Indonesia's National REDD+ Strategy—Carbon and Beyond

SATGAS REDD+
SATUAN TUGAS PEMBENTUKAN KELEMBAGAAN

The vision, the strategic intent

Indonesia's National REDD+ Strategy will be used to translate the country's vision and strategic intent for development into actionable steps for the next 25 years. It is based on current realities, reflecting on past performances, and capitalizes on resources available today and in the foreseeable future.

The vision for Indonesia's development is to be smart, sustainable and equitable:

- Smart: Policies and practices will be designed and implemented for speed, effectiveness and enforce accountability
- Sustainable: Policies and practices will address the economic, social and environmental bottom lines
- Equitable: Policies and practices will ensure opportunities for all and addresses social justice

The strategic intent is to achieve sustainable economic growth of 7 percent per annum or more and reduce overall emission levels by 41% against the Business As Usual level by 2020, while at the same time, protect the country's rich biodiversity and respect the plurality of its population profile and needs.

The baseline foundation

Indonesia's development in the past has been characterized by the desire to grow at a high speed by utilizing its natural resources as its critical competitive advantage. While the general trend shows this strategy has been effective in achieving the targeted growth rate, the social and environmental costs have not been small. Depletion of natural resources, by way of minerals and standing forest, has been very rapid, and downstream economic development has been very slow. Low value-adding economic activities have caused wide disparity of income, and have been inadequate in providing opportunities for skill and capacity development. The reliance on quick returns from exploiting natural resources has raised concerns regarding the nation's inability to develop 21th century competitive advantages, where resources and technology are collectively used as tools for growth, in a manner that advances prosperity for the people, job creation and environment protection.

Future generations cannot afford to continue on this path. A change is needed, and this National REDD+ Strategy is an attempt to initiate this by addressing one of the largest global challenges of our time, Climate Change, through of Reducing Emission from Deforestation and forest Degradation (REDD+)

REDD+ is a United Nations Framework Convention on Climate Change (UNFCCC) agreed term to address the issue of carbon emission from the forest and peatland. While on a global scale this source of emission contributed some 14% of the world's total carbon emission, the picture is more significant in the case of Indonesia. It has contributed 68% to Indonesia's total emissions in 2005, and even as the emissions from other sectors, particularly Energy, Transportation and Waste, is projected to grow at an alarmingly rapid rate, the forestry sector will still contribute more than 54% of emissions in 2020. A significant impact strategy to reduce the forest-related emission is therefore critical to the achievement of the overall national emission reduction target.

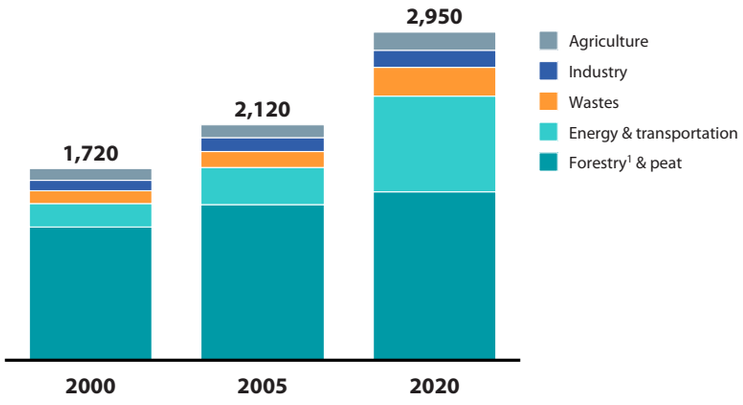
"These rainforests are a critical part of the solution to global warming. Mitigation is only half of the picture; the other half is preserving and expanding the carbon sinks. I believe that the next global climate regime must have a very strong forestry component in it."

"Protecting these forests—the lungs of the earth — is a top priority for my Government. Protecting our forests is a key to low carbon development path".

INDONESIA'S PRESIDENT
SUSILO BAMBANG YUDHOYONO

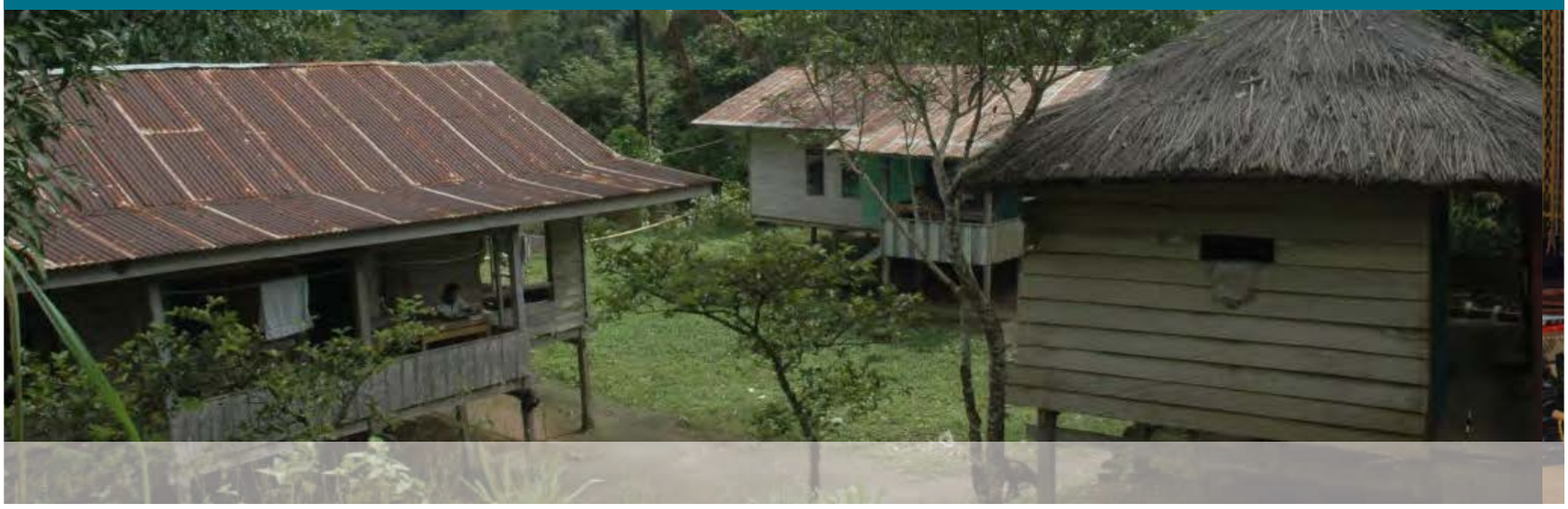
Emissions are dominated by forestry and peat

Projected business-as-usual emissions
Million tons CO2 emissions



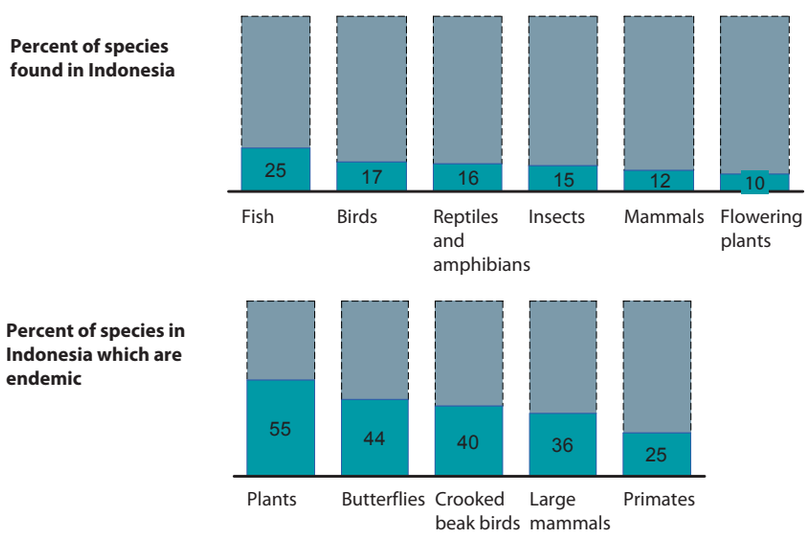
Source: Indonesia's Second National Communication to UNFCCC

Indonesia's commitment to emission reduction and its clear intent to significantly improve its way of managing the forest has drawn the attention of the international world. Norway, beyond the general bilateral and multilateral support to Indonesia's development provided by the international community of nations, has gone one step ahead and signed a Letter of Intent with Indonesia to support the development and implementation of Indonesia's REDD+ Strategy. Ideas were jointly developed and resource requirement for initial implementation identified.



Any intervention to the forest will have implications on its balance. Indonesia's tropical forest is home to a significant number of the world's biological asset. Protecting these is not less critical than addressing the issue of carbon. While the debate regarding the exact value and global impact of diminishing biological assets is still ongoing, not considering these factors seriously now will be mirroring our mistake of not focusing on the carbon issue twenty five years ago. Unfortunately the richness of the land's biodiversity is not in total alignment with where the highest carbon content or absorption potentials are. For example, peatlands are poorer in biodiversity as compared to the mineral soil based natural forest. The Indonesian REDD+ Strategy hence considers the issue of biodiversity, together with sustainable management of the forest and carbon enhancement.

Indonesia has unparalleled biodiversity and is home to the world's species



REDD+ strategy and measures

Coverage of the REDD+ Strategy

The Indonesian REDD+ Strategy covers a wide range of issues related to the health of the forest, which is seen as the last standing terrestrial carbon sink asset of the world. The first approach of the strategy will cover the analysis and strategic direction in addressing the issue of carbon emission reduction. It will be followed by a similar approach on biodiversity, sustainable forest management and carbon enhancement. Ultimately, the Action Plan, monitoring and evaluation will consider emissions, along with other forest related matters, as an integrated issue and provide a holistic solution to the problem. As a national priority, the national REDD+ program will be under the direct control and leadership of the President of Indonesia.

REDD+ mission and guiding principles

Mission

The mission of REDD+ strategy is to lay the ground for a **5-year roadmap** for Indonesia to **reduce CO_2 emissions,** from deforestation and forest degradation, and **preserve biodiversity** while **growing at an economically sustainable rate**

Guiding principles of REDD+ strategy

Impact focused	Focus on levers that will reduce CO_2 emissions from deforestation and forest degradation and preserve biodiversity
Inclusive & social responsible	Involve the community through a multi-stakeholder management process, and distribute benefits of REDD+ amongst forest-based communities, local communities and the private sector
Economically sustainable	Promote initiatives and programs that are cost-efficient and promote environmental-friendly economic activities

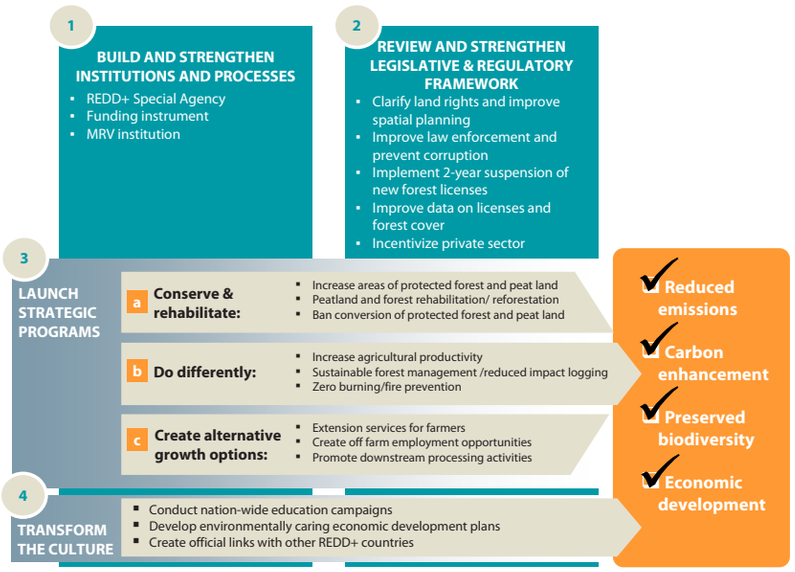
Framing the REDD+ strategy

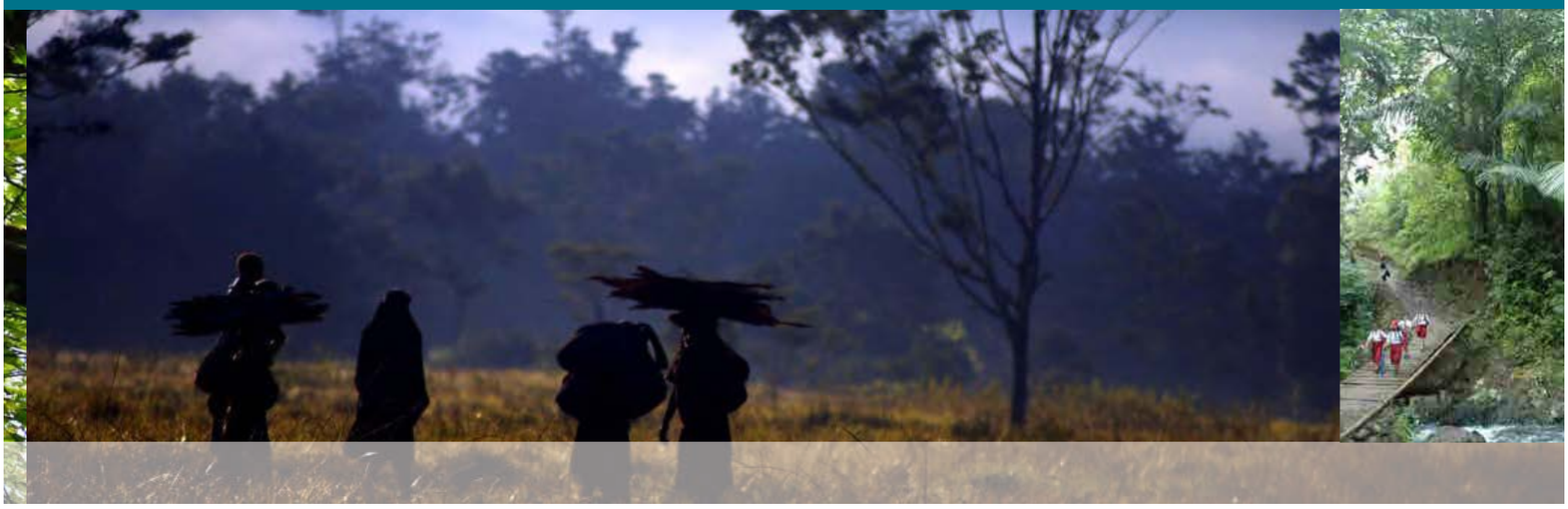
The Indonesian REDD+ strategy consists of four pillars:

1. Build REDD+ institutions and processes
2. Review and strengthen existing regulations, processes, and capacities
3. Launch strategic programs to promote environmentally-friendly economic activities to ensure sustainable economic growth
4. Transform the culture and create the shift in paradigm

The implementation of the strategy will require high-level coordination across ministries and will be coordinated by Indonesia's newly established REDD+ Special Agency, which will report to the office of the President of Indonesia.

The REDD+ strategy is based on 4 strategic pillars





1. Build and strengthen institutions and processes

In order to implement a national REDD+ program, it is necessary to create new institutions and processes. This includes establishing a REDD+ Special Agency, which will oversee a multi-stakeholder consultation process, a special-purpose funding instrument, and a measuring, reporting, and verification (MRV) system. Guidelines will be developed to ensure an equitable distribution of benefits from the national REDD+ program.

REDD+ Special Agency

The REDD+ Special Agency will facilitate and coordinate the implementation of REDD+ in a transparent manner. It will have both coordinating and implementing authority and will work with relevant line ministries and regional governments to implement programs. The Agency is scheduled to be staffed and operational by the middle of 2011. The agency's main roles will be to:

- Develop and drive the REDD+ strategy
- Define and direct the management and disbursement of funds through the funding instrument in accordance with the REDD+ strategy
- Register, approve and monitor strategic programs and projects at national and provincial level
- Monitor performance of REDD-related institutions, including in law enforcement
- Shape and improve the REDD+ regulatory and legal framework
- Coordinate public awareness, communications and multi-stakeholder consultation and engagement efforts
- Create and enforce mechanisms to ensure integrity through audits and anti-corruption mechanisms
- Ensure environmental and social safeguards of REDD+ programs
- Define and implement a benefit-sharing system to ensure forest communities are protected and benefit from Indonesia's development

Funding Instrument

The funding instrument will play the role of a "custodian" of the funds. It will provide support in attracting funds, managing funds and will have the ability to distribute funds to the grounds, either by itself or in cooperation with other institutions.

The funding instrument will consist of an internationally credible institution and a method to channel funds from multiple sources to the projects and programs consistent with the REDD+ Strategy. It will provide a channel for funds supporting REDD+ in Indonesia.

The instrument will meet international fiduciary standards of transparency and integrity and also contain a fiduciary safeguard component to ensure proper utilization of funds. It will include fair representation of stakeholders in a consultative process.

Once the REDD+ regulatory framework is in place and new institutions and capacities are developed, the funding instrument will channel payment for strengthening institutions and capabilities and for delivery of verified emissions reductions. It is scheduled to be operational by the first half of 2011.

Measuring, Reporting and Verification (MRV) System

The MRV system's mandate is to provide measurement from all parts of the REDD+ scheme, including emissions from deforestation and degradation as well as conservation, sustainable forest management and enhancement of forest carbon stocks. Data collected by the MRV Agency will be accessible by the public. An external, independent company will audit and verify the reported data.

The MRV agency is scheduled to be staffed and operational by the middle of 2011. Important tasks of the MRV agency will be to refine data collection protocols, coordinate data integration of existing ongoing activities, and ensure new data collection efforts. The MRV agency will serve as a coordinating agency, building on key data received from other government entities. It will work toward building capabilities beyond the measurement of carbon to include other aspects such as biodiversity.

An Indonesia-wide MRV system will be fully operational by December 2013. The MRV system will provide the national reference emission levels (RELs) and allow for contributions-for-verified emission reductions.

2. Review and strengthen legislative and regulatory framework

The process of reviewing and strengthening regulations, legislations and policies will include clarifying land tenure rights; improving spatial planning, law enforcement, and licensing and land management; announcing and enforcing a 2 year suspension of new forest conversion licenses; fighting corruption; and creating incentive mechanisms for the private sector to stimulate low-carbon economic growth. Such processes will have benefits well beyond their support for REDD+ activities.

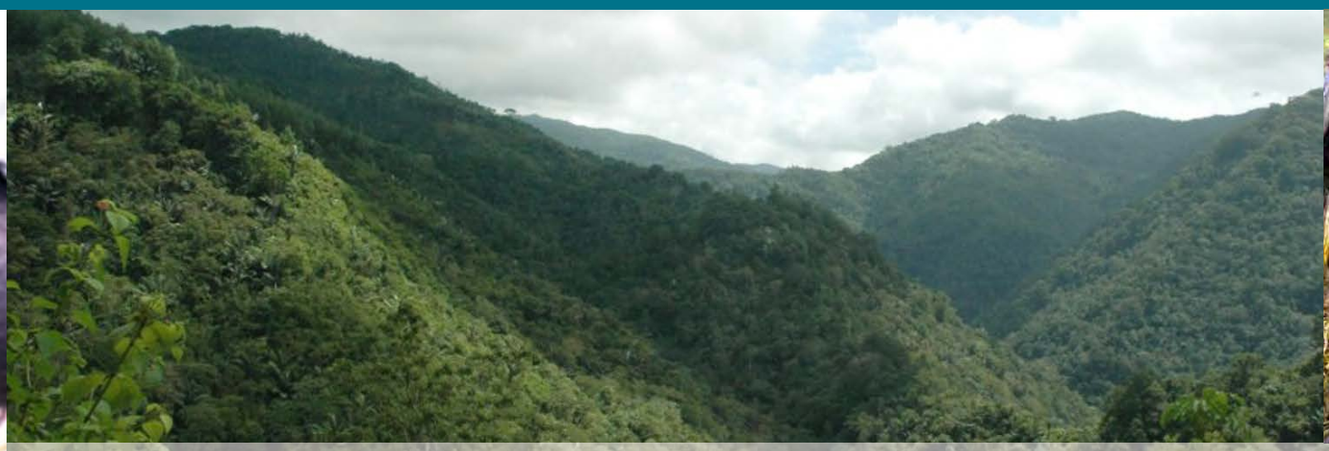
Clarify land tenure

Settling land tenure issues will include clarifying the status and borders of forest areas, recognizing the rights of indigenous groups and forest-based communities to their land, and providing a system to address land conflicting claims.

Capacity will be increased by employing and training specialized surveyors and establishing a land claims court. The legal basis and protocol for addressing land claims will also be refined and transparency of procedures, protocols and results increased to ensure a fair legal process.

Improve spatial planning

The REDD+ strategy will provide proactive input into the spatial planning process. Guidelines on how to develop strategies for low carbon economic growth will be provided, and spatial plans will be assessed in terms of their environmental impact, which will include



the impact on deforestation, degradation, and GHG emissions.

Improving spatial planning involves collecting better spatial, socio-economic, and biophysical data and information; using this to inform and align the strategies of the forestry, agriculture, and mining sectors; and incorporating a sustainability agenda into regional and national spatial plans.

A protocol for data collection will be established, leveraging existing capabilities within relevant institutions. A centralized institution will coordinate the collection and codification of this data, and provide it to the relevant line ministries and central and regional governments. The development of a database of degraded land will be one of the areas of priority in this process.

Improve licensing and forest governance

Essential components involved in improving the effectiveness of forest and peatland management in Indonesia include effective forest administration, good governance, and good legal policy.

The effectiveness of forest administration will be improved through better organization and improving capacity and integrity of forest managers.

Good forest governance will be achieved by increasing transparency in the processes of drafting legislation, decision-making, and licensing; involving local governments and affected communities; and providing effective conflict resolution mechanisms.

Improving legal policy includes aligning legislation in the land use sectors, amending and/or reforming laws and regulations related to protection of peatland in all sectors, and improving technical rules to ensure that effective checks are applied against the violators of forests and peatlands.

Improve law enforcement and forest monitoring

Improving forestry monitoring and law enforcement requires developing the ability to detect non-compliance and illegalities, developing the ability to respond to results of detection, and improving the ability to enforce penalties.

One measure to improve monitoring is a reporting system to allow the public to report non-compliance and illegal activities. At the same time, the capacity of current law enforcement personnel will be increased by procuring equipment, developing technical capabilities, and recruiting more law enforcement officials.

Possible enforcement systems to be employed could include the One Roof Enforcement System (ORES) and a “green bench”.

ORES allows for greater coordination and efficiency by placing law enforcement officials and the investigation and prosecution process into one system and ensuring that highly capable individuals with relevant environmental and forestry knowledge are recruited.

A green bench consisting of judges with relevant knowledge and skills can be established to preside over environmental and forestry cases. This will include appointing special judges, who have good understanding

of the forestry sector and sustainable development and have proven track records, to preside over forestry cases, and establishing special units for environmental and forestry issues at each level of the judiciary.

A system of cooperation will need to be established with neighboring countries in order to address cross-border issues. This will include establishing protocols and procedures for monitoring and prosecution of illegal activities.

Announce and enforce a two-year suspension

In early 2011 the government will announce a two-year suspension on new forest and peatland licenses. This suspension is a short-term measure that will create a "pause" and ensure minimal deforestation and land degradation while the REDD+ strategy is being put into action, solving for the underlying issues such as spatial planning and land tenure, and building the new REDD-related institutions. These two years will provide time to develop solutions that are aligned with an economically sustainable development philosophy.

3. Launch strategic programs

There are 3 main categories of programs:

a. Conserve & rehabilitate: these programs are primarily focused on reduction of GHG emissions of forest and peatland, on carbon enhancement activities and on preservation of biodiversity. Examples include: increasing areas of protected forest and peat land, rehabilitation of peatland, reforestation and banning the conversion of protected forest and peat land

b. Do differently: these programs target existing practices in economically productive sectors. The aim is to continue economically productive activities but make changes to lessen the impact on the environment and reduce/enhance GHG emissions. Examples include: increasing agricultural productivity (so less land expansion is needed to grow the economy), sustainable forest management (e.g. reduced impact logging) and zero burning/ fire prevention

c. Create alternative growth options: these programs consist of creating new drivers of economic growth while keeping GHG emissions low and preserving our biodiversity. Examples of these programs include: shifting new agricultural production onto already degraded lands, creating off-farm employment opportunities, and creating new value-added activities in agriculture, energy and other sectors, in particular through the development of downstream processing.

4. Transform the culture

The REDD+ strategy cannot limit itself to building institutions, changing laws and launching programs. This strategy requires a fundamental shift in paradigm and Indonesia will put substantial efforts to make this shift happen. For the government of Indonesia to transform the culture, multiple actions will take place, such as:

- Conducting nation-wide education campaigns in partnership with other organizations and the REDD+ related institutions
- Building relationships with other REDD+ implementing countries and learning with them
- Embedding an "environmental caring philosophy" in the country's approach to economic development plans
- Promoting and rewarding environmentally friendly activities

Implementing the REDD+ strategy

The REDD+ strategy will be implemented on the principles of inclusiveness, transparency and efficiency.

2011 will see the start of implementation of REDD+ in at least one pilot province. Joint-planning with the province will be inherent to achieve full implementation, e.g. plan to preserve biodiversity. This province will be selected on based on governance, amount of peat and forest cover, threat of deforestation and preexisting relevant data and infrastructure. Support and resources will be concentrated in the province to gain a better understanding of challenges involved in REDD+ implementation, and the policies, incentives and mechanisms that will be required. During this time, the REDD+ Special Agency and the MRV Agency will work closely with the province to capture learnings, which will allow for greater chances of success for the national program. For example, the sub-national MRV system will be built to a Tier 2 level, and will become the learning sources to develop national level MRV later on.

In parallel, the REDD+ strategy will be rolled out at the national level. Further economic and feasibility analyses will be conducted and the timing for implementation of the various components of the strategy will be determined based on pre-existing conditions and capabilities, time needed for planning and coordination, and the evolving balance between Indonesia's multiple development objectives.

DEVELOPMENT OF INDONESIA'S NATIONAL REDD+ STRATEGY – A MULTI-STEP, MULTI-STAKEHOLDER PROCESS

In order to formulate an effective and transparent national strategy, a multi-stakeholder consultation process was employed to ensure sufficient dissemination of the strategy and collection of feedback from relevant stakeholder groups. This process consisted of regional and national consultations and national and international expert workshops.

In 2010, seven regional consultations were conducted across the major affected provinces of Sumatra, Java, Kalimantan, Sulawesi, Bali, and Papua. Participants included government officials from the district (Kabupaten) and provincial levels, heads of NGOs in the regions, representatives of local businesses, scholars from local universities, and indigenous people groups. These consultations, which lasted two days each, allowed all relevant stakeholders to convene in a common location and provide input on the strategy.

The strategy was modified based on input gathered in the regional consultation process and then disseminated to national and international experts in the last quarter of 2010. These experts, who hailed from academia, NGOs, multilateral organizations, and government, convened in workshops to provide feedback, which was then incorporated into the final strategy.

