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Indonesia Climate Change Sectoral Roadmap
ICCSR

Health Sector

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Indonesia Climate Change Sectoral Roadmap – ICCSR
Health Sector

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The Indonesia Climate Change Sectoral Roadmap (ICCSR) is meant to provide inputs for the next five year Medium-term Development Plan (RPJM) 2010-2014, and also for the subsequent RPJMN until 2030, laying particular emphasis on the challenges emerging in the forestry, energy, industry, agriculture, transportation, coastal area, water, waste and health sectors. It is Bappenas' policy to address these challenges and opportunities through effective development planning and coordination of the work of all line ministries, departments and agencies of the Government of Indonesia (GoI). It is a dynamic document and it will be improved based on the needs and challenges to cope with climate change in the future. Changes and adjustments to this document would be carried out through participative consultation among stakeholders.

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Remarks from Minister of National Development Planning/ Head of Bappenas

We have seen that with its far reaching impact on the world's ecosystems as well as human security and development, climate change has emerged as one of the most intensely critical issues that deserve the attention of the world's policy makers. The main theme is to avoid an increase in global average temperature that exceeds°C , i.e. to reduce annual worldwide emissions more than half from the present level in 2050. We believe that this effort of course requires concerted international response – collective actions to address potential conflicting national and international policy initiatives. As the world economy is now facing a recovery and developing countries are struggling to fulfill basic needs for their population, climate change exposes the world population to exacerbated life. It is necessary, therefore, to incorporate measures to address climate change as a core concern and mainstream in sustainable development policy agenda.

We are aware that climate change has been researched and discussed the world over. Solutions have been proffered, programs funded and partnerships embraced. Despite this, carbon emissions continue to increase in both developed and developing countries. Due to its geographical location, Indonesia's vulnerability to climate change cannot be underplayed. We stand to experience significant losses. We will face – indeed we are seeing the impact of some these issues right now- prolonged droughts, flooding and increased frequency of extreme weather events. Our rich biodiversity is at risk as well.

Those who would seek to silence debate on this issue or delay in engagement to solve it are now marginalized to the edges of what science would tell us. Decades of research, analysis and emerging environmental evidence tell us that far from being merely just an environmental issue, climate change will touch every aspect of our life as a nation and as individuals.

Regrettably, we cannot prevent or escape some negative impacts of climate change. We and in particular the developed world, have been warming the world for too long. We have to prepare therefore to adapt to the changes we will face and also ready, with our full energy, to mitigate against further change. We have ratified the Kyoto Protocol early and guided and contributed to world debate, through hosting the 13th Convention of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), which generated the Bali Action Plan in 2007. Most recently, we have turned our attention to our biggest challenge yet, that of delivering on our President's promise to reduce carbon emissions by 26% by 2020. Real action is urgent. But before action, we need to come up with careful analysis, strategic planning and priority setting.

I am delighted therefore to deliver *Indonesia Climate Change Sectoral Roadmap,* or I call it ICCSR, with the aim at mainstreaming climate change into our national medium-term development plan.

The ICCSR outlines our strategic vision that places particular emphasis on the challenges emerging in the forestry, energy, industry, transport, agriculture, coastal areas, water, waste and health sectors. The content of the roadmap has been formulated through a rigorius analysis. We have undertaken vulnerability assessments, prioritized actions including capacity-building and response strategies, completed by associated financial assessments and sought to develop a coherent plan that could be supported by line Ministries and relevant strategic partners and donors.

I launched ICCSR to you and I invite for your commitment support and partnership in joining us in realising priorities for climate-resilient sustainable development while protecting our population from further vulnerability.

Minister for National Development Planning/
Head of National Development Planning Agency

Prof. Armida S. Alisjahbana

Remarks from Deputy Minister for Natural Resources and Environment, Bappenas

To be a part of the solution to global climate change, the government of Indonesia has endorsed a commitment to reduce the country's GHG emission by 26%, within ten years and with national resources, benchmarked to the emission level from a business as usual and, up to 41% emission reductions can be achieved with international support to our mitigation efforts. The top two sectors that contribute to the country's emissions are forestry and energy sector, mainly emissions from deforestation and by power plants, which is in part due to the fuel used, i.e., oil and coal, and part of our high energy intensity.

With a unique set of geographical location, among countries on the Earth we are at most vulnerable to the negative impacts of climate change. Measures are needed to protect our people from the adverse effect of sea level rise, flood, greater variability of rainfall, and other predicted impacts. Unless adaptive measures are taken, prediction tells us that a large fraction of Indonesia could experience freshwater scarcity, declining crop yields, and vanishing habitats for coastal communities and ecosystem.

National actions are needed both to mitigate the global climate change and to identify climate change adaptation measures. This is the ultimate objective of the *Indonesia Climate Change Sectoral Roadmap*, ICCSR. A set of highest priorities of the actions are to be integrated into our system of national development planning. We have therefore been working to build national concensus and understanding of climate change response options. The *Indonesia Climate Change Sectoral Roadmap* (ICCSR) represents our long-term commitment to emission reduction and adaptation measures and it shows our ongoing, inovative climate mitigation and adaptation programs for the decades to come.

Deputy Minister for Natural Resources and Environment
National Development Planning Agency

U. Hayati Triastuti

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Glossary

AMI	: Annual Malaria Incidence
API	: Annual Parasite Incidence
CDF	: Cummulative Distribution Frequency
CFR	: Case Fatality Rate
DBD	: *Demam Berdarah* Dengue
EID	: Infectious Diseases
ENSO	: El Nino Southern Oscilation
FCCC	: Framework Convention on Climate Change
FGD	: Focus Group Discussion
GCM	: Global Circulation Model
GHCN	: Global Historical Climatological Network
GIS	: Geography Information System
GPCC	: Global Precipitation Climatology Center
GRK	: Gas Rumah Kaca
IPCC	: Intergovernmental Panel on Climate Change
ISPA	: *Infeksi Saluran Pernapasan Akut* (Respiratory System Infection)
KIE	: *Komunikasi, Informasi, dan Edukasi* (Communication, Information, and Education)
NSDA	: *Neraca Sumber Daya Air* (Water Resource Balance)
RAN MAPI	: Rencana Aksi Nasional Mitigasi dan Adaptasi Perubahan Iklim
RENJA	: *Rencana Kerja* (Work Plan)
RENSTRA	: *Rencana Strategis* (Strategic Planning)
RKP	: *Rencana Kerja Pemerintah* (Government Work Plan)
RPJM	: *Rencana Pembangunan Jangka Menengah* (Medium Term Development Planning)
RPJPD	: *Rencana Pembangunan Jangka Panjang Daerah* (Regional Long Term Development Planning)
RPJP	: *Rencana Pembangunan Jangka Panjang* (Long Term Development Planning)
RPJMN	: *Rencana Pembangunan Jangka Panjang Menengah Nasional* (National Medium Term Development Planning)

RPJPN	: *Rencana Pembangunan Jangka Panjang Nasional* (National Long Term development Planning)
SARS	: Serve Acute Respiratory Syndrom
SIG	: *Sistem Informasi Geografis* (Goegraphic Information System)
SLR	: Sea Level Rise
SPL	: *Suhu Permukaan Laut* (Sea Level Temperature)
UNCED	: United Nations Conference on Environment and Development
UNEP	: United Nations Environmental Program
UNFCCC	: United Nations Framework Convention on Climate Change
WHO	: World Health Organization
WMO	: World Meteorological Organization
BAKOSURTANAL	: *Badan Koordinasi Survey dan Pemetaan Nasional* (National Coordination Agency for Survey and Mapping)
BMKG	: *Badan Meteorologi, Klimatologi, dan Geofisika* (Meteorology, Climatology and Geophysic Agency)
LAPAN	: *Lembaga Penerbangan dan Antariksa Nasional* (National Institute of Aeuronatics and Space)
BUMN	: *Badan Usaha Milik Negara* (State Owned Company)

CHAPTER 1 INTRODUCTION

1.1 Background

It is well known that climate change is happening and become a threat in various sectors including helath sector in Indonesia. Climate change hazard threat in Indonesia can affect health directly or indirectly which could cause morbidity, psychological impact, refuge, and aven mortality. Climate change hazard related to health sector including extreme temperature and precipitation, flood and drought increase, vector-borne disease change, surface ozone increase, increased malnutrition cases, and increase of disaster related to climate.

Scientific proofs show that climate change and variability could affect vector-borne disease epidemiology. In Indonesia there are 3 main diseases which need to be studied, which are dengue fever (DBD), malaria, and diarrhea because of their wide spread and intensity. The negative effect of climate change and variability would strongly suppress low-income population with limited access to health institution. Thus, making the low-income population with limited health access the most vulnerable population group to health impact due to climate change

To overcome climate change impact to health sector we need adaptation steps supported by high realization, mental attitude, and behavior of the population. These health sector adaptation steps must be integrated into national development planning. At national level, Bappenas has begun compiling **"Roadmap of Mainstreaming Climate Change Issue into 2010-2030 Indonesia National Development Plan"** (abbreviated to "Indonesia Climate Change Sectoral Roadmap/ICCSR"). Health sector roadmap consists of scientific study of climate change issue, impact, vulnerability, and risk which will be faced, and health sector adaptation strategy needed by Indoensia. The final result is the directon and steps to be taken for adaptation to climate change in the health sector.

To assist in preparing and presenting the Roadmap, Indonesia will be devided into 7 areas, which are: 1) Sumatera island and its surrounding 2) Jawa , Madura, Bali islands and their surroundings 3) Kalimantan island and its surroundings, 4) Sulawesi island and

its surroundings, 5) Nusa-tenggara islands (area of the NTB and NTT provinces), 6) Maluku islands, and 7) Papua island (the Indonesian part of Papua island,) and its surroundings.

1.2 Objectives

Taking into account the background conditions, as described before, the objectives of this climate change roadmap preparation in the health sector are as the followings:

1) To identify future problems and challenges in the health sector due to climate change. Solution to the problems will be through identification of existing response capacity, strength, weaknesses, and policies on issues of climate change; challenges in the form of hazards and opportunities in the health sector, which are developed in the health sector because of climate change;
2) To identify vulnerabilities in the health sector in facing hazards due to climate change, information can be obtained as far as possible based on qualitative and quantitative analyses such that it can be put into a form of spatial distribution for each study area;
3) To identify impacts or risk description of the health sector due to hazards faced and known vulnerability;
4) To identify direction of policies and steps to be taken to integrate adaptive capacity within the health sector towards climate change needed to minimize vulnerabilities and risks.

   Adaptation program will be made stepwise within the development phases of 5-year duration starting with 2010 up to 2030 (2010-2014, 2015-2019, 2020-2024, 2025-2029);

1.3 Approaches

Approaches/methodologies used in this report was covers scientific analysis (*scientific basis*) and participative in nature, which involve all stakeholders. Both methods was used simultaneously and inter-related. The first method, *scientific basis*, was used together with an approach at the macro-level, and adapted to the existing data. The second method is a bottom-up approach, used to collect data and information. The bottom–up approach is done by conducting Focus Group Discussion (FGD) with related institutions.

1.3.1 Scientific Basis Approach

Scientific analysis includes all data collecting, analysis and synthesis of several data and information (documents, consultations, discussions) as follows:

- Internal data and information, will be obtained through internal discussions with a sub-team, scientifically based, and with other sectors;
- National data and information will be obtained from existing records and maps at several institutions like the Ministry of Health, BAKOSURTANAL, BMKG, and LAPAN;
- International data and information, like research documents, reports from institutions like the IPCC, UNFCCC, WHO, UNDP, and others will be obtained through internet search.
- Report contents will be reviewed for corrections by a climate change expert, Dr. Irving Mintzer.

1.3.2 Participation of Stakeholders

Participation of stakeholders was accomplished through followings:

- Consultations and discussions with bureaucrats, researchers, and experts at related institutions, especially at the Ministry of Health.
- Establishment of *Forum Group Discussion* (FGD), Pre-FGD, coordination meetings, at the Ministry of Health and other related institutions, like those realizations in the Bappenas as well as the Ministry of Health. Within a FGD can also be discussed about inter-sectoral issues.

CHAPTER 2 PROBLEMS AND CHALLENGES IN THE HEALTH SECTOR

2.1 Health Sector Conditions and Problems

As mentioned in the Long-Term Development Plan (RPJP) of the Ministry of Health, 2005-2025, the society's health condition in Indonesia is faced with low general public health conditions which can be seen by the high infant mortality rate (IMR), high mortality of children below 5 years, high maternal mortality rate (MMR) and high percentage of children below 5 with low and bad nutritional status. Moreover, disparity of health status varies quite a lot among different social-economic status, between different areas, and between gender and income groups. Indonesia also has limited number and quality of health manpower, and lowly skilled health technicians, besides limited finacing sources and unoptimal health finance allocation.

The Medium-Term Development Plan (RPJM) of the Ministry of Health, 2004-2009, mentioned that the main problems within the health sector are the disparity of the state of health, the multiple burden of disease, the low performance and quality of public health services and the public traditional behaviour which does not support the pattern for a healthy hygienic life (PHBS). Besides, there are also the low general public health conditions, the unequal distribution of and the unaffordable health service facilities, the limited number and quality of health manpower, and lowly skilled health technicians, the unequal distribution of health manpower within a population, the low degree of health status of the poor, and constraints such as unavailability of stock and unaffordability of raw materials for drugs, pharmaceutical supply and health instruments. A more detailed explanation on health sector problems in Indonesia can be seen in Appendix A.

2.2 Challenges of Climate Change Impacts on the Health Sector

Health problems in Indonesia as described before, will receive additional and more intense stressor from global climate change. Global change of the environment which influence humans , among others are climate change, the ozone hole, degradation of land, the scarcity of water resources, the change of the functions of the ecosystems, and the loss of biological diversity (see Figure 2.1).

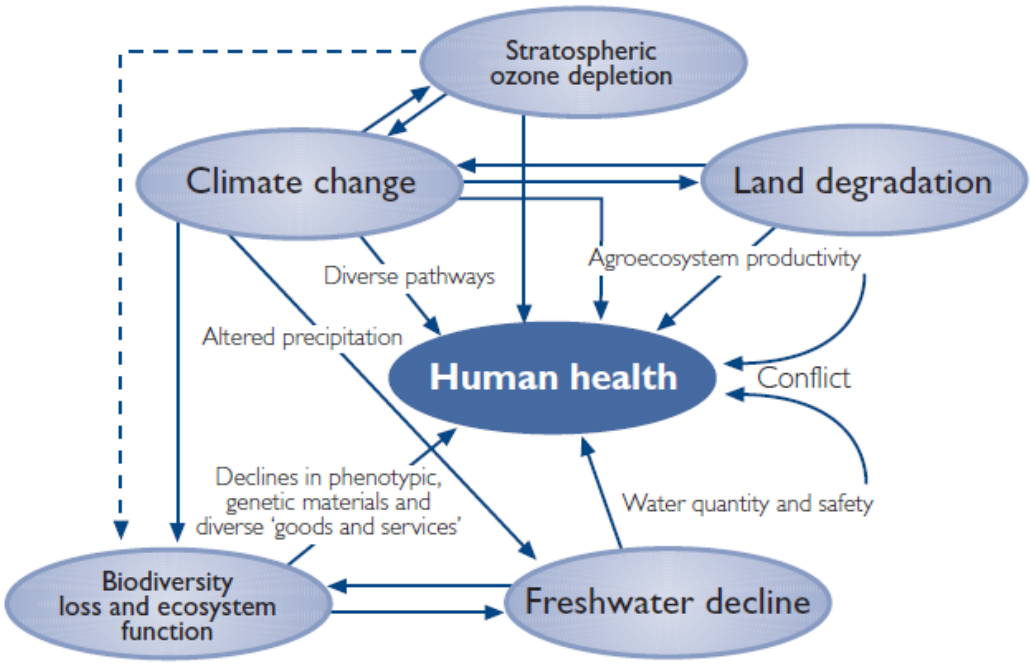

Figure 2.1 Relationship between Various Main Global Environmental Changes which Influence Human Health, Including Climate Change (Mc Michael, 2003)

Environmental change and its impact to health can be explained as follows: (1) the thinning of the ozon layer in the stratosphere, increases the risk of developing skin cancer, (2) the rise in ambient temperature due to climate change also increases the ozon concentration in the troposphere, one of the main air pollutants causing respiratory diseases, (3) the loss of biological diversity could also influence health, due to the increasing scarcity of raw materials for drugs from plants, (4) land degradation and change of ecosystem functions could change the spread of disease vectors, (5) the decreasing water resources, causing limited access to clean water and healthy sanitation.

2.3 Potential Health Impacts due to Climate Change

Figure 2.2 explained the flow of climate change impact to health. Climate change will affect the change in rainfall, increase of ambient temperature, extreme weather, and sea level rise. In the terminology of climate change these components are called climate change hazards.

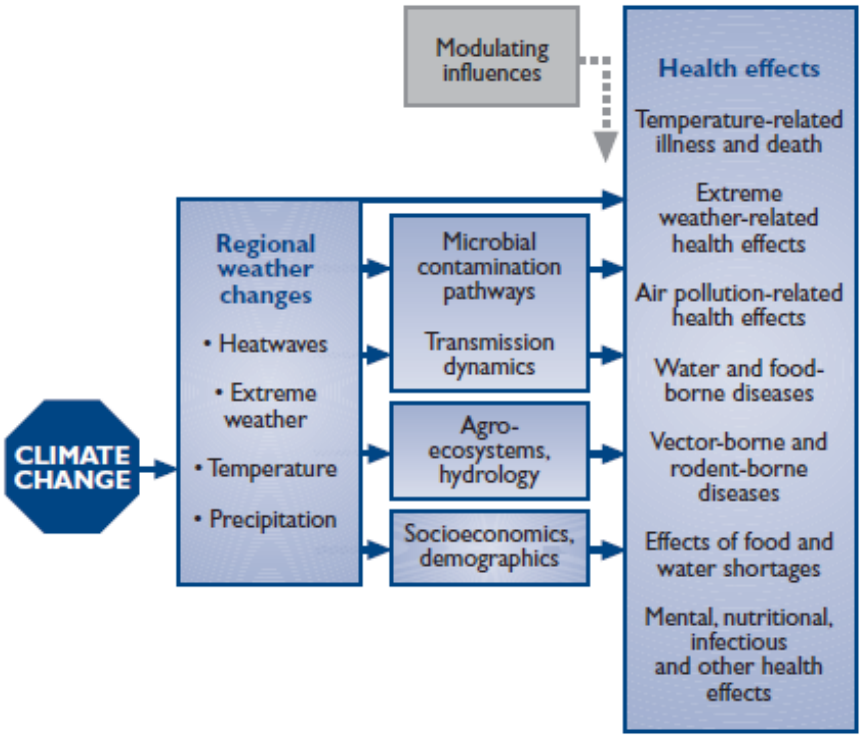

Figure 2.2 Pathways by which Climate Change Affect Human Health
(Patz et al, 2000)

The hazards of climate change to health are marked by (1) significant increase of rainfall at certain months with increasing variability in certain region, (2) decrease of rainfall in dry months, while in the wet season, rainfall will increase, (3) increase in the average ambient temperature. Climate change hazard affects health through microbe contamination and dynamics transmission. Besides, climate change hazard affects the agro-ecosystem and hydrology, and socio-economy and demography. These processes are also affected by modulation of social, economy, and development condition.

Climate change impact to health can be in the form of temperature rise effect to morbidity and mortality, disasters due to extreme weather, air pollution increase, water and food borne disease, and vector and rat borne disease.

Based on the process, the hazards of climate change could influence human health in two ways, directly and indirectly (Figure 2.3):

(1) Directly. Such as direct exposure to seasonal change (temperature, rainfall, sea level rise, and the increase of weather extreme frequency).

(2) Indirectly. The mechanism of climate change influence the changing environmental factors such as the changes in the quality of the environment (water, air, and food quality), the thinning of ozon layer, scarcity of water resources, loss of ecological functions, and degradation of lands which eventually influence human health. Indirect impact such as (a) mortality and morbidity due to diseases. Climate change induces diseases by temperature change, air pollution, water and food borne disease, and vector and rat borne disease. (b) Malnutrition, could happen due to a disturbance in food sources and harvest.

In detail, climate change impact potential to health sector is shown in Table 2.1. It is explained that further climate change hazard and mechanism could affect health sector. Furthermore, the hazard could affect health directly or indirectly. Detailed climate change hazard such as rainfall change and remperature rise is given in Appendix B.

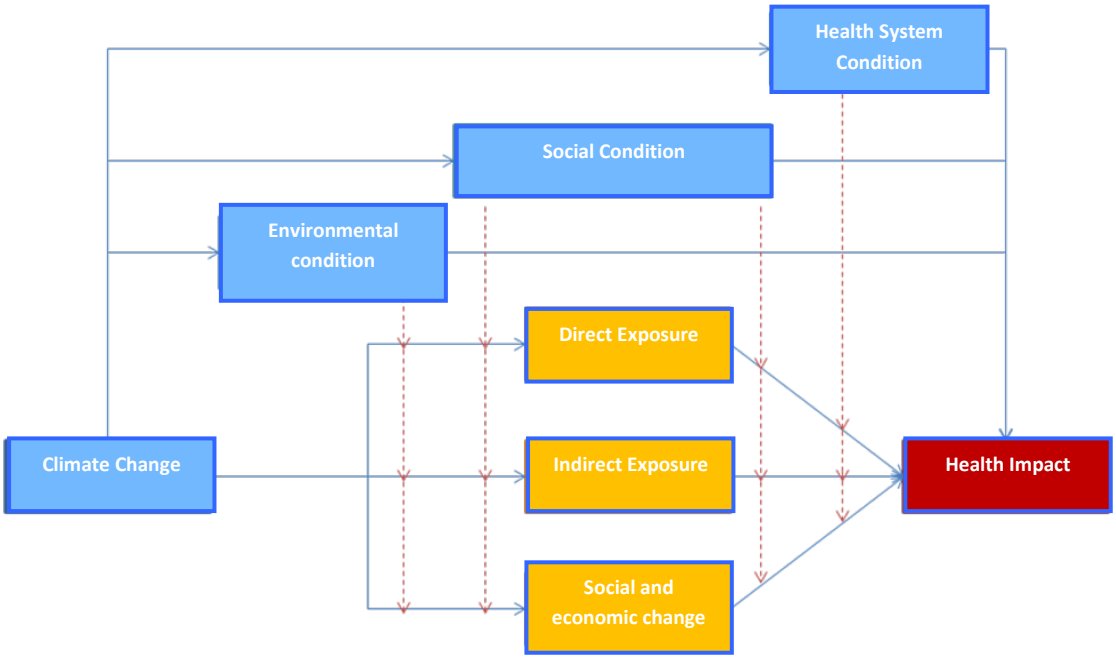

Figure 2.3 Schematic Diagram of Relationship Pattern of Climate Influence on Health, Impacting Directly as well as Influenced by the Modification of the Environmental Conditions, Social, and Health System.
Source: IPCC, Working Group II, 2008

Table 2.1 Hazards of Climate Change as related to the Health Sector

Climate change	Further Hazards of Climate Change to the Health Sector	Climate Change Impact to Health Sector

Temperatur (T) increase	- heat waves
	- increase of evapo-transpiration together with change in rainfall will decrease surface stream, causing:
	  - Scarcity of water supply
	  - Droughts
	  - Distubance of water balance
		- Increase in temperature influences breeding, development, age, and distribution of malaria vector, DHF, chikungunya, and filariasis.
		- Increase in temperature, will expand distribution of vectors and enhance development of parasites to become infective.
		- Decrease of water availability affecting agriculture, thus causing harvest failure, indirectly causing malnutrition

Change of rainfall pattern (CH)	Increase of surface stream and land humidity, causing: - Floods - Distubance of water balance - Landslides Together with increase in temperature, will decrease surface stream, causing: - Decrease of water availability - Droughts	- Flood and water balance disturbance could affect sanitation condition and bring water borne disease such as diarrhea. - Flood and water balance disturbance could affect harvest failure, causing malnutrition. - Rainfall influence type and number of habitat for vector breeding. - Change in rainfall together with increase of temperature and relative humidity, could increase as well as decrease disease vector population density and contact between vector and humans.
Sea Level Rise (SLR)	With the increased level of extraction of certain ground water, sea water intrusion will occur, such that it will influence availability of fresh water and sanitation functions.	- Sanitation function disturbance affects the increase of water borne disease spread such as diarrhea. - Change of mangrove and marshes ecosystems
Increased frequency and intensities of extreme weather	- Rainfall above normal causing increased surface stream and land humidity, resulting in flooding and landslides. - Hurricanes	- Flood, storm, and landslide disaster may cause mortality - Flood, storm, and landslide disaster may cause settlement damage, further causing refuge and many health disturbance - Impact on human immunity

2.3.1 Health Impact Analysis Method related to Climate Change

As mentioned in the previous chapter, climate change impact to health consists of (1) increase of disaster potential, (2) malnutrition, (3) increase of disease events. The followings are methods to analyze climate change impact to the three aforementioned impacts.

The first impact is the increasing disaster potential related to climate change which has wide health problems spectrum as discussed in Table 2.2. To analyze climate-related disaster impact to health, we need the following steps (1) determine analysis scope, (2) determine current climate-related disaster condition (map of disaster-prone area, climate-related disaster history), (3) identify current population characteristic (social, economy, culture) and adaptation capacity (health facilities, sanitation, and supportive infrastructures) as current (baseline) adaptation condition (4) identify current disaster strategies, policies, and preventions as current (baseline) policy condition, (5) estimate climate-related disaster using certain scenario, (6) analyze climate-related disaster impact to health.

Table 2.2 Climate-Related Disaster to Health

Health component	Flood/storm	Drought/forest fire
Morbidity or mortality, wounds and injuries	Drown, collision with hard object, car accident	Dehydration, burns from forest fire
Water borne disease	Houses and hospitals contamination, lack of clean water and sanitation	Lack of clean water for sanitation and cooking, use of unclean water, unclean sanitation
Vector borne disease	More breeding of mosquitos, rats in houses	Certain vector may breed more
Respiration disease	Unhealthy house condition	Forest fires causing smoke
Malnutrition	Inundated agriculture lands, harvest failure, food supply hampering, food purchase inability	Damaged agriculture lands, harvest failure, limited regional food supply, food purchase inability
Mental health impact	Psychological impact to hazard, morbidity, refuge, and loss	Psychological impact to hazard, morbidity, refuge, and loss

The second impact is increasing malnutrition potential related to food source, distribution, and supply. To analyze climate change impact to malnutrition, we need a

comprehensive data which consists of (1) variability and climate change scenario, (2) agriculture, farm, and plantation yield level, (3) agriculture, farm, and plantation processing technology and system, (4) agriculture, farm, and plantation sensitivity to certain climate condition, (5) food transportation and distribution system, (6) population scenario, malnutrition level, consumption level, lifestyle, and purchase ability, (7) supporting policies such as nutritious food distribution, maternal and children health, main food price subsidy, food conversion as renewable energy policy, (8) supporting infrastructures such as nutrition seminar and health facilities.

Based on gathered data, disaster and malnutrition data availability was not available enough to be further analyzed. It is recommended that health sector conduct further study on this climate change impact to disaster and malnutrition because of its important role in health.

The third impact is increasing borne disease events related to change of disease vector. To analyze climate change impact to disease vector change, such as malaria, at least we need data of (1) population scenario, (2) variability and climate change scenario, (3) human's immunity to vector infection and vector borne level to humans, (4) vector's immunity probability to environmental factors: temperature and rainfall, (5) vector transmition potential: vector capacity, vector reproduction level, vector quantity density, vector incubation period, and temperature range during incubation.

Even so, currently, disease vector distribution data in Indonesia is only limited in a few specific areas in Indonesia, thus there is no complete national data in all of Indonesia. So, in this study, we use relevant disease event data as proxy. Proxy is data which is considered to represent a parameter with certain level of accuracy. In this case, disease event is used as disease vector distribution proxy. In this study, we used incidence rate (IR) data of 3 infectious diseases which are malaria, dengue fever, and diarrhea, because the three are the main diseases which have high incidence rate in Indonesia.

2.3.2 Malaria in Indonesia

Scientific evidences have shown that increasing malaria could be identified as potential impact of climate change (M. van Lieshout dkk, 2004). For example, in an area with limited health facility, temperature rise will increase vector-borne disease because of

temperature rise and increase of rainfall and surface water will lengthen the transmission season in endemic areas. Theoretically, malaria distribution is limited by mosquito vector tolerance to climate. Mosquito distribution will be limited if the condition is too dry (small rainfall and dry surface water). Besides, malaria distribution is limited by mosquito's biological condition in surviving and its condition to incubate in the form of infected agent in infected population.

