Republic of Indonesia

National Action Plan

for

Climate Change Adaptation

(RAN-API)

Ministry of National Development Planning/

National Development Planning Agency (BAPPENAS)

2014

Foreword

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

Indonesia, the largest archipelago in the world, is one of the nations that are most vulnerable to the negative impacts of climate change. In general, global climate change models has predicted that all parts of Indonesia would experience a rise in temperature, including sea surface temperature, that would increase and alter the pattern and intensity of rainfall which would increase the risk of flood and drought in the dry season . This would result in, among others, prolonged drought, flooding, and increased frequency of extreme climate events, which would affect the health and livelihood of the people as well as biodiversity and the stability of society and the economy, which in turn could threaten the socio-economic development of Indonesia.

Efforts and adaptation strategies for the short-, medium- , and long-term is considered necessary to protect the poorest communities and avoid greater economic losses in the future as a result of climate change. In Indonesia, the predicted economic impact of climate change is very great, although it is still difficult to estimate accurately. National development with the agenda of adaptation to the impacts of climate change has the ultimate goal to create a development system that is adaptive or resilient to the climate change that is currently happening.

To anticipate the negative impacts of climate change, the Government of Indonesia has conducted various climate change adaptation efforts, including the preparation of a national policy document to address the impacts of climate change , such as the Indonesia Adaptation Strategy (Bappenas , 2011), National Action Plan for Climate Change Adaptation (DNPI, 2011), the Indonesia Climate Change Sectoral Road Map (Bappenas, 2010), National Action Plan on Facing the Climate Change (Ministry of Environment , 2007) and sectoral adaptation plans by the Ministries/Institutions. Strategic Document for Mainstreaming Adaptation in National Development Planning (Bappenas , 2012) has also been prepared .

Nevertheless, there are still many adaptation activities in each sector that can, should, and must be synergized in their implementations with other sectors, and integrated into the development planning and budgeting (RPJMN and RKP) in order to achieve the target of adaptation and improve the resilience to the impacts of climate change. To that end, in realizing the harmonization and operationalization of the various policy documents, it is necessary to have a National Action Plan for Climate Change Adaptation (RAN-API), which is cross-disciplinary for the short- and medium-terms, and also provide direction for adaptation in the long-term.

Finally, I would like to thank all those who have helped in the preparation of this document and hope that this document can be useful for actors at national and local levels.

Jakarta, February 2014Prof. Dr.. Armida S. Alisjahbana , SE , MA

Foreword

Minister of Environment

Situated between the continents of Asia and Australia, and the Indian and Pacific oceans, Indonesia has a high degree of vulnerability to climate change impacts. Studies have shown that increase in the surface temperature reached about 1.0° C in the 20th century. Another effect of climate change, varied and extreme changes in precipitation patterns, has a significant influence which extends to various sectors of development such as food security, health, infrastructure and housing, energy, ecosystems, forestry, and urban and coastal areas.

Potential climate risks in these sectors have increased over the years, as can be concluded from the Studies for Risk Assessment and Adaptation to Climate Change (KRAPI) which has been conducted in several cities and provinces by various agencies. Risk assessment results included in the ICCSR document (Bappenas 2010) and the Second National Communication/SNC (KLH 2010) showed the distribution of areas with the level of climate risk from low to very high in some aspects. The document also stated that the islands of Java, Bali and Sumatra possess high and very high levels of climate risk, due to non-climatic factors such as demographics, geography and infrastructure. Improvement to the adaptive capacity becomes very important, because a strong adaptive capacity can reduce the impact of climate change. In addition, the issue of mainstreaming adaptation to climate change into national and regional development planning must be done in order to formulate development program and activities that are resilient and adaptive to climate change impacts.

Synergy, coordination, and communication between all parties become important in realizing sound and integrated adaptation efforts across sectors and across regions. With the RAN-API, the process toward synergy, communication and coordination is expected to run well because of the direction in the process of mainstreaming and formulating short-, medium- and long-term development plans. Local governments need to follow through national directives in adaptation to climate change by formulating local strategy for adaptation to climate change. The strategy should be formulated based on the recommendations of vulnerability risk assessment results on adaptation to climate change in the region and integrated into the planning for development in the area. With climate change adaptation strategies in each province and regency city, it is expected that climate change impacts can be minimized, and each region has the direction and strategy to increase resilience and reduce the level of vulnerability, improving livelihood and well-being through the development of programs that respond to the impacts of climate change.

Development of communication and information systems and good public education can support the implementation of adaptive development because it can increase the active participation of the entire community through the various local initiatives that have been developed. A good adaptation process is an adjustment process that is done by considering the local conditions and exploring the local potential and initiatives. The Climate Village Program (ProKlim) and various other efforts to

increase local initiative are examples that can be further developed to support in reducing the impacts of climate change and increasing the capacity of communities in dealing with the impacts of climate change.

Finally, I would like to express my gratitude for the participation and cooperation of various parties in the preparation of the RAN-API document. I hope this document can be the national contribution in responding to the impact of climate change through policy directives and climate change adaptation strategies. Thus, the goal of RAN-API which is to increase economic resilience, resilience of living systems, ecosystem resilience, specific area resilience, and other support systems, can be realized.

Jakarta, February 2014

Prof. Dr. Balthasar Kambuaya, MBA

Foreword

Head of Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG)

Climate events and extreme weather phenomena has increased in frequency and intensity. According to BMKG's experience, rise of temperature in Indonesia which has occurred in the last 100 years is around 0.76° C and has always been accompanied by extreme events that triggered hydro-meteorological disasters. Based on data from the National Agency for Disaster Management (BNPB), as many as 87 % of disasters in Indonesia in 2013 were hydro-meteorological in nature, such as floods, landslides, droughts, and others. This is consistent with the results of the global study by the Intergovernmental Panel on Climate Change (IPCC). A BMKG study on greenhouse gas (GHG) concentrations on *Nyepi* Day in Bali clearly showed that human activities is the main cause of the increase in GHG concentrations as the primary source of global warming that triggers climate change. Improved capacity in controlling the increase in greenhouse gas concentrations and the effects of climate change should be a main priority in the development planning of various sectors in the future. The impact of climate change will be a challenge since national development in the future will be eroded by climate change impacts. One example is how the pattern of infrastructure development adaptively responds to changes in rainfall pattern that is becoming more extreme.

I praise Allah SWT for the completion of the National Action Plan for Climate Change Adaptation (RAN-API). This document is the first step in the future development of the nation where a larger step awaits when together we will implement the RAN-API in all sectors. BMKG will always put itself in the upstream for this implementation by providing information regarding the evidence, processes and the scientific basis of climate change, which will be a recommendation to support the sectors in the adaptation efforts. The information provided should explain the historical process, the changes that are now occurring, and projections of future climate change in the local area of Indonesia.

Climate change adaptation action is a solution against the impact of climate change and is necessary as an immediate response to the variety of climate change impacts on society. Adaptive responses to the impacts of climate change can be implemented by utilizing information from BMKG on sectors sensitive to climate change. Thematically, BMKG information is useful for increasing adaptive capacity, reducing the impacts, reducing vulnerability and increasing society resilience. Meanwhile, climate change actions are varied in time and space so that dynamic information is always needed to meet the growing requirements. Accordingly, BMKG will continue its efforts to increase the diversity and scope of climate change information in order to reach more sectors and broader and more detailed regional scale. In addition, BMKG will continue to strive to meet the challenges of the need for "common but differentiated responsibility" where all parties receive the impact of climate change with a different portion of adaptation.

Finally, I would like to give my gratitude and highest appreciation to all stakeholders who made the completion of this document possible. May this be the first step for us in saving the approximately 250 million people of Indonesia from the impacts of climate change. Many things we cannot avoid, but it will be better if we are prepared to face them.

Jakarta, February 2014

Dr. Andi Eka Sakya, M. Eng

Foreword

Daily Chairman of the National Council on Climate Change/President of Indonesia's Special Envoy on Climate Change

Assalammualaikum wr.wb.,

It is indisputable that climate change has become one of the greatest challenges and threats to today's life. Development that has been planned and implemented at various stages and sectors is not immune against this challenge and threat. On one hand, we understand that development can increase the challenge and threat in the form of more rapid and increased climate change, while on the other hand, the development process and result itself will be threatened by more severe climate change impacts.

On behalf of the National Council on Climate Change, I warmly welcome the publication of the National Action Plan for Climate Change Adaptation (RAN - API) document that has been produced through a process of consultation and coordination among stakeholders. The publication of this document will be the base and provide direction in addressing the impact of climate change in a more anticipatory and planned manner as part of the development planning and implementation process. This approach will ultimately provide greater benefits at a relatively smaller cost compared to the presently more common reactive approach, which is executed after the impact occurred.

The publishing of RAN-API will also contribute to Indonesia's role in the process that has been undertaken internationally under the United Nations Framework Convention on Climate Change (UNFCCC). This document gives an overview of the readiness of Indonesia to implement adaptation efforts and will also be a source of information about the support needed by Indonesia in implementing them.

Climate change and its impact are very highly dynamic. Adaptation efforts are the same. Therefore, RAN-API cannot be a static document but it must be able to follow that dynamic. RAN-API should always be a living document that anticipates various developments taking place without disregarding the specifics of the sector and fields of activity, location, social-economy conditions and culture.

Finally, I express appreciation to all those who have contributed in the process of preparation and publication of this document. May the good coordination and contribution continue in the effort to maintain the currency of RAN-API as living document, and, no less important, also in the implementation of adaptation action against the impacts of climate change in Indonesia.

Wassalammualaikum wr.wb.

Jakarta, February 2014

Prof. Dr.Rachmat Witoelar

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Publication of the National Action Plan for Climate Change Adaptation (RAN-API) is made possible through the great commitment and good cooperation between all involved parties. Ministry of Planning/Bappenas would like to thank all members of the Drafting Team and the all parties involved for their hard work and contribution to the completion of this National Action Plan for Climate Change Adaptation.

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We hope that the National Action Plan for Climate Change Adaptation can be a good guide in implementing adaptation efforts both at the national and regional levels, in order to achieve sustainable development that is adaptive to climate change.

Executive Summary

Background

An abundance of scientific evidence has shown that climate change is already happening and affecting the whole world. Preparation of climate change adaptation action plans is aimed at guaranteeing and securing the fulfillment of the main objectives of economic development and increase physical, economic, social and environmental resilience against the impacts of climate change.

The national development agenda of adaptation to climate change has the ultimate goal of creating a development system adaptive or resilient to the current climate change. Sustainable development that accommodates adaptation to climate change is expected to reduce the current vulnerability, in order to ensure the capacity of future generations to meet their needs. This is necessary because climate change will affect and have impact on all development aspects in each sector.

It is expected that the formulation of the National Action Plan for Climate Change Adaptation (*Rencana Aksi Nasional Adaptasi Perubahan Iklim*, RAN-API) will enable adaptation efforts to be implemented in a more integrated and effective fashion, and provide a greater effect in supporting the achievement of national development goals that are sustainable and adaptive or resilient to climate change.

Purpose and Objectives

The purpose of the preparation of the RAN-API is to produce a national action plan to adapt to the impacts of climate change , which is coordinated in an integrated manner with all the stakeholders involved: the government, community organizations, the public, private entities, etc.

The main objective of adaptation to climate change in the RAN-API is the implementation of a development system that is sustainable and highly resilient to climate change impacts. This will be achieved by building economic sustainability, as well as a livelihood that is physically, economically and socially resilient and maintaining ecosystem sustainability and resilience of specific territories such as small islands in order to support a livelihood that can sustain to the effects of climate change.

RAN-API in the National Development Planning

RAN-API is part of Indonesia's national development framework. In terms of national development planning, RAN-API is a cross-disciplinary thematic plan which specifically aims to prepare a climate proof development plan at the national level. RAN-API is expected to provide guidance on the Government Work Plan and the National Medium Term Development Plan *(Rencana Pembangunan Jangka Menengah Nasional, RPJMN*) in the future, in order to be more responsive to the effects of climate change. RAN-API is not a separate document which has formal legal powers of its own, instead it becomes a major input and an integral part of national development planning documents and planning Ministries/Agencies. RAN-API is also a reference for local government in devising

Strategy Action Plan for the Regional Climate Change Adaptation as a direction in preparing development plan documents that are resilient to climate change.

For the implementation of climate change adaptation in each region, it is necessary to prepare strategy action plan at the provincial level. This will be the responsibility of each region with coordination by the Ministry of the Interior. The strategy will be prepared by involving relevant technical offices and in accordance with local development priorities, based on the regional budget (APBD) and the public.

Policies and Objectives of the National Action Plan on Climate Change Adaptation

With an understanding of climate change adaptation and its purpose, adaptation can be regarded as an attempt to increase the resilience of a system to climate change impacts. Therefore, adaptation to climate change in Indonesia is directed as the following:

1 . Adjustment efforts in the form of strategy, policy, management, technology and attitudes so that the (negative) effects of climate change can be reduced to a minimum, and even if possible to utilize and maximize the positive effects.

2 . Efforts to reduce the impact (effect) caused by climate change, either directly or indirectly, either continuous or discontinuous and permanent as well as impacts according to levels.

With regard to sectors and aspects of development that are affected by climate change, it can be said that ensuring the achievement of national development goals in the face of climate change requires economic, social and environmental resilience. Moreover, given that Indonesia is an archipelago country that is vulnerable to climate change, it is also necessary to build resilience in specific areas such as small islands, coastal and urban areas. In this regard, Strategic Objective of RAN-API is directed to: (i) build economic resilience, (ii) establish a (social) livelihood that is resilient to climate change impacts (resilience of living systems) , (iii) maintaining the sustainability of services environmental ecosystems (ecosystem resilience) and (iv) strengthening resilience in urban areas, coastal areas and small islands. To support the reinforcements in various fields will require a system to support the reinforcement of national resilience towards sustainable development and resilience to climate change.

Adaptation Strategy and Action Plan by Sector

Each sector development target may is not optimally achievable without the support of other sectors. Therefore, the establishment of action steps for adaptation of each sector in order to build economy, livelihood, ecosystems and specific regions resilient to the impacts of climate change will have to recognize the relation between each sector’s programs. This can serve as a foundation to build synergy and fill the gap of adaptation actions that need to be developed in order to achieve the goals of RAN-API.

Implementation Mechanism

Coordination mechanism

Preparation of the RAN-API document is expected to improve coordination between relevant ministries/institutions and also the involvement of other stakeholders, be them private, non-governmental organizations, international cooperation agencies, universities and research institutes. In order to facilitate coordination in the handling of both climate change mitigation and adaptation and to improve the efficiency and effectiveness of the achievement of the action plan for mitigation and adaptation to climate change, the Minister of Planning/Head of Bappenas has issued the Decree of the Minister of Planning/Head of Bappenas No. Kep.38/M.PPN / HK/03/2012 on the establishment of the Climate Change Management Coordination Team , which consists of six (6) work groups, including the Adaptation Work Group.

Local Government has a key role in the implementation of adaptation in accordance with the conditions of the region and its level of vulnerability. Basically the direct impacts of climate change occur at a local scale, therefore adaptation actions will be performed on a local level and local conditions. To produce effective adaptation efforts requires overall effort at various levels of government, guided and supported by the strategies and adaptation policies at the central level. Formulation and implementation of the RAN-API need to recognize the division of authority and government in the areas related to climate change adaptation.

Adaptation Funding Mechanism

Until now there has been no funding for climate change adaptation policies that are specifically developed to support the implementation of adaptation action plans in Indonesia.

In the medium-term planning, the issue of climate change has received priority funding through the state budget mechanism. In addition, climate change funding policy is not only derived from domestic funding sources, but developed from a variety of other funding sources, including international cooperation and the private sector. Various programs for adaptation to climate change is widely supported by funding from international cooperation, both in the form of capacity building and financing of pilot projects.

Internal funding, which is a top priority in funding RAN-API, is obtained from the State Budget (APBN) in accordance with the RPJMN 2010-2014 and the current year's development work plan (RKP). Other domestic sources of funding include the regional budget (APBD), government debt, private investment (banking and non-banking), and corporate social responsibility (CSR).

Funding from other international sources is widely used both by government and by private parties. The use of this source is very dependent on the nomination mechanism adopted by each funding institution.

Monitoring, Evaluation, Review and Reporting Mechanisms

The process of monitoring and evaluation of RAN-API is necessary to ensure the achievement of targets and adaptation goals that have been set. The process of monitoring the implementation of the RAN-API is conducted by related Ministries/Institutions and periodically reported to the Ministry of National Development Planning/Head of Bappenas. Mechanisms for Monitoring, Evaluation and Reporting will be arranged at a later time in accordance with the regulations. Monitoring and evaluation efforts have to be in line with the monitoring and evaluation systems that have been adopted for the implementation of development activities.

Ministry of Planning/Bappenas will conduct the integrated evaluation process and review of RAN-API periodically in accordance with national requirements and the latest global development.

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List of Acronyms

ADB	Asian Development Bank
APBD	*Anggaran Pendapatan dan Belanja Daerah* (Regional Budget)
APBN	*Anggaran Pendapatan dan Belanja Negara* (State Budget)
AR4-IPCC	Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change
ASEAN	Association of South-East Asian Nations
ASPL	*Anomali Suhu Permukaan Laut* (Sea Surface Temperature Anomaly)
BAPPENAS	*Badan Perencanaan Pembangunan Nasional* (National Development Planning Agency)
BATAN	*Badan Tenaga Nuklir Nasional* (National Nuclear Energy Agency)
BBN	*Bahan Bakar Nabati* (Botanical Fuel)
BIG	*Badan Informasi Geospasial* (Geospatial Information Agency)
BKKBN	*Badan Kependudukan dan Keluarga Berencana Nasional* (National Population and Family Planning Board)
BMI	*Benua Maritim Indonesia* (Indonesian Maritime Continent)
BMKG	*Badan Meteorologi Klimatologi dan Geofisika* (Agency for Meteorology, Climatology and Geophysics)
BNPB	*Badan Nasional Penanggulangan Bencana* (National Agency for Disaster Management)
BPPT	*Badan Pengkajian dan Penerapan Teknologi* (Agency for the Assessment and Application of Technology)
BUMN	*Badan Usaha Milik Negara* (State-Owned Corporation)
CDF	Cumulative Distribution Function)
CH	*Curah Hujan* (Rainfall Rate)
CH_4	Methane
CIFOR	Center for International Forestry Research
CMAP	Climate Mitigation and Adaptation Plan
CO_2	Carbon dioxide
COP	Conference of the Parties
CRU	Climatic Research Unit
CRV	Climate Resilient Village
CSO	Civil Society Organization
CSR	Corporate Social Responsibility
DAS	*Daerah Aliran Sungai* (Drainage Basin)
DBD	*Demam Berdarah Dengue* (Dengue Hemorraghic Fever)
DHF	Dengue Hemorraghic Fever
DJF	December – January – February
DME	*Desa Mandiri Energi* (Energy-Independent Village)
DMI	*Dipole Mode Index*
DMP	*Desa Mandiri Pangan* (Food-Independent Village)
DNPI	*Dewan Nasional Perubahan Iklim* (National Council on Climate Change)

ENSO	*El Nino*-Southern Oscillation
GCM	Global Climate Model
GEF	Global Environment Facility
GHGs	Greenhouse Gases
GIZ	*Gesellschaft für Internationale Zusammenarbeit* (Germany International CooperationAgency)
GPCC	*Pusat Presipitasi Klimatologi Global* (Global Precipitation and Climatology Center)
HKm	*Hutan Kemasyarakatan* (Community Forest)
HPH	*Hak Pengusahaan Hutan* (forestry rights)
HTI	*Hutan Tanaman Industri* (Industrial Plantation)
HTR	*Hutan Tanaman Rakyat* (Community Plantation)
IAP	*Ikatan Ahli Perencanaan* (Planners Association)
ICCSR	Indonesia Climate Change Sectoral Roadmap
ICCTF	Indonesia Climate Change Trust Fund
IOD	*Indian Ocean Dipole*
IPCC	Intergovernmental Panel on Climate Change
IPO	*Interdecadal Pacific Oscillation*
ISV	Intra-Season Variation
JAS	July – August - December
JICA	Japan International Cooperation Agency
JIDES	*Jaringan Irigasi Desa* (Village Irrigation Network)
JITUT	*Jaringan Irigasi Tingkat Usaha Tani* (Farmer Irrigation Network)
JJA	June – July - August
K/L	*Kementerian/Lembaga* (Ministry/Agency)
Kemenhut	*Kementerian Kehutanan* (Ministry of Forestry)
Kemenkes	*Kementerian Kesehatan* (Ministry of Health)
Kemenpera	*Kementerian Perumahan Rakyat* (Ministry of Public Housing)
Kementan	*Kementrian Pertanian* (Ministry of Agriculture)
Kemen ESDM	*Kementerian Energi dan Sumber Daya Mineral* (Ministry of Energy and Mineral Resources)
Kemen PPN	*Kementerian Perencanaan Pembangunan Nasional* (Ministry of National Development Planning)
Kemen PU	*Kementerian Pekerjaan Umum* (Ministry of Public Works)
KKP	*Kementerian Kelautan dan Perikanan* (Ministry of Maritime Affairs and Fisheries)
KLH	*Kementerian Lingkungan Hidup* (Ministry of Environment)
KLHS	*Kajian Lingkungan Hidup Strategis* (Strategic Environmental Assessment)
KPH	*Kesatuan Pengelola Hutan* (Forest Management Unit)
KRPL	*Kawasan Rumah Pangan Lestari* (Sustainable Food Houses Area)
LAPAN	*Lembaga Penerbangan dan Antariksa Nasional* (National Aeronautics and Space Institute)
LIPI	*Lembaga Ilmu Pengetahuan Indonesia* (Indonesian Institute of Sciences)
Litbang	*Penelitian dan Pengembangan* (Research and Development)
LPND	*Lembaga Penelitian Non Departemen* (Non-Departmental Research Institution)
LSM	*Lembaga Swadaya Masyarakat* (Non-Governmental Organizations)
NGOs	Non-Governmental Organizations

NIE National Implementing Entities
NOAA National Oceanic and Atmospheric Administration (USA)
NSPK *Norma, Standar, Prosedur dan Kriteria* (Norms, Standards, Procedures and Criteria)
N_2O Nitrogen dioxide
OPT *Organisme Pengganggu Tanaman* (Pest Organisms)
O_3 Ozone
PBB *Perserikatan Bangsa-Bangsa* (United Nations)
PDB *Produk Domestik Bruto* (Gross Domestic Product)
PDO *Pacific Interdecadal Oscillation*
Pemda *Pemerintah Daerah* (Local Government)
PHBM *Pengelolaan Hutan Bersama Masyarakat* (Community-Based ForestManagement)
PHLN *Pinjaman/Hibah Luar Negeri* (Loan/Foreign Grant)
PKA *Penurunan Ketersediaan Air* (Decrease of Water Availability)
PLTA *Pembangkit Listrik Tenaga Air* (Hydroelectric power plant)
PLTPB *Pembangkit Listrik Tenaga Panas Bumi* (Geothermal Power Plant)
Pokja *Kelompok Kerja* (Working Group)
PP *Peraturan Pemerintah* (Government Regulation)
PPK *Pulau-Pulau Kecil* (Small Islands)
PPP Public Private Partnership
PTT *Pengelolaan Tanaman Terpadu* (Integrated Crop Management)
PUG *Pengarusutamaan Gender* (Gender Mainstreaming)
RAD Rencana Aksi Daerah (Regional Action Plan)
RAN *Rencana Aksi Nasional* (National Action Plan)
RAN-API *Rencana Aksi Nasional - Adaptasi Perubahan Iklim* (National Action Plan for Climate Change Adaptation)
RAN-GRK *Rencana Aksi Nasional – Penurunan Emisi Gas Rumah Kaca* (National Action Plan for Greenhouse Gas Emission Reduction)
RAN-MAPI *Rencana Aksi Nasional - Mitigasi Adaptasi Perubahan Iklim* (National Action Plan for Mitigation of Climate Change Adaptation)
RDTR *Rencana Detail Tata Ruang* (Detailed Spatial Plan)
REDD *Reducing Emission from Deforestation and Degradation*
Renja *Rencana Kerja* (Work Plan)
Renja K/L *Recana Kerja Kementerian/Lembaga* (Ministry/Agency Work Plan)
Renja SKPD *Rencana Kerja Satuan Kerja Perangkat Daerah* (Regional Working Unit Work Plan)
Renstra *Rencana Strategis* (Strategic Plan)
Renstra K/L *Rencana Strategis Kementerian/Lembaga* (Ministry/Agency Strategic Plan)
RKP *Rencana Kerja Pemerintah* (Government Work Plan)
RKPD *Rencana Kerja Pemerintah Daerah* (Local Government Work Plan)
ROMS-SODA *Regional Ocean Modelling System - Simple Ocean Data Assimilation*
RPJMD *Rencana Pembangunan Jangka Menengah Daerah* (Medium Term Regional Development Plan)
RPJMN *Rencana Pembangunan Jangka Menengah Nasional* (Medium Term National Development Plan)
RPJPD *Rencana Pembangunan Jangka Panjang Daerah* (Long Term Regional Development Plan)

RPJPN *Rencana Pembangunan Jangka Panjang Nasional* (Long Term National Development Plan)
RPPLH *Rencana Perlindungan dan Pengelolaan Lingkungan Hidup* (Environment Protection and Management Plan)
RTH *Ruang Terbuka Hijau* (Green Open Space)
RTRW *Rencana Tata Ruang* Wilayah (Spatial Plan)
RTRWN *Rencana Tata Ruang Wilayah Nasional* (National Spatial Plan)
RTRWP *Rencana Tata Ruang Wilayah Provinsi* (Provincial Spatial Plan)
SDM *Sumber Daya Manusia* (human resources)
SIARANG *Sistem Informasi Kebakaran Hutan Berbasis Keruangan* (Spatial Based Forest Fire Information System)
SJII *Sistem Jaringan Informasi Iklim* (Climate Information Network)
SK *Surat Keputusan* (Decree)
SKPD *Satuan Kerja Perangkat Daerah* (Regional Working Unit)
SLR Sea Level Rise
SNC Second National Communication
SON September - October - November
SPL *Suhu Permukaan Laut* (Sea Surface Temperature)
SST Sea Surface Temperature
SRA Strategic Research Agenda
SRES Special Report on Emissions Scenarios
SRI System of Rice Intensification
SUT *Sistem Usaha Tani* (Agriculture Business System)
TML *Tinggi Muka Laut* (Sea Surface Height)
TRMM Tropical Rainfall Measuring Mission
TTO Ten to Twelve Years Oscilliation
UNDP United Nations Development Program
UNFCCC United Nations Framework Convention on Climate Change
UU *Undang-Undang* (Government Act)
VIM *Variasi Intra-musim* (Intra-season Variation)
WMO World Meteorological Organization
WWF World Wildlife Fund

Glossary

Adaptation

Adjustment in natural or artificial systems to respond to stimuli or climatic influences, whether actual or estimated, with the aim of controlling the hazards posed or creating desired opportunities. Adaptation can also be defined as a natural or human effort to adjust to reduce the impact of climate change that has or may occur.