Printed on 100% recycled paper

This document was prepared by the Indonesian REDD+ Task Force
December 2010
Photo credits: GEF SGP; Anak Agung Gde Agung Widharmika

Republic of Indonesia

Indonesia Climate Change Sectoral Roadmap

ICCSR

Synthesis Report

March 2010

Badan Perencanaan Pembangunan Nasional
(BAPPENAS)

Jl. Taman Suropati No. 2
Jakarta Pusat 10310
www.bappenas.go.id

ISBN 978-979-3764-49-8
1st Edition

Printed in Indonesia

AUTHORS

Indonesia Climate Change Sectoral Roadmap - ICCSR

Adviser

Prof. Armida S. Alisjahbana, Minister of National Development Planning/Head of Bappenas

Editor in Chief

U. Hayati Triastuti, Deputy Minister for Natural Resources and Environment, Bappenas

ICCSR Coordinator

Edi Effendi Tedjakusuma, Director of Environmental Affairs, Bappenas

Editors

Irving Mintzer, Syamsidar Thamrin, Heiner von Luepke, Philippe Guizol, Dieter Brulez

Synthesis Report

Coordinating Authors: Mitigation: Hardiv Haris Situmeang; Adaptation: Djoko Santoso Abi Suroso

Scientific Basis and Sectoral Reports

Authors: Ibnu Sofian, Tri Wahyu Hadi, Hardiv Haris Situmeang, Meirios Moechtar, Wendranirsa, Iwan Adhisaputra, Nur Masripatin, Ngaloken Gintings, I Wayan Susi Darmawan, Asep Sofyan, Enri Damanhuri, Agus Wahyudi, Endang Supraptini, Anandita Laksmi Susanto, Anja Rosenberg, Nicolette Boele, Bona Frazila, Ko Sakamoto, Irawan, Oman Abdurrahman, Budhi Setiawan, Supratman Sukowati, Juli Soemirat Slamet, Hamzah Latief, M. Suhardjono Fitrianto, Wilmar Salim, Eleonora Runtunuwu, Medrilzam.

Technical Supporting Team

Chandra Panjiwibowo, Indra Ni Tua, Edi Riawan, Wahyunto, Hendra Julianto, Leyla Stender, Tom Harrison, Ursula Flossmann-Krauss

Administrative Team

Altamy Chrysan Arasty, Risnawati, Rinanda Ratna Putri, Siwi Handinah, Wahyu Hidayat, Eko Supriyatno, Rama Ruchyama, Arlette Naomi, Maika Nurhayati, Rachman

ACKNOWLEDGMENTS

The Indonesia Climate Change Sectoral Roadmap (ICCSR) is meant to provide inputs for the 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.

High appreciation goes to Mrs. Armida S. Alisyahbana as Minister of National Development Planning / Head of the National Development Planning Agency (Bappenas) for the support and encouragement. Besides, Mr. Paskah Suzetta as the Previous Minister of National Development Planning/ Head of Bappenas who initiated and supported the development of the ICCSR, and Deputy Minister for Natural Resources and Environment, Ministry of National Development Planning /Bappenas, who initiates and coordinates the development of the ICCSR.

To the following steering committee, working groups, and stakeholders, who provide valuable comments and inputs in the development of the ICCSR document, their contributions are highly appreciated and acknowledged:

Steering Committee (SC)

Deputy of International Cooperation, Coordinating Ministry for Economy; Secretary of Minister, Coordinating Ministry for Public Welfare; Deputy of Demography, Health, and Environment, Coordinating Ministry of Public Welfare; Secretary General, Ministry of Energy and Mineral Resources; Secretary General, Ministry of Forestry; Secretary General, Ministry of Agriculture; Secretary General, Ministry of Marine and Fisheries; Secretary General, Ministry of Public Works; Secretary General, Ministry of Industry; Secretary General, Ministry of Transportation; Secretary General, Ministry of Health; Secretary of Minister, Ministry of Environment; Executive Secretary, Agency for Meteorology, Climatology; Deputy of Economy, Deputy of Infrastructures, Deputy of Development Funding, Deputy of Human Resources and Culture, Deputy of Regional Development and Local Autonomy, National Development Planning Agency; and Chief of Secretariat of the National Council for Climate Change.

Working Group

Ministry of Agriculture

Gatot Irianto, Irsal Las, Mappaona, Astu Unadi, Elza Sumairni, Aris Pramudia, Suryo Wiyono, Sony Sumaryanto, Setiari Marwanto, Bambang Budiarto, Pamella Fadhilah, Andriarti. K, Anna, Tri Aris, M. Aosyad. M, Elza Surmarni

Ministry of Energy and Resources

FX. Sutijastoto, Maritje Hutapea, Bambang Praptono, Djoko Prasetyo, Muhammad Ikbal Nur, Agus Rianto, Arief Sugiyanto, Rizky Chandra Gita Lestari, Mira Suryastuti, Inayah Fatwa. K, Deszri Runostari, Bambang Edi. P, Heri Nurjito, Asep Hermawan

Ministry of Environment

Sulistyowati, Haneda Sri Mulyanto, Dadang Hilman, Upik S. Aslia, Agus Gunawan, Yulia Suryanti

Ministry of Forestry

Sunaryo, Wandojo, Hilman Nugroho, Ernawati, Bambang Edy Purwanto, Bambang Soepijanto, Haryadi, M. Ali Arsyad, Yuyu Rahayu, Adi Susmianto, Harry Santoso, Maman Mansyur Idris, R. Iman Santoso, Wardoyo, Adi Nugroho, Ernawati, Magdalena, Agung Gunardo, Ari Sylvia, Achmad. P, Yudi, Nining

Ministry of Health

Wan Alkadri, Budi Sampurno, Sri Endah S., Ann Natallia, Tutut Indra Wahyuni, Slamet, Mukti Rahadian, Sonny Narou, Martini. M, Dirman Siswoyo, Agus Handito, Winarno

Ministry of Industry

Imam Haryono, Endang Supraptini, Yasmita, Zurlasni, A Juanda, A. Wahyudi, Rochmi. W, Lilih. H, Agung Gunardo, Yudhi Syahputra

Ministry of Marine and Fisheries

Gellwyn Yusuf, Subandono Diposaptono, Ida Kusuma Wardhaningsih, Budi Sugianti, M. Eko Rudianto, Sunaryanto, Toni Ruchima, Umi Windriani, Agus Supangat, Budiasih Erich, Wany Sasmito, Firman. I, T. Bambang Adi, M Yusron, Setiawan

Ministry of Public Works

Djoko Murjanto, Mochammad Amron, Susmono, A. Hasanudin, Djoko Mursito, Handy Legowo, Setya Budi Algamar, Agus S.K, Adelia Untari.S, Leonardo B, Desfitriana, Devina Suzan, Nur. F. K, Agung. T, Rindy Farrah, Yuke Ratnawulan, Zubaidah. K, Savitri. R

Ministry of Transportation

Wendy Aritenang, Santoso Edi Wibowo, Balkis K., Saladin, Endang Rosadi, Rudi Adiseta, Suwarto, Dyah C. Pitaloka, Imam Hambali, Danawiryya. S, Eka Novi Adrian, Tutut. M, Yuki Hasibuan, Yusfandri, Ira J

National Development Planning Agency

Sriyanti, Yahya R. Hidayat, Bambang Prihartono, Mesdin Kornelis Simarmata, Arum Atmawikarta, Montty Girianna, Wahyuningsih Darajati, Basah Hernowo, M. Donny Azdan, Budi Hidayat, Anwar Sunari, Hanan Nugroho, Jadhie Ardajat, Hadiat, Arif Haryana, Tommy Hermawan, Suwarno, Erik Amundito, Rizal Primana, Nur H. Rahayu, Pungki Widiaryanto, Maraita, Wijaya Wardhana, Rachmat Mulyanda, Andiyanto Haryoko, Petrus Sumarsono, Maliki,

Agency for Meteorology, Climatology and Geophysics

Edvin Aldrian, Dodo Gunawan, Nurhayati, Soetamto, Yunus S, Sunaryo

National Institute of Aeuronatics and Space

Agus Hidayat, Halimurrahman, Bambang Siswanto, Erna Sri A, Husni Nasution

Research and Implementatiton of Technology Board

Eddy Supriyono, Fadli Syamsuddin, Alvini, Edie P

National Coordinating Agency for Survey and Mapping

Suwahyono, Habib Subagio, Agus Santoso

Universities and Professionals

ITB: Saut Lubis, Safwan Hadi, Retno Gumilang, Arwin Sabar; IPB: Rizaldi Boer, Handoko, Dietriech Geoffrey Bengen, Hariadi Kartodiharjo; UI: Budi Haryanto; Asia Carbon: Architrandi Priambodo, Susy Simarangkir; Dishidros, TNI-AL: Letkol Ir. Trismadi, MSi; LIPI: Wahyoe Hantoro; KNI WEC: Aziz Trianto

Grateful thanks to all staff of the Deputy Minister for Natural Resources and Environment, Ministry of National Development Planning/ Bappenas, who were always ready to assist the technical facilitation as well as in administrative matters for the finalization process of this document.

The development of the ICCSR document was supported by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) through its Study and Expert Fund for Advisory Services in Climate Protection and its support is gratefully acknowledged.

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 2°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

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

3R	Reduce, Reuse, Recycle
ADT	Absolute Dynamic Topography
AMI	Annual Malaria Incidence
ANI	Indonesian National Atlas
API	Annual Parasite Incidence
APBN	State Expenditure and Revenue Budget
ASEAN	Association of South East Asian Nations
ASI	Indonesian Cement Association
Bappenas	National Development Planning Agency
BaU	Business as Usual
BMKG	Meteorology Climatology and Geophysics Agency
BPOM	Food and Drug Monitoring Agency
CCS	Carbon Capture and Storage
CERs	Certified Emission Reductions
CFR	Case Fatality Rate
CGCM	Coupled General Circulation Model
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
EN	El Nino
ENSO	El Niño Southern Oscillation
ESCO	Energy Services Companies
FAO	Food and Agriculture Organization
FNC	First National Communication
GCM	General Circulation Model
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHGe	Greenhouse Gas Emissions
GoI	Government of Indonesia
HTI	Industrial Plant Forest
HTR	Community Plant Forest
IEA	International Energy Agency
IFFM	Integrated Forest Fire Management
IPCC AR-4	Intergovernmental Panel on Climate Change Assessment Report 4
IR	Incidence Rate
JITUT	Small Agriculture Level Irrigation Network
KPH	Forest Management Units
K/L	Ministry/Agency
LN	La Nina
LUCF	Land Use Change Forestry
LULUCF	Land Use, Land Use Change and Forestry

MoMF	Ministry of Marine and Fisheries
MRI	Meteorological Research Institute
MtCO2	Million Tons Carbon Dioxide
MW	Mega Watt
NAPZA	Psychotropic Substances and Addictives
NOAA	National Oceanic and Atmospheric Agency
NO_x	Nitrogen Oxide
NPP	Nuclear Power Plant
NPV	Nett Present Value
OI	Optimum Interpolation
PTT	Integrated Crop Management
PUSKESMAS	Public Health Center
RAN-PI	National Action Plan on Climate Change
REDD	Reducing Emissions from Deforestation and Degradation
RENSTRA	Strategic Plan
RENJA	Annual Working Plan
RKP/D	Government/Regional Work Plan
RPJMN	National Medium-Term Development Plan
RPJPN	National Long-Term Development Plan
RUPTL	Master Plan for Electricity Supply
SAT	Surface Air Temperature
SC1	Scenario 1
SC2	Scenario 2
SC3	Scenario 3
SC4	Scenario 4
SFM	Sustainable Forest Management
SKPD	Regional/Local Work Apparatus Unit
SLI	Field School of Climate
SLPHT	Field School of Integrated Pest Control
SL-PTT	Field School of Integrated Crop Management
SLR	Sea Level Rise
SRA	Special Report on Aviation
SRES	Special Report on Emission Scenario
SST	Sea Surface Temperature
TNA	Technology Need Assessment
TPA	*Tempat Pemrosesan Akhir* (final solid waste disposal/landfill)
TPS	*Tempat Pengumpulan Sementara* (solid waste collection station)
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States (of America) dollars or US$
WP3K	Coastal Zones and Small Islands

1

BACKGROUND

Indonesia plays an active role in various international negotiations on climate change, and hosted the 13th Conference of the Parties to the UNFCCC in Bali, which created the Bali Action Plan. With vast coastline, high susceptibility to natural disasters, and highly vulnerable agriculture production systems, Indonesia is one of the countries that are most vulnerable to the negative impacts of climate change. Thus, Indonesia needs to be at the forefront of collective international efforts to manage the risks of global climate change.

In fact, Indonesia has a dual role in these international efforts. On the one hand, Indonesia is estimated to be one of the top ten countries in terms of GHG emissions, and thus has an important role in global GHG mitigation efforts. On the other hand, Indonesia's extensive vulnerability to the negative impacts of climate change makes adaptation a critical national priority. Aware of both aspects of the climate challenge, Indonesia recognises that mitigation and adaptation actions have to be taken jointly by all countries. Therefore Indonesia is ready to cooperate both bilaterally and multilaterally with international efforts.

Indonesia also recognizes that tackling climate change is an integral part of the development challenge facing the nation. Climate change planning cannot and should not be performed separately from national economic development planning, thus planning for both mitigation and adaptation must be integrated into all aspects of national, regional, and local development planning.

It is expected that the ICCSR serves as a detailed policy guidance and mainstreaming tool for the sectoral and cross-sectoral development programs in order to take up considerations of climate change into all aspects of development planning.

On February 5th 2007 the Indonesian Government issued Law No. 17 of 2007 on the National Long-Term Development Plan (RPJPN) for Years 2005-2025. The sixth mission statement of this document is:

"To make Indonesia wonderful and preserved by keeping the balance between utilization, sustainability, existence, and usefulness of natural resources and the environment, by protecting the function, capacity and the comfort of living in the present and the future, through balanced land use for settlement, social economic activities and conservation; augmenting the economic utilization of natural resources and environment sustainably; improving the management of natural resources and the environment to support the quality of life; providing the wonder and comfort of life; and enhancing the preservation and utilization of biodiversity as basic capital of development".

In order to achieve this vision of sustainable development, the Government of Indonesia concluded that "the long term sustainability of development will face the challenges of climate change and global warming which affect activities and livelihood".

In November 2007, the Indonesian Government published the National Action Plan on Climate Change (RAN-PI), which contains initial guidance for a multi-sectoral coordination effort designed to address

jointly the challenges of mitigation and adaptation to climate change.

In December 2007, Bappenas (the National Development Planning Agency) published a document titled **"National Development Planning: Indonesian Responses to Climate Change"[1].** The document is intended to strengthen and reinforce the RPJMN (National Medium-Term Development Plan) 2004-2009 as well as to include inputs that can guide the integration of considerations of climate change into the preparation of RPJMN 2010-2014.

To elaborate further on the documents mentioned above and also to speed up the implementation by various relevant sectors, Bappenas initiated the development of a roadmap to serve as a detailed policy guidance and in order to mainstream climate change issues into national development planning. The "Indonesia Climate Change Sectoral Roadmap" (ICCSR) will be referred to simply as The Roadmap throughout this Synthesis Report.

[1] This document was then revised in July 2008

2

APPROACH

2.1 Goals

Cimate change will create tremendous challenges for sustainable development in Indonesia. To anticipate these challenges the GOI established the Indonesia Climate Change Sectoral Roadmap (ICCSR 2010 - 2030) to set national goals, sectoral targets, milestones and priorities for actions with regards to adaptation and mitigation of climate change for all affected sectors of the economy.

The ICCSR is meant to provide inputs to the 5 year Medium-term Development Plan (RPJM) 2010-2014, and also to the subsequent RPJMN moving forward until the target year of 2029.

Furthermore, the ICCSR shall serve as detailed policy guidance for further implementation of national adaptation and mitigation responses to climate change through the development of annual government workplans in the years 2010 – 2020 and in particular to reach the national targets of 26 % and 41 % reduction in national greenhouse gas emissions, as mandated by the soon established presidential decree.

The ICCSR will guide the following initiatives:

1. a. Advanced research on the impact of climate change and the mapping of local vulnerability will be performed to strengthen the information system for adaptation in 2015.

   b. The inventory of CO_2 emissions will be refined and the target of emission reduction will be adjusted in 2015.

2. a. With the strengthening of institutional capacity to anticipate climate change impacts among national ministries and agencies by 2015, the goal of climate-proofing national policies and regulations can be achieved by 2020.

   b. The ICCSR will serve as policy guidance for decreasing emissions of greenhouse gases from the projected "business-as-usual" emissions scenario in by 26% in 2020, using the nation's domestic resources and by up to 41% from the business-as-usual scenario if adequate international support becomes available.

3. a. The successful implementation of climate change adaptation and mitigation efforts will help to advance achievement of national development goals by 2025.

   b. During this period, alternative sources of energy supply will be significantly increased, while the use of non-renewable energy sources will be proportionately reduced.

4. a. The risks of negative climate change impacts on all sectors of development will be considerably reduced by year 2030 through public awareness-raising, strengthened local capacity, improved knowledge management, and the application of adaptive technology.

   b. All sectors that contribute to greenhouse gas emissions will have adopted low-carbon development strategies and implemented them in ways that advance the prospects for balanced and sustainable development in Indonesia.

2.2 ICCSR Scope

The sector classification used in the Roadmap deviates from the standard approach recommended by the IPCC for the preparation of national communications by non-Annex 1 Parties to the UNFCCC. However, this scope was selected for the ICCSR in order to align the ICCSR effort with Indonesia's national development priorities and to support the GOI's perceived sense of urgency in developing effective responses to the risks of climate change.

The high priority sectors for adaptation actions include the following: water resources sector; marine and fisheries sector; agriculture sector; and health sector, while for mitigation, the high priority sectors consist primarily of the forestry sector; energy sector; industry sector; transportation sector; and waste sector. For the purposes of the ICCSR, the Energy Sector was divided into the power generating sector for Java-Bali and Sumatra (the main producers of energy in Indonesia) and the energy demand side of the industry, and transport sectors.

Inter-sectoral linkages. Following principally from the sectoral classification of the national development planning system, the Roadmap process included several activities designed to address inter-sectoral issues related to climate change. Workshops were held to discuss and analyze linkages between the forest, energy and agriculture sectors as well as the implications of these linkages for national security. Based on the initial findings of these workshops, a follow-up to the Roadmap will be required to address the issues related to impacts of climate change on biodiversity, energy and food security, population and gender in Indonesia. Most importantly, the issue of land use deserves greater attention in the future when seen from an inter-sectoral perspective as land use conversions are planned in the agriculture, forestry and energy sectors, the issue of future GHG emissions must be addressed. These inter-sectoral linkages and inter-dependencies will be dealt with in the follow-up process to the ICCSR. The way forward will involve integrated land-use planning that integrates consideration of climate change issues, increased institutional capacities, and enhanced enforcement mechanisms for national laws and regulations.

Regional scope. The Roadmap recognizes that, because of its diversity along physical, economic, political, and cultural dimensions, Indonesia requires region-specific approaches to national development planning. The proposed policy responses to climate change that are outlined in this ICCSR have been tailored to the specific characteristics of Indonesia's main regions: Sumatra, Jamali (Java, Madura, Bali), Kalimantan, Sulawesi, Nusa Tenggara, Maluku, and Papua.

2.3 Linkages between Climate Change Roadmap and Development Planning: approach and methodology

To ensure involvement and ownership of the Roadmap by the relevant ministries and agencies of the GoI, the development of the Roadmap has been carried out through a participatory approach involving three parties; the National Development Planning Agency (Bappenas), the individual ministries and agencies, plus the Technical Team. As a consequence, the priority activities highlighted in the Roadmap reflect the vision and priorities of each ministry and agency. Bappenas has acted primarily as a facilitator of the analytic and policy development processes.

The inter-linkages between the Climate Change Sectoral Roadmap and the National Development Planning Process are illustrated in Figure 1 below:

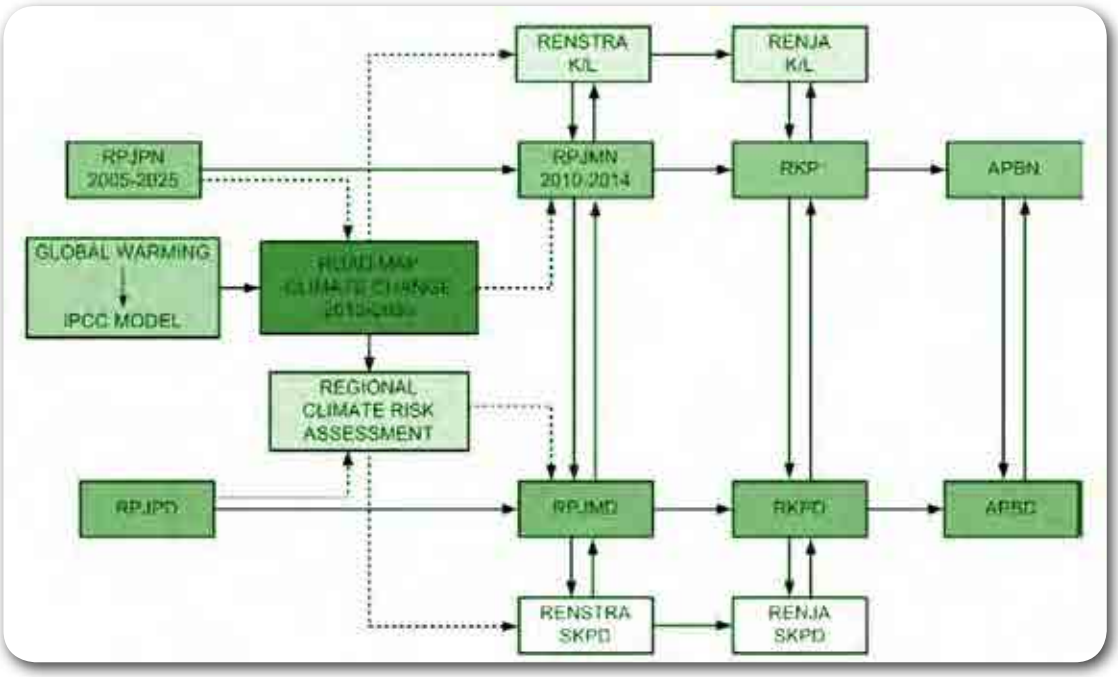


Figure 1: Inter-linkages between the Climate Change Roadmap and Development Planning

The ICCSR team has applied a risk assessment framework, beginning with the identification of climate hazards, to guide the formulation of adaptation strategies in the priority sectors. This process begins with the development of regional climate change projections, including future projections of temperature, rainfall, sea level rise, and the occurrence of extreme events. The impact of climate change on each of the priority sectors (Figure 2) is then analyzed. Priority activities for adaptation have been formulated based on the resulting understanding of potential impacts.

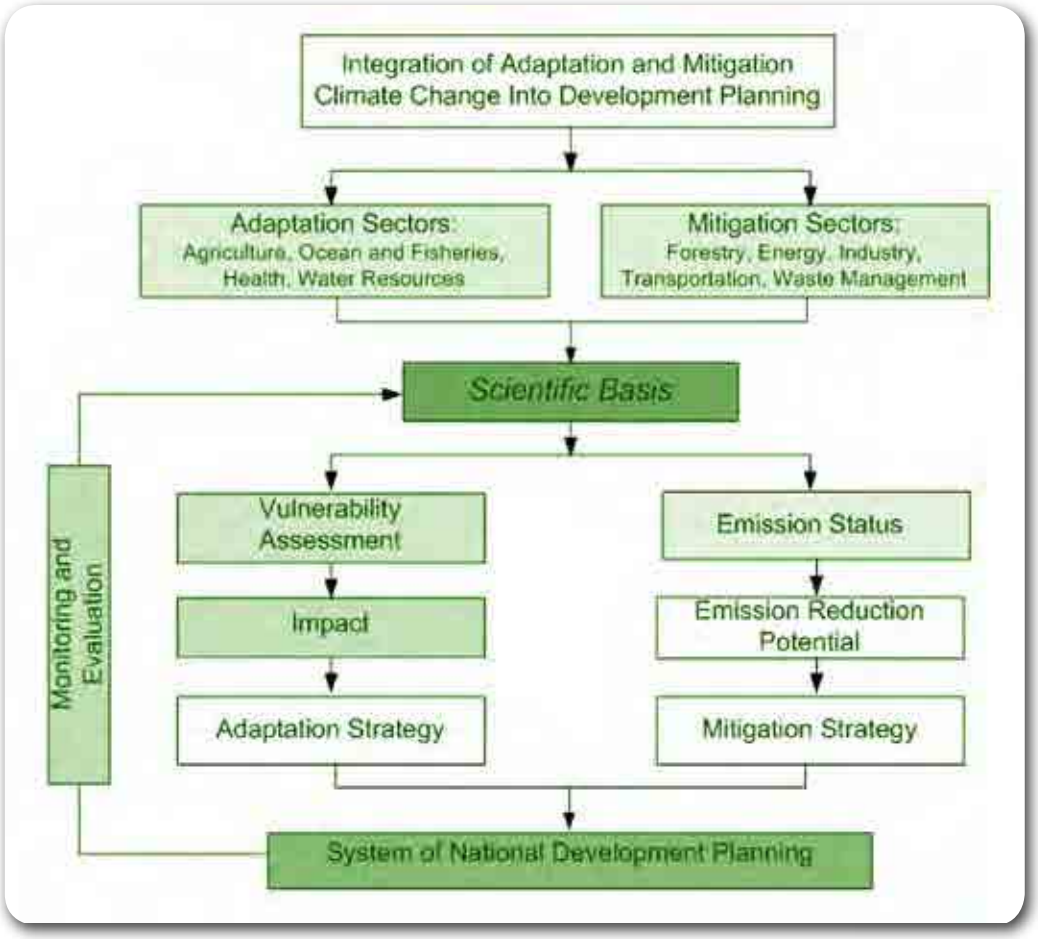


Figure 2: Roadmap Development Approach

Meanwhile, the formulation of priorities for GHG mitigation is based on the study of current emissions levels (National Greenhouse Gas Inventory[2]) and the emission reduction scenarios developed for each sector (e.g., energy, transportation, industries, forestry, and waste). In order to ensure comparability and consistency, a standardized methodology was used to evaluate the impact of candidate mitigation activities in all priority sectors. That methodology included the following elements:

[2] The national GHG emissions baseline still needs to be formulated for Indonesia; for the ICCSR, sectoral baselines were already formulated. It will be adjusted to the extent possible so as to reflect future guidance provided to Parties by the UNFCCC, including the international requirements and standards expected for monitoring, reporting and verification (MRV), which are still in the process of being negotiated in the UNFCCC.