Malaria distribution also depends on social, economic, and environmental factor of infected human population such as (1) global climate change, (2) land use change, (3) drug and vector resistency, (4) population mobility, (5) social-economic change, (6) health service condition, (7) political and war situation, (8) economic crisis and poverty.

In 2007 the number of positive malaria was 311.789 cases. Furthermore, malaria in Indonesia re-emerges, and being influenced by malaria termination program intensity and several environmental factors. Cases of malaria in Java and Bali, expressed as annual parasite incidence (API) for the period of 1995-2000, increases rapidly from 0,07 ‰ in 1995 to become 0,81 ‰ in the year 2000. In 2002 and 2003 API decreased to 0,47‰ and 0,22‰ respectively.

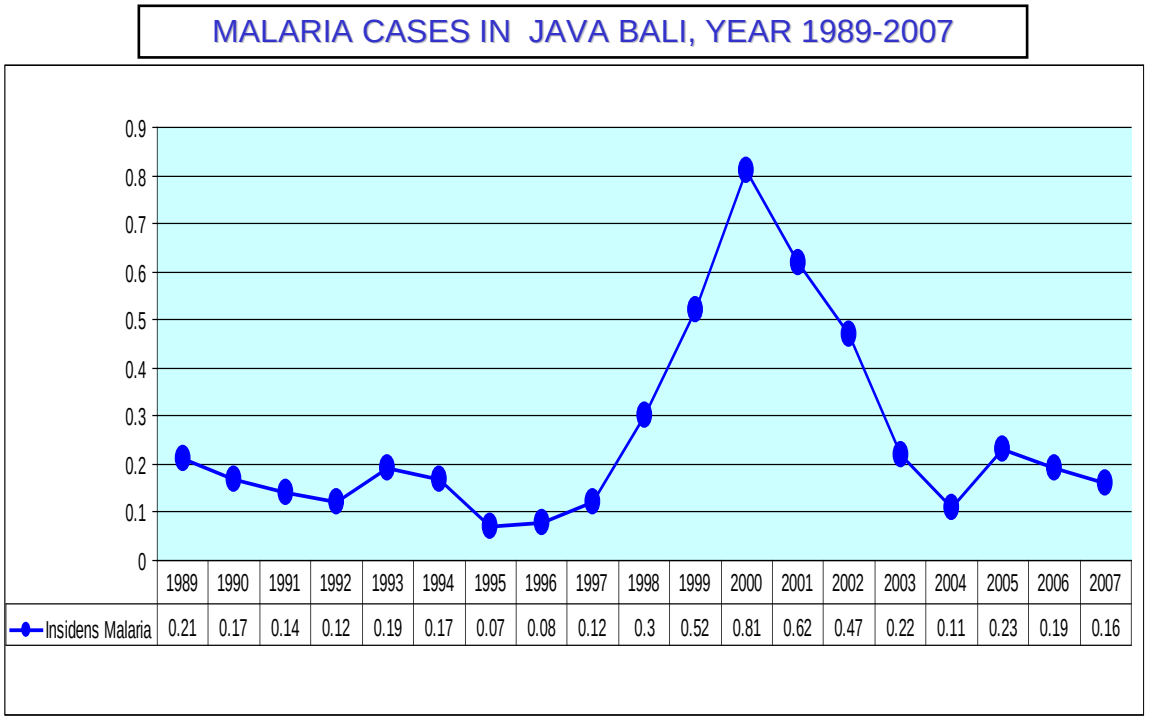

Figure 2.4 Malaria Cases in Java and Bali, Year 1989- 2007

Source SubDit P2 Malaria, Direktorat Jendral P2PL

Malaria cases outside Java and Bali islands, expressed as AMI, during the period of 1995-2003 fluctuates sharply from time to time, starting from 20 ‰ (1995) up to 22,7‰ (2002). Then, it becomes stable for a period of 2003-2004, i.e., 21,80 ‰ and 21,20‰. Further on, it increases again in 2005 to become 24,75‰ and decreases again during 2006-2007, i.e., from 23,98‰ to become 19,67‰ (Ditjen P2LP, Ministry of Health RI 2008).

To see the malaria distribution, we show map of 2004-2005 malaria outbreak (Figure 2.5), map of malaria endemy in 2007 (Figure 2.6), and map of malaria cases distribution in 2008 (Figure 2.7). Based on these maps, we see that the highest malaria distribution was in Papua.

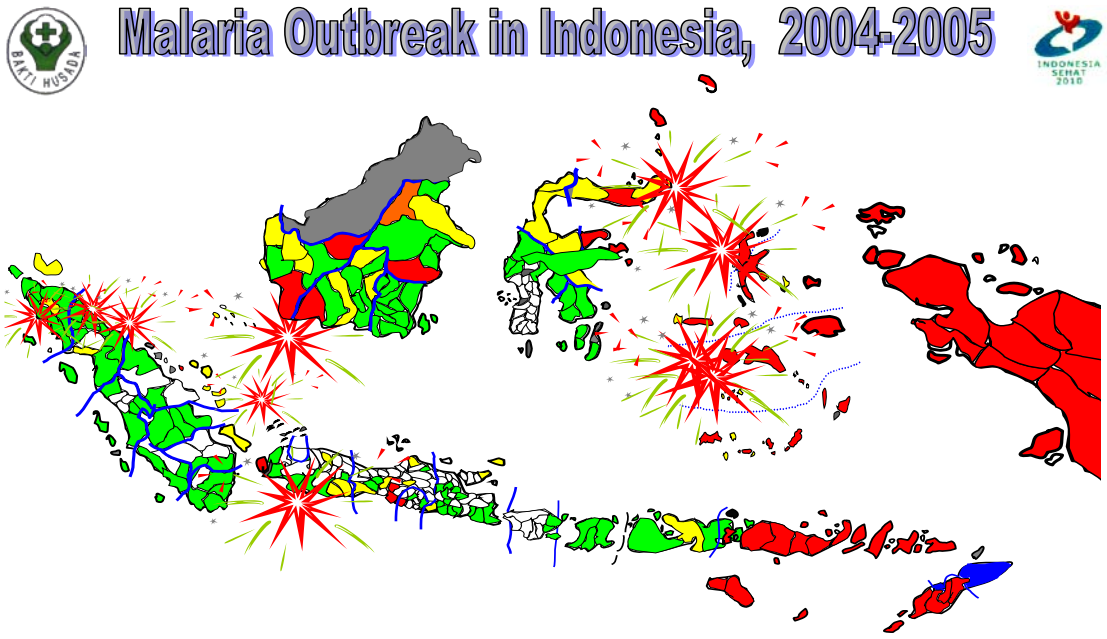

Figure 2.5 Malaria Outbreak Map (KLB), 2004-2005
Source: SubDit P2 Malaria, Directorate General P2PL

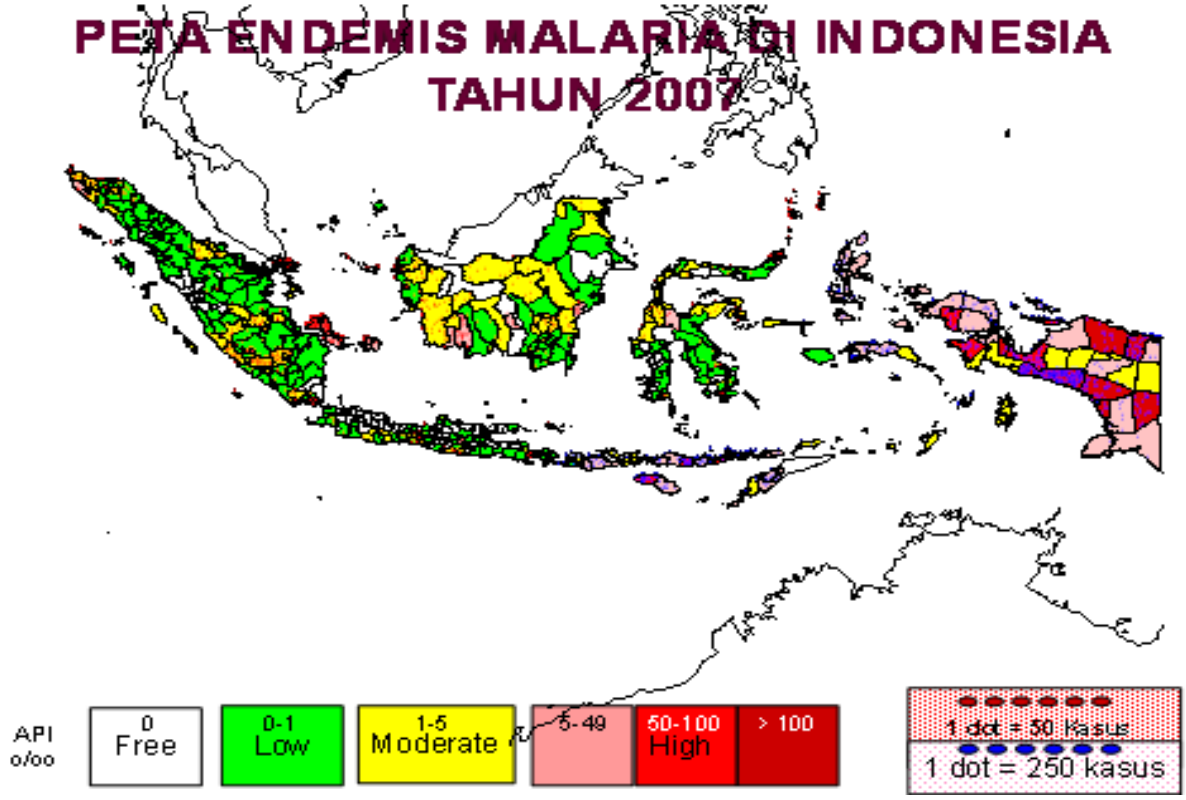

Figure 2.6 Map of Malaria Endemy, 2007

Source : SubDit P2 Malaria, Directorate General P2PL

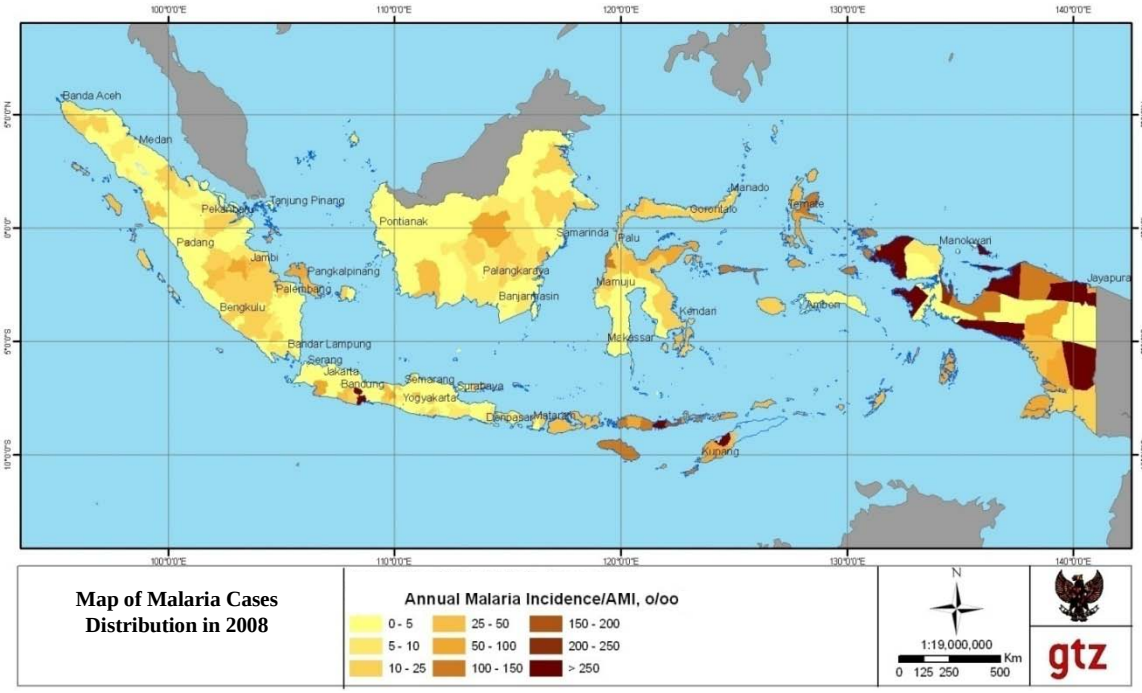

Figure 2.7 Map of Malaria Cases Distribution, 2008

(Source: Analysis of Data, Ministry of Health, RI)

To see the potential of mosquito distribution transmission we need to analyze the type and density of malaria mosquito distribution in Indonesia (see Figure 2.8). Figure 2.8 shows the distribution of malaria vector spesies in Indonesia. The western part of Indonesia, the *Anopheles* species are oriental, among others, *An. aconitus, An. sundaicus, An. subpictus, An. balabacensis, An. leucosphyrus, An. punctulatus, An. koliensis, An. longirostris* and *An. bancrofti.* Some oriental species migrate to the east, such that at the Papua area the oriental group can also be found, and so are some Australasian groups that migrate to the west of Lydekker line. Mosquitoes, in Maluku are a mix of both oriental and Australasian groups.

The distribution of *Anopheles* mosquitoes is not only based on geography of zoo-distribution, but is also influenced by high altitude, land use, and the ecosyistem. In Java-Bali, there are 4 species of malaria vector, namely, *An. sundaicus* as a vector at the coastal areas, *An. aconitus* at stratified rice paddies areas, *An. balabacensis* in vegetated mountainous areas, and *An. maculatus* in mountainous area sparsely vegetated.

Malaria vector density at coastal areas (*An. sundaicus* and *An. Subpictus)* will increase at the beginning of the dry season, and the peak density will occur about more than 2-3 months after the dry season ended. During the dry season, the water level at fish ponds, lagoons, and other waterways around the coast will become brackish, which support the growth of water gulma, like algae and mosses. With the growth of gulma, vector habitat is developed just as needed by species such as *An. Subpictus* and *An. sundaicus.*

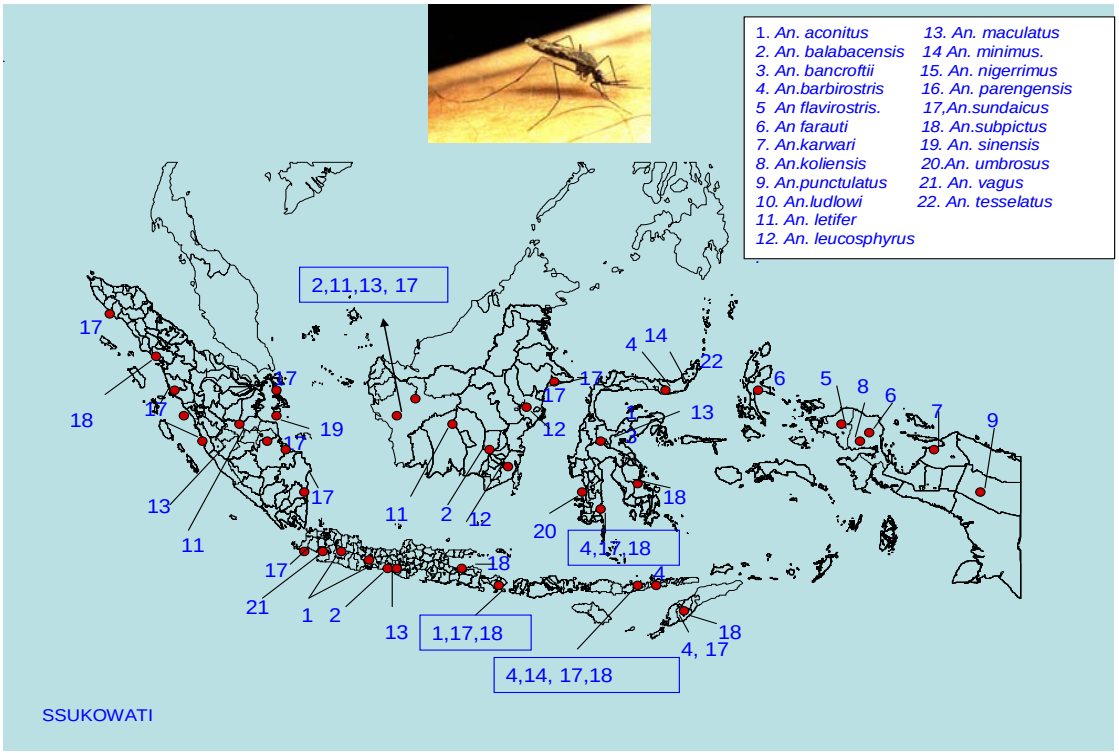

Figure 2.8 Distribution of Malaria Vector Species in Indonesia (Source: Ministry of Health, RI)

2.3.3 Dengue Haemorrhagic Fever (DHF) in Indonesia

Dengue haemorrhagic fever has spread to all cities throughout Indonesia since the 1968. In 1968 IR of DHF reported cases were 0,05/100.000 population with a case fatality rate (CFR) of 41,3%, thereafter, outbreaks frequently occur in several areas. In 1998 an outbreak with 72.133 cases, and a mortality rate of 2%, was the most severe outbreak ever happened since the first DHF case was reported in Indonesia. In 2004 a national outbreak occured, in 40 districts and cities in 12 provinces with a number of cases of 28.077, with mortality of 381 cases, and CFR of 1.36%. Figure 2.9 shows DHF increases continuosly for the period of 1999-2007 reaching an IR of 71,78 per 100.000 population, even if there had been a case of decrease in 1998.

All year round throughout 2007, 11 provinces suffered from DHF outbreaks, namely, West Java, South Sumatera, Lampung, DKI Jakarta, Central Java, East Kalimantan, Central Sulawesi, East Java, Banten, and DI Yogyakarta. In 2007 the number of cases were 156.767, an IR of 71,18/100.000 population, and fatality of 1570 cases, and CFR of 1,00 %. In 2008 the number of district/city that suffer from outbreaks decreases (Ditjen PP-PL, Ministry of Health 2008).

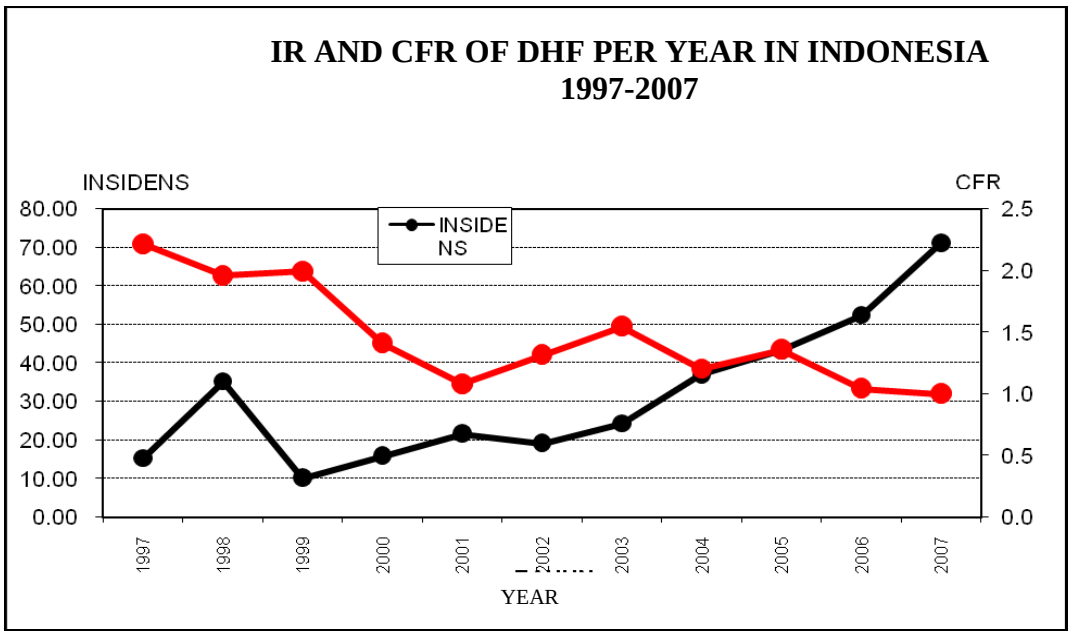

Figure 2.9 DHF Morbidity and Mortality in Indonesia, 1997- 2007 Expressed as IR and CFR (Ministry of Health RI, 2009)

Directorate general of communicable disease control and environmental sanitation (P2PL Ministry of Health RI) in 2008 mentioned that DKI Jakarta, was the province with the highest IR for DHF of 392,94 per 100.000 population, followed by Bali (IR=193,18) and East Kalimantan, IR=193,15 per 100.000 population. The province with the highest mortality number throughout 2007 was Papua, with a CFR = 3,88%, followed by the province of North Maluku, and Bengkulu, each with CFR of 2,55%. Figure 2.10 showed the distribution of DHF incidence rates for the year 2008.

Until now, drugs and vaccine for DHF are still unavailable, such that prevention and control of DHF are conducted through vector control, a program known as 3M plus and optimized through communication to change people's behavior based on existing local way of life. To decrease fatality rate, technology of case treatment plan need to be improved. (RPJM Ministry of Health).

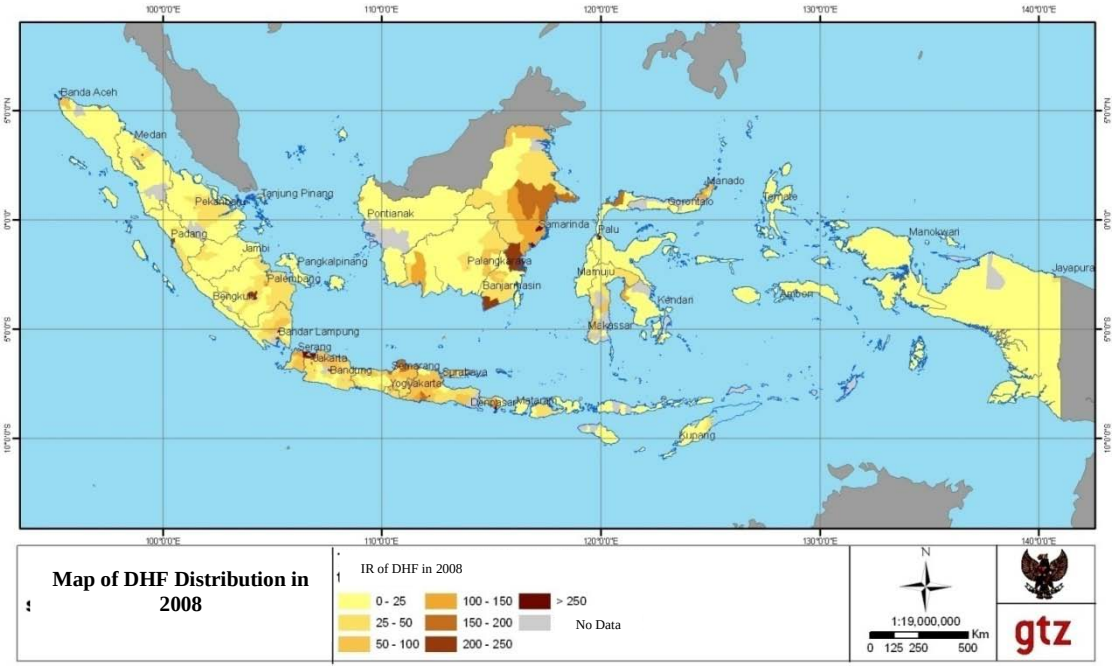

Figure 2.10 IR of DHF Distribution Map, Year 2008

Source: Analysis of Data Ministry of Health, RI

CHAPTER 3 DEGREE OF VULNERABILITY OF THE HEALTH SECTOR

3.1 Understanding Vulnerability in the Health Sector

Vulnerability is a function of exposure, sensitivity, and adaptive capacity. Therefore, there are three variables of vulnerability in its analysis, i.e., Exposure (E), Sensitivity (S) and Adaptive Capacity (AC). Vulnerability (V) function can be formulated as follows:

$$V = \frac{f(E \times S)}{AC}$$

Where:

- E : exposure, described as a physical aspect of vulnerability. In this case exposure will be stressed on physical aspects of impacts due to climate change, such as level of population density, level of isolation of a settlement area and location, design, and the availability of material for important infrastructure construction (*Affeltranger, et al.* 2006).
- S : Sensitivity is defined as a potential level of ability to response to a kind of climate change condition, such as the spread of malfunction, structure and composition within an ecosystem (UNEP and WMO, 1996).
- AC : Adaptation capacity is referred to as the potential capability of a system to adapt to an impact or influence due to climate change. AC is very much influenced by the vulnerablity of the population/area impacted by hazards of climate change (Bohle *et al.*, 1994; Downing *et al.*, 1999; Kelly and Adger, 1999; Mileti, 1999; Kates, 2000).

Vulnerability identification is needed, not only for information on risks, but also for detection from past events/experiences, what aspects are contributing to a certain risk, such that AC actions/program can be implemented to actually reached the stated objectives. Vulnerability can be obtained by the addition of all vulnerabilities at each component, related to each hazard, at the vulnerability analysis for each existing hazard.

3.2 Exposure as a Vulnerability Factor in the Health Sector

As mentioned in section 3.1, exposure is described as a physical aspect of vulnerability. In relation to this understanding, E will stress on all physical aspects impacted by climate

change such as level of poplation density, the level of isolation of a settlement location, location, design, and the availability of material for important infrastructure construction. The more densely populated an area, the lesser the environmental carrying capacity will become. As a result, access to hygienic natural resources such as safe water supply, clean air, and environmental sanitation will become less as well. Threats of population explosion to health have become very important for health status.

Within this study of exposure, population density will be used as an indicator. The level of population density in Indonesia is distributed as shown in Figure 3.1. As can be seen, the island of Java has the highest density level.

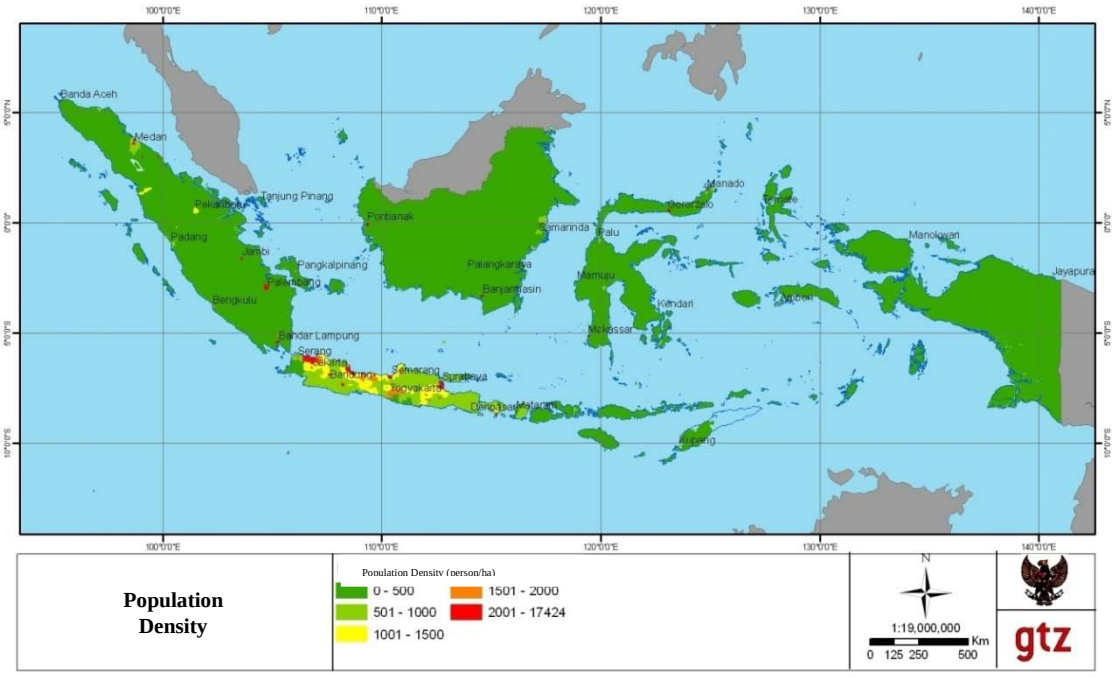

Figure 3.1 Map of Population Density 2008(Source: BPS, 2009)

3.3 Sensitivity as Vulnerability Factor in the Health Sector

As mentioned before, in section 3.1 sensitivity is a potential degree of a system to response to a change in climate condition, such as the spread of change of ecological functions, its structure and compositions. (UNEP and WMO, 1996). In this study, indicators for sensitivity were chosen to be the level of population welfare and IMR. These indicators were selected due to the high accuracy of available data.

