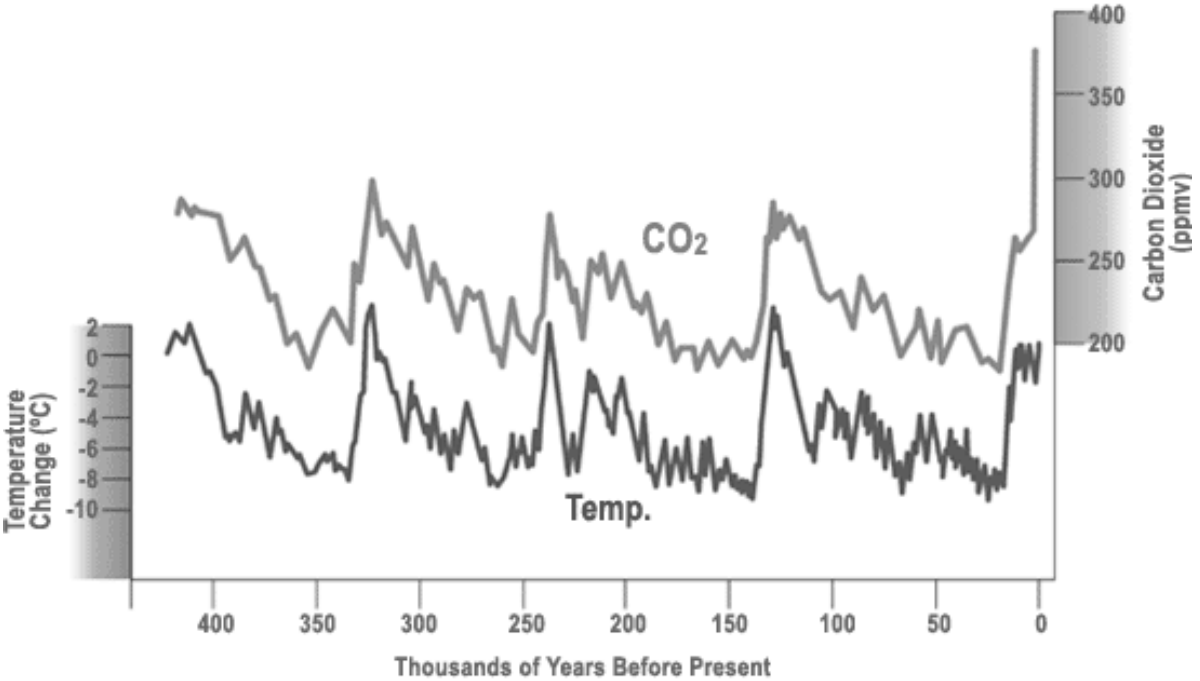


Figure 2: Carbon dioxide concentration and temperature anomalies during the past 400'000 years (www.architecture2030.org)

When looking at the temperature evolution during the last 400’000 years, we find a strong correlation between the amount of carbon dioxide in the atmosphere and temperature. Carbon dioxide concentrations increased from 280 parts per million (ppm) in preindustrial times to 379 ppm in 2005. During the same period, the global temperatures have increased by 0.8° C. Most of the observed warming happened in the last 50 years.

If we further emit greenhouse gases at present rates, global warming continues at about 0.2° C per decade. If we stopped emitting greenhouse gases now, however, global temperatures would still continue to rise by about 0.1° C per decade due to the inertia of the climate system. The world is warming now and it will keep warming in the future.

Global warming, however, is just the most obvious and best understood aspect of climate change. Many more aspects of global and regional climate have been found to change as well. As a direct consequence of the warming, the sea level rises and the snow and ice cover decreases. Furthermore, the weather patterns change with widespread changes in rainfall and increases in droughts and/or heavy rainfall events in some regions (IPCC, 2007).

These changes have severe socio-economic and environmental consequences. Hundreds of millions of people suffer from water shortage, floods in coastal low-land areas, heat waves, droughts, and increases in cardio-respiratory and infectious diseases due to climate change. Furthermore, thousands of species will die out and agricultural yields may severely decrease in some regions. The impacts of climate change already affect hundreds of millions of people today and in the next twenty years the number of people seriously affected by climate change will likely double.

These harmful effects of climate change cannot be avoided completely. Thus, we have to prepare to be able to cope with the changing climate. In the long run, global warming can be slowed down or maybe even stopped, if the international community manages to drastically reduce the emission of greenhouse gases.

3 Climate Change in Indonesia

3.1 Trends, Risk Analysis and Impacts

3.1.1 Past Trends of Climate Change

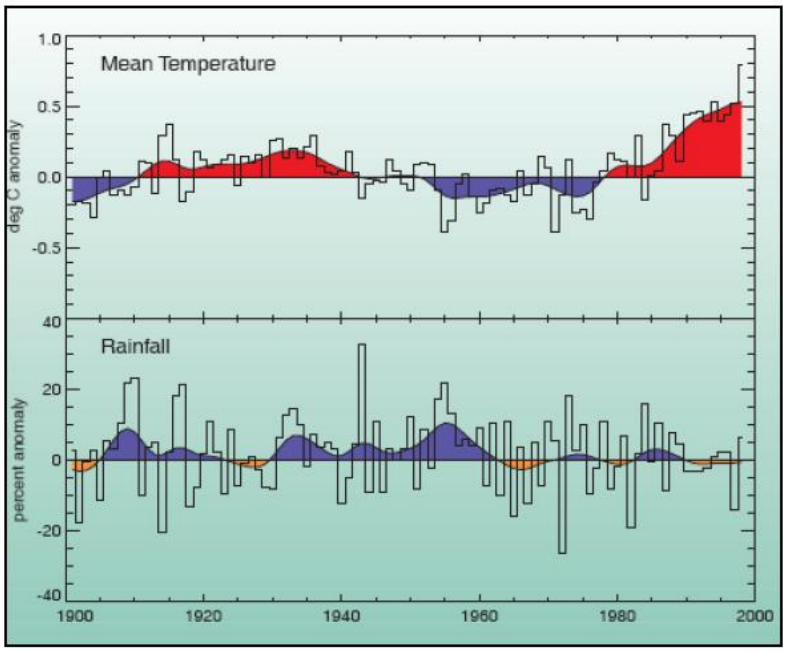


Figure 3: changes in annual mean temperature, 1901-1998 (top) and annual rainfall, 1901-1998 (bottom) across Indonesia (Hulme and Sheard 1999).

Climate change is already taking place now, thus past and present changes help to indicate possible future changes. Over the last decades, the temperature in Indonesia increased at about 0.3° C (1901-1998). Annual precipitation has decreased by 2 to 3% in Indonesia. Precipitation patterns have changed; there has been a decline in annual rainfall in the southern regions of Indonesia and an increase in precipitation in the northern regions. The seasonality of precipitation (wet and dry seasons) has changed; the wet season rainfall in the southern region of Indonesia has increased while the dry season rainfall in the northern region has decreased (Hulme and Sheard 1999; Boer and Faqih, 2004).

The El Nino-Southern Oscillation (ENSO), is a large-scale phenomenon and strongly influencing precipitation in Indonesia. Indonesia typically experiences droughts during El Niño events (the warm phase of ENSO) and excessive rain during La Niña events (cool phase of ENSO). Some researchers suggest that there will be more frequent and perhaps intense ENSO events in the future because of the warming global climate (Tsonis et al., 2005).

IPCC 2007 shows that sea level has risen by an average of 2.5 mm annually. Indonesia, an archipelagic country with over 17,000 islands and 80,000 km of coastlines is very vulnerable to sea level rise.

Intense tropical cyclone activity has likely increased in some regions since 1970. Variations in tropical cyclones, hurricanes and typhoons are dominated by ENSO and decadal variability. Globally, estimates of the potential destructiveness of hurricanes show a significant upward trend since the mid-1970s, with a trend towards longer lifetimes and greater storm intensity, and such trends are strongly correlated with tropical sea surface temperature (IPCC 2007).

3.1.2 Projected Trends of Climate Change

Temperature: Warming will occur in Indonesia from 0.2 to 0.3°C per decade. Under IPCC scenarios, it is projected that temperature may warm anywhere from 0.72 to 3.92°C by the end of the century. Downscaled modelling specific for Indonesia projects that the rate of warming will rise across all of Indonesia from about 0.36 to 0.47°C until 2020 (Figure 4), with the highest temperatures potentially occurring in the islands of Kalimantan and the south-eastern part of the Moluccas (Susandi 2007).