1. Indonesia's Second National Communication to the UNFCCC was used to harmonize the estimates of greenhouse gas emissions in all sectors.
2. A range of scenarios were created to cover the 20-year time period of the roadmap. The likely patterns of development in each sector were translated into a set of emissions trajectories (e.g., scenarios of power supply development in Java-Bali/Sumatra system, including the optimal power supply mix under different constraints);
3. Mitigation scenarios were developed, including policy interventions, technologies, and actions;
4. The scenarios were divided in 2 periods of ten years each: 2010 until 2020, 2020 to 2030;
5. The costs of the relevant actions were assessed, resulting in an estimate of system abatement costs;
6. The cumulative emissions reductions were calculated in TCO2e;
7. Scenarios were selected that were considered to be the most likely to reduce emissions (including technology mix, policies and actions) while advancing national development priorities;
8. The scenarios were used as input to discussions with each of the sector teams and an agreement was reached on the preferred approach;
9. The outcomes of these discussions were incorporated into the Mitigation Matrix; and
10. Sectoral programs and budgets were established to reflect both the scenarios and the appropriate response measures.

2.4 Sectoral activity categories

As a nationally concerted effort to cope with climate change, the Indonesia Climate Change Sectoral Roadmap sets up three categories of activities in each development sector as follows:

Category 1. Data, Information and Knowledge Management (KNOW-MANAGE)

This category consists of activities related to data collection, information development and knowledge management concerning the impacts of climate change and the GHG emissions from each sector that need to be mitigated. This is to be achieved through scientific research, based on collaboration between universities, research institutions and the government.

Category 2. Planning and Policy, Regulation and Institutional Development (PLAN-PRIDE)

This category consists of activities related to the formulation of plans for specific adaptation and mitigation actions that utilize information derived from activities in Category 1 supplemented by additional capacity

development and institutional strengthening measures. These programs are designed to develop plans, policies, regulations, and new institutional development, all of which will support the implementation of adaptation and mitigation actions.

Category 3. Implementation and Control of Plans and Programs with Monitoring and Evaluation (ICON-MONEV)

This category consists of activities to implement plans for adaptation and mitigation of climate change. In addition, monitoring and evaluation measures are embedded in the actions included in this category in order to ensure effective implementation of the activities formulated in Category 2 above.

In order to allocate national resources efficiently and effectively toward several goals over the next 20 years, each category has a different programming strategy. The principle strategies are as follows:

1. During the first period of implementation of the National Medium-Term Development Plan (RPJMN) 2010-2014, funding is concentrated on activities in Category 1. Consequently, activities which are included in Category 2 and 3 receive a smaller portion of the available budget. This strategy aims to strengthen institutional capacity in the areas of data and information management, climate risk assessment, and greenhouse gas inventory development. The precise proportions of funding available in each category will depend on the capacity of each sector to respond to climate change. Sectors that have already prepared for climate change impacts may set up more advanced programs and activities; these sectors may receive disproportionately greater funding.

2. During the later period, each sector will focus increasingly on activities that are classified in Category 2 and Category 3. The ICCSR posits that each sector will focus more on activities in Category 3 (Adaptation and Mitigation Action) beginning in the period of 2020-2025.

The National Roadmap for mainstreaming climate change into development planning can be summarized as illustrated in the diagram below. Activities for adaptation and mitigation are proposed in each sector, representing the elaboration of activities in the three categories described above. Figure 3 below illustrates the process.

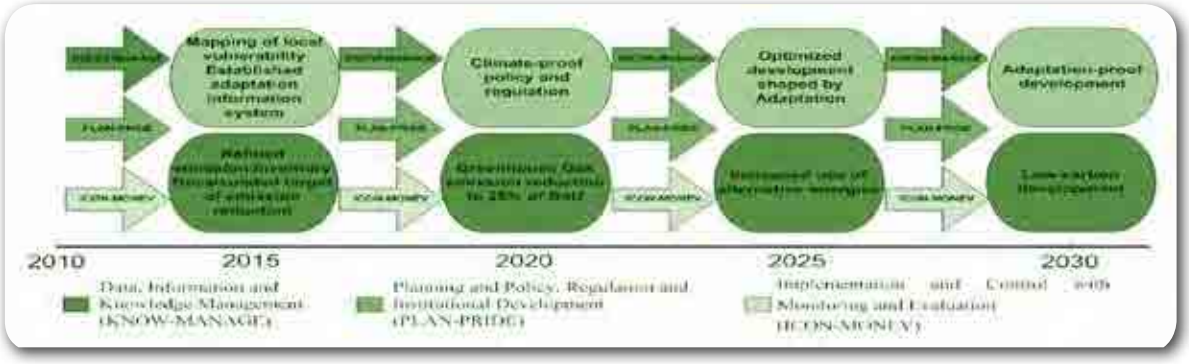


Figure 3 Chart of National Roadmap for Climate Change Adaptation and Mitigation

2.5 Connection of ICCSR with related climate change initiatives

Relationships among the ICCSR, the Presidential Decree, and the Action plan to reduce GHG emissions. The ICCSR provides detailed guidance that can aid both the national and local governments**,** national in their efforts to integrate emissions mitigation actions into their annual and strategic workplans, advancing national development priorities as they prepare measures to reach the targets of reducing GHG emissions by 26 and 41% respectively.

During 2010 – 2011, the GOI will undertake mainstreaming exercises at provincial levels, which should generate further guidance for the formulation of actions at local levels that will reinforce efforts to meet the national target of reducing GHG emissions.

Linkages of ICCSR with the Indonesia Climate Change Trust Fund. To facilitate financial support for actions needed to respond to the risks of future climate change, the GOI has developed a national trust fund mechanism called the Indonesian Climate Change Trust Fund (ICCTF). The ICCTF will serve as a key financial mechanism through which the government, private sector and civil society groups can contribute to national and international efforts to advance development while reducing future emissions of greenhouse gases. It will be one of several financing mechanisms for national policies and programs and will take guidance on implementation issues from the ICCSR.

The following sections summarize the Roadmap report for each sector, starting with the identification of climate change hazards likely to affect Indonesia. This discussion of climate impacts is followed first by the adaptation sectors (water, marine and fisheries, agriculture, and health), and then by the prioritiy sectors for mitigation activities (transportation, forestry, industry, energy, and waste).

3

IDENTIFICATION OF CLIMATE CHANGE HAZARDS IN INDONESIA

3.1 Surface Air Temperature Increase and Precipitation Change

The increase of Surface Air Temperature (SAT) is seen as the main climate change issue as it is attributable to the anthropogenic driven increase of CO_2 and other greenhouse gas emissions. Observed monthly SAT in Indonesia over a period of 100 years shows that a certain degree of climate change has occurred in Indonesia. The data that have been collected from a limited number of stations suggest that a temperature increase of around 0.5ºC has occurred during the 20th century. This magnitude of temperature increase is in agreement with the rate of average global temperature increase as estimated in IPCC AR-4, which is about 0.7ºC ± 0.2 per century.

Based on the analysis of Global Circulation Model (GCM) output, projected average temperature increase in Indonesia is between 0.8º - 1ºC for the period of 2020-2050, relative to the baseline period of 1961-1990. The differences in projected SAT between Special Report on Emission Scenario (SRES) B1, A1B, and A2[3] are not significant for 2030, but become more distinct for the period of 2070-2100. The temperature increase in the Java-Bali region are projected to reach 2ºC, 2.5ºC, and 3ºC for B1, A1B, and A2 scenarios respectively. There are higher probabilities for higher temperature increase in Kalimantan and Sulawesi, but the largest temperature increase of around 4ºC will likely occur in Sumatra. The trend of temperature increase is generally different for each month by 0-2ºC.

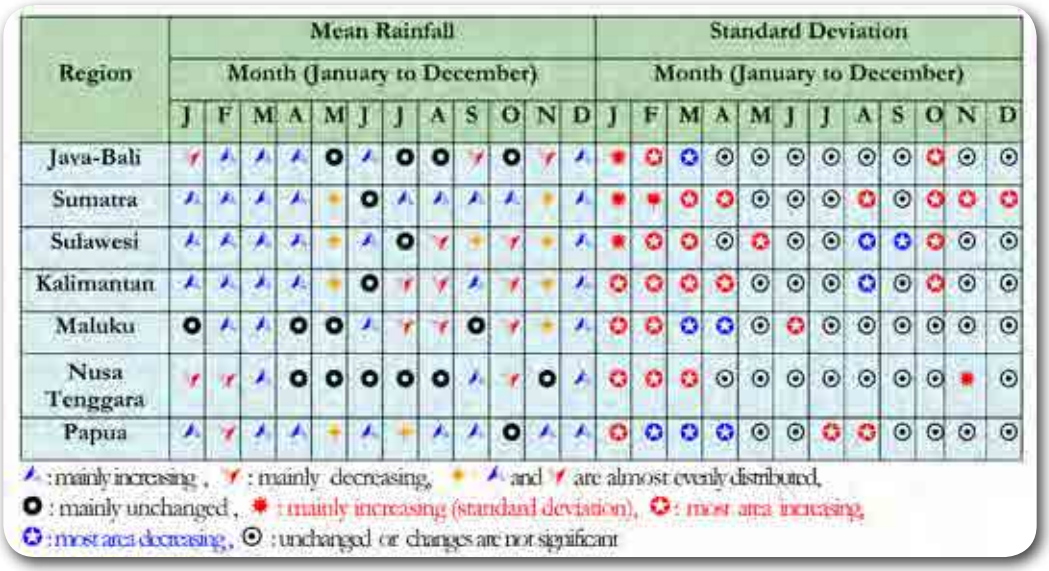
Different from the projected temperature increase, the projected precipitation pattern has more significant temporal and spatial variation. For Indonesian rainfall, in general it is important to note that the trend of rainfall change may be quite different, not only seasonally but also from month to month. Based on analysis of observed rainfall patterns in Jakarta for example, there has been an increase of around 100 mm January rainfall of 1955-1985 (1970s) compared to that of 1885-1915 (1900s).[4] Other results indicate that the rainfall over central and northern parts of Sumatra has been increasing by 10-50 mm over recent decades compared to that of 1960-1990.

Rainfall change projections based on observational data analysis indicate that there will not be significant changes from the recent (period of 1981-2010, but the available data only until 2007) mean annual precipitation over the Java-Bali region for the period of 2010 to 2015. However, projected rainfall of the 1990 to 2020 period shows more significant increases in the rainfall of the December-January-February-March period over large regions. Also, with larger variability, rainfall over Sumatra and Papua is expected to increase for almost all seasons until 2020. On the other hand, rainfall is projected to decrease during the July-August-September periods for regions like Java-Bali, Sulawesi, Kalimantan, and Maluku. This implies that the magnitude of changes in rainfall pattern, relative to recent decades, are expected to be more significant during the period of 2015-2020, compared to that of 2010-2015. A rough summary of results from the trend analysis are shown in Table 1

[3] SRES scenarios are global emission scenarios used in the IPCC climate projections. B1, A1B, and A2 are three of six SRES illustrative scenario groups. In practice, these scenarios differ in the stabilization of CO2 concentration by 2100 i.e 550 ppm (low), 750 ppm (moderate), and unstabilized (high) for B1, A1B, and A2 scenarios respectively.

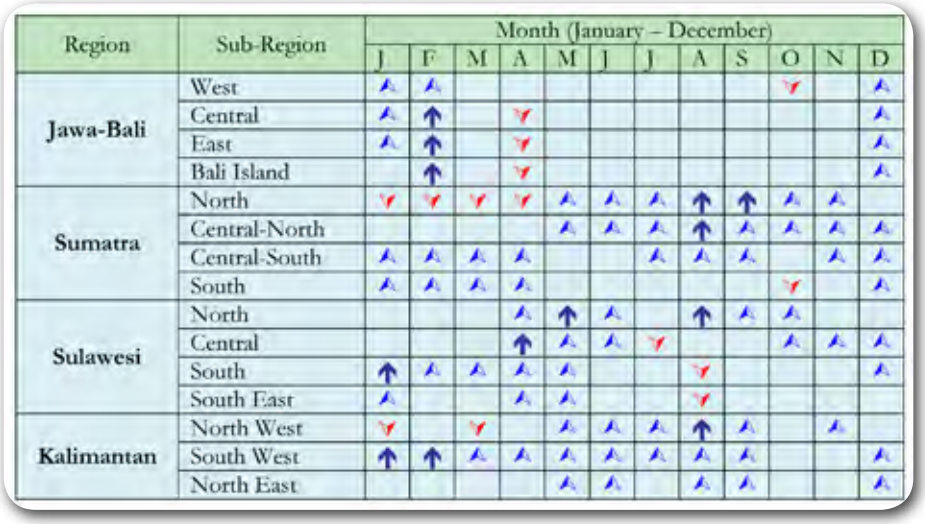
[4] More detailed information is provided in the Report of Scientific Basis: Analysis and Projection of Climate Change in Indonesia

Table 1 Projected rainfall changes (mean and standard deviation) in Indonesia during the period of 2010-2020 (relative to 1980-2007 period), based on polynomial trend analysis of observational data



Results from GCM output do not show significant change in the rainfall pattern during the period of 2020-2050. However, large changes can be found in the projected rainfall of the 2070-2100 period, especially for higher CO_2 emission scenario (SRES A2). The results of this projection are summarized in the following table (Table 2):

Table 2 Trend of rainfall change in Indonesia based on GCM data with A2 scenario 2070-2100



Region	Sub-Region	Month (January – December)											
		J	F	M	A	M	J	J	A	S	O	N	D
	South East	↗	↗			↗				↗			↗
Maluku	North	↗			↑	↑	↑	↑	↑	↑	↑	↑	↑
	Central				↗	↗	↑		↗	↑	↑		
	West				↑	↗		↘					
	South				↗	↑	↗			↑	↑	↗	
Nusa Tenggara	West		↗		↘						↗		
	Central		↗										
	East				↘	↘					↗		
	Timor Island					↘					↗		
Papua	West	↑	↗	↗	↗	↑	↑	↗	↑	↑	↑	↗	↗
	Central	↑	↗	↗	↗	↗	↗	↗		↑	↑	↗	↑
	East	↑	↗	↗	↗	↗	↗	↗		↑	↑	↗	↑
	South	↗							↘				

↑ Highly significant increase (≥50 mm), ↗ significant increase (≥25 mm; <50 mm), ↘ significant decrease, ↓ highly significant decrease

3.2 Sea Surface Temperature Rise, Sea Level Rise and Extreme Climatic Events

Sea Surface Temperature (SST) rise is a direct consequence of surface air temperature increase. The average SST in Indonesian sea waters is projected to increase by as much as 0.65°C in 2030, 1.10°C in 2050, 1.70°C in 2080, and 2.15°C in 2100 (based on trend analysis from historical data). One of the immediate impacts of SST increase is a depletion and movement of fishing stocks away from Indonesian waters.

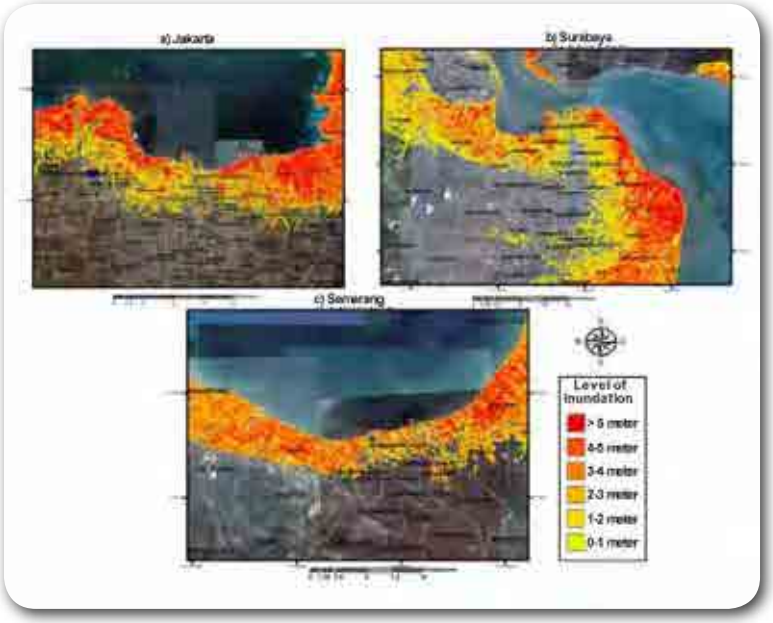
Sea Level Rise (SLR) is another important climate change issue. It is brought about by the melting of ice and glaciers at the poles, and by the thermal expansion of sea water. SLR for Indonesia has been projected from observed satellite altimeter and tidal data, as well as from GCM output. An average SLR of 0.6 cm/year to 0.8 cm/year has been estimated from the output of four GCMs i.e. MRI, CCCMA CGCM 3.2, Miroc 3.2 and NASA GISS ER, and more complete results are summarized in Table 3.

Table 3 Sea Level Rise Projection since 2000

Period	Tide Gauge	Altimeter ADT	Model	Level of confident
2030	24.0cm±16.0cm	16.5cm±1.5cm	22.5±1.5cm	Moderate
2050	40.0cm±20.0cm	27.5cm±2.5cm	37.5±2.5cm	Moderate
2080	64.0cm±32.0cm	44.0cm±4.0cm	60.0±4.0cm	High
2100	80.0cm±40.0cm	60.0cm±5.0cm	80.0±5.0cm	High

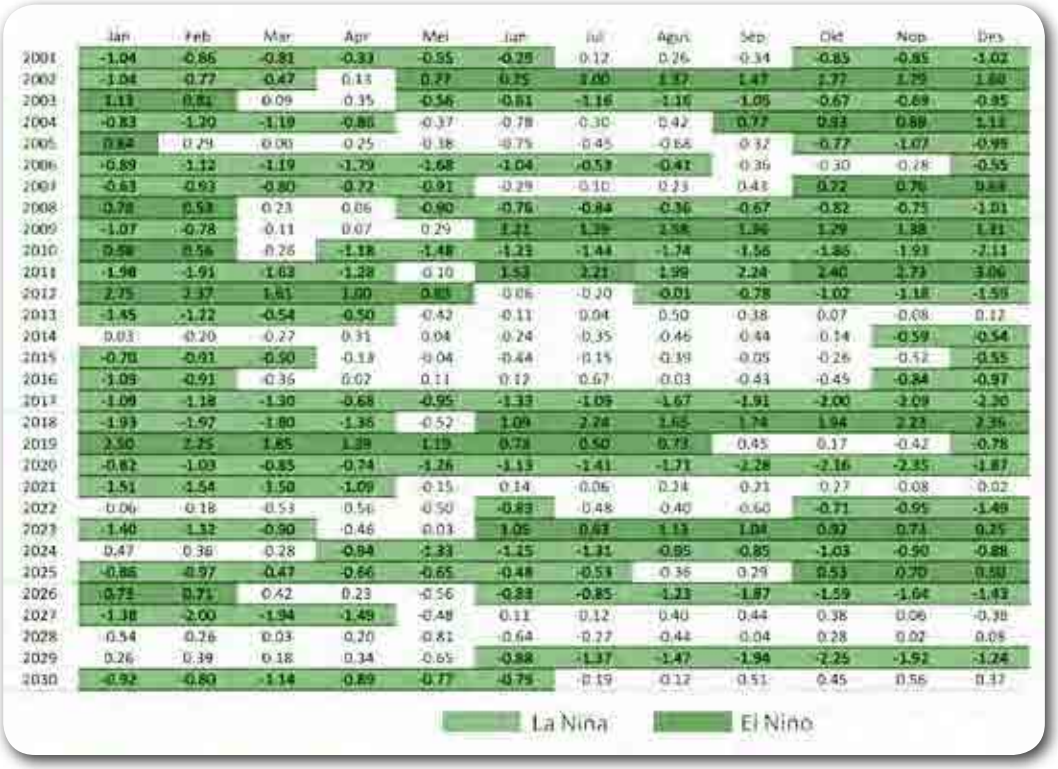
With thousands of islands and a vast coastline, Indonesia is expected to suffer from the severe and drastic impacts of SLR. Many large cities such as Jakarta, Semarang, and Surabaya are expected to suffer from flooding and inundation. During extreme weather conditions, extreme waves with heights of 2-3 meters can be triggered. Figure 4 below are future inundation projections for three major cities in Indonesia, based on the pessimistic scenario for 2100.

Figure 4 Projected Sea Level Rise in Jakarta, Surabaya and Semarang in 2100



Changing ocean environmental condition will also affect climate variability. For example, the projected frequency of ENSO events, El Niño and La Niña, is expected to increase from its current of 3 to 7 years interval to happening every 2 to 3 years. El Niño and La Niña phenomena are well known to have impacts on rainfall variation in Indonesia but they also affect sea level and ocean weather by inducing more extreme waves. The occurrence of El Niño and La Niña is believed to induce wave height variations in the order of 2 to 5 meters. More complete projections of El Niño and La Niña occurrences in the future are shown in the following table (Table 4):

Table 4 Projection of El Niño and La Niña (derived from the ouput of MRI Model)



	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agus	Sep	Okt	Nop	Des
2001	-1.04	-0.86	-0.81	-0.33	-0.55	-0.29	0.12	0.26	0.34	-0.85	-0.85	-1.02
2002	-1.04	-0.77	-0.47	0.13	0.77	0.75	1.00	1.37	1.47	1.77	1.79	1.88
2003	1.13	0.81	0.09	0.35	-0.56	-0.81	-1.16	-1.16	-1.05	-0.67	-0.69	-0.95
2004	-0.83	-1.20	-1.19	-0.86	-0.37	-0.78	0.30	0.42	0.77	0.93	0.88	1.11
2005	0.82	0.79	0.08	0.25	-0.18	-0.75	-0.45	-0.66	0.32	-0.77	-1.07	-0.99
2006	-0.89	-1.12	-1.19	-1.79	-1.68	-1.04	-0.53	-0.41	0.36	0.30	0.28	-0.55
2007	-0.63	-0.93	-0.80	-0.72	-0.91	-0.29	0.10	0.23	0.43	0.22	0.76	0.88
2008	0.78	0.53	0.23	0.06	-0.90	-0.76	-0.84	-0.36	-0.67	-0.82	-0.75	-1.01
2009	-1.07	-0.78	-0.11	0.07	0.29	1.21	1.39	1.58	1.36	1.29	1.38	1.31
2010	0.58	0.56	0.26	-1.18	-1.48	-1.23	-1.44	-1.74	-1.56	-1.86	-1.93	-2.11
2011	-1.98	-1.91	-1.63	-1.28	0.10	1.53	2.21	1.99	2.24	2.40	2.73	3.06
2012	2.75	2.37	1.61	1.00	0.83	0.06	0.20	-0.01	-0.78	-1.02	-1.18	-1.55
2013	-1.45	-1.22	-0.54	-0.50	-0.42	-0.11	0.04	0.50	0.38	0.07	0.08	0.12
2014	0.03	-0.20	-0.27	0.31	0.04	-0.24	-0.35	-0.46	-0.44	-0.14	-0.59	-0.54
2015	-0.78	-0.91	-0.50	-0.18	-0.04	-0.44	-0.15	-0.39	-0.05	-0.26	-0.52	-0.55
2016	-1.09	-0.91	-0.36	0.02	0.11	0.12	0.67	0.03	-0.43	-0.45	-0.84	-0.97
2017	-1.09	-1.18	-1.30	-0.68	-0.95	-1.33	-1.09	-1.67	-1.91	-2.00	-2.09	-2.30
2018	-1.93	-1.97	-1.80	-1.36	-0.52	1.09	2.24	1.65	1.74	1.94	2.23	2.36
2019	2.50	2.25	1.85	1.38	1.19	0.78	0.50	0.73	0.45	0.17	-0.42	-0.78
2020	-0.82	-1.03	-0.85	-0.74	-1.26	-1.13	-1.41	-1.71	-2.28	-2.16	-2.35	-1.87
2021	-1.51	-1.54	-1.50	-1.09	-0.15	0.14	0.06	0.24	0.21	0.27	0.08	0.02
2022	0.06	0.18	-0.53	0.56	-0.50	-0.83	0.48	0.40	0.60	-0.71	-0.95	-1.49
2023	-1.40	-1.32	-0.90	-0.46	0.03	1.05	0.63	1.13	1.08	0.92	0.71	0.25
2024	0.47	0.38	0.28	-0.94	-2.33	-1.15	-1.31	-0.85	-0.85	-1.03	-0.90	-0.88
2025	-0.86	-0.97	-0.47	-0.66	-0.65	-0.48	-0.53	-0.36	0.29	0.53	0.70	0.50
2026	0.73	0.71	0.42	0.23	-0.56	-0.88	-0.85	1.23	-1.87	-1.59	-1.64	-1.43
2027	-1.38	-2.00	-1.94	-1.49	-0.48	0.11	0.12	0.40	0.44	0.38	0.06	-0.38
2028	0.54	0.26	0.03	0.20	-0.81	-0.64	-0.27	-0.44	0.04	0.28	0.02	0.05
2029	0.26	0.39	0.18	0.34	-0.65	-0.88	-1.37	-1.47	-1.94	-2.25	-1.92	-1.24
2030	-0.92	-0.80	-1.14	-0.89	-0.77	-0.75	-0.19	-0.12	0.51	0.45	0.56	0.37

La Nina El Nino

4

ADAPTATION IN THE WATER SECTOR

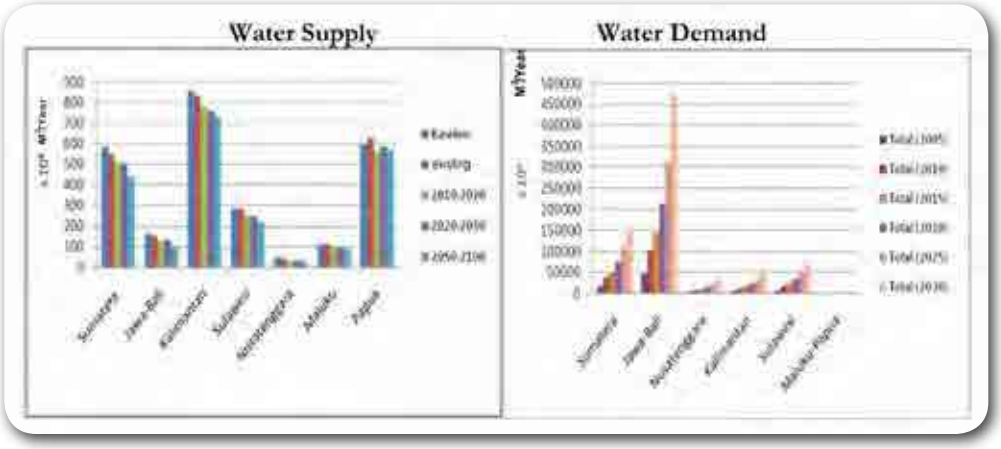
4.1 Current Condition and Projection of Water Sector

4.1.1 Water Shortage

The projected climate change in Indonesia will likely impose stress on water resources. At present, the Java-Bali regions have already faced a deficit in its water balance, while for other regions like Sumatra, Sulawesi, Nusa Tenggara, and the Moluccas are projected in critical conditions. Based on climate projections, most regions in Indonesia will suffer from a gradual decrease of water supply due to temperature increase and rainfall changes that will affect the water balance as illustrated in the table below (Table 5). Combined with estimated population growth rates, increased water demand will cause severe water shortages to occur, especially in Java and Sumatra for the period of 2020-2030.