3.3.1 Welfare Status of the Population

The main component of sensitivity as related to climate change in the health sector is the level of the population welfare. This is being chosen due to the fact, that level of welfare can represent the capability to fullfil health services and requirement of food, such that good nutritional status can be maintained. On the other hand, if the fulfillment of food and nutrition are not acquired, than vulnerability to contracting diseases as related to climate change will occur.

Data on poverty in 2007, between provinces, showed that there are six provinces that could be categorized as having relatively low percentage of poor population (<10%), namely Bangka Belitung (9,54%), Central Kalimantan (9,38%), Banten (9,07%), South Kalimantan (7,01%), Bali (6,63%), and DKI Jakarta (4,61%). Then, there are 15 provinces categorized as having percentage of poor population in the range of 10-20%, 9 (nine) provinces having percentage of poor population above 30%, namely, Papua (40,78%), West Irian Jaya (39,31%), and Maluku (31,14%) (Ministry of Health, 2008). Figure 12 shows the distribution of the number of families of poor population (*Pra Keluarga Sejahtera/Pra KS*) and KS 1 (*Keluarga Sejahtera 1*). The area having the highest percentage of families belonging to Pra KS dan KS 1 are the most vulnerable.

The lower the welfare, the higher the possibility or potential to become sick. In accordance to the Indonesian Health Profile document of 2007, diseases suffered by poor population are lung tuberculosis, malaria and HIV/AIDS. The low level of health status of the poor population, are mainly due to the lack of access to health services caused by the geographical and financial constraints (*cost barrier*).

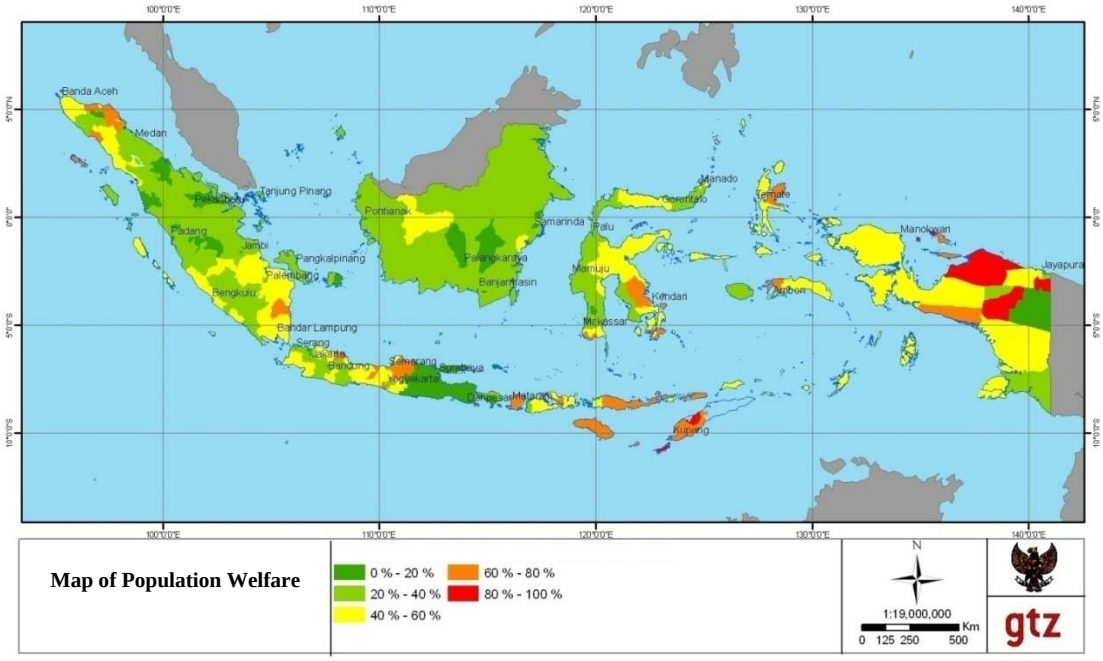

Figure 3.2 Map of Level of Population Welfare Status (Source: BPS, 2009)

The main problem to find access to health services is due to the cost barrier, distances, and transportation. Utilization of hospitals are dominated by the 'haves', while the poor tend to use services from health centers. So does the case with child labor and delivery assisted by health personnel, only 39,1% among the poor as compared to 82,3% among the 'haves'. The poor are also not yet covered by health insurance system. Health insurance as a form of social security system only reaches 18,74% of the population (2001), the bigger part of this insurance are being used by the government employees, and the 'haves'. Even if the Law on National Social Security System (SJSN) is already implemented, experiences in many part of this nation show that affordability of the poor population to get services from SJSN are not quite enough.

3.3.2 Infant Mortality Rate

Sensitivity is being influenced by age structure, hence IMR/AKB can be used as indicator for sensitivity, to determine the level of public health. At the present moment, public health programs in Indonesia, mostly focus on lowering the IMR. IMR is being defined as the number of deaths among children between 0-1 year old divided by the number of live births for the same calendar year. The Central Bureau of Statistics estimated IMR for the year 2007 as 34 per 1.000 live births. The tendency of IMR to decrease is being influenced by equal distribution of health services with its facilities. The increase of income can take a role through improvement of nutritional status, which in

turn will improve the immunity status of the population towards diseases attacks. Currently, society health programs in Indonesia are mostly focused on IMR reduction.

Infectious diseases, the main causes of infant and children below 5 years mortality rates, are acute upper respiratoty tract infections/ISPA, diarrhea, tetanus neonatorum, and diseases related to pregnancy and labor. Figure 13 shows a map of distribution of IMR in Indonesia; it can be seen that areas having high IMR are West Sulawesi with a number of more than 60. Other areas with IMR between 50-40 are in South Kalimantan, central Sulawesi, Maluku, and Nusa Tenggara islands.

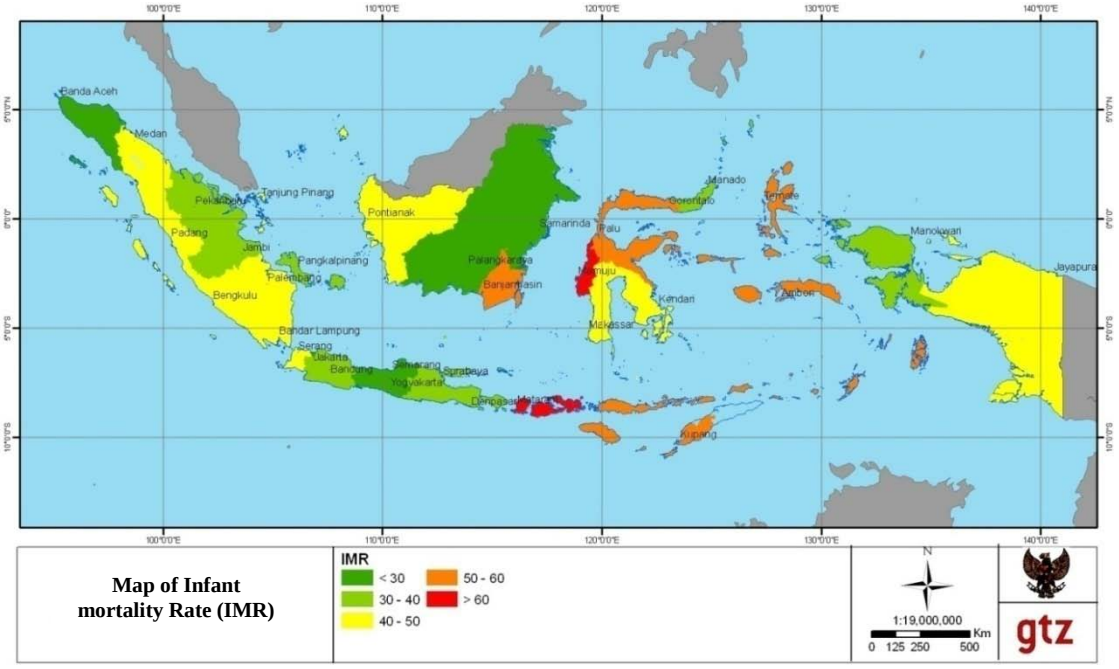

Figure 3.3 Map of IMR Distribution in Indonesia

(Source: Analysis of Data Ministry of Health, RI 2008)

3.4 Adaptation Capacity as Vulnerability Factor in the Health Sector

Adaptation capacity (AC) of the health sector, includes the ability of the health services system and the population to manage climate change impacts. The frequently used indicator for AC are the economic resources, availability and access to technology, information and skill. Other important factors are also the indicator of the readiness of infrastructure and institutional aspect in facing climate change. (Smith et al., 2001).

This study took as indicator for adaptive capacity, the existing health facilities, community access to safe water supply and sanitation. The health facilities taken into account are the existing hospitals, health centers, etc.

3.4.1 Hospitals

Hospitals are one of many important health facilities within the health services sector in facing climate change. Indicators that will be used to assess the development of hospitals among other, with the development of the number of hospitals and their repective beds for in-patients cases, and their ratio towards the number of population. In 2008 the number of hospitals in Indonesia, were 1.556 units, shown in Figure 3.4.

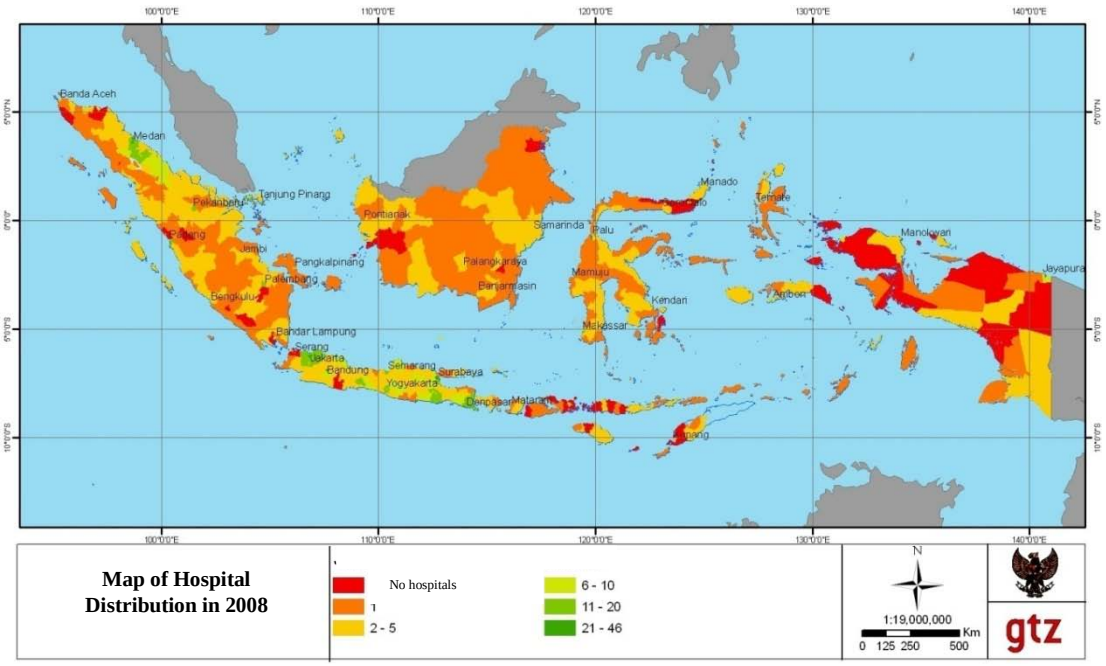

Figure 3.4 Map of Hospital Distribution in Indonesia, 2008

(Source: Analysis of Data Ministry of Health RI)

Hospitals managed by the government consist of those owned by the Ministry of Health, by the provincial health offices, by the Kabupaten/Kota, TNI/POLRI (the army), and other departments such as BUMN, are 667 units/50,57%, and those managed by private institutions, are 652 units (Ditjen PP-PL Ministry of Health, 2008).

The above map of distribution of hospitals throughout Indonesia, shows that there are still many cities/districts that do not have hospital facilities such as part of North Sulawesi, Kabupaten Aceh Jaya, Kabupaten North Aceh, Kabupaten Bener Meriah, Kabupaten Bima, Kabupaten Asmat, Kabupaten Baloangan, and in Papua island.

3.4.2 Health Centers

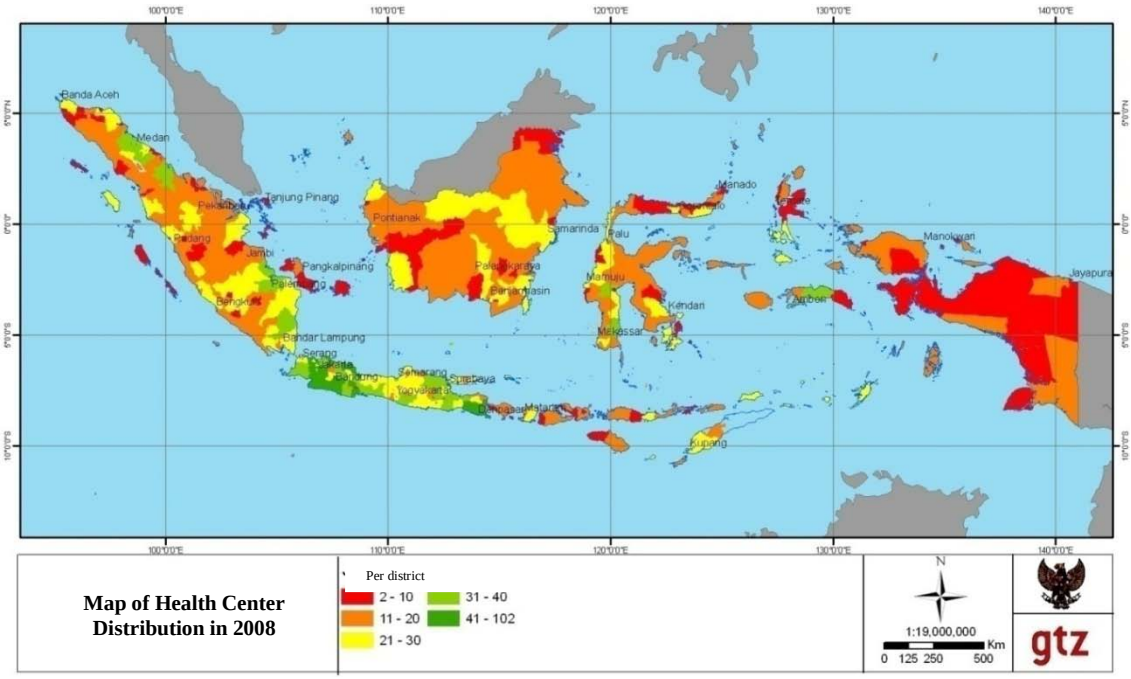

Figure 3.5 Distribution of Health Centers in Indonesia, 2008
(Source: Analysis of Data Ministry of Health RI)

A map of distribution of health centers throughout Indonesia can be seen in Figure 3.5 for the year 2008. Health centers are program implementing units of the local health offices at the district/city levels, located in subdistricts/kecamatan, implementing operational tasks and public health development. The establishment of at least one health center in each subdistrict plays a very important role in maintaining community health.

Looking at the work-area of a health center, the ratio of a health center in 2003-2007 already suffice the concept of work-area of a health center, namely, on the average of one health center to 30.000 population, meaning that nationally, a health center is expected to to be able to reach/cover the population basic health need within their work-area. (Indonesia health profile, 2007).

3.4.3 Posyandu

Posyandu is different from a health center, in a way that it is not owned and/or managed by the government, but work together very closely with a nearby health center. It is a kind of community participation in the health field. It is owned by the people, work for the people, and by the people organization, even if they are financially being partly supported by the local government. It is therefore playing a very important role in the

villages and should become one of the many components of adaptive capacity at village level. Posyandu is implementing at least five priority programs, i.e., mother and child care, family planning, improvement of nutritional status, immunization, and management of diarrhea. To monitor its progress, posyandu are grouped into 4 strata, namely, Posyandu Pratama, Posyandu Madya, Posyandu Purnama, and Posyandu Mandiri.

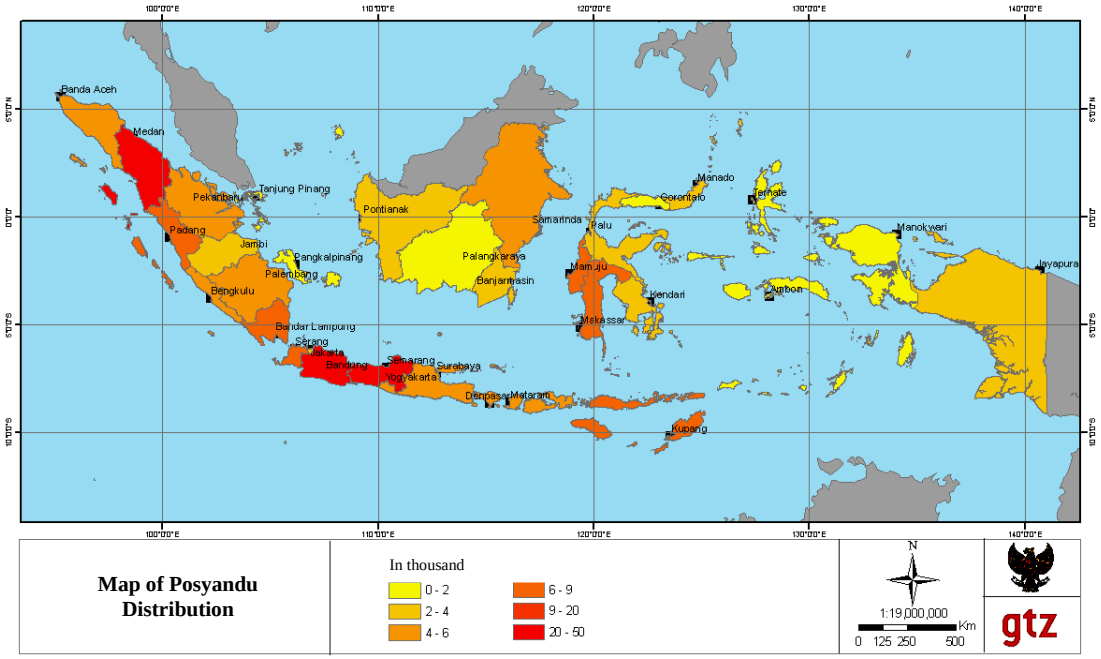

Figure 3.6 Distribution Map of Posyandu, 2008

(Source: Analysis of Data Ministry of Health RI)

The number of Posyandu in Indonesia in 2008 is 8.521 units. It is found more frequent in North Sumatera, DKI Jakarta, West Java, and Central Java, namely, about 20-50 units/district or kabupaten/city. Such conditions show that the ability of health adaptation is quite good. Other areas such as the larger part of Sumatra island, East Java, South Sulawesi, East Kalimantan, Banten, part of South-east Nusa Tenggara, show their ability to adapt moderately, with the number of posyandu of 9-20 units. The province of Maluku and West Irian Jaya need special attention because their capacity for adaptation is very low, with the number of posyandu of 0-6 units.

3.4.4 Immunization Coverage

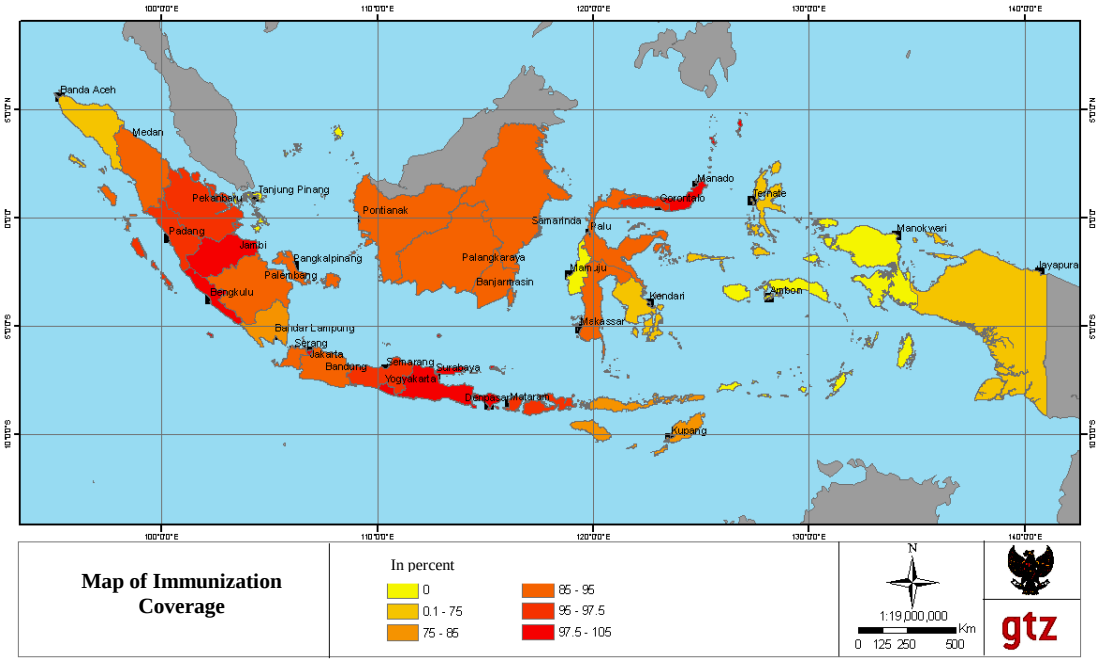

Figure 3.7 Map of the Spread of Immunization Coverage, 2008

(Source: Analysis of Data Ministry of Health RI)

Figure 3.7 shows a map of distribution of immunization coverage for the year 2008. Routine imunization in Indonesia covers the provision for babies aged 0-1 year, against several prevalent child diseases such as Tuberculosis, Pertussis, Tetanus, Diphtherie, Poliomyelitis, Morbilli, and Hepatitis B. The vaccines are known as the BCG, DPT, Polio, Morbilli, Hepatitis B vaccines. Other immunizations are for mothers at productive age/pregnant mothers (TT), and for primary school-aged children (DT for first grade primary school and TT for grade class of 2-3). Meanwhile for additional imunization activities, are done in accordance with a need, such as the existence of problems in villages for a non UCI (*Universal Child Immunization*), potential disease outbreaks, finding a wild polio virus or other activities based on technical policies (Indonesia health profile, 2008).

Most part of Indonesia are covered by immunization, and quite good, i.e., about 85-100%. Some areas with low coverage are the Nanggroe Aceh Darussalam, West Sulawesi, Nusa Tenggara islands, Maluku, Papua, and West Irian Jaya, i.e., around 0-75%. The low coverage of immunization in the mentioned places show that the degree of sensitivity is high to suffer from diseases related to climate change (Indonesia health profile, 2008).

3.4.5 Health Manpower

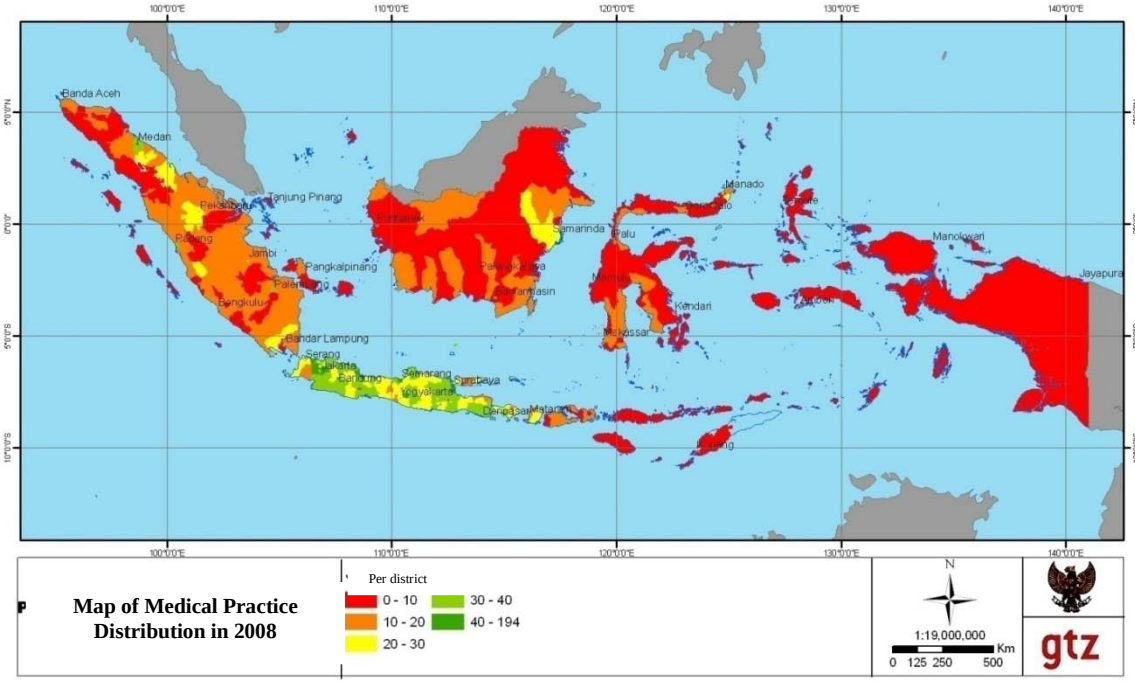

Figure 3.8 Distribution Map of Private Medical Practice, 2008

(Source: Analysis of Data Ministry of Health RI)

Indonesia is suffering from lack of almost all type of needed medical manpower. In 2001, it was estimated that each 100 000 population can only be served by 7,7 general practitioners, 2,7 dentists, 3 specialized medical doctors, and 8 midwives. As for public health professionals, per 100.000 population can only be served by 0,5 public health specialists, 1,7 pharmacists, 6,6 nutritionist, 0,1 epidemiologists, and 4,7 sanitarian. Many health centers do not have a medical doctor and public health specialist. This limitation is becoming worst by the unequal distribution of the existing medical personnel. For example, more than two-thirds of medical specialists are on Java and Bali. Disparity ratio of general practitioner per 100.000 population between areas are also still high with a range of 2,3 in Lampung up to 28,0 in DI Yogyakarta. Figure 3.8 shows a map of medical private practice distribution, 2008.

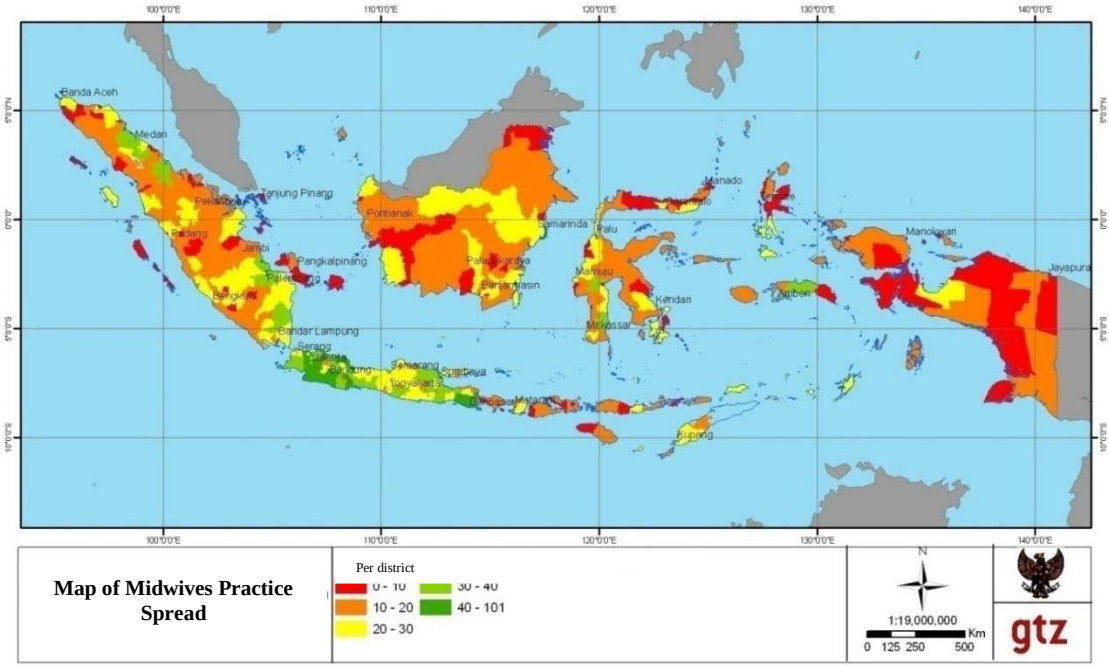

Figure 3.9 Spread of Midwives Practice Location 2008

(Source: Analysis of Data Ministry of Health RI)

Figure 19 shows a map of the locations of midwive practice 2008. According to a national social-economic survey in 2007, the percentage of children under five having a primary midwive assistance during their delivery was 53,96%, by traditional midwive/*dukun* 30,37% and medical doctor 12,32%. Those assisted by midwives in urban area were 64,24%, and in rural areas were 46,36% (Indonesia Health Profile, 2008). The distribution of practicing midwives is still concentrated in Java Island and part of Sumatra Island.