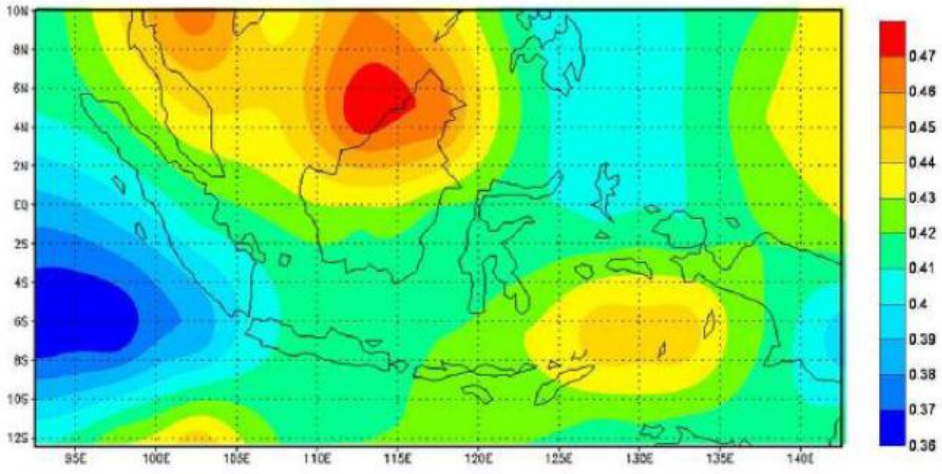


Figure 4: Change of Annual temperature in 2020 (Susandi 2007)

Precipitation: Changes in annual mean precipitation are varying largely. Mainly increasing across the majority of the Indonesian islands, except in southern Indonesia where is it projected to decline by up to 15 percent.

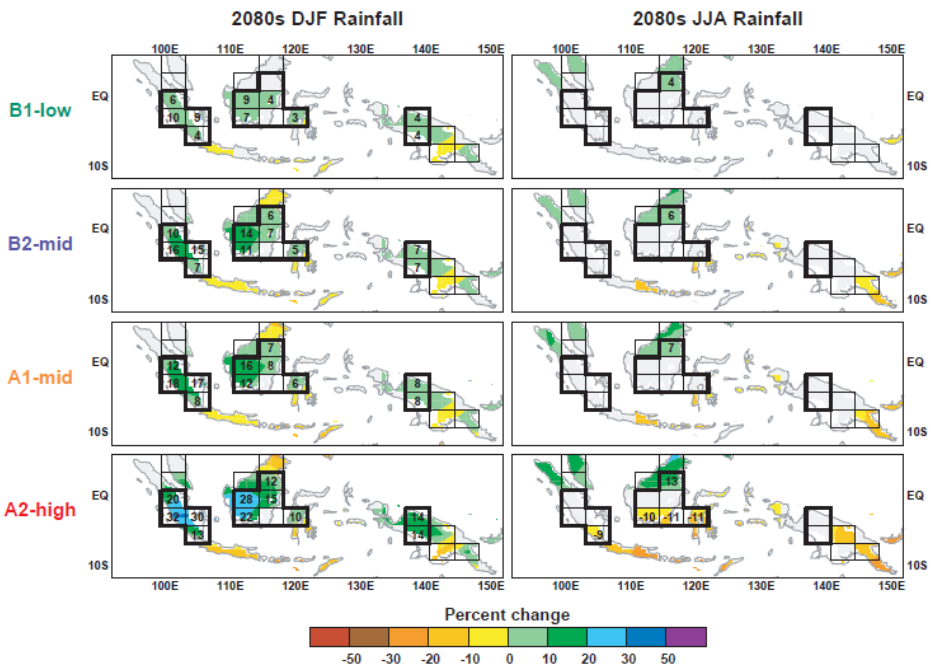
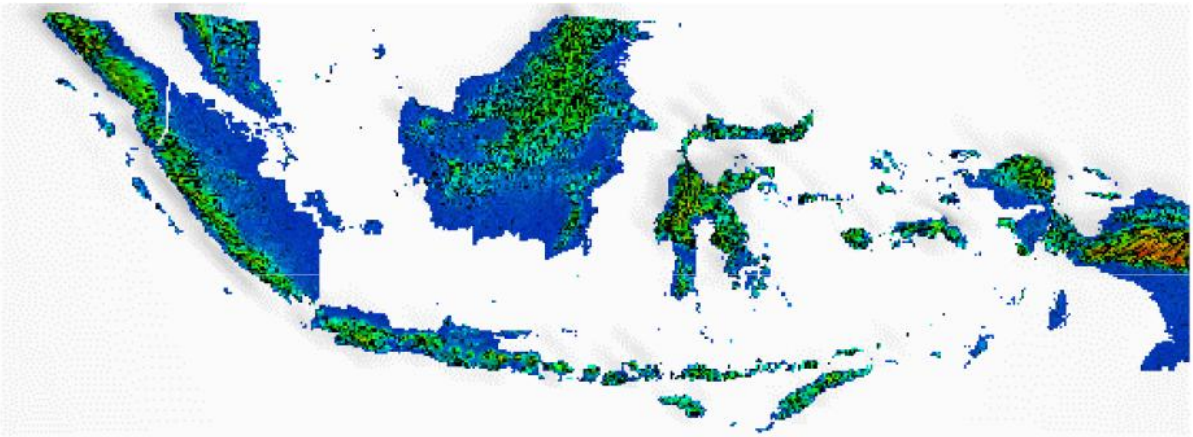


Figure 5: Change in December-February and June-August rainfall (per cent change from the average 1961-90 climate) for the 30-year period centred on the 2080s for the four scenarios. The printed numbers show the estimated change for each model land gridbox across Indonesia. Changes are only shown where they are large in relation to simulated natural rainfall variability on 30-year time-scales (Hulme and Sheard, 1999).

Change in the seasonality of precipitation is also not uniform. Parts of Sumatra and Borneo may become 10 to 30% wetter by the 2080's during December-February. In contrast Jakarta is projected to become 5 to 15% drier during June-August (Hulme and Sheard, 1999). Changes in the timing and seasonality of rainfall is also projected to change; a recent analysis suggests that there is an increased likelihood that the annual monsoon could be delayed by 30 days because of changes in regional climate and there may be a 10% increase in rainfall later in the crop year (April-June), but a substantial decrease (up to 75%) in rainfall later in the dry season (July–September) (Naylor et al., 2007).
Consequently, regions of Indonesia with decreasing rainfall might be exposed to high drought risk, while those with increasing rainfall might be exposed to high flood risk and the frequency of extreme events might increase (Boer and Faqih, 2004).

Sea level: The trend of rising sea level continues. Indonesia may lose as many as 2000 low-lying islands- including coral reefs and uninhabited islands by 2030. Additionally, rising sea level of 8-30 cm by 2030 is likely to cause severe impacts. At this magnitude of rise, low-lying coastal cities such as Jakarta and Surabaya will have higher risks of flooding (PEACE, 2007). A simulation of Susandi (2007), Figure 6, indicates a sea level rise of 1.1 metre until 2100 and a loss of 90,260 km2 land area.

Figure 6: Sea level rise 2100 (Susandi 2007)



Extreme events: Extreme rainfall and winds associated with tropical cyclones are *likely* to increase in Southeast Asia but there is less consistency between scientists about how occurrence will change (IPCC 2007)

3.1.3 Geophysical Risk Analysis

Geophysical factors (e.g earthquakes, landslides, volcanoes or tsunamis) are not climate change related but natural hazards which can cause disasters.

Indonesia experiences a wide range of natural hazards because it is located along the major tectonic plate boundaries. It is along these boundaries that the biggest earthquakes happen, including those that cause tsunamis such as the one that devastated many countries in Asia in December 2004. These boundaries also create volcanoes and as a result Indonesia is the most volcanically charged country in the world with more than 150 active volcanoes and over 130,000 lives have been lost since 1800. While earthquakes and tsunamis have caused major disasters in Indonesia, the frequent floods and landslides that kill families and push communities back into poverty affect more Indonesians every year (AIFDR 2010).