Altimeter

Tool for measuring altitude or the height of a location from the Earth's surface by air pressure differences (commonly used in aircraft)

Anthropogenic

Caused by human activity.

Biodiversity

Diversity of living things and matters related to the ecology of their habitat. Biodiversity includes genetic, species and ecosystem diversity

Capacity Development

In the context of climate change, capacity development is the process of developing the skills and human resources and institutions to enable them to participate in all aspects of adaptation, mitigation, and research related to climate change.

Climate

In general, defined as the average conditions of temperature, precipitation, air pressure and wind in a long period of time, between 30 and 100 years (inter-centennial). Essentially, climate is the weather pattern that occurred over the years.

Climate Change

Significant change in climate lasting for a minimum of 30 years or longer.

Climate Change Impact

The impact of climate change on natural processes and humans, such as in coastal tidal flooding due to sea level rise.

Climate Projections

Projected response (change) of the climate system to global warming which is caused by emissions of greenhouse gases and other pollutants, where the projections were made based on the calculation of the Global Climate Model (GCM).

Climate Models

Equation that can explain changes in the atmospheric climate system dynamics, as well as the interacting aspects of physics, chemistry and biology that influences it.

Climate Proof

Development of human life system that takes climate change factors into account, so that the system can function as expected in various scenarios of climate conditions

Climate Smart Agriculture

Efforts in the agricultural sector to mitigate the impact of climate change, by adapting to climate change through various means, methods, and tools, knowledge, and technology.

Climate Variability

Variations in average climatic conditions in an annual or even decade scale. Extreme events such as El Nino, La Nina, or the Indian Ocean Dipole can lead to climate variability

Conference of the Parties (COP)

The supreme body of the Convention. Currently meets once a year to review the progress of the Convention. The word "conference" is not used here in the sense of "meeting" but rather the meaning of the word "association."

Convection

One of the processes of cloud formation due to moist air rising from the bottom layer up to a layer high enough in the atmosphere. Very heavy rain may occur from the convection clouds.

Dipole Mode Index (DMI)

Index based on the difference between the sea surface temperature anomaly (ASPL) in the Western Indian Ocean (off the east coast of Africa) and the East Indian Ocean (off the southwest coast of Sumatra).

Diurnal

Cycle that takes place on a daily basis (within one day)

Drought

Meteorological drought occurs when the rainfall rate is far below normal conditions for long periods of time.

In addition, hydrological drought can also be influenced by the absorption of rain water on the soil surface.

Economic resilience

Climate change impacts on economic stability and efforts to achieve economic development goals. Economic resilience is the ability of an economic system to maintain its function and recover quickly in the event of disruption. The economic resilience part of RAN-API gives emphasis to the aspects of food security and energy independence.

Ecosystem

System that consists of living organisms interacting with the physical environment around them.

Ecosystem resilience

Preservation of forest ecosystem and essential ecosystem from the impacts of climate change so that the existence of biodiversity and ecosystem services can be sustained. Biodiversity, as a core component of the ecosystem, is a provider of environmental services that hold the key to the sustainability of the ecosystem. The relevant environmental services are the provisioning, regulating, cultural and supporting services.

El Nino

The phenomenon of rising sea surface temperatures at the mid-eastern to the eastern part of the Pacific Ocean (approximately around coastal regions of Latin America), which is then followed by sea surface temperature fall in Indonesia and surrounding areas, causing a decrease in rainfall (potential drought).

El-Nino is one phase of the El Nino-Southern Oscillation (ENSO), which is the combination of

variations in sea surface temperatures at the eastern part of Pacific Ocean with the variations in surface air pressure at the ocean's western part.

Emission

The substances that are released into the atmosphere as air pollutants

Emissions Scenario

Prediction of how greenhouse gas emissions (and other pollutants) caused by human activities will change in the future. This estimate is based on several assumptions on changes in Earth's population, where they live, economic growth, the amount of energy used, how that energy is generated, and others

Extrapolation

Expansion or the estimation of data outside the available data, which still follows the trend pattern of the available data.

Polynomial extrapolation is a type of extrapolation that uses the assumption that the data trend pattern is consistent with a mathematical polynomial function

Extreme Climate Events

Anomalous climate event (different to average climatic conditions) in an area within a certain period of time; usually only has a small chance of occurring. These events include heat waves, storms, El-Nino, La Nina, etc.

Forest Management Area

A forest in which there are certain activities dealing with forest governance and forest management planning, forest usage, forest area usage, forest rehabilitation and reclamation, forest protection and nature conservation

Greenhouse gases (GHGs)

Gases in the atmosphere, both natural and manmade, that absorb and release infrared radiation (heat). The major greenhouse gases are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3).

Geostrophic

Atmosphere flow or ocean current which is driven by pressure differences in spatial space and which direction is influenced by the Coriolis force

Global Warming

The increase in temperature of the earth's surface on average worldwide.

Global warming is believed by scientists around the world who joined in the IPCC to be caused by anthropogenic factors (caused by humans) and cause climate change in almost the entire world.

Heat Island

The air/atmospheric condition in an area (generally urban) where the surface temperature is warmer than the surrounding conditions, so that if the area is represented on a heat map it will resemble a “heat island"

Hydro-meteorological Disaster

Disaster caused by weather and climatic factors originating from the atmosphere (such as precipitation and air temperature) or from the sea (e.g. sea wave impact, sea level rise).

Indian Ocean Dipole

Non-regular oscillation of sea surface temperatures in western Indian Ocean (off the east coast of Africa) and the eastern part (approximately off the southwest coast of Sumatra).

IOD index is calculated based on the difference between the sea surface temperature anomalies in each part of the Indian Ocean. Positive phase (index) occurs when the temperature is higher in the west accompanied by cooling sea level in the east, resulting in lower rainfall in some parts of Indonesia and Australia (potential drought).

Intergovernmental Panel on Climate Change (IPCC)

A scientific panel consisting of scientists from all over the world. This panel is responsible for reviewing or researching all aspects of the problem of climate change

Integrated Forest Fire Management

Integrated forest fire management efforts which serve as a framework that integrates the ecological, socio-economic and technological aspects related to fire management

Invasive species

Species of animals and plants that grow very rapidly in the region, thereby disrupting the growth/development of other species.

La Nina

Opposite extreme climatic conditions of the El-Nino , that is, the decrease of sea surface temperatures ranging from the middle to the eastern Pacific Ocean (around the beach area of Latin America) , which is then followed by the "warm pool" due to the increased sea surface temperature in Indonesia and surrounding waters , which can cause additional precipitation (flooding potential).

Lat/lon

The geographical position of a location on the surface of the earth marked with latitude (lat) and longitude coordinates (lon). This position can be determined by using GPS (Global Positioning System).

Living System Resilience

Climate change has an impact on the people's living system and efforts to achieve the livelihood development goals. Living systems resilience is the ability of the community to sustain its life and recover quickly in the event of disruption..

Mitigation

Things that can be done to reduce greenhouse gases in the atmosphere. For example, generation of electricity with less greenhouse gas emissions, or reducing demand for electricity

Microhydroelectric Power

Hydroelectric plants that generate electricity with a power output range of 5-100 kW.

Mixed Food Policy

Policy to diversify food, also called food diversification policy

Monsoon

Climate characterized by changes in wind direction and the wet or dry season within approximately six months, following the sun's position in June and December, found in tropical and subtropical regions flanked by continents and oceans.

Winter monsoon comes from the continent in the winter, while the summer monsoon comes from the ocean in the summer.

National Communications

Documents prepared and submitted in accordance with the Kyoto Protocol and Convention in order for the recipient party to receive information on activities addressing climate change in a country.

Non-Annex I Parties

Refers to the countries that have ratified or acceded to the UN Convention on Climate Change but was not included in the list of Annex I of the Convention Non-Governmental Organizations (NGOs)

Organizations that are not part of the government structure. This group includes environmental groups, research institutions, business groups, and local and village government associations. Many NGOs attend climate talks as observers. In order to attend the meeting of the Climate Change Convention, the NGO should be non-profit.

.Picohydroelectric Power

Hydroelectric plants that generate electric power output of not more than 5 kW. This plant has several advantages, such as: the cost of manufacture is relatively cheap, easy to manufacture with materials found on the market , eco-friendly because it does not use fossil fuels, the construction can be combined with that of irrigation networks, and the technology has seen relatively little development, so it is suitable for long periods of usage.

Projected Sea Level Rise

Projected responses (change) of the physical condition of the sea water to global warming, in the form of sea-level rise.

Given that the projection process uses dynamic models, the accuracy of the calculations needs to be included, for example, 22.5 ± 1.5 cm which indicates a sea level rise of 22.5 cm with an error margin of about 1.5 cm.

Resilience

The magnitude of change where a system can still run without altering its condition. Resilience can also be defined as the ability of social and ecological systems to absorb disturbances while retaining the system structure and function.

Sea Level Rise

Continuous increase in sea level relative to a fixed level or the average annual.

Silviculture systems

Agroforestry systems or forest farming technique that starts from seed selection, plant growing, to the harvesting or logging (Ministerial Decree No.309/Kpts-II/1999). Silvicultural system is a series of planned forest management activities that include logging, rejuvenation and maintenance of forests in order to ensure the sustainable production of timber and other forest products.

Special region

Within the framework of the RAN-API, a special area is an area that needs to be prioritized due to its handling of the most affected and vulnerable to climate change, namely the coastal and urban areas.

Specific Region Resilience

Climate change impacts are different in each region according to the exposure, the level of vulnerability and the characteristics of each region. Specific region resilience refers to the ability of areas facing the threat of specific changes to survive and recover in the event of disruption. Specific changes in this regard relates to areas that have a high degree of

vulnerability, such as areas inhabited by marginalized communities, which require greater and more specific attention. In the context of climate change, specific region resilience is emphasized for coastal areas, small islands and urban areas.

Support System Resilience

The ability of the supporting aspects to survive and recover in the event of disruption. Implementation of climate change adaptation is supported in various aspects with emphasis on capacity building, development of reliable climate information, research and development, as well as planning and budgeting.

Sustainable Development

Development that meets the needs of the present without compromising the ability of future generations to meet their needs.

Technology Transfer

The series of processes which include the flow of knowledge, experience and equipment for mitigating and adapting to climate change amongst different stakeholders.

United Nations Framework Convention on Climate Change (UNFCCC)

The agreement was signed by over 150 countries in 1992. The purpose of this agreement is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent danger due to human intervention with the climate system.

Visible Canal

Channel section of remote sensing satellite sensor which is in the range of the spectrum that can be seen by the human senses

Vulnerability

The degree to which a system is sensitive to, or cannot manage, the negative effects of climate change, such as climate variability and extremes. Vulnerability is a function of the characteristics, scale/degree, and rate of climate variation that shows the sensitivity and adaptability of a system.

Weather

State of the air/atmosphere (temperature, sunlight, humidity, wind speed, etc.) at a particular place within a set period of time.

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Chapter 1. Preliminary

1.1 Background

An abundance of scientific evidence has shown that climate change is already happening and is felt by the whole world. Various efforts and strategies for the short- and medium-term and long-term anticipation have been started in many countries. This is deemed necessary because delaying the implementation of adaptation efforts are expected to increase greater economic losses in the future. In Indonesia, the estimated economic impact of climate change is very great although it is still difficult to calculate with certainty. However, some studies indicate that economic losses due to climate change either directly or indirectly in Indonesia in 2100 may reach 2.5 %, which is four times the average global GDP loss due to climate change (World Bank, 2010). In fact, when the chances of a disaster due to climate change are taken into account the economic losses could reach 7% of GDP (World Bank, 2010; ADB, 2010). To protect the poorest and prevent the emergence of undesirable economic costs, adaptation activities need to be done through the formulation of a national-scale adaptation action plan. Preparation of climate change adaptation action program is aimed at guaranteeing or securing the achievement of the main objectives of development and increase the physical, economic and social resilience of the people against climate change impact.

At this time, some of the Ministries/Agencies have developed an Action Plan on Climate Change Adaptation. However, there are still many adaptation actions in these sectors that can, should, and must be synergized with those in other sectors, so that the adaptation target can be achieved and resilience to climate change impacts can be improved, in order to achieve the development goals in each sector. Therefore, mainstreaming the issue of adaptation to climate change in national and regional development is a necessity. This issue should be an integral and inseparable part in the preparation of national and sectorial development plans, which are then derived into integrated and continuous adaptation action plan programs. The national development agenda of adaptation to climate change impacts has the ultimate goal to create an adaptive system development or resistance to climate change that is presently happening. Sustainable development that accommodates adaptation to climate change activities is expected to reduce the present vulnerability to ensure the capacity of future generations to meet their needs. This is necessary because climate change will affect and impact on all aspects of the development of each sector in the short and long term.

Development of every sector seeks to meet the needs of society, fairly and equally for all men and women. National Action Plan for Adaptation to Climate Change (RAN-API), as an integral part of the development, is prepared by integrating gender aspects. This is because climate change has a specific and different effect on women and men. In the policy paper on gender mainstreaming in adaptation to climate change in Indonesia (Bappenas, 2012), it is stated that climate change adaptation actions must consider the needs, aspirations, potentials, and the experiences of men and women in various fields. To that end, RAN-API is prepared by considering the influence of climate change on gender.

Adaptation action plans of each sector, especially the medium and long term as well as the fundamentals, requires the support of scientific studies of the direct impact at the field or sector

levels, as well as the indirect impact at the higher levels (regional and national). For example, studies of climate change impacts on social conditions and national economic growth. Studies of the implications of policy changes in response to climate change issues and each sector's ability to meet its targets in contributing to national economic growth are also needed. It is expected that with the formulation of RAN-API, adaptation efforts, including the necessary scientific studies, can be implemented more effectively in a more integrated manner and provide a greater impact in supporting the achievement of national development goals of sustainable and adaptive or resilient to climate change.

1.2 Purpose and Objectives

The purpose of the preparation of RAN-API is to produce a national action plan to adapt to the impacts of climate change, which is coordinated in an integrated manner with all the stakeholders involved: the government, community organizations, society, private entities, etc.

The main purpose of adaptation to climate change in RAN-API is the implementation of development system that is sustainable and highly resilient to climate change impacts. The main objective will be achieved by building economic resilience, as well as a livelihood that is physically, economically and socially resilient, and maintaining ecosystem sustainability and resilience of specific territories to support the living system. As for the specific purpose of the preparation of the RAN-API document is to:

- Provide direction for mainstreaming climate change adaptation issues in the national development planning process
- Provide direction for climate change adaptation actions in each sector, and integrated (cross-sectorial) climate change adaptation actions in the short-term plan (2013-2014), medium term (2015-2019) and long term (2020-2025).
- Provide direction to propose short-term priority adaptation action steps, in order to garner special attention and support of international funding
- As a direction for each sector and region in developing synergistic adaptation action steps and as an effort in building a more effective communication system and coordination

RAN-API is expected to be beneficial in:

- Encouraging the establishment of synergy in inter-regional and inter-sectorial programs implementation to improve society resilience to the impacts of climate change, in order to support the achievement of national development goals
- Encourage the establishment of a better system of coordination between sectors and between central and local governments in developing policies and action plans for climate change adaptation

1.3 Legal Framework

The preparation of RAN-API refers to the legislation in force, as follows:

1. Act No. 6 of 1994 on Ratification of the United Nations Framework Convention on Climate Change;
2. Act No. 17 Year 2003 on State Finance;
3. Act No. 17 Year 2004 on Ratification of the Kyoto Protocol over the Framework Convention of the United Nations on Climate Change;
4. Act No. 25 Year 2004 on National Development Planning System (State Gazette of the Republic of Indonesia Year 2004 Number 104, Supplement to State Gazette of the Republic of Indonesia Number 4421);
5. Act No. 17 Year 2007 on National Long Term Development Plan 2005-2025 (State Gazette of the Republic of Indonesia Year 2007 Number 33, Supplement to State Gazette of the Republic of Indonesia Number 4700);
6. Act No. 32 Year 2009 on Environmental Protection and Management (State Gazette of the Republic of Indonesia Year 2009 Number 140, Supplement to State Gazette of Republic of Indonesia Number 5059);
7. Act No. 26 Year 2007 on Spatial Planning (State Gazette of the Republic of Indonesia Year 2007 Number 68, Supplement to State Gazette of the Republic of Indonesia Number 4725);
8. Act No. 7 of 2004 on Water Resources (State Gazette of the Republic of Indonesia Year 2004 Number 32, Supplement to State Gazette of the Republic of Indonesia Number 4377);
9. Act No. 24 Year 2007 on Disaster Management (State Gazette of the Republic of Indonesia Year 2007 Number 66, Supplement to State Gazette of the Republic of Indonesia Number 4723);
10. Act No. 32 Year 2004 on Regional Government (State Gazette of the Republic of Indonesia Year 2004 Number 125, Supplement to State Gazette of the Republic of Indonesia Number 4437), has been amended by Act No. 12 of 2008 (State Gazette of the Republic of Indonesia Year 2008 Number 59, Supplement to State Gazette of the Republic of Indonesia Number 4844);
11. Act No. 27 Year 2007 on the Management of Coastal Areas and Small Islands (Republic of Indonesia Year 2007 Number 84, Supplement to State Gazette of Republic of Indonesia Number 4739);
12. Act No. 1 of 2011 on Housing and Settlement Region (State Gazette of the Republic of Indonesia Year 2011 Number 7, State Gazette Republic of Indonesia Number 5188);
13. Government Regulation No. 40 Year 2006 on Procedures for the Preparation of the National Development Plan (State Gazette of the Republic of Indonesia Year 2006 Number 97, Supplement to State Gazette of the Republic of Indonesia Number 4664);
14. Government Regulation No. 26 Year 2008 on National Spatial Plan (State Gazette of the Republic of Indonesia Year 2008 Number 42, Supplement to State Gazette of the Republic of Indonesia Number 4828);
15. Government Regulation No. 38 Year 2007 on Affairs Division between the Government, Provincial Government, and the Government of Regency/City (State Gazette of the Republic of

Indonesia Year 2007 Number 82, Supplement to State Gazette of the Republic of Indonesia Number 4747);

16. Government Regulation No. 15 Year 2010 on the Implementation of Spatial Planning (State Gazette of the Republic of Indonesia Year 2010 Number 21, Supplement to State Gazette of the Republic of Indonesia Number 5103);
17. Government Regulation No. 8 of 2008 on Stages, Procedure for Formulation , Control and Evaluation of Regional Development Plan (State Gazette of the Republic of Indonesia Year 2008 Number 11, Supplement to State Gazette of the Republic of Indonesia Number 4817);
18. Government Regulation Number 21 of 2008 on the Implementation of Disaster Management (State Gazette of the Republic of Indonesia Year 2008 Number 48, Supplement to State Gazette of the Republic of Indonesia Number 4833);

1.4 Standing of the National Action Plan for Adaptation to Climate Change (RAN-API)

RAN-API is part of Indonesia's national development planning framework. Description of the standing of RAN-API is shown in Figure 1.1. In terms of national development planning, RAN-API serves as a more specific planning across sectors in preparing development plans resilient to climate change (climate proof) at the national level, where the RAN-API itself is expected to provide guidance on the Government Work Plan and the National Medium Term Development Plan (RPJMN) in the future, in order to be more responsive to the effects of climate change. RAN-API is not a separate document which has the formal legal powers of its own, but it is a major input and an integral part of national development and Ministries/Agencies planning documents. RAN- API is also a reference for local governments in preparing the Action Plan/Regional Climate Change Adaptation Strategy as a direction in preparing local development planning documents that are resilient to climate change.

To ensure the involvement and ownership of RAN-API by related Ministries and Agencies of the Government of Indonesia, the preparation of RAN-API has been carried out through a participatory approach involving various Ministries/Agencies, facilitated by four primary Ministries/ Agencies, namely the Ministry of National Development Planning/ National Development Planning Agency (Bappenas), Ministry of Environment (KLH) , the Agency for Meteorology, Climatology and Geophysics (BMKG), and the National Council on Climate Change (DNPI), and supported by a team of experts. Thus, the priority activities on which RAN-API is focused are a form of enhancement to the strategic plans of each Ministry and Agency for adaptation to climate change. Ministry of Planning/Bappenas, Ministry of Environment, BMKG, DNPI and the Team of Experts act primarily as facilitators of the analytic process and policy development. In addition, there is the involvement of Community Service Organizations (CSO) and Development Partners in the drafting process.

Nationally, RAN-API will be under the Coordination Team for Handling Climate Change, especially the Adaptation Working Group, which was formed by Decree of the Minister of Planning/Head of Bappenas No. 38/M.PPN/HK/03/2012 on the establishment of the Coordination Team for Handling Climate Change. This Working Group is responsible for plan synchronization and program implementation and activities related to adaptation to climate change so as to have a more targeted focus and locus.

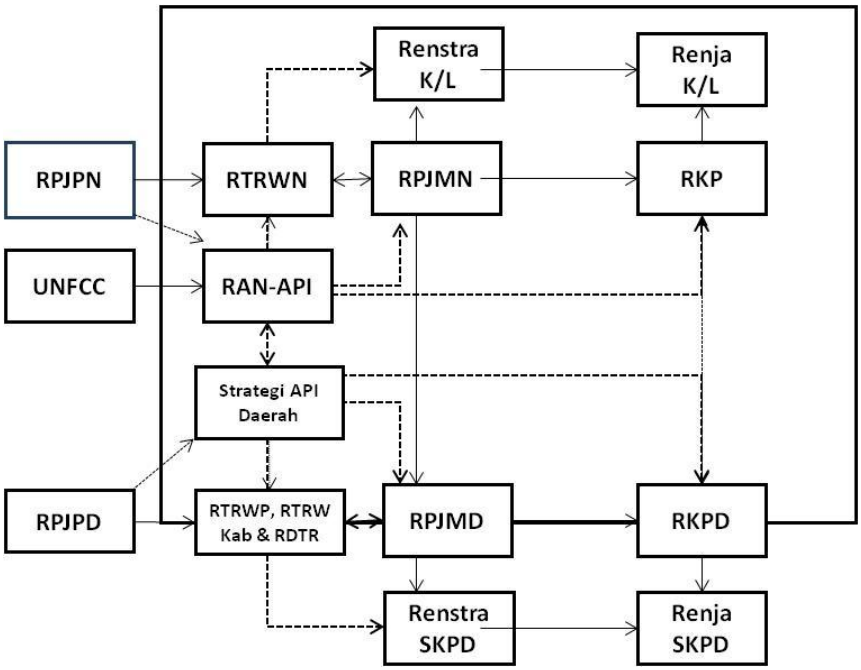

Figure 1.1 Standing of RAN-API in the National Development Framework

For the implementation of climate change adaptation in the regional level, regional adaptation strategies need to be formulated at the provincial level, which is the responsibility of each region with the coordination of the Ministry of the Interior. Regional Adaptation Strategy is formulated with the involvement of relevant technical offices and in accordance with local development priorities based on the ability of the budget and the public. The governance authority arrangements at the local level including provincial and district/city refers to Act no. 32 of 2004 and Act no. 38 of 2007. Programming and adaptation action plans in some fields/sectors need to be harmonized with the arrangement of authority as stipulated in PP. 38 of 2007.

1.5 Approach and Framework

RAN-API is formulated with reference to existing documents and action plans. The preparation begins with a review of the existing documents, identifying the risks of climate change on various areas of life, and setting goals, objectives, strategies, and action plans to anticipate the risk of future climate change, which is synchronized with the work program of the Ministries/Agencies.

With regards to the main purpose of adaptation to climate change in RAN-API, namely the achievement of national development that has resilience to the impacts of climate change and takes into consideration existing scientific studies, gap analysis assessment between the ICCSR (Indonesia Climate Change Sectorial Roadmap) academic documents with the RPJMN and the Strategic Plan of each Ministry/Agency, and consultation with the sector and other stakeholders, action plans for national climate change adaptation are formulated to be implemented within 1-2 years including mainstreaming into the next National Medium Term Development Plan (RPJMN) (2015-2019 and 2020-2025). RAN-API documents that have been prepared will be reviewed and improved periodically, supported by more focused scientific studies.