3.4.6 Poskesdes

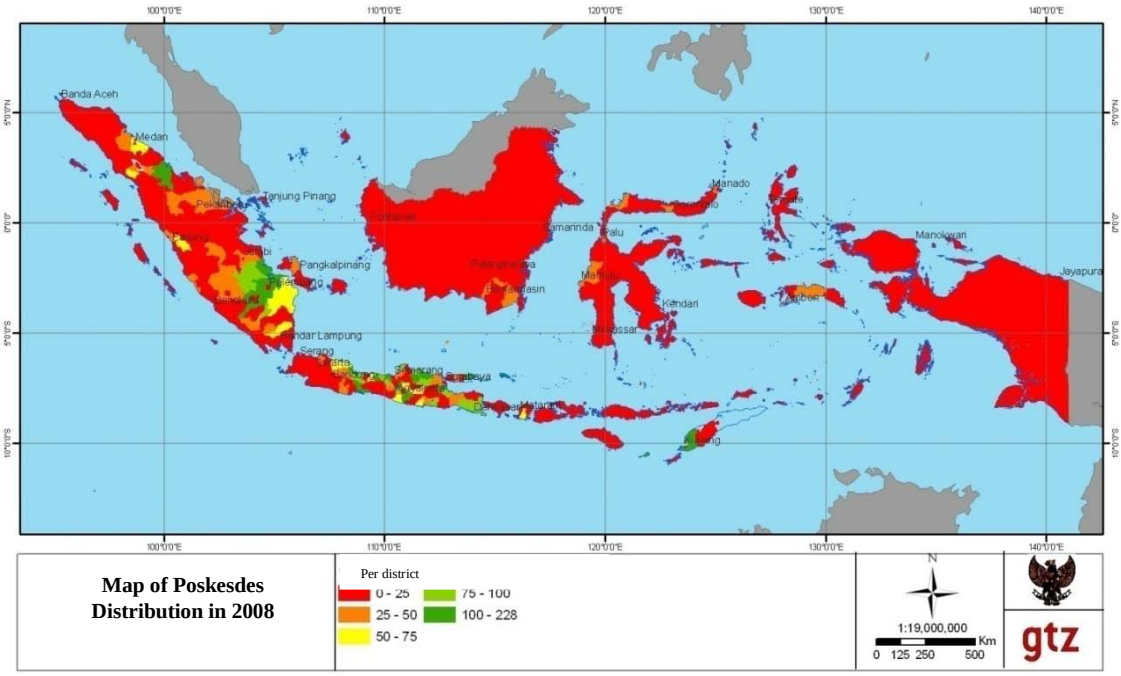

Figure 3.10 Distribution Map of Distribution of Poskesdes, 2008

(Source: Analysis of Data Ministry of Health RI)

One of the criteria to become a *desa siaga* (alert village) is to have at least one Poskesdes, which is a health clinic in a village. There should be at a minimum of one midwive, and 2 (two) cadres. Recorded poskesdes up to 2008 were 8107 units. Figure 3.10 shows a map of poskesdes distribution in Indonesia. Poskesdes are frequently found in South Sumatera, North Sumatera, part of Java Island, and a small part in East Nusa Tenggara. The existence of a poskesdes in other area, in small number, is, namely, less than 25 poskesdes.

3.4.7 Polindes

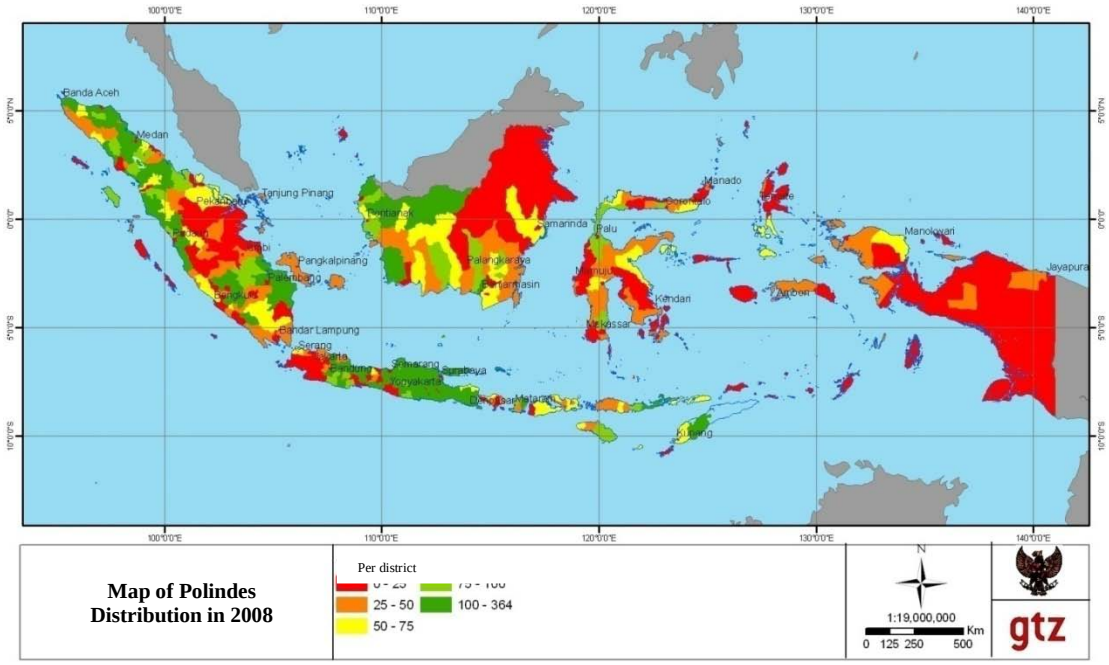

Figure 3.11 Polindes Distribution, 2008 (Source: Analysis of Data Ministry of Health RI)

Polindes is a poli-clinic at the village level, providing medical treatments, and is one of the many important health facilities at the kabupaten level. Distribution of polindes in Indonesia can be seen in Figure 3.11. The distribution of polindes is quite equal in Indonesia, only certain areas such as Papua, East Kalimantan, part of Sulawesi, Maluku, part of Sumatera, and Banten are still low in polindes.

3.4.8 Community Access Coverage to a Safe Water Resources and Sanitation

One other important factor influencing the status of public health is the condition of the environment, reflected among others, by the access the community have to safe water supply and basic sanitation. In 2002, the percentage of family having access to water supply that is safe for consumption amounted to only 50%, and families having access to basic sanitation amounted to only 63,5% (RPJM, 2009). Environmental sanitation, an inter-sector activity, is not managed by one health territorial system.

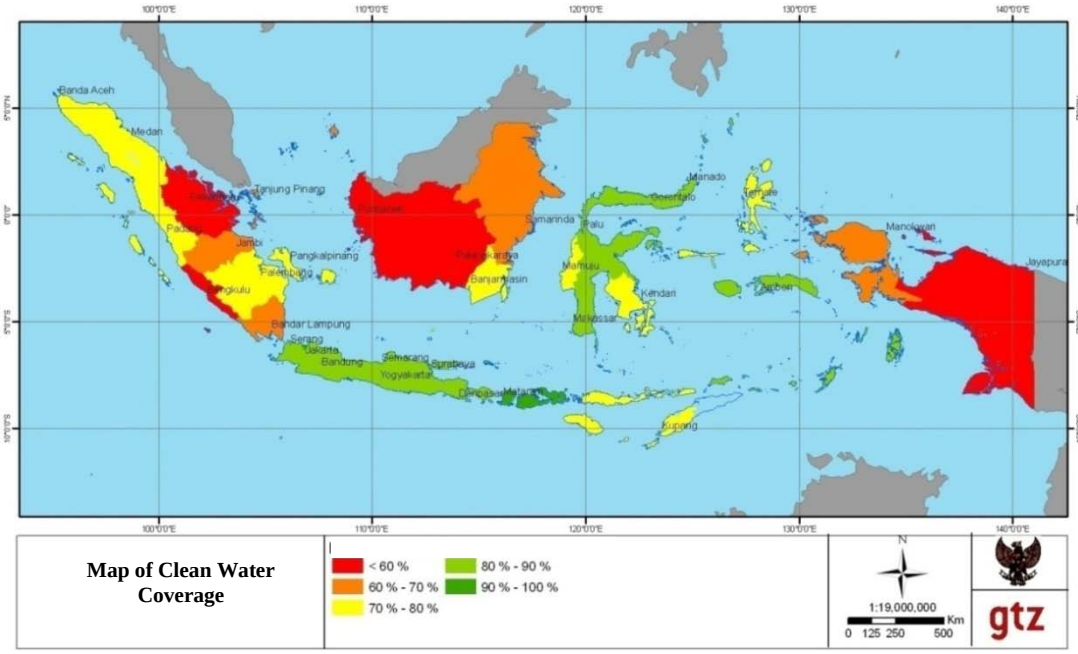

Figure 3.12 Percentage of Community Access to Safe Water Supply

(Source: Analysis of Data Ministry of Health, RI 2008)

Figure 3.12 shows the percentage of community having access to safe water supply. Safe water sources, in the figure, are defined as water from piped water supply, protected spring water, bottled water, pumps, and protected dug-wells. Figure 3.12 for the province of Riau, Jambi, Central and West Kalimantan, and Papua have a low coverage percentage of safe water supplies, i.e., less than 60%. Lampung, East Kalimantan, and Bengkulu have acoverage of 60-70%. Other areas which have coverage of 70-80% are Nanggroe Aceh Darussalam, South Sumatera, archipelago of Riau, South Kalimantan, West Sulawesi, South-east Sulawesi, Maluku, and East Nusa Tenggara.

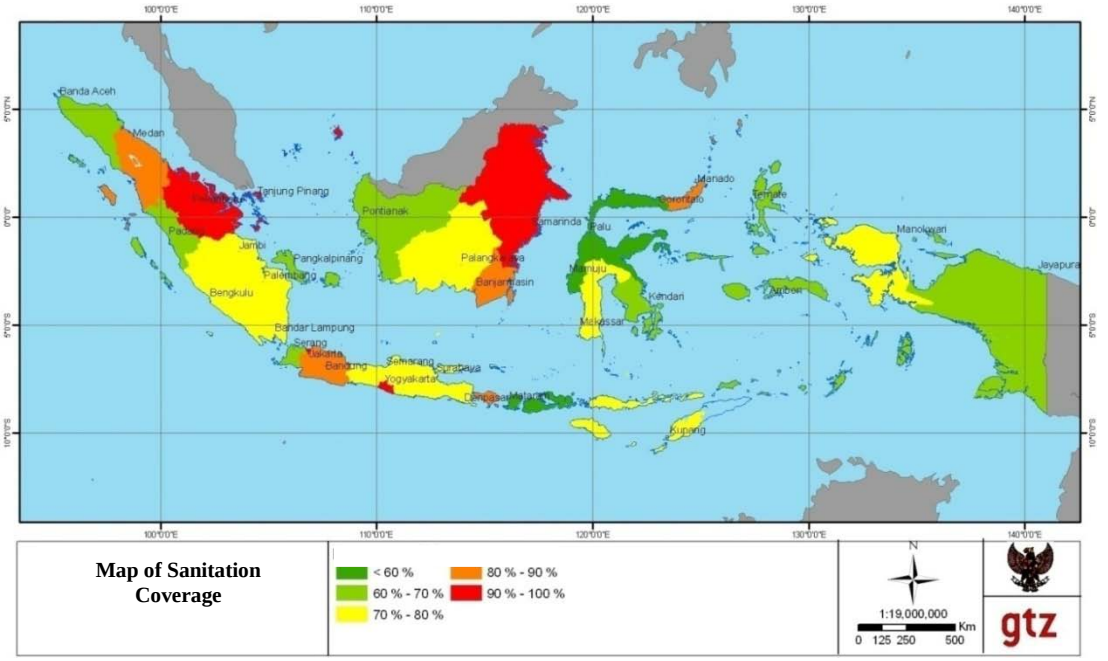

Figure 3.13 Distribution of Sanitation Coverage

(Source: Analysis of Data Ministry of Health, RI 2008)

Figure 3.13 shows the distribution of sanitation coverage. Sanitation facilities in the above figure is defined as a facility for defecation (private, commnal, or public). Figure 3.13 shows Riau, DI. Yogyakarta, and East Kalimantan having a good sanitation coverage, namely, in the range of 90-100%. West Java, North Sumatera, and South Sulawesi, Bali and South Kalimantan have sanitation coverage in the range of 80-90%. A territory that need to be attented to are the West Nusa Tenggara and Central Sulawesi, because of the very low sanitation coverage, ie. less than 60%. Other territory such as NAD, West Sumatera, Banten, West Kalimantan, Papua, East Nusa Tenggara also have low sanitation coverage, namely, in the range of 60-70%.

3.5 Vulnerability of Diseases Related to Climate Change in Indonesia

As was explained in section 3.1, vulnerability is a function of exposure, sensitivity, and adaptive capacity. Climate change impacts to health are (1) disaster due to increasing frequency of extreme climate (flood, landslide, storm), (2) malnutrition due to disturbed agriculture and fishery, and (3) change of disease pattern due to change of environment and vector. But in this study, vulnerability analysis to disaster due to extreme climate and malnutrition was not done because of lack of time and data. Thus, in this study, vulnerability analysis only done to the change of disease pattern due to environment and vector change. Since the national vector spread data is not available, we used disease

prevalency data as vector spread proxy. In this study, we chose malaria, DHF, and diarrhea because these infectious diseases are highly prevalence in Indonesia and very related to climate change.

Based on data of exposure, sensitivity, and adaptive capacity that were explained before, vulnerability to a certain disease will be at regions with the largest spatial spread in Indonesia and maybe related to climate change, would be malaria, DHF, and diarrhea, computed as follows:

$$V = \frac{f(E \times S)}{AC}$$

3.5.1 Vulnerability to Malaria

In this study, analysis of vulnerability to malaria are computed based on the addition of the E,S, and AC components using weighting method as shown in the following table.

Table 3.1 Vulnerability Computation to Malaria in Indonesia

VULNERABILITY		
Components	**Sub Component**	**Weight**
E: Exposure	Population density	0.06
S: Sensitivity	Annual Malaria Incidence (AMI) , 2008	0.32
	Level of population welfare	0.20
AC: Adaptive Capacity	Health Facility	0.20
	Percentage access to safe water	0.11
	Percentage access to sanitation facility	0.11

Figure 3.14 shows the map of vulnerability to malaria for 2008. It can be seen that regions with high and very high vulnerability to malaria are within the Papua territory and for a small area in Sulawesi and Nusa Tenggara islands.

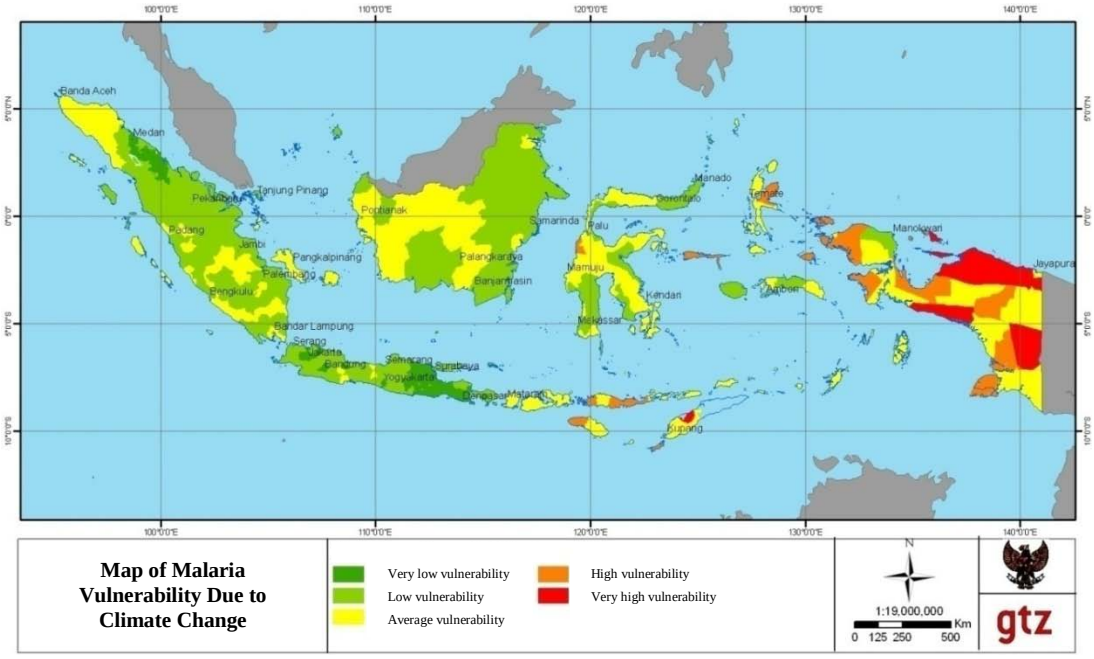

Figure 3.14 Map of Vulnerability to Malaria

For a few years, in several areas such as the NTT province, Purwerejo, and Sukabumi, *Anopheles vagus* mosquitoes were positive for malaria parasite, while some researches showed that *Anopheles vagus* prefer animal blood rather than human blood. It is therefore neccessary to do further research to find out the possibility of change of bionomics (Ministry of Health, RI 2008). This condition is in line with the above map that shows the spread of malaria, whereby those regions are shown to be the most vulnerable to this disease.

3.5.2 Vulnerability to Dengue Haemorrhagic Fever

Analysis of vulnerability to DHF was computed based on the additions of components E,S, and AC using weighting such as described in Table 3.2, as follows:

Table 3.2 Computation of Vulnerability to DHF in Indonesia

VULNERABILITY		
Components	**Sub Component**	**Weight**
E: Exposure	Population density	0.35
S: Sensitivity	Incidence Rate DHF, 2008	0.25
	Level of population welfare	0.17
AC: Adaptive Capacity	Health facility	0.11
	Percentage access to safe water	0.06
	Pecentage access to sanitation facility	0.06

Figure 3.15 shows the map of vulnerability to DHF in Indonesia. Regions with very high vulnerability to DHF are those in South Sumatera, East Java, and South Kalimantan. Other areas with high vulnerability are within the Lampung province, part of Java Island, East Kalimantan, Central Sulawesi, and Papua islands.

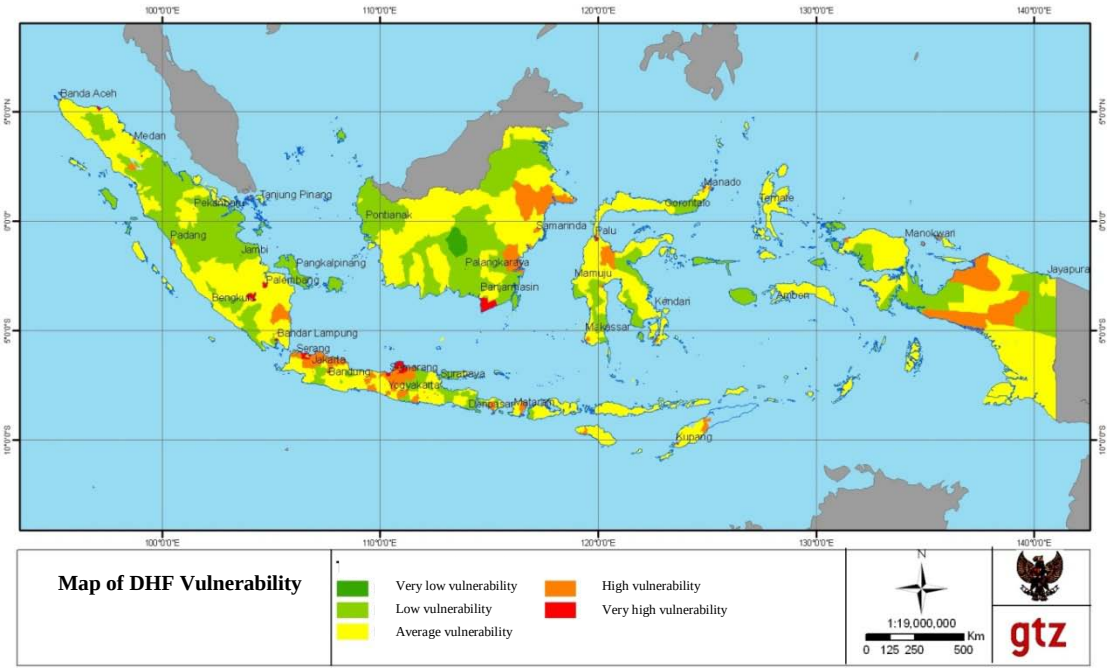

Figure 3.15 Map of Vulnerability to Dengue Haemorrhagic Fever

DHF vector transmitting the disease are the *Aedes aegypti* and *Aedes albopictus* as a potential vector, harbouring in clean water around the house. DHF are increasing in insidence at the start of a rainy season, i.e., between October-May. DHF had been transmitted

throughout Indonesia reaching the subdistricts and villages. Information from an entomologist working in the region of East Nusa Tenggara, mentioned that there is an indication of the mosquitoes to change their behaviour; i.e., they usually take a blood meal during the day, but presently, the *Aedes* also find their blood meal at night, neccessitating further observations to confirm the accuracy of the information (Ministry of Health RI, 2008).

3.5.3 Vunerabillity to Diarrhea

Analysis of vulnerability to Diarrhea are being computed based on additions of the E,S, and AC components with weighting method as shown in Table 3.3 as follows:

Table 3.3 Computation of Vulnerability to Diarrhea in Indonesia

VULNERABILITY		
Components	**Sub Component**	**Weight**
E: Exposure	Population density	0.04
S: Sensitivity	Incidence Rate Diarrhea, 2007	0.28
	Level of population welfare	0.19
	IMR	0.07
AC: Adaptation Capacity	Health facilities	0.19
	Precentage access to safe water	0.12
	Percentage access to sanitation facilities	0.12

Figure 3.16 shows a map of vulnerability to diarrhea in Indonesia. Regions with high vulnerability are spread in Sumatera, Kalimantan, Sulawesi, Nusa Tenggara, and Papua. Java Island shows low vulnerability, and in certain area, vulnerability are even very low. These conditions can be caused by the quality of the existing health services, and their health facilities which are quite good, and their quality of welfare, which already implement the pattern of hygienic and healthy living (PHBS).

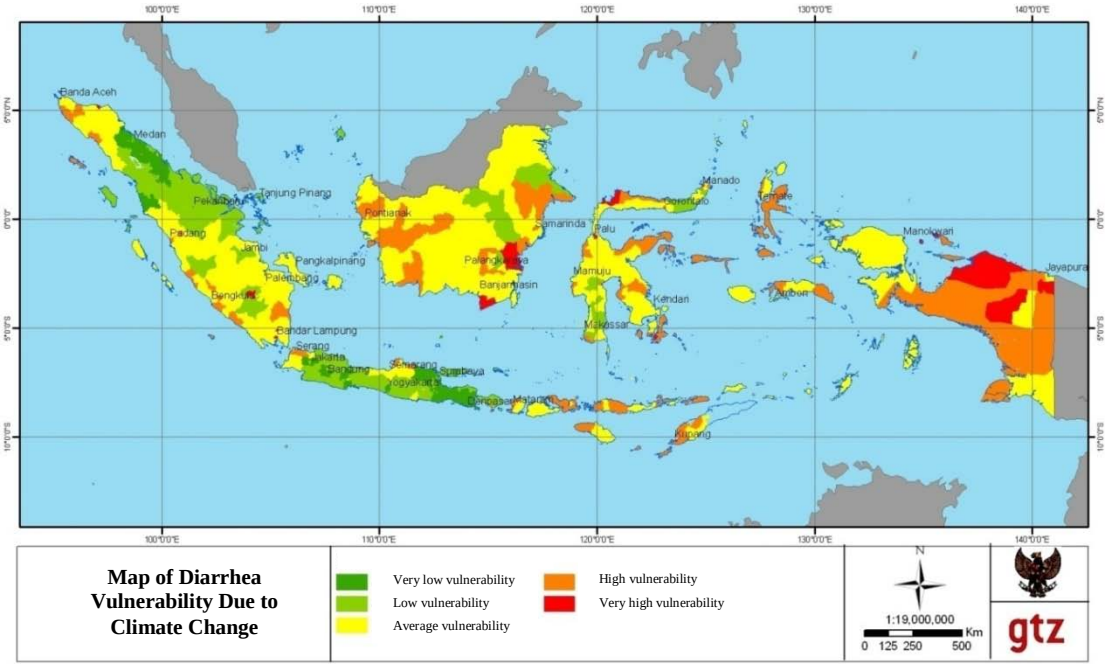

Figure 3.16 Map of Vunerability to Diarrhea

CHAPTER 4 RISK OF CLIMATE CHANGE TO THE HEALTH SECTOR

4.1 Understanding Risk to Climate Change

Risk can be defined as the potential loss caused by a disaster within a region and certain time period, and may take a form of death, injuries, pain, mental threat, insecurity, evacuation, damage and loss of belongings, and interruption of community activities (UN ISDR, 2004). In other words, risk is a function of probability and hazard characteristic and also human vulnerability to impact. Mathematically, risk (R) can be written as follows:

$$R = H \, x \, V$$

where H = hazard or danger, and V = vulnerability (UN ISDR, 2004). The understanding and equation of hazard has already been explained in Chapter 2 and vulnerability in Chapter 3.

4.2 Calculation Result of Climate Change Risk

To understand risk, qualitatively or quantitatively, risk processing to climate change has been done using a process flow in Figure 4.1. Next, with the available spatial data, we can draw a map or spatial information of hazard, vulnerability, and risk, forming a map of hazard, vulnerability, and risk. But, this study has a limited discussion scope.

Overall, health risk analysis due to climate change consists of risk to (1) hazard due to increasing frequency of extreme climate (flood, landslide, storm), (2) malnutrition due to disturbance in agriculture and fishery, and (3) the changing disease pattern due to environmental and vector change. But, as explained in Chapter 2, in this study, risk analysis related to extreme climate and malnutrition are not calculated due to limited data.