The map of OCHA 2007, Figure 7, illustrates Indonesia's exposure to seismic, volcanic and tropical storm hazard. Earthquake intensity zones indicate where there is a 20% probability that degrees of intensity indicated will be exceeded in 50 years; tropical storm intensity zones indicate where there is a 10% probability of a storm of this intensity striking in the next 10 years.

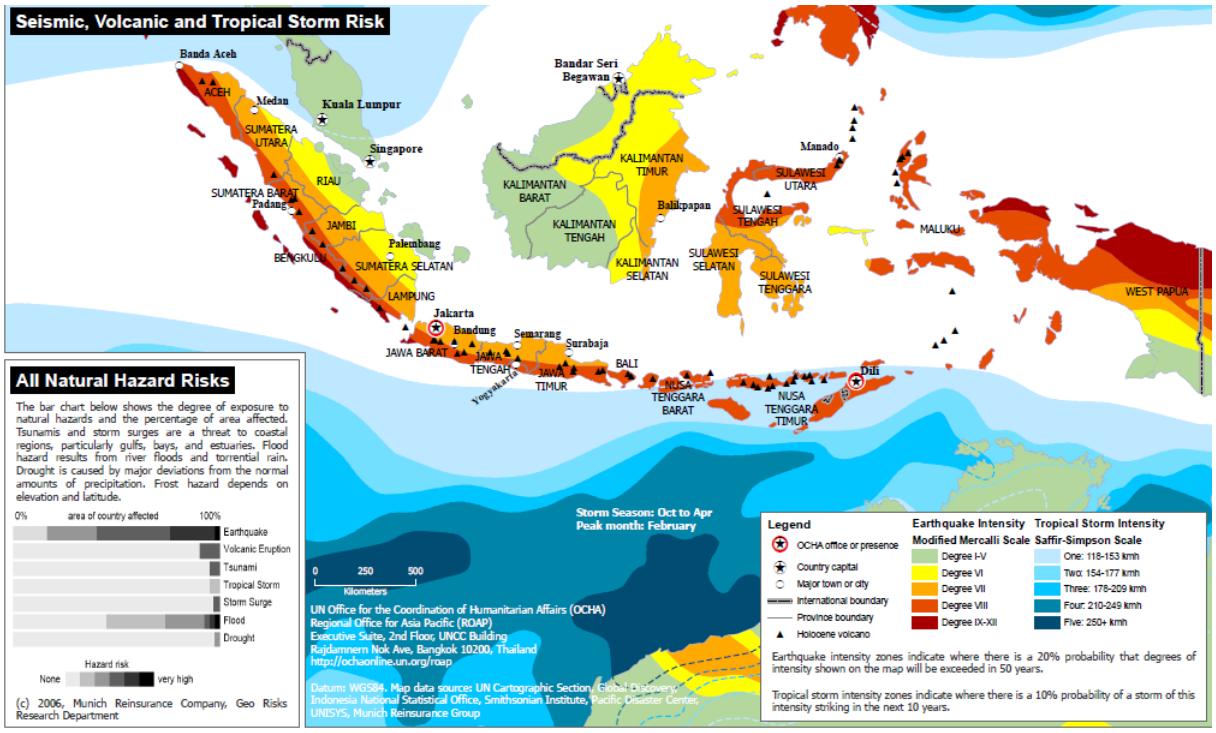


Figure 7: Indonesia's exposure to seismic, volcanic and tropical storm hazard (OCHA 2007)

3.1.4 Impacts of Climate Change in Indonesia

Detrimental and beneficial impacts of the ongoing and projected climate change and variability are widespread in both socio-economic and natural systems. There impacts include:

Water resources: Precipitation in parts of Indonesia has decreased and is projected to continue to decrease during critical times of the year (i.e., during the dry season) and can lead to prolonged droughts. In other areas of Indonesia, it is projected that rainfall will increase and may occur in fewer, more intense events which could lead to flooding. These types of trends combined with an overall shift of the seasonality and timing of rainfall will lead to unpredictable and uncertain water availability and consequently, uncertain ability to produce agricultural goods and economic instability. Groundwater near the coasts is also at risk due to saltwater intrusion, a result of higher sea levels, over-extraction of the resource (resulting in lower groundwater levels), and recharge with more saline surface waters (WWF 2007).

Agriculture, Food Security: Agriculture's share of GDP in 2006 was 13 per cent and generates 43 per cent of the country's total employment (IFAD 2010). Agricultural productivity will be constrained due to e.g. prolonged droughts, increased flooding, and more frequent and severe storms. Indonesia may experience even more adverse impacts, including less food production and increased hunger. For example, a recent study that looked at assessing the risks of climate change on Indonesia rice production suggests that under future climate projections, there is a significant 30-day delay in the onset of monsoon season and a substantial decrease in precipitation later in the dry season (Nayor et al., 2007), which when combined with temperature increases of up to 4°C (for every 1°C increase in minimum temperature, rice yields decrease by 10%; Peng et al., 2004), will lead to massive drops in rice production. A temperature increase beyond 2.5°C and the resulting drop in rice yield would incur a loss in farm-level net revenue of 9 to 25% (Lal, 2007). Besides agricultural damage, sea level rise might also lead to a loss of traditional resources such as fish, fishponds and prawn production. Therefore climate change will weaken national food security and self-sufficiency (PEACE 2007).

Biodiversity and ecosystem services: The IPCC states that up to 50% of Asia's total biodiversity is at risk, specifically due to climate change (Cruz et al., 2007). Climate change poses an additional risk to coral reefs, especially those whose habitats are already threatened. In a 2000 survey, only 6 percent of Indonesia's coral reefs are in excellent condition, 24 percent in good condition, and the remaining 70 percent are in fair to poor condition (John Hopkins University and Terangi 2003) The loss of coral reefs in Asia may be 88 per cent in the next 30 years because of warming sea-surface temperatures, sea level rise, and other added stresses. Massive coral bleaching lead to widespread loss of coral reefs and biodiversity, including the fish that many Indonesians rely on for food and livelihoods. Also Indonesian's marine turtle population might be impacted by sea-level rise, increased extreme weather events, warming temperatures, and changes in ocean circulation and salinity patterns (WWF, 2007).
Indonesia contains some of the world's most endangered species and is therefore especially threatened by the effects of climate change. More frequent forest fires might have a significant impact on wildlife habitat and biodiversity and translate into serious economic and domestic and trans-boundary pollution consequences as well as changes in species distribution, reproduction timings, and phenology of plants (WWF, 2007).

Coastal zones: Warming ocean temperatures, sea-level rise, and increased storms will impact coastal systems by increasing coral bleaching events, changes in fish availability, inundation of coast lines and mangroves, and exacerbating risks to human health affecting millions of people.
Sea level rise will undoubtedly result in significant losses of Indonesia's 80,000 km of coastline (up to 90260 km2 until 2100, Susandi 2007) and thousands of islands and the associated marine resources (e.g., coral reefs, fisheries, mangroves, etc.) Under very conservative sea level rise scenarios (40cm by 2100), the annual number of people flooded in coastal

populations will increase. Approximately 60% of all Indonesians live in coastal areas and low-lying coastal cities like Jakarta and Surabaya. Sea-level rise when combined with the present subsidence or sinking that is being observed in Jakarta Bay will result in massive impacts on infrastructure and businesses. Sea-level rise, reduced freshwater flows, and salt-water intrusion, in addition to the existing stresses primarily due to human activities threaten Indonesia's coastal mangroves (WWF 2007).

Human health: Human health in Indonesia will be adversely affected by climate change and its associated effects both directly (e.g., deaths due to heat waves, floods, and storms) and indirectly (e.g., increases in infections and diseases and less available food). Direct effects, such as higher temperatures, changes in precipitation and sea-level rise can cause more frequent and severe heat waves, floods, extreme weather events, and prolonged droughts and lead to increased injury, illness, and death. Indirect effects, which are more difficult to attribute to climate change, may include more widespread vector-borne infections (e.g., malaria and dengue), an expansion of water-borne diseases (such as diarrhoea), an increase in infectious diseases, poor nutrition due to food production disruption, ill-health due to social dislocation and migration, and increased respiratory effects from worsening air pollution and burning. Rising temperatures can compound the effects of poverty and poor hygiene on bacterial proliferation, leading to diarrhoeal disease and endemic morbidity and mortality (WWF 2007).

