



Republic of Indonesia

INDONESIA ADAPTATION STRATEGY

Improving Capacity to Adapt

**Ministry of National Development Planning/
National Development Planning Agency (BAPPENAS)**

November 2011

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Photos by Amin Budiarjo, ICCTF Secretariat

CLIMATE CHANGE IN **INDONESIA**



I. CLIMATE CHANGE IN INDONESIA

Indonesia as a country in the tropics made up of thousands of island experiences climate pattern changes. The impact of climate change in Indonesia's territories is marked by the climate pattern change in which there is a shift to the start of a season. Some areas experience delayed in beginning rainy season and beginning of dry season. The change in the beginning of the season is not consistent in all areas in Indonesia. Some areas even experience early change of season. The current rainfall intensity also differs from those of previous years. Currently, there is a tendency for larger divergence between the rainfall intensity during rainy season and the rainfall intensity during dry season, and sometimes the divergence in intensity is really extreme. The incidents of flood, drought and landslide are proofs of the climate change phenomena caused by the change of rainfall intensity in Indonesia. These incidents certainly impact the development process in the affected regions.

The other major threat as result of climate change impact in relation to Indonesia's geographical condition is sea level rise. The threat of sea level rise and islands subsidence into the sea in the future will be made worse by the incident of high sea waves along the coastal areas, especially during the transitional season. Other review in support of above-mentioned IPCC (Inter-Governmental Panel on Climate Change) report states that with the sea rise of about 1 meter, it is estimated that 405.000 hectares of coastal areas including small archipelago will be flooded.

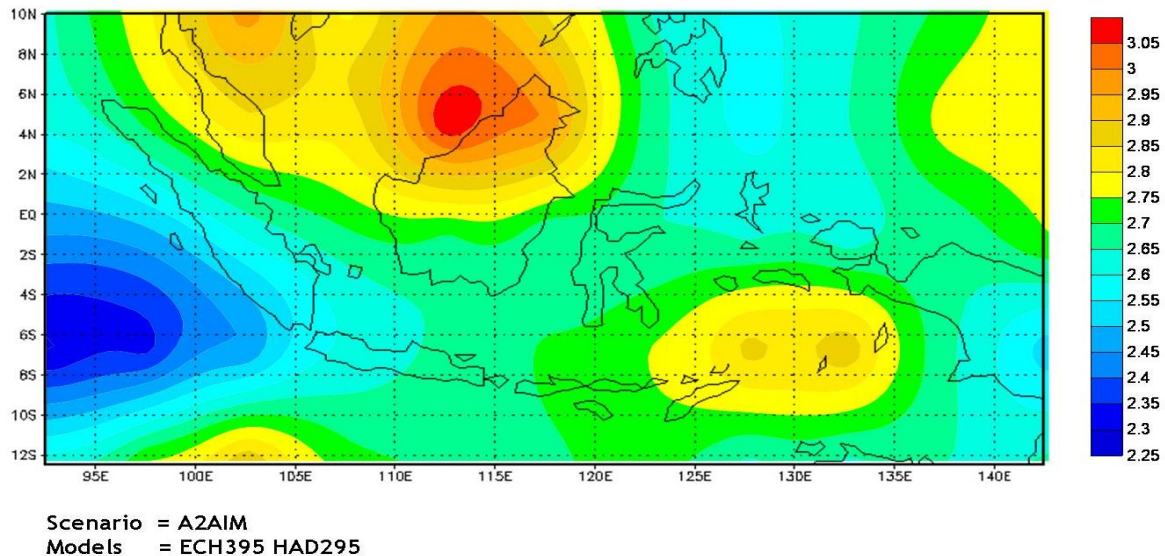
A. The Rising of Indonesia's Sea Level Temperature

Based on the global simulation model of A2 scenario¹, the average temperature change in Indonesia in 2100 will rise 3⁰C relative to the average temperature in 1990. Such temperature rise is still lower compared to the global temperature rise which will reach 6⁰C in 2100. However, Indonesia's geographical condition as an archipelago will generate more dynamic atmosphere condition in Indonesian territory which will affect the rainfall pattern change. The highest temperature change anomaly will take place in Borneo region with the potential of a more widespread drought. Furthermore, in several regions with high temperature anomaly, there is potential for increased condensation due to the areas being surrounded by the ocean. For instance, in

¹ Scenario A2: regionalization, emphasis on human wealth Regional, intensive (clash of civilizations)

The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological changes are more fragmented and slower than in other storylines.

the region of Nusa Tenggara, it is forecasted that there will be temperature anomaly of 2.7 – 2.9°C in 2100 with the potential of increased level of rainfall intensity in those areas (Figure 1).



GrADS: OOLA/IGES

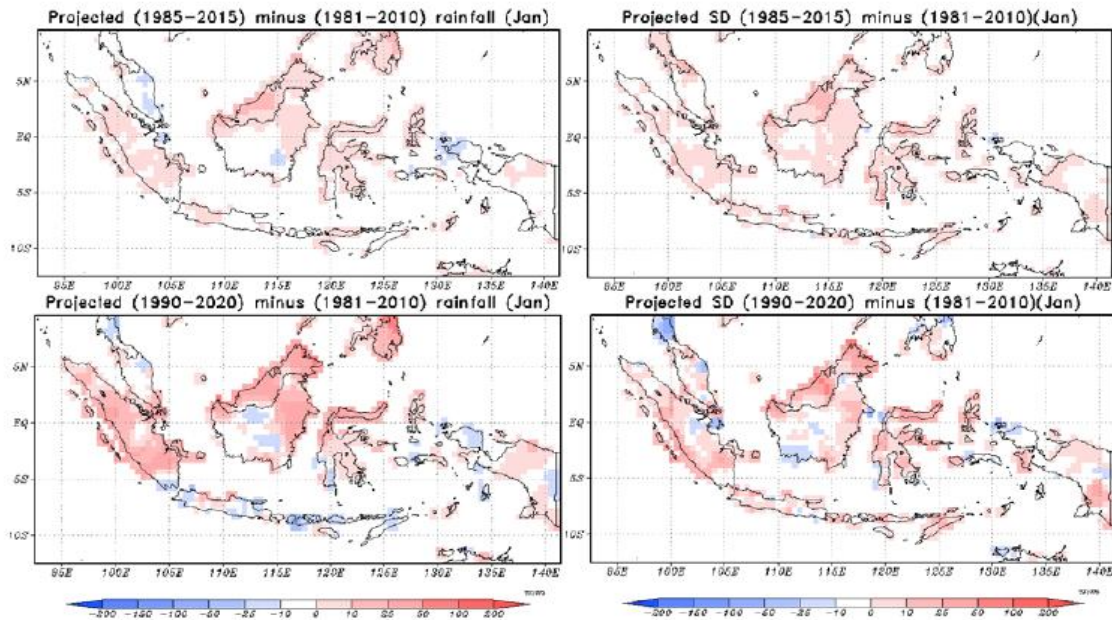
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Figure 1 Projected Change of Average Temperature in Indonesia in 2100 based on Scenario A2