Table 5 Indonesia's current (2009) and projection of Water Balance (2015 and 2030) (M^3/Year)

No	Area	Supply (S)	Demand (D)	Balance 2009 (S - D)	Balance 2015s (S - D)	Balance 2030s (S - D)
1.	*Sumatra*	111,077.65	37,805.55	73,272.10	48,420.07	-67,101.34
2.	*Java-Bali*	31,636.50	100,917.77	-69,281.27	-118,374.36	-454,000.33
3.	*Kalimantan*	140,005.55	11,982.78	128,022.77	118,423.17	88,821.14
4.	*Sulawesi*	34,787.55	21,493.34	13,294.21	13,490.80	-21,021.99
5.	*Nusa Tenggara*	7,759.70	2,054.04	5,705.66	-17,488.89	-67,848.68
6.	*Moluccas*	15,457.10	540.23	14,916.87	12,648.91	9,225.75
7.	*Papua*	350,589.65	385.58	350,204.07	325,937.74	315,647.73



A risk analysis for projected water shortages has also been carried out under the framework of this study. Based on this risk analysis, the roadmap defines areas that have high risk or extremely high risk condition which need further attention for adaptation responses. For water sector, the priority areas are as follows (see Figure 5):

1. **Extremely High Risk** is likely for parts of the Java-Bali region, especially in a few locations in the northern and southern of West Java, middle and southern of Central Java and East Java; as well as in the capital of the North Sumatra, West Sumatra, Bengkulu and Lampung (Sumatra), Nusa Tenggara Barat and South Sulawesi;

2. **High risk** is observed in about 75% of the Java region, in large parts in the southern of Bali, in a small part of the northern, western, and southern of Sumatera region, part of the Lombok Island (Nusa Tenggara Barat) and South Sulawesi

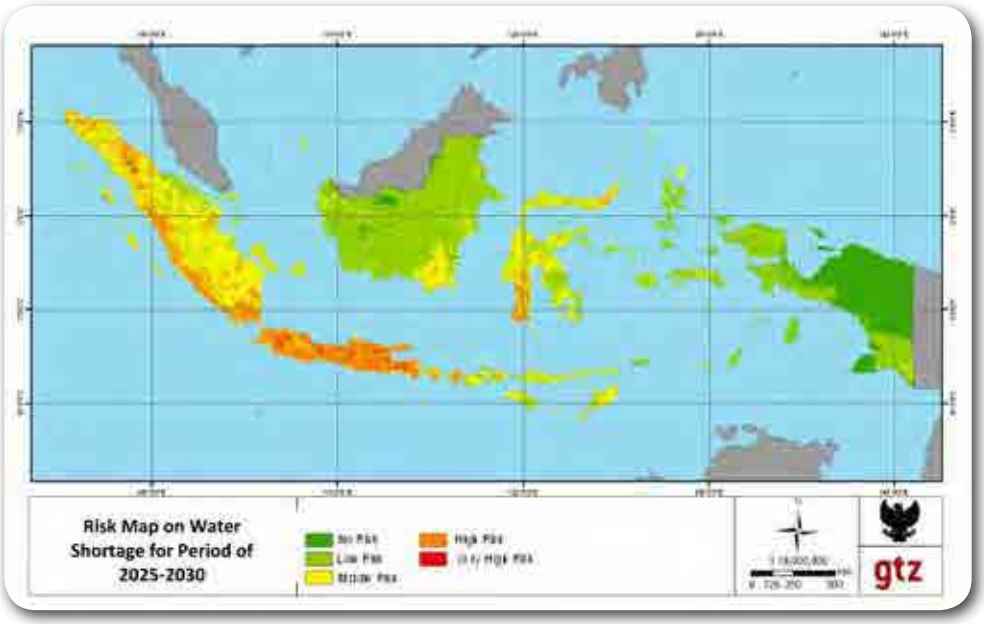


Figure 5 Risk Map on Water Shortage using IPCC's SRA2 Scenario 2025-2030

4.1.2 Flood

Another impact of climate change on water sector is the increase of risk to flooding. Almost all parts of Indonesia are vulnerable to flood hazards. According to the Indonesian National Atlas (Bakosurtanal, 2008), Sumatra and Java-Bali have the largest vulnerable areas. Factors contributing to flooding are: the extreme rainfall of up to 400/mm/month (as per BMKG); overloaded run off in water shed, such as rivers, ponds, dams, etc; land characteristics and conditions in the upper of the catchment area. In some cases, floods are related to landslides[5], as happened in Sinjai, Southern Sulawesi, in July 2006, causing hundreds of casualties. In some area, especially in urban area with high population and development activities, i.e. in Jakarta and Bandung, flood is also generated by land subsidence due to groundwater overpumping and groundsurface overburden[6]. Based on the analysis of flood risk, the areas which are classified as extremely high and high risks are as follows:

1. **Extremely High Risk** of flooding is projected especially for areas along major rivers, particularly in downstream areas of Java, Eastern Sumatra; most parts of Western, Southern, and Eastern Kalimantan, Eastern Sulawesi and Southern Papua;
2. Areas which will face **High Risk** are concurrence to those with extremely high risk mentioned

[5] (Indonesian: *banjir bandang*)

[6] (Indonesian: *banjir genangan*)

above.

Figure 6 Risk Map on Flood based on Scenario SRA2 in 2025-2030

4.1.3 Drought

Drought has become increasingly frequent phenomenon in Indonesia during the dry season. There is increased threat of drought hazard during periods when mean rainfall (CH) is below normal and temperature increases. The hazard intensity of drought tends to increase from the period of 2010-2015 to 2025-2030; with distribution of affected area as shown in Figure 7. Drought risk is significant for the Java-Bali region, most areas in northern Sumatera, part of Nusa Tenggara and South Sulawesi. Drought makes it difficult for people to find freshwater, reduces surface water in reservoirs; and limits the yield of crops, particularly rice. Many agricultural areas in Indonesia are vulnerable to planting and harvesting failure due to drought onset or to shifting of the dry season period.

Findings from the drought risk analysis are as follows:

1. **Extremely High risk** areas are stretched out over small areas of the Central Java, Northern Sumatra, and Nusa Tenggara;
2. **High risk** areas are found in large parts of Central Java, Sumatra, and Nusa Tenggara, small part of South Sulawesi.

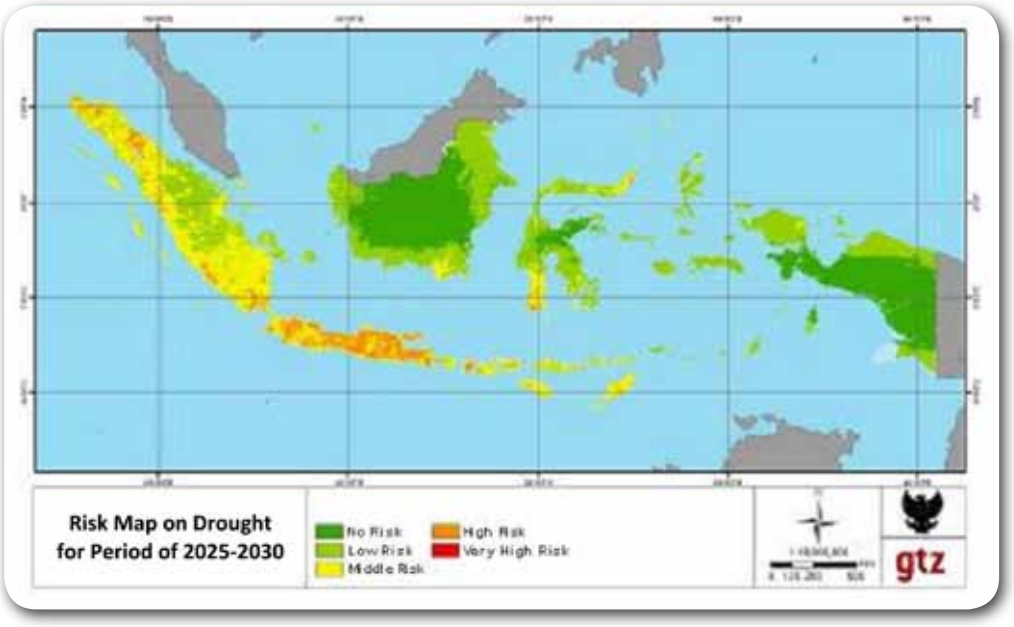


Figure 7 Risk Map on Drought Risk based on Scenario SRA2 for 2025-2030

4.2 Issues and Strategies of Water Sector

As a result of the risk analysis, the following issues have to be addressed in order to successfully adapt the water sector to climate change:

1. The need to maintain the balance between water availability and water demand (water balance);
2. Insufficiency of water infrastructure and the need for provision of alternative water sources in certain areas;
3. Limited availability of data, technology and research as a basis for water resource management;
4. The necessity to reduce vulnerability and risk from water shortage, flood and drought;
5. The need to find synergetic solutions for cross-sector issues with agriculture, forestry, health, energy, and industry sectors;
6. The need to integrate water resources management and flood control;

7. The need to conserve water based on innovation, community participation and local wisdom.

When addressing these key issues, the water supply and water demand for domestic, urban and industrial use have to be balanced. In order to ensure this, the following strategies should be pursued:

1. Prioritizing water demand for domestic use, especially in regions with water scarcity and in regions of strategic importance;
2. Controlling the use of groundwater and enhancing the use of surface water for water supply;
3. Intensifying the development of water storages for water supply and optimization and maintenance of existing resources;
4. Encouraging involvement of the private sector for financing the development of water infrastructure.
5. Acceleration and completion of implementing regulations of the Law No. 7 of 2004;
6. Capacity Building of institutions involved in water resource management to communicate, cooperate, and coordinate;
7. Community empowerment and participation at local level in water resource management;
8. Partnership between government and community in water resource management.

4.3 Activities of Water Sector

From many activities that had been discussed during several focus group discussions and stakeholder consultations, five "champion" activities for adapting the water sector to climate change are recommended and illustrated in the table below (Table 6). The details of the activities for water sector for the next 20 years by main Indonesian regions are available in the Roadmap for water sector. Total cost of adaptation

Table 6 Priority Activities of Water Sector

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information and Knowledge Management	Vulnerability and risk assessment at regional level and strategic zone	Focus area: BBWS Sumatera I and Mesuji Sekampung in Sumatera, BBWS Bengawan Solo and Pemali Juwana in Java, BWS Kalimantan II in Kalimantan, BBWS Pompengan Jenebarang in Sulawesi, BWS Nusa Tenggara I in Nusa Tenggara, BWS Maluku, and BWS Papua.	Focus area: *BBWS* Brantas and Ciliwung-Cisedane; *BBWS* Sumatera II dan V; *BWS* Kalimantan III; *BWS* Sulawesi II; *BWS* Nusatenggara II; Maluku and Papua	Focus area: *BBWS* Serayu-Opak, Cimanuk-Cisanggarung and Bali; *BBWS* Sumatera IV and VI; *BWS* Kalimantan I; and *BWS* Sulawesi I	Focus area: *BBWS* Citarum-Citanduy and Cidanau-Ciujung-Cidurian; *BBWS* Sumatera VIII and Sumatera III; Kalimantan I; and Sulawesi
Planning and Policy, Regulation and Institutional Development	Revitalization of local wisdom and building the capacity and participation of community in adapting to climate change	Focus area: *SWS* Musi in Sumatera, *WS* Citarum, Ciliwung and Citanduy in West Java and Jakarta, *WS* Mahakam in Kalimantan, and *SWS* Jeneberang in Sulawesi.	Focus area: *WS* Bengawan Solo, Pemali, Comal; *SWS* Krueng; *WS* Kapuas	Focus area: *WS* Brantas; *SWS* Batangharileko; *WS* Barito; and Tondano	Focus area: *WS* Opak; *SWS* Mesuji; *WS* Kahayan; and North Sulawesi
	Enhancement of water conservation and reduction of hazard and disaster related to climate change	Focus area: West Sumatera Province, Banten and West Java Province, West Kalimantan Province, Gorontalo Province, East Nusa Tenggara Province, Maluku Province, and West Papua Province.	Focus area: Central Java; Bengkulu; South Kalimantan; East Sulawesi; West Nusatenggara	Focus area: DI Yogyakarta; Lampung; Central Kalimantan; and North Sulawesi	Focus area: East Java; Aceh; East Kalimantan; and Southeast Sulawesi
Implementation and Control with Monitoring and Evaluation	Enlargement of water supply using appropriate technology and development of local water resources	Focus area: *BBWS* Sumatera VIII in Sumatera, and *BWS* Kalimantan II in Kalimantan; Papua: *BWS* Western Papua	Focus area: *BWS* Kalimantan III; *BWS* Northern Papua	Focus area: *BWS* Kalimantan I; *BWS* Southern Papua	TBD
	Improvement of storage capacity and water infrastructure for safeguarding water balance and disaster prevention	Focus area: construction of dams in Deli Serdang, North Sumatera, in Ponorogo, East Java, in Wajo, South Sulawesi, and in East Lombok, West Nusa Tenggara	TBD	TBD	TBD

5

ADAPTATION IN THE MARINE AND FISHERIES SECTOR

5.1 Current Condition and Projection of Marine and Fisheries Sector

5.1.1 Coastal Inundation

Indonesia is an archipelagic country consisting of 17,480 islands with total coastline of 95,181 km. Coastal inundation due to SLR will cause serious problems along coastal zones where a large part of population (about 50-60% of total) resides. Significant infrastructure and economic assets are located in these areas. As an example, there are about 968 fishery ports that have been built without considering SLR projection. Many important tourist destination and attractions, both natural and man-made, lie in coastal areas. The estimated average rate of SLR in Indonesia is around 0.6 cm/year. Based on available SLR scenarios by considering ENSO, storm surges, and highest tides, maps of inundated area have been developed as seen in Figure 8 for Java-Bali region. Meanwhile, the projection of the size of inundated areas in each region in Indonesia for the year 2030 is illustrated in Figure 9.

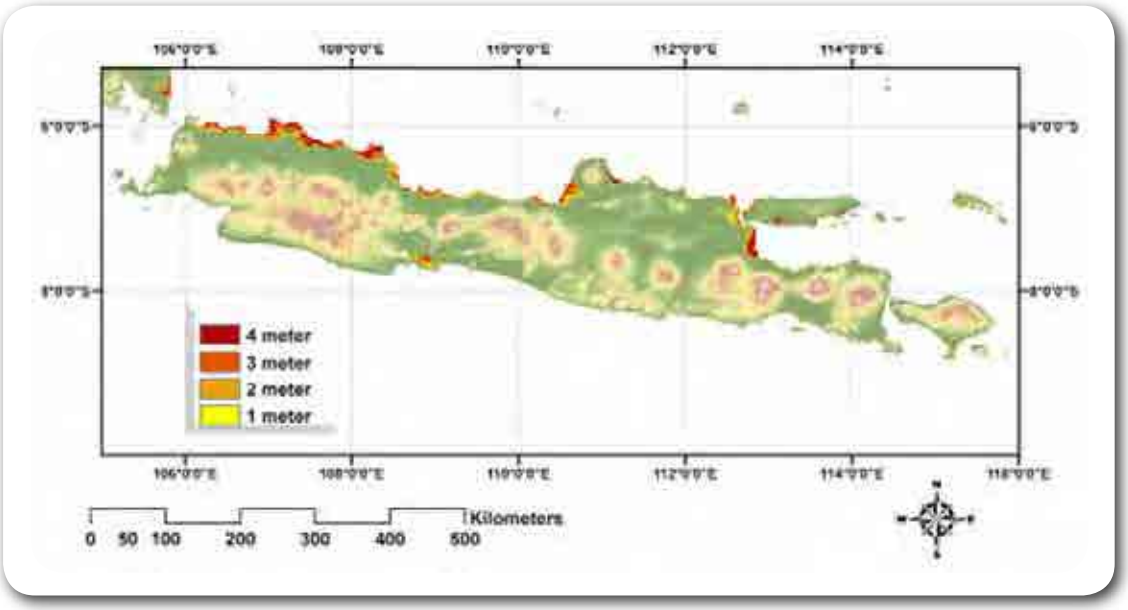


Figure 8 Simulation of Coastal Inundation in Java-Madura-Bali

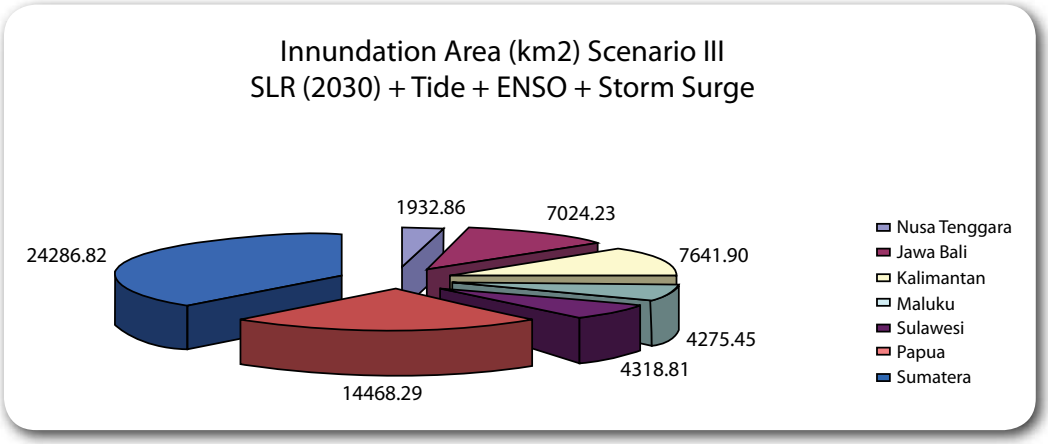


Figure 9 Projection of Inundation Area in 2030

5.1.2 Sea Surface Temperature (SST)

Based on National Oceanic and Atmospheric Agency (NOAA) optimum interpolation (OI) data from 1983 to 2008, the average of SST trend over the Indonesian Seas is 0.65°C ± 0.05°C in 2030. Coral reefs are very vulnerable towards abrupt change of temperatures. Temperature increase of 1°C to 2°C from long-term average will also cause coral bleaching.

Indonesia also possesses the largest area of coral reef in the world, with an area reaching 60,000 km^2 which is around 18% of the world's coral reef. According to the Directorate General of Coastal and Small Islands, Ministry of Marine and Fishery Affairs (DKP, 2005), the current condition of Indonesia's reefs is as follows: damaged (42.78%), moderate (28.30%), preserved (23.72%). However, the reefs which are still considered to be in pristine condition are only 6.20% of the total. In the meantime, the warmer SST may shift fishing grounds from tropical area to the sub-tropical regions with a lower temperature.

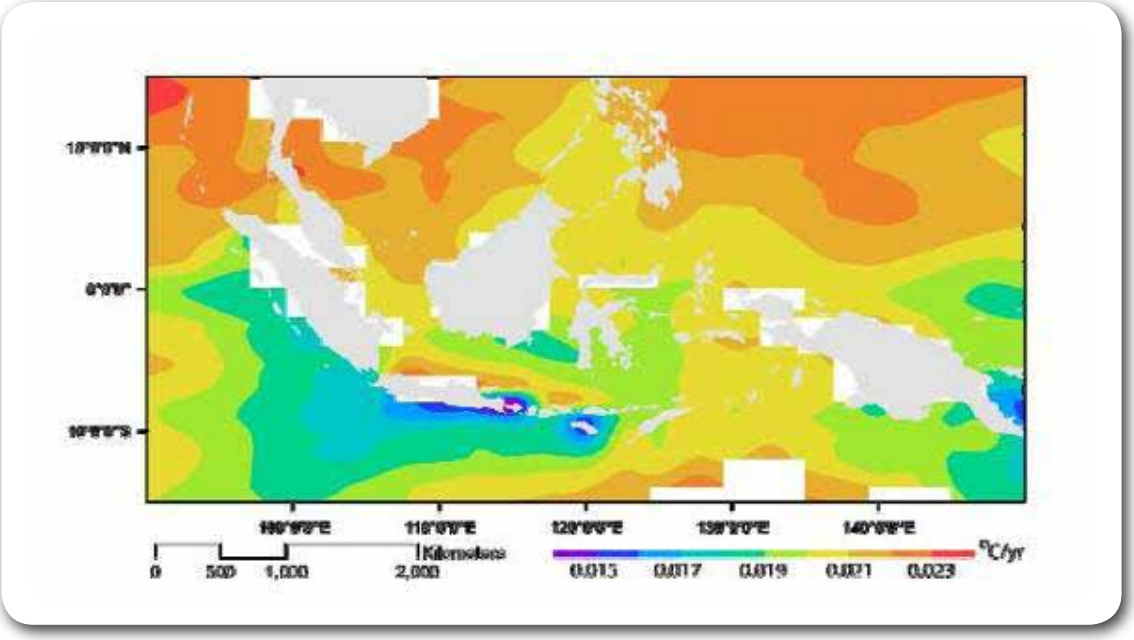


Figure 10 Sea Surface Temperature Increase Based on SRES A1B Using MRI_CGCM 3.2 Model

5.1.3 Extreme Events

Many oceanographers argue that global warming has a strong relationship with a higher frequency of extreme event, such as El Niño and La Niña (Timmermann et. al., 1999 and Timmerman, 2000). Generally, El Niño and La Niña occur once every 3-7 years, but since 1970, the frequency of El Niño and La Niña increases to once every 2-6 years (Torrence and Compo, 1999). La Nina could also heighten wave height by around 20 cm. Additionally, rising SST will lead to an increase of extreme weather events (storms, cyclone). According to Saunders and Lea (2008), an increase in Sea Surface Temperature by 0.5ºC is correlated with an increase of hurricanes by as much as 40%. Although very few tropical cyclones hit land

areas in Indonesia, extreme marine weather events that occur in the southern parts of Indonesia (during the rainy season), and the northern parts of Indonesia (during the dry season), may cause significant impact (in the form of massive high waves and storm surges) to vulnerable coastal areas.

5.2 Issues and Strategies of Marine and Fisheries Sector

Several issues that were initially identified in the marine and fisheries sector from the risk analysis are:

1. Existing regulation and policy have not specified the need for climate change adaptation;
2. Inundation of settlements, business areas, fishponds, and ports because of SLR and damage caused by storms have not been considered by policy makers at national and local government;
3. Shifting of fishing grounds, depletion of fishing stocks, and the changing pattern of winds will bring severe damages;
4. Degrading and sinking of outer small islands (Indonesia's territory border).

The strategies for Roadmap of climate change adaptation in marine and fishery sector are as follows:

1. Physical adaptation in coastal zones and small islands by an integrated management and environmentally sound physical engineering;
2. Settlement management;
3. Infrastructure and public facility management;
4. Resource management of fisheries, water resources and defense and security (outer small islands);
5. Integrated management of coastal zones, small islands and marine ecosystems;
6. Formulation of regulations, policies, and institutional capacities;
7. Data and research inventories as well as human resource development.

5.3 Activities of Marine and Fisheries Sector

Several activities to anticipate hazards brought by intensified climate change were discussed in several focus group discussions with stakeholders from the marine and fisheries sector and illustrated in the table below (Table 7).

Among those activities, there are five champion activities recommended for the marine and fisheries sector based on current and projected conditions as follows:

1. Activities of formulation or adjustment of regulation, policy and institutional capacity of the marine and fishery sector to adapt to climate change in coastal areas and small islands consists:
    - Formulating norms, standards, guidelines, and criteria for climate change adaptation and mitiga tion;
    - Adjustment of regulation and policy related to climate change;
    - Acceleration of the issuance of local government decision on Strategic Plan of Coastal Zone And Small Islands (*WP3K*) that has incorporated climate change issues and a risk map.
2. Activities of "Elevation adjustment and strengthening of buildings and vital facilities on coastal areas prone to climate change" consists of these activities:
    - Identification of existing and projected condition of all infrastructure and vital facilities in the coastal areas;
    - Elevation adjustment and strengthening of building and vital facilities;
    - Study on elevated house construction and its dissemination;
    - Construction and maintenance of beach protection structures.
3. The adjustment of integrated captured fishery management activities consists of:
    - Development and dissemination of information system, and mapping of the dynamic fishing ground;
    - Development and dissemination of real-time weather information system on ocean;
    - Capacity building of fishermen in order to reach distance, off-shore fishing grounds;
    - Development and improvement of stock/logistic management, using cold storage.

4. Adjustment of cultured fishery management activities that includes saltwater, brackish water and freshwater fish farms consists of:

   - Development of fish breeds that are resilient to climate change;
   - Expansion and improvement of existing fishponds and their water channels;
   - Development and improvement of fish market depots as part of stock management;
   - Development of cultured fishery on wetlands.

5. Adjustment of the management of strategic small islands consists of :

   - Identification of current and projected conditions of strategic small islands including the remote islands on the Indonesian border;
   - Construction and maintenance of beach protection structure and navigation safety facilities;
   - Surveillance and protection of remote strategic small islands.