Infrastructure: Flooding and sea-water intrusion due to sea-level rise and declining dry-season precipitation, will seriously affect infrastructure. Much of Indonesia's population and industries infrastructure are concentrated in low lying coastal areas. Thus loss of property and coastal habitats might also lead to displacement of people (WWF 2007).

It is important to notice, however, that other factors threaten the livelihoods of Indonesian's communities as well. For example resource degradation and the overexploitation of natural resources such as unsustainable fishing practices in association with the environmental decline.

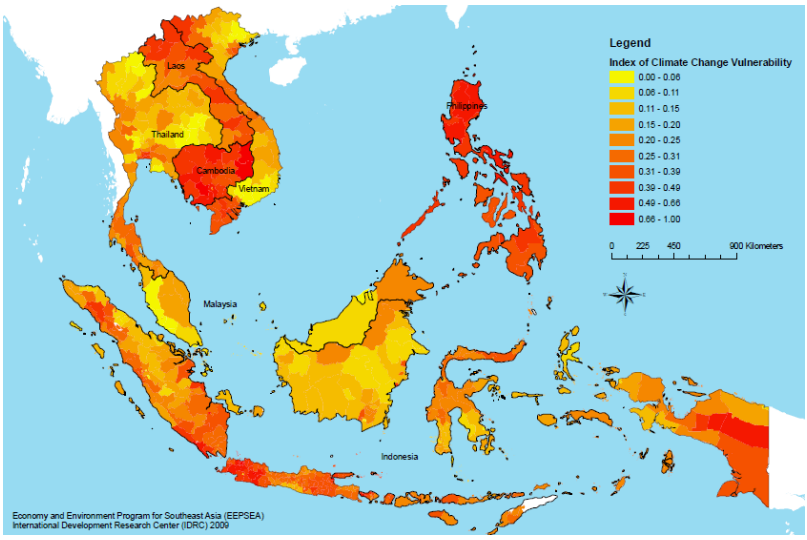


Figure 8: Climate Change Vulnerability in Southeast Asia in 2009 (IDCR 2009)

Summarizing the climate change vulnerability in Indonesia, all the regions of West Sumatra, South Sumatra, Western Java, and Eastern Java of Indonesia are among the most vulnerable regions in Southeast Asia (See figure 8, a mapping assessment of IDRC).

3.2 Indonesia's Contribution to Climate Change

Indonesia has become one of the three largest emitters of greenhouse gases in the world (see Figure 9). 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 equivalents (MtCO2e). Emissions from energy and industrial sectors are relatively small, but are growing very rapidly. Yet land-use change and forestry (LUCF) alone is estimated to release about 2,563 MtCO2e – mostly from deforestation, as estimated by the IPCC (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 (PEACE, 2007). Nevertheless, looking at per capita emission Indonesia ranks on position 130 with 1.8 metric tons of CO_2 per capita worldwide (US rank with 18.9 metric tons of CO_2 per capita on position 11), (US Department of Energy CDIAC, 2010).

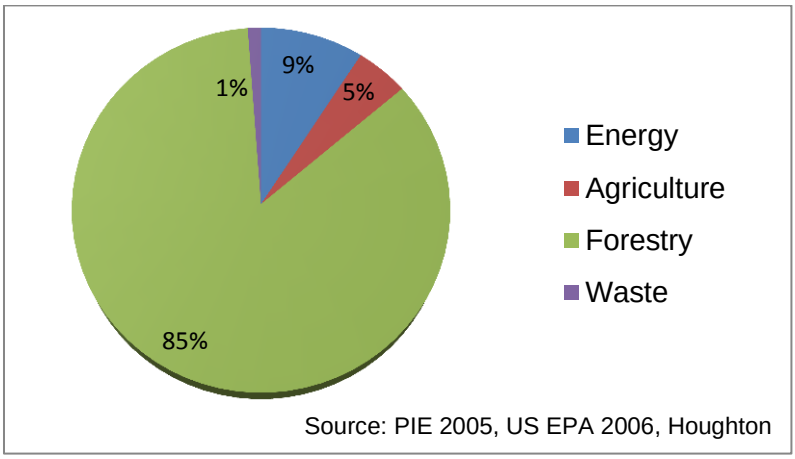


Figure 9: GHG emission in MtCO2e in 2005 in Indonesia

Indonesia is host to vast forested areas and has the third largest tropical forest. 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 (Department Kehutanan RI, 2006). Land use change and deforestation, estimated at 2 million hectares (ha) per year results in the release of a large amount of Indonesia's carbon reservoir and has significantly increased (Forest Watch Indonesia 2002). Indeed, the emissions from Land use, land use change and forestry (LULUCF), notably deforestation, account for 83% of the yearly emissions of greenhouse gases in Indonesia, and 34% of global LULUCF emissions (PEACE, 2007). Figure 10 below shows the extend of deforestation in Kalimantan up to 2020.

Deforestation and land conversion: The largest carbon dioxide emissions in the forestry sector, 74 percent come from deforestation and land conversion (LUCF), followed by forest-related energy consumption (23%), and the remainder is from forest-related industrial processes (3%). Forest fires are the main contributor of deforestation and land conversion, accounting for 57%. Annually, around 2000 million tons (Mt) of CO2 are released from forests: 600 Mt are caused by decomposition of dry peat and 1,400 Mt through annual burning season (Wetlands International 2006). 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 (PEACE, 2007).

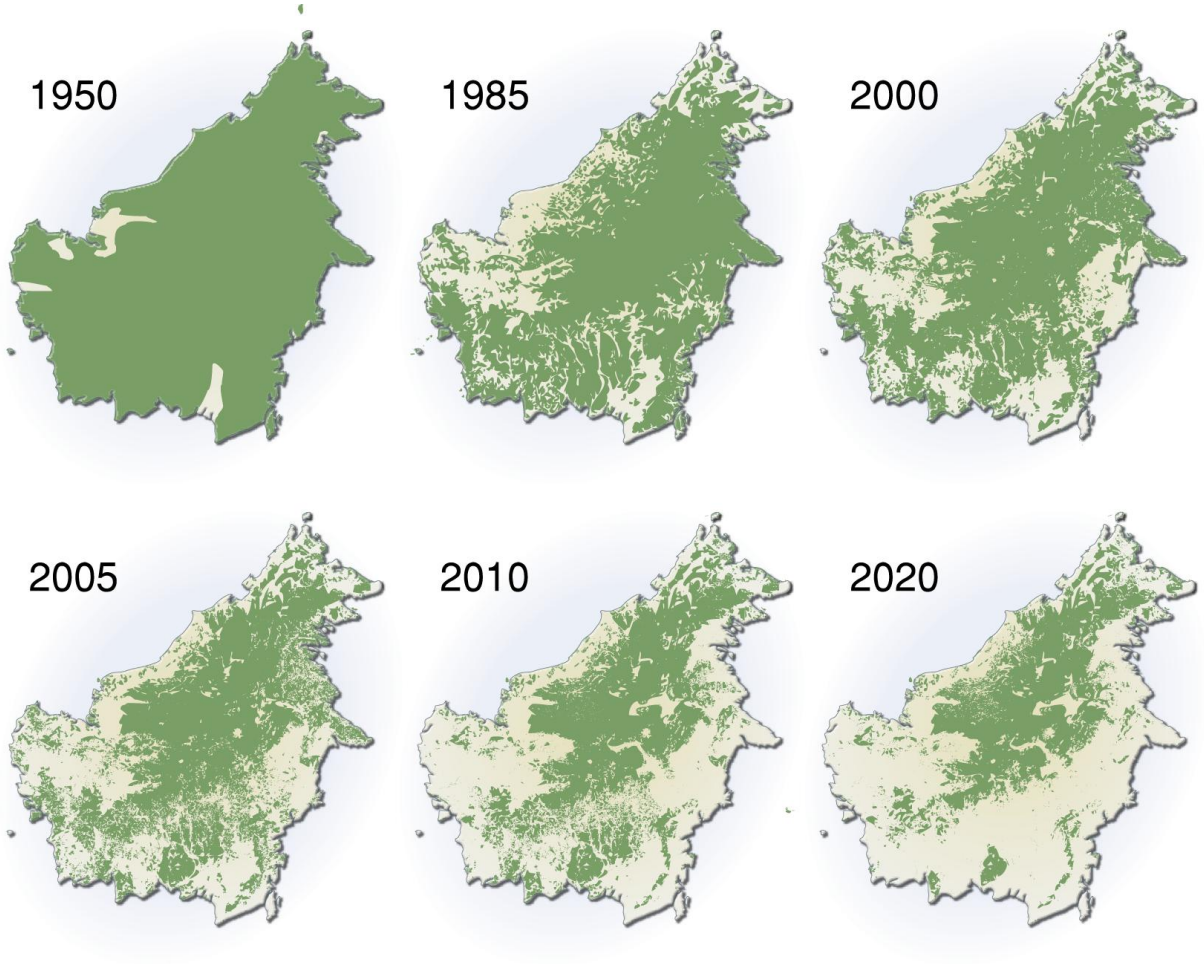


Figure 10: Extent of deforestation in Borneo 1950-2005, and projection towards 2020 (UNEP/GRID-Arendal, 2007)

Energy sector: 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 MtCO2e, 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 MtCO2e in 2003 to about 716 MtCO2e 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 (World Resources Institute 2007).