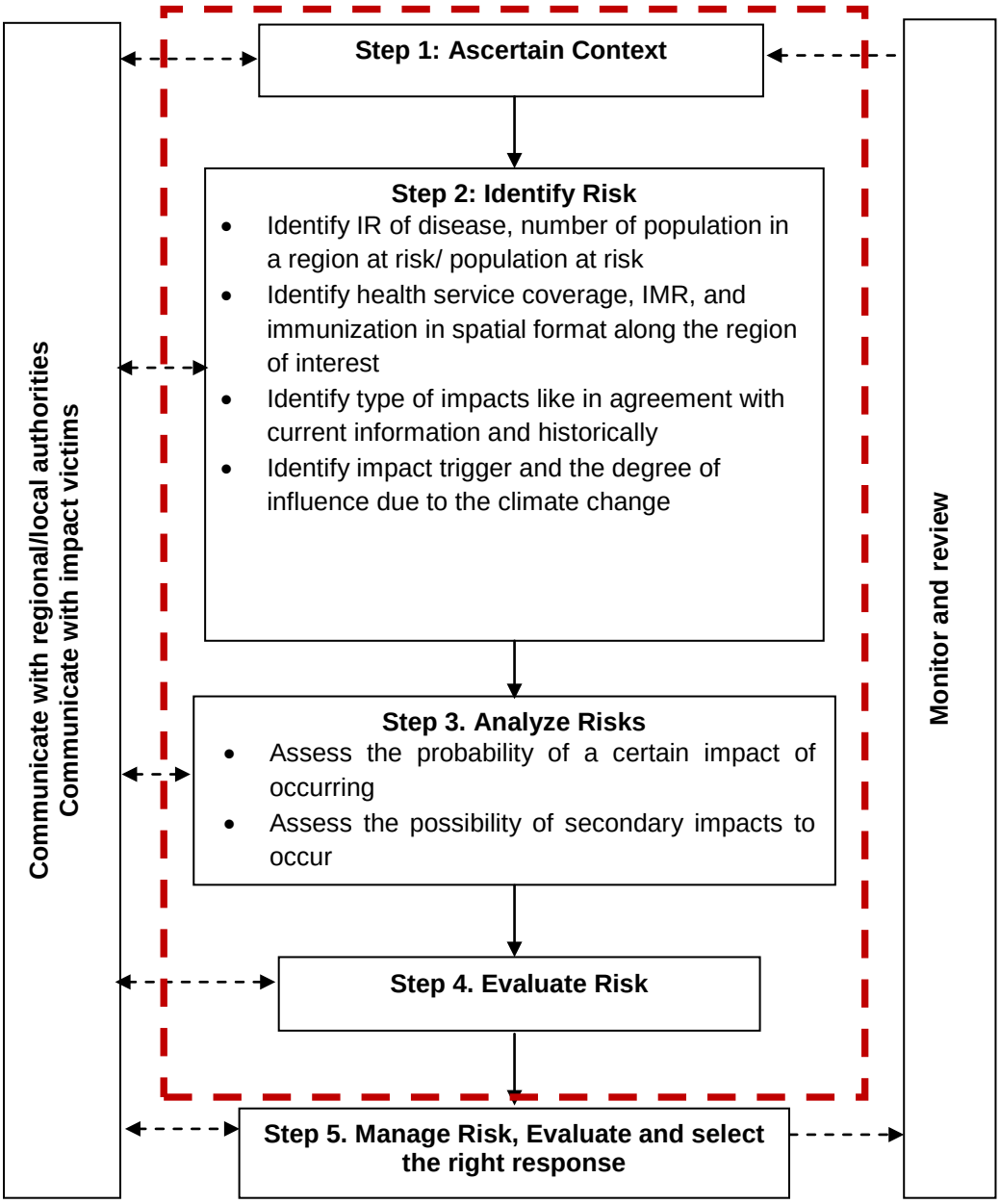

Figure 4.1 The Process of Risk Assessment

Note :

Discussed in this report

In this study, we have only done disease risk analysis due to changing vector and environmental spread pattern related to climate change. Due to unavailable national vector spread data, we used incidence rate data as vector spread proxy. In this study, we chose malaria, DHF, and diarrhea due to its high incidence in Indonesia and very related

to climate change. By using Geographic Information System (GIS), risk result calculation is shown in the form of spatial data, which are Figure 4.2 for malaria risk, Figure 4.3 for DHF risk, and Figure 4.4 for diarrhea risk.

4.2.1 Malaria Risk

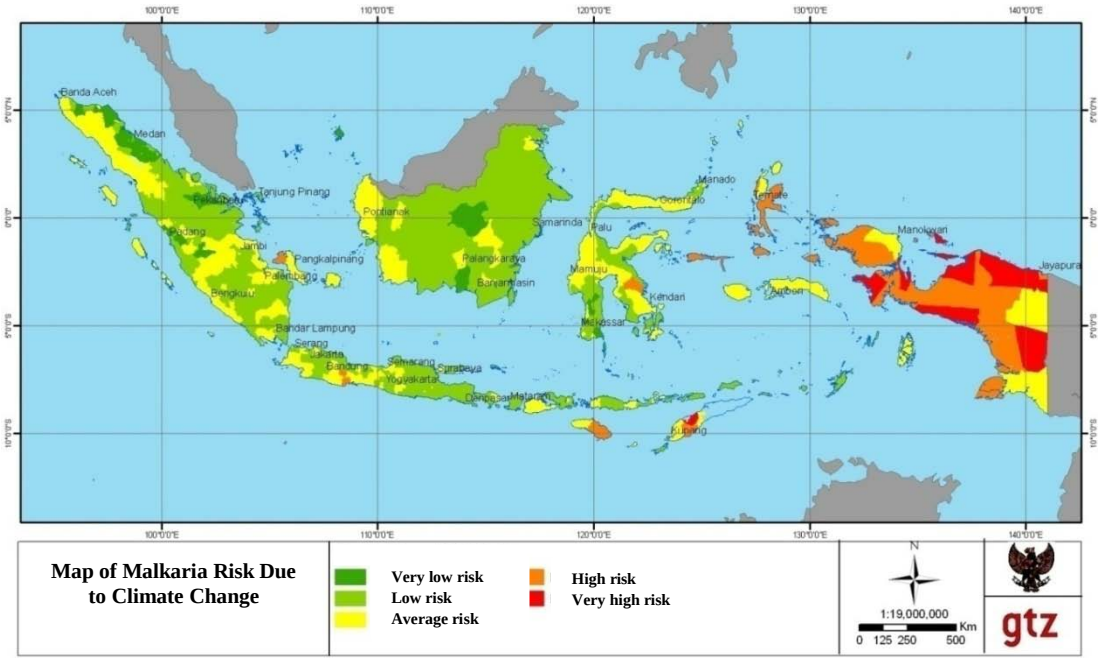

Figure 4.2 Risks of Climate Change Impact to IR of Malaria

Analysis of risk values for IR malaria due to climate change in Indonesia shows that the region having very high risk to malaria being the Papua islands. This is in line with the hazard potentials influencing the IR of malaria, i.e., maximum rainfall pancaroba on those islands ranging about 450-500 mm. The high rainfall (above normal), and unstable change of weather, supports the rapidity of malaria vector breeding, i.e., the *Anopheles* mosquitoes. The risk values are also determined by the vulnerability of the population, where in Papua, most of the population are still living in poverty *(keluarga Pra-sejahtera, Sejahtera I)* causing the low ability in providing health services, and the inability to fullfil requirement for good nutritional status, causing high vulnerability to become infected with malaria.

Other region having high risk to suffer from malaria, are the Maluku islands, a small part of Sulawesi, and Nusa Tenggara islands.

4.2.2 DHF Risk

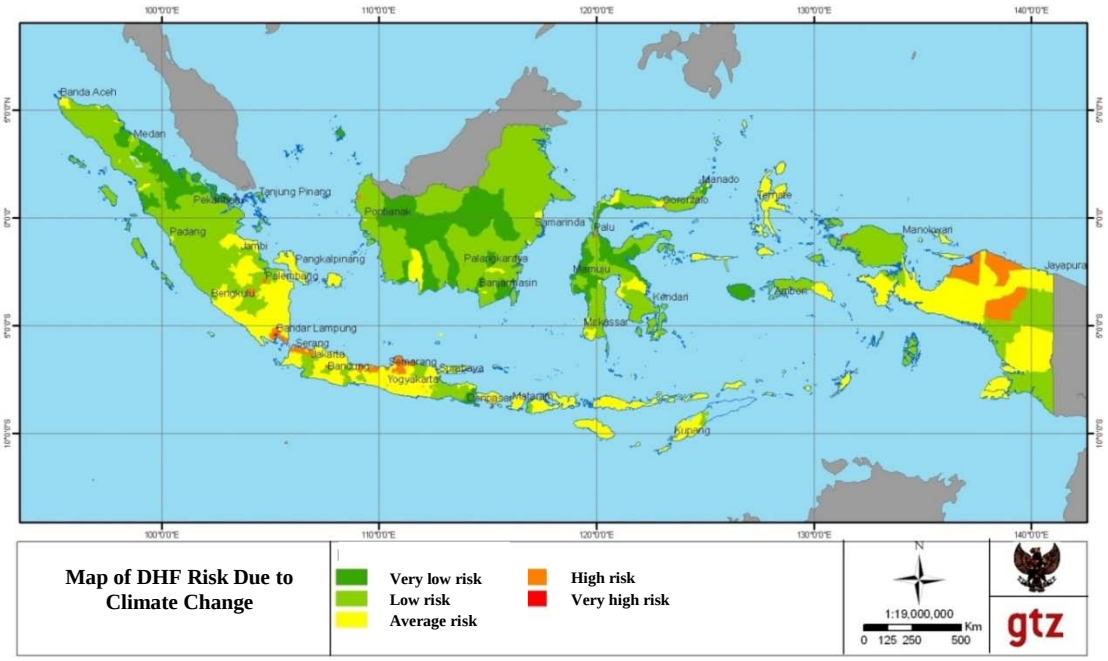

Figure 4.3 Risk of Climate Change Impacts to Dengue Haemorrhagic Fever

Figure 4.3 shows risk projections for DHF, it can be seen that regions having high and medium risks are found to be concentrated in the eastern region of Indonesia, especially Papua Island, and part of Nusa Tenggara islands. Some cities and districts on Java Island have low risks to DHF.

4.2.3 Diarrhea Risk

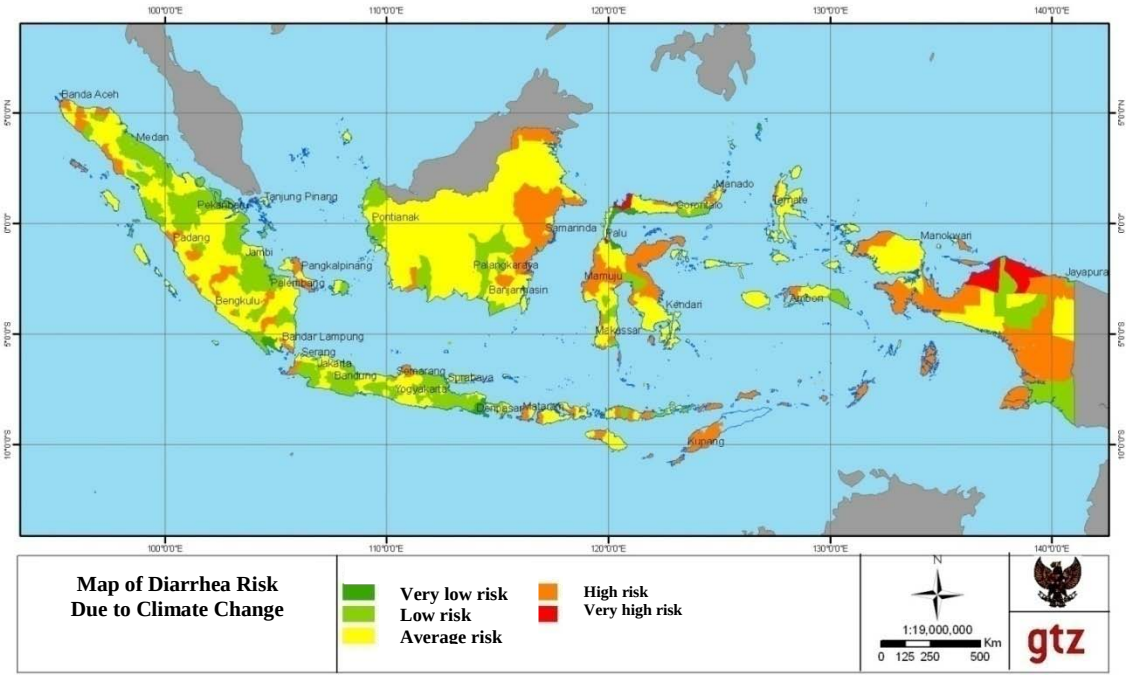

Figure 4.4 Risk of Impacts Due to Climate Change to IR of Diarrhea

Analysis and risk assessment of climate change impacts to IR of diarrhea in Indonesia shows that regions having very high risks are all located on the Papua islands. Part of Sumatera, Kalimantan, Sulawesi, and Nusa Tenggara have high risk to IR of diarrhea. These conditions are being supported by the potential hazard of flooding, droughts, and decrease of water availability in those regions.

Besides spatial analysis, calculation result of malaria, DHF, and diarrhea risk for every district in Indonesia are shown in detail in the risk table in Appendix D. As an example, risk calculation result for Nangroe Aceh Darussalam (NAD) and Papua are shown in Table 4.2 and 4.2. The risk value has been normalized within the range of 0-1, with 0 being the lowest risk and 1 being the highest risk.

As seen in Table 4.1, a number of districts in NAD have high diarrhea risk. Different with NAD, a number of districts in Papua have high and very high risk (Table 4.2).

Table 4.1 Malaria, Diarrhea, and DHF Risk to Climate Change in Nanggroe Aceh Darussalam (NAD)

DISTRICT	Malaria		Diarrhea		DHF	
	Value	Risk	Value	Risk	Value	Risk
SIMEULUE	0.54	intermediate	0.66	high	0.25	low
ACEH SINGKIL	0.40	low	0.70	high	0.23	low
ACEH SELATAN	0.43	intermediate	0.70	high	0.31	low
ACEH TENGGARA	0.19	very low	0.56	intermediate	0.22	low
ACEH TIMUR	0.21	low	0.60	high	0.25	low
ACEH TENGAH	0.17	very low	0.62	high	0.18	very low
ACEH BARAT	0.37	low	0.69	high	0.26	low
ACEH BESAR	0.40	low	0.68	high	0.39	low
PIDIE	0.41	intermediate	0.66	high	0.33	low
BIREUEN	0.21	low	0.63	high	0.25	low
ACEH UTARA	0.23	low	0.76	high	0.28	low
ACEH BARAT DAYA	0.46	intermediate	0.45	intermediate	0.32	low
GAYO LUES	0.20	very low	0.63	high	0.16	very low
ACEH TAMIANG	0.21	low	0.60	intermediate	0.28	low
NAGAN RAYA	0.37	low	0.18	very low	0.28	low
ACEH JAYA	0.46	intermediate	0.51	intermediate	0.25	low
BENER MERIAH	0.17	very low	0.24	low	0.11	very low
PIDIE JAYA	0.23	low	0.74	high	0.27	low
KOTA BANDA ACEH	0.34	low	0.71	high	0.75	high
KOTA SABANG	0.44	intermediate	0.23	low	0.25	low
KOTA LANGSA	0.21	low	0.25	low	0.25	low
KOTA LHOKSEUMAWE	0.19	very low	0.63	high	0.50	intermediate
KOTA SUBULUSSALAM	0.42	intermediate	0.62	high	0.25	low

Table 4.2 Malaria, Diarrhea, and DHF Risk Due to Climate Change in Papua

DISTRICT	Malaria		Diarrhea		DHF	
	Value	Risk	Value	Risk	Value	Risk
MERAUKE	0.19	very low	0.24	low	0.11	very low
JAYAWIJAYA	0.71	high	0.15	very low	0.41	intermediate
JAYAPURA	0.82	very high	0.82	very high	0.19	very low
NABIRE	0.58	intermediate	0.69	high	0.19	very low
YAPEN WAROPEN	0.88	very high	0.67	high	0.29	low
BIAK NUMFOR	0.82	very high	0.70	high	0.27	low
PANIAI	0.48	intermediate	0.29	low	0.20	low
PUNCAK JAYA	0.51	intermediate	0.08	very low	0.24	low
MIMIKA	0.84	very high	0.36	low	0.40	low
BOVEN DIGOEL	0.81	very high	0.73	high	0.20	very low
MAPPI	0.59	intermediate	0.73	high	0.20	low
ASMAT	0.50	intermediate	0.59	intermediate	0.41	intermediate
YAHUKIMO	0.35	low	0.69	high	0.10	very low
PEGUNUNGAN BINTANG	0.36	low	0.44	intermediate	0.09	very low
TOLIKARA	0.44	intermediate	0.43	intermediate	0.23	low
SARMI	0.60	high	0.20	low	0.42	intermediate
KEEROM	0.97	very high	0.57	intermediate	0.22	low
WAROPEN	1.00	very high	0.77	high	0.32	low
SUPIORI	0.83	very high	0.76	high	0.32	low
MAMBERAMO RAYA	0.83	very high	0.08	very low	0.25	low
KOTA JAYAPURA	0.47	intermediate	0.17	very low	0.28	low

4.3 Risk Reducing Activities

Risk information as discussed in Chapter 4.2 is very important because it can increase society's and government's awareness to risk. Society becomes more vulnerable when they didn't know to threatening hazard on their health and life. Besides, accurate data

and information on hazard, vulnerable, and risk will help equating society's and government's perception to risk in their environment.

Risk information as discussed in Chapter 4.2 is a considerable material in determining urgent management and early warning system. Besides, risk identification and impact study could be used as a tool to (1) increasing societies and government's awareness, (2) knowledge development, (3) political commitment, such as policy and law making and organization development. Political commitment is the basis in implementing risk reducing acts such as (a) repairing environmental management towards a better one, (b) steps to develop social and economy, such as poverty reduction activities, repairing work, small industry financing mechanism, increasing health service, increasing agriculture immunity to disaster, etc., (c) physical and technical activities such as repairing land use and city planning, and protecting important facility. Overall, risk reduction scheme related to hazard and vulnerability can be seen in Figure 4.5.

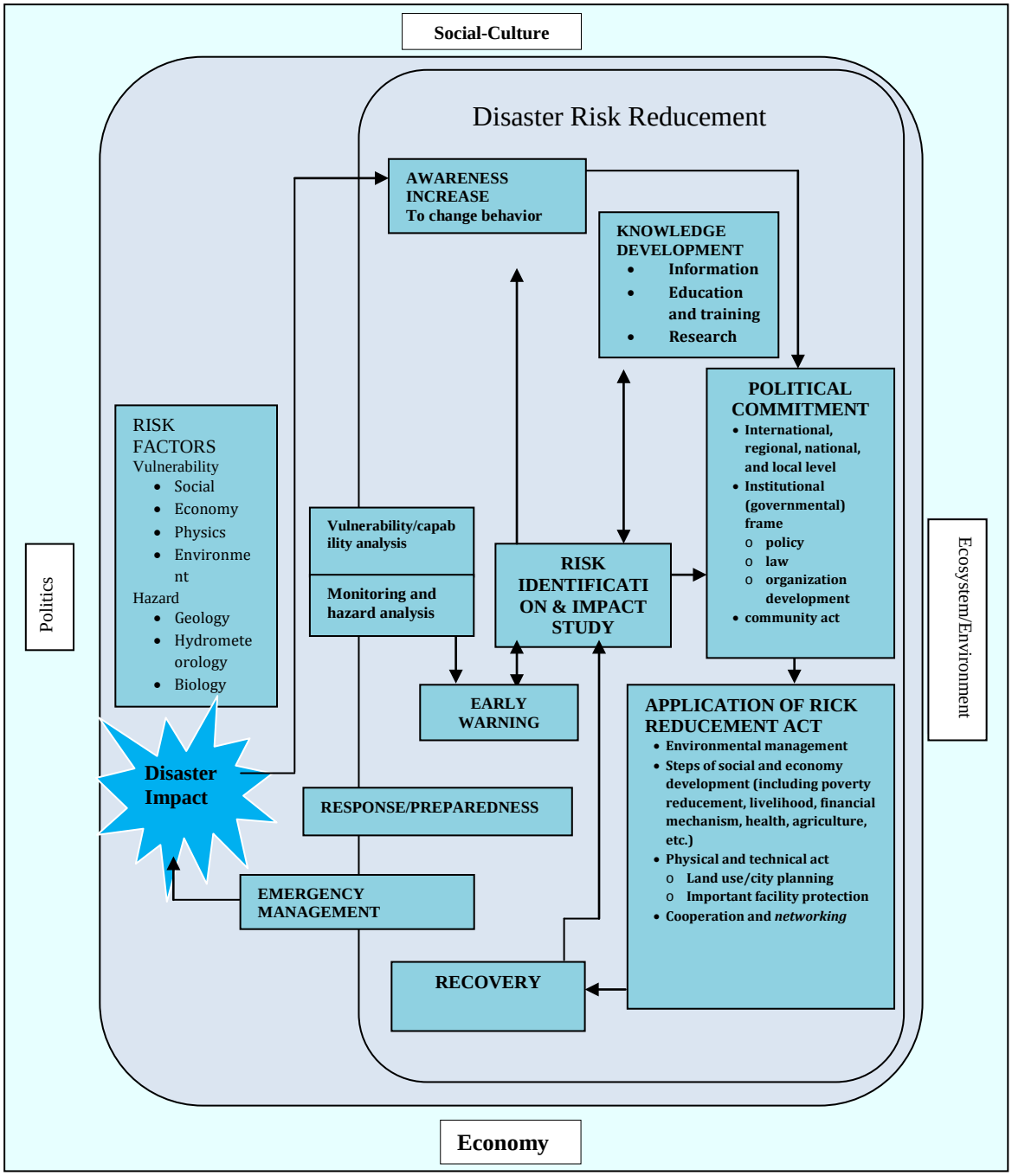

Figure 4.5 Scheme of Risk Reduction Related to Hazard and Vulnerability (modified from UN ISDR, 2004)

Besides government, health risk reduction activity related to climate change can also be done by individual and community institution (society's independent organization). Individual, government and institution can share their role to achieve a good risk reduction. In general, role division between individual, government, and society's institution can be seen in Table 4.3. This risk reduction activities is part of health sector climate change adaptation program that in general will be discussed in Chapter 5.

Table 4.3 Role Sharing between individual, government and institution in reducing health risk related to climate change

Stakeholders	**Steps in reducing exposure**	**Steps in reducing and handling disease and mortality**
Extreme climate event (flood, landslide, storm)		
Individual	Information response on extreme climate event related to climate change Follow emergency response policy	Follow policy for as long and after extreme climate event (such as evacuation during disaster) Search for drugs if necessery
Central and local government	Preparing scientific and technical guide to standardized infrastructure and development Obey infrastructure and development standard Testing early warning system and response paln before disaster Enact emergency response education	Develop policy and law supported by scientific and technical analysis for early warning system and emergency response plan, including the right individual act Implementing early warning system and emergency response plan
LSM and others	Important role in emergency response and assist during disaster	Education and training related to risk from extreme weather event
Vector-borne diseases		
Individual	Reduce exposure from infected vector, including preventing vector breeding	Vaccination for diseases potential in infecting individual health

Stakeholders	**Steps in reducing exposure**	**Steps in reducing and handling disease and mortality**
	around settlement	Search for cure if necessary
Central and local government	Preparing scientific and technical guide and stake holders in early warning system Preparing control and monitoring program of effective vector and patogen Spread information on individual behavior to prevent vector exposure	Sponsorizing research and development of vaccine and other preventive acts Sponsorizing research and development of diagnostic with high rate Sponsorizing research and develop treatment options Spread information on signs of disease to help individual in search of treatment Provide cheap vaccination for those vulnerable to exposure
Water-borne food-borne disease		
Individual	Obey policy to drink water from clean water sources Obey policy to cook food	Search for medication if necessary
Central and local government	Develop and implement laws on safe drinking water	Sponsorizing research and development of high velocity diagnostic for water and food borne diseases and its medication

Stakeholders	**Steps in reducing exposure**	**Steps in reducing and handling disease and mortality**
		Spread information on signs of disease to help individual in search of treatment
Disease related to air pollution		
Individual	Obey suggestion on good behavior when surface ozone concentration is high	For individual with certain respiratory disease, must obey health suggestion during high air pollution Search for medication if necessary
Central and local government	Develop and enact laws on air pollution	Develop policy and stakeholders scientificially and technically for early warning system Enact education on exposure risk from air pollution Sponsorizing research and development of medication options

CHAPTER 5 DIRECTIONS AND PHASES OF FUTURE INTEGRATION OF ADAPTATION TO CLIMATE CHANGE INTO NATIONAL PLANNING OF THE HEALTH SECTOR

5.1 Recommendations and Problems for Alternative Strategy Adaptation

As discussed in Chapter 2, we can conclude that health sector problems related to climate change in Indonesia are

- Problems due to direct impact of climate change
  Climate change can increase extreme climate events that cause landslides, floods, and storms. These disasters can cause morbidity and mortality
- Problems due to indirect impact of climate change
  Climate change could affect environment such as (1) drought and flood which could cause harvest failure and malnutrition, (2) disease vector change which could widen infectious disease spread, and (3) worsening air quality which could cause various diseases.

Problems become more complex because of the low adaptive capacity of Indonesia's society. Low adaptive capacity includes health status disparity (gap between rich and poor), disease's double burden (society suffer both infectious disease and uninfectious disease), limited facility and health service, limited clean water and sanitation facilities and PHBS (clean and healthy lifestyle) which is still not fully implemented.

Basically, this health sector roadmap is formulated to overcome the above problems. The process of making this roadmap is generally done by doing FGD (Focus Group Discussion) with Department of Health and Bappenas. Several important recommendations to develop alternative strategy for adaptation to climate change in the health sector are as follows:

- Strengthen the vulnerability and risk assessment methodology in the health sector due to climate change,
- Develop a framework for policy development supported by needed decrees and regulations.
- Develop planning and decision making methodology based on local/regional evidences,

- Improve inter-sectoral collaboration and partnerships
- Improve community participation, including private, and higher education institutions /academics,
- Strengthen the capability of local governments,
- Develop networking and sharing of information,
- Strengthen early warning system and emergency response at the community level institutions institutions.

5.2 Program Phases for Adaptation in the Health Sector

Health sector climate change adaptation program is made by following Life Cycle Analysis (LCA) because life cycle analysis can provide as a guide to systematically produce the neede program. In LCA, the ultimate objective for all region can then be stated in the form of a concept and/or policy statement, thus the results should then be applied in each respective region. The steps to conduct life cycle analysis are as follows:

- Synthesis
- Analysis
- Design of Program
- Implementation of Program
- Maintenance
- Monitoring, Evaluation
- Review of Program
- Program Improvement
- Sustainability of Program, .etc.

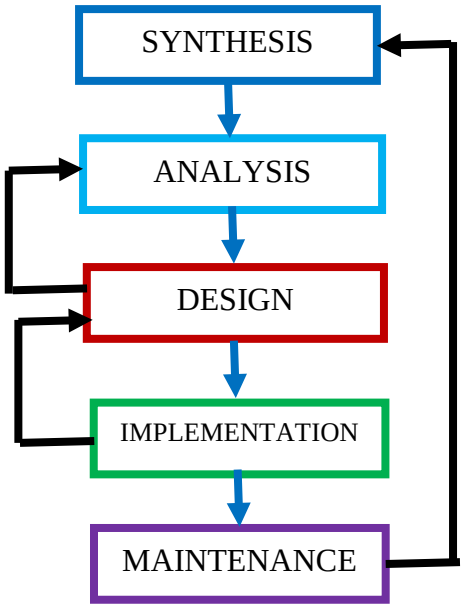

Figure 5.1 The Process of Planning, Design, and Implementation of Health Program due to Climate Change

(Modified from Environmental LCA, Curran, Mary Ann, 1996)

As can be seen in the above figure, planning of a program in general can not be done perfectly all at once. If problems arise in the design and/or the implementation phases, then these problems should be fed back into the system, such that the program could be improved. The above steps of planning should then be incorporated within the phases of programs development. Within each development phase, the activities should be stressed on a certain aspect of this life cycle analysis.

Due to the urgency of the climate change situation, the process in program development should therefore be done rapidly, correctly, specifically. Priorities of program development for each region can also be understood that it would be different. The difference of characteristic of the many islands in Indonesia, need a more specific program for each region, based on its need. A dangerous environment due to climate change will also be different. As well as vulnerability, sensitivity, adaptation ability, and development barriers that are also different. So, different program strategy needs to be implemented. Even so, general steps to be taken in all regions should be in line with the life cycle analysis.

Strategy and program in the health sector, for adaptation to climate change, for the period of coming 20 years (2010-2029) are devided into four periods, starting with the first period of 2010 up to 2014.

Implementation target of the first step should be the same for all region, i.e., statement of the outcome at the end of the last period should be:

- stable and consistent with program implementation,
- achieving good adaptive capacity, lowered vulnerability, decreased risks, increased welfare, independent in program adaptation and hazards management,
- well prepared should any kind of emergency occur.

These programs are based on the recommendations and suggestions from health experts and other sectors related to climate change. This program has been discussed several times in the FGD (Focus Group Discussion) which was attended by various stakeholders related to the health sector in climate change adaptation efforts.

In general, health adaptation program is going through phases as follow:

Period	Program Phase
2010-2014	Preparation Phase: data inventory, existing condition analysis, and choosing appropriate alternative method
2015-2019	Implementation Phase: management, monitoring, maintenance, and evaluation of all programs
2020-2024	Implementation Stability Phase: consistent and stable program implementation management, effective Monitoring and evaluation, and sustainable fixing
2024-2029	Implementation Stability Phase: monitoring, evaluation, and development of current program capacity

5.3 Health Program Phase, Period 2010-2014

As explained in Figure 5.1, the program follows LCA flow which are synthesis, analysis, design, implementation, and maintenance. In the first phase (2010-2014), the main program determined for each region, might be different from one another, depending on the existing hazards, risks, vulnerability, sensitivity and contraints, limitation, available resources existing within each region. Hence the first step in the preparation phase is to

develop the objective to be accomplished at the end of the year 2014, which can be done if self evaluation can be accomplished in each region.

Each region will have to list all factors mentioned above and prioritized what so ever that should be controlled first. A cost-benefit analysis could be done in case of difficulty to decide on priority of programs. As was previously discussed, that each region had different health problems, different capacity to develop, different hazards to overcome.