Table 7 Activities of Marine and Fisheries Sector

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information and Knowledge Management	Research and Development of Marine Science and Technology: - Inventory of data, information system and research	**Focus in Ocean Area:** Western Pacific Ocean (Maluku, Papua) **Focus in Coastal Area:** High Risk Region (Sumatera, Java)	**Focus in Ocean Area :** Makasar Strait (Kalimantan, Sulawesi); Lombok Strait (Nusa Tenggara) **Focus** in Coastal Area : Medium Risk Region (Sumatera, Nusa Tenggara, Kalimantan, Sulawesi)	**Focus** in Ocean Area: Eastern Indian Ocean (Sumatera, Java, Nusa Tenggara) **Focus** in Coastal Area : Low Risk Region (Maluku, Papua)	**Focus** in Ocean Area: South China Sea (Sumatera, Java, Kalimantan) **Focus** in Coastal Area : Low Risk Region
Planning and Policy, Regulation and Institutional Development	Optimization of Coastal and Marine: - Integration of climate change Adaptation into coastal planning	**Focus**: Northern Java, Bali, Region: Eastern Sumatra	**Focus**: Medium Risk Region (Sumatera, Nusa Tenggara, Kalimantan, Southern, Western Sulawesi)	**Focus**: Low Risk Region (Maluku, Southern Papua)	**Focus**:National and City/ Regency level in coastal areas and small islands
	Spatial Planning and Management of Marine, Coastal and Small Islands: - Adjustment of regulation and policy related to climate change	**Focus**: High Risk Region: Northern Java, Bali, Eastern Sumatra	**Focus**: Medium Risk Region (Sumatera, Java, Kalimantan, Southern, Western Sulawesi)	**Focus**: Low Risk Region (Maluku, Southern Papua)	**Focus**:National and City/ Regency level in coastal areas and small islands
Implementation and Control with Monitoring and Evaluation	Optimization of Coastal and Marine: - Adjustment of elevation and strengthening of building structures and vital facilities in coastal areas	**Focus**: High Risk Region: Northern Java, Bali, Eastern Sumatra	**Focus**: Medium Risk Region: Sumatera, Nusa Tenggara, Eastern, Western, Southern Kalimantan, Southern, Western Sulawesi	**Focus**: Low Risk Region (Maluku, Southern Papua)	**Focus**: All areas in coastal and small islands
	Management and Development of Conservation Zone: - Adjustment of integrated natural resources and ecosystem management	**Focus**: mangrove ecosystem and Coral reef	**Focus**: Coral reef ecosystem and mangrove	**Focus**: wet land ecosystem and sand dune	**Focus**: estuaria ecosystem and continental land
	Optimization of Small Islands: - Adjustment of strategic small islands management	**Focus**: Borderline region with ASEAN countries and India	**Focus**: Borderline region with Australia, Timor Timur, and New Guinea	**Focus**: All strategic small islands	**Focus**: Small islands for naure
	Optimization of Coastal and Marine: - Strengthening disaster mitigation capacity	**Focus:** Pacific Ocean (Kalimantan, Sulawesi, Maluku, Papua)	**Focus:** Indian Ocean (Sumatera, Java, Nusa Tenggara, Maluku, Papua)	**Focus:** Southern China Sea (Sumatera, Kalimantan, Sulawesi)	**Focus:** Other regions within the Indonesian waters
	Management of Fishery Resources: - Adjustment of captured fishery management	**Focus**: Sulawesi, North of Halmahera Island; Cendrawasih Bay, Pacific Ocean; Aru Sea, Arafuru Sea, Eastern Timor Sea	**Focus**: Makassar Strait, Bone Bay, Flores Sea, Bali Sea; Tolo Bay, Banda Sea; Tomini Bay, Maluku Sea, Halmahera Sea, Seram Sea, Berau Bay;	**Focus**: Malaka Strait, Andaman Sea; Karimata, Natuna Sea, Southern China Sea; Java Sea;	**Focus:** Indian Ocean in Western Sumatra,Sunda Strait; Indian Ocean in Southern Java through Southern Nusa Tenggara, Sawu Sea, West of Timor Sea;
	Development of Fishes environment health and environment of cultured fishery: - Adjustment of cultured fishery management	**Focus**: Eastern Fishery Cluster: Pangkep, Sulsel; Gorontalo, Tomini Sulteng; Mamuju, Sulbar	**Focus**: Central Fishery Cluster Dompu, NTT; East Sumba, NTB.	**Focus**: Western Fishery Cluster 1. Serang, Banten; 2. Sumenep, Jatim; Karimun, Kepri	**Focus**: 9 Fishery Clusters and outside clusters

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
	Management and Development of Conservation Zone: - Adjustment of integrated natural resources and ecosystem management	**Focus**: mangrove ecosystem and Coral reef	**Focus**: Coral reef ecosystem and mangrove	**Focus**: wet land ecosystem and sand dune	**Focus**: estuaria ecosystem and continental land
	Optimization of Small Islands: - Adjustment of strategic small islands management	**Focus**: Borderline region with ASEAN countries and India	**Focus**: Borderline region with Australia, Timor Timur, and New Guinea	**Focus**: All strategic small islands	**Focus**: Small islands for naure
	Optimization of Coastal and Marine: - Strengthening disaster mitigation capacity	**Focus:** Pacific Ocean (Kalimantan, Sulawesi, Maluku, Papua)	**Focus:** Indian Ocean (Sumatera, Java, Nusa Tenggara, Maluku, Papua)	**Focus:** Southern China Sea (Sumatera, Kalimantan, Sulawesi)	**Focus:** Other regions within the Indonesian waters
	Management of Fishery Resources: - Adjustment of captured fishery management	**Focus**: Sulawesi, North of Halmahera Island; Cendrawasih Bay, Pacific Ocean; Aru Sea, Arafuru Sea, Eastern Timor Sea	**Focus**: Makassar Strait, Bone Bay, Flores Sea, Bali Sea; Tolo Bay, Banda Sea; Tomini Bay, Maluku Sea, Halmahera Sea, Seram Sea, Berau Bay;	**Focus**: Malaka Strait, Andaman Sea; Karimata, Natuna Sea, Southern China Sea; Java Sea;	**Focus:** Indian Ocean in Western Sumatra,Sunda Strait; Indian Ocean in Southern Java through Southern Nusa Tenggara, Sawu Sea, West of Timor Sea;
	Development of Fishes environment health and environment of cultured fishery: - Adjustment of cultured fishery management	**Focus**: Eastern Fishery Cluster: Pangkep, Sulsel; Gorontalo, Tomini Sulteng; Mamuju, Sulbar	**Focus**: Central Fishery Cluster Dompu, NTT; East Sumba, NTB.	**Focus**: Western Fishery Cluster 1. Serang, Banten; 2. Sumenep, Jatim; Karimun, Kepri	**Focus**: 9 Fishery Clusters and outside clusters

6

ADAPTATION IN THE AGRICULTURE SECTOR

6.1 Current Condition and Projection of Agriculture Sector

6.1.1 Food Production

Indonesia's agricultural sector has succeeded in increasing rice production during the last three years, with a rate of about 5.2% per year. However, impacts of climate change should be considered seriously because climate change is foreseen to directly or indirectly reduce agricultural food production. The climate change impact on agriculture is highly dependent on the locally specific context and hence its vulnerability. For example, agricultural land located near coastal areas is more vulnerable to sea level rise (SLR). Based on the VA analysis, it was clearly shown that one of the impacts of sea level rise to agriculture is decreasing paddy fields in coastal area: until 2050, paddy field in Java and Bali will decrease around 174,461 ha and 8,095 ha respectively (Figure 11 and 12). The decrease of paddy fields will also happen in Sulawesi (78,701 ha), Kalimantan (25,372 ha), Sumatera (3,170 ha), and Lombok Island (2,123 ha)

Figure 11 Sea Level Rise Indicative Map of Java Island

Figure 12 Sea Level Rise Indicative Map of Bali Island

Global warming will potentially alter water vapor flux and may increase humidity, hence more intensive rainfall in one area. However, projected rainfall change shows that precipitation will be more concentrated during the wet season, while the dry season tends to be dryer. The decrease of food production due to rainfall change in 2050 compared to current condition is predicted to be as follows: rice (-4.6%), maize (-20%), soy (-65.2%), sugar (-17.1%) and palm oil (-21.4%).

Agricultural food production is also vulnerable to temperature increase. This is because plants need a certain range of climate (temperature, precipitation etc) for optimal growth and harvest. The decrease in planting area caused by an increase of temperature in 2050 is predicted to reach 3.3% in Java and 4.1% outside of Java from the current total paddy production area. Decrease in productivity due to early ripening reaches around 18.6%-31.4% in Java and around 20.5% outside Java. Decrease in productivity, including rice, caused by increase in temperature which influences rate of plant respiration is predicted to reach 19.94% in Central Java, 18.2% in DI Yogyakarta, and 10.5% in West Java, also 11.7% outside Java and Bali (Handoko *et al.,* 2008)

Extreme climatic events like those triggered by ENSO could reduce food production due to harvest failure. According to the scientific basis of the ICCSR (Sofian, 2009) it is estimated that in 20 years there will be about 13-15 years of alternating El-Nino (EN) or La Nina (LN) and only very few years with normal conditions. The estimated ENSO sequence can be described as: (1) EN-LN in 2010-2012 (with 1 year transition period), (2) EN-LN in 2017-2021 (1.3 year transition), and (3) EN-LN 2023-2027 (6-9 months transition), and (4) EN in 2029-2030. Based on the historical ENSO data (El-Nino 1991, 1994, 1997, and La-Nina 1988, 1995), average impact of harvest failure caused by drought and flood reached 3.95% of total crop area.

The vulnerability of agriculture sector to drought, particularly paddy, is different among development regions. The VA result showed that the drought-vulnerable (medium-high) paddy field area in national reached around 5.33 million ha with the largest distribution in Java (2.75 million ha) and Sumatera (1.86 million ha). The spatial distribution of paddy field areas that are vulnerable to drought in Java is shown in Figure 13.

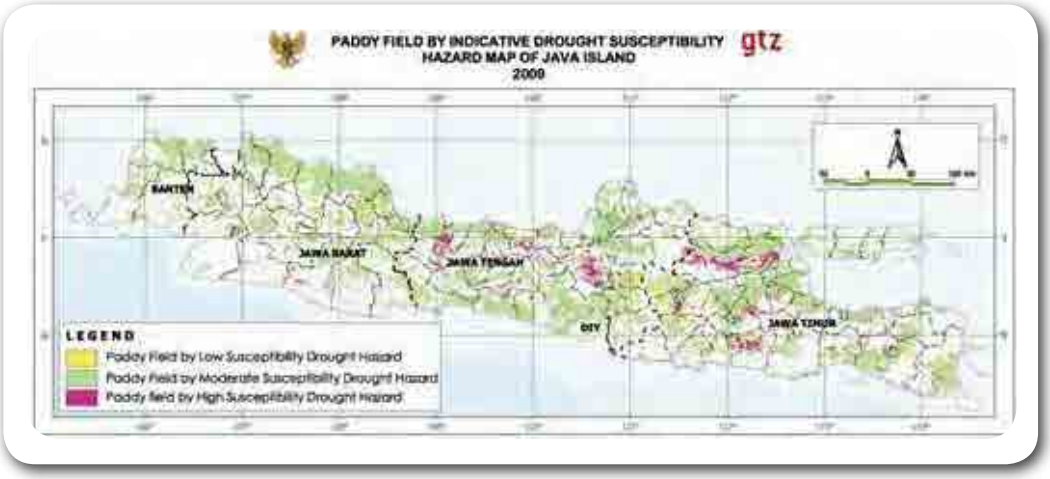


Figure 13 Paddy Field by Indicative Drought Susceptibility Hazard Map of Java Island

6.1.2 Plantation Production

The Directorate General of Estate Crops, MOA (2009) has examined the impacts of drought to commodities such as coffee, cacao, rubber and palm oil. The impact of drought to coffee is highly dependent on the plantation's biophysical condition (land, elevation, and climate), plant condition, drought intensity, and also planting methods. Robusta coffee is more vulnerable to drought than Arabica due to shorter root. Robusta is common to be planted in lowlands area (with higher soil surface temperature). Loss from drought reaches 44-76% in wet areas and 11-19% in dry areas.

Cacao is vulnerable to continuous drought which lasts for 3 months. Loss from drought could reach 40% in dry areas and 20-26% in wet areas depending on the length of drought and wet season in the following years. On the other hand, long drought will affect the growth of productive rubber and cause potential loss of latex production by as much as 175 kg/ha. Drought during July-September will decrease latex production as much as 10% or 250 kg/ha.

Palm production will decrease due to water deficit under drought condition. Loss of fresh fruit bunches may reach as much as 21% if there is 200-300 mm annual water deficit, and 65% if water deficit is more than 500 mm. Wild fire may occur collaterally with long drought, which often causes 100% damage to palm plantation.

Plant damage in plantation caused by drought and inundation that already happen in several regions are reported by communities through the related governmental institutions. As an example, damage of sugar cane in Pati, Central Java and cacao in Mamuju, West Sulawesi show the vulnerability of plantation plants to climate change impacts.

6.2 Issues and Strategies of Agriculture Sector

Several issues of the agriculture sector are identified as follows:

1. Agriculture sector is the main producer of food, supplier of agro-industry, and bioenergy
2. Sea level rise would decrease agriculture land in the coastal zone;
3. Increase of atmospheric temperature would decrease crop productivity, damage agriculture land resources and infrastructure;
4. Limited land resources because of degrading land quality and declining production potential;
5. Change in rainfall pattern, causing a shift in planting period, season and planting pattern, land degradation, and decrease in water availability.

The strategies for Roadmap of climate change adaptation in agriculture sector are as follows:

1. Increase of main food production, commodity consumption diversification, equity of commodity distribution (including export, import and domestic distribution), and food accessibility;
2. Increase of human resources capacity (farmers and authorities);
3. Development and rehabilitation of agriculture infrastructure;
4. Optimalization of land and water resources use and development of agricultural activities with environmental knowledge;
5. Protection of agricultural activities and its production (subsidy, agricultural insurance, tariff, price stability);
6. Increase of research and dissemination activities, particularly in the production and development of crop varieties and adaptive agriculture technology to climate change.

In response toward climate change several regulation/guidelines have been established, including the Minister of Agriculture Regulation No. 47/2006 on Guidelines for Agriculture Cultivation in Highlands; Minister for Agriculture Regulation No.26/2007 on Guidelines of Plantation License; and Minister of Agriculture Regulation No.14/2009 on Guidelines of Peat Land Utilization for Oil Palm Plantation. The latest regulation tightens the requirement of peat land utilization for oil palm plantation, which not only consider the depth of peat bog (<3m) but also the main composition of soil under the peat, the maturity of peat, and the fertility of peat land.

6.3 Activities of Agriculture Sector

Activities that are recommended for adaptation and mitigation in the agriculture sector, incuding activities for each program are depicted in the table below (Table 8). The breakdown of each program in each five-year period is available in the full ICCSR report for the agriculture sector. In 2009, the available budget is IDR 1.273 trillion for adaptation activities and programs, namely organic fertilizer, equipment for making compost, Pest Control Field School (SL-PHT), and Climate Field School (SLI). With the projection that the budget availability have increased 10% per year, the budget that will be available throughout year 2010-2014 is **IDR 8.548 trillion.** However, to finance the champion programs the fund that will be needed for five years is **IDR 24.269** trillion (LPEM UI, 2009).

Table 8 Activities of Agriculture Sector

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information and Knowledge Management	Crafting and preparation of crop variety tolerant against drought, flood, salinity, and pest, short-lived and high productivity	20 packages	20 packages	20 packages	20 packages
	Development of adaptive technology innovasion, including superior variety, cultivation technic, and land and water management	increasing IP for Java and Sumatera	Productivity of crop outside Java (especially Sumatera, Sulawesi) can be equal with Java and Bali	Productivity of crop outside Java (especially Sumatera, Sulawesi) can be equal with Java and Bali	Productivity of crop outside Java (especially Kalimantan, Nusa Tenggara) can be equal with Java and Bali
	Impact analysis of climate anomaly to planting season shifting	Finishing of national cropping calendar map	Planting calendar update in Java and Bali	Planting calendar update in Sumatera and Sulawesi	Planting calendar update in Kalimantan and Nusa Tenggara

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
Planning and Policy, Regulation and Institutional Development	Coordination with authorities, vertically and horizontally, including socialization on climate information	30 Provinces	33 Provinces	33 Provinces	33 Provinces
	Development of clean water safeguarding, handling, and storage system during post-harvest activities and production	25 Regencies	25 Regencies	25 Regencies	25 Regencies
	Building and development of cold chain system (CCS) and warehousing during post-harvest activities and food storing	25 Regencies	25 Regencies	25 Regencies	25 Regencies
	Field development of integrated crop management on rice (SL-PTT padi)	13 – 14 million ha of planting area	17-18 million ha of planting area	20-21 million ha of planting area	23-24 million ha of planting area
	Field development of integrated crop management on secondary crops (maize, soybean, peanut) (SL-PTT Palawija)	10 – 11 million ha of planting area	15-16 million ha of planting area	18-19 million ha of planting area	22-23 million ha of planting area
	Development of food crop varieties tolerant to drought, inundation, and or pest	6-6.5 million ha of planting area	6.5-7 million ha of planting area	6.5 – 7 million ha of planting area	6.5 – 7 million ha of planting area
	Extent estate crops on mineral soil, non-peat and non-forest land	1-1.3 million ha	0.3-0.4 million ha	0.2 – 0.3 million ha	0.5-0.6 million ha

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
Implementation and Control with Monitoring and Evaluation	Reduction of harvest-failure areas	≤ 3 % of planting area	< 3 % of planting area	< 3 % of planting area	< 3 % of planting area
	Implementation of climate change adaptation and management of food scarcity through development of food independent village program	125 Regencies/ Cities	125 Regencies/Cities	125 Regencies/Cities	125 Regencies/Cities
	Acceleration of food consumption diversity and fresh food security	5 provinces of Java island;	10 provinces of Sumatera (2015-2019);	10 prov. of Kalmantan and Sulawesi (2020-2024);	8 provinces of Papua, NT, Maluku
	Increase of storage and handling on food scarce regions	130 Regencies	160 Regencies	160 Regencies	130 Regencies

7

ADAPTATION IN THE HEALTH SECTOR

7.1 Current Condition and Projection

Being one of the most populated countries in the world, Indonesia is still facing serious public health problems. These health problems are becoming more complex due to climate change impacts that affect human health either directly and/or indirectly. In addition, changes in environment due to climate change may increase the prevalence of certain illnesses. Potential impacts of climate change on the health sector include:

- Morbidity and mortality due to climate-related disasters. Climate change is projected to cause an increase in the frequency of extreme weather events that will trigger more water-related disasters such as floods, landslides, and destructive storms;
- Malnutrition can occur in certain regions because of reduced food production under changing climate, and the disruption of food supplies and failure of crop harvest due to extreme weather;
- Deaths and morbidity due to illness. Climate change-related diseases triggered by a change in temperature, air pollution, water congenital diseases, food, and congenital disease vectors and rodents.

Vulnerability assessment and risk analysis of health sector against projected climate change in Indonesia have been carried out but, due to limited data availability, only those related to infectious disease are presented below.

7.1.1 Vector-borne infectious disease: Malaria and Dengue fever

Malaria and Dengue Fever is probably the most well-known climate related diseases that currently have a high incidence rate (IR) in Indonesia. The first appearance of dengue fever in Indonesia was reported in 1968, with an IR of 0.05/100,000 population and mortality of 14.3%. Since then, Dengue Fever has spread widely all over Indonesia (see Table 9).

Table 9 Lists of Dengue Fever events in Indonesia

Year	No. of Incidence	Incidence Rate (IR)	Deaths/Case Fatality Rate (CFR)	Remarks
1968	-	0.05/100,000	-/14.3%	First occurrence
1998	73,133	-	1411/2%	Extreme event
2004	28,077	-	1.36%	334 districts/cities
2007	156,767	71,18/100,000	1570/1.00%	357 districts/cities
2008	98,869	43,62/100,000		346 districts/cities

During the last decade, malaria in Indonesia has been reoccurring, and around 35% of Indonesia's population is living in an endemic area. Cases of malaria in Java and Bali, which is stated in the annual parasite incidence (API) during the period of 1995-2000 has increased drastically from 0.07/1,000 (1995) to 81/1,000 (2000). During 2002 and 2003 API has decreased to consecutively 0.47/1,000 and 0.22/1,000. Malaria cases outside Java and Bali which are stated in annual malaria incidence (AMI) during

Figure 14 Map of Dengue Fever Risks in 2030

Figure 15 Map of Malaria Risks in 2030

1995-2003 period fluctuates sharply from time to time starting from 20/1,000 (1995) to 22.7/1,000 (2002). Projections of future risks of dengue fever and malaria because of climate change are illustrated in the following maps.

7.1.2 Diarrheal Disease

Direct contagious diseases such as diarrhea are still a problem for public health. Extreme events which decrease the quality of drinking water and poor sanitation occur yearly. The 2004 and 2005 data show that diarrhea events are always high during January-March, however during 2006 diarrhea events are constantly high throughout the year with the peak of events in January, April, and October. In general, contagious

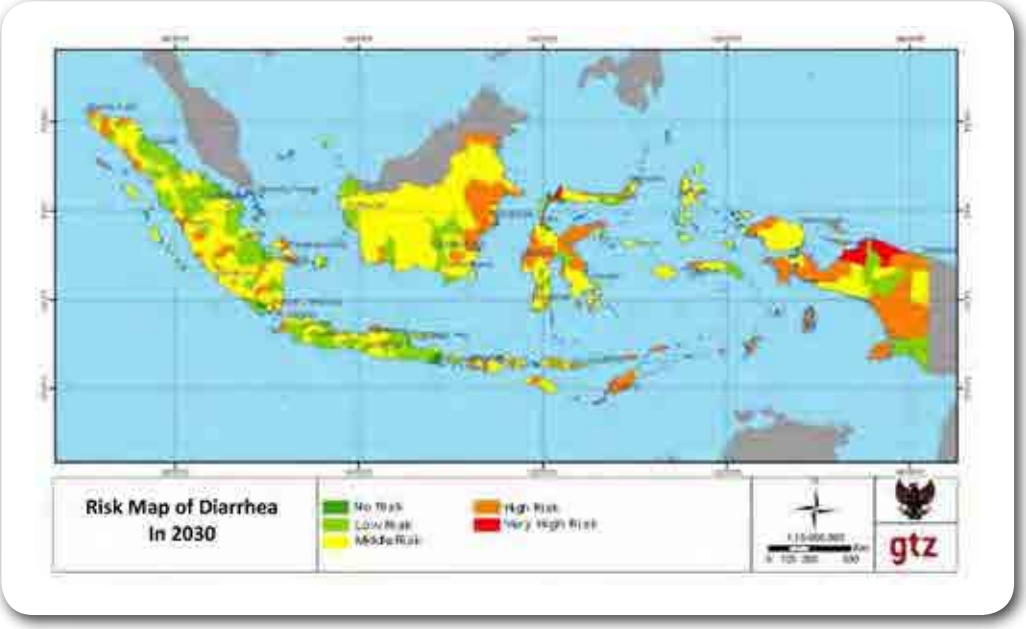


Figure 16 Map of Diarrheal Risk in 2030

diseases are not directly influenced by environmental but often occur within vulnerable society (toddlers and pregnant women) especially in villages which in majority have low income and poor access to health services. Projection of future risks due to climate change on diarrhea is illustrated in the map below.

7.2 Issues and Strategies of Health Sector

The issues for formulating priority adaptation in the health sector are prepared based on the risk analysis. Those issues are:

- Diseases or deaths caused by disasters related to extreme climate events and diseases that might be outbreak in the refugee sites;

- The increase of respiratory diseases as a result of increasing air pollution, which are associated with the rise of surface air temperature;
- The increase of agents of water-borne diseases or contagious diseases, which normally take place during droughts or floods;
- Malnutrition during famine due to harvesting failure;
- Changing pattern of diseases brought by vectors such as mosquito due to land use conversion and climate change. Moreover, temperature rise of 2-3 degree Celsius is projected to increase the number vector-borne diseases by 3-5% and also to increase the distribution of the vectors;
- Precipitation level also contributes to the type and intensity of vectors' habitat.

The strategies for Roadmap of climate change adaptation in health sector are as follows:

- Improving access, equity, affordability and quality of health services especially for the poor, through services and increase infrastructure facilities and basic health services (in part financed through the Special Allocation Fund);
- Increasing the availability of medical and paramedical staff, especially for basic health services in remote and high risk areas;
- Prevention and eradication of infectious disease, through proper infectious disease treatment, increased surveillance, discovery and proper case treatment methodology;
- Preparation and implementation of surveillance, handling of patients/people with avian influenza, avian influenza drug provision, facilities and infrastructure, handling cases in the hospital;
- Treatment for malnutrition in pregnant women, infants and children aged below five years old, through community education for nutrition awareness, increased nutrition surveillance.

7.3 Activities of Health Sector

A number of recommended activities for climate change adaptation in health sector are the results of focus group discussions with the stakeholders. Beside a number of activities that will be conducted at the national level, activities are also focused on provinces that are highly prone to Malaria, Dengue fever, and Diarrhea such as Papua and Nusa Tenggara. Focus will also be put on some areas in Java and Southern Sumatra that are prone to Dengue Fever, and some areas in Kalimantan, Sulawesi and Eastern Sumatra that are prone to Diarrhea.

Table 10 Activities of Health Sector

Category	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information and Knowledge Management	Analysis of climate change hazard, vulnerability, risk and impact to health on national, province and regency/city level and develop adaptation model for selected cities and villages.	Improvement of analysis on climate change hazard, vulnerability, risk and impact to health on national, province and regency/city level and expantion of developing adaptation model for selected cities and villages.	Detail of analysis on climate change hazard, vulnerability, risk and impact to health following the complexity of disease, environment, and social system	Detail of analysis on climate change hazard, vulnerability, risk and impact to health following the complexity of disease, environment, and social system
	Analysis of impact of climate change related to disaster, food security/ malnutrition issue, vector of diseases, and environmental change	Improvement of analysis on impact of climate change related to disaster, food security/ malnutrition issue, vector of diseases, and environmental change	Detail of analysis on impact of climate change related to disaster, food security/ malnutrition issue, vector of diseases, and environmental change	Detail of analysis on impact of climate change related to disaster, food security/ malnutrition issue, vector of diseases, and environmental change
	Database, information system, and community health profile arrangement and modernization	Database, information system, and community health profile modernization	Implementation of integrated online GIS database to support information system and community health profile	Expansion and integration of climate change management information system in public service and national planning
Planning and Policy, Regulation and Institutional Development	Strengthening of policy and regulation based on community health in order to strengthening adaptation action and prevention of diseases included their socialization	Strengthening of policy and regulation based on community health in order to prevention of epidemi/pandemic of diseases included their socialization	Strengthening of policy and regulation based on community health included their socialization	Strengthening of policy and regulation based on community health included their socialization
	Climate change adaptation strategy training and networking at central, province, and regency/city level	Improvement of climate change adaptation strategy training and networking at central, province, and regency/city level	Climate change adaptation strategy training and networking at central, province, and regency/city level	Climate change adaptation strategy training and networking at central, province, and regency/city level

Category	2010-2014	2015-2019	2020-2024	2025-2029
Implementation and Control with Monitoring and Evaluation	Development of early warning system for climate change impact areas	Improvement of early warning system for climate change impact areas	Establishment of early warning system for climate change impact areas	Establishment of early warning system for climate change impact areas
	Strengthening of health service system as response to climate change in high risk area	Strengthening of integrated health service system considering community growth, demographic change, poverty, general health infrastructure, sanitation, health facility, nutrient, healthy lifestyle, pesticide resistance, and environmental damage in high and medium risk area	Expansion the coverage of integrated health service system to all villages in Indonesia	Expansion the coverage of integrated health service system to all villages in Indonesia
	Improvement of financial support, equipment, and infrastructure to support disease control program, for instance, through international cooperation	Improvement of financial support, equipment, and infrastructure to support disease control program, for instance, through international cooperation	Improvement of financial support, equipment, and infrastructure to support disease control program, for instance, through international cooperation	Improvement of financial support, equipment, and infrastructure to support disease control program, for instance, through international cooperation
	Improvement of public access to health service in high risk regencies/cities	Improvement of public access to health service in high and medium risk regencies/cities	Improvement of public access to health service in all regencies/cities	Improvement of public access to health service in all regencies/cities
	Strengthening of monitoring system, surveillance, and health information system in climate change	Strengthening of monitoring system, surveillance, and health information system in climate change	Strengthening of monitoring system, surveillance, and health information system in climate change	Strengthening of monitoring system, surveillance, and health information system in climate change
	Public participation through Communication, Information, and Education module making, campaign, and health promotion especially for health adaptation program and improvment of environmental sanitation	Improvement of public participation through ongoing socialization	Improvement of public participation through ongoing socialization	Improvement of public participation through ongoing socialization
	Implementation of appropriate adaptation technology on sanitation and adaptive healthy housing technology to climate change in high risk area	Implementation of appropriate adaptation technology on sanitation and adaptive healthy housing technology to climate change in high and medium risk area	Implementation of integrated sanitation system and adaptive healthy housing technology to climate change in all cities and villages in Indonesia	Implementation of integrated sanitation system and adaptive healthy housing technology to climate change in all cities and villages in Indonesia
	Improvement of public health education and campaign on health and clean lifestyle	Improvement of public health education and campaign on health and clean lifestyle	Improvement of public health education and campaign on health and clean lifestyle	Improvement of public health education and campaign on health and clean lifestyle

8

SUMMARY OF PROPOSED ADAPTATION ACTIVITIES

From the various risk assessments to climate change, including the ones which were conducted for the Indonesia Climate Change Sectoral Roadmap (ICCSR), it has become more obvious that adaptation planning should be based on scientifically sound climate projection and risk assessment. Therefore, it is necessary to precede the formulation of adaptation activities with risk assessment. Hence, it is expected that proposed activities for adaptation to climate change are well suited with the region characteristics (projected hazards and vulnerability). This is to prevent over-adaptation, mal-adaptation and under-adaptation (Australian Government, 2005). However, level of accuracy of adaptation plans is predominantly determined by the level of accuracy of future climate projection. Therefore, Suroso et.al (2009) proposes to divide hierarchically the scale of adaptation planning into macro, meso and micro levels. The level of plan being formulated will determine the level of accuracy of risk assessment required.