The main funding source for implementation of RAN-API is the State Budget (APBN), but RAN-API can also be associated with non-APBN funding sources such as the Indonesia Climate Change Trust

Fund (ICCTF) and others. Therefore, it is necessary to identify activities that can be funded through APBN and those that cannot, so that funding can be done through non-APBN sources. As a concept that supports RPJMN and Renstra, RAN-API is an umbrella for the plan documents and results of the activities within the existing ministries, such as RAN-MAPI and Vulnerability Analysis conducted by the Ministry of Public Works, Map of Vulnerability and Climate Change Impact of Indonesia by the Ministry of Environment and the pillar (strategy) for healthcare adaptation conducted by the Ministry of Health. RAN-API also serves to guide the recording and reporting of adaptation sectors to the UNFCCC regarding climate change initiatives. Meanwhile, with regard to disaster risk reduction, RAN-API serves as a connection to the National Action Plan (RAN) and Regional Action Plan (RAD) for Disaster Risk Reduction for disaster causes associated with climate change impact, such as hydro-meteorological disasters.

Chapter 2. Climate Change and Its Impact in Indonesia

The preparation of RAN-API is based on a scientific belief about climate change itself. One of the important scientific bases to discuss issues of climate change today is the Fourth Assessment Report (AR4), published by the Intergovernmental Panel on Climate Change (IPCC) in 2007. By using a variety of observational data and the output of global climate models, the report confirms the role of human activity (anthropogenic factor) in increasing concentrations of greenhouse gases (GHGs) in the atmosphere that accelerate the rate of global average surface temperature increase to 0.74°C ± 0.18° over the period of 1906-2005 (IPCC, 2007). The trend of increasing global temperatures (global warming) is believed to have led to climate change in various places in the world today.

2.1 Climate in Indonesia

The climate in Indonesia is generally influenced by the monsoon circulation patterns that control annual rainfall in most areas.

2.1.1 Annual Rainfall Patterns and Surface Temperature

Rainfall in Indonesia varies spatially and temporally. Generally, there are annual and semi-annual cycles in the seasonal pattern of rainfall in Indonesia (Chang and Wang, 2005). Some studies tried to characterize the seasonal patterns of rainfall in various regions in Indonesia based on three types of rain: monsoonal, equatorial, and local (Boerema, 1938; Aldrian and Susanto, 2003). Until now, this division is also adopted by the Agency for Meteorology, Climatology and Geophysics (BMKG) as shown in Figure 2.1.

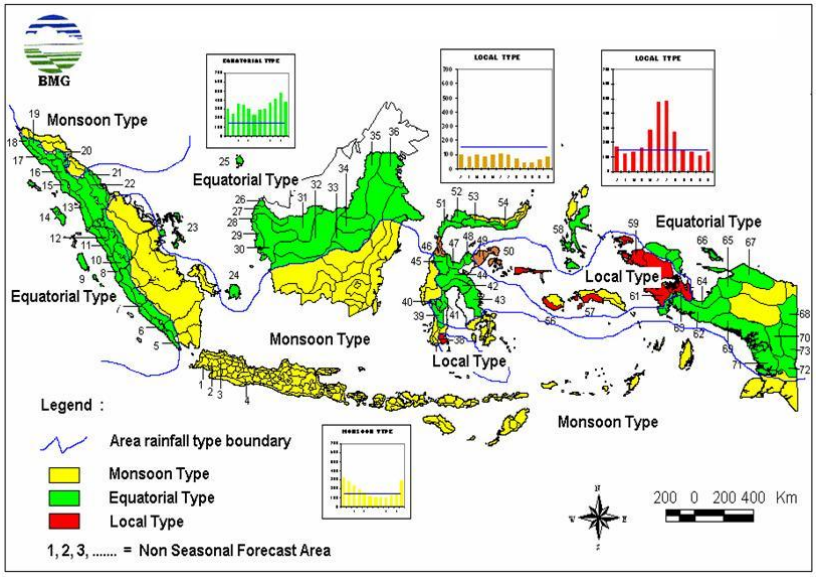

Figure 2.1 Rain type map in Indonesia used by the Agency for Meteorology, Climatology and Geophysics (BMKG; Makmur 2012)

However, some regions require a more detailed climate classification, considering local factors such as topography.

2.1.2 Climate Variability

On average, the daily variation of convective cloud activity is the dominant daily weather pattern affecting the Indonesian archipelago. Convection is a process of cloud formation and rain due to

moist air rising from the bottom layer up to a layer high enough in the atmosphere. Diurnal variations generally cause rain in parts of Indonesia, in the afternoon until evening on land, and over the ocean in the evening until morning (e.g. Nitta and Sekine, 1994). A series of satellite images in Figure 2.2 illustrates how the diurnal convective activity affects the evolution of daily weather over the island of Java.

Although the daily time scale is more associated with weather patterns over the short term, changes in the characteristics of the diurnal variation of convective activity is closely associated with climate change. Kitoh and Arakawa (2005) suggest that global warming will reduce the strength of the diurnal convection and result in a reduction in the amount of rainfall in the mainland. In addition, the characteristics of air flow at the meso scale may be affected by changes in land cover in coastal areas, which in turn modifies the characteristics of diurnal convection.

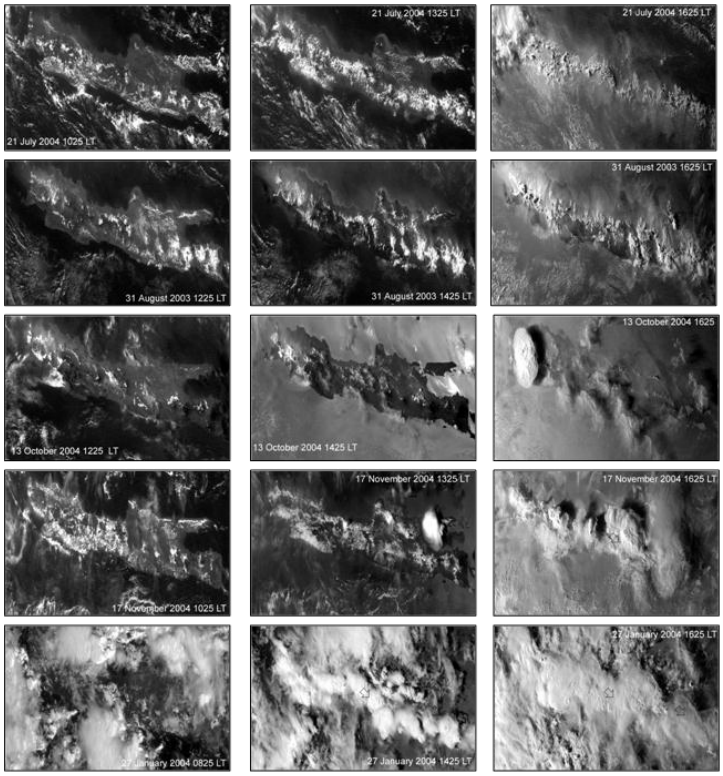

Figure 2.2 Satellite image in the visible channel showing the evolution of diurnal convective activity in a variety of scales. The left, center and right columns show the observation times in the morning, afternoon and evening, while each row shows a different date.

2.1.2.1 Intra-seasonal Variations

In general, phenomena associated with meteorological disturbances that affect the convective activity and the nature of seasonal rain is known as intra-seasonal variation (ISV). Activities of various atmospheric phenomena related to ISV may cause what is often perceived by people as the irregularity of the season (rain in the dry season or drought in the rainy season). Some studies also indicate ISV as a trigger for extreme weather events in Indonesia.

A fairly comprehensive study on the effect of ISV to monsoon circulation in the Indonesia-Australia territory is presented by Wheeler and McBride (2005). Nevertheless, the interaction between the various phenomena associated with ISV in Indonesia is not yet fully understood and more studies have to be done. As an illustration, a summary of relevant information about the ISV phenomenon

can be seen in Table 2.1. The presence of ISV makes the climate patterns in the Indonesian Maritime Continent (BMI) more complex and analysis on climate change have to be performed with more detailed data in a more thorough manner.

Table 2.1 Trends in Surface Temperature Changes from Several Indonesian Climate Assessments

No.	Reference	Linear Tread	Data Period	Remarks
1	Harger (1995)	1.35°–1.64°C over 100 years	1949 – 1992	Observation data from 33 stations in Indonesia
2	KLH (2007)	0.047° C/year (minimum) and 0.017° C/year (maksimum)	1980 – 2002	Trend analysis of maximum and minimum temperatures for 33 stations (the average value obtained is about 3.2°C/100 years)
3	Bappenas (2010c)	0.5° C /100 years	20th century	Observation data in Jakarta and Ampenan (Lombok) which, in terms of of data record length, is considered the most representative
4	KLH	0.63° C /100 years in Malang (KLH, 2012a), 0.20° C /100 years in Tarakan (KLH, 2012c), -0.14° C /100 years in Palembang (KLH, 2012d)	20th century	Study in Malang, Tarakan and Palembang based on data from the University of Delaware and local observation during the 20th century (1910-2010); the trend is generally positive for the last 25 years

2.1.2.2 Inter-annual Variations

Rainfall patterns in Indonesia also have a characteristic of inter-annual variability that has long been documented by Braak (1929). Various studies to date (e,g,, Chang et al., 2004; Hendon, 2003; Wang et al., 2000) proved that the variation of inter-annual rainfall in Indonesia is influenced by climatic phenomena associated with variations in sea surface temperature anomalies (ASPL) in central and eastern Pacific and sea surface pressure anomalies in the western Pacific (northern Australia), known as the El Nino Southern Oscillation (ENSO). The increase (decrease) of ASPL in those regions is a sign of the El Nino (La Nina) phenomenon which can lead to increased length of the dry (wet) season and results in a decrease (increase) in the number of seasonal and annual rainfall in most parts of Indonesia.

Besides the effect of S. Pacific ENSO, inter-annual variation of rainfall in the monsoon region is also caused by a similar phenomenon in the Indian Ocean, a phenomenon known as the Indian Ocean Dipole (IOD) (Saji et al., 1999). Positive (negative) Dipole Mode (DM) is associated with decreased (increased) rainfall in Indonesia (especially the western parts). El Nino event that coincide with positive DM like in the year 1997/98 can cause severe drought in almost all regions of Indonesia.

IOD has a greater effect on parts of Indonesia around the Indian Sea near the Sunda Strait to the Java Sea. On the other hand, the influence of ENSO is more widespread in almost all regions of

Indonesia except for a small area of Sumatra near the eastern Indian Sea. It should be noted that rainfall in some parts of the west coast of Sumatra in general does not show significant correlation with either ENSO or IOD.

El Nino events are generally associated with drought in parts of Indonesia. For example, of the 37 El Nino events since 1850 according to records by D'Arrigo et al. (2008), as many as 21 of them are associated with drought. Falcon et al. (2004) have even linked the Nino 3.4 index with rice production. However, it should be noted that the impact of El Nino on the climatic conditions in Indonesia depends on its strength or intensity.

It is also worth noting from Figure 2.2 that although La Nina in many ways causes opposite impact to El Nino, it is not necessarily associated with flooding. Major floods that occurred in Jakarta, for example, did not occur in strong La Nina years. Therefore, the recurrence of flood events is rather difficult to associate directly with (as a direct result of) ENSO and IOD.

2.1.2.3 Inter-decadal Variations

The phenomenon of atmospheric oscillation periods of 10-12 years (ten-to-twelve oscillation; TTO) has long been identified by researchers (e.g,, Labitzke and Van Loon, 1995). The results of the analysis of rainfall data in many places also often show a signal with a similar period, which also correlates with the period of black spot activity on the Sun (sun spots). However, the physical mechanisms that explain the relationship between sunspot activities with rainfall are still being debated. Research related to climate variability in inter-decadal scale is currently based more on the findings of ASPL variations in the Pacific, known as the Pacific Interdecadal Oscillation (PDO; Mantua et al., 1997; Mantua and Hare, 2002) or the Interdecadal Pacific Oscillation (IPO; Folland et al., 1999; Power et al., 1999).

Teleconnections (linkage based on statistical correlation) between monsoon rainfall in the region with PDO has also been quite widely studied (e.g., Krishnan and Sugi, 2003), although the physical mechanisms that explain the relationship between the two is not clear. Similar studies have not been done for many parts of Indonesia, but rainfall observation data from multiple places indicate significant anomalies of wet and dry periods in the interdecadal time scale.

The linkage between climate variability with extreme climate events still needs to be closely examined.

2.1.3 Maritime Climate and Sea Level Height Variation

As on land, weather and climatic conditions on the Indonesian oceans are strongly influenced by the Asia-Australia monsoon circulation but with characteristics that may be very different. Unlike on land, sea surface temperatures (SSTs) are not only determined by solar radiation but also influenced by ocean currents and vertical motion of the sea water, be it upward movement (upwelling) or down (downwelling). As can be seen in Figure 2.3, the SST in the Java Sea is the lowest in September, even though the air temperature is almost at the highest.

In general, SST in Indonesia is greater than 28°C in January and lower than 27°C in August. Sea levels fluctuate daily due to the tidal cycle. In addition, the monsoon circulation also affects the seasonal sea level in Indonesian waters. In general, sea levels rise in January and are low in August. In Bappenas (2010b) it is reported that in the event of El Nino, sea levels in Indonesia fell by about 20

cm below normal and in La Niña period rose by 10-20 cm. According to Sofian et al. (2007), increase in sea levels during transition between El Nino and La Nina, and also during La Nina, is caused by the increased strength of trade wind in the Pacific Ocean that brings water masses from the East Pacific around Peru to the Indonesian waters.

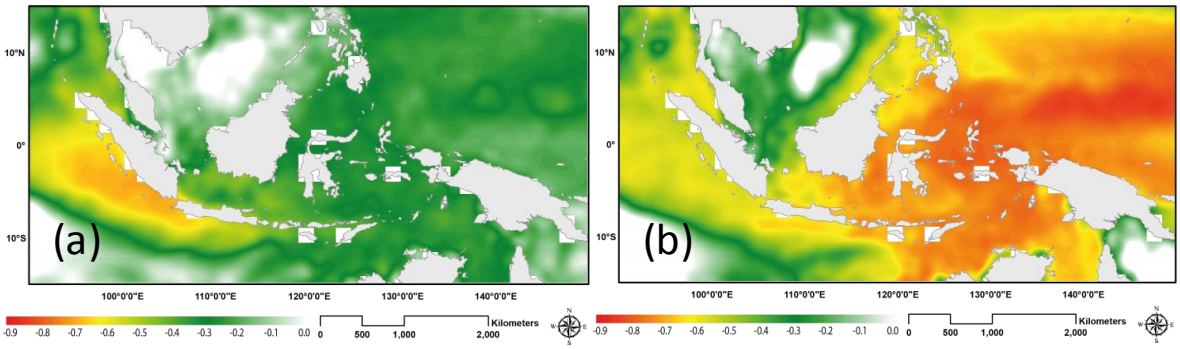

Figure 2.3 The results of the analysis are similar to Figure 2.3 but for the sea levels with (a) DMI and (b) NINO 3.4 index

Momentary sea level rise within a certain period is also caused by more irregular weather and climate phenomena occurrence such as tropical storms and other weather disturbances. Tropical storms that occurred in the waters near the coast may result in rise in sea levels, known as storm surges. Storm surges events, although fairly short in duration, can cause considerable damage in coastal areas. Some coastal areas also experience momentary sea level rise occurrence known as tidal flooding.

2.2 Analysis of Climate Change in Indonesia Based on Observation Data

According to the IPCC (2007), a study on climate change and its effects can be done with a bottom-up approach, which is based on observational data, as well as a top-down approach, which is based on the results of climate model simulations. According to Meehl et al. (2000), climate change can be said to occur when the average value (mean) and/or the variance of the observed climate parameters in a climatic period (30 years according to the WMO operational definition) is different from the previous climatic periods. In principle, longer climate observation historical data will provide better information on how much climate change has occurred in a given area.

2.2.1 Trends in Surface Temperature Changes

The effect of global warming on surface temperature rise in Indonesia is expected not to be greater than 1.0°C during the 20th century. Once again, it should be noted that an exact value is rather difficult to obtain given the lack of consistent data recording in Indonesia.

This tendency can be seen in Figure 2.4, which shows the variation of the average temperature for the whole of Indonesia calculated using data from CRU, which is one of the global climate databases from the University of East Anglia that is often used as an alternative to local observational data. In addition, the trend of local temperature changes due to heat island effect is also considered quite to be a dominant influence in urban observation data (Bappenas, 2010c).

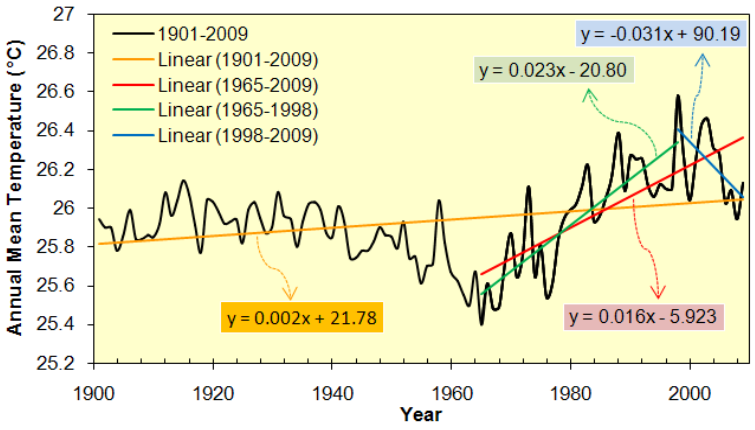

Figure 2.4 Trends in annual average temperature for land areas in Indonesia (6°N-11°08'S and 95°E-141°45'E) based on data from the CRU TS3.1.

2.2.2 Trends in Rainfall Changes

Based on the analysis of seasonal rainfall in parts of Indonesia in the Indonesia Second National Communication report (KLH, 2010), the increase in precipitation for December-January-February (DJF) occurs in almost all Java and eastern Indonesia, such as Bali, NTB, and NTT. As for the June-July-August (JJA) rainfall, a significant downward trend can be found in almost all parts of Indonesia, except Pandeglang (West Java) , Makassar (South Sulawesi), Manokwari, Sorong (Papua), and the Moluccas (Figure 2.5).

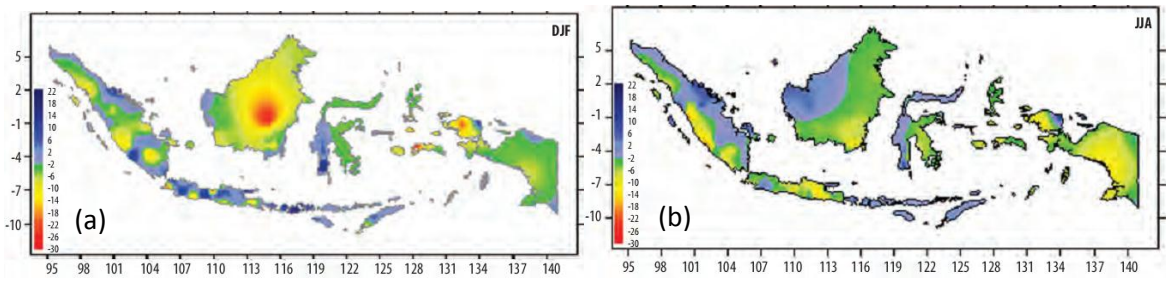

Figure 2.5 Trends in Seasonal Precipitation Changes on the Months of (a) DJF and (b) JJA in Indonesian Region (KLH, 2010)

In another study by the National Development Planning Agency (2010c), it is indicated that the trend of changes in rainfall is not only different for each season, but can also be different for each month. Figure 2.6 shows the moving 30-year rainfall average for every 5 years using data from Jakarta station. Based on this figure, the January rainfall increase in the 1970's was more significant than it was in the 1900's, with a 30-year average margin value of about 100 mm. Changes that occurred each month were different from each other and in general rainfall in the month of January to April was more sensitive to change than in the other months. Furthermore, it can also be seen that the January rainfall tends to decrease around the 2000's, while the February rainfall tends to rise. It can be concluded that, to an extent, Jakarta has experienced climate change in terms of the change in average value (mean) in the rainfall data between a 30-year period and another 30-year period.

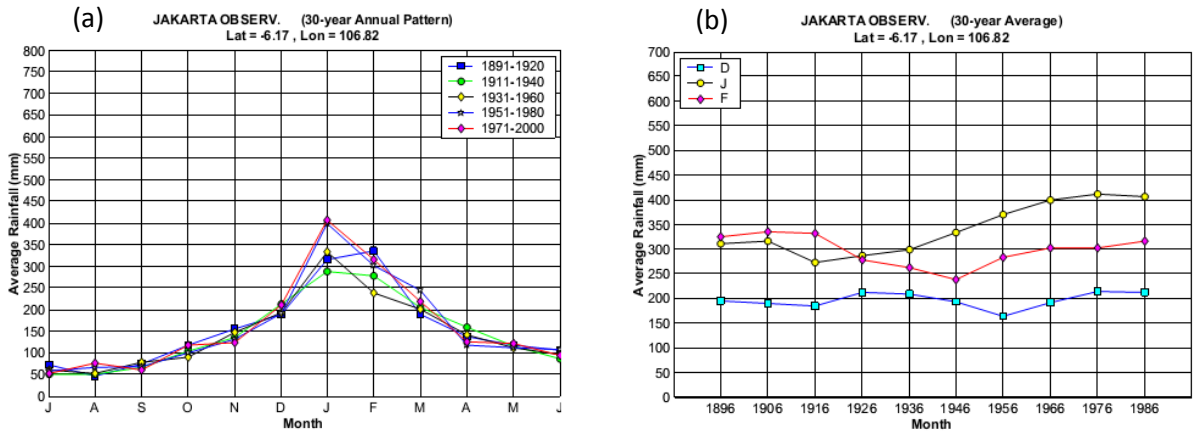

Figure 2.6 Monthly Changes in Rainfall 30-year Average (a) in Multiple Timelines and (b) The Moving Average Graph for The DJF Wet Months (Bappenas, 2010c)

Rainfall change trends for each month also varied spatially. Figure 2.5(b) and Figure 2.7(a) give the pattern of rainfall trends that is quite varied in the wet months (January represents the DJF wet months). Increase in rainfall in most parts of Sumatra is illustrated by Figure 2.5(b), while the decrease and increase in rainfall tends to be uniform in Figure 2.7(a). As in Figure 2.5(b), Figure 2.7(a) also indicates the trend of spatial variation in precipitation changes In the Java-Bali region, with a tendency of increase in rainfall in West Java, East Java, and Bali, and the tendency of decreasing rainfall in Banten and Central Java. The northern part of Sulawesi Island as well as the central and southern parts of Papua experience decreased rainfall according to both figures. However, there are differences in precipitation change trends for Borneo, central part of Sulawesi, Halmahera Island, and Nusa Tenggara Islands. Figure 2.5(b) shows the rising trend for the region , while Figure 2.7(a) shows the opposite . It can be concluded that, although there are some differences, both studies showed that precipitation change trends have a high spatial variation in Indonesia.

Accordingly, there was a change in the average rainfall value that is not uniform for all regions of Indonesia in January of the 1980-2010 period compared to the baseline. In Sumatra, most regions had an increase in average rainfall of 10-50 mm. In other regions, there are areas where the average rainfall increased, but also areas where the value decreased.

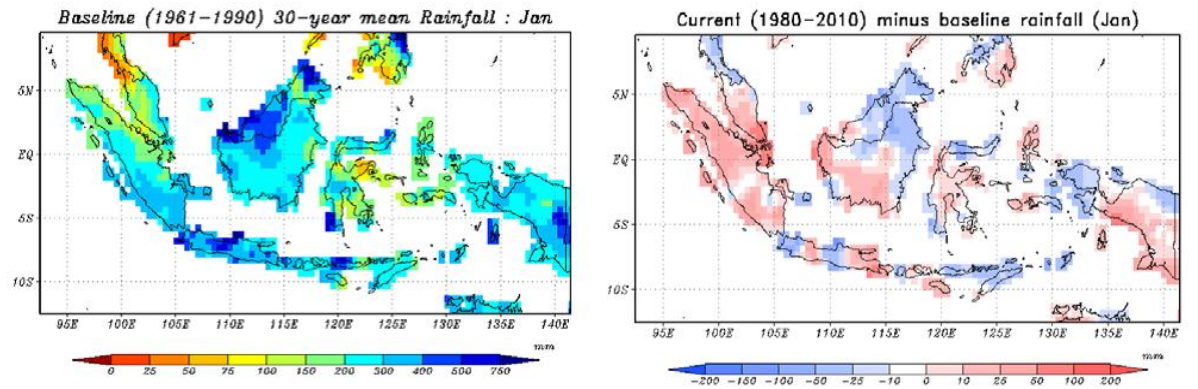

Figure 2.7 An example of the results of the analysis of rainfall trends in January GPCC data: (a) the average value of the baseline from 1961 to 1990 and (b) the difference between the average value of the period 1980 to 2010 (data through 2007) with the baseline (Bappenas , 2010c).