B. The Change in Rainfall Intensity and Pattern in the Islands of Indonesia

The change in regional climate pattern due to global warming is affecting the local rainfall pattern. Such change is setting in motion the potential danger of the tendency of high intensity rainfall during wet months and low intensity rainfall during transitional months. This condition will be even worse in the future by 2080s. Based on analysis conducted in Java – Bali regions, West Java is the most vulnerable region under such extreme condition

The result of analysis conducted by Boerdan Faqih (2004) using the monitoring results from the existing 210 rain stations as well as the comparison with the current average rainfall intensity trend, it is noted that there has been trend of dwindling rainfall intensity in Java, Lampung, South Sumatera, South Sulawesi and Nusa Tenggara. On the other hand, the trend of increasing rainfall intensity is found in Borneo and North Sulawesi (Figure 2).

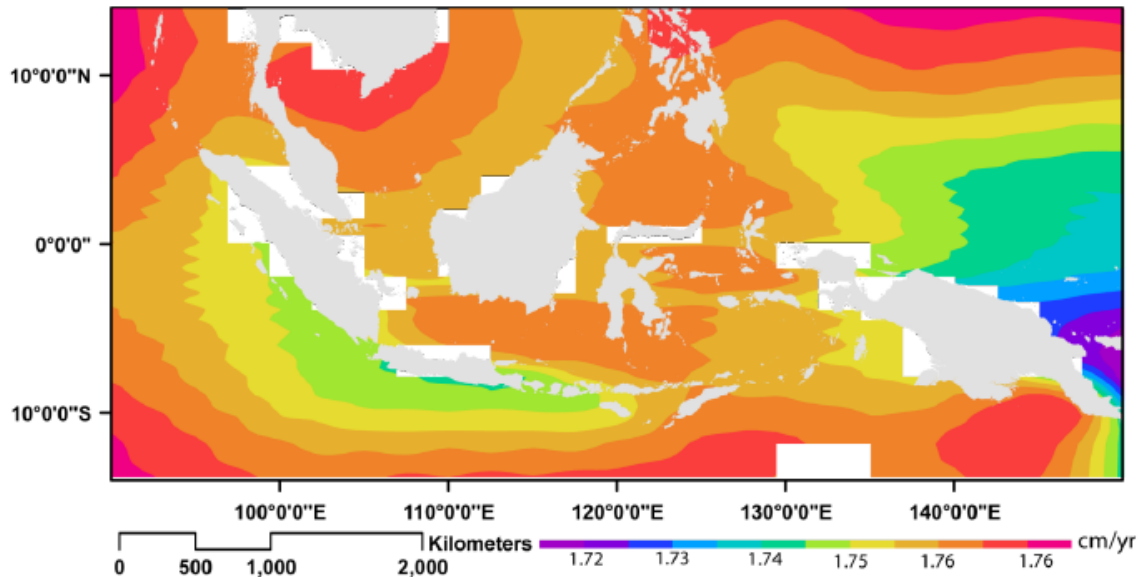


Source: Analysis and Projection, ICCSR, 2010

Figure 2 Projected Change of Rainfall in the Month of January

C. Indonesia's Sea Level Rise

The increase in the Greenhouse gases concentrate which affects global warming will indirectly affect the sea level rise through a process called thermosteric. The increase of Greenhouse gases concentrate is responsible for sea level temperature rise. The sea level temperature rise affects the expansion of sea water volume, whereby each degree Celcius increase will cause the sea level to rise by 0.2 – 0.4 m (Knutti et al, 2000). Furthermore, the sea level temperature rise will also have an affect on the defrosting of glaciers and icebergs in Greenland and the Antartics. Indonesia's sea-water territory has been experiencing sea level rise trend averaging 0.6 – 0.8 cm/year.



Source: Analysis and Projection ICCSR, 2010

Figure 3 Estimated Sea Level Rise in Indonesia Oceans Based on the Dynamic Increase of Ice Melting Model Post IPCC AR4

Based on Figure 3, Sea Level Rise will reach 175 cm in 2100 relative to the Sea Level Height in 2000. Meantime, Sea Level Height will rise by 52.5 cm in 2030, will rise by 87.5 cm in year 2050, and will rise by 140 cm by 2080. This trend elevates the increase of abrasion, erosion and sea water inundation, which is not only caused by the Sea Level Rise, but also by the storm wave, high and low tide by the moon's and sun's gravity, as well as the extreme climate such as La Nina which is modulated by the high Sea Level Rise. Moreover, the inconsistent Sea Level Rise in Indonesia, whereby the rise in Pacific Ocean's level is greater than that of Indian Ocean, has effects on the seasonal flow pattern, Indonesia Through Flow (ITF), the increase in erosion, the change of coastal line, and the reduction of wetland ecosystem. The change of ITF affects the regional climate change pattern in Indonesia such that the local rainfall pattern also changes. Besides, the reduction of wetland ecosystem will impact the coastal ecosystem and as well as increases the intrusion of sea water into the coastal aquifer.

The IMPACTS



II. THE IMPACTS

The climate change in the world has direct and indirect impact on Indonesia in sectoral context. There are several main impacts of the climate change in Indonesia:

A. Impact on Marine and Fishery

As a maritime country, there are certainly many marine and fishery potentials in Indonesia being threatened by sea level rise. Serious potential impacts are observed in several coastal areas of Indonesia such as northern coastal areas of Java, eastern coastal areas of Sumatera and southern coastal areas of Sulawesi. The subsidence of several small islands in the outermost borderline of Indonesia's territory has also become a serious threat due to sea level rise and sea water intrusion into the land area. A one (1) meter rise alone can sink 405.000 hectares of coastal areas and sink 2.000 small islands located at sea level as well as the coral reef areas. Data from the Ministry of Marine Affairs and Fisheries show that within the period of only 2 years, i.e 2005-2007, Indonesia has lost 24 small islands in the Archipelago. Out of those 24 sunken islands, three islands were located within Nanggroe Aceh Darussalam (NAD) province, three islands were located in North Sumatera province, three islands were located in Papua province, five islands were located in Riau Islands province, two islands were located in West Sumatera province, one island were located in South Sulawesi province, and seven islands were near Thousand Islands, Jakarta. These incidents have affected the borderlines of Indonesia's territories. One of the latest researches reveals that minimum 8 out of the 92 outermost small islands which form the borderline of Indonesia sea-water territory are extremely vulnerable to sea level rise. There are many parts in coastal areas, which are made more vulnerable by the erosion, which were already deteriorated by human activities such as the construction of piers and ocean dams, river dams, sand and rock mining, and also mangrove deforestation.