A macro level risk assessment conducted for the ICCSR is intended for formulating adaptation activities at the national level. As seen from the risk map of water shortage, areas in all over Indonesia which could experience very high and high risks were identified. Therefore, priority activities for adapting to the risk of water shortage can be focused on those priority areas. However, to identify more precise action such as whether a dam is a best option to be built or not in an area to address the risk of water shortage, a further detail assessment at local level is needed.

By methodology, hazards and vulnerability assessment precedes risk assessment. In the context of climate change, hazards assessment is conducted by projecting future change of temperatures, rainfall, sea level rise and extreme climatic events. For projecting such changes, "bottom up analysis" (trend from historical observational data) and "top down analysis" (down scaling from global circulation model) are applied. For either approaches, Indonesia is still facing the challenges on providing good historical observational data as well as discovering the most suitable global circulation model representing Indonesia's climate condition to be used for down scaling climate projection into national and local level.

The risk assessment in each adaptation sector has identified regions in Indonesia with different level of risks generated from climate change. As we can see in Table 11, the type of risks threatening each region varies as well. Java-Bali and Sumatra are two regions that have all level of risks, with risk intensity that could be experienced by Java-Bali is greater than Sumatra.[9] Java-Bali is the most populated region of Indonesia, with population concentrated in coastal areas, which makes this region highly vulnerable to hazards caused by climate change.

[9] This summary does not generalize that all parts of those regions as vulnerable to each hazard, it serves only as a tool to compare risk exposure of all regions in Indonesia. Please refer to the summary of sectoral roadmap report in the previous sections above or its individual report for detail location of risk in each region

Table 11 Summary of Risks of Climate Change by Region

Risks	Sumatra	Java-Bali	Kalimantan	Sulawesi	Nusa Tenggara	Moluccas	Papua
Water shortage	M, H, VH	H, VH	L, M	H, VH	H, VH	L, M	L
Flood	H, VH	H, VH	L, M, H	L, M, H	L	L	M, L
Drought	H, VH	H, VH	L	L, M	L, M, H	L	L
Coastal inundation	M, H	M, H, VH	M, H, VH	M, H	M, H	M, H	M, H
Paddy field drought	H, VH	H, VH	-	-	H, VH	-	-
Dengue fever	L, M, H	L, M, H	L, M	L, M	L, M	L, M	L, M, H
Malaria	L, M	L, M, H	L, M	L, M, H	L, M, H, VH	M, H	M, H, VH
Diarrhea	L, M, H	L, M, H	L, M, H	L, M, H	L, M, H	L, M, H	L, M, H VH

Notes: L: low; M: Moderate; H: High; VH: Very High

It is advisable that adaptation activities in the National Medium-term Development Plan (RPJMN) 2010-2014 need to be focused on strengthening the capacity of data, information, climate modeling and risk assessment. In addition, in this period, serious attention should be dedicated to capacity development such as adjustment of regulation and enhancement of human resources capability. However, programs on adaptation action should also begin from the planning term of 2010-2014, although the proportion of resources allocation will be still smaller than for financing the climate information system and capacity building. Once the capacity of information system and research on climate change is established by 2015, the proportion of the resources for adaptation actions will be increasingly bigger starting from the RPJMN 2015-2019 onward.

As seen in Table 11, the Java-Bali region is projected to experience the highest and most diverse risks of climate change, especially along the Northern Coast of Java. Similarly, Suroso and Sofian (2009) also concluded that many key infrastructures, densely populated areas, paddy fields, fishponds, industrial sites, tourism sites located on the Northern Coast of Java would be exposed to multiple stressors from climate change. Such findings lead to the need to urgently respond to those potential risks with appropriate adaptation actions. For an example, fisherman villages along the northern coast of Jakarta have routinely been disturbed by storm tides which caused serious trouble on the fishing activities. The disturbance has also been experienced by harbors located along the Northern Coast of Java. For an example, the distribution of goods and services to and from the Tanjung Mas Port, Semarang experienced trouble in May 2009 due to seawater inundation which was complicated by other severe coastal degradation i.e. land subsidence. It means that, in this micro level context, even though the most appropriate adaptation

action has to be based on risk assessment at micro level, we should not be prevented to begin with more concrete adaptation action from now on i.e. revising spatial plan along the northern coast of Java

A synoptic view on the priority adaptation activities, especially for the RPJMN 2010-2014, can be seen in Table 12. It shows that, although adaptation activities proposed by each sector vary to suit the need of each sector, they can be classified into three categories. For Category 1, all adaptation sectors focus their activities on climate impact and risk assessment. Adaptation activities included in Category 2 vary considerably. The water sector proposes enhancement of water conservation through revitalization of local wisdom and community participation. The marine and fisheries sector focuses on the integration of adaptation into coastal planning and reforming regulation to include climate change issues. The agriculture sector emphasizes the need to strengthen agricultural extension to prepare farmers in adapting to climate change. The health sector recommends to amend the regulation, and to strengthen the capacity and networking. Proposed activities under Category 3 by all adaptation sectors primarily well reflect the findings from the risk map resulted by each sector.

Table 12 Summary of Proposed Activities by Adaptation Sectors for 2010 - 2014

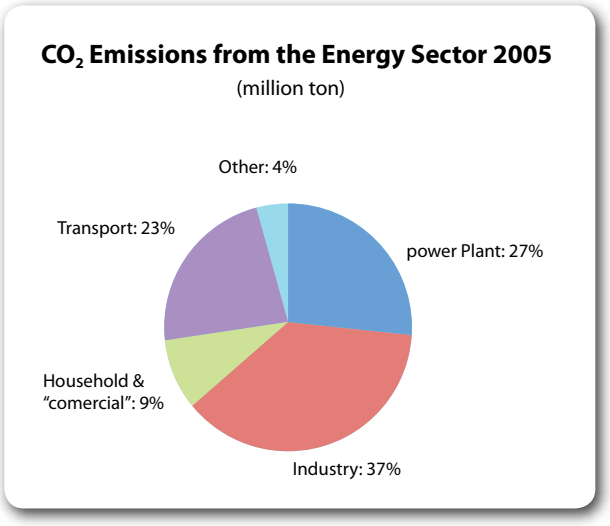
Category	Water	Marine – Fishery	Agriculture	Health
Data, Information and Knowledge Management	Vulnerability and risk assessment at regional level and strategic zone	Inventory of data, information system and research	▪ Crafting and preparation of crop variety tolerant against drought, flood, salinity, and pest, short-lived and high productivity ▪ Development of adaptive technology innovasion, including superior variety, cultivation technic, and land and water management ▪ Impact analysis of climate anomaly to planting season shifting	▪ Analysis of climate change hazard, vulnerability, risk and impact to health on national, province and regency/city level and develop adaptation model for selected cities and villages. ▪ Analysis of impact of climate change related to disaster, food security/ malnutrition issue, vector of diseases, and environmental change ▪ Database, information system, and community health profile arrangement and modernization
Planning and Policy, Regulation and Institutional Development	▪ Revitalization of local wisdom and building the capacity and participation of community in adapting to climate change ▪ Enhancement of water conservation and reduction of hazard and disaster related to climate change	▪ Integration of climate change adaptation into coastal planning ▪ Adjustment of regulation and policy related to climate change	▪ Coordination with authorities, vertically and horizontally, including socialization on climate information ▪ Development of clean water safeguarding, handling, and storage system during post-harvest activities and production ▪ Building and development of cold chain system (CCS) and warehousing during post-harvest activities and food storing ▪ Field development of integrated crop management on rice (SL-PTT padi) ▪ Field development of integrated crop management on secondary crops (maize, soybean, peanut) (SL-PTT Palawija) ▪ Development of food crop varieties tolerant to drought, inundation, and or pest ▪ Extent estate crops on mineral soil, non-peat and non-forest land	▪ Strengthening of policy and regulation based on community health in order to strengthening adaptation action and prevention of diseases included their socialization ▪ Climate change adaptation strategy training and networking at central, province, and regency/city level
Implementation and Control with Monitoring and Evaluation	▪ Enlargement of water supply using appropriate technology and development of local water resources ▪ Improvement of storage capacity and water infrastructure for safeguarding water balance and disaster prevention	▪ Adjustment of elevation and strengthening of building structures and vital facilities in coastal areas ▪ Adjustment of integrated natural resources and ecosystem management ▪ Adjustment of strategic small islands management ▪ Strengthening disaster mitigation capacity ▪ Adjustment of captured fishery management ▪ Adjustment of cultured fishery management	▪ Reduction of harvest-failure areas ▪ Implementation of climate change adaptation and management of food scarcity through development of food independent village program ▪ Acceleration of food consumption diversity and fresh food security ▪ Increase of storage and handling on food scarce regions	▪ Establishment of early warning system for climate change impact areas ▪ Expansion the coverage of integrated health service system to all villages in Indonesia ▪ Improvement of financial support, equipment, and infrastructure to support disease control program, for instance, through international cooperation ▪ Improvement of public access to health service in all regencies/cities ▪ Strengthening of monitoring system, surveillance, and health information system in climate change ▪ Improvement of public participation through ongoing socialization ▪ Implementation of integrated sanitation system and adaptive healthy housing technology to climate change in all cities and villages in Indonesia ▪ Improvement of public health education and campaign on health and clean lifestyle

9

MITIGATION IN THE TRANSPORTATION SECTOR

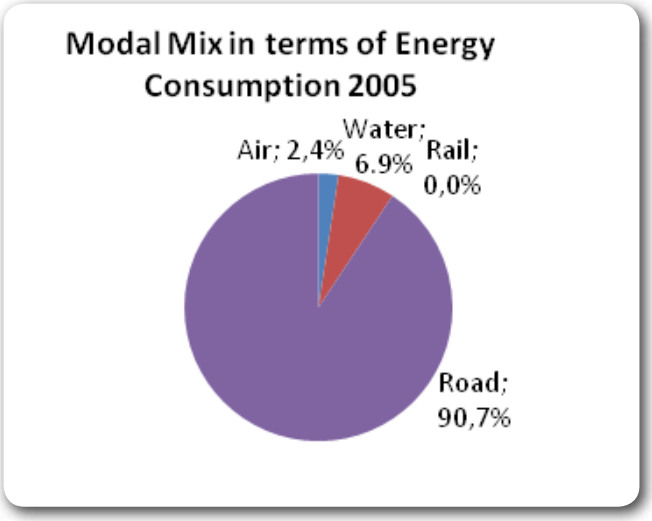
9.1 Emission Status

Transport is a major source of greenhouse gas (GHG) emissions in Indonesia. In 2005, it contributed 23% of the total CO_2 emissions from the energy sector or 20.7% percent of the country's overall CO_2 emissions. The sector generates annual emissions of about 68 million tons of CO_2 equivalents, representing 23% of the total energy sector CO_2 emissions in 2005. This was the third largest contribution to energy-sector emissions, eclipsed only by emissions from industrial sources and power plants.



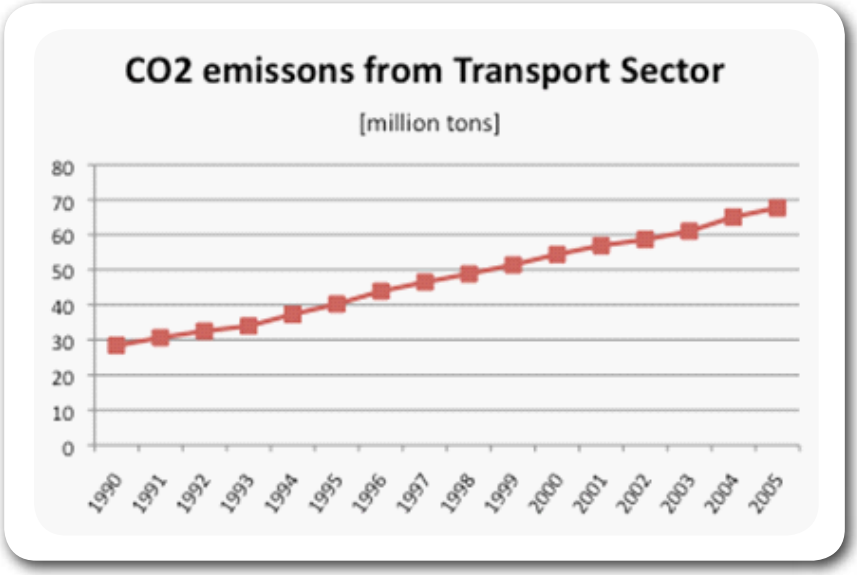
Source: Indonesian National Greenhouse Gas Inventory under the UNFCCC, "Enabling activities for the preparation of Indonesia's Second National Communication

Besides being a major source of greenhouse gas (GHG) emissions, the transportation sector is also the biggest contributor to air pollution, especially in urban areas where motor vehicle usage is concentrated. Emissions of local pollutants from road transport have been growing at an average annual rate of 8-12%. Based on the Ministry of Environment's research in 2005, in Java's big cities (including Jakarta, Bandung, Semarang, and Surabaya), motorized road vehicles are the major source of air pollution. They contributed almost 99% of local pollutants in Jakarta, , including about 73% of NOx and 89% of HC gas emissions. Since reduction of motor vehicles' fuel consumptions would simultaneously reduce emissions of CO_2 and local pollutants, mitigating GHG emissions has major co-benefits for urban dwellers.



Source: "Why Have CO2 Increased in the Transport Sector in Asia? Underlying Factors and Policy Options", Policy Research Working Paper, The World Bank Development Research Group Environment and Energy Team, September 2009

Road transport represents around 90% of CO_2 emissions from the transport sector. This is by far the single biggest source of CO_2. The other transport sub-sectors have significantly smaller contributions, as summarized in the following diagrams.

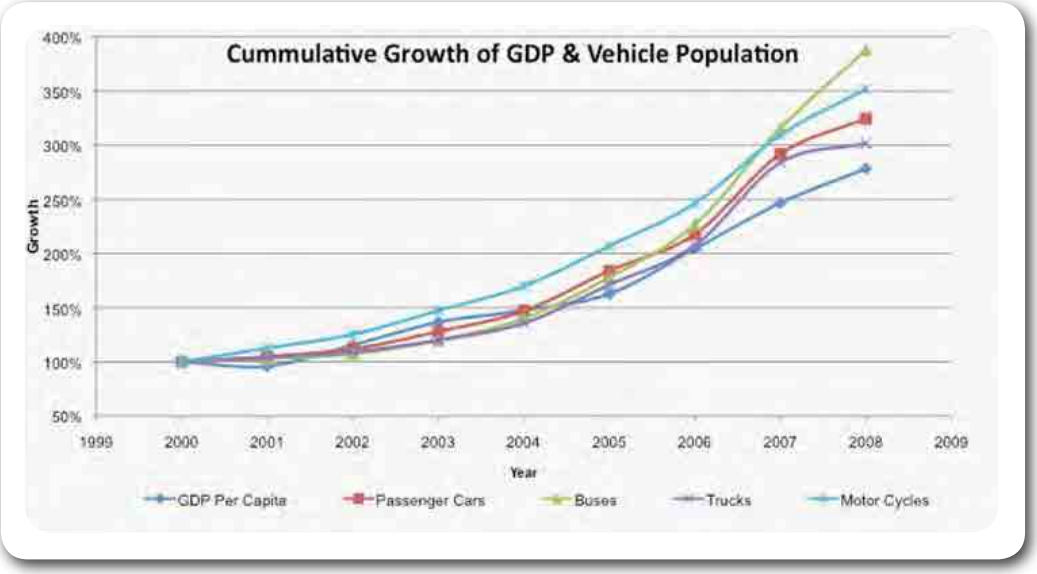


Source: Handbook Statistik Ekonomi Energi 2006, Ministry of Energy and Mineral Resources

The fuel sales data show that transport-related CO2 emissions have been steadily increasing, climbing from about 40 million tons in 1995 to over 54 million tons in 2000 and to around 68 million tons in 2005.

A closer look at the vehicle population confirms the increasing trend of CO2 emissions in past years, a trend that grew at faster rates than Indonesia's GDP. After the stagnant years of 1997-2001, Indonesia's GDP per Capita grew from $748 in 2001 to $2,170 in 2008, meanwhile each cohort of the vehicle population grew by more than tripled in size. (See the following diagram.)

If there is no intervention to stem the growth in vehicle ownership, the country's vehicle population will grow at an accelerated rate. With GDP projected by various international organizations to grow at



Source: GDP data from World Resources Institute (http://www.wri.org), and Vehicle Population data from Statistik Indonesia 2009, BPS

a rate of 4.5% or more annually, Indonesia's vehicle population is expected to expand at a rate that is faster than GDP. This is attributable to various factors including the high elasticity of vehicle ownership for individuals at lower income levels (GDP per Capita lower than $20,000) and the deterioration of the public transport sector. The slow expansion of road infrastructure (that has currently been at 1.0% in urban areas and 5.1% in outer-urban areas[10]) was thought to be one of the few factors that could restrain the vehicle population growth. However, the increase of vehicle ownership in Jakarta (currently at 250 passenger cars per 1000 people, during a period when GDP per Capita is around $4000/person) contradicts this assumption, despite widespread exposure to traffic congestion. The following diagram shows one forecast of vehicle population through 2025 and 2035.

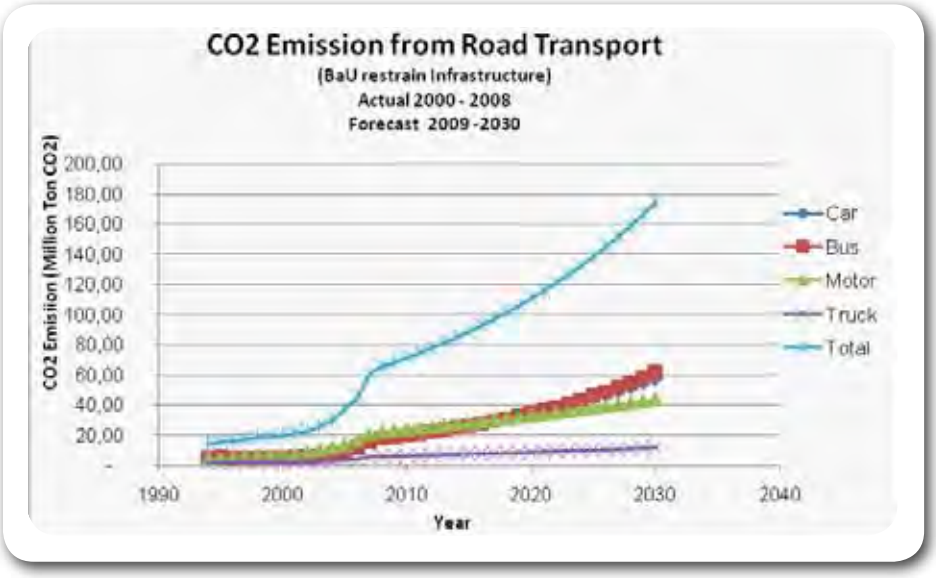
[10] Analysis data from Ministry of Public Works data

Population	2005	2010	2015	2025	2035
2-W	18.8	30.0	38.0	52.9	52.7
3-W	0.0	0.0	0.0	0.1	0.1
HCV	0.8	1.0	1.2	1.9	3.0
LCV	2.9	3.6	4.4	8.4	15.1
Car, SUV	1.2	1.4	1.8	3.6	7.0
Grand Total	23.7	36.0	45.5	66.9	77.8

Note:
2-W = 2-wheeler (motorcycle, etc.); 3-W = 3-wheeler (tricycle, etc.); HCV = heavy-duty commercial vehicle; LCV = light-duty commercial vehicle; SUV = sport utility vehicle.

Source: ADB 2006 in "Energy Efficiency and Climate Change Considerations for On-road Transport in Asia"

If one assumes that there is no change in the transport demand pattern (e.g. due to expansions of land conversion along a pattern comparable to the current one), similar travel behavior (e.g. no reduction in vehicle-kilometers travelled, no modal shift due to the continuing deterioration of public transport and no Transport Demand Management (TDM) measures as well as no improvements in vehicle fuel economy, then vehicle fuel consumption, and the associated CO2 emissions from road transport will increase significantly. The expected increase is illustrated in the following diagram.



9.2 Mitigation Potentials

There are three primary strategies available to reduce greenhouse gas emissions in the transport sector. These are: **Avoid** (i.e. avoid or reduce travel or the need to travel); **Shift** (i.e. shift to more environmentally friendly modes); and **Improve** (i.e. improve the energy efficiency of transport modes and vehicle technology).

1. **Avoiding or reducing the distance travelled** through careful land-use planning allows Indonesians to maintain their personal mobility while reducing the vehicle-kilometers travelled. This notion of mobility is defined as the possibility to achieve different human activities such as business, work, purchase, leisure and other social and cultural activities. Integrated, dense structures of housing, working and shopping facilities and places for leisure allow people to practice their activities without experiencing long transport distances. A transit-orientated pattern of development further increases the density along a highly efficient public transport. As a result of sustainable transport measures already implemented, an individual may take a decision not to travel for certain trips or to reduce the distances traveled. The number of travels and the total daily trip length can be reduced in this way due to mixed land use, and shorter distances to trip destinations.

2. **The modal Shift** strategy aims to satisfying each citizen's remaining transport needs using the most environmentally friendly transport modes possible. The different transport modes – walking, cycling, riding in busses, trains, or ships and driving cars – have different environmental impacts. Strategies to encourage modal shifts can result in a higher proportion of trips being made by walking or cycling. These non-motorized modes have the lowest impact on the environment, followed by riding in buses or trains, while driving cars has the heaviest impacts.

   A secondary objective is to shift as many trips as possible to public transport vehicles, such as buses or rail. Although there are CO_2 emissions associated with both bus and rail trips, the high occupancy levels in these modes means the emissions of greenhouse gases per passenger-km is reduced by a factor of 4-8, compared to the average private vehicles. Transport Demand Management (TDM) measures, such as congestion charges, parking limitations and usage fees, play an important role as incentives for modal shifts.

3. **Improve vehicle technologies and fuels:** The third strategic pillar involves improvements in vehicle technology as well as lowering the carbon content of fuels. Where private cars and other low-occupancy vehicles continue to be used, the strategy of improving vehicle energy efficiency and decarbonizing vehicle fuels can help to reduce emissions significantly.

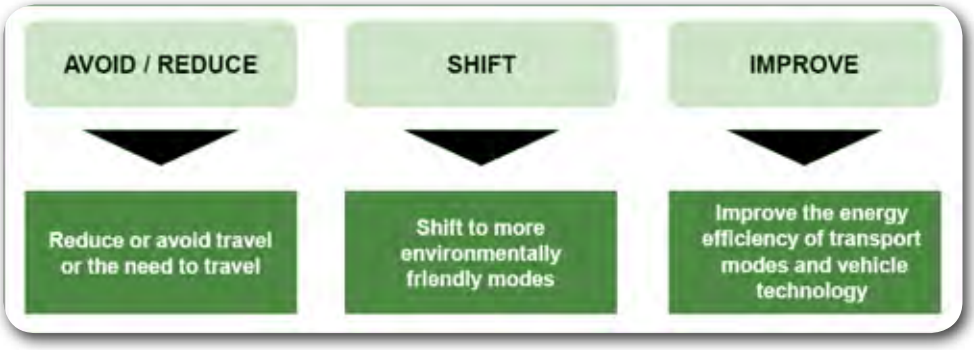


Figure 17: The "Avoid / Reduce-Shift-Improve" approach

Applying these strategies to the Indonesian context means developing a comprehensive approach to GHG reduction and identifying a set of practical policies. The table on the following pages outlines a suite of measures that could enable Indonesia to achieve a meaningful GHG emissions reductions in the transport sector.

The abatement cost of CO_2 emissions reductions for each policy measure (calculated in USD/ton of avoided CO_2) is obtained by dividing the present value of the cost associated with emissions reductions by the cumulative total CO_2 reductions over the analysis period, and. Highlights of the analysis are presented in Table 13 below.