Agriculture and waste sector: 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 (CH4) and nitrous oxide (N2O) emissions. 70 per cent 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 MtCO2e. This ranks Indonesia as the sixth largest emitter in the waste sector (USEPA 2006).

4 How to Deal with Climate Change?

Two possible coping strategies can be distinguished: adaptation to the impacts of climate change and mitigation of the causes (mainly greenhouse gas emissions) of climate change. Adaptation seeks to reduce vulnerabilities both in the short and long term. Mitigation aims at slowing down and eventually stopping or even reversing the global warming. Adaptation measures will have to be implemented regardless of the mitigation measures taken, as the climate system will keep changing for the coming decades due to its inertia.

4.1 Adaptation Measures in Indonesia

Indonesia's strategies to deal with climate risks are:

Marine, coastal and fisheries sectors

- Conduct inventory to all structures (building) in the coastal area to anticipate the impact to sea level rise and high tidal wave that could impact those building and planning the effort to rearrange the coastal area which have high risk to the impact of sea level rise.
- Planting mangroves or other coastal plants in the coastal area involving the community and fisher families.
- Implementing related integrated coastal management (ICM) with restoration of river water catchments area with the objective to increase the community's income.
- Guidance and awareness rising to the fisherman and coastal community in general about early warning system on the event of climate change and the utilization of weather information for marine activities.
- Development of fishing ships that is resilient to weather change and high wave as well as environmentally friendly equipment for capture fisheries.
- Conduct research concerning the impact of climate change to the cultured fisheries and resilient fish species.
- Formulation of a disaster strategic mitigation plan (related to extreme events such as tropical storms and high waves/ wave climate)
- Collect data to conduct hazard/risk mapping of coastal areas and small islands to exposure of climate change (NAP 2007).

Agricultural sector

- Improve data and information management: e.g. mapping monitoring of drought prone areas, developing a spatial and temporal early detection system for drought or using climate information including weather and climate forecasting to increase the effectiveness of agro business.
- Management of farming activity: e.g. water efficient use by developing System Rice Intensification (SRI) and Integrated Plant Management (TPT) or irrigation system, increase land fertility, appropriate technology to accelerate planting and implement good agricultural practices (GAP) to revitalize farming system.
- Management of irrigation infrastructure: rehabilitate and improve irrigation network to increase cropping intensity and efficiency of water use, use of alternative water resources and systems and pump mobilization trough participative movement.
- Institutional Management: e.g. formation of working group on climate change and strengthen intersectional and institutional exchange.
- Research: e.g. conducting climate change impact analysis on season shifting and researching on resilient seed to climate change with high productivity
- Socialization and Advocacy: e.g. awareness raising on climate change and its impact on agriculture sector as well as the governmental mitigation and adaptation policies,

implementing planting calendar mapping, forming an information system to prevent loss due to forest/land fire and developing an agricultural information system.
- Others: e.g. developing a food diversification and agricultural product marketing policy, planning water supply for agriculture activities during dry seasons or rearrangement of food production system (NAP 2007).

Water resources

- Conduct inventory of raw water intake locations for drinking water in river and irrigation area that will be impacted by sea level rise and identify the effort to address it;
- Conduct inventory on polluted river watersheds and rehabilitate them
- Implement water storage facilities (e.g. reservoir or pond) in Java, Sumatra, Sulawesi, Maluku, Bali, NTB and NTT.
- Continue water saving efforts
- Increase the carrying capacity of river watersheds by preventing damage and rehabilitating water catchment areas through (i) land conservation by mechanic (for example terracing) and vegetation methods, (ii) dam construction or (iii) reduce the flow speed and increase water absorption.
- Institutionalize the use of weather and climate forecast information to minimise the risks of flood and drought trough management of reservoir and dam levels
- Conduct geo-hydrological research for ground water basin and foster development of them.
- Foster other water resources, e.g. desalination or recycling technology for drinking water.
- Implement the national sustainable strategy on peat land
- Conduct an inventory of peat land according to its characteristics
- Rehabilitate water management in peat land area through the replacement of open channels with close-opened channel method (NAP 2007)

Infrastructure sector

- Modify standard criteria for planning, implementation, operation and maintenance of infrastructure due to structural fatigue by rainfall, drought or tropical storms
- Boost sidewalks, bike roads as well as trees along the road to encourage the community to use a bicycle or walk instead using a vehicle.
- Construct community houses with a vertical (stack) housing system
- Consider prediction on sea level rise as well as the spatial plan to construct land roads (NAP 2007)

Health sector

- Conduct health guidance to all communities for prevention of climate change impacts (e.g. malaria, dengue, and other tropical diseases) trough improving sanitary facilities.
- Conduct research to identify risk of new diseases due to changing climate boost domestic production of medicine.
- Strengthened surveillance of disease and health protection as well as the health system itself.
- Improve communication, information and education to increase awareness of community.
- Develop an early warning system (NAP 2007).

Forestry and biodiversity sector

- Protect the forest ecosystem to ensure its richness of forest products and use as natural resource.
- Conduct an inventory of the Indonesia's biodiversity and establish a genetic bank for plant species (NAP 2007)

4.1.1 Multi-/Bilateral Adaptation Projects in Indonesia (incomplete list)

Climate Change and Sustainable Development, UNDP funded: UNDP is supporting Indonesia in maintaining and managing the country's rich environment, including Indonesia's vast marine and terrestrial biodiversity and energy resources. UNDP is working for a sustainable environment and development policy, which integrates climate change concerns and at the same time provides poverty reduction and human development (UNDP 2010a)

Building local capacity for climate change adaptation: One example of UNDPs local climate change work is UNDPs focus on the vulnerable Aceh province. UNDP will, in cooperation with the International Centre for Aceh and Indian Ocean Studies (ICAIOS) and supported by the Ford Foundation, train local researchers in the Indonesian province of Aceh to become experts on climate risk management, including adaptation and mitigation in relation to poverty. This thorough training will enable the researchers to provide information and policy advice on climate change and poverty to the local government, as well as map the future challenges of Aceh in relation to these issues. The aim is to strengthen the local government's capacity to develop environmentally sound and sustainable policies in a changing climate (UNDP 2010a).

Crisis Prevention and Recovery, UNDP funded: Indonesia is one of the most disaster-prone countries in the world. Natural disasters threaten human development and undermine the achievement of the Millennium Development Goals. Social conflict is another serious development impediment. The United Nations Development Programme (UNDP) therefore gives top priority to supporting Indonesia's crisis prevention and recovery efforts. UNDP is supporting Indonesia's long-term peace and stability through three key focus areas: (1) disaster risk reduction, (2) peace through development (3) disaster recovery (UNDP 2010b).

Climate Change Programme, WWF funded: There is a strong and growing consensus that humans have had a role in this change, and because of this WWF helps to slow down this process and supports nature and communities to adapt to these changes (WWF 2010).

Marine Programme, WWF funded: WWF-Indonesia is working with relevant stakeholders to create a network of Marine Protected Areas, in which communities are actively involved in the planning, implementation and reaping of benefits with marine conservation areas and fisheries management schemes (WWF 2010)

Vulnerability and capacity assessment in West Kalimantan, Indonesia, World Vision funded: the project aimed at strengthening the capacity of people in poor communities, mobilizing them for action, supporting their adaptation of the impacts of climate change, assessing local wisdom, and using secondary scientific information and new methods to assess risks. New programming methods and standardized vulnerability assessment tools are now being rolled out in World Vision's programming (World Vision 2010).