Climate change poses vast impacts on the coastal fishermen. The change in rainfall pattern and the high sea level rise forces these fishermen in their fishing boats to face unpredictable weather and high tide. Climate change has also disrupted the livelihoods in many islands, such as the fishermen in Maluku claim that they can no longer predict the right time and location to catch fish due to the altered climate pattern. Out of the 2, 7 million fishermen in Indonesia, about 80 percent of them are small-scaled and traditional fishermen who are vulnerable to extreme climate variation at the sea. The following table shows the potential impacts of climate change on the marine and fishery sector:

Table 1 Impact of Climate Change on Marine and Fishery Sector

No.	Environment Physical Change	Potential Impact
1	Flooding/Inundation at coastal areas	Disruption on social activities at the housing settlements
		Disruption on the operational activities of infrastructure and essential facilities at the coastal areas
2	The Increase of coastal erosion	Damage on housing settlements at the coastal areas
		Damage on the infrastructure and essential facilities at he coastal areas
3	The subsidence of small islands	Disruption on economic activities
		Damage on the infrastructure and essential facilities
4	The subsidence of the strategic outermost islands	Chaging in country's borderline due to the subsidence of strategic outermost islands
5	Flood on rivers and estuaries	Damage on the housing settlement, infrastructure, and essential facilities at the coastal areas
6	Decrease of water debit and water quality of the rivers and estuaries (drought)	Diminishing the fresh water supply at the coastal housing settlement, essential facilities, and fish ponds
		Decreasing the productivity of estuary and fresh water ponds
7	The increase of salt intrusion on the mass of rivers and lands	Diminishing the fresh water supply at the coastal housing settlements, vital facility, and fish ponds
8	The change in primary productivity → The change in fish migration pattern → The shifting of fishing ground	Decreasing or increasing the production of catch fishery → Decreasing or increasing the capacity of fish processing unit
9	The sudden change of wind pattern at the sea	Decreasing the duration of fish catching at the sea → decreasing the production of catch fishery
		Increasing the gasoline consumption by fishermen's boats
10	The change on diverse composition of marine life,	Degradation of ocean resources and beach environment

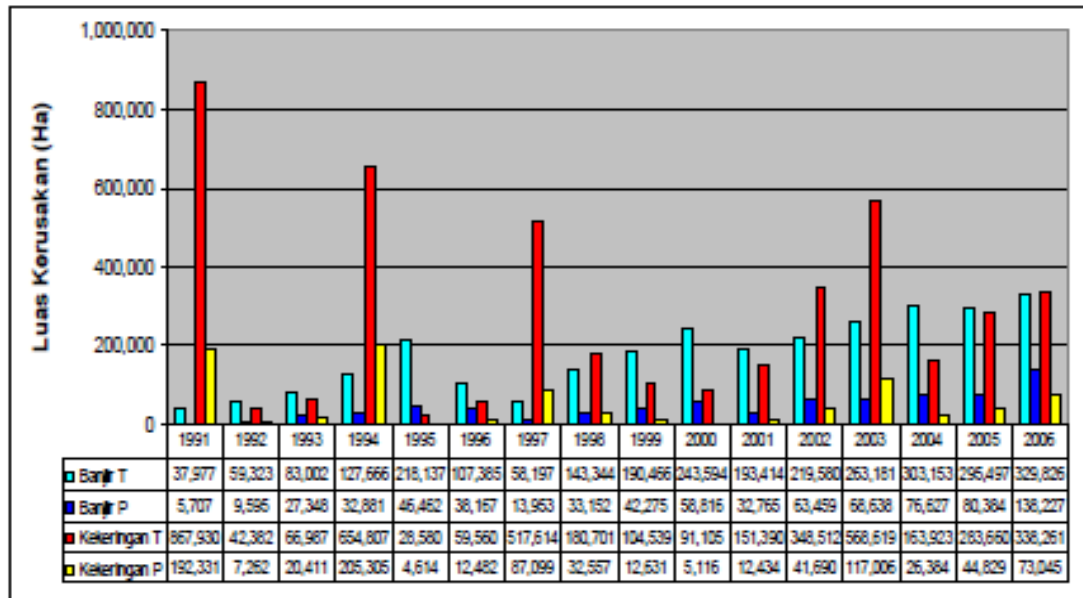
No.	Environment Physical Change	Potential Impact
	marine habitat damage	
11	The change of hydraulic regime at wetlands	Degradation of wetlands functioning as beach protection
12	The weakening of deep sea circulation flow (termohalin)	Heightening the disturbance on global climate
		Affecting the human livelihood

Source: Analysis and Projection ICCSR, 2010

B. Impact on Agriculture

The climate change which induces rainfall pattern change, temperature rise, and sea level rise has effects on the quantity and quality of agriculture yields, especially food crops. Farmers are finding it more difficult nowadays to determine the suitable types of plants and planting calendar due to unpredictable climate. In various areas in Indonesia, drought and flood have destroyed food crop harvests. There were many rice paddy fields destroyed or simply failed to produce due to long dry season or flood. The main impacts of climate change on agricultural areas in Indonesia are the degradation of land and water resources as well as damage on infrastructure (irrigation).

For example, rainfall pattern change and extreme climate cause rice paddy fields in several regions/areas to experience drought when other areas are damaged by flood. The result of all that is the potential increase of diminishing yields from 2.4-5 percent to become more than 10 percent (R&D Ministry of Agriculture, 2008) During period of 1991 to 2006, the area of rice paddy fields suffered from drought was around 28,580 to 867,930 hectares per year and damaged area was about 4,614 to 192,331 hectares (Directorate of Plant Protection, 2007). A more widespread drought was experienced during El Nino years (Graph1)



Source: Directorate of Food Crop Protection, 2007

Graph 1 the size of Rice Paddy Fields Affected by Drought and Flood in Indonesia within the period of 1991-2006

The growing threat of flood on rice paddy fields is responsible for the declining harvest area and reducing rice paddy production. Nationally, the flood vulnerability level per district in the entire territory of Indonesia can be observed from Graph 1. In Java, the size of rice paddy fields which is prone to flood/inundation reaches 1,084,217 hectares, and the extremely prone ones are 162,622 hectares, whereas in Sumatera there are 267,278 hectares, 124,465 hectares out of which are 1998 in South Sumatera and 50,606 hectares are found in Jambi. Based on the report of the Directorate of Food Crop Protection (2007), the size of area affected by flood within 16 years period (1991-2006) fluctuated with average size of damaged area of 31,977-32,826 hectares and 5,707-138,227 hectares failed to produce.