Table 13 Abatement Cost Estimation by Policy Measure

Policy / Measures	Spending type	Total Cost Relative to BAU	NPV (rel. to BAU) (disc. rate: 12%)	Cumulative CO2 abatement	System abatement Cost	
		(Mill. Rp.)	(Mill. Rp.)	(Mil.Ton)	(Mill. Rp./mil.ton CO2)	(US$/ mil.ton CO2)
"Avoid" Measures	public	9.9	150	0.89	185.96	18.6
	private	74.3	32			
"Shift" Measures	public	88.0	529	5.48	248.51	24.9
	private	133.1	152			
"Improve" Measures	public	25.3	53	4.80	236.52	23.7

Table 14: Overview of GHG reduction measures in the transportation sector (land transport)[11] in Indonesia until 2030

No	Measure	Description	Way to achieve GHG emission reduction	GHG emission reduction in 2020 against total baseline	Co-benefits	Required Policy Measures and Instruments	Responsibilities	Reference to other measures
"AVOID / REDUCE" Measures / Smart growth oriented transport planning								
1.	Integrated Land Use and Transportation Planning	Development of a guideline for urban development / transport planning, including rules on land use. In hands walking/cycling infrastructure and pedestrian zones. Applying traffic impact control (TIC) in urban development.	Avoid/reduce kilometers driven through giving access to destinations that are at low distances through promoting.	2%	Lower emissions of local pollutants Equity between poor and wealthy people	Minister of Transportation (MoT) Decree and Local Regulation and Government Decree	Province and City Planning Agency	Public transport improvements (in terms of transit oriented development)
2.	Promote modern logistics systems	Introduction of a modern logistic platform Time restrictions for business district areas	Reduction of empty haulage	2-3%	Lower emissions of local pollutants	Minister of Transportation (MoT) Decree	Provincial and Municipal Transportation Agency	
No	**Measure**	**Description**	**Way to achieve GHG emission reduction**	**GHG emission reduction in 2020 against baseline**	**Co-benefits**	**Required Policy Measures and Instruments**	**Responsibilities**	**Reference to other measures**
"SHIFT" Measures / Travel Demand Management								
PULL Measures								
3.a.	National Urban Transport Policy	Develop, consult and approve national urban transport policy and strategy, including a financing scheme for sustainable urban transport investments	Selection of best proposals through comprehensive city mobility plans. Contribute to public transport investments and NMT infrastructure	(see below)	Improvement of mobility options Lower emissions of local pollutants	Government Decree on TDM, followed by MoT Decree on TDM	MoT	Create public transport funding mechanism, fed through fuel and vehicle taxation
3.b.	Public Transport Improvement Programme	Measures to improve and increase high quality public transport (Utmost importance)	Attract people to public transport and hence reduce private car use.	6-8%	Improvement of mobility options Lower emissions of local pollutants	MoT Decree on BRT/ Transit System Guidelines	Provincial and Municipal Transportation Agency	Closely related to a better NMT infrastructure
3.c.	NMT National Development Program	Measures to promote cycling, walking and the use of public space	Attract people to walk and cycle and hence reduce private car use.	2%	Improvement of mobility options Lower emissions of local pollutants	Decision Letter of Director about NMT Technical Guidelines	Municipal Transportation Agency	Closely related to high quality public transport
3.d.	Campaigns and , Education program at schools	Training and outreach material to provide information about public transport and NMT options	Raise awareness on options for environmentally friendly modes and thus reduce private car use	1%	Improvement of mobility options Lower emissions of local pollutants	Ministry of Education Decree on Socialization of Environmental Control	Provinces and Cities Ministry of Education	Only applicable if public transport and NMT infrastructure is available

[11] We assume that this table is only meant for land transport sector. Therefore under column 5 we predict for land transport only

No	Measure	Description	Way to achieve GHG emission reduction	GHG emission reduction in 2020 against baseline	Co-benefits	Required Policy Measures and Instruments	Responsibilities	Reference to other measures
PUSH Measures								
3.e.	Congestion Charging and Road Pricing (needs to be combined with HQ public transport)	Setting higher fees under congested conditions to reduce traffic volumes Defining the area and installation of observation technologies Several specific types to implement congestion charging (Cordon ring, Area license, Corridor, Network)	Attract people to use other modes than private vehicle and so avoid/reduce kilometers driven	Jakarta 5-10% (Stockholm[1]: CO2 -14%, London[2]: CO2 -16%)	Stockholm: Increase in public transport ridership (+8%), Increase of retail sales (+10%) Peak hour congestion reduction (-22%) London: Peak hour congestion reduction (-26%)	Government Decree Earmarking	Municipal Transportation Agency	Revenues used for public transport improvements
3.f.	Parking Management and Pricing	Limit supply of free and low-charged parking areas Appropriate prices for parking (e.g. in downtown) Application of parking control system	Avoid/reduce kilometers driven through appropriate prices for parking Attract people to use more environmentally friendly modes and hence prevent car use	1%	Recovery of public space Lower emissions of local pollutants	MoT Decree on Parking Control which based on TDM	Municipal Transportation Agency	Public transport service improvements financed by parking charges

[12] Source: Manfred Breithaupt (2008), "Environmental Vehicle Taxation: International Experiences", presented at the International Workshop on Integrated Transport for Sustainable Urban Development in China (15-17 December 2008).

[13] Source: Impact monitoring – Sixth Annual Report, July 2008, Transport for London, available at http://www.tfl.gov.uk/roadusers/congestioncharging/6722.aspx#tes.

No	Measure	Description	Way to achieve GHG emission reduction	GHG emission reduction in 2020 against baseline	Co-benefits	Required Policy Measures and Instruments	Responsibilities	Reference to other measures
"IMPROVE" Measures								
Cars and Motor Cycles								
4.a.	CO2 Emission Standards for Passengers Cars	Set fuel efficiency emission standards for new vehicles according to international benchmarks like EU (130g CO2/ km 2015)	Enforce technical change (e.g. fuel efficient tires etc.)	1-2%	Lower emissions of local pollutants Increase of energy security	Ministry of Industry Decree (MoI)	MoE, MoT	Could be supplemented by a phase out programme for inefficient cars
4.b.	CO2 Emission Standards for Motor Cycles	Set fuel efficiency emission standards for new motorbikes	Enforce technical change	1-2%	Lower emissions of local pollutants Increase of energy security	Ministry of Industry Decree (MoI)	MoE, MoT	Could be supplemented by a programme for e-bikes
4.c.	Fuel efficient government fleets	Stringent fuel efficient standards	Enforce technical change	1%	Lower emissions of local pollutants Increase of energy security	Government Decree on Official Vehicles Efficiency	MoE, MoT	
4.d.	Mandatory Inspection and Maintenance for all motor vehicles	Regulate inspection rules and enforce certification. This could be carried out by a. Certification of private garages b. Public authorities	Improving performance of existing vehicles	0.5-1%	Lower emissions of pollutants Increase of energy security Increase road safety	MoT Decree	MoE, MoT	Fuel efficiency standards
No	**Measure**	**Description**	**Way to achieve GHG emission reduction**	**GHG emission reduction in 2020 against baseline**	**Co-benefits**	**Required Policy Measures and Instruments**	**Responsibilities**	**Reference to other measures**
4.e.	Car Labelling	Introduction and enforcement of a "car label" that promotes high fuel efficiency standard and	Attract the use of CO2 efficient technology and raise awareness on the use of environmentally friendly vehicles	0% (as long as fuel subsidies reduce incentives to buy fuel efficient cars)	Increase of energy security Lower emissions of pollutants	Ministry of Environment (MoE) Decree	Minister of Environment (MoE) Ministry of Transportation Ministry of Industry and Trade	
4.f	Training Program for smart driving (eco-driving) incl. corporative drivers	Way of driving that increases efficiency of vehicle use / driving style	Raise awareness on ways to reduce fuel consumption and CO2 emissions caused by inefficient driving	0% (as long as fuel subsidies reduce incentives to buy fuel efficient cars)	fewer accidents noise level reduction	MoT Decree	Municipal Transportation Agency	
Public Transport								
5.a.	Adopt bus fleet replacement and modernization program (A precondition is that the bus industry can develop a model for cost covering at high service level)	Regulations of vehicle design (clear design standards) and use of modern technology and fuel consumption standards	Replace old technology through	0.5-1%		Ministry of Industry Decree	Gaikindo (The Association of Indonesia Automotive Industries)	High quality public transport

No	Measure	Description	Way to achieve GHG emission reduction	GHG emission reduction in 2020 against baseline	Co-benefits	Required Policy Measures and Instruments	Responsibilities	Reference to other measures
Freight								
6.a.	Adopt truck fleet replacement and modernization program (A precondition is that the bus industry can develop a model for cost covering at high service level)	Regulations of vehicle design (clear design standards) and use of modern technology and fuel consumption standards	Replace old technology through - wind shields	0.5-1%		Ministry of Industry Decree	Gaikindo (The Association of Indonesia Automotive Industries)	
Fuels								
7.a.	Introduction of a low carbon fuel quota	Regulation of fuel standards e.g. adding 2nd generation biofuels (not palm oil) of about 10%, increase CNG use, electric cars and bikes)	Replacing fossil fuels through biofuels lead to reduced carbon emissions.	2-3%	CNG lead to reduction of local pollutants (!) Biofuels may compete with food production	Ministry of Energy Mineral Resources Decree	Minister of Energy Mineral Resources Ministry of Agriculture, Pertamina	
GENERAL MEASURES								
8.a.	Fuel Taxation (utmost importance)	Fuel tax imposed on the sale of fuel considered as a general tax or road user fee that increases the price for using the vehicle (Example: Fuel tax in Germany: 0.654 €-Cent/l Gasoline 0.47 €-Cent/l Diesel Germany slightly reduced CO2 emissions from land transport within the last 10 years mainly through the very high fuel prices)	Reduce kilometers driven through high prices for fuel Attract people to use more environmentally friendly modes and hence prevent them from car driving	0% (assuming that the fuel price increases to the average sales price of neighbour countries at least a doubling of existing fuel price over coming years, by approx. 20% per year)	Lower emissions of pollutants Increase of energy security	Ministry of Finance and Insudtry	Minister of Finance (MoF), MoT and General Directorate for Tax	Success of most measures in this table depend on appropriate fuel prices
8.b.	Vehicle taxation (based on CO2 Emissions)	A levy on motor vehicles that is totally or partly based on the car's CO2 emissions and/or fuel consumption Example Ireland: Vehicles emitting less than 120g CO2 per km are taxed 100€ per year and those emitting 226g/km are taxed 2.000€ per year	taxation encourages to buy more fuel-efficient cars	n/a	Lower emissions of pollutants Increase of energy security	Ministry of Industry	Minister of Finance (MoF) General Directorate for Tax	Are complementary to fuel taxes

The estimated reduction potential all measures are implemented from 2010 until 2020 (see roadmap) will lead to a GHG reduction of at least 10 percent below the Business-as-Usual scenario. The reduction potential from these measures actually increases significantly after 2020, as many of the measures have mostly longer term effects. For example, using land-use planning as an instrument to influence transport activities requires a time horizon of at least 25–30 years.

Although these calculations have some unresolved uncertainties and they depend on assumptions concerning the future of Indonesia's economy, they nonetheless demonstrate that ambitious policies would enable Indonesia to significantly reduce GHG emissions and would also bring various co-benefits to cities and citizens. These co-benefits includebetter air quality, energy security, reduction of congestion, more equity between social groups, etc.

In order to achieve the optimal effect, it is necessary to combine the strategies into programmes or packages of practical, cost-effective measures. Three main programmes have been identified:

1. **A national urban transport policy** (which could lead to a 5-10 percent reduction in CO_2 emissions by 2020). This policy could be supported economically by an escalating fuel tax with tax revenues earmarked for transportation-related programs. A comprehensive transport policy is key for successfully tackling the transport sector challenges in Indonesia. This type of comprehensive urban transport policy would likely include an ambitious public transport improvement programme, promotion of non-motorized transport, transportation demand management measures, sound land-use planning etc. Therefore, it is essential to establish incentives for local governments to create good transport systems, and that encourage companies and consumers to choose energy-efficient modes or travel, co-locating their activities within short distances. To achieve this, it is essential to develop, consult and approve a national urban transport policy and strategy, including a financing scheme for sustainable urban transport investments. The selection of best proposals aligned with comprehensive city mobility plans will lead to expanded investments in public transport and in non-motorized transit (NMT) infrastructure. Earmarking revenues from increasing fuel taxes for transport-related projects can provide the financial resources for municipalities to buy more energy efficient motor vehicles and public transit equipment.

2. The third approach involves a package of policies related to **increasing freight transport efficiency.** This package has the potential to reduce CO_2 emissions by 2-3 percent in 2020). The package promotes accelerated replacement of existing vehicle fleets and promotes modern logistic systems that avoid empty back-hauls. The package also includes incentives to promote the delivery of inter-urban freight by rail and ship.

3. **Fuel efficiency programmes** can reduce CO_2 emissions by 4-8 percent in 2020: CO_2 emission standards are necessary to bring more energy efficient vehicles into the market. This must be complemented by regular maintenance and inspection programs, an increasing fuel price (with elimination of subsidies, and increasing fuel taxes, as described above) as well as a CO_2-based vehicle

tax. These measures can help individuals and firms to buy more efficient vehicles and cleaner fuels.

4. **Increased use of Renewable Energy** can lower CO_2 emissions by 1-2 percent in 2020. Currently, the use of renewable energy and biofuels in Indonesia is quite limited. The situation is likely to remain limited for many years. Second generation biofuels that could have a substantial impact on CO_2 may be available in 5-10 years. Analyzing the life cycle costs of these second generation biofuels shows that the net impact of current, first-generation biodiesel may be quite small.

While programme 1 and programme 2 above focus on "avoid" and "shift" strategies the third package emphasizes the "improve" approach to energy efficiency. For all these strategies, rising fuel prices are helpful. High fuel prices provide very visible incentives to users, encouraging them to drive less. High prices also create incentives for purchase of more fuel-efficient vehicles. A characteristic of the transport sector is that all technologies need to be installed in a huge variety of sources (cars, trucks, etc.). As it is not possible to focus efforts on a few big emitters, there is a need to design policies that have effects on all transport users. Only intelligently combined bundles of policies that address both supply and demand can be successful. Hence, the success of the measures will often depend on how they are implemented "on the ground."

Roadmap for implementation

The policies advance other national priorities in addition to GHG emissions reduction. They can help to overcome a variety of transport-related environmental problems and thus contribute to sustainable development. The most successful cities and countries (e.g., Switzerland) have the best transport systems. However, to achieve this level of performance in the transport sector, sustained political leadership and a vision of change is needed to overcome deep-seated barriers for implementation of market-based policies. Thus, in order to improve the transport system, a clear strategy and political commitment is essential.

The following figure shows a feasible way to tackle the climate and transport challenge and indicates a timeline of implementation (roadmap) for GHG reduction policies in Indonesia.

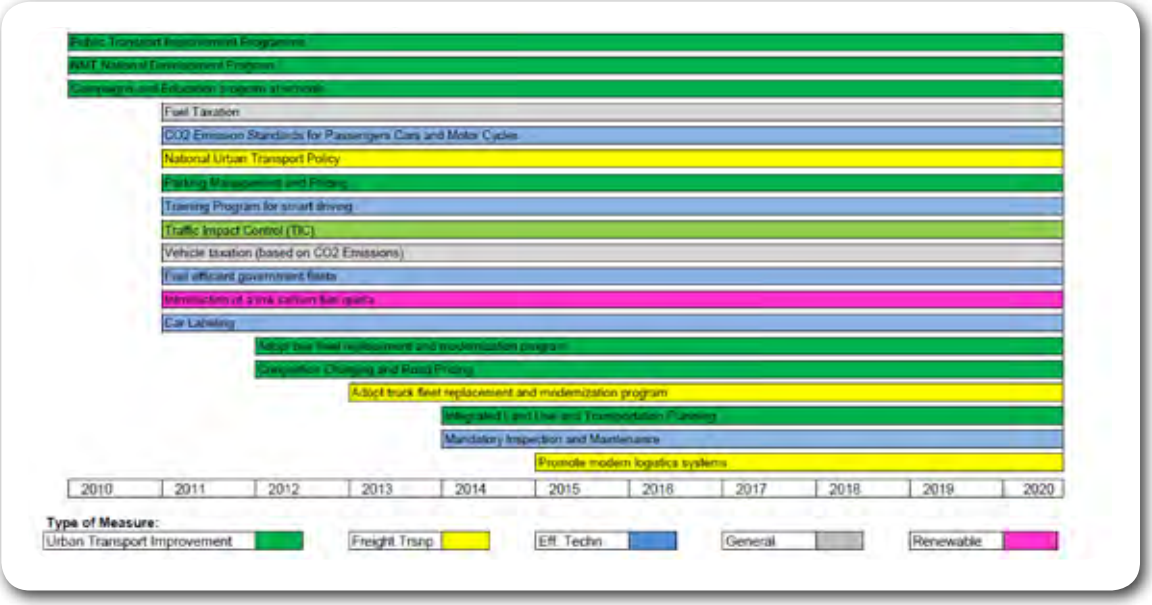


Figure 18: Roadmap for implementing GHG reduction measures in the (land-) transportation sector in Indonesia 2010 – 2030

Barriers

In order to pursue the Avoid-Shift-Improve strategy effectively, it is important that the following barriers be addressed:

- Policy paradigm –the existing transportation development mindset is based on a hope for high rates of motorization. This must be replaced by a policy paradigm that balances economic, social and environmental sustainability, and which recognizes the benefits of pursuing a low-carbon transport strategy.
- Political acceptance – some policies may prove publicly unpopular in 2010, but these policies can be designed and packaged in a way that highlights the benefits of change in tangible and easily understood ways. Public awareness campaigns and other capacity-building measures can also play a large role in increasing political acceptability.
- Financing –the current lack of financial resources to support low-carbon transport can be alleviated through the development of new funding mechanisms. Alternatively, by reallocating existing resources towards low-carbon transport, Indonesia could attract significant levels of international financial flows either in the form of ODA or various forms of UNFCCC and climate-related funding.
- Capacity building – can help institutions and their staff to become more fully empowered to implement low-carbon transport policies.

- Technology and knowledge transfer –appropriate technologies and knowledge can be transferred to Indonesia from our international partners in order to encourage the implementation of policies that promote low carbon transport.
- Data and monitoring –data on transport activity and emissions can be collected systematically and regularly, reducing the current dearth of statistical data. To realize an ambitious MRV framework, transport data collection is a key.

Potential support for GHG reduction measures

A main purpose of committing to action on CO_2 emissions reductions in transport is to acquire support for capacity building, technology transfer and international development assistance. It appears likely that the Copenhagen Green Climate Fund or other uni-lateral funds will be developed in Indonesia during 2010 in order to match international actions and new funding offers. The following table suggests support needed for the measures listed above.

Table 15: Potential support needed

Measure	Support needed
Fuel Taxation	Capacity building
Mandatory Inspection and Maintenance	Capacity building
CO2 Emission Standards for Passengers Cars and Motor Cycles	Technology transfer
National Urban Transport Policy	Capacity building, finance
Public Transport Improvement Programme	Finance
NMT National Development Program	Finance
Parking Management and Pricing	Capacity building
Campaigns and Education program at schools	n/a
Training Program for smart driving	Capacity building
Integrated Land Use and Transportation Planning	Capacity building
Vehicle taxation (based on CO2 Emissions)	Capacity building
Adopt truck fleet replacement and modernization program	Finance
Adopt bus fleet replacement and modernization program	Finance
Fuel efficient government fleets	Technology Transfer
Introduction of a low carbon fuel quota	Technology Transfer, capacity building
Congestion Charging and Road Pricing	Capacity building
Promote modern logistics systems	Capacity building
Car Labeling	Capacity building

Through their bi-annual communications to the UNFCCC, developing countries will report their GHG emissions and provide verification of NAMAs supported with international funds. By contrast, NAMAs that do not receive international support will be reviewed domestically. Having the opportunity to register NAMAs that include new policies and to gain international financial support for these increases their feasibility and attractiveness. So far, there are no other agreed provisions for measurement, reporting and verification (MRV) of achieved greenhouse gas reductions. However, a certain level of review is necessary to justify financial flows, capacity building activities, and support of technology transfer from developed countries. Hence, there is a need to carefully improve transportation and fuel sale statistics in Indonesia so as to be able to demonstrate easily and in a credible fashion the transport-related CO_2 emissions reductions that will have been achieved by implementing the associated policies and measures.

10

MITIGATION IN THE FORESTRY SECTOR

This peat land and forestry sector climate change roadmap is a temporary document, which should be further developed and revised in 2010 through a process of coordination involving Ministry of Forestry, Bappenas, and other ministries of concern such as Agriculture, Environment, Public Works, Marine and Fisheries as well as the research community. Indeed, consensus on priorities, activities and decisions related to this important sector are still need to be reached in order to meet climate change government objectives.

10.1 Sector status: GHG emission sources and removals, vulnerability and adaptation

Indonesian forests and climate change

In Indonesia, the role of forest in the context of climate change is crucial for its adaptation and mitigation functions. Indonesian adaptation and mitigation policies for the forestry sector will impact both national and global levels because of the sector significant levels of GHG emissions as well the need to enhance the resilience of forest ecosystems.

Vulnerability and Adaptation of the Forest sector

Depending directly on the main climatic parameters rainfall and temperature, Indonesia´s forests are highly vulnerable to the negative impacts of climate change. As the assessment of the ICCSR showed, climate change parameters which are expected to directly influencing the forest sector in Indonesia are temperature increase and precipitation changes, ENSO frequency and magnitude as well as sea level rise. However, climatic effects interact with non-climatic factors, such as land-use practices and related socio-economic factors through destabilizing feedback systems, such as forest degradation processes in combination with increased fire risk, which are aggravated by higher temperatures and drier conditions. This has important implications for the adaptation of forest management, for forest dependant people and for the preservation of the important environmental functions of forests in climate change mitigation.

Mitigation in the forest sector

Indonesia has lost approximately 1.7 million ha of its forest per year during the period of 1985-1997. The highest forest loss occurred during 1997-2000, reaching 2.8 million ha per year. The latest published data (MoF, 2009) showed that net forest lost has decreased during 2000-2005, reaching about 1.09 million ha annually. Based on the statistic from the Ministry of Forestry in 2008, there is 77 million ha of critical land[14] all over Indonesia, 59 million ha are located in forest area and needs to be rehabilitated (MOF, 2009b).

Table 16: Indonesia´s forest lands and non-forest lands (MOF, 2009b)

Indonesia lands in million ha									
	Forest lands							APL	Total
	Conservation	Protection	Limited Production	Production	Total Permanent Forest	Convertion Forest	Total forest land	Non Forest land	Total
Forest cover	15,2	23,0	18,8	22,1	79,1	11,0	90,1	8,3	98,5
Non-Forest cover	3,8	5,9	5,5	13,1	28,3	11,0	39,3	46,5	85,8
Data deficiency	0,7	0,9	0,5	0,5	2,6	0,3	3,0	0,6	3,6
Total	**19,7**	**29,9**	**24,8**	**35,7**	**110,0**	**22,4**	**132,4**	**55,4**	**187,8**
%	18	27	23	32	100				

Source: *Extent of Land Cover Inside and Outside Forest Area Based on the Interpretation of Satelite Image Landsat 7 ETM+*

Deforestation and degradation drivers: status and emissions

Developing policies and actions for reducing forestry sector CO_2 emissions will not be effective without addressing the drivers of deforestation and forest degradation (DD). At national scale, drivers of DD have been identified. Deforestation causes are conversion of forests to perennial plants (oil palm, shrubs, short-rotation pulpwood plantations), conversion of forests to annual cropland, energy and mining exploration in forest lands, conversion to exploit mineral resources, conversion to slash-and-burn (shifting cultivation) lands, and conversion to urban lands or other human infrastructure. Drivers are for instance the price of commodities, labor market, lands' rights insecurity, demographic growth and development policies. The drivers of deforestation and degradation may change over time.

Forests have two major mitigation functions: to act as carbon sink and source of GHG emissions. High rates of deforestation, degradation of peat lands and forests degradation constitute the key sources of emissions. Most of emissions come from a limited number of Provinces (10 Provinces, 78 % of emissions on dry land and 96 % of swamp forests). Riau, Central Kalimantan and South Sumatra account currently for over half of emissions and deforestation (MoFor, IFCA, 2008). The SNC[13] indicates that average net annual emissions from land use, land use change and forests (LUCF[14]) are 638 MtCO2/year between 2000 and 2004. One should add another 690 $MtCO_2$/year consisting of 220 $MtCO_2$/year from peat oxidation[15] and 470 $MtCO_2$/year from peat fire[16]. These estimations result into a business as usual

Ton its vegetation condition, the land could be classified as : very critical, critical, slight critical, potential critical and normal condition (MOF, 2009 b)

[13] Second National Communication

[14] LUCF is LULUCF without peat fire and peat oxidation

[15] Estimation from Bappenas peat report (2009),

[16] From Bappenas peat report (2009)

scenario (BAU) for peat and forest land use change of 1, 33 $GtCO_2$/year. This amount was used for the BAU in the scenarios below.

A recent Ministry of Forestry proposal for the Reference Emission Level (REL) is approximately of the same magnitude than the LUCF from SNC above. It indicates that gross emissions are 1,24 $GtCO_2$/year and absorption 660 $MtCO_2$/year, which results into a net annual emissions of 580 $MtCO_2$/year without peat lands. But these figures are not yet validated, discussions are still ongoing (per March 2010).

Peat lands

In Indonesia there are about 21 million ha of peat lands (Bappenas, 2009), of which half is still forested. About 11 millions are protected by law either as their thickness is more than three meters or they are on conservation or protection forest lands. About 3 million ha of peat lands are classified as conversion forest, 7 million ha as production forest, and 6 million ha are outside forest lands. As laws are not yet enforced peat lands are currently, and could remain in the future, a main source of emissions.

General peat degradation and related emission processes start from drainage, generally made for agriculture or plantation development. Drainage is followed by: 1) peat oxidation, which produces emissions, 2) land fire, 3) loss of above ground biomass due to legal or illegal logging and associated degradation. According to the latest survey on peat lands (Bappenas, 2009) peat land related emissions was 900 $MtCO_2$/year between 2000 and 2006. This is disaggregated into (1) emissions from oxidation (estimation: 220 $MtCO_2$/year), (2) emissions from above ground biomass removal (calculated: 210 $MtCO_2$/year) and fire emissions (470 $MtCO_2$/year from van der Werf *et al*, 2008). But uncertainties on peat emissions are very high due to uncertainties on the emission processes themselves and uncertainties on the quantities of carbon stored as the thickness of the peat and the carbon contents per cubic meters are both very irregular from place to place. Furthermore emissions from fire are very variable from year to year: 194 $MtCO_2$ in 2001, 678 $MtCO_2$ in 2002 (SNC, 2009).

10.2 Ongoing forest policies related to Climate Change

Indonesian ongoing strategies for adaptation

Adaptation of the forest sector is a new topic for Indonesia, hence only a few initiatives address explicitly the issue of increasing resilience to the negative impacts of climate change. A number of existing strategies address the issue indirectly (such as fire management, forest and biodiversity conservation, mangrove management), which are anchored in the long term plan of the Ministry of Forestry (2006 – 2025) but a comprehensive vulnerability analysis still needs to be conducted in order to derive specific activities.

In the RPJM 2010 – 2014, adaptation activities are accommodated in two programs namely, i) the Biodiversity Conservation and Forest Protection Program and ii) the Improvement Program for watershed functions and Empowerment of watershed based communities. Supporting programs are the Forestry Research and Development Program, Forestry sector Macro Planning, Stabilization of Forestry Area,

and Management Support and Technical Task Program.

Indonesian ongoing strategies for mitigation

In general terms, Indonesia pursues a twofold strategy for mitigation, which reflects the two major functions of forests in the context of climate change, i.e., as a carbon source and a carbon sink. Protecting the existing forest will maintain the stock of carbon and its absorption capacity, reforestation and forest rehabilitation will increase the forests' capacity as carbon sink, while deforestation and forest degradation will increase emission of GHGs. Key strategies can be summarized as follows:

1. SFM – Forest Mitigation Strategy 1: Enhancement of forest carbon stock and avoiding emissions linked to unwanted degradation and unplanned deforestation; the goal is to move to sustainable forest management (SFM) through consistent policies, law enforcement supported at local level by a fast development of KPHs[17],

2. RED- Forest Mitigation Strategy 2. Avoiding emissions linked to planned deforestation, through management of conversion forest land: using REDD for financing incentives, associated to the development of KPHs to ensure permanence at local level,

3. Plantations- Forest Mitigation Strategy 3- Increasing carbons sink capacity by promoting plantations on non forest cover lands. These plantations can be disaggregated into wood plantations and rehabilitation plantations. Wood plantations have also an indirect mitigation effect as an alternative to wood from natural forest for supplying industries.