4.2 Mitigation Measures in Indonesia

Forestry and Energy are the sectors with the largest mitigation potential in Indonesia. In the National Action Plan Addressing Climate Change Indonesia identified therefore also energy, forest as well as marine and fisheries sector as priorities:

Energy:

To support the mitigation effort in energy sector and to achieve the optimal energy mix, three key points were identified:

a. Energy diversification;
b. Energy conservation; and
c. Implementation of clean technology (such as Carbon Capture and Storage – CCS).

In detail, the following activities were identified for a. Energy Diversification:

- Mapping the potential, research and development on new energy and renewable energy that appropriate with the Indonesian characteristic
- Giving incentive to the development and utilization of new energy and renewable energy.
- Encourage reasonable pricing for commodities, technology and fuel by calculating and including social and environmental costs in the production costs and selling price
- Encourage an economic growth path based on low pollution energy by increasing the use of renewable energy.
- Conduct decentralized energy systems and boost the use local new energy and renewable energy.
- Build more infrastructures for low emission technology.

In detail, the following activities were identified for b. Energy Conservation:

- Dissemination of Information about energy conservation to the energy consumers.
- Incentive and disincentive through financial mechanism
- Regulation to implement energy conservation to all user sector and implement saving energy standard
- Reduce energy intensity, among other with implementation of carbon labelling in industry production.
- Utilize science and technology to develop light weight, functional, efficient and good quality products.
- Formulate and implement energy saving building standards (NAP 2007)

Forest

- Preventing illegal logging to reduce the release of CO2 emissions into the atmosphere
- Forest and land rehabilitation to increase the capacity of carbon absorption (sink enhancement).and foster the resistance and adaptability to extreme climate related events.
- Restructuring the forestry sector, particularly the industry and accelerate the development of plantation forest to increase the capacity of carbon absorption.
- Strengthen the forest area by clarifying the forest status and boundaries with its institution, then the illegal activities could be reduced and carbons sinks increased.
- Incentive and disincentive mechanism for local government in increasing the forest vegetation coverage, with monitoring and evaluation.
- Tackling and preventing forest fire.
- Sustainable peat land management (NAP 2007)

Marine and Fisheries Sector

- Mangrove and coastal vegetation planting with community involvement and increase at the same time their income.

- Coral reef rehabilitation through transplantation and artificial coral reef.
- To expand the Marine Protection Area up to 20 million hectares in 2020.
- Research to study the potential and to increase the CO2 absorption from marine sector by plankton, coral reef and sea weed etc (NAP 2007)

4.2.1 Multi- /Bilateral Mitigation Projects in Indonesia (incomplete list)

UN- REDD-Programme, funded by Norway: Indonesia holds the world's third largest tropical rainforest, but has the world's second largest deforestation rate. In fact, approximately 70% of Indonesia's GHG emissions are related to land degradation, inappropriate land uses, and land conversion. UNDP is therefore assisting Indonesia in preparing for large scale reduction of GHG emissions through the UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD Programme). UN-REDD is a collaboration initiative between FAO, UNDP and UNEP, aiming to assist tropical forest countries in establishing a fair, equitable and transparent regime for reducing emissions from deforestation and forest degradation (UNDP 2010a).

Climate benefits through Ozone Layer Protection, UNDP: UNDP has been the lead agency in assisting Indonesia in ratifying and implementing the Montreal Protocol, which concerns the reduction and phasing out of substances that both threaten the ozone layer and/or cause climate change. The aim of an elimination of chlorofluorocarbons (CFCs) is particularly important, and notably the Government of Indonesia banned all CFC imports in 2008. The reduction and phasing out of hazardous and toxic substances from industrial pollution is an equally important aim. UNDP is additionally on track to generate large scale GHG emission reductions from the private sector with over 300 private companies involved in the Montreal Protocol project (UNDP 2010a).

Climate Change Development Policy Loan (CC DPL) Program, World Bank funded (US$ 200 million): It supports the Government's policy agenda on climate change, an issue of growing global concern. CC DPL provides support in three core areas: (i) addressing the need to mitigate Indonesia's greenhouse gas emissions; (ii) enhancing adaptation and resiliency efforts in key sectors; and (iii) strengthening the institutions and cross-cutting policy framework needed for a successful climate change response. An approach that increases adaptive ability, builds community resilience and increases preparedness for managing disasters makes economic sense for Indonesia, a kind of insurance. Indonesia may also be able to tap into new forms of global financing to assist in this adaptation response (World Bank 2010).

Indonesia Climate Change Trust Fund (ICCTF): Effective financial mechanisms are critical in order to attract resources on climate change mitigation and adaptation. Indonesia is currently in the process of operationalizing the 'Indonesia Climate Change Trust Fund' (ICCTF), a Multi-Donor Trust Fund (MDTF) intended to fund climate change initiatives in Indonesia. The ICCTF is, in fact, the first nationally owned, led and administered MDTF in Indonesia. UNDP has been appointed as the transitional fund manager for ICCTF, and assists the Government in the operationalization of the fund. Several donors are already committed to contribute to ICCTF, such as DFID, AusAID, Norway and the US Department of Energy (UNDP 2010a).

Kalimantan Forests and Climate Partnership (KFCP), Australian Government Initiative supported[1] ($30 million over four years): Under the KFCP, Australia and Indonesia are working together to develop and implement a large-scale REDD demonstration activity in Central Kalimantan. It aims to demonstrate a credible, equitable and effective approach to reducing

[1] With an overall funding target of $100 million, the KFCP aims to raise the remaining funding through contributions from, or coordinated actions with, the private sector or other donor countries.

emissions from deforestation and forest degradation, including from the degradation of peat lands that can inform a post-2012 global climate change agreement (KFCP 2010)

FORCLIM, GTZ: With the Forests and Climate Change Programme (FORCLIME), Germany supports Indonesia's efforts to reduce greenhouse gas emissions from the forestry sector, to conserve forest biodiversity within the regional Heart of Borneo Initiative and to implement sustainable forest management for the benefit of the people. Germany's immediate action will focus on helping Indonesia to get ready for the implementation of a future REDD mechanism ("readiness process") (GTZ 2010).

Cool Earth Partnership, Japan (loan up to 300 million U.S. dollars): Climate Change Program Loan, on which the Government of Japan and the Government of Indonesia agreed, is allocated for projects to reduce GHG emissions. Capital and guarantees are shared by Japan Bank for International Cooperation (JBIC), Nippon Export and Investment Insurance (NEXI), New Energy and Industrial Technology Development Organization (NEDO), and by the ADB Clean Energy Fund. A $300 million loan to Indonesia was provided in July 2008.

The Central Kalimantan Peat land Project (CKPP), funded by Wetland: It is a project which works in one of the main degraded peat lands of the region: the ex-Mega Rice project in Central Kalimantan to protect the remaining peat swamp forests and restore the degraded peat lands in Indonesia (Wetland 2010).

Climate Change, Pelangi Indonesia: Indonesia is highly vulnerable to climate change, thus development programs in various sectors must incorporate climate change issues in its planning to be better prepared. Pelangi Indonesia plays its part by mainstreaming climate change into national and local policies. It includes collaborations in climate change mitigation and adaptation activities as well as participation in international climate change negotiations. For example, forestry in the CDM: This research is aimed at understanding the local aspects of the implementation of the clean development mechanism (CDM) under the Kyoto Protocol in the forestry sector. The research is carried out in collaboration with local researchers in areas most potential to become the sites of forestry CDM projects. Three case studies were undertaken in Jambi, Central Kalimantan, and Central Sulawesi partially funded by the Government of Finland (Pelangi 2010).

Forest Conservation Initiative (FCI), WWF funded: The expansion of oil palm generates concern among consumers and NGOs because of its environmental (e.g. burning of land while clearing their areas, the destruction of high conservation value forests and pollution of rivers) and social impacts. The FCI serves as a big challenge in Indonesia, among others due to the recent 2nd meeting of the Roundtable on Sustainable Palm Oil (RSPO) held in Jakarta in 2004 which aims for the continuation of high conservation value forests (HCVF) work on the ground and better management practices development. WWF-Indonesia has been included as a member in both Steering and Organizing Committee of RSPO. WWF focuses, for example for HCVFs, on supporting ground work inside oil plantations and also the need for developing lessons-learned and good reporting documents (WWF 2010).