More so towards year 2050, without any national effort to adapt to climate change, it is estimated that the strategic food crop yield will decline by 20.3-27.1% for rice paddy, 13.6% for corn, 12.4% for soybean, and 7.6% for sugar cane compared to the condition in 2006. The potential decline for the rice paddy yield is related to the declining of rice paddy field for the size of 113,003-146,473 hectares in Java, 1,314-1,345 hectares in North Sumatera, and 13,672-17,069 hectares in Sulawesi (Handoko et al. 2008). The extent of loss due to sea level rise against the rice paddy field shrinkage in the form of rice paddy production in 2050 is

estimated to reach 4.3 million tons of dry milled bran or 2.7 million ton of rice. That potential impact is based on the productivity level and plant index which will have already increased by that time compared to current condition. For example, the average productivity of rice paddy field in Java and Bali by then will reach 7 tons/hectare with plant index (IP) 240%, whereas it is 5-6 tons/hectare with IP 150-200% for outside of Java and Bali.

Table 2 The Impact of Sea Level Rise Against the Decrease of Rice Paddy Field Coverage and Paddy/Rice Production until Year 2050

Area	Size of Rice Paddy Field (ha)	Decreased Size of Rice Paddy Field (ha)	Loss in the Equivalent of Dry Milled Bran (million tons)	Loss in Equivalent of Rice (Million Tons)
Java and Bali	3,309,264	182,556	3,067	1,932
Borneo	995,919	25,372	0,190	0,119
Sumatera	2,340,642	3,17	0,038	0,024
Sulawesi	892,256	79,701	0,956	0,602
Nusatenggara	341,304	2,123	0,025	0,016

Source: ICCSR, 2010

C. Impact on Health

The impact of climate change on human's health is specifically on water-borne diseases, vector borne diseases, malnutrition, mental disorders, and heat stress. Climate factor has effects on the contagion risk of the vector-borne diseases such as dengue (DBD) and malaria. As rainfall increases, the cases of DBD rise as well. Temperature is corresponding negatively with DBD cases, such that a rise in air temperature per week will reduce DBD cases.

The danger of climate change which affects human's health directly takes the form of direct exposure from the weather pattern change (temperature, rainfall, sea level rise, and the increased frequency of extreme weather). For example, the change in rainfall and salinity can increase or decrease the population density of vector-borne disease. Apart from that, it has direct effects on disasters such as floods, landslide, and tornado. Based on data from the Crisis Management Center of the Ministry of Health, during 2009, as many as 14 disasters occurred, e.g floods, landslides, thunderstorms and forest fires.

Scientific proofs have shown that the increase in malaria can be identified as potential impact of climate change (M. van Lieshout & Associates, 2004). For example, in the area with limited health facility, the rise in temperature will increase vector-borne diseases since the rise in temperature accompanied by the increase in rainfall intensity and surface water will prolong the transitional season in endemic areas. The distribution of mosquitos will be limited if condition is overly dry (low intensity of rainfall and low surface water). Malaria cases in Indonesia are quite high, i.e 11,789 of positive malaria cases in 2007. Furthermore, the number of malaria cases fluctuates depending on the intensity of malaria extermination program run by the government as well as environmental factors.

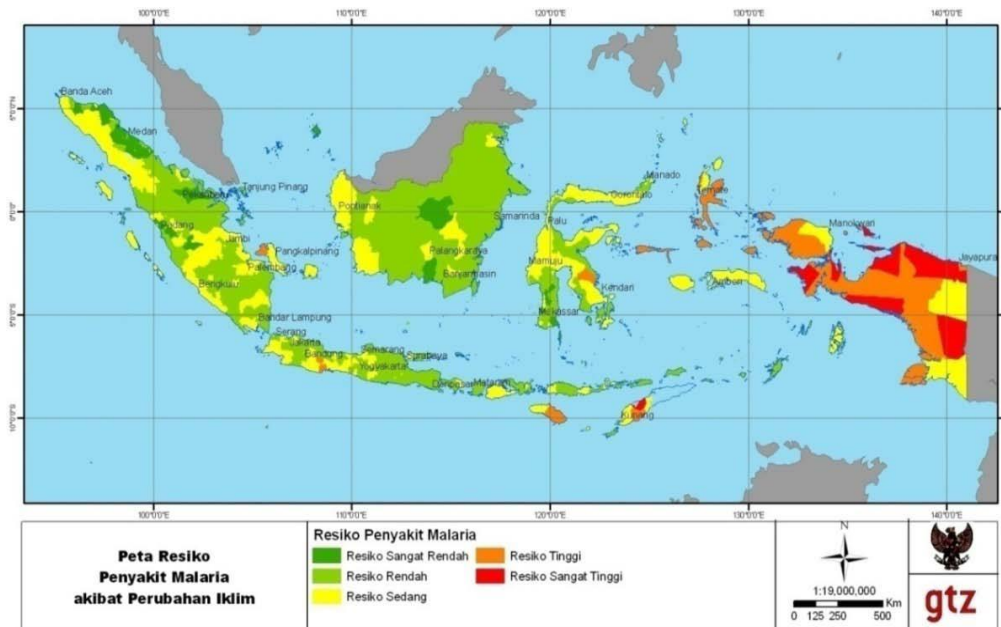


Figure 4 Risk of Climate Change on Incidents of Malaria Disease

Based on Figure 4 the analysis result on the impact risk calculation on climate change against the incidents of malaria disease in Indonesia shows that the areas with the highest risk are in Papua Island. This is consistent with the potential danger which affects malaria disease namely the transitional rainfall maximum intensity in that area which is around 450-500 mm. The above normal high intensity of rainfall and the unstable weather change induce the rapid reproduction of vector-borne disease malaria that is Anopheles mosquito. Apart from

that, the welfare condition of the people in Papua region comprising of marginal families accounts for the low access to health services and nutritious feeding as well as malnutrition issue such that they are prone to suffer from malaria disease. Other areas with high risk of malaria disease are Maluku, a minor part of Sulawesi, and Nusa Tenggara islands.

Extreme climate runs the risk of increasing dengue cases. The research done by Sitorus (2003) shows that there is a strong correlation between rainfall intensity and dengue cases in East Jakarta during the 1998-2002 period. The higher intensity of rainfall was followed by higher number of dengue cases. The areas with high and medium risk are still concentrated in the eastern part of Indonesia, particularly Papua Island and some part of Nusa Tenggara archipelago. Some cities and districts in the Java Island have low risk of dengue disease.