Other important activity that should conducted is to do inventory of existing regulations that would support all activities required to adapt to climate change. Should there be found, that some new regulation are needed, then this activity should also be conducted within this first phase.

The resulting inventory data should be reported and recorded, the presentations of data could be in any kind of format, like maps or tables, depending on available software, hardware, manpower etc. The most important is that the data will become information for the stakeholders, in order that further analysis could be done.

The second step would be a step to analyze the existing conditions as the continuation of inventory activity, and try to develop alternative methods that could be used to accomplish the stated objectives for each region. This second step would be to find the methods and approaches that would become the strategic ways to accomplish the objectives. It could for instance be, epidemiologic studies, strategic method for vector control, for health services improvement, for hazards prevention and control, for control of most prevalent diseases, or strategic method for manpower development, etc. Hence, this analysis phase is important to find the best methods to be used, that is realistic and specific within the existing conditions to accomplish the stated objectives.

The result of this analysis stage would then be, for all region,

- to find strategic methods, to be used to reach the objectives effectively.
- all needed facilities, input data needed, soft-ware, and hard-ware should already be purchased,
- data base management, management information system, training materials developed, emergency response plan should also be well developed, and

- organization for implementation should already be developed, including inter-sectoral collaborations, networking, coordinations, communications, etc.

The third step in this first phase would be as follows:

- To finalyze programs that should be accomplished within each region, and prepare for implementation of the programs.
- Socializations of progams,
- Training of manpower needed for implementation, which could be technicians for vector monitoring, professionals to assess hazards, to prepare materials for training and provide the actual training sessions, operator of system, data input personnel, financial support, community participations, emergency response, etc.
- Training is a very important activity for the preparation of implementation of programs. It can be referred to as advocacy, non-pharmaceutical prevention, etc. but the central point being training community in many different aspects, such as:
    - Emergency response for prevention of disease outbreaks, such as vector-borne, water-food-borne diseases.
    - Training to conduct continuous lowering of risks, vulnerabilities, sensitivities, and to be able to adapt to climate change.
    - Training could also be conducted for the detection, early disease symptoms, early reporting and early treatment of diseases,
    - Training in communication, and team work,
    - Training in appropriate technology, construction of infrastructure, such as low-cost water-supply and sanitation affordable to the existing, not only to be able to construct, but more importantly how to use them hygienically,
    - Training to participate in organizations for program implementations
- Monitoring and evaluation of the system/program evaluation should also be made ready.

It can be summarized that the program adaptation in health sector for the period of 2010-2014 is the preparation phase, which is to prepare the community within each

region to adapt to climate change by controling hazards, lowering risks, lowering vulnerability and sensitivity and improve adaptive capacity.

Here is a proposed program for the year 2010-2014:

- Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the national and provincial levels.
- Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases.
- Studies of climate change impacts to food security and malnutrition.
- Preparation and update of database, information system, and community health profile.
- Develop regulations that would support actions for adaptation to climate change in the health sector.
- Inventory and promulgations of needed regulations to support and create preventive environment in management of disease.
- Strengthening public health policies for development based on community health.
- Socialization of climate change adaptation strategies for the whole range of legislative and local and central governments to build commitment to the establishment and implementation of action plans.
- Develop appropriate technology for sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization
- Strengthening health system as response to climate change.
- Develop network internally within the Ministry of Health, and inter-sectoral with private institutions, and NGO's
- Establish working group on impacts of climate change at the central, provincial, and district/city levels.
- Increase financial support, materials, and facilities for the support of disease control programs.
- Strengthening monitoring and evaluation system, surveillance, and health information system of climate change.

5.4 Health Program Phase, Period 2015-2019

This second phase (2015-2019) is the implementation phase for program adaptation to climate change in the health sector. All programs developed within each region should be started and monitored. Should there be problems encountered within this phase, then the analysis phase should be re-examined and improvement be made.

The most important actions within this phase would be the management, control, maintenance, and monitoring and evaluation of all programs. Other activities would among others be as follows:

- Analysis of monitoring and evaluation data, review programs, find improvement needed, prepare the needed action plan for improvement, and
- When all goes well, identify other next priorities, and need, go through the life cycle analysis again to develop new programs

In detail, the programs proposed are as follows:

- Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of climate change impacts towards health at city and district levels.
- Model developement of integrated health sector adaptation at the city/district levels
- Updating database, information system and Health profile
- Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector.
- Preparedness for an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation.
- Improve community participations through continuous socialization.
- Strengthen surveillance of vectors ; environmental risk factors and adaptation of infrastructure planning at all levels.
- Strengthening management programs, (case detection, treatment,prevention, and risk factor control)
- Stengthening management information system for climate change /SIM-PI
- Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program

- Intensify control programs before transmission period to prevent outbreaks.
- Improve network of the Ministry of Health and inter sectoral with private institutions and NGO's
- Improve international collaborations for the efforts to adapt to climate change
- Increase support in terms of funds, materials, facilities, for disease control.
- Strengthening monitoring and evaluation system, surveillance, and health information system of climate change.
- Implement healthy housing technology adaptive to climate change

5.5 Health Program Phase, Period 2020-2024

At this phase, the community are expected to be ready to face climate change impacts in the health sector, management and implementation of programs are consistent, health condition is stable if not improving, monitoring and evaluation are effective, continuous improvement is well in place. Expected in this phase:

- Adaptive capacity should be improved
- Vulnerability decreased
- Sensitivity decreased
- Hazards well managed
- Emergency response effective
- Disease well controlled,etc

At this stage the community is expected to be ready to face the impact of climate change on the health sector so that programs proposed will focus more on the implementation of programs that have been planned in the previous stage and begin their control by monitoring and evaluation so that the programs planned will run effectively. Activities at this stage include:

- Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels.
- Updating database, information system and Health profile
- Improve community participation, especially in the prevention activities for environmental sanitation.

- Development of preparedness for an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation.
- Improve community participations through continual socialization.
- Increase the capacity of management information system of ckimate change.
- Use of integrated database GIS online to support information system and community health profile
- Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at the local level.
- Increase support of funds, materials, facilities to support disease control program.
- Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change.
- Improve international collaborations for the efforts to adapt to climate change
- Improve network of the Ministry of Health and inter sectoral with private institutions and NGO's
- Evaluation of healthy housing technology adaptive to climate change

5.6 Health Program Phase, Period 2025-2029

Within this phase, the community is expected to be able to work independently, and is conditioned to adapt to impacts of climate change in the health sector. Programs at this phase are focussed on supervision, evaluation, and capacity development of the previous programs. Programs proposed at this phase are mainly maintenance, supervisions, re-training, monitoring-evaluation, review-improvements, etc. Here are the details of the programs proposed in this stage:

- Updating database, information system and Health profile
- Evaluate health resources, organization & coordination of reform, making legislation.
- Improve community participations through continual socialization.
- Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning.
- Improve and strengthen surveillance of vectors ; environmental risk factors & disease , and adaptation of infrastructure planning at all levels.

- Improve and strengthen health services sytem integrated with demographic consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage
- Increase support of funds, materials, facilities to support disease control program.
- Improve international collaborations for the efforts to adapt to climate change.
- Improve use of integrated database GIS online to support information system and community health profile.
- Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change.
- Evaluation of healthy housing technology adaptive to climate change.

RECOMMENDED STRATEGY FOR ADAPTATION TO CLIMATE CHANGE HEALTH SECTOR AT NATIONAL LEVEL

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2025 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Indonesia region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon in trofosfer,) due to temperature increase.	- Topography in form of mountainous areas, in Indonesia become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Indonesia will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Indonesia. - Main cities are located at coastal areas with	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of water-borne diseases agents will increase outbreak of	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations - Improve participations among	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the national levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases. - Studies of climate change impacts to food security and	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at national levels. - Model developemet of integrated health sector adaptation at national levels - Updating database, information system and Health profile	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Updating database, information system and Health profile Planning & Policy, Regulation and Development Institutions:	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2025 – 2029**
- Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Indonesia have a low social economic and education status, level of welfare and capacity for adaptation for north and south Sumatera classified as medium. - Part of the population has not been praticing to live healthily and	finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Indonesia. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and filariasis) will change with the change of land use, micro	communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create preventive environment in management of	Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve	- Improve community participation, especially in the prevention activities for environmental sanitation. - Development of preparedness for an epidemy / pandemy through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation :	Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of infrastructure planning at all levels.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2025 – 2029
	hygienically. - Part of Indonesia has limited health services. - Part of the population in Indonesia have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts are still limited. - Lack of data on health conditions availability,	climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of temperature of 2-3ºC will increase the number of morbidity		disease. - Strengthening public health policies for development based on community health. - Socialization of climate change adaptation strategy for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation : - Develop appropriate technology for sanitation, including	community participations through continual socialization. Planning&Implementation, and monitoring-evaluation: - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention, and risk factor	- Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at the local level. - Increase support of funds, materials, facilities to support	- Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support disease control program.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2025 – 2029**
	are in line with population growth	of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in marshy areas and mangrove can cause distribution pattern		strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels. - Increase financioal support materials, facilities for the	control) - Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of	disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private institutions and NGO's - Evaluation of healthy housing	- Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate change

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2025 – 2029**
		of vectors to change		support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at national level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	health and inter sector with private institutions and NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	technology adaptive to climate change	

RECOMMENDED STRATEGY FOR ADAPTATION TO CLIMATE CHANGE HEALTH SECTOR AT REGIONAL LEVEL

1.SUMATERA ISLAND AND ITS SURROUNDING

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2026 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Sumatera region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon in trofosfer,) due to	- Topography in form of mountainous areas, in Sumatera become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Sumatera will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Sumatera.	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of water-borne diseases	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the regional levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases. - Studies of climate	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at regional levels. - Model developemet of integrated health sector adaptation at regional levels - Updating database, information system	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels. - Updating database, information system and Health profile Planning & Policy, Regulation and Development	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2026 – 2029**
temperature increase. - Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	- Main cities are located at coastal areas with insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Sumatera have a low social economic and education status, level of welfare and capacity for adaptation for north and south Sumatera classified as medium. - Part of the population	agents will increase outbreak of finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Sumatera. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and filariasis) will change	- Improve participations among communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	change impacts to food security and malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create preventive	and Health profile Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation.	Institutions: - Improve community participation, especially in the prevention activities for environmental sanitation. - Development of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization. Planning &	continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of infrastructure

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2026 – 2029
	has not been praticing to live healthily and hygienically. - Part of Indonesia has limited health services. - Part of the population in Sumatera have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts are still limited.	with the change of land use, micro climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of temperature of 2-3ºC		environment in management of disease. - Strengthening public health policies for development based on community health. - Socialization strategy to indigenous to climate change for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation : - Develop appropriate	- Improve community participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention , and risk factor control)	Implementation, and Monitoring-Evaluation : - Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at the local level.	planning at all levels. - Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support disease control

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2026 – 2029**
	- Lack of data on health conditions availability, are in line with population growth	will increase the number of morbidity of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in marshy areas and		technology for sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels. - Increase financioal	- Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of health and inter sector with private	- Increase support of funds, materials, facilities to support disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private institutions and	program. - Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate change.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2026 – 2029**
		mangrove can cause distribution pattern of vectors to change		support materials, facilities for the support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at regional level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	institutions and NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	NGO's - Evaluation of healthy housing technology adaptive to climate change	

2.JAVA, BALI, AND MADURA ISLANDS

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2027 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Java, Bali, Madura region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon	- Topography in form of mountainous areas, in Java, Bali, Madura become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Java, Bali, Madura will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Java, Bali, Madura.	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the regional levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases.	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at regional levels. - Model developemet of integrated health sector adaptation at regional levels - Updating database,	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels. - Updating database, information system and Health profile Planning & Policy, Regulation and	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2027 – 2029**
in trofosfer,) due to temperature increase. - Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	- Main cities are located at coastal areas with insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Java, Bali, Madura have a low social economic and education status, level of welfare and capacity for adaptation for north and south Java, Bali, Madura classified as medium.	water-borne diseases agents will increase outbreak of finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Java, Bali, Madura. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and	- Improve participations among communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	- Studies of climate change impacts to food security and malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create	information system and Health profile Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation.	Development Institutions: - Improve community participation, especially in the prevention activities for environmental sanitation. - Development of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization.	participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2027 – 2029
	- Part of the population has not been praticing to live healthily and hygienically. - Part of Indonesia has limited health services. - Part of the population in Java, Bali, Madura have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts	filariasis) will change with the change of land use, micro climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of		preventive environment in management of disease. - Strengthening public health policies for development based on community health. - Socialization strategy to indigenous to climate change for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation :	- Improve community participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention , and risk factor	Planning & Implementation, and Monitoring-Evaluation : - Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at	infrastructure planning at all levels. - Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2027 – 2029**
	are still limited. - Lack of data on health conditions availability, are in line with population growth	temperature of 2-3ºC will increase the number of morbidity of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in		- Develop appropriate technology for sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels.	control) - Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of health and inter	the local level. - Increase support of funds, materials, facilities to support disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private	disease control program. - Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2027 – 2029**
		marshy areas and mangrove can cause distribution pattern of vectors to change		- Increase financioal support materials, facilities for the support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at regional level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	sector with private institutions and NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	institutions and NGO's - Evaluation of healthy housing technology adaptive to climate change	change.

3. KALIMANTAN ISLAND

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2028 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Kalimantan region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon in trofosfer,) due to temperature	- Topography in form of mountainous areas, in Kalimantan become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Kalimantan will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Kalimantan. - Main cities are located	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of water-borne diseases agents will increase outbreak of	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations - Improve	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the regional levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases. - Studies of climate change impacts to	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at regional levels. - Model developemet of integrated health sector adaptation at regional levels - Updating database, information system and Health profile	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels. - Updating database, information system and Health profile Planning & Policy, Regulation and Development Institutions:	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2028 – 2029**
increase. - Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	at coastal areas with insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Kalimantan have a low social economic and education status, level of welfare and capacity for adaptation for north and south Kalimantan classified as medium. - Part of the population has not been praticing	finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Kalimantan. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and filariasis) will change with the change of land use, micro	participations among communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	food security and malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create preventive environment in	Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community	- Improve community participation, especially in the prevention activities for environmental sanitation. - Development of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization. Planning & Implementation, and Monitoring-	socialization. Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of infrastructure planning at all levels.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2028 – 2029
	to live healthily and hygienically. - Part of Indonesia has limited health services. - Part of the population in Kalimantan have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts are still limited. - Lack of data on health	climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of temperature of 2-3ºC will increase the number of morbidity		management of disease. - Strengthening public health policies for development based on community health. - Socialization strategy to indigenous to climate change for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation : - Develop appropriate technology for	participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention, and risk factor control)	Evaluation : - Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at the local level. - Increase support of	- Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support disease control program.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2028 – 2029
	conditions availability, are in line with population growth	of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in marshy areas and mangrove can cause distribution pattern		sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels. - Increase financioal support materials,	- Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of health and inter sector with private institutions and	funds, materials, facilities to support disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private institutions and NGO's	- Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate change.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2028 – 2029**
		of vectors to change		facilities for the support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at regional level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	- Evaluation of healthy housing technology adaptive to climate change	

4.SULAWESI ISLAND

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2029 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Sulawesi region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon in trofosfer,) due to temperature increase.	- Topography in form of mountainous areas, in Sulawesi become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Sulawesi will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Sulawesi. - Main cities are located	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of water-borne diseases agents will increase outbreak of	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations - Improve	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the regional levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases. - Studies of climate change impacts to	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at regional levels. - Model developemet of integrated health sector adaptation at regional levels - Updating database, information system and Health profile	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels. - Updating database, information system and Health profile Planning & Policy, Regulation and Development Institutions:	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2029 – 2029**
- Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	at coastal areas with insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Sulawesi have a low social economic and education status, level of welfare and capacity for adaptation for north and south Sulawesi classified as medium. - Part of the population has not been praticing	finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Sulawesi. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and filariasis) will change with the change of land use, micro	participations among communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	food security and malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create preventive environment in	Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community	- Improve community participation, especially in the prevention activities for environmental sanitation. - Development of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization. Planning & Implementation, and Monitoring-	socialization. Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of infrastructure planning at all levels.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2029 – 2029
	to live healthily and hygienically. - Part of Indonesia has limited health services. - Part of the population in Sulawesi have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts are still limited. - Lack of data on health	climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of temperature of 2-3ºC will increase the number of morbidity		management of disease. - Strengthening public health policies for development based on community health. - Socialization strategy to indigenous to climate change for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation : - Develop appropriate technology for	participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention, and risk factor control)	Evaluation : - Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at the local level. - Increase support of	- Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support disease control program.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2029 – 2029**
	conditions availability, are in line with population growth	of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in marshy areas and mangrove can cause distribution pattern		sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels. - Increase financioal support materials,	- Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of health and inter sector with private institutions and	funds, materials, facilities to support disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private institutions and NGO's	- Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate change.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2029 – 2029**
		of vectors to change		facilities for the support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at regional level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	- Evaluation of healthy housing technology adaptive to climate change	

5.NUSA TENGGARA ISLAND

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2030 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Nusa Tenggara region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon in trofosfer,) due to	- Topography in form of mountainous areas, in Nusa Tenggara become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Nusa Tenggara will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Nusa Tenggara.	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of water-borne diseases	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the regional levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases. - Studies of climate	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at regional levels. - Model developemet of integrated health sector adaptation at regional levels - Updating database, information system	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels. - Updating database, information system and Health profile Planning & Policy, Regulation and Development	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2030 – 2029**
temperature increase. - Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	- Main cities are located at coastal areas with insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Nusa Tenggara have a low social economic and education status, level of welfare and capacity for adaptation for north and south Nusa Tenggara classified as medium.	agents will increase outbreak of finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Nusa Tenggara. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and filariasis) will change	- Improve participations among communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	change impacts to food security and malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create preventive	and Health profile Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation.	Institutions: - Improve community participation, especially in the prevention activities for environmental sanitation. - Development of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization. Planning &	continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of infrastructure

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2030 – 2029
	- Part of the population has not been praticing to live healthily and hygienically. - Part of Indonesia has limited health services. - Part of the population in Nusa Tenggara have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts are still limited.	with the change of land use, micro climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of temperature of 2-3ºC		environment in management of disease. - Strengthening public health policies for development based on community health. - Socialization strategy to indigenous to climate change for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation : - Develop appropriate	- Improve community participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention , and risk factor control)	Implementation, and Monitoring-Evaluation : - Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at the local level.	planning at all levels. - Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support disease control

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2030 – 2029
	- Lack of data on health conditions availability, are in line with population growth	will increase the number of morbidity of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in marshy areas and		technology for sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels. - Increase financioal	- Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of health and inter sector with private	- Increase support of funds, materials, facilities to support disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private institutions and	program. - Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate change.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2030 – 2029**
		mangrove can cause distribution pattern of vectors to change		support materials, facilities for the support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at regional level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	institutions and NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	NGO's - Evaluation of healthy housing technology adaptive to climate change	

6.MALUKU ISLAND AND ITS SURROUNDING

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2031 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Maluku region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon in trofosfer,) due to	- Topography in form of mountainous areas, in Maluku become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Maluku will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Maluku.	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of water-borne diseases	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the regional levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases. - Studies of climate	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at regional levels. - Model developemet of integrated health sector adaptation at regional levels - Updating database, information system	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels. - Updating database, information system and Health profile Planning & Policy, Regulation and Development	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2031 – 2029**
temperature increase. - Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	- Main cities are located at coastal areas with insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Maluku have a low social economic and education status, level of welfare and capacity for adaptation for north and south Maluku classified as medium. - Part of the population	agents will increase outbreak of finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Maluku. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and filariasis) will change	- Improve participations among communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	change impacts to food security and malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create preventive	and Health profile Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation.	Institutions: - Improve community participation, especially in the prevention activities for environmental sanitation. - Development of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization. Planning &	continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of infrastructure

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2031 – 2029
	has not been praticing to live healthily and hygienically. - Part of Indonesia has limited health services. - Part of the population in Maluku have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts are still limited.	with the change of land use, micro climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of temperature of 2-3ºC		environment in management of disease. - Strengthening public health policies for development based on community health. - Socialization strategy to indigenous to climate change for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation : - Develop appropriate	- Improve community participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention , and risk factor control)	Implementation, and Monitoring-Evaluation : - Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at the local level.	planning at all levels. - Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support disease control

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2031 – 2029
	- Lack of data on health conditions availability, are in line with population growth	will increase the number of morbidity of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in marshy areas and		technology for sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels. - Increase financioal	- Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of health and inter sector with private	- Increase support of funds, materials, facilities to support disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private institutions and	program. - Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate change.

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2031 – 2029**
		mangrove can cause distribution pattern of vectors to change		support materials, facilities for the support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at regional level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	institutions and NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	NGO's - Evaluation of healthy housing technology adaptive to climate change	

7.PAPUA ISLAND AND ITS SURROUNDING

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2032 – 2029**
- Floods and landslides can occur due to change of rainfall pattern. Rainfall in part of Papua region has the tendency to increase as compared to the baseline and is projected to continuously increasing up to the year 2020 - The increasing air pollution, and photochemical reactions (ozon in trofosfer,)	- Topography in form of mountainous areas, in Papua become vulnerable to landslides, especially when rainfall and flood increase. - Damage to riversheds in part of Papua will cause water to decrease, due to worst conditions of decreasing rainfall, Increase in temperature and change of rsinfall pattern very likely to cause drought in western part of Papua.	- Mortality and morbidity due to extreme weather (landslide, flood,hurricane. Evacuation due to extreme weather, cause increase of morbidities. Increasing morbidity of ISPA due to increaasing of air pollution (ozon). Ozon is increasing as average temperatue increases. - The increase rate of transmission of	- Strengthen vulnerability studies, and risk assessment in the health sector due to climate change. - Develop a framework of policies, supported by regulations. Acts, decrees, and their implementations. - Develop planning, decision making based on existing evidences/facts - Improve inter-sector collborations	Data Management, Information and Knowledge : - Studies, health risk assessment of hazards, vulnerabilities, and impacts due to climate change at the regional levels. - Relationships studies of climate change and development of water-borne, vector-borne, air -borne diseases, disasters, accidents, and non communicable diseases.	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at regional levels. - Model developemet of integrated health sector adaptation at regional levels - Updating database,	Data Management, Information and Knowledge : - Improve studies, analysis, and researches on hazards, vulnerabilty, risk assessment of ckimate change impacts towards health at city and Kabupaten levels. - Updating database, information system and Health profile Planning & Policy, Regulation and	Data Management, Information and Knowledge : - Updating database, information system and Health profile. Planning & Policy, Regulation and Development Institutions: - Evaluation of health resources, organization & coordination of reform, making legislation. - Improve community

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2032 – 2029**
due to temperature increase. - Rob and floods at coatal areas due to sea level rise and extreme weather - Unsuccessful harvest due to change of rainfall, temperature, and variability of weather(ENSO dll).	- Main cities are located at coastal areas with insufficient water retention construction against sea level rise . - Economic status of the community are mainly dependent on natuiral products, such as agriculture, plantations vulnerable to droughts and floods. - Part of the population of Papua have a low social economic and education status, level of welfare and capacity for adaptation for north and south Papua classified as medium. - Part of the population has not been praticing	water-borne diseases agents will increase outbreak of finfectious diseases such as leptospirosis, diarrhea, and cholera. These diseases increase in morbidity, when availability of safe water for sanitation is low after flood events. Diarrhea has the highest risk of occurring in part of Papua. - Malnutrition will occur when there is harvest failure. - Pattern of vector-borne disease (malaria, DHF, chikungunya, and	- Improve participations among communities, private institutions, higher educations institutions, academici, etc. - Improve /strengthening capacity building of local government personnel. - Develop networking and information sharing. - Strengthening of early warning system and emergency response at the community level.	- Studies of climate change impacts to food security and malnutrition. - Preparation and update of database, information system, and community health profile. Planning & Policy, Regulation and Development Institutions: - Develop regulations that would support actions for adaptation to climate change in the health sector. - Inventory and promulgations of needed regulations to support the create	information system and Health profile Planning & Policy, Regulation and Development Institutions: -Socialization of legislation that supports the creation of a preventive environment from disease and climate change adaptation efforts the health sector. -Preparation of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation.	Development Institutions: - Improve community participation, especially in the prevention activities for environmental sanitation. - Development of an epidemic / pandemic through the evaluation of health resources, organization & coordination of reform, making legislation. - Improve community participations through continual socialization.	participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Expansion and integration of management information system, for climate change /SIM-PI in providing community services, and national planning. - Improve and strengthen surveillans of vectors ; environmental risk factors & diseases , and adaptation of

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2032 – 2029
	to live healthily and hygienically. - Part of Indonesia has limited health services. - Part of the population in Papua have limited access to health services due to far distances. - Health facilities are not capable of giving the right response to climate change impacts. - Vulnerability and risk information within the health sector and adaptation due to climate change impacts are still limited. - Lack of data on health	filariasis) will change with the change of land use, micro climate. Change of climate also change the pattern of vector-borne diseases - Increase of temperature influences breeding, growth, age, and distribution of disease vector such as malaria. - Risk assessment showed that regions like Lampung and Bengkulu have a high risk of suffering from DHF. - Increase of		preventive environment in management of disease. - Strengthening public health policies for development based on community health. - Socialization strategy to indigenous to climate change for all for the whole range of legislative and local and central government's commitment to the establishment and implementation of action plan activities. Planning & Implementation, and Monitoring-Evaluation :	- Improve community participations through continual socialization. Planning & Implementation, and Monitoring-Evaluation : - Strengthen surveillance of vectors ; environmental risik factors and adaptation of infrastructure planning at all levels. - Strengthen management programs, (case detection, treatment,prevention , and risk factor	Planning & Implementation, and Monitoring-Evaluation : - Increase the capacity of management information system of climate change. - Improve use of integrated database GIS online to support information system and community health profile - Improve monitoring and evaluation activities, spatial mapping, (GIS) of morbidities and their causes due to climate change at	infrastructure planning at all levels. - Improve and strengthen health services sytem integrated with demography consideration, population growth, change of demography, poverty, general health infrastructure, sanitation, health facilities, nutritional status, habits to live healthily and hygienically, pesticides resistance and environmental damage - Increase support of funds, materials, facilities to support

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	Vulnerability	Impacts		2010 – 2014	2015 – 2019	2020 – 2024	2032 – 2029
	conditions availability, are in line with population growth	temperature of 2-3ºC will increase the number of morbidity of vector-borne diseasesby 3- 5% - Increase of temperature will expand distribution of vectors and increase growth and development of parasites to become infective. - Change of rainfall, together with change of temperature and humidity can increase or decrease population density of disease vector and contact of humans with vectors. - Ecosystem change in		- Develop appropriate technology for sanitation, including strategy for adaptation yang dituangkan in the form of workshops, seminars, advocacy, and sosialization - Strengthening health system as response to climate change. - Develop network internally within the MOH, and inter-sectoral with private institutions, and NGO's - Establish working group on impacts of climate change at the central levels.	control) - Strengthening management information system for climate change /SIM-PI - Use of several disease management methods for disease control through decrease of risks factor management and integration with other sectors and related program - Intensify control programs before transmission period to prevent outbreaks. - Improve network of the ministry of health and inter	the local level. - Increase support of funds, materials, facilities to support disease control program. - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Improve international collaborations for the efforts to adapt to climate change - Improve network of the ministry of health and inter sector with private	disease control program. - Improve international collaborations for the efforts to adapt to climate change - Improve use of integrated database GIS online to support information system and community health profile - Strengthening monitoring and evaluation system, surveillance, and helath information system of climate change. - Evaluation of healthy housing technology adaptive to climate

Scientific Basis			Recomendations for Alternative Adaptation Strategy	Program Priorities			
Hazards	**Vulnerability**	**Impacts**		**2010 – 2014**	**2015 – 2019**	**2020 – 2024**	**2032 – 2029**
		marshy areas and mangrove can cause distribution pattern of vectors to change		- Increase financioal support materials, facilities for the support of disease control programs. - Strengthening monitoring and evaluation system, surveillance, and health information system of imate change at regional level. - Empowerment of comunity through development of KIE modules and campaigns, promottion of health.	sector with private institutions and NGO's - Improve international collaborations for the efforts to adapt to climate change - Increase support in terms of funds, materials, facilities, for disease control. - Strengthening monitoring and evaluation system, surveillance, and health information system of climate change. - Implement healthy housing technology adaptive to climate change	institutions and NGO's - Evaluation of healthy housing technology adaptive to climate change	change.