In addition to reviewing the changes in rainfall compared with the baseline period, Bappenas (2010a) also used polynomial extrapolation to show the trend of rainfall which may occur up to 2020. Table 2.2 summarizes the projected changes in precipitation that occurred in Indonesia until 2020. Temporally, the trend of increasing rainfall across Indonesia indicate that there is an increase in the months of March and December, and in Sulawesi, Borneo and Sumatra rainfall tends to rise even for the December to April period. In contrast, the downward trend in rainfall for the July to October period is observed in most regions except Papua and Sumatra.

Table 2.2 Projected changes in average rainfall in parts of Indonesia for the 2010-2020 period (relative to 1980-2000) based on a polynomial trend analysis of observational data (Bappenas, 2010a).

Region	Average Rainfall											
	Month (January to December)											
	J	F	M	A	M	J	J	A	S	O	N	D
Java-Bali	↓	↑	↑	↑	O	↑	O	O	↓	O	↓	↑
Sumatra	↑	↑	↑	↑	✦	O	↑	↑	↑	↑	✦	↑
Sulawesi	↑	↑	↑	↑	✦	↑	O	↓	✦	↓	✦	↑
Borneo	↑	↑	↑	↑	✦	O	↓	↓	↑	↓	✦	↑
Moluccas	O	↑	↑	O	O	↑	↓	↓	O	↓	✦	↑
Nusa Tenggara	↓	↓	↑	O	O	O	O	O	↑	↓	O	↑
Papua	↑	↓	↑	↑	✦	↑	✦	↑	↑	O	↑	↑

Description:

↑: mostly increased, ↓: mostly decreased, ✦: ↑ and ↓ evenly distributed,
O : mostly unchanged

2.2.3 Sea Surface Temperature Increase Trend

The effects of global warming trends are also reflected in the long-term changes in the sea surface temperature (SST). Figure 2.8 shows the change in the value of the global average SST, the tropics average, and the average on the waters of Indonesia from 1854 to 2010, which is calculated based on National Oceanic and Atmospheric Agency (NOAA) data reconstruction results (Smith and Reynolds, 2004). From these data it can be seen that there is a upward trend of SST increase over time since 1905 with an average increase rate of 0.7°C/100 years. For parts of Indonesia, the upward trend is slightly higher than the global and tropics average, which ranges from 0.8°C/100 years or 1.5°C/100 years if counted from 1945. This upward trend is still comparable to the trend of global temperature rise of 0.78°C ± 0:18 (IPCC, 2007).

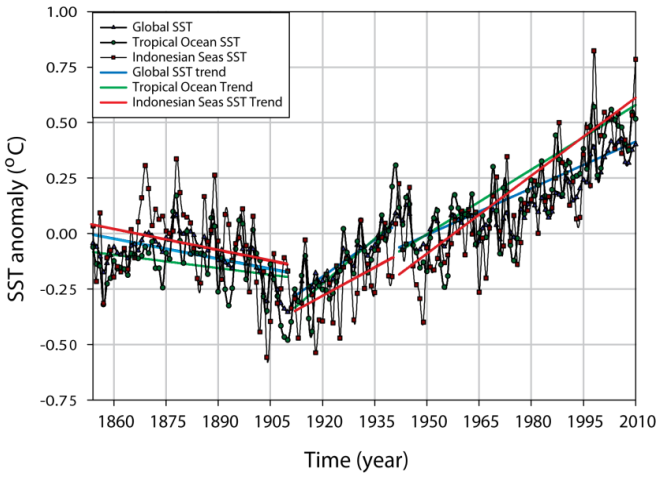

Figure 2.8 Time-series of SST anomalies relative to the average SST in 1901-2000 and trends, globally (blue), in the tropics (green), and Indonesian waters (red) which is calculated based on the NOAA data reconstruction results for the period 1854-2010.

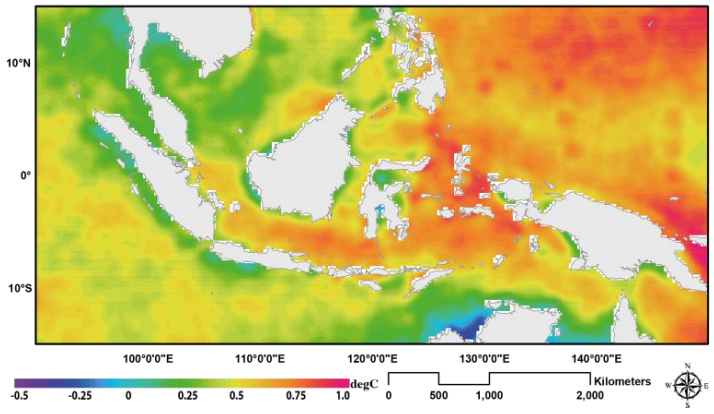

Figure 2.9 Linear increase trend in SST for 30 years from 1982 to 2011 calculated from NOAA data reconstruction with a resolution of 0.5° lat/lon

In general, the increase in Pacific Ocean SSTs is higher than those in the Indies Ocean. The increase in SST over the past 30 years range from -0.2°C to 1°C with the highest growth occurring in the Pacific Ocean north of Papua Island. Meanwhile, the lowest increase occurred in northern Australia. The increase in SST in the Java, Banda and Arafura Seas and most of the waters in eastern Indonesia is relatively high compared to the increase in SST in the South China Sea of only 0-0.25°C. The low increase in SST in the South China Sea may be caused by upwards sea water mass movement (upwelling) and the mass flow of fresh water (fresh water flux) from rivers and rain. Furthermore, the low increase in SST in the south of Java and Sumatra is caused by the intensification of upwelling due to the higher frequency of El Nino than La Nina from 1982 until mid-2000. Meanwhile, the increase in SST on the south coast of Java to the east, south of Bali, Lombok and Nusa Tenggara islands are relatively high due to the transport of warm water from the Pacific Ocean through the Makassar, Banda, and Timor Straits.

2.2.4 Trends in sea levels rise (SLR)

Figure 2.10 shows the dynamics of SLR from 1860 to 2010. From the characteristics of the sea level in Indonesia, patterns of 30 to 50 years (1860-1910 , 1910-1950 , 1950-1990) or decadal variations can be observed, although this variability has not been seen clearly since 1990. Calculated from 1960 to

2008, based on Simple Ocean Data Assimilation (SODA) data, the SLR in Indonesia was 0.8 mm/year, then increased to 1.6 mm/year since 1960 and jumped to 7 mm/year from 1993.

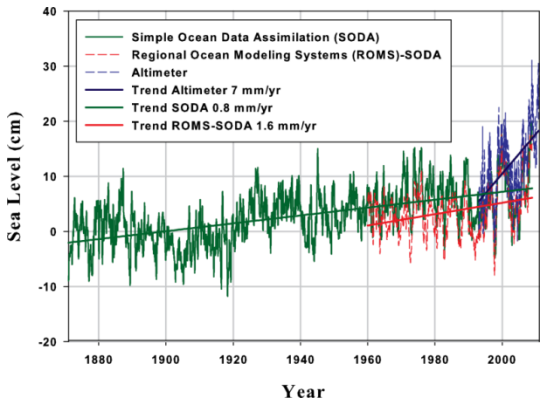

Figure 2.10 Variation of the average SLR anomaly in the waters of Indonesia in 1860-2010, which is calculated from the SODA data (full green line) , ROMS - SODA (red dotted line), and altimeter (blue dotted line). The linear trend line calculated for each of these data is also shown.

Spatial patterns of SLR in Indonesia is shown in Figure 2.11, which was calculated based on data from the altimeter. From Figure 2:11 (a) it can be seen that the increase in SLR is highest in northern Papua, Java and Banda Seas, Indian Ocean, and most of the waters in eastern Indonesia, with the highest SLR reaching 2.5 cm/year. In addition, Figure 2:11 (b) shows that SLR has increased significantly in 2005-2011 relative to 1993-2004.

In general, the altimeter data show that the highest SLR increase occurred in western Pacific Ocean at more than 12 cm, while the smallest increase occurred in the Indian Ocean south of Java and Sumatra, South China Sea, and northern Sumatra. In general, the difference between the rate of SLR increase in the Pacific and Indian Oceans can lead to changes in the geostrophic flow characteristics from the Pacific to the Indian Ocean. Which eventually, may lead to regional change of SLR, caused by the increased intensity of the transport of warm water from the Pacific to the Indian Ocean, which can lead to changes in local rainfall patterns in Indonesia.

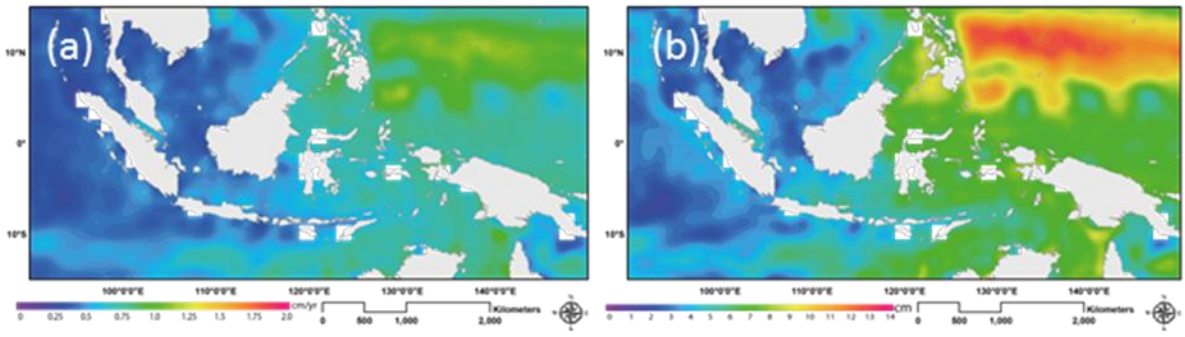

Figure 2.11 SLR spatial patterns in the waters of Indonesia, which is shown by : (a) SLR upward trend in the period 1993-2011, and (b) the difference between average SLR in 2005-2011 period and the average SLR of the period 1993-2005.

2.2.5 Trends in Extreme Weather and Climatic Events

Extreme weather and climatic events are an intrinsic part of the climate system, which is chaotic in nature. Nevertheless, the climate change that is happening now is believed to potentially increase the frequency of extreme events in various regions of the world.

For brevity, extreme weather and climate events will be referred to simply as "extreme events." Thus, the definition of extreme events depends on a threshold value determined from observational data statistics and may be relative to the place, time, and purpose.

Figure 2.12 shows the trend of change in the probability of extreme daily rainfall based on the analysis of cumulative distribution function (CDF) from TRMM satellite data. These results indicate an increased chance of extreme daily rainfall in most parts of Indonesia, except for some areas in Maluku, within a period of approximately 10 years during 1998-2008.

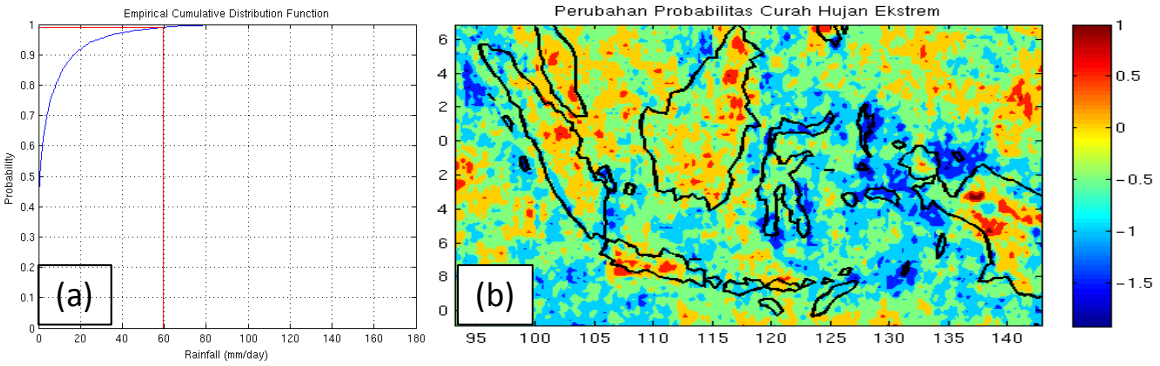

Figure 2.12 (a) cumulative distribution function (CDF) curve with a threshold value for highest 1% daily rainfall chances based on TRMM satellite data over the period 1998-2008. (b) The distribution of value changes in extreme daily rainfall chance in the TRMM data for the period 2003-2008 relative to the chance value in the period 1998-2002.

2.3 Projected Climate Change Based on AR4-IPCC Models

Climate projections can be understood as an attempt to get an idea of the response of the climate system to changes in radiative force, mainly due to the increase in the concentration of greenhouse gases and aerosols in the atmosphere, up to a point of time in the future. Simulation result using a variety of climate models is used for the analysis of global climate projections up to the year 2100 by the IPCC (2007). The results of climate projections is dependent upon the scenario of an increase in greenhouse gas concentrations in the atmosphere based on an assumption of global socio-economic development as well as key technology that supports it. In the AR4-IPCC, the scenario used is based on the Special Report on Emission Scenarios (SRES).

2.3.1 Projected Surface Temperature Increase

Projected surface temperature increase based on AR4-IPCC models generally shows a linear trend with a rate of increase that is almost uniform for the three scenarios B1, A1B, and A2 up to the year 2030. For example, Figure 2.13 is the projected increase in the average temperature for the region of Malang in East Java. This trend is generally the same for all parts of Indonesia because the models assume that the AR4-IPCC temperature rise is caused predominantly by the greenhouse gas spread evenly in the atmosphere. Thus, the projected rise in average surface temperatures across Indonesia due to GHGs until the period 2020-2050 is approximately 0.8-1°C relative to the final climatic period in the 20th century (Bappenas, 2010c). As discussed earlier, the pattern of seasonal change is determined by the apparent position of the sun so that the differences in monthly temperatures remain within one year ranges from 0-2°C.

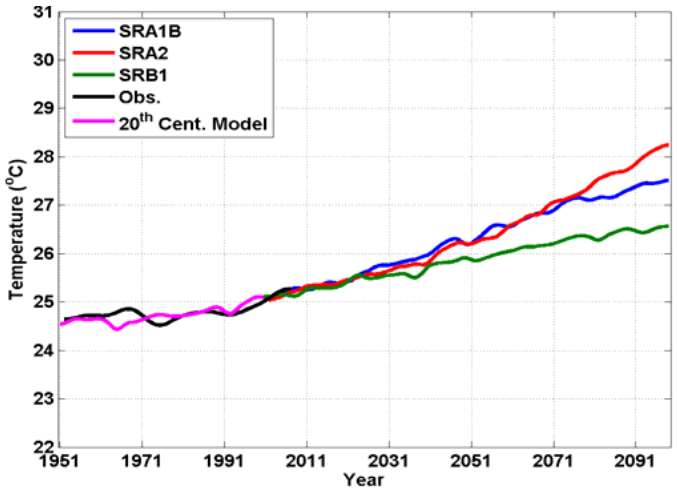

Figure 2.13 Projected surface temperature for the average area of Malang , East Java based on AR4-IPCC model output after downscaling and ensemble averaging. Also shown are the historical data from 1951 to 2010 and the results of GCM model simulations for the 20th century as well as projections for the three SRES scenarios B1, A1B, and A2. Monthly time series data has been smoothed to show the long-term trend (KLH, 2012a)

2.3.2 Projected Changes in Precipitation

AR4-IPCC output models generally exhibit more varied changes in precipitation patterns in Indonesia, both temporally and spatially. Although the results of the analysis and extrapolation of historical data up to 2020 shows a significant trend of rainfall change, the analysis of the output of seven GCM on average showed no significant change for the period 2020-2050 (Bappenas, 2010c). This indicates that, up to the period 2020-2050, natural climate variability has more influence than the effect of greenhouse gases in determining changes in precipitation. However, change in rainfall leading up to and after 2050 needs more attention.

To complete this review, a summary of the results of several studies related to projections of rainfall in Indonesia, as can be seen in Table 2.3 Report of the Second National Communication (SNC; KLH, 2010), shows the trend of 14 GCM models on changes in seasonal rainfall in Indonesia based on two emissions scenarios, the SRES A2 and B1, for the period 2025 and 2050. In terms of the "agreement" between climate models, among others, there is a tendency to reduction in rainfall in the dry season of June-July-August (JJA) and transition season of September-Oct-November (SON) in Java and Nusa Tenggara Islands and increased rainfall in the rainy season of December-January-February (DJF). This trend tends to reverse the outcome projected for most areas in the other islands. Meanwhile, the projected rainfall in Malang (KLH, 2012a) also shows a trend reduction in rainfall in the JJA months, which indicates strengthening of the Australian monsoon. These results are consistent with the analysis of the projection of Naylor et al. (2007) which states that the 2050 rainy season in Java will experience a delay of up to 30 days.

Table 2.3 Summary of studies related to projections of rainfall in Indonesia

No.	Source	Main Conclusion	Projection Period	Remarks
1	Naylor *et al.* (2007)	Significant decrease in rainfall in the dry season (July–August–September; JAS)	2050	AR4-IPCC model output with scenarios A2 dan B1; regional scale analysis with empirical downscaling; projection result relative to 1979–2004 observation

No.	Source	Main Conclusion	Projection Period	Remarks
2	Li *et al.* (2007)	Decrease in rainfall in the dry season (JAS)	2050–2099 (and 2101–30)	AR4-IPCC standard model output with scenario A1B using 11 models (and 3 models); projection result relative to CMAP data from 1979–1999 (and 1970–99)
3	KL1H (2010)	Increase in rainfall in December–January–February (DJF), except in northern Sumatera and Kalimantan; rainfall decrease in June–July–August (JJA), especially in West Java and South Sumatra provinces	2050 and 2080	Output consolidation from 14 AR4-IPCC models with scenarios A2 and B1 (*Second National Communication*)
4	Bappenas (2010c)	Significant changes especially in the 2080s period with a tendency of rainfall increase in the wet season and decrease in the transition months.	2001–2100 with time-slice analysis of 2020–50 and 2070–2100	AR4-IPCC model output with scenarios A1B, A2, and B1 with emphasis on scenario A2; using selective ensemble averaging method on 7 models (average of 4 best results taken); projection result relative to 1961–1990 observation
5	KLH (2012a, 2012c, 2012d)	In general, change is average rainfall up to 2030 is not very significant; result for Malang indicates trend of rainfall decrease after 2030s, consistent with Naylor (2007)	2001–2100	AR4-IPCC model output with scenarios A1B, A2, and B1; local/regional analysis from several statistical downscaling methods

2.3.3 Projected Increase in Sea Surface Temperature and Sea Surface Height

The results of the analysis of SST projections show an average increase reaching 1-1.2°C by 2050 relative to the value of 2000 (Bappenas, 2010b). This upward trend is still within the range of global temperature rise that is quite consistent with the results of the AR4-IPCC analysis models for surface temperature. However, as described earlier, the influence of global climate variability on the SST variation in Indonesian waters is very significant. For example, El Nino events and strong DM (+) in 1997/98 led to a huge change in the Indonesian waters resulting in to damage the coral reefs.

Sea level rise (SLR) is a very big threat potential to Indonesia, which consists of many small and large islands. In 2050, the SLR due to global warming is projected to reach 35-40 cm relative to the value of 2000. Based on these results, the maximum SLR in Indonesia may reach 175 cm in 2100 (Bappenas, 2010b). Based on these results, and taking into account climate variability factor, a summary of projected SLR for Indonesia can be seen in Table 2.4.

This trend is unlikely to be linear, but exponential, if the dynamic ice melting factor is taken into account. Figure 2.14 shows the average SLR rate in Indonesian waters after considering dynamic ice melting factor. Based on these results, the maximum SLR in Indonesia may reach 175 cm in 2100 (Bappenas, 2010b).

Table 2.4 Projected SLR Wihout Dynamic Ice Melting in Indonesian Waters (Bappenas, 2010b)

Period	SLR Projection	Confidence Level
2030	22.5±1.5cm	Medium

2050	37.5±2.5cm	Medium
2080	60.0±4.0cm	High
2100	80.0±5.0cm	High

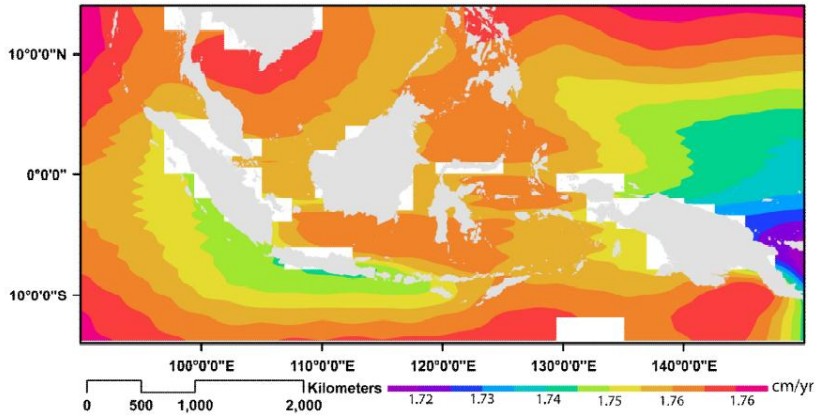

Figure 2.14 SLR Estimation in Indonesia According to Model with Dynamic Ice Melting Consideration (Bappenas, 2010b)

2.3.4 Projection of Extreme Weather and Climatic Events

In addition to SLR, information about extreme climatic and weather events (extreme events) is very important for adaptation planning. However, of projection analysis of extreme events is not easy to perform because it is time consuming and requires more detailed data. It is therefore understandable that a comprehensive study related to extreme events in Indonesia is still very limited.

The study of changes in extreme events probability for Indonesian territory is more focused on extreme rainfall events. The temperature change-related extreme events such as heat waves do not show a significant trend either from historical data (e.g. Manton et al., 2001) or from GCM output, at least until 2050.

2.4 Potential Impacts of Climate Change

Theoretically, the change in climate indicators such as surface temperature, rainfall, sea surface temperature, sea levels, and extreme weather events and climate as projected above will lead to a range of potential impacts on areas related to the national development system, particularly economic, livelihood, ecosystem, as well as specific region. Table 2.5 below illustrates the potential impact of climate change according to the indicators used, as well as identifying areas and sub-areas that could be affected. In general, indicators of climate change are Surface Temperature, Rainfall (CH), sea surface temperatures (SSTs), Sea levels (TML), extreme climate events (ENSO, IOD/DMI, PIO/IPO) as well as extreme weather events (Heavy rain, strong winds, and storm surge).

The increase in surface temperature can impact directly on humans, plants, and animals such as insects. In countries that have summer, there have been heat waves that result in loss of life. Although Indonesia does not have a summer, the heightened temperatures during the day can lead to local heating during the day which causes more frequent use of air conditioners and increase energy consumption. Rising temperatures are also suspected to lead to excessive evapotranspiration in plants, forest fires, as well as much faster and wider breeding of insects.

Table 2.5 Summary of Climate Change Impacts in Related Fields

Climate Change Indicator	Potential Dangers of Climate Change	Sectors Affected								
		Food Security	Energy	Health	Infrastructure	Residential	Ecosystem	Forestry	Urban	Coastal
Surface temperature	Increased evapotranspiration can cause dryness	V	V				V	V		
	The decline in agricultural production due to rising temperature	V		V						
	Local heating due to heightened air temperature at noon		V	V		V	V		V	
	The widespread distribution of disease vector insect population			V		V			V	V
	The increasing spread of airborne disease			V		V				
	Changes in the pattern of population growth and migration of pests and plant diseases	V								
Rainfall	Drought due to rainfall deficit	V	V	V			V	V	V	
	Decreased water availability due to precipitation deficit	V	V		V	V		V	V	V
	Flooding due to an increase in the number, duration, and intensity of rain	V	V	V	V	V			V	
	Landslide	V		V	V	V		V	V	
	The decline in agricultural production due to changes in precipitation	V		V						
	Increased mosquito population due to large puddles of water			V		V			V	V
	The increasing spread of disease through the mediums of air and water puddles			V		V			V	V
Sea surface temperatures (SSTs)	Changes in fish migration patterns caused by changes in ocean circulation currents due to SST increase distribution	V				V	V		V	V
	Damage to coral reefs (coral bleaching) due to increased SSTs and sea water acidity	V					V			V
Sea level	Widespread inundation of sea water in coastal areas can cause shoreline retreat	V		V	V	V	V		V	V
	Widespread areas of seawater intrusion via groundwater and river	V		V	V	V	V			V
Extreme climate events • ENSO • IOD/DMI • PIO/IPO	Occurrence of consecutive dry years				V					V
	The change/shift in seasonal rainfall patterns	V	V					V	V	
	Increased chances of heavy rain, strong winds, storms and storm surges	V			V					V

Climate Change Indicator	Potential Dangers of Climate Change	Sectors Affected								
		Food Security	Energy	Health	Infrastructure	Residential	Ecosystem	Forestry	Urban	Coastal
Extreme weather events • Heavy rain • Storm • Strong winds • Storm surge	Increased frequency and intensity of erosion and abrasion (due to changes in flow parallel and perpendicular to the coast) that cause changes in shoreline	V					V			V
	Increased chances of tidal flood events due to storms and storm surges	V	V	V	V	V	V		V	V
	Increased damage to public infrastructure	V	V		V	V			V	V

Excessive rainfall can result in flooding and landslides, but on the other hand too little rainfall can result in drought and decreased water availability. The decrease in water availability will affect the water supply for urban and agricultural areas. Flood events also typically cause material loss in residential, urban, and agriculture areas. Meanwhile, landslides also sometimes cause loss of both material and life on steep residential areas.