D. Impact on Water Resources

The analysis result by the Geographic Information System (GIS) describes comparatively the risk of water availability reduction in Indonesia during 2010-2015 up to 2025-2030 period as effected by the climate change. The impacts include:

1. Reduced Water Availability

There are five risk levels with the highest level of water availability reduction is found in the region of Java-Bali, particularly in several limited areas in the northern and southern parts of West Java, central and southern part of Central Java and East Java, in the capital city of North Sumatera, West Sumatera, Bengkulu and Lampung (Sumatera); Bali, NTB (Nusa Tenggara) and South Sulawesi (Sulawesi); whereas the high risk of water availability reduction is in about 75% of Java-Bali region; a minor parts in the northern, western and southern region of Sumatera; some parts of Lombok Island (Nusa Tenggara), and South Sulawesi (Sulawesi).

2. Flood

There are five levels of flood risk and flood distribution, with the highest flood risk is found very limitedly along the big rivers, particularly at the downstream in Java, eastern part of Sumatera; West, South, and East Borneo; East Sulawesi, and South Papua, whereas the high flood risk is found in the same regions of highest flood risk, only with greater area size.

3. Drought

The highest drought risk is found in general in the limited region in the central part of Java; northern part of Sumatera, and minor part in Nusa Tenggara, whereas the high drought risk is found in the greater area size in the central part of Java, Sumatera, and Nusa Tenggara;

4. Landslide

The highest landslide risk is generally found in the central and southern parts of Java-Bali, central and western parts of Sumatera, the most parts of Nusa Tenggara, and Sulawesi, and also central part of Papua, whereas the high landslide risk is found along the highest landslide risk areas as mentioned above with narrower areas.

5. Sea water intrusion

The potential impact of sea water intrusion in line with the danger and vulnerability of sea water intrusion is limited to several coastal areas, particularly in the regions of Java-Bali (Jakarta, Semarang, Denpasar) and Sumatera (Palembang and Padang). The risk of sea water intrusion is prompted by the increasingly shallow sea water surface - sea water interface at the coastal areas as well as related vulnerability including population density, land usage, water requirement and deep water drilling. Sea water intrusion causes reduction on water supply due to water quality deterioration and also land or building foundation damage.

E. Impact on Disaster Incidents

Threat of drought due to El Nino phenomenon is certainly (again) a supporting factor for forest fire which has been destroying million hectares of forest area. In reference to forest fire in 1997/1998 which destroyed an area of 9.7 million hectares, the aftermath of which has exacerbated the socio economic and environmental loss at national level as well as at neighboring countries. On the other hand, an incident such as flood and landslide has also increased in intensity. This is due to extreme change in rainfall pattern such that rain distribution falls out of pattern compared with previous seasons.

The climate change has increased both natural disaster and non-natural disaster risk experienced by the community. The most likely impact of climate change in Indonesia is the increased of rainfall frequency which affects infrastructure and housing damage in a way that many people lose their homes. Natural disaster such as flood accounts for 1/3 of all disasters taking place in Indonesia and has claimed more than 50% lives and

1/3 of total economic loss due to disaster. Climate change has also been responsible for intensifying tropical storm and the increase of of high tide frequency at the sea, which in turn enlarges the risk of death.

The impacts of climate change on other disasters incidents can be observed in the following table:

Table 3 Impact of Climate Change on Disaster Management

Type of Disaster	Climate Change			
	Precipitation	Surface Temperature	Extreme Climate	Sea Level Rise
Natural :				
Flood	V			V
Drought	V	V	V	
Typhoon			V	
Landslide	V			
Non Natural :				
Forest Fire		V		
Epidemy	V	V	V	
Pandemy/Disease Outbreak	V	V		

ADAPTATION STRATEGY



III.ADAPTATION STRATEGY

Indonesia aims to reduce the vulnerability of its economy and community to adverse impacts of climate change that are already occurring. At the same time, Indonesia intends to prepare its national and local institutions, as well as vulnerable communities, for the possible future impacts of climate change. These preparations will include measures to increase adaptive capacity through improved planning, enhance resource management, and expand coordination to deal with inter-sectoral and cross-cutting issues. Indonesia has established the Indonesia Climate Change Sectoral Roadmap (ICCSR 2010 - 2030)) to set its national goals, sectoral targets, milestones and priorities for actions with regards to adaptation and mitigation of climate change for all affected sectors of the economy.

To deal with and to minimize the impact of climate change, Indonesia shall concentrate on activities based on following strategies :

1. To enhance knowledge about the hazard and impacts of climate change to the ecosystem and community's livelihood
2. To integrate the climate change issues into the national and regional development planning
3. To integrate the climate change issues in the spatial planning of the urban, rural areas and, and small islands.
4. To build the capacity of the regional governments in formulating the strategies and climate change adaptation activities as well as to recognize, support, and facilitate smart adaptation efforts made by the community.
5. To develop and use technology to support the adaptation efforts and to improve community's sustainability in dealing with climate change impacts, especially in order to increase food sustainability and health quality.
6. To increase the application of climate information in the activities of agriculture, fishery, health, water resources management and disaster management in order to increase community's resilience in adapting to the climate change.
7. To formulate the policies and protection tools for the most vulnerable groups of people who are not able to anticipate and adapt to the climate change.

Next, the priority of adaptation activity in each sector is determined in the context of facing the challenge, risk and vulnerability which is unique and distinct in each sector. The priority of adaptation activity in the sector of marine and fishery, health, agriculture, water resources and climate related disaster management is elaborated as follows:

A. Adaptation Strategy in Marine and Fishery Sector

Geographically, Indonesia consists of islands and makes the country extremely vulnerable to climate change. Thousands of islands are in threat of subsidence and number of small islands have indeed sunken or are in the brink of subsidence. Moreover, socially the marine and fishery sector is dominated by fishermen and coastal community. The climate change affects the livelihood of this community in terms of fishing, for example. The unpredictable climate pattern has discouraged the fishermen to go out fishing thus resulting in declining income.

Indonesia's Adaptation Strategy in marine and fishery sector consists of :

1. Physical adaptation at coastal areas and small islands through integrated management and environmental friendly physical engineering.
2. Residential areas management
3. Infrastructure and public facility management
4. Management of fishery resources, water resources, security and defense of the outermost islands
5. Integrated management of coastal areas, small islands and marine ecosystem
6. Developing policy, rules and institutional capacity

Indonesia has formulated five priority activities for adapting to climate change in marine and fishery sector in 2010-2030. Those activities have been chosen considering the extent of the impact which is already and is inflicting the marine and fishery sector up to the current moments. The selection of priority activities in sequence can be based on several criteria, among others are: level of effectiveness (in responding to the potential impact of climate change), cost, feasibility, socio-cultural feasibility, competence in anticipating the existing impact, speed of implementation, as well as consistency with the policies of the central government and regional governments. These priority activities may be seen as present below.