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APPENDIX A

Public Health Condition and Problems in Indonesia

The public health condition in Indonesia currently is facing a low health quality which can be seen by the high infant mortality rate (IMR), children under 5 years mortality rate (AKABA) and maternal mortality (AKI) and the high proportion of malnutrition of children under 5 years; disparity of health quality and access to appropriate health service between regions, gender and income groups; insufficient quantity, spread, composition, and health manpower quality; also the limited fund source and unoptimal health fund allocation (RPJP Department of Health, 2005-2025)

As mentioned in the Medium-Term Development Plan of the Ministry of Health, 2004-2009, the main problems within the health sector are the disparity of the state of health, the multiple burden of disease, the low performance and quality of public health services and the public traditional behaviour which does not support the pattern for a healthy hygienic life (PHBS). Besides, there are also the low general public health conditions, the unequal distribution of and the unaffordable health service facilities, the limited number and quality of health manpower, and lowly skilled health technicians, the unequal distribution of health manpower within a population, the low degree of health status of the poor, constraints of unavailability of stock and unaffordability of raw materials for drugs, drugs, pharmaceutical supply and health instruments. All of these are negative aspects of public health in Indonesia (RPJM Ministry of Health).

1. Disparity of Public Health Status

Even if the national quality of public health has improved, disparity of health status varies quite a lot among different social-economic status, between different areas, and between urban and rural areas. Infant mortality rate (IMR) and mortality of children below 5 years within the poor are 4 times higher as compared to the high income society. Besides, IMR and maternal mortality rate (MMR) are higher in rural areas, on the eastern part of Indonesia, and among those with low education levels. Percentage of children below 5 with low and bad nutritional status, are higher in rural as compared to urban areas. Assistance of child labor and delivery by skilled medical personnel and coverage of immunization of children below five among the poor are lower as compared to the rich (RPJM Ministry of Health).

2. Multiple Burden of Disease

The disease pattern suffered by the population are mostly communicable diseases, like lung tuberculosis, acute infection of the upper respiratory tract (ISPA), malaria, dengue haemorrhagic fever (DBD), diarrhea, and skin infections. There are also other neglected communicable diseases, like frambusia, filariasis, dan taeniasis-cysticercosis. Indonesia also has new communicable diseases such as H1N1 and bird flu. At the same time there is an increase of chronic non communicable diseases such as degenerative cardio-vascular diseases, diabetes mellitus and cancer. The occurence of multiple burden of disease accompanied by the increase of population and their high mobilization, and the change in age structure, i.e., the increasing productive and old-aged population. This condition will influence the quantity and and type of health services needed in the coming future (RPJM Ministry of Health).

3. The Low Performance of Health Services

The main factor causing high IMR in Indonesia could actually be intervened affordably and simply. The performance of the health services, therefore, becomes very important as one of the most influencing factor in the effort to improve the quality of public health. The low performance of health services can be noted from several indicators, such as the proportion of child delivery by medical personnel, proportion of babies immunized against morbilli, and proportion of Case Detection Rate of lung tuberculosis. In 2002, coverage of child delivery by medical personnel was 66,7%, varying about 34,0% at the province of south-east Sulawesi and 97,1% in the Province of DKI Jakarta. For the year of 2002, coverage of morbilli immunization for children of 12-23 months old was 71,6%, with a range of 44,1% in the Province of Banten and 91,1% for the Province of D.I. Yogyakarta. The proportion of Case Detection Rate for lung Tuberculosis in 2002 was 29% (RPJM Ministry of Health).

4. Public Behavior Which Does not Support Hygienic and Healthy Life Pattern

Hygienic and healhy life behavior of the community is one of the most important factors to support public health improvement. Unhealthy behavior of the community can be seen from their habit to smoke, to refuse exclusive nursing program for their babies (ASI), the high prevalence of under- and over-nutrition of children under five years, and

the increasing trend of patients with HIV/AIDS, addiction to narcotics and psychotropics, and other addictive substances (NAPZA), and mortality due to accidents. Proportion of smoking in adult population was 31,8%, while the proportion of those starting smoking below 20 years was increasing from 60% in 1995 to 68% in 2001. By 2002, only 13.9% of 4-5 months old babies received exclusive mother nursing. Persentage under nutrition of children under 5 years was 25,8% (2002), while the over nourished children reached 2,8% (2003). Recorded AIDS patients in 2004 were 2.363 cases and for HIV 3.338 cases, those suffering from addiction increased from about 44.500 cases in 2002 to 52.500 cases in 2003. Accidents became one of the ten most prevalent cause of general mortality, i.e. in 1995 ranked as the number 8, and rose to become number 6 in 2001 (RPJM Ministry of Health).

5. Communicable Diseases

Up to the present moment, communicable diseases are still the most prevalent public health problems in Indonesia. The degree of public health status in Indonesia is still low, one of causes of which was the high incidences of communicable diseases, the increase of incidences of non communicable diseases, and the unhealthy conditions of the environment. Population increase, industrialization, urbanization, tourism, agriculture, forest openings, and migration influence the change in the quality of the environment. Indonesia as a tropical achipelago, consists of more than 17.508 islands, rich in flora and fauna, including disease vector, reservoir, and disease agents, such that communicable diseases still become the most important health problem. This condition has resulted in negative impacts such as the emerging of new diseases, and re-emerging diseases which in the past had been well-controlled. (RPJM Ministry of Health).

Communicable diseases can be categorized into two groups, namely the directly communicables such as Tuberculosis, acute infection of the upper respiratory tract (ISPA), diarrhea, poliomyelitis, morbilli; and the indirectly communicable diseases, (through vectors, intermediate hosts, and reservoir) such as malaria, dengue haemorrhagic fever (DHF), chikungunya, filariasis, anthrax, viral infections such as Severe Acute Respiratory Syndrom (SARS), bird influenza, H1N1, and leptospirosis. There are also some neglected communicable diseases, such as framboesia, taeniasis, and cysticercosis. Vector borne diseases are endemic in Indonesia, causing the increase of

their morbidity and mortality and have the potential to cause epidemics (KLB[1]). Vector borne diseases in Indonesia are principally environmentally based, they are prevalent among the vulnerable population in the rural area, mostly belonging to the low income group, and do not have access to health services (RPJM Ministry of Health).

[1] **Kejadian Luar Biasa** (KLB) or outbreak is a status that classifies spread or epidemics of disease, enforced in Indonesia. Such an outbreak classification is regulated by the ministrial decree, i.e., Ministry of Health RI No. 949/MENKES/SK/VII/2004. An outbreak is defined as a significant increase of morbidity or mortality epidemiologically within an area, and at a specified time period.

APPENDIX B

Climate Change Hazard

1. Decreased Availability of Water (PKA)

The Roadmap team of the Water Sector (Oman Abdurahman et.al.) had computed the risks of PKA, which according to the health team, should be considered as danger/hazard of climate change. PKA could lower the adaptive capacity of the community in providing water supply for consumption (drinking, cooking, sanitation).

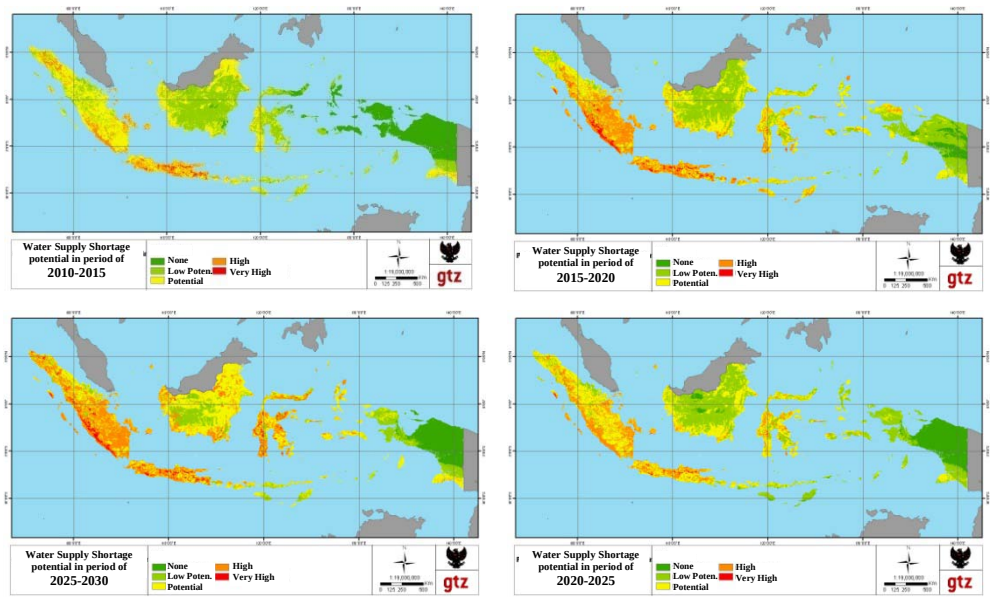

Figure L.1 Decrease of Water Availability, from upper left clockwise: periode of 2010-2015, 2015-2020, 2020-2025, and 2025-2030 (Oman Abdurahman, 2009)

Very high PKA was found in the region of Java-Bali, especially at several places, North and South of West Java, central and south of Central Java and East java; in the capital city of North Sumatra, West Sumatra, Bengkulu and Lampung (Sumatera); Bali; NTB (Nusatenggara) and South Sulawesi. **High PKA** are generally about 75% in the region of Java-Bali; a small partin the North, West, and South of the Sumatra region; part of Lombok Island (Nusatenggara), and South Sulawesi.

2. Floods

The roadmap team of water sector, had computed the risk of flooding, which could pose a hazard to the health sector, in the form of disease threats, accidents, and deaths.

Regions with significantly very high risk for flooding are the low regions, especially, surrounding the downstream of large rivers in Java, East Sumatera, West Kalimantan, South and East of East Sulawesi and South Papua.

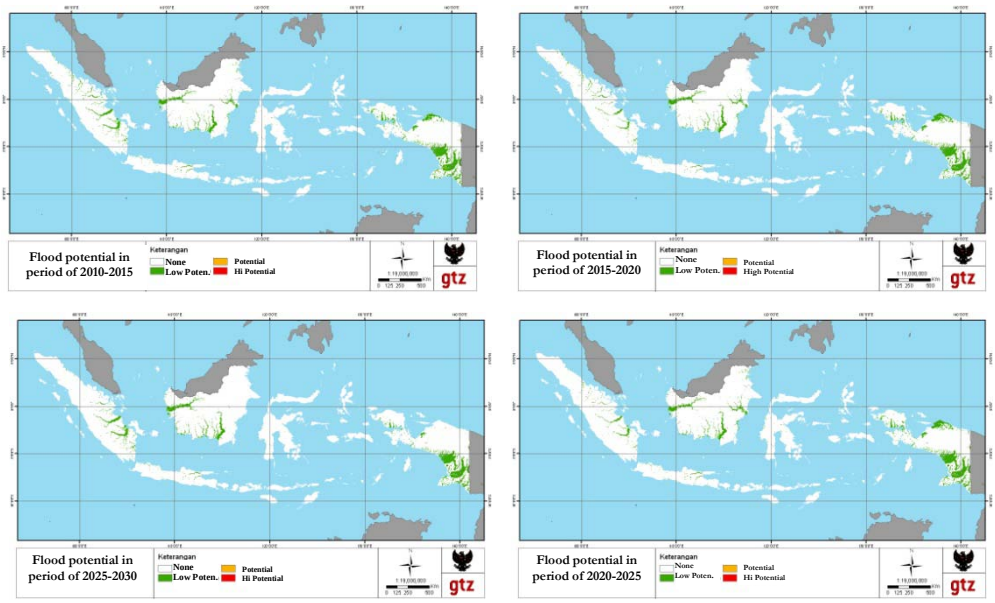

Figure L.2 Risk of Flooding, from upper left side, clockwise: period 2010-2015, 2015-2020, 2020-2025, dan 2025-2030 (Oman Abdurahman, 2009)

Floods could result in increased deaths, destruction of private belongings, loss of employments, increase cost for rehabilitation or reconstruction of destroyed infrastructures, decreased safe water supply, unsuccessful harvest, diseases such as DHF, and other secondary impacts.

3. Droughts

The roadmap team of the water sector had computed the risk of drought, which according to the health sector team should be considered as hazards, because it can cause decrease safe water supply for drinking, cooking, and sanitation. The agro-industry could also be influenced resulting in decreased harvests, and further on could affect nutritional status. Risk of droughts are significant for the region of Java-Bali, the larger part of North Sumatera, part of Nusatenggara, and Sulawesi.

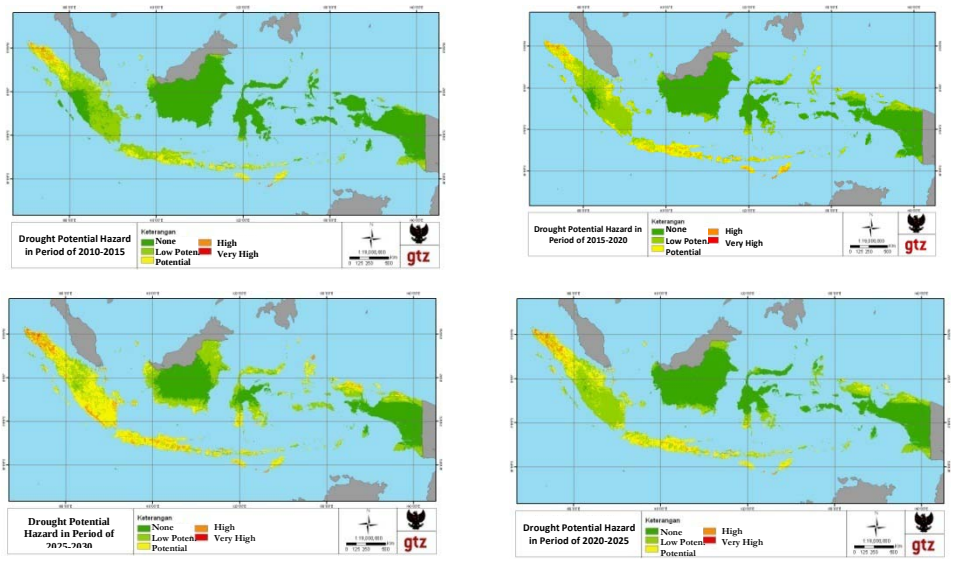

Figure L.3 Risk of Drought, from the upper left side,clockwise: period 2010-2015, 2015-2020, 2020-2025, and 2025-2030 (Oman Abdurahman, 2009)

The secondary risk of drought are more severe than decrease of water supply, both in intensity and the extend of area affected. In the agriculture areas, among others, has to be considered the potential of unsuccessful planting and harvest, due to drought or the shifting of the dry season.

4. Landslides

The water sector roadmap team had computed the risk of landslides, which according to the health sector team should be considerd as hazards, because it could result in increased morbidity, accidents, and mortality. Landslides also could destroy health facilities, and general infrastructure. Significant risk to suffer from landslides are in some region of Indonesia, especially, Java-Bali, Sumatera, Sulawesi, Nusatenggara, and Papua. Very high risk of landslides are found in general on Java-Bali, the Central and Southern parts, Sumatera, the West-Central part, the larger part of Nusatenggara; and Sulawesi, and central Papua.

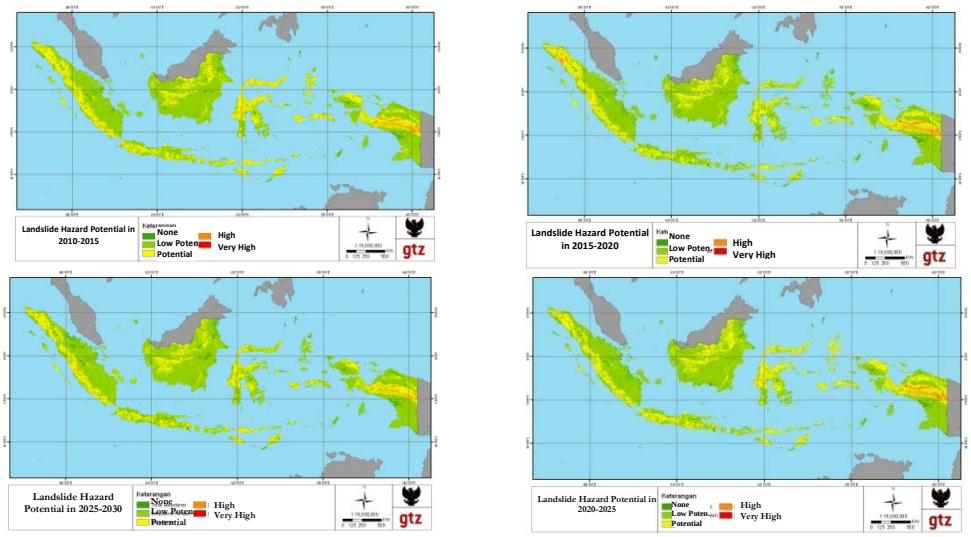

Figure L.4 Risk of Landslide, from the upper left side, clockwise: periode 2010-2015, 2015-2020, 2020-2025, and 2025-2030 (Oman Abdurahman, 2009).

APPENDIX C

Annual Rainfall Pattern

As a theorethical description the following is an explanation of annual rainfall pattern in the larger part of Indonesia. Annual rainfall pattern in the larger part of Indonesia is of monsoon type, meaning that it will follow the circulation pattern of a monsoon. However, research conducted by Aldrian and Susanto (2003) showed that in Indonesia there are at least three annual rainfall pattern, namely: (a) the monsoonal pattern with one peak rain-period around January, (b) the equatorial pattern with two peaks rain-periods around April and November, and (c) local pattern or anti-monsoonal, with one peak rain-period around June (see Figure 37). Rain in tropical areas is dominantly produced from convective clouds. Rainfall pattern in many areas of Indonesia actually varies a lot. Local atmospheric circulation, such as sea and/or land breeze, mountain winds, and topographical effects can influence rainfall pattern. If classified into more detail, there is more rainfall pattern that can be identified. For the Kalimantan Island alone, for instance, Dambul (2008) found 6 different rainfall patterns. It is therefore not recommended to study climate in Indonesia at a global scale, but the variations on a local scale need also be considered.

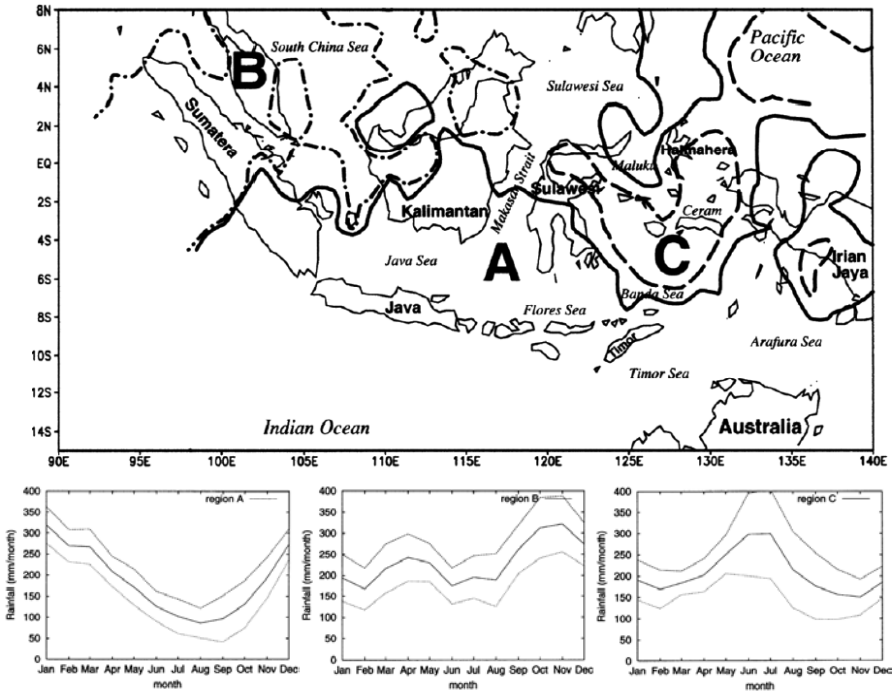

Figure L.5 Map of Regional Groupings in Indonesia, According to Annual Rainfall Pattern (type A, B, and C). Lower part: Average Rainfall Pattern from January up to December for Three Types of Rain Regions in Indonesia.
(Source: Aldrian and Susanto, 2003)

As shown in Figure 37, Indonesia has Three Climate Pattern (Bayong, 1999), namely :

1) **Rainfall Pattern of Monsoon Type (Type A)**

   The characteristic of this monsoon type, are monthly rainfall distribution with a monthly minimum rainfall in June, July, or August, such that within this pattern there will only be 2 transition period/ *pancaroba*.

2) **Rainfall Pattern of Equator Type (Type B)**

   The characteristic of this equator type, are monthly rainfall distribution with a maximum 2 times/year, namely in April and October, such that this pattern has four *pancaroba*.

3) **Rainfall Pattern of Local Type (Type C)**

   The characteristic of this local typpe is the inverse of the monsoon type, namely, with a maximum rainfall occurring in June, July, or Agust. Rainfall pattern such as this is influenced by many local characteritics. Within this pattern, there are 2 *pancaroba*.

APPENDIX D

The result data of risk calculation of malaria, diarrhea, DHF to climate change. The scoring spans from 0-1, with 0 being the lowest risk and 1 being the highest risk.

1. Province of Daerah Istimewa Aceh

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
SIMEULUE	0.54	intermediate	0.66	high	0.25	low
ACEH SINGKIL	0.40	low	0.70	high	0.23	low
ACEH SELATAN	0.43	intermediate	0.70	high	0.31	low
ACEH TENGGARA	0.19	very low	0.56	intermediate	0.22	low
ACEH TIMUR	0.21	low	0.60	high	0.25	low
ACEH TENGAH	0.17	very low	0.62	high	0.18	very low
ACEH BARAT	0.37	low	0.69	high	0.26	low
ACEH BESAR	0.40	low	0.68	high	0.39	low
PIDIE	0.41	intermediate	0.66	high	0.33	low
BIREUEN	0.21	low	0.63	high	0.25	low
ACEH UTARA	0.23	low	0.76	high	0.28	low
ACEH BARAT DAYA	0.46	intermediate	0.45	intermediate	0.32	low
GAYO LUES	0.20	very low	0.63	high	0.16	very low
ACEH TAMIANG	0.21	low	0.60	intermediate	0.28	low
NAGAN RAYA	0.37	low	0.18	very low	0.28	low
ACEH JAYA	0.46	intermediate	0.51	intermediate	0.25	low
BENER MERIAH	0.17	very low	0.24	low	0.11	very low
PIDIE JAYA	0.23	low	0.74	high	0.27	low
KOTA BANDA ACEH	0.34	low	0.71	high	0.75	High
KOTA SABANG	0.44	intermediate	0.23	low	0.25	low
KOTA LANGSA	0.21	low	0.25	low	0.25	low
KOTA LHOKSEUMAWE	0.19	very low	0.63	high	0.50	intermediate
KOTA SUBULUSSALAM	0.42	intermediate	0.62	high	0.25	low

2. Province of Sumatera Utara

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
NIAS	0.28	low	0.60	high	0.20	very low
MANDAILING NATAL	0.23	low	0.63	high	0.25	low
TAPANULI SELATAN	0.26	low	0.72	high	0.22	low
TAPANULI TENGAH	0.28	low	0.62	high	0.30	low
TAPANULI UTARA	0.27	low	0.45	intermediate	0.23	low
TOBA SAMOSIR	0.11	very low	0.83	very high	0.19	very low
LABUHAN BATU	0.08	very low	0.58	intermediate	0.17	very low
ASAHAN	0.09	very low	0.86	very high	0.17	very low
SIMALUNGUN	0.09	very low	0.60	high	0.26	low
DAIRI	0.27	low	0.75	high	0.22	low
KARO	0.11	very low	0.68	high	0.21	low
DELI SERDANG	0.09	very low	0.51	intermediate	0.30	low
LANGKAT	0.10	very low	0.29	low	0.30	low
NIAS SELATAN	0.29	low	0.23	low	0.20	low
HUMBANG HASUNDUTAN	0.28	low	0.22	low	0.21	low
PAKPAK BHARAT	0.36	low	0.50	intermediate	0.26	low
SAMOSIR	0.31	low	0.75	high	0.40	intermediate
SERDANG BEDAGAI	0.09	very low	0.57	intermediate	0.21	low
BATU BARA	0.10	very low	0.60	high	0.19	very low
PADANG LAWAS UTARA	0.26	low	0.60	high	0.18	very low
PADANG LAWAS	0.26	low	0.58	intermediate	0.18	very low
KOTA SIBOLGA	0.31	low	0.57	intermediate	0.43	intermediate
KOTA TANJUNG BALAI	0.16	very low	0.62	high	0.28	low
KOTA PEMATANG SIANTAR	0.11	very low	0.77	high	0.59	intermediate
KOTA TEBING HIGH	0.11	very low	0.46	intermediate	0.54	intermediate
KOTA MEDAN	0.08	very low	0.43	intermediate	0.53	intermediate
KOTA BINJAI	0.09	very low	0.70	high	0.30	low
KOTA PADANGSIDIMPUAN	0.26	low	0.63	high	0.33	low

3. Province of Sumatera Barat

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KEPULAUAN MENTAWAI	0.42	intermediate	0.29	low	0.23	low
PESISIR SELATAN	0.34	low	0.35	low	0.30	low
SOLOK	0.31	low	0.56	intermediate	0.14	very low
SAWAHLUNTO/SIJUNJUNG	0.33	low	0.65	high	0.20	low
TANAH DATAR	0.28	low	0.74	high	0.24	low
PADANG PARIAMAN	0.34	low	0.74	high	0.23	low
AGAM	0.29	low	0.79	high	0.24	low
LIMA PULUH KOTA	0.33	low	0.30	low	0.24	low
PASAMAN	0.30	low	0.70	high	0.21	low
SOLOK SELATAN	0.38	low	0.84	very high	0.20	very low
DHARMAS RAYA	0.29	low	0.29	low	0.14	very low
PASAMAN BARAT	0.32	low	0.28	low	0.23	low
KOTA PADANG	0.23	low	0.69	high	0.61	high
KOTA SOLOK	0.33	low	0.77	high	0.14	very low
KOTA SAWAH LUNTO	0.41	intermediate	0.49	intermediate	0.23	low
KOTA PADANG PANJANG	0.30	low	0.29	low	0.29	low
KOTA BUKITTINGGI	0.29	low	0.15	very low	0.23	low
KOTA PAYAKUMBUH	0.27	low	0.93	very high	0.16	very low
KOTA PARIAMAN	0.36	low	0.73	high	0.26	low

4. Province of Riau

DISTRICT	Malaria		DHF		Diarrhea	
	Score	Risk	Score	Risk	Score	Risk
KUANTAN SINGINGI	0.31	low	0.56	intermediate	0.22	low
INDRAGIRI HULU	0.32	low	0.53	intermediate	0.22	low
INDRAGIRI HILIR	0.27	low	0.30	low	0.21	low
PELALAWAN	0.26	low	0.48	intermediate	0.19	very low
S I A K	0.23	low	0.33	low	0.18	very low
KAMPAR	0.25	low	0.30	low	0.25	low
ROKAN HULU	0.25	low	0.45	intermediate	0.22	low

DISTRICT	Malaria		DHF		Diarrhea	
	Score	Risk	Score	Risk	Score	Risk
BENGKALIS	0.11	very low	0.40	low	0.18	very low
ROKAN HILIR	0.12	very low	0.67	high	0.13	very low
KOTA PEKANBARU	0.18	very low	0.79	high	0.33	low
KOTA D U M A I	0.13	very low	0.68	high	0.13	very low

5. Province of Jambi

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KERINCI	0.29	low	0.66	high	0.19	very low
MERANGIN	0.33	low	0.63	high	0.31	low
SAROLANGUN	0.39	low	0.76	high	0.29	low
BATANG HARI	0.42	intermediate	0.71	high	0.19	very low
MUARO JAMBI	0.32	low	0.40	intermediate	0.21	low
TANJUNG JABUNG TIMUR	0.30	low	0.63	high	0.17	very low
TANJUNG JABUNG BARAT	0.30	low	0.33	low	0.18	very low
TEBO	0.31	low	0.67	high	0.16	very low
BUNGO	0.34	low	0.60	intermediate	0.22	low
KOTA JAMBI	0.25	low	0.40	intermediate	0.19	very low