The increase in sea surface temperature can damage coral reefs (coral bleaching) and change ocean currents that result in the migration patterns of fish in the sea which in turn will affect the livelihood of fishermen. Moreover, the rise in sea levels may result in widespread sea water inundation and erosion in coastal areas as well as increased seawater intrusion into the mainland. All of these will have negative consequences especially for coastal populations, since a lot of Indonesia's population resides in coastal areas, especially coastal urban areas.

In addition, extreme weather and climate events have a variety of spontaneous and massive impact that needs to be adapted in the form of disaster management efforts. In accordance with the Hyogo Framework (ISDR, 2005), the integration of climate change adaptation with disaster risk reduction is a new challenge to synergize in the national development system.

Many studies on the impact of climate change in Indonesia have been performed although the scope is generally still in the national scale. The two main references in Indonesia are the ICCSR (Indonesia Climate Change Sectoral Roadmap) document prepared by Bappenas (2010) and the Second National Communication (SNC) to the Convention on Climate Change prepared by KLH (2010).

The ICCSR document mentioned that the potential climate danger may have impact on key sectors such as water, marine and fisheries, health, agriculture, and forestry. In the water sector, climate change may pose four main dangers, namely a decrease in the availability of water, floods, landslides and droughts which are generally caused by the rainfall and extreme weather and climate events parameters.

The ICCSR document also examines the impact and maps the risk of the four climate change dangers on the water sector as in Figure 2.15.

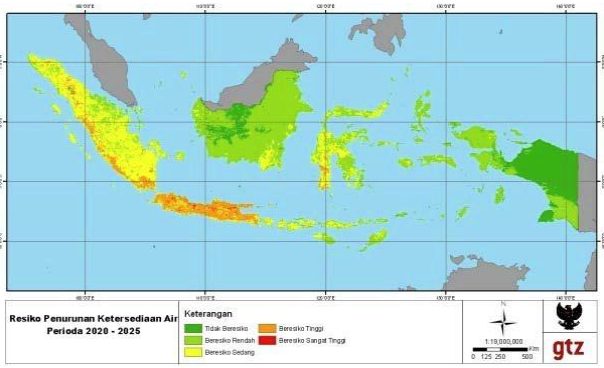

Figure 2.15 The risk of decrease in water availability (top-left), flood (upper-right), drought (lower-left), and landslides (right-bottom) according to SRA2 scenario on the period 2020-2025 (Bappenas, 2010)

A very high risk of decrease in water availability is present in the Java-Bali region, especially in the northern and southern parts of West Java, Central Java and central and southern East Java; urban areas of Sumatra, Bali; Nusa Tenggara; and South Sulawesi. At the same time, a very high risk of drought is generally found in a limited area in the central part of Java; northern Sumatra, and a small part of Nusa Tenggara. This can threaten agricultural and urban activities that require water supply.

Meanwhile, there is a very high risk of flooding in retention areas, coastal cities, riverbanks and low-lying areas downstream of major rivers, such as cities near large rivers in Java and eastern Sumatra; West, South and East Kalimantan; eastern Sulawesi, and southern Papua. And at the same time, very high landslide risk is generally found in the central-southern areas of Java-Bali, western-central Sumatra, most of Nusa Tenggara; Sulawesi, and central part of Papua.

On marine and fisheries sector, the parameters of sea level rise, sea water temperature increase, and climatic and extreme weather events have led to a variety of hazards include coastal inundation, coastal erosion and sedimentation, extreme waves, sea water intrusion through the river water and groundwater, damage to coral reefs from coral bleaching, shifts in aquatic ecosystems that disrupt fishery productivity.

In the above sectors, the ICCSR document has identified the spatial distribution of the risk of coastal flooding, as the combination of the dangers of sea level rise, La-Nina extreme weather event, and storm surge that occurs at high tides during the perigee, as shown in Figure 2.16.

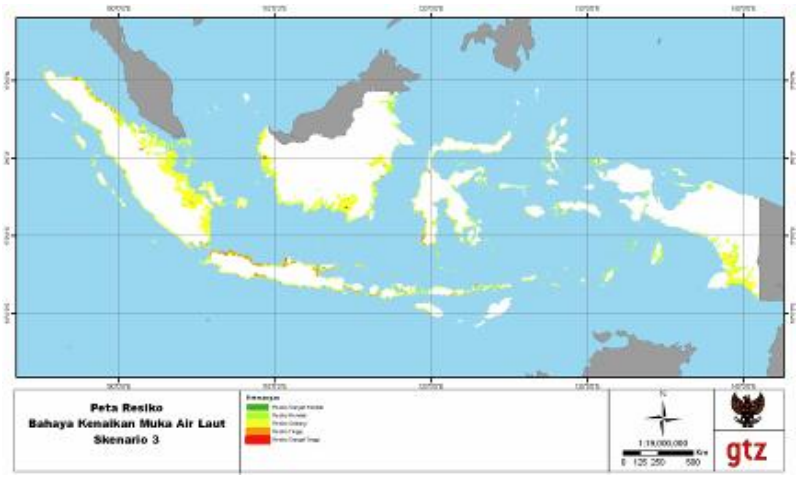

Figure 2.16 The risk of coastal inundation due to the dangers sea level rise, La-Nina climate variability, and storm surge events accompanied by the perigee high tides (Bappenas, 2010)

Regions at risk of coastal inundation include several locations, among others: On the island of Sumatra, some coastal locations at Riau province, North Sumatra, Aceh, West Sumatra, and Lampung. The north coast of the island of Java is a very risky area such as in Jakarta and Tangerang (Banten) and Semarang and Tanjung Muria (Central Java). In Nusa Tenggara, there is a high risk level on the south coast of Lombok island, Saleh Gulf coast in the island of Sumbawa, Ende coast up to around Larantuka coast in Flores Island. On the island of Borneo, some coastal areas such as around Pontianak and Banjarmasin have a very high degree of risk, and on the coast around Samarinda there is a high risk. On the island of Sulawesi, some coastal areas are at high to very high risk as in the west coast of South Sulawesi. In the Moluccas, some locations have a high degree of risk such as the coast around Ternate (Halmahera Island), coastal city of Ambon, and the coastal town of Tual on the island of Kai Kecil, which is mostly caused by the presence of vital infrastructures such as airports. In Papua, although medium risk regions are fairly widespread in the south, high risk areas are contained locally around the city of Jayapura and Biak Island.

In the health sector, the spread of disease through insect vector and air and water/food mediums can be influenced by parameters of air temperature, rainfall, humidity, as well as extreme climatic and weather events. Some diseases are becoming a major indicator of the impact of climate change such as malaria, dengue hemorrhagic fever (DHF), and diarrhea.

These three diseases are becoming a major indicator given the relative availability of data and representative information for risk assessment as set out in the ICCSR document as in Figure 2.17 below.

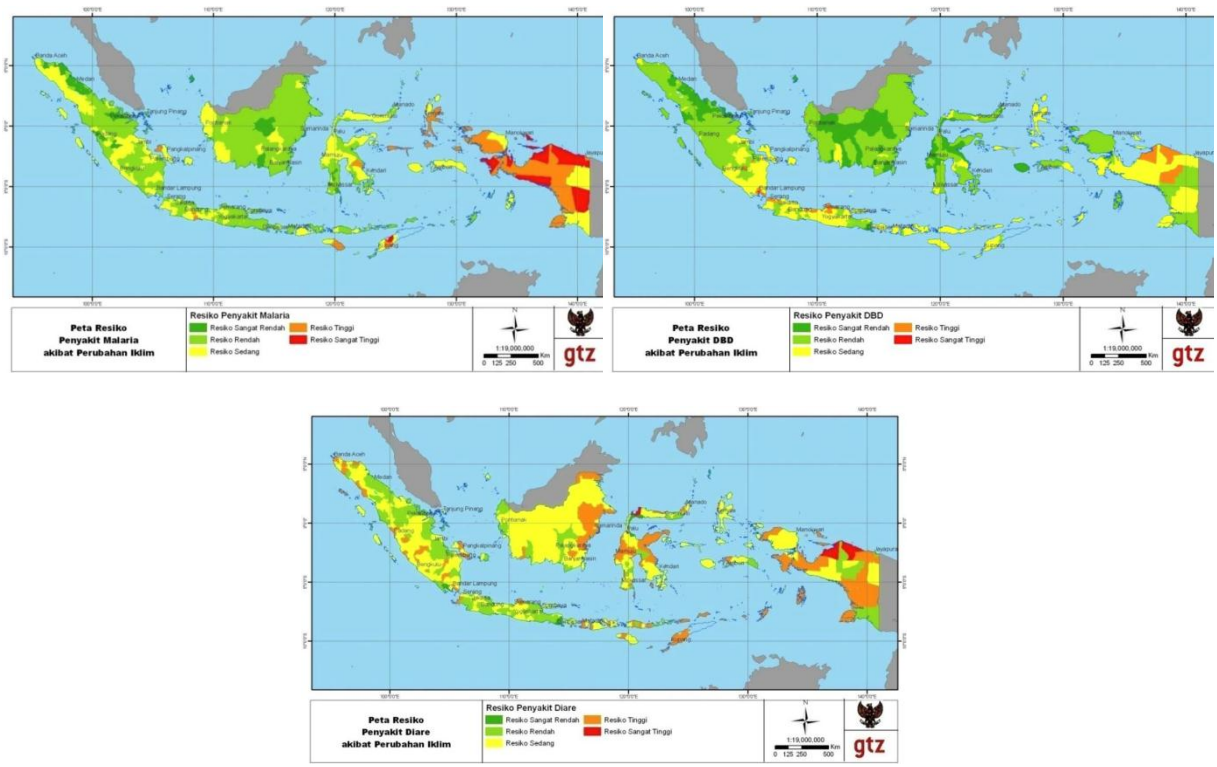

Figure 2.17 Risk of Climate Change Impact on Occurrences of Malaria, Dengue Hemorrhagic Fever, and Diarrhea (Bappenas, 2010)

The area at highest risk of malaria is Papua; high-risk areas include: Maluku, a small part of Sulawesi, and Nusa Tenggara. Areas that have high and moderate risk to DHF are still concentrated in the regions of Eastern Indonesia, especially Papua Island and some of Nusa Tenggara. Some cities and regencies on the island of Java have a low risk of DHF. Areas at highest risk for diarrheal diseases are also on the island of Papua. Parts of Sumatra, Borneo, Sulawesi, and Nusa Tenggara have a high risk of diarrheal disease.

In the agricultural sector, the potential reduction in crop production become the main danger posed by the parameters of rainfall, extreme climatic and weather events, air temperature, and sea level rise on the coast. ICCSR have mapped the risk of decrease in rice production due to drought, particularly in Java as in.

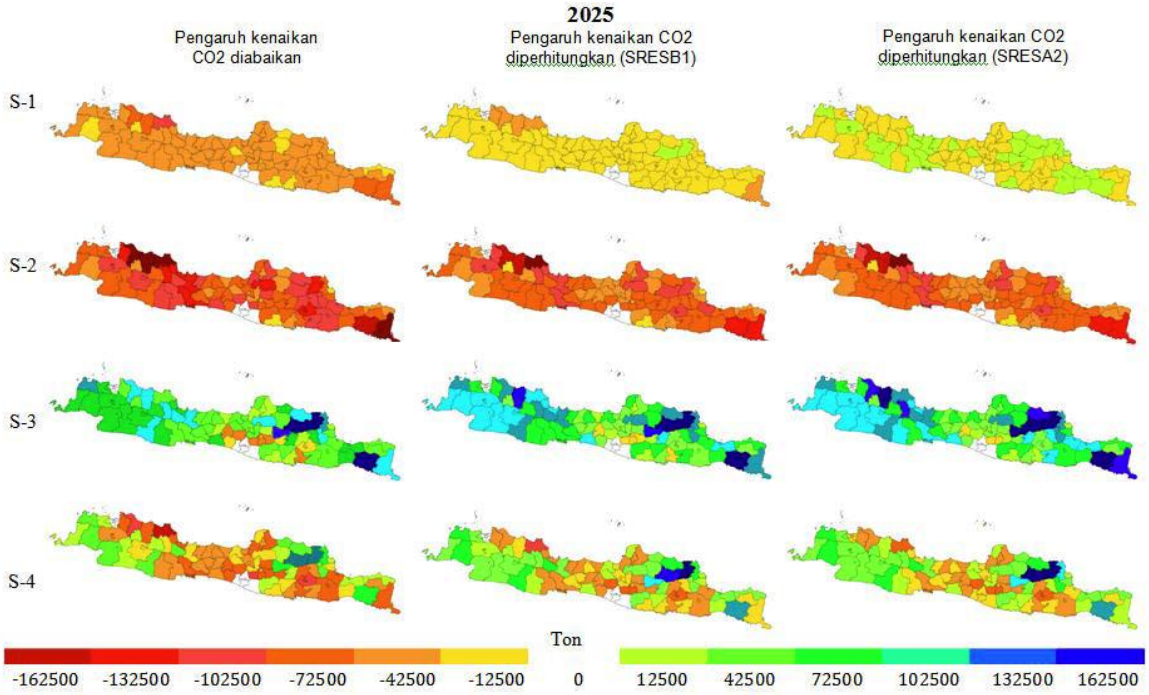

Figure 2.18 Estimated changes in rice production per regency on the island of Java in 2025 compared with current production (2010) as a result of rising temperatures and CO_2 concentrations for the scenarios SRESB1 and SRESA2 on several scenarios of rice field area change and rice cultivation index (Bappenas, 2010).

In the forestry sector, the potential for forest fires become a major climate hazard that is influenced by rainfall decrease and extreme climatic events. SNC document (KLH, 2010) have presented a hot-spot density pattern map, especially for Sumatra (central and southern) and Borneo (western, central, and south) as shown in Figure 2.19. A summary of the analysis of the effects of climate change and identification of risk level in the archipelago region by sub fields can be found in Appendix 2.

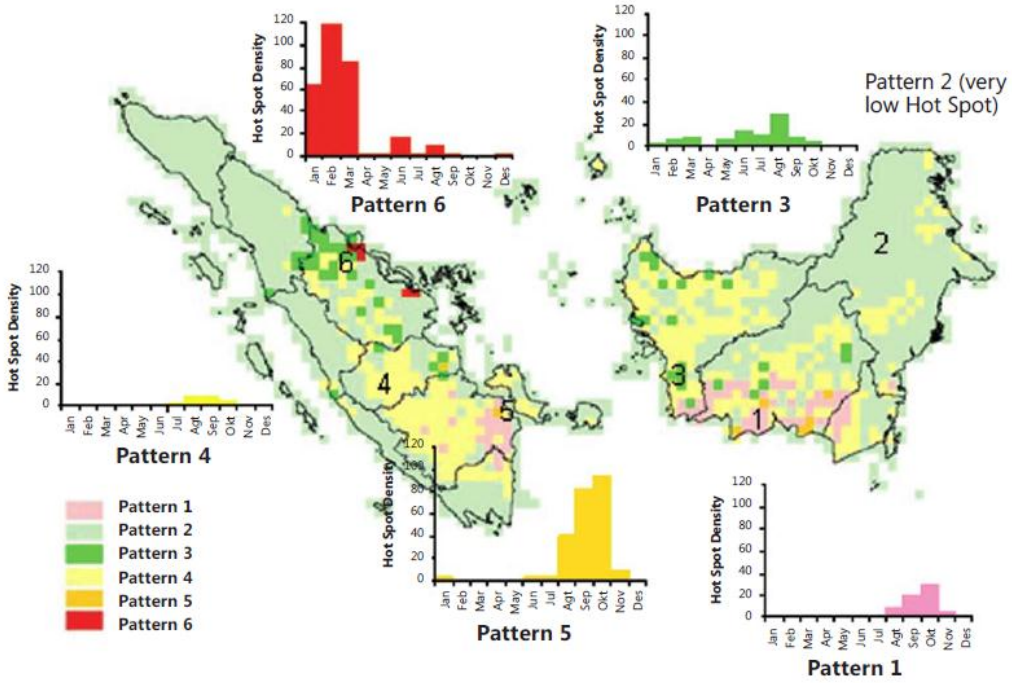

Figure 2.19 Classification of Region Based on Forest Fire Hot-Spot Density Pattern (KLH, 2010)

In conclusion, the risk assessment of climate change on ICCSR (Bappenas, 2010) and SNC (KLH, 2010) has identified the distribution of regions in Indonesia which has a level of risk posed by some of the major dangers of climate change in several sectors, as presented in Table 2.6 below. Java, Bali and Sumatra are the three areas that have a high to very high level of risk compared with other regions, given the high vulnerability caused by a number of residents, residential areas, and the presence of infrastructure.

Table 2.6 Climate Change Risk Levels in Indonesia by Region (modified from ICCSR - Bappenas, 2010 with input from SNC - Ministry of Environment, 2010)

Risk	Sumatra	Java-Bali	Borneo	Sulawesi	Nusa Tenggara	Moluccas	Papua
Decreased water availability	M, H, VH	H, VH	L, M	H, VH	H, VH	L, M	L
Flood	H, VH	H, VH	L, M, H	L, M, H	L	L	L, M
Drought	H, VH	H, VH	L	L, M	L, M, VH	L	L
Coastal inundation	M, H	M, H, VH	M, H, VH	M, H	M, H	M, H	M, H
Spread of dengue fever	L, M, H	L, M, H	L,M	L,M	L,M	L,M	L, M, H
Spread of Malaria	L,M	L, M, H	L,M	L, M, H	L,M, H, VH	M, H	M, H, VH
Spread of diarrhea	L, M, H	L, M, H	L, M, H	L, M, H	L, M, H	L, M, H	L, M, H, VH
Decline in rice production	H, VH	H, VH	-	-	H, VH	-	-
Forest fire	VH, H, M	H, M	-	-	-	-	-

Note: L: Low; M: Medium, H: High; VH: Very High

2.5 Areas Vulnerable to Climate Change

Through studying a range of climate analysis, climate change trends and projections of climate change in Indonesia, as well as the characteristics of the areas, a complete picture of the regions vulnerable to climate change in Indonesia should be obtained. In this regard, there is a study that examines the mapping of areas vulnerable to climate change in Southeast Asia that can be used as a reference (Climate Change Vulnerability Mapping for Southeast Asia, SIDA, 2009). The study based its vulnerability assessment on the parameters of exposure, climate hazards, population density, ecological sensitivity and adaptive capacity which is a function of socio-economic, technology and infrastructure.

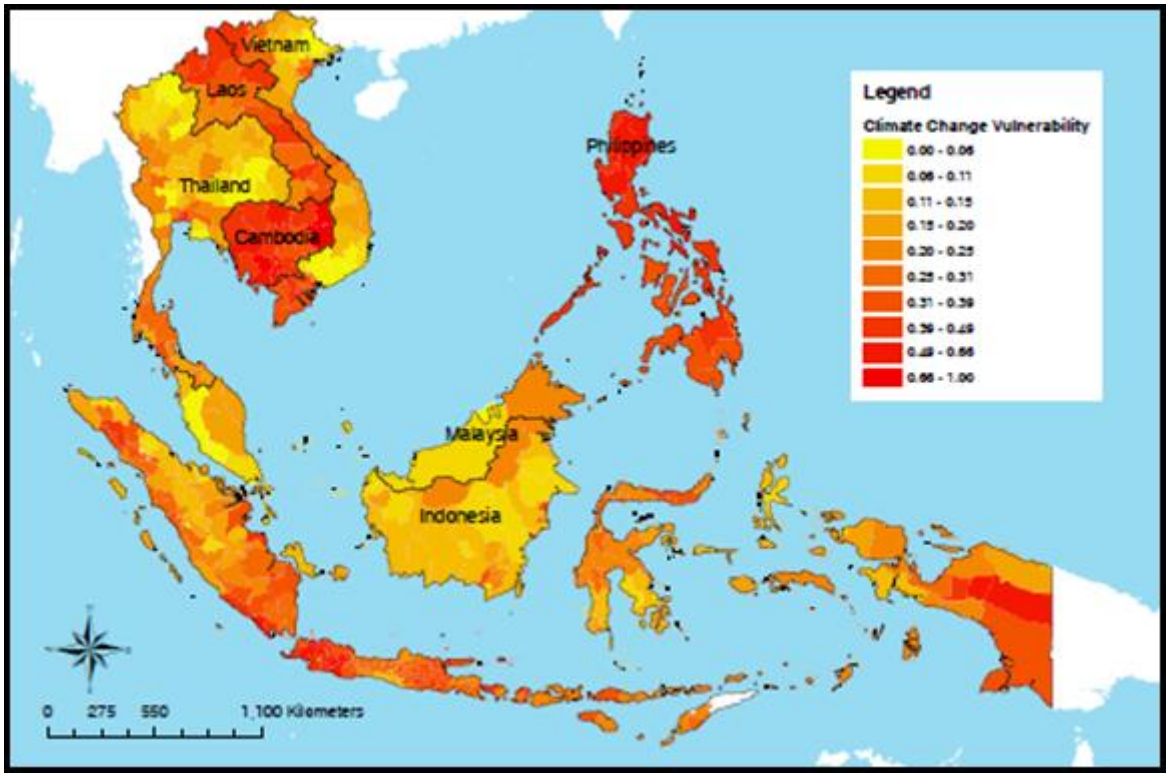

Figure 2.20 Classification of Region Based on Vulnerability to Climate Change (Sida, 2009)

Based on this vulnerability assessment, it was found that the main vulnerable areas of Indonesia are western and southern parts of Sumatra and western and eastern Java. Jakarta Region ranks at the top of vulnerable regions based on this study and also the most vulnerable in the South East Asia region. Central Jakarta is the most vulnerable region despite having the highest adaptive capacity. The area is vulnerable primarily considering the flood in densely populated areas. The same thing happens to other areas of western Java that are vulnerable because of the dangers of flooding and landslides as well as population density factor.

Table 2.7 List of Areas Vulnerable to Climate Change in Indonesia (Sida, 2009)

No.	Region	Vulnerability Index
1.	Jakarta Capital Region	0.77-1
2.	Bandung City	0.77
3.	Surabaya City	0.75
4.	Bekasi City	0.65
5.	Bogor City	0.63
6.	Depok City	0.63
7.	Palembang City	0.60
8.	Tangerang City	0.60
9.	Tangerang	0.60

10.	West Lampung	0.60
11.	Jayawijaya	0.58
12.	Malang City	0.58
13.	Jaya Peak	0.57
14.	Jembrana	0.56
15.	Bogor	0.55
16.	Garut	0.53
17.	Lebak	0.51
18.	Bandung	0.50
19.	Sumedang	0.50
20.	Sukabumi	0.49
21.	Cianjur	0.48
22.	Buleleng	0.46
23.	Pandeglang	0.46
24.	Tanjung Jabung	0.45
25.	Karawang	0.45

Chapter 3. Policies and Objectives of the National Action Plan on Climate Change Adaptation

Adaptation is adjustment in ecological, social and economic systems in responding to climate change impacts that has occurred or is predicted to occur. It refers to the processes, practices, and structures to reduce potential losses and take advantage of the changes caused by climate change. Basically, adaptation efforts to respond to climate change are often associated with reduced vulnerability. The level of vulnerability of a system to climate change impacts is determined by three factors, namely level of exposure, level of sensitivity, and adaptive capacity.

Level of exposure indicates the degree, duration and/or the probability level of a system to come in contact with shocks or disturbances (Adger 2006 and Kasperson et al., 2005 in Gallopin, 2006). Sensitivity is an internal state of the system greatly influenced by the human condition and the environment. The human condition can be seen from the social and human condition such as population, institutions, economic structures and others. Meanwhile, the environment is a combination of biophysical and natural conditions such as soil, water, climate, mineral and structure and function of ecosystems. The human condition and the environment determine the adaptive capabilities of a system that is highly influenced by climate variability. Adaptive capacity indicates the ability of a system to perform adjustment to climate change so that the potential negative impacts can be minimized and positive impacts can be maximized, or in other words the ability to cope with the consequences of climate change (IPCC 2007). Therefore, climate change adaptation efforts can be regarded as an attempt to increase the resilience of a system against the impacts of climate change.

Resilience refers to the ability of the social and ecological systems to absorb disturbances while retaining the system structure and function (Hollings, 1973). Efforts are underway to build the resilience of the system focusing on the capacity to absorb disturbances and maintain the function of the system. In addition, efforts are being made to build system resilience, i.e., the capacity for renewal, restructuring, and development of the system (Berke et al., 2003). In the resilient system, disruption of the system can be absorbed into a potential that can be harnessed for innovation and development of the system (Adger, 2006). An understanding of this will give a reference on how to direct and allocate resources and establish capacity on the local, regional, and national levels.

3.1 Policy of RAN-API

The impact of climate change which has been described in previous chapters makes us aware of the threat of climate change to the environment, society, and economy. This underscores the importance of national policies to anticipate the threat and impacts of climate change. Systematic and integrated efforts with a reliable strategy, and the commitment and responsibility of various stakeholders are needed to anticipate the impacts of climate change on the national and regional development agendas. Consideration of the risks and impact of climate change needs to be translated into action plans, medium-term strategic plan, medium-term development plan, policy or regulation, and institutional structures. Efforts and strategies for climate change adaptation documented in RAN-API is one attempt to provide solution to this problem. This plan is a reflection of sector and cross-sector readiness in responding to and anticipating the threat of climate change through programs based on the projections of the future.