Five Priority Activities on Climate Change Adaptation in Marine and Fishery Sector

- 1.** Formulating and or adjusting the regulations, policies, and institutional capacity of the marine and fishery sector in relation to climate change at coastal areas and small islands
- 2.** Adjusting the elevation, strengthening building structure and essential facilities in coastal areas in relation to climate change
- 3.** Adjusting the management of integrated sea-water fishery potential resources in relation to climate change
- 4.** Adjusting the management of sea, estuary and fresh water fishery potential resources
- 5.** Adjusting the management of strategic small islands in relation to climate change

Source: ICCSR, 2010

B. Adaptation Strategy in Agricultural Sector

The Adaptation Strategy of climate change in agricultural sector (based on the direction of agricultural development policies for Medium-Term Development Planning of 2010-2014 of the Agricultural Ministry) :

1. To increase the production of staple food crops and priority commodity basis local resources and to promote diversification of consumption, balanced distribution, and food accessibility.
2. To increase the capacity of human resources in agriculture sector (farmers, herdsman, and government apparatus) especially in managing climate change and threat to environment.
3. To develop and rehabilitate agricultural infrastructure (irrigation, agricultural methods, extension officer, planting field management including the husbandry sector, as well as land status and ownership).
4. To optimize the usage of land and water resources as well as developing environmental friendly agricultural activities
5. To provide protection to agricultural activities and its production (subsidy, agricultural insurance, tariff, price stability)
6. To promote research activity and dissemination of research result, especially in developing and advancing agricultural technology which is adaptive toward climate change

Despite its small contribution (only 7%) out of the total national greenhouse gases; the climate change impact on agricultural sector is quite significant. The change on rainfall pattern and extreme climate (flood and drought), temperature rise, and sea level rise have all impacted the productivity of the land and plantations. Out of various agricultural commodities, food crop is the most vulnerable to climate change impact. Therefore, the climate change adaptation efforts for food crop is given the first priority compared to other commodities.

The adaptation program in agricultural sector in Indonesia is more focused on the application of technology to support adaptation, building the institutional capacity as well as enhancing the sustainability and adaptation capacity of the community. The programs are elaborated in the form of chosen activities mentioned in the following table.

Priority activities of Climate Change Adaptation in Agricultural Sector consist of :

- Adjusting the planting pattern
- Selection of superior climate-change-resistant types of seeds
- Agricultural diversification
- Use of technology in administering fertilizers, planting fields and water management
- Food crop diversification
- Developing agricultural information system
- Developing agricultural workshop and variability workgroup system
- Developing agricultural insurance system
- Supporting innovative activity in the community
- Implementing the protection instrument for group of people most vulnerable to the unanticipated impacts.

Agricultural sector also has role to play in climate change mitigation efforts by focusing on plantation and agriculture on peat land. The activities may consist of :

- Development of plantation crop, especially palm oil and rubber on greenery and grass root fields.
- Development and implementation of non-burning technology in agricultural process on peat land.

C. Adaptation Strategy in Health Sector

The climate change adaptation strategy in the health sector comprise of :

1. To increase access, fair opportunity, affordability, and quality of health services, especially for the poor people, through the improvement of health services and infrastructure facility and basic healthcare (partly funded by the Special Allocation Fund)
2. To increase the availability of health officers and paramedics, especially for basic health care at remote and high risk areas.
3. To prevent and eradicate contagious diseases through decent management of contagious diseases, improvement of monitoring, finding, and testing of proper case handling method.
4. To prepare and carry out monitoring, handling of patient or people suffering from avian flu, administering of avian flu medication, facility and infrastructure as well as management of health cases at the hospital.
5. The handling of malnutrition cases on pregnant mothers, babies and under fives through community education on nutrition awareness, enhancement of nutrition monitoring.

In relation to climate change in Indonesia, there are 3 main diseases which must be given serious attention because their outbreak is fast: malaria, dengue fever, and diarrhea. The less fortunate people are the most vulnerable healthwise to the impact of climate change due to their limited access to quality healthcare.

In order to anticipate and reduce the impact of climate change which is taking place and will take place, Indonesia has put in place several strategies comprising:

Above strategies elaborated in several priority activities of adaptation including the enhancement of early awareness on disaster at community level, strengthening the disaster vulnerability assessment and risk assessment on the climate change, developing the policy framework and building the sectoral collaboration as well as community's participation. The table below presents some priority activities for adaptation at health sector as recommended to the ICCSR (2010):

Priority activities for adaptation in the health sector comprise:

1. Review, analysis, and research on the hazard, vulnerability, and risk as well as impact of climate change on health at national level and the formulating of adaptation model for selected urban and rural areas.
2. Strengthening the development policy basis community health and its socialization to the government apparatus.
3. Developing effective technology for sanitation, including adaptation strategy in the form of workshop and seminar, advocacy and socialization at the national level.
4. Strengthening the system of health services as response to the climate change in high risked areas.
5. Promoting community health education as well as clean and healthy lifestyle campaign

D. Adaptation Strategy in Water Resources Sector

The climate change adaptation strategy at water resources sector comprises:

1. prioritizing to meet the basic household needs especially in the water shortage areas, underdeveloped regions, and strategic areas;
2. managing the usage of deep water to meet the requirement of water supply and to accordingly improve the effort of water supply generated from surface water;
3. Building more water reservoirs as water supply, and optimizing the existing water supply through surveillance and maintenance.
4. Encouraging the participation of the private parties in the funding of water supply infrastructure construction especially in water distribution (conveyance system).
5. accelerating and complement the regulatory implementation of Law No. 7 of 2004
6. Building the capacity of the institutions involved in managing water resources in terms of communication, collaboration and coordination.
7. Increasing the participation and capacity of the community at the local level in managing water resources.
8. Collaboration between the government and the community in managing water resources.

The other risks at the water sector due to climate change are flood and drought. Nearly all Indonesian territories are prone to flood. Meanwhile, drought is increasingly occurring in Indonesia during the dry season. Therefore, knowledge on the vulnerability and risk in relation to water availability, flood and drought is the key to adaptation activity.

The development at water resources sector is aimed at managing water resources to meet the water requirement of households, urban community and industry. Indonesia implements eight (8) strategies in order to achieve the expected development.