5 Climate Change and Disaster Risk Reduction Policy

5.1 Climate Change Policy

The international framework to tackle the challenge posed by climate change is specified in two Conventions of the United Nations: the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The Convention intends to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Kyoto Protocol sets binding GHG emission reduction targets for the industrialized countries that ratified the Protocol.

In December 2011, South Africa will host the next international climate conference of the United Nations which still needs to do much work left from the last negotiations in Cancun, Mexico 2010. The international communities agreed on a non binding Cancun Agreement with mixed outcomes. The positive side include the setting up of a Green Climate Fund to assist developing countries, a process for addressing issues of loss and damage caused by climate change and a registry for developing country actions to adapt to climate change and money to support their implementation. The decisions also recognize that current emission targets are not ambitious enough and that they must scale them up and provide more transparency on actual progress. Several important shortcomings still remain as for example the question of how the future legal framework will look nor was any time-table established for making this decision.

For Durban, parties need to bring the science back into the UNFCCC process and find ways to bridge the large “gigatonne gap” between current reduction pledges and what is scientifically required to stay below a 1.5°C average global temperature rise. This gap includes for example the EU’s own current weak emissions reduction target of only 20% below 1990 levels, when a science based target would require at least 40% for the EU.

In the past, Indonesia has played an active and constructive role in the international climate negotiations too by hosting the 2007 COP13 UN climate conference, which developed the Bali Roadmap for a new global climate agreement.

On the national level, Indonesia has given attention to environmental management since the early 1980s. The extent of social ecological damage up to now remains a stimulus for Indonesia to take stronger initiatives in restoring and managing the environment. Although Indonesia does not have any obligation to reduce its greenhouse gas emissions, it does have an interest in playing an active role in global efforts to tackle climate change. Indonesia ratified the United Nations Framework Convention on Climate Change (UNFCC) in 1994 and ratified the Kyoto Protocol in 2004 (NAP 2007). Indonesia submitted the First National Communication on Climate Change in 1999 to UNFCCC.

The Ministry of Environment’s Climate Change Division is the focal point serving as the designated national authority for the Clean Development Mechanism (CDM). A National Committee on Climate Change and a related Steering Committee were established to offer broad policy guidance and to make funding allocation decisions. The Steering Committee is served by an advisory panel and a technical committee headed by the MoE and the National Development Planning Agency (BAPPENAS). Indonesia released its National Climate Change Action Plan “*National Action Plan Addressing Climate Change”* in 2007 (ADB 2009).

The National Action Plan covers both mitigation and adaptation as complementary activities. “Adaptation to climate change is a key aspect of the national development agenda, in order to achieve development patterns that are resilient to the impacts of current and future climate change “ (NAP 2007). The Plan identifies the following sectors most at risk:

- Water resources;
- Agriculture;

- Coastal, marine and fisheries;
- Infrastructure;
- Health;
- Forestry and biodiversity.

Indonesia has carried out several actions to implement the Convention and Protocol in anticipation of climate change, which cover the mitigation and adaptation effort, including, among others (NAP 2007):

LULUCF Sector	• Addressing Forest Fire: (i) the Government Regulation No. 4/2001 concerning Environmental Damage Control and or Environmental Pollution related with Forest and Land Fire. (ii) Preventive Forest Fire efforts with satellite monitoring, field monitoring of companies, air quality monitoring, and community empowerment to change the practice of land clearing from slash and burn to not using fire or controlling fire. The implementation is accompanied by the participation of communities and appropriate measures e.g. increasing their or training of farmers. (iii) Establish Manggala Agni (forest fire control brigade) to monitor, prevent and address the forest fire. • Issued the Presidential Instruction No.4/2005: In this decree, the President has ordered to accelerate the elimination of illegal tree cutting in forest area and its distribution throughout the Republic of Indonesia territory. • Integrated Coastal Management was implemented through mangrove forest planting activities in the north of Java, east coast of Sumatra and several provinces. The aim was to sensitize the communities, especially women, to the degradation of coastal vegetation which serve as carbon sinks, develop economic potential for ecotourism and encourage the use of coconut charcoal as source of energy instead of mangroves. • Formulation of draft Guidance for Water Conservation (absorption and water reservoir) and National Water Saver Partnership Movement. • Management of coral reef by transplanting live coral reefs from one place to another to accelerate the regeneration of the damaged coral reef. • Use of breakwaters to reduce erosion in coastal areas. • Land Rehabilitation and Reforestation: (i) National Movement for Land rehabilitation (Gerhan) to replant forest over 59 million ha of critical land in Indonesia. (ii) Toward Green Indonesia (MIH), has run as a program from 2006 to increase the coverage of vegetation (improvement of water management, soil and coastal stabilization), energy conservation and atmospheric protection. • Management of Peat Land: (i) Presidential Instruction No. 2/2007 concerning Revitalization and Rehabilitation of Sustainable Peat Land. (ii) Draft formulation on Sustainable Peat Land Management. (iii) Ministry of Environment conducted an inventory and mapping of peat characteristics. (iiii) Peat land restoration by damming channels to increase and maintain their water level. • River watershed programs stated that 472 river watersheds should be addressed. • The Heart of Borneo (22 million ha of tropical rain forest in Kalimantan (Indonesia, Malaysia and Brunei Darussalam)) declaration was signed in 2007 by all three countries' and included the commitment to manage the Kalimantan forest region sustainably. • Improvement of land policy results indirectly in a reduction of GHG

	emissions through the decrease of forest degradation and deforestation.
Marine Sector	• The APEC Marine and Fisheries Ministerial Meeting in Bali in September 2005 adopted the "Bali Plan of Action" which anticipates the impacts of climate change to national development of marine resources. • In 2007 at APEC Summit in Australia, the 21 leaders of the APEC members supported the"Coral Triangle Initiative" (CTI) with the main objective to adapt to climate change through conservation and preserving 75,000 km2 coral reefs in six countries. • For "semi-enclosed water", according to United Nations Convention on the Law of the Seas 1982 (UNCLOS-1982) supports a cooperation between Indonesia, Australia and Timor Leste to conserve the marine and eco-system in the Arafura and Timor Seas. • With the Sulu-Sulawesi Marine Eco-region (SSME) program Indonesia and Malaysia cooperate for marine conservation.
Energy Sector	• Act N0. 17/2006 to give free or reduced import tax for clean technology equipment • Presidential Instruction No. 10/2005 and Regulation No. 0031/2005 to regulate energy saving, • Presidential Instruction No. 1/2006 concerning Supply and Application of Biofuel as alternative fuel. • Presidential regulation No. 5/2006 concerning National Energy Policy • Regulation No. 1122K/30/MEM/2002 regarding Small Scale Power Plant respectively Regulation No. 002/2006 regarding Medium Scale Power Plant using renewable energy • Regulation No. 0002/2004 regarding the policy on renewable energy development and energy conservation • Monitoring of Air Pollution emission from industry sector with motor vehicle emission test. • Rural Energy Self Sufficient Program for energy sources by using hydro or solar power plant. • Implementation of Cleaner Production Program (CPEE) and Energy Efficiency in industry sector (e.g. cement, steel or fertilizer) • Regulate and Ban the import of environmentally unfriendly goods. • Regulation No.7/2007 regarding static source emission standard for boiler
Capacity Building	• To encourage CDM project activities in Indonesia, CDM training activities have been conducted for key stakeholders. • Establish climate field schools in 25 provinces to increase farmers' understanding of climate information and its application. A climate field school has been established in Indramayu.

Under the Kyoto Protocol, developing countries are encouraged to contribute to emission reductions through trading of emissions rights. The Clean Development Mechanism (CDM) allows mitigation projects in developing countries to earn certified emission reduction (CER) credits, which can be sold to industrialized countries to help them meet their emission targets. This mechanism aims at stimulating sustainable development and emission reductions in developing countries.