With regard to climate change adaptation and understanding its purpose, adaptation can be regarded as an attempt to increase the resilience of a system to climate change impacts. Therefore, adaptation to climate change in Indonesia is directed as:

1. Adjustment efforts in the form of strategy, policy, management, technology and attitudes so that (negative) impacts of climate change can be reduced to a minimum, and even if possible to utilize and maximize the positive impacts.
2. Efforts to reduce the impact caused by climate change, direct and indirect, continuous and discontinuous and permanent as well as impacts by level.

In short, the action plan is directed to: (a) reduce the effects of climate change to a minimum, (b) increase the resilience and/or reduce the level of vulnerability of natural system, livelihood, programs and activities to the impacts of climate change.

Each sector has set in a concrete manner the direction and main target of development in the Strategic Plan (RENSTRA), Development Plan (RPJM) and Government Work Plan (RKP). Based on the success estimation analysis, one of the threats is climate variability and change. Therefore, philosophically in terms (interest) of national development related to RPJM, RENSTRA and annual RKP of each sector or Ministry/Agency, in essence adaptation to climate change is none other than an attempt to "rescue and secure" so that all development goals can be achieved without being significantly affected or disrupted by climate change.

With regard to sectors and development aspects affected by climate change, as described in Chapter 1 and Chapter 2, it can be said that to ensure the achievement of national development goals in the face of climate change impact, economic, social and environmental resilience is necessary. Moreover, given that Indonesia is an archipelago country that is vulnerable to climate change, resilience in specific areas such as small islands, coastal and urban areas is also needed. To that end, in this regard, the Strategic Objective of the National Action Plan for Adaptation to Climate Change (RAN-API) is directed to: (i) build economic resilience, (ii) establish (social) livelihood that is resilient to climate change impacts (resilience of living systems), (iii) maintain the sustainability of ecosystem services (ecosystem resilience) and (iv) strengthening resilience in urban areas, coastal areas and small islands. To support the reinforcement in the various sectors, a support system is needed to reinforce national resilience towards a development system sustainable and resilient to climate change.

In addition, programs and action plans for climate change adaptation need to consider efforts to reduce vulnerability, especially in communities that are vulnerable to climate change, such as women, children, low-income, elderly groups, and others.

A series of strategic objectives of RAN-API can be described in five (5) sectors of resilience as the scheme below (Figure 3.1).

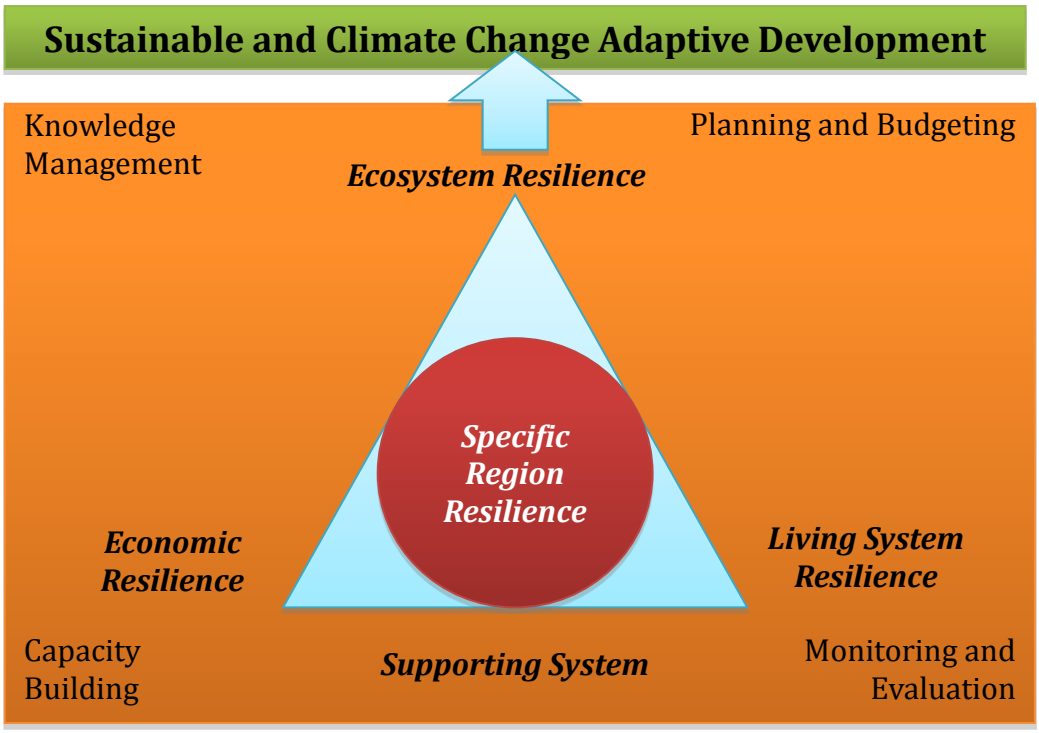

Figure 3.1 Strategic Purpose and Objectives of RAN-API

3.2 Objectives of RAN-API

With regard to the sectors and development aspects affected by climate change, as described previously, the goals of RAN-API is divided into 5 (five) areas as follows:

1. **Economic Resilience**

   Climate change has impacts on economic stability and efforts to achieve development goals in economics. The sector of economic resilience emphasizes on aspects of **food security** and **energy independence**.

   - **Objectives of Food Security Sub-Sector**

     The general objectives of Food Security are the realization of solid and steady food security in terms of supply, distribution and accessibility, as well as in the context of the independence, sovereignty and food safety. The general objectives of Food Security will be difficult to achieve if the agriculture development system does not have the resilience to climate variability and change. Therefore, the main objectives of the Food Security Sector of RAN-API are:

     1. Decreasing food production loss due to extreme weather events and climate change.
     2. Development of new growth areas of food production in areas with a low climate risk and minimum environmental impact (low emission).
     3. Development of food security of farmers and communities (micro) with a pattern of healthy and nutritious and balanced food, as well as the realization of food diversification to an optimum level.

All three goals were developed by focusing on the economy and welfare of farmers, as well as its contribution to climate change mitigation and environmental sustainability (Climate Smart Agriculture).

- **Objectives of Energy Independence Sub-Sector**

  The national energy development goals are to decrease the portion of petroleum consumption in the portfolio of national energy consumption and increase the portion of non-petroleum energy. Based on Presidential Decree No. 5 of 2006 on National Energy Policy, in 2025, the contribution of renewable energy as a source of non-petroleum energy will be increased to 17% of national energy needs. Two sources of renewable energy that are expected to be significantly affected by climate change are hydropower and biofuels. Both of these energy sources are targeted to contribute about 8% of national energy needs. Therefore, the efforts of adaptation action plan to ensure the ability of the two sources of energy today and in the future to support the national energy independence needs to be done. Thus the main objectives of RAN-API sub-sector of energy independence are:

  1. The development of hydropower and geothermal energy in areas with a low climate risk and supporting ecosystem conditions
  2. The development of bio-energy crops (biomass and biofuels) with high productivity and resilience to climatic stress
  3. Optimizing the utilization of organic waste for energy production and gas, particularly in densely populated areas to reduce environmental pollution and enhance the tolerance interval of the region to extreme rainfall.
  4. Increased utilization of renewable energy sources in remote villages to encourage the preservation of ecosystems and sustainable energy supply

2. Living System Resilience

Climate change has an impact on the people's living system and efforts to achieve development goals in livelihood. Living system is public access to all the resources needed for life including social and cultural resources. Living system resilience emphasizes on aspects of public health, housing and infrastructure.

- Objectives of Public Health Sub-Sector:

  As discussed, climate change results in an increase in surface temperature and varying rainfall patterns, both of which have an impact on the increase and spread of disease and its vector through diverse mediums. To address that, in RAN-API several goals need to be established for the sub-sector of public health in order to achieve the target sector robustness of living systems, namely control of communicable diseases and non-communicable diseases due to climate change. In order to achieve these objectives, several objectives of the public health sub-sector have to be considered in developing an action plan for climate change adaptation in the public health sub-sector, including:

1. Identification and control of factors of vulnerability and risk to public health posed by climate change.
2. Strengthening the awareness and utilization of early warning system against outbreaks of infectious diseases and non-communicable diseases caused by climate change.
3. Strengthening regulation, legislation, and institutional capacity at central and local levels of the public health risks that can be posed by climate change.
4. Improvement of science, technology innovation, and community participation related to health adaptation to climate change.

- **Objectives of Housing Sub-Sector**

  To support the sector of living system resilience that is sustainable and resilient to the effects of climate change, the main objective of the housing sub-sector is the realization of accessibility to decent and affordable climate change adaptive housing. As has been considered, climate change results in changes in rainfall patterns and extreme weather events that may impact on the quality of the living environment, especially in areas with a significant degree of social vulnerability. To that end, the objective of the housing sub-sector as stated earlier is elaborated into multiple objectives as the following:

  1. Implementation of study and research on improving the housing security that is adaptive to climate change.
  2. Development and implementation of housing management integrated with the mitigation of climate change impact and sustainable development.
  3. Improving understanding of stakeholders and the public regarding housing that is resilient to climate change.
  4. Increased access to decent and affordable housing

- **Objectives of Infrastructure Sub-Sector**

  It is known that climate change is causing changes in rainfall patterns, sea level rises, and extreme weather events, which have an impact on the quality of infrastructure services nationwide. To support the sector of living system that is sustainable and resilient to climate change, the main objectives of the infrastructure sub-sector are the improvement of service coverage and reinforcement of reliable and quality infrastructure in facing the climate change impacts. These main objectives can be achieved through multiple goals as the following:

  1. The development of the concept of infrastructure security that is adaptive to climate change
  2. Development of infrastructure adaptive to climate change
  3. Provisioning and adjustments of infrastructure that have a direct impact on public health and has a high level of accessibility, especially for the most vulnerable population, and resilient to climate change

4. Layout management of infrastructure that is integrated with spatial planning in sustainable development

3. Ecosystem Resilience

The general objective of ecosystem resilience is maintaining forest ecosystems and essential ecosystem from the impacts of climate change so that the existence of biodiversity and ecosystem services can be sustainable. Biodiversity, as a core component of the ecosystem, serves as a provider of environmental services that holds the key to the sustainability of the ecosystem. Ecosystem services that have a role are provisioning, regulating, cultural and supporting services. Preservation of forest ecosystems, as well as the essential areas of biodiversity will ensure the availability of water and ecosystem services and become one of the key components to achieving food security, energy independence, and society livelihood. This target can be achieved when disturbance and major damage to the forest ecosystem can be reduced. Thus the main objectives of RAN-API for ecosystem resilience are:

1. Decreasing the extent of damage to marine and terrestrial natural ecosystems by extreme climatic events and climate change
2. Increasing the quality and quantity of coral reefs and forest cover in the priority watershed areas
3. Decreasing endangerment levels of key species due to climate change
4. Developing ecosystem resilience system

4. Specific Region Resilience

Climate change impacts are different in each region according to the exposure, the level of vulnerability and the characteristics of each region. Specific region resilience sub-sector emphasizes on the coastal, small islands and urban areas.

- **Objectives of Urban Sub-Sector**

  In RAN-API, the preparation of objectives for the urban sub-sector is to achieve the objective of specific region resilience sector, among others, urban, coastal and small islands, as well as disaster risk reduction. The main target of this sub-sector is the creation of climate resilient urban cities, which can be achieved through multiple objectives as follows:

  1. Integrating climate change adaptation into urban spatial planning.
  2. Adjustment of infrastructure and urban facilities with the current threat of climate change.
  3. Urban Population Capacity Building regarding Climate Change Threat Issues

- **Objectives of Coastal and Small Islands Sub-Sector**

  In RAN-API, the preparation of objectives for the Coastal and Small Islands sub-sector is to achieve the objective of priority areas resilience sector, namely the management of coastal areas and small islands that are vulnerable to the impacts of

climate change. To achieve the objective of Coastal and Small Islands sub-sector, the objective can be described as follows:

1. Increasing the capacity of coastal and small island communities regarding the issue of climate change.
2. Management and utilization of the environment and ecosystems for climate change adaptation
3. Implementation of structural and non-structural adaptation actions in coastal areas and small islands which are vulnerable to climate change.
4. Integrating climate change adaptation efforts into coastal zone and small islands management plan
5. Increased support system for climate change adaptation in coastal areas and small islands

5. Adequate Support System

Climate change adaptation efforts need to be supported in various aspects with emphasis on capacity building, development of reliable climate information, research and development, as well as planning and budgeting.

The scale of the space and achievement of program implementation efforts in RAN-API requires support resources, implementation methodologies, monitoring, and evaluation of the performance to be able to overcome the fragmentation of the main tasks between concerned Ministries/Agencies and improve coordination. Therefore, supporting components need to be strengthened is in the form of capacity building, development of climate data and information, research and development of science and technology, planning and budgeting as well as monitoring and evaluation to oversee and support climate change adaptation action programs. Specifically, support system components for climate change adaptation programs should be achievable and measurable, among others:

1. Capacity building for stakeholders of climate change adaptation
2. The development of reliable and up-to-date climate information
3. The increase in research and development of science and technology related to climate change adaptation
4. Planning and budgeting that is responsive to climate change.
5. Monitoring and evaluation of climate change adaptation activities.

Chapter 4. Adaptation Strategy and Action Plan by Sector

Effectiveness of programs addressing climate change in every sector, in order to support the implementation of climate resilient development system, can be enhanced by building synergy of adaptation action activities between sectors. Each sector's development targets may not be achievable optimally without the support of other sectors. Therefore, to determine the adaptation action steps of each sector in order to build economic, livelihood, ecosystems and specific region resilience to the impacts of climate change, it is necessary to look at the connection between each sector's programs. This can be used as a foundation in building synergy and fills the gap between adaptation action activities that needs to be developed in order to achieve the targets of RAN-API. Furthermore, the plans of action that is performed on each group (Cluster) are presented in Appendix 1.

4.1 Sector of Economic Resilience

Economic resilience is the ability of the system to maintain the function of the economic system and quickly recover in the event of disruption (Rose, 2009). The two main factors that will determine such ability is the condition of food security and energy independence. Disruption of these two factors due to lack of construction capacity to adapt to climate change will directly affect economic resilience. RAN-API for the economic resilience sector only focuses on these two sub-sectors.

4.1.1 Action Plan for Food Security Sub-Sector

The main strategy for achieving the targets of RAN-API for Food Security Sector is done through (a) Adjustment and development of farming systems against climate change, (b) Development and implementation of adaptive technology to climatic stress, (c) Development and optimization of land, water and genetic resources.

These strategies are realized through the 7 Main Programs (Cluster), namely:

(1) Cluster of Food Production Systems Adjustment. Cluster of food production system adjustment (planting pattern, technology and agriculture and aquaculture business systems) to reduce the level of risk and yield loss due to variability and climate change, due to productivity decrease or planting area decrease. This action plan is done by adjusting the activity and technology of agriculture and fisheries with the support of other related sectors.

(2) Cluster of Agriculture and Aquaculture Area Expansion. Expansion to new agricultural areas is not only necessary to compensate for land conversion and yield loss, but also very necessary to keep pace with the increasing need for food, mainly due to population growth. Cluster of agriculture and aquaculture expansion, is done with attention to the possibility of change in the level of climate risk, and the carrying capacity of the environment and not reducing the conservation function of region and habitat. The implementation of this program should emphasize climate proof spatial planning in accordance with Government Act no. 32/2009 on the Strategic Environmental Assessment (Kajian Lingkungan Hidup Strategis, KLHS), especially and prioritized to take advantage and at the same time repair degraded and/or neglected soil condition

(3) Cluster of Restoration and Development of Climate Proof Agricultural Infrastructure[1]. The mainstays of food agriculture are wetlands and aquaculture areas which vulnerability and

[1] *Climate Proof* is the construction or development of systems that take climate change into account so that the system can function as expected on changing climatic conditions

adaptability to climate change impacts are strongly associated with irrigation capacity. Today most of the irrigation network in food production and aquaculture centers has been damaged and degraded with decreasing potential planting area and high vulnerability to climate change, especially extreme climatic events. In addition, development of new food production sources (expansion) requires or has to be supported by the development of irrigation networks. Restoration and development program of agricultural infrastructure will also consider the possibility of climate change and environmental conditions, particularly the vegetation cover in the catchment area (DAS).

(4) Cluster of Food Diversification Acceleration. Cluster of food diversification acceleration (crop, livestock, fish) is done through the development of a variety of healthy food products from alternative food commodities that are more resistant to climatic stress and more land and water resource-efficient than rice crops, such as corn, green beans and various local commodities (sago, canna, yams, beans, and other local food). Supporting the cluster requires *mixed food policy* that is location (region) specific and fish consumption among the population needs to be increased.

(5) Cluster of Innovative and Adaptive Technologies Development. Cluster of innovative technologies development is aimed at assembling a variety of technology adaptive to climate stress and genetic engineering of food and fish resources, as well as optimizing the utilization of low emission land and water resources. In addition to innovative and frontier technologies, the action program is also directed to explore and develop *indigenous technologies*, including local knowledge. The main objectives of this action plan are: (a) the utilization of genetic resources and engineering (plant and fish farming), (b) the optimization of land and water resources through the development of adaptive cultivation technology, and (c) utilization and optimization of carbon, biomass and/or organic waste.

(6) Cluster of Development of Information and Communication Systems (Climate and technology). The success of climate change adaptation action programs will be determined by the existence of an effective system of climate information and climate information communication systems and agriculture and aquaculture technologies (fisheries and fishing). Therefore, this cluster is directed at improving the accuracy and completeness of information as well as climate and the availability of technology dissemination system and accelerating the flow of information delivery.

(7) Cluster of Support Program. Technical implementation of the above action programs must be supported by analysis and scientific studies related to the vulnerability and impacts of climate change on food security, policy analysis and synthesis for land and water resources, institutional development for food production systems (agriculture and fisheries) and attention to the socio-economic aspects of culture, gender aspects and specific environmental conditions.

Appendices 3 and 4 respectively describe the synergy of action plans across Ministries and Agencies for Food Security sub-sector.

4.1.2 Action Plan for Energy Independence Sub-Sector

The main strategies to achieve the goals of RAN-API Energy Independence Sector are: (a) the improvement and conservation of rain on the catchment area of the watershed that is the source of hydro and geothermal energy generation, and (b) Optimizing the utilization of organic waste and biomass and the development of botanical biofuels (BBN).

These strategies are realized through 4 Main Programs (Clusters), namely:

(1) Cluster of Restoration and Conservation of Catchment Area. Action plan on this cluster is geared towards accelerating establishment of forest areas, especially in the rain catchment in the watershed that will be the location of hydropower and geothermal development and accelerated rehabilitation in watersheds which are hydropower and geothermal locations that have a high climate risk through community participation.

(2) Cluster of Renewable Energy Usage Expansion. Kl a plan of action on this ster d iarahkan to optimize the utilization of organic waste for the production of gas and energy in dense residential areas, thereby reducing the environmental burden and increasing the tolerance interval of the region of high incidence of extreme rainfall and expand the utilization of hydropower energy sources pico and micro scale in the region remote sites as part of an energy independent country programs (DME) which can encourage people to protect the environment and the sustainability of environmental services.

(3) Cluster of Development of Innovative and Adaptive Technology for Biofuel Plant Cultivation and Energy Plantation. Action plan on this cluster is directed at the development of technologies for cultivation of high yielding biofuel plants that are adaptive to climatic stress as well as the discovery of varieties of fast growing trees for energy plantation.

(4) Cluster of Support Program. Action plan on this cluster is directed to the implementation of scientific studies on watershed system vulnerability to climate change impacts, and research into the development of biofuel crop cultivation technology.

4.2 Sector of Living System Resilience

Resilience is the ability of living systems to sustain community life and recover quickly in the event of disruption (Uy *et al.*, 2012). It is influenced and determined by the extent to which communities have the necessary resources and is able to organize itself both before and during times of need. Resilience of living systems can be divided into several sub-areas, namely health, housing, and infrastructure.

4.2.1 Action Plan for Health Sub-Sector

The fact that some Indonesian societies have not implemented a healthy and clean living culture has the potential to be the cause of health vulnerability due to climate change. In addition, the factors of limited access to health services due to territorial constraints, inadequate health infrastructure especially at the local level, as well as the lack of information and data on health-related risks due to climate change also cause Indonesia to be vulnerable to climate change in terms of health.

The approach of RAN-API Health Sub-Sector action program preparation is associated and integrated with the programs and activities listed in the Strategic Plan (Renstra) of the Ministry of Health in 2010-2014. In addition, the Ministry of Health has also established health sector adaptation strategy to climate change, climate change guidelines for risk factors and climate change module.

The main strategy for achievement of RAN-API Healthcare Sector goals are: (a) Strengthening and updating of information on health risk and vulnerability due to climate change, (b) Development of policies, planning, networking, and cooperation among government agencies at the local, regional and national levels regarding climate change health risk, and (c) Strengthening capacity and early awareness of climate change-related threats to health in the community and government levels.

These strategies are realized in 4 Main Programs (Clusters):

(1) Cluster of Identification and Control of Vulnerability and Risk Factors Public Health Caused by Climate Change. This action plans on this cluster are directed at updating the risk assessment and adaptation to climate change for the health sector in the regency/city level, observation

and control of disease agents, intermediaries, environmental quality and human infection, particularly in vulnerable groups: women, children, seniors and low-income communities.

(2) Cluster of Awareness System Enhancement and Early Warning System Utilization against Infectious Diseases and Non-Communicable Diseases Caused by Climate Change. The action plan on this cluster is directed at improving the health sector response to climate change through monitoring and continuous data collection, coordination and implementation of measures, emergency response plans for health care and information to the public about outbreaks of infectious diseases and non-communicable diseases due to climate change.

(3) Cluster of Improvement of Regulation, Legislation, and Institutional Capacity in Central and Local Level against the Risks to Public Health Brought by Climate Change. The action plan on this cluster are directed at improving regulation and legislation and strengthening institutional capacity through the preparation of an action plan and road map , task coordination, institutional capacity, partnerships and networking.

(4) Cluster of Science Advancement, Technology Innovation, and Public Participation Related to Health Adaptation to Climate Change. Action plan on the cluster is geared towards research, education and development of technology related to climate change and adaptation related to health, health sector human resource development and community participation related to health adaptation to climate change.

4.2.2 Action Plan for Housing Sub-Sector

The achievement of housing that is adaptive to climate change, decent and affordable is done with several strategies. Strategies for housing sub-sector are (a) the provision of facilities for study and research activities on resilience of housing adaptive to climate change, (b) development of affordable residential structures that are resilient to the impacts of climate change, (c) Dissemination of information about housing resilient to the impacts of climate change to the government at various levels, (d) Preparation of climate change adaptation programs of action for the housing sub-sector which refers to the needs of the sector in facing climate change impacts.

This action program aims to introduce and develop the concept of housing adaptive to climate change and integrated within sustainable development plans and can reach all levels of society.

These strategies are realized in 4 Main Programs (Cluster), namely:

(1) Cluster of Studies and Research on Improving the Adaptive Housing Security. The action plan on this cluster are directed to the study and mapping of risk and adaptation to climate change, especially on housing and housing infrastructure, sustainable landed housing area development, and the study and dissemination of stage house construction in coastal areas vulnerable to sea level rise.

(2) Cluster of Housing Development and Management. Action plan on the cluster is geared towards the provision of infrastructure in response to climate change in urban settlements and infrastructure adjustments on settlements in areas vulnerable to climate change disasters.

(3) Cluster of Community Development Efforts. Action plan in this cluster is focused on efforts to increase public awareness of climate change adaptation in urban and rural areas related to housing, community participation and capacity enhancement against PRB climate change in vulnerable areas, and preparedness against climate change disaster in vulnerable

residential areas. Related to community empowerment, Appendix 5 describes some experiences of civil society organizations in adaptation to climate change..

(4) Cluster of Access to Decent and Affordable Housing. Action plan on the cluster is directed at providing decent and affordable housing with a strong structure and adaptive to climate change including relocation planning for settlements affected by the impact of climate change, standards and structure concept for housing that is resilient to the impact of climate change, increasing the number of population using standard housing structure adaptive to climate change, incorporate a gender perspective in the design and planning of residential construction adaptive to climate change and energy-efficient building design concepts. Appendix 6 describes the priority areas and considerations on integrating gender in climate change adaptation action.

4.2.3 Action Plan for Infrastructure Sub-Sector

The impact of climate change on infrastructure has a significant influence on the sustainability of community activities, especially economic and social. Existing infrastructure, particularly in urban areas and special areas such as small islands and coastal areas generally have not been built with consideration of climate change and projected impacts that may occur. Meanwhile, planning for new infrastructure should consider the projected impacts of climate change that will occur. Thus, there needs to be an implementation direction in the form of infrastructure sub-sector adaptation action that is resilient to climate change. The main strategies that need to be done for infrastructure sub-sector are (a) Adjustment of structures, components, design and location of infrastructure to be resilient to climate change, (b) improvement of the existing infrastructure which is vulnerable to climate change in terms of structure, function and location, (c) Facilitate the study and research activities on the concept of infrastructure resilience to climate change.

The preparation of the infrastructure sub-sector action programs for climate change adaptation refers to the National Action Plan - Mitigation Adaptation to Climate Change (RAN - MAPI), which was compiled by the Ministry of Public Works in 2012, and the Strategic Plan of the Ministries/Agencies from various related sectors.