To minimize the potential risk impact of climate change and its vulnerability toward water resources and water requirement of the community and industry, adaptation activity for water resources shall include data gathering, information system, research and capacity building, regulation and policy formulation. Several priority activities for adaptation at water resources sector are presented in the following table:

Priority Programs in the context of climate change adaptation at the water sector include :

1. Reviewing the vulnerability and risk of climate change at water sector at the regional level and strategic areas.
2. Increasing the capacity of reservoir and water infrastructure for the stability of water resources balance and water disaster prevention.
3. Increasing water availability at extremely vulnerable areas through effective technology and local water resources development.
4. Increasing water resources conservation and reducing the intensity of hazard and disaster due to climate change.
5. Reviving the local wisdoms, building capacity and participation of the community in climate change adaptation at water sector.

E. Adaptation Strategy in Disaster Management

In the past several years, the government has taken steps to manage various forms of natural diseases such as earthquake, tsunami, volcanic eruption, arson, and all kinds of extreme weather incidents. Indonesia needs to quickly respond to disaster caused by climate change which has different characteristics and requires different and unique management. In general, adaptation to disaster management aims to reduce risk of disaster through main strategy of reducing hazard and vulnerability as well as enhancing the existing capacity either at related institutions or at the community level.

In order to achieve the mentioned objectives, the adaptation strategy is elaborated into several main programs consisting of enforcing the rules and regulations and institutional capacity, integrated disaster management planning, research, education and training as well as building the capacity and participation of the community and other stakeholders in disaster risk reduction.

The adaptation strategy and program to manage climate-related-disaster is achieved through several priority activities. The table below presents the priority activities to anticipate disasters in relation to climate change.

Priority activities in anticipating climate change related disaster:

- Formulate regulations which contain mechanism on disaster risk reduction
- Forming and Empowering the Regional Agency for Disaster Management
- Education and Training on building the capacity of human resources in disaster management
- Collaboration with universities as facilitators of capacity building
- Formulating manual and reference on disaster management based on existing standard.
- Drafting disaster management planning both at national and regional level
- Including the component of disaster management planning in development planning
- Developing Science and Technology for disaster management
- Implementing Science and Technology for disaster management
- Integrating disaster management knowledge into school curriculums
- Building the capacity of human resources of educators in disaster management
- Disseminating information in relation to disaster management to the public.
- Utilizing the media to increase community readiness in handling disasters
- Establishing regional forum of disaster risk reduction
- Increasing the participation of volunteers
- Forming the mechanism of disaster risk funds (such as disaster insurance)

Apart from implementing the strategy programs and activities which are in direct response to the impacts of climate change, reducing the impacts of climate change indirectly can be achieved through the strategy to increase the adaptive capacity of the community and the government. Through efforts of building adaptive capacity, vulnerability may be reduced. Increasing adaptive capacity can reduce the risks and impacts of climate change.

There are three approaches which can be taken to increase the adaptive capacity of the community, namely:

a. Economic Capacity

Economic condition is a main factor in influencing the disaster vulnerability level of the community. Therefore, it is extremely crucial to increase the economic capacity in the community especially for those under welfare condition. As for the way to increase this capacity, it can be done by allocating a special fund for preparation in dealing with disasters. Such fund can be obtained from alternative sources outside of government's routine budget. Besides, a preparation can be made for non-interest bearing loan for poor people which may be used to renovate their damaged homes after the disaster.

b. Infrastructure Capacity

Enhancing the infrastructure capacity in general can increase the sustainability of the community and the country in facing climate change. This can be accomplished by fixing and improving the quality as well as the quantity of existing infrastructure, particularly those most prone to disaster.

c. Social Capital

A number of lessons learnt have shown that a society with social capital has greater sustainability in facing various shocks, pressures, and unpredictable changes. Increasing the social capacity of the community among others in the form of establishing institutions and mechanism in reaching consensus either directly or indirectly will enhance their resistance level in facing the risk of climate change. Increasing this capacity can be done by means of increasing the frequency of interactions among the community within a certain small environment. In this way, the dissemination of information in relation to climate change and building adaptation strategy at local level will be easier to achieve.

F. Mobilizing and Managing Knowledge and Technology, Stakeholders Network and Capacity Building

1. Mobilizing and Managing Knowledge and Technology on Adaptation

Indonesian institutions and experts are already done many activities in the area of climate change including on adaptation. Inventory on their activities will be catalogued and used for improvement of the adaptation strategy and formulation of a detail adaptation action plan. Several activities will be conducted to mobilize and manage knowledge and technology: (i) taking inventory and managing

knowledge on adaptation; (ii) mobilizing knowledge for policy setting and knowledge-based planning; (iii) managing technology for adaptation.

2. Stakeholder Network

Knowledge, capacity and experiences do not lie only in the government institutions, but rather stay in the university, non government think tank and also non government organization. Since formulation of adaptation plan and plan for implementation are huge task and responsibilities, therefore mobilizing stakeholder capacity is key to the success of adaptation and also mitigation of climate change. In both mitigation and adaptation, a network between government with university and NGO is in the process of establishment. Cooperation network and mobilization of their expertise and experiences especially at the implementation level in the local area and on the ground is important. The government plans to utilize the stakeholder network productively and effectively to perform the big task and to consistently implement the plan on adaptation and mitigation. The network should be facilitated with the working mechanism and sharing through direct mechanism and indirect mechanism using electronic media and IT.

3. Capacity Building

Capacity is very important to implement at the ground level and also for the local government in facilitating activities in local area. At the national level, capacity is needed in the area of policy formulation and adjustment, and program formulation and also impact analysis. Capacity building is very important also to continuously update the plan and implement it according to the current situation and adjust to the dynamics. A framework for capacity improvement will be formulated, including capacity to align all policy, program and activities to make the efforts and MRV system according to the global standard.

A close-up, low-angle shot of a lush green rice field. The plants are tall and dense, with long, narrow leaves and several panicles (seed heads) visible. The lighting is bright, creating a vibrant green color palette. The text "THE WAY FORWARD" is overlaid in the upper center of the image.

THE WAY FORWARD

IV. THE WAY FORWARD

Having laid out adaptation strategy in the 4 (four) main sectors, a more detail action plan is in the formulation process. There are 2 (two) steps to do next, while include: (i) Finalizing the adaptation action plan; and (ii) Putting the plan into implementation.

A. Finalizing the Adaptation Action Plan

Adaptation strategy was identified through stakeholder discussions. Several discussions with technical institutional and NGO were conducted, and resulted in the strategy formulated in this document. The discussion however, is not yet resulted in elaboration of detail and concrete actions. The formulation of detail action plan needs a consensus in the nature of vulnerability, who are vulnerable, in what way they are vulnerable and what kind of measurement and the methodology to determine the magnitude of vulnerability.