The National Commission on the Clean Development Mechanism was set up in 2005 as the designated national authority (DNA). The commission is responsible for issuing approval letters to CDM project proposals that fulfil Indonesia's sustainable development criteria. The

commission consists of representatives of nine government agencies. In the middle of January 2011, 48 CDM projects were registered and 49 at validation in Indonesia. Out of the registered project are 23 methane avoidance projects (most waste water recovery), 8 biomass energy and 6 landfill gas projects. For more information about CDM in Indonesia, please view http://dna-cdm.menlh.go.id/.

5.2 Disaster Risk Reduction Policy

Disaster risk reduction is about putting in place measures to limit the negative impacts of natural disasters, especially the frequent medium-scale disasters that continually erode the development gains of communities. Disaster risk reduction activities reduce the likelihood of a disaster occurring (through things like flood protection mechanisms, livelihood diversification, safe building practices), or/and strengthen community's ability to respond and cope with a disaster (disaster preparedness activities- like cyclone shelters or evacuation routes).

Disaster risk reduction integrates the physical conditions of a hazard with the social and economic factors affecting a community's vulnerability and resilience. Thus it is often similar and strongly linked to climate change adaptation. Both disaster risk reduction and climate change adaptation aim to minimise the impact of natural hazards, including extreme weather events.

Building communities' resilience to natural disasters and climate change is critical to development. Therefore many governments, development agencies and community groups are integrating climate change adaptation into disaster risk reduction.

Indonesia linked the adaptation agenda to address climate change with the National Action Plan on Reduction of Disaster Risk (RAN-PRB) (NAP 2007).

Indonesia's disaster management landscape changed significantly following the 2004 Indian Ocean tsunami and its 2005 commitment to the Hyogo Framework for Action 2005-2015. During this time, the world's countries, including Indonesia, recognised that responding to disasters is not enough - more must be done to reduce the risk of these disasters occurring. Investing in disaster risk reduction not only saves lives and livelihoods - it helps reduce the costs involved in responding to disasters, can offer a measure of protection to developing economies, and helps safeguard critical infrastructure (AIFDR 2010).

In 2007 Indonesia passed its first Disaster Management Law (24/2007), which outlines the many roles and responsibilities of the Government of Indonesia, sub-national governments and individuals in protecting the country from natural disasters. As part of this law, the Indonesian National Disaster Management Agency, Badan Nasional Penanggulangan Bencana, (BNPB), was formed and given responsibility of taking this law forward. The key government and community sector partners of BNPB, such as the National Platform for Disaster Risk Reduction, work with BNPB to achieve the mitigation and risk reduction components of this law through the implementation of the National Action Plan for Disaster Risk Reduction (2010-2013) and the Disaster Management Plan (2010-2014) (AIFDR 2010).

6 Bibliography

ADB, 2009: *The Economics of Climate Change in Southeast Asia: A Regional Review.* Mandaluyong City, Philippines. p.188

AIFDR, 2010:http://www.aifdr.org/aifdr_public_website/index.php?option=com_content&viem=article&id=60&Itemid=65&lang=en, Accessing 3.1.2011.

Baumert K. et al, 2005: *Navigating the Numbers; Greenhouse Gas Data and International Climate Policy.* Washington DC: World Resource Institute, 2005.

Boer R. and Faqih A., 2004: *Current and Future Rainfall Variability in Indonesia. In An Integrated Assessment of Climate Change Impacts, Adaptation and Vulnerability in Watershed Areas and Communities in Southeast Asia*. Report from AIACC Project No. AS21. International START Secretariat, Washington. District of Columbia.

Cruz, R.V. et al, 2007: *Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 469-506.

Department Kehutanan RI, 2007: www.dephut.go.id

FWI/GFW, 2002: *The State of the Forest. Indonesia*. Forest Watch Indonesia and Global Watch.

GRDP, 2011: *Global Risk Data Plattform*. http://preview.grid.unep.ch/index.php?preview=map&iso=IDN, Accessed 3.1.2011.

GTZ, 2010: *FORCLIME.* http://www.forclime.org. Accessed 1.11.2010

Hulme, M and N. Sheard. 1999. *Climate Change Scenarios for Indonesia.* Climatic Research Unit, Norwich, UK, 6pp.

IICTF, 2010: *The Indonesia Climate Change Trust Fund (ICCTF).* http://www.icctf.org/site/en/about-icctf/objectives.html. Accessed 1.11.2010.

IDCR, 2009: *Climate Matters in Southeast Asia.* Online: http://www.preventionweb.net/ english/professional/maps/v.php?id=7864, Accessed 3.1.2011.

IFAD, 2010: Online: http://www.ruralpovertyportal.org/web/guest/country/home/tags/ indonesia

IPCC, 2007: *Climate Change 2007: Synthesis Report.* Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva.

John Hopkins University and Terangi, 2003: *Coral Reef Education Database.*

KFCP, 2010: *Kalimantan Forests and Climate Partnership.* http://www.climatechange.gov.au/government/initiatives/international-forest-carbon-initiative/~/media/publications/ international/kfcp_factsheet.ashx. Accessed 6.1.2011.

Ministry of Finance (2009), *Ministry of Finance Green Paper: Economic and Fiscal Policy Strategies for Climate Change Mitigation in Indonesia*, Ministry of Finance and Australia Indonesia Partnership, Jakarta.

NAP, 2007: *National Action Plan Addressing Climate Change.* State Ministry of Environment Republic of Indonesia.

Nayor, R.L. et al, 2007: *Assessing risks of climate variability and climate change for Indonesian rice agriculture.* Proceedings of the National Academy of Sciences of the United States of America 104(19): 7752-7757.

OCHA, 2007: *INDONESIA Natural Hazard Risks.* http://www.preventionweb.net/english/ professional/maps/v.php?id=3794, Accessed 3.1.2011.

PEACE, 2007: *Indonesia and Climate Charge: Current Status and Policies*.

Pelangi Indonesia, 2010: http://www.pelangi.or.id. Accessed 6.1.2011.

Peng S. et al, 2004: *Rice yields decline with higher night temperature from global warming.* Proceedings of the National Academy of Sciences of the United States of America 101: 9971–9975.

Risoe Center 2011: *CDM Pipeline overview.* http://cdmpipeline.org/publications/ CDMpipeline.xlsx, Accessed 6.1.2011.

State Ministry of Environment, 2003: *National Strategy Study on CDM in Forestry Sector.* Jakarta: s,n, 2003)

Susandi A., 2007: *Impact of Climate Change on Indonesian Sea Level Rise With Reference* to It's Socioeconomic Impact. Department of Meteorology.

Tsonis A.A. et al, 2005: *Unfolding the relation between global temperature and ENSO.* Geophysical Research Letters, Vol. 32, L09701, doi:10.1029/ 2005GL022875.

UNDP, 2010b: *UNDP Programs for Disaster Risk Reduction.* http://www.undp.or.id/ programme/ cpr/

UNDP, 2010a: *UNDP Programs for Climate Change.* http://www.undp.or.id/programme/ environment. Accessed 6.1.2011.

UNEP/GRID-Arendal, 2007: *Extent of deforestation in Borneo 1950-2005, and projection towards 2020.* UNEP/GRID-Arendal Maps and Graphics Library. http://maps.grida.no/go/ graphic/extent-of-deforestation-in-borneo-1950-2005-and-projection-towards-2020. Accessed 5 January 2011.

US Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC), 2010: mostly based on data collected from country agencies by the United Nations Statistics Division.

US Environmental Protection Agency, *2006: Global Anthropogenic Non CO2-GHG Emissions: 1990-2020.* www.epa.gov

Wetland, 2010: http://www.wetlands.org/Default.aspx?TabId=59&articleType=ArticleView& articleId=7. Accessed 1.11.2010.

Wetlands International, 2006. www.wetlands.org

World Bank, 2010: *Climate Change Development Policy Loan (CC DPL) Program.* http://web.worldbank.org/external/projects/main?Projectid=P120313&theSitePK =40941&piPK=64290415&pagePK=64283627&menuPK=64282134&Type=Overview, Accessing 1.11.2010.

World Resource Institute, 2007: *Climate Analysis Tools Version 04.*

World Vision, 2010: http://pubs.pembina.org/. Accessing 1.11.2010.

WWF, 2007: *Climate Change in Indonesia Implications for Humans and Nature.*

WWF, 2010: WWF: http://www.wwf.or.id/en/about_wwf/whatwedo. Accessing 1.11.2010.