These strategies are realized through 7 Main Programs (Clusters), namely:

(1) Cluster of Research and Development of Infrastructure Resilience Concept. The action plan on this cluster are directed at carrying out research and development on improving the resilience of infrastructure adaptive to climate change, especially to provide a database of the conditions and projections of all vital infrastructure and facilities in coastal and urban areas as well as the norms, standards, guidelines and criteria (NSPK) on infrastructure resilient to the impacts of climate change.

(2) Cluster of Development of Infrastructure Adaptive to Climate Change. The action plan on this cluster is aimed at providing environmentally sustainable urban drainage system; the identification, development and maintenance of coastal protection structures; development, operation, and maintenance of flood and drought control infrastructure.

(3) Cluster of Reducing Risk of Disruption of Transport Accessibility Function for Roads, Bridges, Railways, Ports and Airports Due to Climate Change Impact. This action plan on cluster are directed at reducing the risk of disruption of the function of accessibility to roads and bridges due to the impact of climate change; planning, management and operation of land transportation systems, railway management, marine transportation management and air transport management that takes into account the impact of climate change.

(4) Cluster of Improvement, Provision and Adjustment of Infrastructure with Direct Impact on Public Health and Resilient to Climate Change. The action plans on this cluster are directed at strengthening the knowledge and capacity of the government on infrastructure that is resilient to climate change and has a direct impact on public health (clean water, wastewater, and sanitation) and the provision of sanitation infrastructure and wastewater treatment systems that are resilient to climate change.

(5) Cluster of Integration to Sustainable Development. The action plan on this cluster is directed to the application of the concept and structure of cities and regions based on studies of society and infrastructure vulnerability and the implementation of Green Cities development, including green building, green energy, green water, green transportation, green waste and utilization surface water.

(6) Cluster of Enhancement of Climate Change Adaptation Infrastructure Support System. The action plans on this cluster are directed at collecting data and information through research on climate change; environmental vulnerability and risk factors; social vulnerability and risk factors; economics and geography; development of reliable and cutting-edge climate change response information systems and development of technologies that support the water resource infrastructure management.

(7) Cluster of Design, Provision and Management of Energy Infrastructure to be Adaptive to Climate Change. The action plans on this cluster are directed at improving knowledge dissemination to local governments and communities about adaptive energy-providing infrastructure; energy infrastructure protection from the effects of climate change by identifying vulnerable infrastructure and protection measures; as well as new energy infrastructure planning, including drafting and providing new energy infrastructure.

4.3 Ecosystem Resilience Sector

Strategies to build resilience of ecosystems to climate change are directly related to interaction in the social system to form strategies for community resilience. Ecosystem resilience is how to adapt to the changes that occur, among others, from extreme drought that led to water limitation, changes in vegetation due to changes in weather patterns, the puddles due to rising sea levels that cover residential, farms and agricultural areas. Environmental sustainability is not intended to restore environmental patterns that have changed but seek mechanisms to cope with and avoid the same changes occurring in other environments.

The strategy to achieve the main objectives is as the following (a) Securing and Protecting Water Availability from Extreme Weather, (b) Avoiding Ecosystem and Biodiversity Loss, and (c) Sustainable Water Supply and Conservation of Ecosystems and Biodiversity.

The strategy was developed with attention to the principles of conservation and welfare of forest communities (including indigenous peoples) and Indonesia's role in mitigating climate change. Implementation of strategies to build ecosystem resilience is embodied in 7 Main Programs (Clusters), namely:

(1) Cluster of Restoration/Improvement of Spatial Planning and Land Classification. Restoration/improvement of spatial planning is directed towards climate proof spatial planning and land use while considering the values of the local community. Improvement of forest macro planning that considers integrated watershed management, carbon emissions, and assesses the impact on the sustainability of other ecosystem services, including guaranteeing water function in supporting food security and energy independence. Efforts to restore/improve forest and marine ecosystems should be accelerated, especially in areas

with a high rate of development to avoid spatial development which leads to increased vulnerability of the region to climate change impacts. Restoration/improvement of marine ecosystem is a blend of strengthening ecological functions with the local wisdom.

(2) Cluster of Management and Utilization of Sustainable Productive Region. Productive forest area management and marine services need to consider aspects of environmental conservation, among others with multisystem application in its management as well as providing space for the central government, local government and other multi-stakeholders to participate in the management of the productive area. Forest management is the joint responsibility of central and local government, including through the establishment and implementation of institutional strengthening forest management at the site level (KPH), for instance through the People's Forest (HTR), Community Forest (HKm), Joint Forest Management (CBFM) and Forest Village, so it can deliver local initiatives in the areas of protection and preservation of integrated ecosystem services. Clear and unequivocal Regulations in provision of incentives and disincentives for actors who push/break the rules in the field need to be built with the principles of stewardship, justice and respect for the natural functions of forests.

(3) Cluster of Improving Governance of Conservation Areas and Essential Ecosystem. Governance and ecosystem conservation area is one of the key essential in the resilience of environmental services. Climate change may threaten the existence of biodiversity and essential ecosystem directly or indirectly. Threat level on biodiversity needs to be reduced by increasing efforts to protect the flora and fauna, wildlife trade decrease, prevent forest degradation and marine ecosystems, as well as regulatory and enforcement efforts of law enforcement. Development of small-scale forest and marine exploitation (for diversification of income) should be developed to improve the livelihood of society which is directly related to the local biodiversity..

(4) Cluster of Degraded Ecosystem Rehabilitation. Forest and land rehabilitation in the long term not only can inhibit the rate of global warming so that the frequency and intensity of extreme weather can be reduced, but also increase ecosystem resilience to climate change impacts. Forest and land rehabilitation activities, in addition to enhancing carbon sequestration and storage, can also potentially hold water and improve water management functions. Restoration of water function is indispensable in supporting resilience and energy independence, through the utilization of the kinetic energy of the water to turn a turbine power plant and the input of water vapor to ensure the utilization of geothermal energy. Increased carbon sequestration and storage as well will increase the potential of bioenergy through the utilization of bio-pellets from biomass. Increased carbon sequestration and storage capabilities through forest rehabilitation also provide co-benefits such as improved water system so as to prevent the occurrence of run-off which leads to various problems such as flooding, erosion, and landslides. It will also indirectly affect the durability of various facilities and infrastructure such as roads, bridges, dams, and other infrastructure that has been and is planned to be built. However, it should be noted that forest and land rehabilitation activities cannot be carried out in all forest areas.

(5) Cluster of Ecosystem Threat Reduction. Decreasing the frequency of forest fires, land and pasture is developed in an integrated manner across sectors, the central-regional, and cross-country through Integrated Forest Fire Management. Therefore, any activity which may have implications on the chances of a fire should be prioritized in bilateral relations with neighboring countries. Development of land clearing without burning technology (non-fire), as well as monitoring and fire control technology should be a priority of the central and local government program. Implementation of land clearing without burning is not just a matter of the adoption of the technology but also embedded with social, economic, and cultural

aspects. At the technical level, the adoption of technology without burning for land clearing. If this is hard to do, then the alternative for clearing land is implementing controlled burning system.

(6) Cluster of Development of Information and Communication Systems. Developing Information and Communication Systems for detecting damage to the ecosystem, as well as early detection (early warning system) of points of fire and other trigger factors, is very important to prevent forest fires which chronically occur each year. Monitoring and effective control of forest fires is one of the key activities that need to be developed at locations of critical forest areas. Monitoring also needs to be done to the forest cover as well as damage to ecosystem services (e.g. watershed). Monitoring is carried out should include preventive aspects, such as land clearing policy implementation and development of non-fire land clearing. In addition to information related to forest fires, strengthening of forestry information and communication systems in general also need attention.

Most of the data and information presented in the report of forestry statistics are not compatible with the data and information standards agreed internationally, including standard data presentation and forestry information determined by the State at K-State oversight of Southeast Asian (ASEAN). Similarly, the flow of information and communication of data reporting to the central area and the dissemination of information from the center to the regions in the forestry sector is still very weak. Information and communication problems are not only related to system data traffic, but also the lack of validity and reliability of data and information both at the central and forestry in the area. In some cases, the very diversity of institutions dealing with forestry matters in the region and the political interests of the local economy further complicate the establishment of forestry information and communication system that is effective.

(7) Cluster of Support Program. Technical implementation of action programs must be supported by scientific studies of vulnerability and impacts of climate change on ecosystem resilience. Research on the influence of climate variability and climate extremes on ecosystems and biodiversity needs to be done in order to know the key species and species susceptibility to climate change impacts on species distributions and natural resistance. Research on Silviculture System adjustment to climate change needs to be done carefully with consideration of climate change impacts on the emergence of new pests and diseases.

Other research topics that need to be observed are (i) Climate-resilient vegetation, (ii) exploitation of genetic variability for food and medicine, (iii) invasive spcies and its impact on local biodiversity, (iv) the adaptation strategies of various flora and fauna at risk of extinction, (v) landscape architecture that is resilient to climate change, (vi) modeling various scenarios to obtain the best design for adaptation to climate change, (vii) adaptation strategies to climate change: the protection/restoration of habitat and optimal management. In addition to research programs, training programs and capacity building should be prioritized because of the quality of human resources is the key to the success of the program.

4.4 Specific Region Resilience Sector

Climate change impacts are different in each region according to the exposure, the level of vulnerability and the characteristics of each region (see Appendix 7). Specific region resilience in the context of climate change adaptation includes urban resilience and sustainability of coastal and small islands. Resilience of urban areas include the city itself and the interaction within urban systems where the effects of climate change directly influences the spatial, physical, and economic

network of urban communities. Meanwhile, coastal areas and small islands have a high vulnerability due to sea level rise.

4.4.1 Action Plan for Urban Sub-Sector

Achieving the goals of RAN-API Urban Sub-Sector will be done through several strategies, namely: (a) Adjustment of spatial planning of urban areas against the threat of climate change, (b) environmental management of urban areas in a sustainable manner, (c) Improving the quality of infrastructure and facilities in urban areas, (d) Increasing the capacity of urban communities in the face of the threat of climate change, and (e) Development and optimization of systems research and information about climate change in urban areas.

The preparation of the program of action for climate change adaptation and coastal sub-areas of small islands refers to the National Action Plan - Mitigation Adaptation to Climate Change (RAN-MAPI) compiled by the Ministry of Public Works, 2012. The program of action designed to achieve the target sub-urban areas in terms of adaptation to climate change.

These strategies are realized through 3 Main Programs (Clusters), namely:

(1) Cluster of Integrating Climate Change Adaptation Efforts into Urban Planning. Action plan in this cluster focuses on efforts to integrate adaptation to climate change in the spatial plan that starts with risk assessment and adaptation to climate change in urban areas; assessment and risk mapping for sectorial/sub-sectorial adaptation to climate change of the regency/city; preparation and revision of urban planning document based on the results of risk assessment and adaptation to climate change; and monitoring and control for spatial planning and zoning urban areas to climate change.

(2) Cluster of Urban Infrastructure and Facilities Adjustment to Anticipate the Threat of Climate Change. This action plan on this cluster is directed at preparing housing and urban infrastructure development strategies that are integrated with climate change adaptation efforts; implementing green cities development; and improving the quality of housing infrastructure in urban areas.

(3) Cluster of Urban Population Capacity Building Concerning Threat of Climate Change. Action plan on this cluster is geared towards socializing public awareness of the phenomenon and impact of climate change; improving the research capacity of the phenomenon and the impact of climate change in urban areas; developing early warning systems for climatology and oceanography disasters; and developing institutional capacity and network related to climate change adaptation.

4.4.2 Action Plan for Coastal and Small Islands Sub-Sector

Achieving the objectives of RAN-API Coastal and Small Islands Sub-Sector will be done through several strategies, namely (a) the stability of coastal communities and small island against the threat of climate change, (b) Improving the environmental quality of coastal areas and small islands, (c) Implementation of adaptation structure development in coastal areas and small islands, (d) Adjustment in layout plan of urban areas against the threat of climate change, and (e) Development and optimization of research and information system on climate change in coastal areas and small islands.

The preparation of the program of action for climate change adaptation and coastal sub-areas of small islands refers to the *Indonesian Climate Change Sectoral Roadmap* (Bappenas, 2010) in the Marine and Fisheries sector. The action program is structured to achieve the target sub-sector of Coastal and Small Islands in terms of adaptation to climate change.

These strategies are realized through 5 Main Programs (Clusters), namely:

(1) Cluster of Increasing the Capacity of Coastal and Small Islands Population Concerning Climate Change. The action plan in this cluster is directed at socializing public awareness of the phenomenon and the impact of climate change; developing coastal and small islands resource utilization p Developing coastal and small islands for the people, maintenance and rehabilitation of water resources in coastal areas and small islands, and p Strengthening infrastructure (electricity transport network, clean water, and communications) in the coastal areas and small islands te rluar using appropriate technology.

(2) Cluster of Management and Utilization of Environment and Ecosystem for Climate Change Adaptation. Action plan in this cluster is directed at improving the quality of the environment in coastal areas and small islands; identification, maintenance, and rehabilitation of coastal ecosystems and small islands; and maintenance and rehabilitation of non-structural protective zones or natural beach and the area behind it based on the results of the study and identification of coastal ecosystems and small islands.

(3) Cluster of Implementation of Structural and Non-Structural Adaptation Measures for Anticipating the Threat of Climate Change. Action plan in this cluster is directed towards the development of Coastal Resilience Village (CRV); providing assistance in the development of PPK; identification and elevation adjustment and strengthening of vital structures and facilities, such as roads, seaport docks, and settlements in coastal areas and small islands; increasing the resilience of agricultural resources and coastal ponds to the threat of climate change; and identifying, building and maintaining coastal protection structures (sea walls, groins, breakwaters, beach nourishment, tidal sluice, etc.).

(4) Cluster of Integration of Adaptation Measures in Coastal and Small Islands Management Plan. Action plan in this cluster is directed at identifying and mapping the potential of small islands; formulating norms, standards, guidelines, and criteria (NSPK) for rehabilitation and adaptation to climate change in coastal areas and small islands; carrying out risk assessments and adaptation to climate change in coastal areas and small islands; assessment and mapping of sectorial/sub-sectorial risk and adaptation to climate change at the regency/city level; preparing layout and management planning documents for coastal zone and small islands based on the results of risk and climate change adaptation assessment; and to supervise and control the spatial planning and zoning of coastal and marine areas to climate change.

(5) Cluster of Enhancing the Support System for Adaptation to Climate Change in Coastal Areas and Small Islands. Action plan in this cluster is focused on efforts to improve the research and study of potential coastal resources; increase research capacity on the phenomenon and impacts of climate change in coastal areas and small islands; developing climatologic and oceanographic disaster early warning system; and strengthening institutional and cross-sector coordination for mitigation and adaptation in coastal areas and small islands.

4.5 Sector Support Systems

Adaptation strategies to climate change in RAN-API are directed according to the five targets of support system. Capacity building is one of the targets that aim to improve the ability of the stakeholders and society in terms of adaptation to climate change. Increased capacity, in simple terms, is also associated with efforts to improve and enhance the capacity from low/weak or high vulnerability into improved/better/higher on specific knowledge and expertise and reduce the factors that are considered vulnerable to climate change. This capacity building program includes

several levels: the individual level, the institutional level, and community level. In addition, adaptation to climate change will not obtain effective results without estimation of vulnerability and impact/risk. Various studies are also necessary to be able to identify the various causes of climate change. Other studies may lead to the identification of catastrophic climate change adaptation strategies. For that, it is necessary to develop a knowledge management strategy for risk and vulnerability related to climate change.

Various changes and measurable consequences are necessary to be able to do a proper response and adaptation to climate change. Adaptation to climate change is also one of the key aspects that must be integrated into development planning at the local, regional, and national levels. This is done in order to develop a pattern of development that is resilient to the impacts of climate change and weather anomalies in the present and anticipated future. Lastly, monitoring and evaluation efforts to provide useful information for the progress and achievement of the program, a variety of issues that must be anticipated, interesting and good lessons to be learned, and so on. Stakeholders associated with climate change adaptation program of action will then analyze the information generated from the monitoring and evaluation results to formulate future strategies.

These strategies are realized through 5 Main Programs (Clusters), namely:

(1) Cluster of Capacity Building for Stakeholders in Climate Change Adaptation. Action plan in this cluster is focused on efforts to implement education, counseling, and training on climate change adaptation; establishment of a forum/networking/alliance/working group for adaptation to climate change; and increasing the active role of the Central Government, Local Government and stakeholders in climate change adaptation and achieving the government policy objectives on climate change.

(2) Cluster of Development of Reliable and Up-to-date Climate Information. The action plan on this cluster is directed at the development of information systems and response to climate change that are reliable and up to date as well as reviewing and mapping multi-sectorial risk and adaptation to climate change in the national and provincial levels.

(3) Cluster of Improving Research and Development of Science and Technology Related to Climate Change Adaptation. The action plan on this cluster is directed at collecting data and information through research on climate change, environmental vulnerability and risk factors, social vulnerability and risk factors, economics and geography and development of innovation and technology related to climate change and adaptation.

(4) Cluster of Planning and Budgeting and Legislation to Respond to Climate Change. The action plan on this cluster is directed to the preparation of planning and budgeting documents that incorporate vulnerability factors, risks, and adaptation to climate change.

(5) Cluster of Monitoring and Evaluation of Climate Change Adaptation. The action plan on this cluster is directed to formulating the design of monitoring and evaluation system that will provide information about the progress and achievement of climate change adaptation programs and implement monitoring and evaluation of climate change adaptation activities.

Schematically, the train of thought of RAN-API can be seen in Table 4.1 below.

Table 4.1 RAN-API Train of Thought

	Objectives	Strategy	Cluster Action Plan
1. Economic Resilience	1.1. Food Security Sub-Sector • Decreasing food production loss due to extreme weather events and climate	• Adjustment and development of farming systems to climate change • Development and application of	1.Food Production Systems Adjustment 2.Agriculture and Aquaculture Area

	Objectives	Strategy	Cluster Action Plan
	change. • Development of new growth areas of food production in areas with a low climate risk and minimum environmental impact (low emission) • Development of food security of farmers and communities (micro) with a pattern of healthy and nutritious and balanced food, as well as the realization of food diversification to an optimum level	technology adaptive to climate stress • Development and optimization of land, water and genetic resources.	Expansion 3.Restoration and Development of Climate Proof Agricultural Infrastructure 4.Food Diversification Acceleration 5.Innovative and Adaptive Technologies Development 6.Development of Information and Communication Systems (Climate and technology) 7.Support Program
	1.2 Energy Independence Sub-Sector • The development of hydropower and geothermal energy in areas with a low climate risk and supporting ecosystem conditions • The development of bio-energy crops (biomass and biofuels) with high productivity and resilience to climatic stress • Optimizing the utilization of organic waste for energy production and gas • Increased utilization of renewable energy sources in remote villages	• Restoration and conservation of catchment area in the watershed as an energy source of hydroelectric and geothermal power plants • Optimizing the utilization of organic waste and biomass energy sources and the development of biofuels (BBN).	1.Restoration and Conservation of Catchment Area 2.Renewable Energy Usage Expansion 3.Development of Innovative and Adaptive Technology for Biofuel Plant Cultivation and Energy Plantation 4.Support Program
2. Living System Resilience	2.1 Public Health Sub-Sector • Identification and control of factors of vulnerability and risk to public health • Strengthening the awareness and utilization of early warning system against outbreaks of infectious diseases and non-communicable diseases caused by climate change • Strengthening regulation, legislation, and institutional capacity at central and local levels • Improvement of science, technology innovation, and community participation	• Strengthening and updating of information and health risk vulnerability to climate change, • Development policy, of planning, networking, and cooperation among government agencies at the local, regional and national levels regarding health risks related to climate change • Strengthening the capacity and early awareness of climate change-related threats to health in the community and government levels.	1.Identification and Control of Vulnerability and Risk Factors Public Health Caused by Climate Change 2.Awareness System Enhancement and Early Warning System Utilization against Infectious Diseases and Non-Communicable Diseases Caused by Climate Change 3.Improvement of Regulation, Legislation, and Institutional Capacity in Central and Local Level against the Risks to Public Health Brought by Climate Change 4.Science Advancement, Technology Innovation, and Public Participation Related to Health Adaptation to Climate Change
	2.2 Housing Sub-Sector • Implementation of study and research on improving the housing security that is adaptive to climate change. • Development and implementation of housing management integrated with the mitigation of climate change impact and sustainable development. • Improving understanding of stakeholders and the public regarding housing that is resilient to climate change. • Increased access to decent and affordable housing	• Provision of supporting facilities for study and research activities concerning housing resilience to climate change • Developing an affordable housing structure resilient to climate change impacts • Dissemination of information about housing resilient to the impacts of climate change to the government at various levels • Preparation of climate change adaptation programs for housing sub-sector, referring to the housing needs in the face of climate change impacts.	1.Studies and Research on Improving the Adaptive Housing Security 2.Housing Development and Management 3.Community Empowerment Efforts 4.Access to Decent and Affordable Housing
	2.3 Infrastructure Sub-Sector • The development of the concept of infrastructure security that is adaptive to climate change • Development of infrastructure adaptive to climate change • Provisioning and adjustments of infrastructure that have a direct impact on public health and resilient to climate change • Layout management infrastructure that is integrated with spatial planning	• Adjustment in structure, components, design and location of infrastructure that is resilient to climate change. • Improvement of the existing infrastructure that are vulnerable to climate change in terms of structure, function and location. • Facilitating the study and research activities on the concept of infrastructure resilience to climate change	1.Research and Development of Infrastructure Resilience Concept 2.Development of Infrastructure Adaptive to Climate Change 3.Reducing Risk of Disruption of Transport Accessibility Function for Roads, Bridges, Railways, Ports and Airports Due to Climate Change Impact 4.Improvement, Provision and Adjustment of Infrastructure with Direct Impact on Public Health and Resilient to Climate Change 5.Integration to Sustainable

	Objectives	Strategy	Cluster Action Plan
	in sustainable development		Development 6.Enhancement of Climate Change Adaptation Infrastructure Support System 7.Design, Provision and Management of Energy Infrastructure to be Adaptive to Climate Change
3. Ecosystem Resilience	3. Ecosystem Resilience • Decreasing extensive damage to marine and terrestrial natural ecosystems due to climate change. • Increasing the quality and quantity of coral reefs and forest cover in the priority watershed areas; • Decreasing endangerment levels of key species due to climate change; • Developing ecosystem resilience system;	• Securing and Protecting Water Availability from Extreme Weather, • Avoiding Ecosystem and Biodiversity Loss • Sustainable Water Supply and Conservation of Ecosystems and Biodiversity	1.Restoration/Improvement of Spatial Planning and Land Classification 2.Management and Utilization of Sustainable Productive Region 3.Improving Governance of Conservation Areas and Essential Ecosystem 4.Degraded Ecosystem Rehabilitation 5.Ecosystem Threat Reduction 6.Development of Information and Communication Systems 7.Support Program
4. Specific Region Resilience	4.1 Urban Sub-Sector. • Integrating climate change adaptation into urban spatial planning; • Adjustment of infrastructure and urban facilities with the current threat of climate change; • Urban Population Capacity Building regarding Climate Change Threat Issues.	• Adjustment of the spatial planning of urban areas against the threat of climate change • Environmental management of urban areas in a sustainable manner • Improving the quality of infrastructure and facilities in urban areas • Increasing the capacity of urban communities in the face of climate change threat • Development and optimization of research and information systems about climate change in urban areas	1.Integrating Climate Change Adaptation Efforts into Urban Planning 2.Urban Infrastructure and Facilities Adjustment to Anticipate the Threat of Climate Change 3.Urban Population Capacity Building Concerning Threat of Climate Change
	4.2 Coastal and Small Islands Sub-Sector • Increasing the capacity of coastal communities and islands; • Management and utilization of the environment and ecosystems for adaptation; • Implementation of structural and non-structural adaptation actions; • Integrating climate change adaptation into coastal zone and small islands management plans; • Increased support system for climate change adaptation in coastal areas and small islands;	• Stabilizing coastal and small island population to the threat of climate change • Improving environmental quality of coastal areas and small islands • Implementation of adaptation structure development in coastal areas and small islands • Adjustment of layout plan of urban areas against the threat of climate change • Development and optimization of research and information systems about climate change in coastal areas and small islands	1. Increasing the Capacity of Coastal and Small Islands Population Concerning Climate Change 2. Management and Utilization of Environment and Ecosystem for Climate Change Adaptation 3. Implementation of Structural and Non-Structural Adaptation Measures for Anticipating the Threat of Climate Change 4. Integration of Adaptation Measures in Coastal and Small Islands Management Plan 5. Enhancing the Support System for Adaptation to Climate Change in Coastal Areas and Small Islands
5. Support System	5. Support Systems Sector • Effective functioning of the adaptation support system; this system includes: capacity enhancement, climate information, research, planning, budgeting; monitoring and evaluation. • Establishment of coordination mechanisms able to synergize the efforts of adaptation between Ministries/Agencies and between central and local governments.		1.Capacity Building for Stakeholders in Climate Change Adaptation 2.Development of Reliable and Up-to-date Climate Information 3.Improving Research and Development of Science and Technology Related to Climate Change Adaptation 4.Planning and Budgeting and Legislation to Respond to Climate Change 5.Monitoring and Evaluation of Climate Change Adaptation

Chapter 5. Implementation Mechanism

5.1 Coordination Mechanism

Preparation of RAN-API document is expected to improve coordination between related ministries/agencies and also the involvement of other stakeholders: private entities, non-governmental organizations, international cooperation agencies, universities and research institutes. In order to facilitate coordination in the handling of both climate change mitigation and adaptation and to improve the efficiency and effectiveness of the achievement of the action plan planning mitigation and adaptation to climate change, Minister of Planning/Head of Bappenas has issued the Decree of the Minister of Planning/Head of Bappenas No. Kep. 38/M.PPN/HK/03/2012 on the establishment of the Coordination Team for Addressing Climate Change. Based on the mandate and membership composition, the coordination team has an important role in the coordination across ministries/agencies at the central level.