A.1 Assessment on vulnerability

Vulnerability assessment is an important steps to understand exactly the nature of vulnerability, its magnitude and what kind of impact it brought to the which community/people. Several vulnerability studies have been conducted by many experts both from universities and/or international institutions. Impact has been felt at the ground level. Matching the study results and the impact felt on the ground is very important to have a realistic measure on vulnerability. An objective measurement to know the magnitude and degree of vulnerability is important as an objective measure on vulnerability. People perception, especially the one who are vulnerable and suffer from the climate change impact, is also important to know the relative vulnerability across community. These two will complete the understanding on the climate change impact and input for vulnerability measurement.

Therefore, the next step is to finalize discussion on vulnerability and make consensus which measure to use, to objectively measure vulnerability. This will be the base to determine the current level of vulnerability, and a base to formulate actions to manage the impact of climate change and help to people to adapt to the new situations.

A.2 Identify and formulate actions to facilitate adaptation to climate change

Clear assessment on vulnerability and also the victims and their conditions will provide a base to identify actions needed to facilitate people to adapt to climate change. Discussion will be done both at the expert level, but more importantly also from the actors/victim of the climate change impact. Local and field input will provide a realistic situation. Discussion with people will also increase ownership and people participation later on in the adaptation process.

Starting points would be government program and activities in the Medium Term Development Plan (RPJMN) 2010-2014, especially in the cross sectoral program on climate change. While these cross sectoral program is a good and comprehensive input to the formulation of mitigation actions compiled in the Presidential Regulation No. 61/2011 on The National Action Plan for Greenhouses Gas Emission Reduction (RAN-GRK). Several program and activities in there will be qualified as adaptation activities/actions. Serial discussion will add new activities needed to help people adapt to climate change. To accommodate and seek input, a wider stakeholder's discussion will be done, especially at the local level.

Discussion at the local level can be done because intensive talk with local government is underway in facilitating the local government to formulate Local Action Plan on Reducing GHG Emission (RAD GRK). The same team and mechanism will be used, so that mitigation and adaptation action plan will be an integral part of government action on climate change, both at the national level and local level.

Actions identified and formulated should come from National Development Planning (RPJMN and RKP) and new activities/actions are put into the said document to ensure that activities will be funded and implemented. The same mechanism is also used for mitigation activities in the RAN GRK. With this formulation, a complete set of policy and actions on mitigation and adaptation on climate change is done and available for Indonesia, for the implementation at the national as well as local (provincial) level (Figure5)

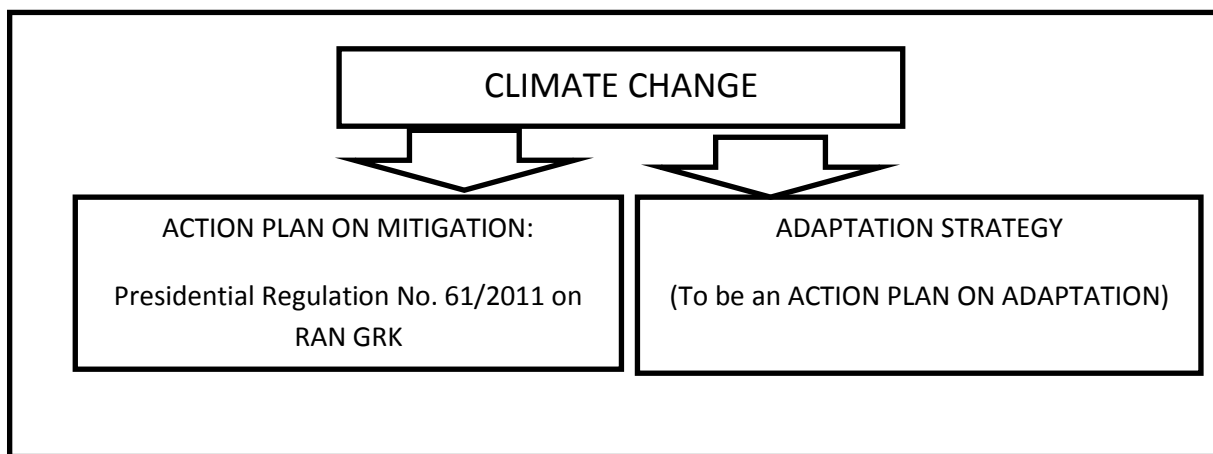


Figure 5 A complete set of Climate Change Action Plan

B. Putting the plan into implementation

Upon the finalization of the Adaptation Action Plan, implementation plan has to be prepared, from the national level to the local and ground level. This is very important step so that people and the community can feel the support provided to adapt to climate change. The implementation step starts with an integration of adaptation into a national climate change actions.

B.1. Integrating adaptation activities into national climate change actions

The Government of Indonesia already finished a mitigation plan called a National Plan for GHG Emission Reduction (RAN GRK), which was officially enacted as Presidential Regulation on September 2011. The RAN GRK elaborates program and activities to reduce GHG emission in which the President committed to reduce at the amount of 26% from BAU and 41% with international support. The RAN GRK also allocate the committed target on to 5 (five) main sectors, namely forest and peatland, agriculture, industry, energy and transportation and waste.

The National Action Plan is followed by a local action plan for provincial level. With this mitigation plan, a national and local institutions framework and mechanism is set up. Therefore, the Adaptation Action Plan later on will be integratedly put into the same framework so that synchronization between mitigation and adaptation can be done. Therefore, finalization of Adaptation Strategy is the beginning of this

integrated response to climate change. The next finalization of Adaptation Action Plan will then complete the Indonesia's actions to respond to climate change.

B.2. Institutional and community capacity

Implementation of mitigation and adaptation plan will optimally use the existing technical ministries at the central and offices at the local level. The mitigation action plan will be implemented by technical ministries responsible for sectors involved in the actions. Similarly, the adaptation plan will use the same mechanism to make an integrated response to climate change. The use of climate change network both with universities and also NGO will be strategically key to the success of Indonesia's climate change policy and program.

B.3. Collaboration to produce concrete results

The strategy on climate change adaptation which will be elaborated into action plan will be implemented by government at the central and local level, private sectors and the community. This shows that collaboration with all those parties and supported by other stakeholders is important to the success of Government of Indonesia in mitigating and adapting to climate change. Framework for collaboration and network with this stakeholder is established. Initial talk and inventory on their capacity and role in climate change is conducted. With this, collaboration action can be implemented, so that every stakeholder in Indonesia inclusively will be part of the big task on mitigating and adapting climate change for maintain and increasing prosperity of Indonesia's people.