6. Province of Sumatera Selatan

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
OGAN KOMERING ULU	0.14	very low	0.17	very low	0.14	very low
OGAN KOMERING ILIR	0.19	very low	0.61	high	0.23	low
MUARA ENIM	0.14	very low	0.85	very high	0.22	low
LAHAT	0.17	very low	0.71	high	0.16	very low
MUSI RAWAS	0.17	very low	0.61	high	0.18	very low
MUSI BANYUASIN	0.19	very low	0.33	low	0.21	low
BANYU ASIN	0.17	very low	0.30	low	0.19	very low
OGAN KOMERING ULU SELATAN	0.18	very low	0.62	high	0.17	very low
OGAN KOMERING ULU TIMUR	0.14	very low	0.61	high	0.20	very low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
OGAN ILIR	0.19	very low	0.75	high	0.22	low
EMPAT LAWANG	0.18	very low	0.79	high	0.21	low
KOTA PALEMBANG	0.13	very low	0.21	low	0.58	intermediate
KOTA PRABUMULIH	0.14	very low	0.35	low	0.49	intermediate
KOTA PAGAR ALAM	0.16	very low	0.30	low	0.14	very low
KOTA LUBUKLINGGAU	0.16	very low	0.33	low	0.25	low

7. Province of Bengkulu

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BENGKULU SELATAN	0.19	very low	0.34	low	0.24	low
REJANG LEBONG	0.18	very low	0.39	low	0.21	low
BENGKULU UTARA	0.38	low	0.43	intermediate	0.31	low
KAUR	0.24	low	0.32	low	0.21	low
SELUMA	0.23	low	0.36	low	0.19	very low
MUKOMUKO	0.41	intermediate	0.66	high	0.26	low
LEBONG	0.41	intermediate	0.62	high	0.19	very low
KEPAHIANG	0.19	very low	0.53	intermediate	0.16	very low
KOTA BENGKULU	0.33	low	0.66	high	0.31	low

8. Province of Lampung

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
LAMPUNG BARAT	0.16	very low	0.15	very low	0.15	very low
TANGGAMUS	0.17	very low	0.08	very low	0.32	low
LAMPUNG SELATAN	0.20	very low	0.71	high	0.30	low
LAMPUNG TIMUR	0.16	very low	0.53	intermediate	0.26	low
LAMPUNG TENGAH	0.14	very low	0.62	high	0.29	low
LAMPUNG UTARA	0.18	very low	0.60	high	0.27	low
WAY KANAN	0.20	low	0.72	high	0.26	low
TULANGBAWANG	0.22	low	0.16	very low	0.30	low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
PESAWARAN	0.21	low	0.45	intermediate	0.22	low
KOTA BANDAR LAMPUNG	0.16	very low	0.27	low	0.72	high
KOTA METRO	0.13	very low	0.22	low	0.51	intermediate

9. Province of Bangka Belitung

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BANGKA	0.40	low	0.74	high	0.23	low
BELITUNG	0.37	low	0.62	high	0.17	very low
BANGKA BARAT	0.47	intermediate	0.65	high	0.18	very low
BANGKA TENGAH	0.40	low	0.53	intermediate	0.23	low
BANGKA SELATAN	0.39	low	0.76	high	0.21	low
BELITUNG TIMUR	0.33	low	0.24	low	0.20	very low
KOTA PANGKAL PINANG	0.34	low	0.70	high	0.34	low

10. Province of Kepulauan Riau

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KARIMUN	0.24	low	0.29	low	0.24	low
BINTAN	0.12	very low	0.74	high	0.16	very low
NATUNA	0.12	very low	0.74	high	0.08	very low
LINGGA	0.17	very low	0.12	very low	0.14	very low
KOTA B A T A M	0.10	very low	0.77	high	0.37	low
KOTA TANJUNG PINANG	0.13	very low	0.58	intermediate	0.17	very low

11. Province of DKI Jakarta

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KEPULAUAN SERIBU	0.10	very low	0.20	very low	0.20	low
KOTA JAKARTA SELATAN	0.03	very low	0.49	intermediate	0.58	intermediate
KOTA JAKARTA TIMUR	0.05	very low	0.31	low	0.62	high

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KOTA JAKARTA PUSAT	0.06	very low	0.00	very low	0.60	intermediate
KOTA JAKARTA BARAT	0.04	very low	0.27	low	0.72	high
KOTA JAKARTA UTARA	0.06	very low	0.29	low	0.56	intermediate

12. Province of Jawa Barat

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BOGOR	0.08	very low	0.57	intermediate	0.43	Intermediate
SUKABUMI	0.14	very low	0.39	low	0.30	Low
CIANJUR	0.11	very low	0.86	very high	0.23	Low
BANDUNG	0.08	very low	0.59	intermediate	0.30	Low
GARUT	0.14	very low	0.35	low	0.33	Low
TASIKMALAYA	0.12	very low	0.35	low	0.27	Low
CIAMIS	0.26	low	0.34	low	0.32	Low
KUNINGAN	0.07	very low	0.41	intermediate	0.23	Low
CIREBON	0.10	very low	0.31	low	0.40	Intermediate
MAJALENGKA	0.10	very low	0.31	low	0.28	Low
SUMEDANG	0.09	very low	0.63	high	0.36	Low
INDRAMAYU	0.14	very low	0.27	low	0.41	Intermediate
SUBANG	0.13	very low	0.60	high	0.42	Intermediate
PURWAKARTA	0.09	very low	0.65	high	0.32	Low
KARAWANG	0.10	very low	0.71	high	0.42	Intermediate
BEKASI	0.11	very low	0.66	high	0.44	Intermediate
BANDUNG BARAT	0.10	very low	0.46	intermediate	0.21	Low
KOTA BOGOR	0.06	very low	0.63	high	0.52	Intermediate
KOTA SUKABUMI	0.12	very low	0.28	low	0.69	High
KOTA BANDUNG	0.08	very low	0.68	high	0.75	High
KOTA CIREBON	0.12	very low	0.48	intermediate	0.57	Intermediate
KOTA BEKASI	0.09	very low	0.61	high	0.61	High
KOTA DEPOK	0.06	very low	0.59	intermediate	0.52	Intermediate
KOTA CIMAHI	0.09	very low	0.73	high	0.64	High

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KOTA TASIKMALAYA	0.09	very low	0.79	high	0.24	Low
KOTA BANJAR	0.12	very low	0.27	low	0.33	Low

13. Province of Jawa Tengah

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
CILACAP	0.14	very low	1.00	very high	0.31	low
BANYUMAS	0.12	very low	0.70	high	0.36	low
PURBALINGGA	0.15	very low	0.26	low	0.44	intermediate
BANJARNEGARA	0.19	very low	0.36	low	0.35	low
KEBUMEN	0.14	very low	0.57	intermediate	0.47	intermediate
PURWOREJO	0.14	very low	0.72	high	0.28	low
WONOSOBO	0.20	low	0.42	intermediate	0.31	low
MAGELANG	0.13	very low	0.65	high	0.48	intermediate
BOYOLALI	0.16	very low	0.60	high	0.49	intermediate
KLATEN	0.11	very low	0.32	low	0.51	intermediate
SUKOHARJO	0.13	very low	0.68	high	0.30	low
WONOGIRI	0.14	very low	0.70	high	0.44	intermediate
KARANGANYAR	0.11	very low	0.64	high	0.42	intermediate
SRAGEN	0.19	very low	0.65	high	0.42	intermediate
GROBOGAN	0.17	very low	0.62	high	0.45	intermediate
BLORA	0.17	very low	0.66	high	0.44	intermediate
REMBANG	0.19	very low	0.22	low	0.49	intermediate
PATI	0.16	very low	0.81	very high	0.52	intermediate
KUDUS	0.11	very low	0.33	low	0.52	intermediate
JEPARA	0.15	very low	0.76	high	0.57	intermediate
DEMAK	0.18	very low	0.83	very high	0.39	low
SEMARANG	0.15	very low	0.72	high	0.63	high
TEMANGGUNG	0.14	very low	0.75	high	0.34	low
KENDAL	0.15	very low	0.32	low	0.49	intermediate
BATANG	0.19	very low	0.62	high	0.38	low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
PEKALONGAN	0.16	very low	0.61	high	0.49	intermediate
PEMALANG	0.16	very low	0.72	high	0.37	low
TEGAL	0.14	very low	0.55	intermediate	0.37	low
BREBES	0.15	very low	0.85	very high	0.35	low
KOTA MAGELANG	0.15	very low	0.58	intermediate	0.29	low
KOTA SURAKARTA	0.12	very low	0.67	high	0.44	intermediate
KOTA SALATIGA	0.17	very low	0.26	low	0.45	intermediate
KOTA SEMARANG	0.11	very low	0.70	high	0.47	intermediate
KOTA PEKALONGAN	0.13	very low	0.77	high	0.32	low
KOTA TEGAL	0.15	very low	0.51	intermediate	0.55	intermediate

14. Province of Daerah Istimewa Yogyakarta

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KULON PROGO	0.13	very low	0.43	intermediate	0.32	low
BANTUL	0.08	very low	0.53	intermediate	0.46	intermediate
GUNUNG KIDUL	0.12	very low	0.71	high	0.32	low
SLEMAN	0.07	very low	0.59	intermediate	0.37	low
KOTA YOGYAKARTA	0.13	very low	0.23	low	0.58	intermediate

15. Province of Jawa Timur

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
PACITAN	0.08	very low	0.66	high	0.18	very low
PONOROGO	0.05	very low	0.25	low	0.32	low
TRENGGALEK	0.09	very low	0.36	low	0.38	low
TULUNGAGUNG	0.05	very low	0.58	intermediate	0.35	low
BLITAR	0.05	very low	0.50	intermediate	0.29	low
KEDIRI	0.05	very low	0.39	low	0.47	intermediate
MALANG	0.04	very low	0.54	intermediate	0.30	low
LUMAJANG	0.05	very low	0.36	low	0.22	low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
JEMBER	0.04	very low	0.65	high	0.31	low
BANYUWANGI	0.05	very low	0.57	intermediate	0.18	very low
BONDOWOSO	0.06	very low	0.62	high	0.19	very low
SITUBONDO	0.09	very low	0.55	intermediate	0.29	low
PROBOLINGGO	0.05	very low	0.57	intermediate	0.30	low
PASURUAN	0.05	very low	0.73	high	0.16	very low
SIDOARJO	0.04	very low	0.46	intermediate	0.28	low
MOJOKERTO	0.04	very low	0.90	very high	0.29	low
JOMBANG	0.04	very low	0.37	low	0.25	low
NGANJUK	0.05	very low	0.38	low	0.29	low
MADIUN	0.06	very low	0.72	high	0.36	low
MAGETAN	0.06	very low	0.53	intermediate	0.24	low
NGAWI	0.06	very low	0.43	intermediate	0.19	very low
BOJONEGORO	0.05	very low	0.47	intermediate	0.22	low
TUBAN	0.06	very low	0.47	intermediate	0.21	low
LAMONGAN	0.05	very low	0.33	low	0.27	low
GRESIK	0.04	very low	0.66	high	0.26	low
BANGKALAN	0.07	very low	0.89	very high	0.17	very low
SAMPANG	0.08	very low	0.74	high	0.18	very low
PAMEKASAN	0.07	very low	0.83	very high	0.16	very low
SUMENEP	0.07	very low	0.63	high	0.27	low
KOTA KEDIRI	0.06	very low	0.60	intermediate	0.46	intermediate
KOTA BLITAR	0.07	very low	0.51	intermediate	0.46	intermediate
KOTA MALANG	0.05	very low	0.32	low	0.28	low
KOTA PROBOLINGGO	0.08	very low	0.56	intermediate	0.23	low
KOTA PASURUAN	0.09	very low	0.84	very high	0.27	low
KOTA MOJOKERTO	0.07	very low	0.38	low	0.18	very low
KOTA MADIUN	0.07	very low	0.27	low	0.36	low
KOTA SURABAYA	0.04	very low	0.35	low	0.38	low
KOTA BATU	0.08	very low	0.37	low	0.17	very low

16. Province of Banten

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
PANDEGLANG	0.17	very low	0.98	very high	0.27	low
LEBAK	0.16	very low	0.28	low	0.28	low
TANGERANG	0.11	very low	0.24	low	0.71	high
SERANG	0.15	very low	0.46	intermediate	0.22	low
KOTA TANGERANG	0.08	very low	0.47	intermediate	0.71	high
KOTA CILEGON	0.12	very low	0.65	high	0.24	low
KOTA SERANG	0.15	very low	0.85	very high	0.22	low

17. Province of Bali

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
JEMBRANA	0.09	very low	0.64	high	0.17	very low
TABANAN	0.07	very low	0.64	high	0.38	low
BADUNG	0.06	very low	0.24	low	0.41	intermediate
GIANYAR	0.06	very low	0.29	low	0.34	low
KLUNGKUNG	0.10	very low	0.29	low	0.20	very low
BANGLI	0.11	very low	0.57	intermediate	0.16	very low
KARANG ASEM	0.14	very low	0.58	intermediate	0.35	low
BULELENG	0.09	very low	0.22	low	0.29	low
KOTA DENPASAR	0.04	very low	0.82	very high	0.50	intermediate

18. Province of Nusa Tenggara Barat

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
LOMBOK BARAT	0.23	low	0.66	high	0.29	low
LOMBOK TENGAH	0.20	very low	0.65	high	0.36	low
LOMBOK TIMUR	0.21	low	0.57	intermediate	0.37	low
SUMBAWA	0.19	very low	0.62	high	0.23	low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
DOMPU	0.25	low	0.56	intermediate	0.30	low
BIMA	0.22	low	0.36	low	0.29	low
SUMBAWA BARAT	0.17	very low	0.72	high	0.13	very low
KOTA MATARAM	0.18	very low	0.70	high	0.52	intermediate
KOTA BIMA	0.23	low	0.66	high	0.30	low

19. Province of Nusa Tenggara Timur

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
SUMBA BARAT	0.34	low	0.62	high	0.31	low
SUMBA TIMUR	0.30	low	0.47	intermediate	0.23	low
KUPANG	0.30	low	0.59	intermediate	0.22	low
TIMOR TENGAH SELATAN	0.24	low	0.70	high	0.25	low
TIMOR TENGAH UTARA	0.41	intermediate	0.72	high	0.27	low
BELU	0.25	low	0.73	high	0.33	low
ALOR	0.29	low	0.84	very high	0.25	low
LEMBATA	0.28	low	0.27	low	0.26	low
FLORES TIMUR	0.27	low	0.32	low	0.29	low
SIKKA	0.35	low	0.28	low	0.28	low
ENDE	0.37	low	0.71	high	0.26	low
NGADA	0.34	low	0.79	high	0.23	low
MANGGARAI	0.25	low	0.65	high	0.23	low
ROTE NDAO	0.35	low	0.66	high	0.26	low
MANGGARAI BARAT	0.31	low	0.38	low	0.21	low
SUMBA TENGAH	0.35	low	0.73	high	0.23	low
SUMBA BARAT DAYA	0.34	low	0.27	low	0.29	low
NAGEKEO	0.34	low	0.26	low	0.28	low
MANGGARAI TIMUR	0.27	low	0.16	very low	0.23	low
KOTA KUPANG	0.25	low	0.39	low	0.22	low

20. Province of Kalimantan Barat

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
SAMBAS	0.34	low	0.33	low	0.22	low
BENGKAYANG	0.36	low	0.17	very low	0.17	very low
LANDAK	0.41	intermediate	0.36	low	0.22	low
PONTIANAK	0.41	intermediate	0.37	low	0.22	low
SANGGAU	0.36	low	0.55	intermediate	0.18	very low
KETAPANG	0.39	low	0.60	intermediate	0.20	low
SINTANG	0.40	low	0.55	intermediate	0.21	low
KAPUAS HULU	0.40	intermediate	0.56	intermediate	0.19	very low
SEKADAU	0.40	intermediate	0.34	low	0.19	very low
MELAWI	0.45	intermediate	0.33	low	0.21	low
KAYONG UTARA	0.43	intermediate	0.53	intermediate	0.18	very low
KUBU RAYA	0.38	low	0.22	low	0.22	low
KOTA PONTIANAK	0.32	low	0.51	intermediate	0.28	low
KOTA SINGKAWANG	0.36	low	0.38	low	0.33	low

21. Province of Kalimantan Tengah

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
KOTAWARINGIN BARAT	0.36	low	0.11	very low	0.26	low
KOTAWARINGIN TIMUR	0.34	low	0.34	low	0.23	low
KAPUAS	0.19	very low	0.28	low	0.15	very low
BARITO SELATAN	0.17	very low	0.38	low	0.15	very low
BARITO UTARA	0.33	low	0.32	low	0.19	very low
SUKAMARA	0.41	intermediate	0.77	high	0.15	very low
LAMANDAU	0.44	intermediate	0.31	low	0.19	very low
SERUYAN	0.37	low	0.57	intermediate	0.17	very low
KATINGAN	0.34	low	0.57	intermediate	0.13	very low
PULANG PISAU	0.19	very low	0.55	intermediate	0.11	very low
GUNUNG MAS	0.34	low	0.48	intermediate	0.08	very low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BARITO TIMUR	0.17	very low	0.22	low	0.13	very low
MURUNG RAYA	0.40	intermediate	0.57	intermediate	0.14	very low
KOTA PALANGKA RAYA	0.31	low	0.59	intermediate	0.23	low

22. Province of Kalimantan Selatan

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
TANAH LAUT	0.15	very low	0.11	very low	0.37	low
KOTA BARU	0.16	very low	0.70	high	0.13	very low
BANJAR	0.14	very low	0.60	high	0.19	very low
BARITO KUALA	0.16	very low	0.43	intermediate	0.17	very low
TAPIN	0.16	very low	0.52	intermediate	0.14	very low
HULU SUNGAI SELATAN	0.14	very low	0.72	high	0.28	low
HULU SUNGAI TENGAH	0.15	very low	0.70	high	0.20	very low
HULU SUNGAI UTARA	0.16	very low	0.63	high	0.25	low
TABALONG	0.15	very low	0.49	intermediate	0.13	very low
TANAH BUMBU	0.17	very low	0.36	low	0.16	very low
BALANGAN	0.16	very low	0.61	high	0.15	very low
KOTA BANJARMASIN	0.11	very low	0.61	high	0.42	intermediate
KOTA BANJAR BARU	0.13	very low	0.56	intermediate	0.18	very low

23. Province of Kalimantan Timur

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
PASER	0.16	very low	0.64	high	0.28	low
KUTAI BARAT	0.28	low	0.59	intermediate	0.21	low
KUTAI KARTANEGARA	0.23	low	0.79	high	0.29	low
KUTAI TIMUR	0.31	low	0.58	intermediate	0.31	low
BERAU	0.27	low	0.60	intermediate	0.20	low
MALINAU	0.34	low	0.44	intermediate	0.12	very low
BULUNGAN	0.31	low	0.67	high	0.17	very low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
NUNUKAN	0.30	low	0.72	high	0.26	low
PENAJAM PASER UTARA	0.19	very low	0.66	high	0.26	low
TANA TIDUNG	0.33	low	0.40	intermediate	0.10	very low
KOTA BALIKPAPAN	0.08	very low	0.09	very low	0.43	intermediate
KOTA SAMARINDA	0.21	low	0.32	low	0.61	high
KOTA TARAKAN	0.22	low	0.54	intermediate	0.46	intermediate
KOTA BONTANG	0.24	low	0.53	intermediate	0.43	intermediate

24. Province of Sulawesi Utara

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BOLAANG MONGONDOW	0.28	low	0.24	low	0.21	low
MINAHASA	0.28	low	0.73	high	0.41	intermediate
KEPULAUAN SANGIHE	0.34	low	0.66	high	0.31	low
KEPULAUAN TALAUD	0.35	low	0.08	very low	0.28	low
MINAHASA SELATAN	0.28	low	0.83	very high	0.34	low
MINAHASA UTARA	0.27	low	0.55	intermediate	0.30	low
BOLAANG MONGONDOW UTARA	0.29	low	0.71	high	0.15	very low
SIAU TAGULANDANG BIARO	0.36	low	0.25	low	0.31	low
MINAHASA TENGGARA	0.32	low	0.63	high	0.20	low
KOTA MANADO	0.38	low	0.53	intermediate	0.85	very high
KOTA BITUNG	0.32	low	0.71	high	0.47	intermediate
KOTA TOMOHON	0.35	low	0.75	high	0.54	intermediate
KOTA KOTAMOBAGU	0.29	low	0.40	low	0.21	low

25. Province of Sulawesi Tengah

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BANGGAI KEPULAUAN	0.24	low	0.34	low	0.21	low
BANGGAI	0.24	low	0.35	low	0.26	low
MOROWALI	0.19	very low	0.75	high	0.13	very

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
						low
POSO	0.41	intermediate	0.40	intermediate	0.31	low
DONGGALA	0.38	low	0.30	low	0.27	low
TOLI-TOLI	0.38	low	0.84	very high	0.33	low
BUOL	0.47	intermediate	0.33	low	0.26	low
PARIGI MOUTONG	0.33	low	0.08	very low	0.28	low
TOJO UNA-UNA	0.27	low	0.76	high	0.17	very low
KOTA PALU	0.32	low	0.74	high	0.26	low

26. Province of Sulawesi Selatan

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
SELAYAR	0.16	very low	0.78	high	0.25	low
BULUKUMBA	0.18	very low	0.27	low	0.21	low
BANTAENG	0.21	low	0.59	intermediate	0.28	low
JENEPONTO	0.21	low	0.73	high	0.27	low
TAKALAR	0.20	low	0.49	intermediate	0.36	low
GOWA	0.16	very low	0.48	intermediate	0.27	low
SINJAI	0.18	very low	0.79	high	0.24	low
MAROS	0.15	very low	0.52	intermediate	0.31	low
PANGKAJENE DAN KEPULAUAN	0.13	very low	0.44	intermediate	0.26	low
BARRU	0.17	very low	0.67	high	0.27	low
BONE	0.14	very low	0.71	high	0.17	very low
SOPPENG	0.13	very low	0.36	low	0.16	very low
WAJO	0.14	very low	0.31	low	0.25	low
SIDENRENG RAPPANG	0.13	very low	0.53	intermediate	0.14	very low
PINRANG	0.15	very low	0.37	low	0.22	low
ENREKANG	0.16	very low	0.31	low	0.18	very low
LUWU	0.16	very low	0.38	low	0.22	low
TANA TORAJA	0.14	very low	0.71	high	0.20	low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
LUWU UTARA	0.18	very low	0.85	very high	0.18	very low
LUWU TIMUR	0.19	very low	0.25	low	0.19	very low
KOTA MAKASSAR	0.12	very low	0.24	low	0.38	low
KOTA PARE-PARE	0.14	very low	0.59	intermediate	0.40	intermediate
KOTA PALOPO	0.17	very low	0.57	intermediate	0.37	low

27. Province of Sulawesi Tenggara

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BUTON	0.25	low	0.28	low	0.27	low
MUNA	0.23	low	0.40	intermediate	0.25	low
KONAWE	0.23	low	0.38	low	0.23	low
KOLAKA	0.18	very low	0.66	high	0.14	very low
KONAWE SELATAN	0.22	low	0.56	intermediate	0.20	low
BOMBANA	0.22	low	0.62	high	0.16	very low
WAKATOBI	0.23	low	0.47	intermediate	0.20	low
KOLAKA UTARA	0.17	very low	0.57	intermediate	0.22	low
BUTON UTARA	0.25	low	0.27	low	0.19	very low
KONAWE UTARA	0.26	low	0.74	high	0.16	very low
KOTA KENDARI	0.17	very low	0.87	very high	0.51	intermediate
KOTA BAU-BAU	0.24	low	0.42	intermediate	0.38	low

28. Province of Gorontalo

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
BOALEMO	0.40	low	0.43	intermediate	0.24	low
GORONTALO	0.39	low	0.50	intermediate	0.28	low
POHUWATO	0.43	intermediate	0.32	low	0.24	low
BONE BOLANGO	0.35	low	0.25	low	0.29	low
GORONTALO UTARA	0.41	intermediate	0.78	high	0.27	low
KOTA GORONTALO	0.33	low	0.60	high	0.43	intermediate

29. Province of Sulawesi Barat

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
MAJENE	0.18	very low	0.77	high	0.12	very low
POLEWALI MANDAR	0.16	very low	0.32	low	0.19	very low
MAMASA	0.18	very low	0.74	high	0.17	very low
MAMUJU	0.19	very low	0.68	high	0.19	very low
MAMUJU UTARA	0.27	low	0.70	high	0.18	very low

30. Province of Maluku

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
MALUKU TENGGARA BARAT	0.22	low	0.68	high	0.21	low
MALUKU TENGGARA	0.20	low	0.62	high	0.17	very low
MALUKU TENGAH	0.17	very low	0.59	intermediate	0.16	very low
BURU	0.16	very low	0.55	intermediate	0.13	very low
KEPULAUAN ARU	0.25	low	0.66	high	0.17	very low
SERAM BAGIAN BARAT	0.23	low	0.56	intermediate	0.20	low
SERAM BAGIAN TIMUR	0.22	low	0.24	low	0.17	very low
KOTA AMBON	0.15	very low	0.24	low	0.28	low
KOTA TUAL	0.22	low	0.66	high	0.14	very low

31. Province of Maluku Utara

DISTRICT	Malaria		DHF		Diarrhea	
	Score	Risk	Score	Risk	Score	Risk
HALMAHERA BARAT	0.49	intermediate	0.60	intermediate	0.24	low
HALMAHERA TENGAH	0.54	intermediate	0.31	low	0.26	low

DISTRICT	Malaria		DHF		Diarrhea	
	Score	Risk	Score	Risk	Score	Risk
KEPULAUAN SULA	0.28	low	0.37	low	0.08	very low
HALMAHERA SELATAN	0.50	intermediate	0.37	low	0.27	low
HALMAHERA UTARA	0.44	intermediate	0.46	intermediate	0.27	low
HALMAHERA TIMUR	0.63	high	0.46	intermediate	0.29	low
KOTA TERNATE	0.36	low	0.65	high	0.41	intermediate
KOTA TIDORE KEPULAUAN	0.40	low	0.60	intermediate	0.24	low

32. Province of Irian Jaya Barat

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
FAKFAK	0.37	low	0.61	high	0.13	very low
KAIMANA	0.42	intermediate	0.60	high	0.15	very low
TELUK WONDAMA	0.72	high	0.68	high	0.14	very low
TELUK BINTUNI	0.21	low	0.61	high	0.07	very low
MANOKWARI	0.37	low	0.72	high	0.22	low
SORONG SELATAN	0.37	low	0.40	intermediate	0.08	very low
SORONG	0.73	high	0.73	high	0.21	low
RAJA AMPAT	0.59	intermediate	0.57	intermediate	0.14	very low
KOTA SORONG	0.42	intermediate	0.83	very high	0.48	intermediate

33. Province of Papua

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
MERAUKE	0.19	very low	0.24	low	0.11	very low
JAYAWIJAYA	0.71	high	0.15	very low	0.41	intermediate
JAYAPURA	0.82	very high	0.82	very high	0.19	very low
NABIRE	0.58	intermediate	0.69	high	0.19	very low
YAPEN WAROPEN	0.88	very high	0.67	high	0.29	low
BIAK NUMFOR	0.82	very high	0.70	high	0.27	low
PANIAI	0.48	intermediate	0.29	low	0.20	low
PUNCAK JAYA	0.51	intermediate	0.08	very low	0.24	low

DISTRICT	Malaria		Diarrhea		DHF	
	Score	Risk	Score	Risk	Score	Risk
MIMIKA	0.84	very high	0.36	low	0.40	low
BOVEN DIGOEL	0.81	very high	0.73	high	0.20	very low
MAPPI	0.59	intermediate	0.73	high	0.20	low
ASMAT	0.50	intermediate	0.59	intermediate	0.41	intermediate
YAHUKIMO	0.35	low	0.69	high	0.10	very low
PEGUNUNGAN BINTANG	0.36	low	0.44	intermediate	0.09	very low
TOLIKARA	0.44	intermediate	0.43	intermediate	0.23	low
SARMI	0.60	high	0.20	low	0.42	intermediate
KEEROM	0.97	very high	0.57	intermediate	0.22	low
WAROPEN	1.00	very high	0.77	high	0.32	low
SUPIORI	0.83	very high	0.76	high	0.32	low
MAMBERAMO RAYA	0.83	very high	0.08	very low	0.25	low
KOTA JAYAPURA	0.47	intermediate	0.17	very low	0.28	low