The Coordination Team for Addressing Climate Change consists of a Steering Committee and 6 (six) Working Groups, namely:

(1) Agriculture;
(2) Forestry and Peatlands;
(3) Energy, Transportation and Industry;
(4) Waste Management;
(5) Other Supporting Fields and Cross-Sectorial, and
(6) Adaptation

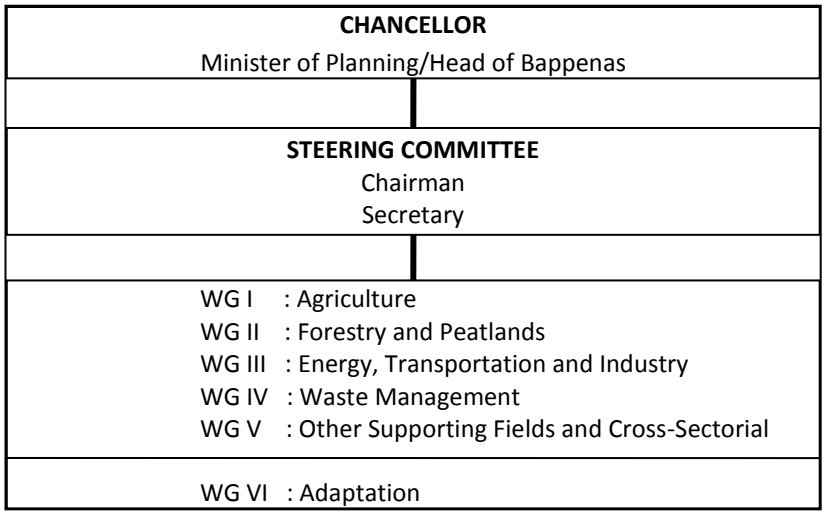

Figure 5.1 Structure of the Coordination Team for Addressing Climate Change

The Steering Committee is comprised of Echelon I officials of the Ministry/Agency and has the following duties:

1. Providing general direction on the implementation of the working group tasks,
2. Recommending policy /strategies for addressing climate change (mitigation and adaptation) with reference to the RAN-GRK and RAN -API and
3. Delivering report on the implementation of the programs/activities of mitigation and adaptation.

Working Group (WG VI) for Adaptation is one of the working groups established with the following tasks:

1. Coordinating the implementation of climate change adaptation programs;
2. Synchronizing work plans of each Ministry/Agency;
3. Formulating the National Action Plan for Climate Change Adaptation;
4. Compiling quarterly and annual reports of the Working Group, and reporting the implementation of programs and activities to the Chairman of the Steering Committee on Addressing Climate Change;
5. Carry out other relevant duties as directed by the Chairman of the Steering Committee on Addressing Climate Change.

In accordance with the scope of their duties, the preparation and implementation of RAN-API is the duty of Adaptation Working Group, including coordination and synchronization of the adaptation program implementation in each ministry/agency. Therefore, the preparation and implementation of RAN-API will be coordinated through the Adaptation Working Group, under the control of the Coordination Team for Addressing Climate Change coordinated by the Ministry of Planning/Bappenas.

During the implementation of RAN- API, it will be necessary to set the role of institutions outside the Adaptation Working Group and Coordination Team for Addressing Climate Change, mainly for adaptation action in each region. To that end, the division of tasks in RAN-API is as follows:

1. Coordinating Minister for People's Welfare is in charge of coordinating and monitoring the implementation of RAN-API with the involvement of the Minister and the Governor related to climate change adaptation efforts, and reporting the integrated implementation of RAN-API to the President at least once a year
2. Minister of Planning/Head of Bappenas is responsible for coordinating the evaluation and review of integrated RAN-API, and to develop guidelines for the preparation of regional climate change adaptation strategy
3. Minister of the Interior is in charge of facilitating the preparation of regional climate change adaptation strategy with the Minister of Planning/Head of Bappenas and the Ministry of Environment.
4. The other Ministries/Agencies are in charge of implementing RAN-API according to their domains so that it can be measured, reported and verified with its own funding or cooperation with the international community, as well as monitoring the implementation of the RAN-API and report periodically to the Ministry of Planning/Head of Bappenas.
5. The provincial government is expected to prepare the regional climate change adaptation strategy that refers to the RAN-API and is in accordance with local development priorities based on the ability of the budget and the public.
6. Governor communicates regional climate change adaptation strategy to the Minister of the Interior and the Ministry of Planning/Head of Bappenas to be integrated in the national adaptation efforts.

Local Government has a key role in the implementation of adaptation in accordance with the conditions of the region and its level of vulnerability. Basically the direct impact of climate change occurs at a local scale so that adaptation actions are to be performed on a local level and local conditions. To produce effective adaptation efforts requires overall effort at various levels of government, guided and supported by the strategies and adaptation policies at the central level.

Formulation and implementation of RAN-API needs to consider the division of authority and government in the areas related to climate change adaptation. Establishment of authority of national, provincial, regency/city governments refers to the Act No. 32 of 2004 and Act No. 38 of 2007. Formulation of programs and adaptation action plans in some areas/sectors need to be harmonized with the regulation authorities stipulated in Government Regulation No. 38 of 2007.

Strategic document and action plans prepared by local government (provincial, regency/city) should be integrated with regional development planning, in this case RPJMD and RTRW of Province/Regency/City. In addition, the strategic document and action plan contain programs and priority activities by sector and are closely related to the Strategic Plan of related local government offices.

Based on the above, some important things to consider in order to integrate RAN-API and local governments' adaptation strategy/action plan is as follows:

- Considering its association with the National Action Plan on Climate Change Adaptation (RAN-API);
- Integrating in the preparation of the Spatial Plan (RTRW) of each province, regencies and cities in all of the preparation process;
- Integrating the RPJMN/D in all the drafting process, i.e., from the Initial Draft of RPJMN/D, then the Draft of RPJMN/D, and Final Draft RPJMN/D;
- Incorporate as a reference in the preparation of Local Development Work Plan (RKP).

Basically the implementation effort of RAN-API has specific loci, so regions have a very important role. In addition to the scope of the authority of the central/national, there are also combined and local scopes. The division of the scope of this authority will provide clarity of ownership and implementation of the API program.

5.2 Adaptation Financing Mechanisms

Until now there has been no funding for climate change adaptation policies that are specifically developed to support the implementation of adaptation action plans in Indonesia. Funding policy related to climate change adaptation financing is part of the overall development policy based on the annual development plan at the central, provincial and regency/city.

In the medium-term planning, the issue of climate change has received priority funding through the state budget mechanism. In addition, climate change funding policy is not only derived from domestic funding sources, but developed from a variety of other funding sources, including international cooperation and the private sector. Various programs for adaptation to climate change is widely supported by funding from international cooperation, both in the form of capacity building and financing of pilot projects.

5.2.1 Domestic Sources of Funding

Internal funding that is a top priority in funding RAN-API is from the State Budget (APBN) in accordance with the RKP RPJMN 2010-2014 and the current year's RKP. Other domestic sources of funding include the regional budget, government debt, private investment (banking and non-banking), and *corporate social responsibility* (CSR).

State Budget-related funding sources can be either in pure cash or PHLN (foreign loans and grants). Foreign loans follow the mechanisms that have been set on the same rules as in the management of foreign grants. Foreign grants are funding sources that have a relatively low risk. Grants in the country can be a potential source of funding for addressing climate change. Grants in the country can follow the government-run mechanism aligned with grants from abroad. Because

of its grant, such arrangements are not expected to provide too many obstacles to the grantor in the distribution.
Funding from the State Budget in general will be channeled through Ministries/Agencies, central government and State-Owned Enterprises with established mechanism. Nevertheless, the source of funds from the State Budget can be channeled back to the private sector with a particular mechanism in accordance with the type of source of funds.

Regulation on foreign grant management is set in Government Regulation no. 2/2006 on Procedures for Loan Procurement and/or Foreign Grants and PHLN Forwarding and Ministerial Decree No.. 05/2006 on Procedures of Planning and Proposal and Assessment of Activities financed from PHLN.

ICCTF (Institution of Climate Change Trust Fund) is intended to accommodate the grant funds, both domestic and foreign. Financing activities through ICCTF will allow the emphasis of 'incentive' aspect because the funds are only given to the proposer who passes the selection. In addition, ICCTF is not bound by 'fiscal year', as activities can be started at any time as long as got consent of *the Steering Committee* and implemented in accordance with the proposal period. ICCTF monitoring and evaluation system is already very comprehensive.

Some sources of funding include domestic private banks, non-bank, *Corporate Social Responsibility* (CSR), *Public Private Partnership* (PPP), and insurance. Domestic sources of private funding can be identified to support the funding source that comes from the government. Banking can be mobilized to finance private investment with favorable financial returns. Banking funds that can be mobilized can come from general banking and Islamic banking. To that end, government policies need to be implemented that provide incentives for banking institutions that provide loans to industries that employ green technology or support a reduction in greenhouse gas emissions. In this case, coordination between Bank Indonesia and the government is needed to formulate strategic banking policies.

Non-banking sources consist of funds from the domestic capital market, insurance, financial institutions, and pension institutions. Criteria of activities that can be financed is relatively similar to the activities financed by the banks, namely having high financial returns. Similar tos banking institutions, there needs to be coordination of relevant parties to implement appropriate incentive policies for the use of resources from non-bank institutions to implement green technology.

In addition, the potential for private investment can also be used by policy incentives on parties to support mitigation efforts. Incentives can be given to the efficient use of energy with low carbon emissions, but often require funding not least because of the need for low-carbon technologies. The potential of the private sector that can take advantage of the carbon market in the forestry sector has also began to open although still voluntary.

Corporate Social Responsibility (CSR) is a voluntary activity of business entities to make a positive contribution to the surrounding community. Because it is voluntary, the government can provide guidance so that the use of CSR can be focused to provide assistance in dealing with the impacts of climate change. To date, the potential of CSR is expected to be larger as more enterprises interested in implementing CSR in the environmental field.

5.2.2 International Funding Sources

Source of funds from various international agencies is widely available and can be used either by the government or by private parties. The use of this source is very dependent on the nomination mechanism prevailing at each institution fund providers. Related to climate change, the UNFCCC mechanism opens access for developing countries to get funds from developed countries. *Global Environment Facility* (GEF) is designated as the agency that manages the fund and channels it through multilateral agencies (World Bank, UNDP, and others) acting as trustee.

In the context of the UNFCCC negotiations, since COP 13 in Bali climate change mitigation efforts have included initiatives of Reducing Emissions from Deforestation and Degradation (REDD) which then has evolved into REDD+. These negotiations have paved the way for the availability of support of international funding for REDD + initiatives and spawned an opportunity for developing countries to take on the international funding opportunities, including Indonesia. However there are several preconditions that must be met for this, among them the conditions that favor investment and effective performance-based mechanisms.

With regards to the Copenhagen Accord, there is expected to be available funds of about USD 30 billion by 2012 and USD 100 billion by 2020 which can be used to fund adaptation, mitigation, and supporting technology transfer mechanisms and REDD+. Although the Copenhagen Accord is not binding, the potential of this funding could be explored. Looking ahead, it is predicted that in the international community there will be some new mechanisms and institutions to fund climate change mitigation action.

The new UNFCCC funding mechanism is not yet established. Although the Copenhagen Accord declared the establishment of Copenhagen Green Climate Fund, there has been no agreement on the form, the distribution mechanism, acceptance criteria, and so on.

Other international funding mechanisms are: the Adaptation Fund, the Least Developed Countries Fund, the Special Climate Change Fund, the Climate and Development Knowledge Network, the Global Climate Change Alliance, the Global Facility for Disaster Reduction and Recovery; International Climate Initiative. Several Bilateral and Multilateral cooperations can also be utilized to support adaptation activities. In order to access this funding source the following needs to be done: increase ICCTF capacity to obtain NEI accreditation; preparation of medium-term priority list of activities and cost estimates. In addition, it is also necessary to formulate horizontal and vertical coordination mechanisms for effective implementation of RAN-API; and good Monitoring and Evaluation system.

To maximize the potential benefits of international cooperation and funding climate change, RAN-API document clearly emphasizes on the following aspects:

- Linking climate change adaptation outcomes with poverty alleviation and other development projects, reducing risk and vulnerability to climate change (including other threats) as a development effort that offer mutual benefits. Various development projects should contribute to the reduction of vulnerability and give attention to the most vulnerable groups of society.
- Improving communication regarding adaptation priorities and targets associated with international funding opportunities. Funding priorities of international cooperation agencies are not always the same as the priorities of the Indonesian government. Therefore, the government and stakeholders need to determine the necessary priority action plan rather than adjusting priorities according to the existing funding opportunities.
- Importance of 'mainstreaming climate change'. In the context of regional development, the issue of climate change has not been a top priority compared to the sectors of health, education and social welfare. Mainstreaming climate change boosts the adaptation capacity society without changing the limited resources of the regional policy priorities.
- RAN-API is expected to identify sources of funding available both from domestic and international, for the implementation of adaptation action plans in Indonesia. The mechanism of funding from domestic sources follows the administration of the existing financial management. In connection with the support of international funding sources, RAN-API provides direction in linking to the Ministries/Agencies as well as other stakeholders in international funding sources. Clearly, RAN-API document provides guidance on how the Ministries/Agencies, non-governmental organizations and community can

coordinate with each other in preparing funding proposals from international cooperation agencies.

5.3 Mechanism Monitoring, Evaluation, and Reporting the Review

In the implementation of RAN-API, monitoring, evaluation, reporting and review mechanisms will be formulated as part of the cycle of formulation and updating of RAN-API in accordance with the latest developments in climate change at national and global levels.

5.3.1 Monitoring Evaluation and Reporting

The process of monitoring and evaluation of RAN-API needs to ensure achievement of targets and adaptation targets that have been set. The process of monitoring the implementation of the RAN-API is performed by Ministries/Agencies and periodically reported to the Ministry of Planning/Head of Bappenas. Mechanism of Monitoring, Evaluation and Reporting will be arranged later in accordance with applicable regulations. Effort of monitoring and evaluation should be done in line with the monitoring and evaluation system that has been carried out for the implementation of development activities.

5.3.2 RAN-API Review Mechanism

Adaptation to climate change requires a base of comprehensive study taking into account the dynamic developments occurring globally and nationally. In addition, the development of science and technology permits a variety of new breakthroughs in the future. Therefore, it is possible to update RAN-API based on the results of monitoring and evaluation conducted periodically.

Ministry of Planning/Bappenas will conduct the evaluation process and review of integrated RAN-API periodically in accordance with national requirements and the latest global developments.

Chapter 6. RAN-API Pilot Site Selection

Formulation of strategy/Plan for local adaptation to climate change for area based on a complete vulnerability assessment is essential for the implementation of adaptation. However, given that the resources and the capacity of local government are still limited, the Central Government took the initiative to conduct a pilot climate change adaptation based on RAN-API in vulnerable areas. Selection of pilot areas is done by mapping the vulnerability assessment that has been carried out by various Ministries/Agencies, Development Partners and Civil Society Organization (CSO), in cooperation with local government.

Implementation of pilot adaptation activities to climate change is expected to provide a good and complete overview on implementation of climate change adaptation in the region which is a collaboration/cooperation between the various stakeholders, including central and local governments, development partners and the community.

The pilot implementation is also expected to encourage local governments to put climate change as an important factor in the development and conduct sufficient studies, as well as to plan and integrate it into a strategy/plan of the area of climate change adaptation. Strategy/plan of adaptation to climate change is also expected to later be aligned with the planning and local government budgets. To ensure the implementation of adaptation goes well, it is also necessary to implement monitoring and evaluation systems that will be a feedback for further adaptation planning.

To support the implementation of this pilot, coordination between Central Ministries/Agencies with Local Government (SKPDs or Office) related with action adaptation is needed. Thus, based on the adaptation action of every sector that is in the RAN-API document, an identification of Quick Wins activities is needed as a pilot project in the suitable vulnerable region or location and require special handling for adaptation action.

Pilot site selection is done based on several selection criteria , Namely:

1. Completeness of Vulnerability Assessment including assessment, Sectors and Action Clusters
2. Regional Commitment including the existence of strategies and plans, integration into the planning and budgeting, as well as other sources of funding
3. Adaptation-related activities that have been or are being run, with funding from the regional budget or other funding sources (private sector, development partners, etc.)
4. The existence of Climate Change Working Group in the area
5. Compliance with RAN-API

Based on those criteria there are 15 areas with high scores (scores 4 and 5 on the scale of 5), which become priority areas of RAN- API Pilot, namely:

Table 6.1 Priority areas RAN-API Pilot Project

No..	Province/Regency/ City	Value
1	Bali Province	5
2	Semarang City	5
3	Pekalongan City	5
4	West Java Province	5
5	Blitar City	5
6	Bandar Lampung City	5
7	East Java Province	4
8	Malang Regency	4
9	Batu City	4
10	Malang City	4
11	West Nusa Tenggara Province	4
12	Lombok Island	4
13	Tarakan City	4
14	South Sumatra Province	4
15	North Sumatra Province	4

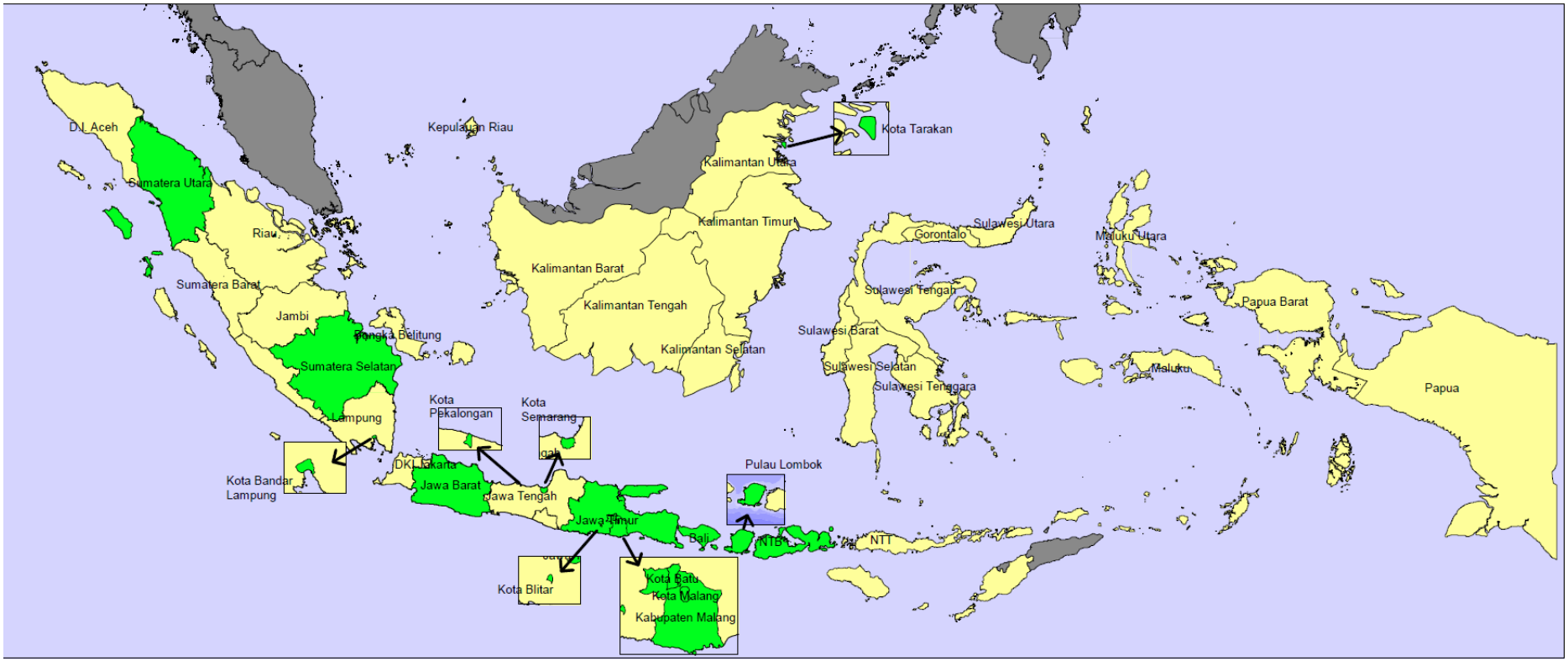

Figure 6.1 Map of Priority Areas for RAN-API Pilot Project

Table 6.2 Summary of Vulnerability Assessment for Priority Pilot Area of RAN-API (Preliminary Results)

No.	Province/Regency/City	Vulnerability Assessment (VA)			Local Government Commitment			Climate Change Working Group	Compliance with RAN-API	Result Valuation
		Availability	Sector	Cluster Action	Adaptation Strategy/Action Plan	Integration into the planning and budgeting	Other sources of funding			
1	South Sumatra Province	V	Agriculture, Coastal, Health		V	V	None	V	Field of Life System Resilience Sub field (1).Infrastructure, and (2).Health	4
2	Tarakan Regency	V	Health	Construction of irrigation and drinking water, raw water supply and management, and the development of a healthy environment	V	V	None	V	Field of Life System Resilience Sub field (1).Infrastructure, and (2).Health	4
3	East Java Province	V	Agriculture, Water		V	V	None	V	Field of Economic Security Food Security Sub-field	4

No.	Province/Regency/City	Vulnerability Assessment (VA)			Local Government Commitment			Climate Change Working Group	Compliance with RAN-API	Result Valuation
		Availability	Sector	Cluster Action	Adaptation Strategy/Action Plan	Integration into the planning and budgeting	Other sources of funding			
4	Malang Regency	V	Agriculture (corn, apples), Clean Water, landslide hazards, and Health	Making ponds, certified seeds, agricultural infrastructure, irrigation and drinking water, reforestation, etc.	V	V	None	V	Economic Resilience Sub-field areas of Food Security, and System Security Sector Infrastructure Sub Life, and Health	4
5	Batu City	V	Agriculture (apple production area)	Seeds certified, organic fertilizer, rejuvenation and expansion of the apple crop, agricultural infrastructure	V	V	None	V	Field of Economic Security Food Security Sub-field	4
6	Malang City	V	Health, clean water and avalanche danger	Construction of irrigation and drinking water, raw water supply and management, development of a healthy	V	V	None	V	Field of Life System Resilience Sub fieldInfrastructureand Health	4

No.	Province/Regency/City	Vulnerability Assessment (VA)			Local Government Commitment			Climate Change Working Group	Compliance with RAN-API	Result Valuation
		Availability	Sector	Cluster Action	Adaptation Strategy/Action Plan	Integration into the planning and budgeting	Other sources of funding			
				environment, and reforestation						
7	Blitar City	V	Agriculture, Water and Sanitation, Health	Food production systems, adaptive infrastructure to climate change, strengthening awareness of disease outbreaks	V (Integrated Strategy on Climate Change Blitar)	V	V (Budget)	V	Field of Security Systems Infrastructure Sub Life and Health	5
8	Semarang City	V	Economic infrastructure , settlements	Flood and Tide Control	V (Construction of sea dikes and flood canals; Relocation most industries)	V There in RPJMD	V Mercycor p ACCCRN	V	Sub Sector Resilient Life Systems settlement areas; andSpecial Regional Security Sector Sub-field of Coastal and Small Islands	5

No.	Province/Regency/City	Vulnerability Assessment (VA)			Local Government Commitment			Climate Change Working Group	Compliance with RAN-API	Result Valuation
		Availability	Sector	Cluster Action	Adaptation Strategy/Action Plan	Integration into the planning and budgeting	Other sources of funding			
9	Pekalongan City	V	Settlements, Public Works, Economic	Tidal Flood, clean water, and sanitation	V	V	GIZ	V	Special Regional Security Sector Sub-field of Coastal and Small Islands	5
10	Bandar Lampung City	V	Infrastructure (water supply, drainage, waste settlement, Coastal, Fishing, Health, Education	The provision of clean water, soil water conservation, waste management, coastal community development, education and quality of health	V (Preparation of city resilience strategy against climate change)	V	ACCCRN, Budgets and State Budget	V	Special Regional Security Sector Sub Urban areas, and P esisir and Small Islands	5
11	NTB Province	V			V	V	None	V		4
12	Lombok Island	V	Agricultural, horticultural, forestry, fisheries, and coastal, health, and clean water	Anticipate shortages of clean water, anticipate hazards and abrasion rob	V	V	None	V	Special Regional Security Sector Sub-field of Coastal and Small Islands	4
13	West Java Province	V			V	V	ADB	V		5

No.	Province/Regency/City	Vulnerability Assessment (VA)			Local Government Commitment			Climate Change Working Group	Compliance with RAN-API	Result Valuation
		Availability	Sector	Cluster Action	Adaptation Strategy/Action Plan	Integration into the planning and budgeting	Other sources of funding			
14	Bali Province	V	Agriculture	Training for farmers, formation of farmer cooperatives, provision of seeds	V	V	Budgets	V	Field of Economic Security Food Security Sub-field	5
15	North Sumatra Province	V	Agriculture, water, urban, coastal areas	None	V (Agriculture)	V	None	V	Economic Resilience field, sub-field of Food Security	4