In current policies a lot of means have been devoted to plantations for increasing carbon sink capacity. But little is planned, outside the development of KPHs, to ensure that the trees are well maintained and are actually growing, or to monitor accurately the plantation growth and carbon absorption. KPH development and establishment is an important means to safeguard permanence of carbon sequestration in forests and should therefore be viewed as a crucial precondition for all mitigation activities.

Cross Cutting Issues with other sectors

The roadmap identified three sectors with major influences on mitigation efforts in the forestry sector, i.e., agriculture, energy and mining and several sectors having interactions with the forest sector, such as ocean and fishery, transportation, industry, and health. Without addressing these cross sectoral issues properly, mitigation efforts as described in the scenarios above are at risk.

In the light of climate change mitigation efforts and to deal successfully with these cross sectoral issues, the existing regulations[18] can indeed serve to synchronize these different activities, so more efficient and

[17] KPH (Kesatuan Pengelolaan Hutan) is a Forest Management Unit

[18] Law No. 5 year 1967 (basic forestry regulation), Law No. 5 Year 1990 (natural resources and ecosystem conservation),

effective program implementation can be achieved, provided that law enforcement is strengthened. The integrated land use planning should be enforced. For development purposes of strategic importance, some forest lands need to be used and this should be compensated by allocating other lands to forest land. In case of non compliance this can cause a further significant increase of emissions from the forestry sector. Since the current set of regulations both in and outside forestry sector have been made without sufficient consideration of climate change issues, more analysis of regulations and policies should be done.

Sectors other than forestry:	Forestry Sector:
Agriculture	Policy synchronization needed with a view to expansion of agricultural land and palm oil plantation as well as other sources of bio fuel for enhancement of sinks and reducing emissions from deforestation
Mining	Open pit mining in the forest area, mining exploration in forests
Energy	Forest conversion to increase energy alternative supply, geothermal in forest area and exploration in forests
Public Works, Water Resources	Priority for river catchment area rehabilitation and irrigation infrastructure development in forest area
Ocean and Fishery	Coordination of National park management and mangrove forest management
Transportation	Transportation infrastructure development in forest area
Industry	Wood supply industry (pulp & paper, timber)
Health	Disease spread indication as the impact of forest and mangrove forest conversion

Table 17: Cross sectoral issues between forestry sector and other sectors

10.3 Vulnerability and adaptation options 2010 - 2029

Climate change related hazards can be estimated in three major areas : forest resources, forest dependent people and forest industries. Some identified vulnerabilities and hazards are summarized in the table 3 and described in the subsequent parts, but further analysis is needed in order to derive specific and conducive adaptation strategies.

Table18: Identified climate hazards, vulnerabilities and possible further assessment tools

System perturbation and hazards	Current vulnerabilities		Indicative adaptation actions
1. **Forest resources**	Climatic	Anthropogenic, land use and other stressors	
Forest biodiversity	Changing site conditions by temperature and precipitation patterns	Forest exploitation, alteration of species composition, forest fires	Review impacts and vulnerability analysis (e.g., on distribution, migration, inter-species interaction), Biodiversity conservation and forest protection, with a target of reducing conflict and tension in National parks + other conservation areas, and encroachment of forest areas in 12 priority provinces, increasing buffer zones
Forest fire	ENSO occurrence, droughts, temperature icrease	Land clearing, lacking means to control fires	Increasing staff and developing human resources for forest fire management and control (e.g., "Forest Fire Supervision Brigade" (BPKH)) – community empowerment, land tenure clarification Identification of hotspot by satellite, develop fire break, establishment of community fire fighter, revitalization of fire prevention tools, demonstration of land clearing without burning
Forest productivity and changed site conditions		Forest degradation	Reviewing match species – site conditions, vulnerability analysis, adaptive management, including mixed native species to enhance resilience of silvicultural systems
Mangrove / coastal forests recession	Extreme events (waves, storms)	Coastal erosion, intensive mangrove use	Research (adaptive capacity of mangroves, coastal forests) and mangrove reforestation
Suggested assessment tool for further assessment: Mapping of interactions atmosphere, plants, soil[3]			

System perturbation and hazards	Current vulnerabilities		Indicative adaptation actions
2. **On forest dependent people / livelihoods**	Climatic	Anthropogenic, land use and other stressors	
Income/livelihoods	Extreme events (landslides, erosion, droughts, fires)	Dwindling with degrading forest resources	Enhancing communities' capacity to manage forests by making rights to forest management certain, institutional strengthening, participation and active role of the stakeholders)
Cultural/traditional value systems		Dwindling with degrading forest resources	
Possible assessment tool: Sustainable Livelihoods Framework and Community-based Risk assessment Tools [4]			

System perturbation and hazards	Current vulnerabilities		Indicative adaptation actions
3. **Forest industries**	Climatic	Anthropogenic, land use and other stressors	
Forest plantations – productivity decline	Extreme events (wind, drought)	Monocultures, low level genetic variation	Adaptive forest management including mixed native species to enhance resilience of silvicultural systems[5]
Negative impact on wood based industries		Gap between wood supply and demand by industry	Research & development, Forest product diversification to increase economical resilience of the sector
Suggested assessment method: combination of plant-soil maps and economic model (e.g., CGE model)			

10.4 Mitigation Scenarios for 2010 - 2029

The following section contains a set of preliminary scenarios for mitigation over the period 2010 – 2029 for peat lands and forest on dry lands (peat, SFM, RED, plantations)[22].

Peat scenario and results

Bappenas peat survey proposes for the period 2010-2025 three main following scenarios (Bappenas, 2009):

1. Law enforcement and best management practices in existing land under production use including forests and agriculture crops.
2. Peat land rehabilitation and prevention of uncontrolled fire.
3. Revision of land allocation, forest conversion and land swaps, possibly using REDD as an incentive, that direct future development away from peat lands.

These results were summarized under a "peat scenario", developed for the period 2010-2029, and taking into account the existing rehabilitation work plan from the Ministry of Forestry (RAN-GRK[23]). The effectiveness of peat management will depend also on the development of forest management units, which are assumed to be progressive[24]. In these conditions the peat scenario could produce 93 MtCO2/year of average emission reductions during the period 2010-2019, which is increasing to 544 MtCO2/year during the period 2020-2029.

Forest scenarios and results

The forest scenarios cover periods 2010-2019 and 2010-2029; they have been aggregated into three key scenarios (Bappenas, 2009):

1. SFM – Law enforcement and sustainable forest management will depend on the consistency of national policies to protect forests and the development of forest management units at local level. These combined efforts will enhance forest carbon stock in protected and production forests with forest cover. They will also curb encroachment, illegal logging and fire on forests, which will reduce emissions from unwanted degradation and unplanned deforestation. SFM could produce 160 MtCO2/year of average emission reductions during the period 2010-2019, this increasing to 370 MtCO2/year during the period 2020-2029.

---

[22] These scenarios need to be further discussed, integrated and peer-reviewed in 2010

[23] The draft RAN-GRK was merely used as a reference for data. It should be noted that more accurate estimates are still needed.

[24] It was assumed that forest management unit will allow controlling 100 million ha of permanent forest lands by 2029

2. RED - Avoiding emissions linked to planned deforestation. In this scenario it was assumed that, at least, during the next 20 years period, a third of planned deforestation of forest land with high carbon value on dry land would be avoided by revising land allocation. This could be facilitated using land swap agreements and REDD as financing incentives, associated to the development of KPHs to ensure permanence at local level. This would add an emission reduction of 138 MtCO2/ year at average.

3. Plantations - Increasing carbon sink capacity thanks to plantations on non forest cover lands would add another 37 MtCO2/year from 2010 to 2019 and 90 MtCO2/year during the following period until 2029. A constant effort of 1,4 million ha per year of new plantations was assumed consisting of I) rehabilitation of protected watershed (0,22 million ha per year)[25], ii) social forestry (0,61 million ha per year) and iii) industrial and wood plantations (HTI,HTR: 0,58 million ha per year). As most successful plantations are planted for timber and plantations need time to grow and store carbon, a relatively small mitigation can be achieved in relation to the financial resources needed[26]. It was assumed that plantations are harvested after 8 to 15 years according to their type and are systematically replanted after harvesting. Actually plantations have an indirect mitigation effect by reducing pressure on natural forests; they contribute to the mitigation strategies above: Peat, SFM and RED. Efforts allocated to plantations should not be assessed only from a mitigation perspective but be adjusted with the needs of wood industries, the demands of local communities and the protection of watershed.

Mitigation scenarios results

In Table 19, the key activities for mitigation in the forest and peatland sector are displayed and the most important results are given in Table 20.

[25] It is very difficult to estimate the mitigation impact of rehabilitation and social forestry plantations efforts as no monitoring of plantation growth is made after 3 years, so no fair estimation of mitigation is possible. MoF announces results in ha which are a mix of full plantations, enrichment and agroforestry plantations. 0.83 million ha a year is an effort, which should be re-assessed considering the society needs and the cost associated. Past experiences show that a total of 0,3 million ha a year for these two categories of plantations is already a challenging target.

[26] About 4 trillion IDR per year from the central government plus another 8 trillion a year from private investors and local government budgets.

Table 19: Scenarios description according to activities

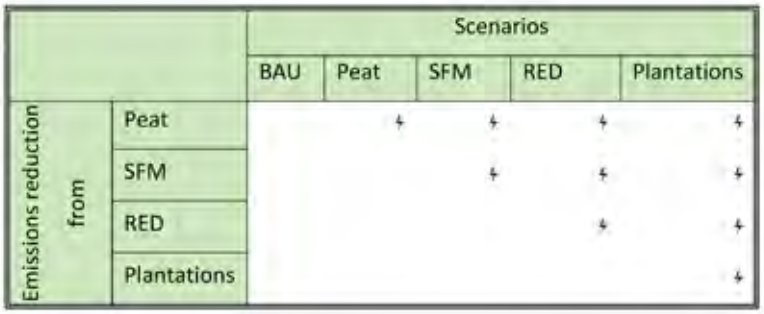


Table 20: Mitigation scenario key results until 2029

Sector / scenario	Cumulative BAU ($MtCO_2$)	Cumulative Emission Reduction ($MtCO_2$)	Total Mitigation Cost [billion IDR]	Abatement Cost [USD/tCO_2]
Peat		6379	266	4,2
SFM		5300	53	1,0
RED dry land		2760	55*	2,0
Plantations		1270	241	19,0
Total	**32722**	**15708**	**615**	**3,9**

Scenario discussion

By 2019 an emission reduction of 727 $MtCO_2$ per year can be produced with the assumed scenarios, which would allow meeting the RAN-GRK objective (figure 19).

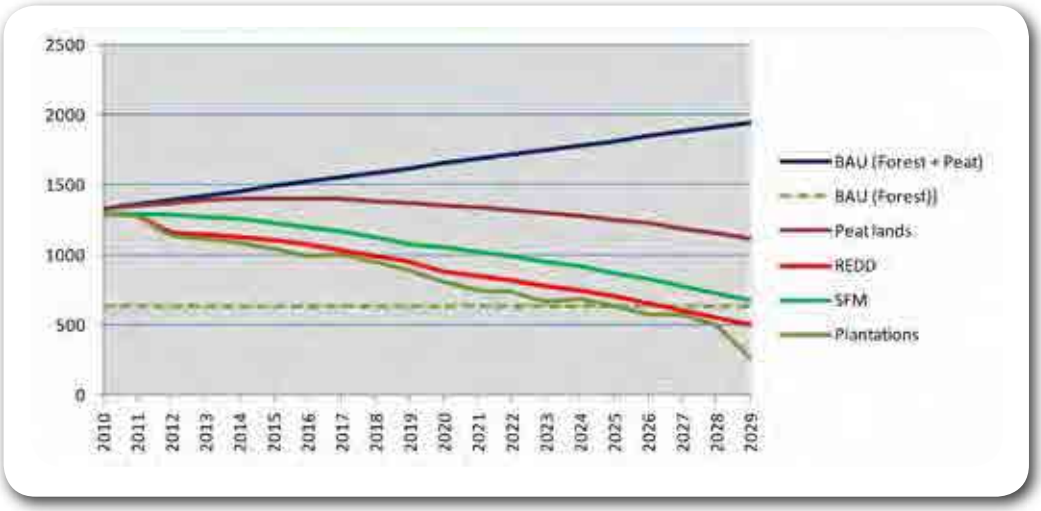


Figure 19: Annual GHG emissions reduction (Mio TCO2) for the forest and peat sector scenarios

Note on figure 19: the cumulative emission reduction is the area between lines BAU (Forest + peat) and plantations.

However this achievement will depend on consistent national policies to protect forests and the development of forest management units at local level that. Following this assumption, 65 million ha of permanent forest land will be attained by 2019 and 100 million ha by 2029. The results could decline for instance to 352 $MtCO_2$ per year by 2019 if the development of forest management units would be limited to 20 million ha of permanent forest land in that year.

By 2020, with these scenarios and preconditions in place, the forest and peat sector will emit only one fifth of its emissions compared to 2010(figures 19 and 20).

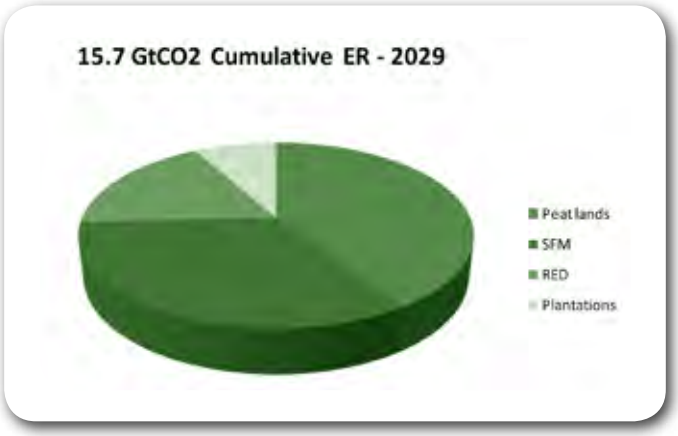


Figure 20: Cumulative emissions reduction

These scenarios show some preliminary priorities: peat lands over dry lands, within dry lands to focus first on sustainable forest management and law enforcement, then land allocation and plantations for wood production and last plantations for rehabilitation. But these priorities should be adjusted to local contexts.

Mitigation strategies should be elaborated in synergy to development and adaptation goals. For instance if a mitigation strategy denies access to resources to local communities, it would create conflicts.

In this regards, the clarification of land rights, which precede forest management units (KPH) establishment and the possibility to provide clear rights to local communities and local entrepreneurs to access forest land are very important steps to find synergies between development needs, adaptation and mitigation efforts. Forest management units' development will enable to take more decisions locally which will facilitate finding synergies between adaptation and mitigation strategies and between sustainable forest management and local communities' development needs. Such approach requires platforms for negotiation at local level to further discuss and define rights roles and responsibilities and make some parts of mitigation decisions locally.

Monitoring, Reporting, and Evaluation

All the mitigation activities need to be supported by a monitoring system for forest carbon stock changes and associated emissions and removals.

The reporting system used by Indonesia is the Revised 1996 IPCC Guidelines for LULUCF (Land Use, Land Use Change and Forestry) and the more recent 2006 IPCC Guideline for AFOLU (Agriculture, Forestry, and other Land Use). The Ministry of Forestry has designed a monitoring system for practical/ supportive use on decision-making. The system is called the Forest Resource Information System (FRIS). The National Carbon Accounting System (NCAS) is also designed in accordance with the guidelines provided by UNFCCC (See Figure 21). In the light of the forthcoming requirements for Measurable, reportable, and verifiable (MRV) emissions reduction, Indonesia should prepare itself for a more frequent measurement and associated reporting system for carbon stock changes and GHG emissions and removals from LULUCF. Such a system might be designed to measure the effect of mitigation activities in relation to the_national reference emissions level and possibly detect leakage and non-permanence. Furthermore, streams of payments, credits, supportive and enabling activities (e.g., capacity building, technologies introduced) might be subject to MRV, if internationally supported. Generally, methods will have to be developed that allow the measurement and reporting of mitigation actions in the forest sector. These methods will have to be synchronized with the national system of MRV.

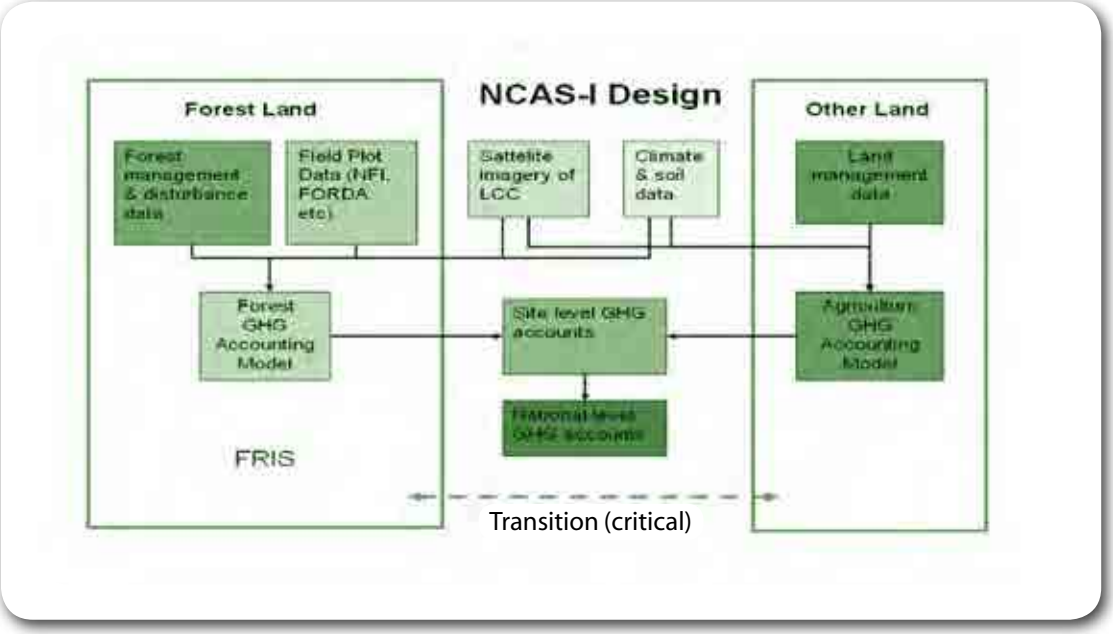


Figure 21: National Carbon Accounting System

Forest management data are required to produce emissions reduction accurate enough to allow emissions reduction credited at local level. This will be supported by the development of KPHs on the field, where trained foresters will monitor the forest and gather data from management, which in turn might feed into an MRV system.

10.5 Recommendations for Roadmap 2010-2029

Recommendations for adaptation priority programs (2010 – 2029)

Considering the estimated vulnerabilities of the Indonesian forest sector, the potential adaptation programs in the forest sector should be targeted to increase the resilience of forest ecosystems and local communities to extreme natural events as well as the sector's adaptability to the negative impacts of climate change. Accordingly, forestry programs are linked to forest resource preservation, forest dependent communities and actors, and sustainability of forest businesses. The implementation of these activities also supports the success of mitigation programs (i.e., addressing permanence). Adaptation priority programs are directed at accomplishing: forest resource conservation and preserving the potentials of biodiversity, research on e.g. germ plasma, enhancing the potentials and value of natural biotic resources to maintain the role of forestry in national development and the revitalization of river catchment areas. The detailed activity recommendations are as follow:

Strengthening vulnerability analysis. The roadmap contains the first attempt to assess the vulnerability of the Indonesian forest sector at national level. In order to design specific activities for the adaptation of the forest sector over the following two decades, it becomes apparent that more data and information

are required to be able to undertake the following suggested steps towards a more detailed vulnerability analysis:

- Downscaling from the macro level (large scale climate models) to local level by applying appropriate models and assessment tools,
- Mapping expected climate change impacts: GIS mapping of expected hotspots of vulnerability and climate change risks and overlay with forests in current critical conditions,
- Building an adaptation strategy for the three areas identified: forest resources, forest dependent people and forest industries.

Forest resources – Biodiversity. The vulnerability assessment could result into the following measures: adjustment and expansion of National parks and wildlife reservoirs, revitalization of riverbanks, expanding maritime preservation area. Lessons learnt can be drawn from screening and assessing existing programs for biodiversity conservation and community empowerment according to their ability to address vulnerabilities and hazards.

Coastal zones. It should be planed research on impacts of seawater frequency, on adaptive strains of mangroves, and on ways to enhance mangrove-ecosystem conservation and restoration efforts.

Impacts on forest industries. Research and strategy building are needed on forest product diversification to increase economical resilience of the sector.

Development of neighboring communities capacities: is needed to enhance communities' capacities to take collective decisions about renewable resources, to organize and manage conflicts, to clarify role and responsibilities at their level, to make certain forest management rights for managing forest. This can be summarized by institutional strengthening and developing platforms for negotiation to let some strategic decisions made at local level with local communities. Interactions between these platforms with KPHs should be designed.

Adaptive forest management at local level. Strengthen applied research on KPH level, and introduction of adaptive forest management at KPH level.

Forest health. Development of forest health monitoring (forest including plantations and growth monitoring is a cross cutting issue as needed for mitigation) means equip KPHs with a monitoring team and MoF structure with a monitoring system.

Recommendations for mitigation priority programs (2010 – 2029)

MRV and forest growth monitoring. Managing forest wood stocks and forest assets is relatively new in Indonesia, monitoring wood stocks and plantations growth is not yet a routine, so managing carbon is challenging and requires efforts and new approaches regarding forest management. In consequence, to allow measuring the results of the mitigation activities described above, the existing monitoring systems

should be adjusted for the issues of climate change under the UNFCCC (Monitoring, reporting and verification, MRV). To contribute to this future system of "Measurement, reporting and verification regime", the Ministry of Forestry should further develop a monitoring system gathering forest management data.

Peat. In order to mitigate peat land emissions, a policy focused on peat carbon needs to be developed that addresses: (a) institutional issues, (b) policy instruments within and outside of the forest estate, (c) methodologies and systems for MRV emission reductions, (d) national peat land carbon accounting, (e) policies and mechanisms for fiscal incentives and equitable sharing of carbon-related revenues.

A critical point to highlight in terms of national policy is that Indonesia's peat and lowlands are home to millions of people, many of whose families have used and depended on the forests and natural resources of these areas for centuries. Past studies have highlighted that these communities often have relatively high levels of poverty and can be caught in a spiral of poverty and environmental degradation. Policies to address peat emissions in Indonesia will ultimately need to be "people- focused" and in particular address issues such as community land rights, local livelihoods and the broader economic development of Indonesia's 40 million hectare lowland area, within which the majority of its peat lands are found.

Sustainable forest management and forest management units (KPHs). In the forestry sector, at constant budget, development of KPHs should be prioritized. Weak governance system, as well as lack of forest rangers, facilitates cases of illegal logging and fires, which lead to further source of forest degradation and unplanned deforestation. KPHs will give to Indonesia the capacity to control and manage its extensive 110 million ha of forest land. Land tenure and demarcation should be clarified and human capacities be developed in order to facilitate controlled access on forest lands to neighbouring communities, allow local development and prevent conflict. Budgets and human capacity development shall be provided at national and sub-national levels in a constant way as to allow for rapid and continuous development of KPH. This activity conciliates climate change objectives with development objectives. If developed fast enough during the period 2010-2019, it will boost efficiency of other forest mitigation activities during 2020-2029 period. It will help to collect taxes revenues from forests. In this sector, it is the most cost efficient state budget allocation on medium and long term.

REDD. Activities for reducing emissions from deforestation and degradation (REDD), including peat land degradation, are promising mitigation measures. It is far more effective to avoid deforestation than to rehabilitate forestland, as the scenarios have shown.

Leakage[27] and non permanence[28] are major threats to REDD implementation. The system of carbon national accounting and MRV associated to law enforcement could detect and prevent leakages at

[27] The risk that REDD activities merely displace deforestation

[28] Lower emissions at current time, followed by higher emissions later

National level. KPHs should address the risk of non-permanence as the KPHs are conceived to manage the forest sustainably and so the carbon stock. There is a risk that illegal activities moved from places where KPHs has been developed to other places where they have not yet been (i.e., leakage); this should be tightly monitored. Development of KPHs is key regarding REDD and should be done as fast as possible to avoid both leakage and non-permanence.

The successful implementation of REDD requires establishing a number of activities at national / subnational levels, based on the national REDD strategy. REDD implementation requires institutional and human capacities and effective control over forest land, which means efforts in KPHs development and local community capacity building. A national and subnational REDD architecture includes:

- National reference emissions level
- Establishment of MRV system at national level
- Institutional building and development (national registry, national – local level roles and responsibilities, incentive systems, payment mechanisms)
- Communication (information, data, awareness etc) and capacity development (for monitoring and reporting, negotiation and testing of REDD mechanisms)
- Demonstration activities (local level).

Amongst the activities, which can be carried out under the REDD strategy are:

- Land swaps from carbon reach peat lands and/or natural forest to forest with no forest cover on dry land,
- Options to supply the requirements of the pulp and paper industry. As to shift from harvesting native mixed tropical hardwoods to wood from communities and small holders' owned pulpwood plantations grown on degraded forest and agricultural lands (e.g. alang alang grasslands).
- Production Forests, protected areas, oilpalm, Peatland REDD strategy development

Forest plantations. Rehabilitation activities should be focused in order to increase the efficiency of this activity and to use state budgets wisely. During the period of the first RPJM (2010-2014) it should be targeted to forestland in place where KPHs have already been established and outside forestland with communities and private entrepreneurs, where market forces support plantations activities. Rehabilitation activities could come in force in following periods on forestland along with the development of KPHs.

HTI-HTR plantations should be prioritized during the first period as they are more efficient in terms of mitigation than rehabilitation activities. HTI can be developing at a moderate cost for the state, as most of this cost is bear by the private companies. HTI could be facilitated by the development of KPHs as land security is a key incentive to attract investors in plantation business.

According to criteria of effectiveness and efficiency, mitigation priorities at national level for the LULUCF sector are in the following order: Peat, SFM, REDD, plantations. Wood plantation to supply wood industries should be prioritized upon plantations for rehabilitation purposes as the first is pro-job and pro-growth and offers a substitute to wood from natural forest for supplying industries. The development of KPHs should be at the top of the mitigation priority list as it contributes to law enforcement, enhanced forest governance, increase efficiency of all mitigation activities and will ease communication and partnerships with local communities.

Any mitigation strategies should be preceded by the clarification on land rights, roles and responsibilities on land and resources as this would later facilitate mitigating conflict at local level and finding synergies

11

MITIGATION IN THE INDUSTRY SECTOR

with development and adaptation strategies. Furthermore at local level, some platforms of negotiation should allow local stakeholders to readjust National strategies according to local priorities.

11.1 Emission Status

The purpose and objectives of the Industry Sector Roadmap are (1) to estimate Indonesia's potential greenhouse gas emissions (GHGe) resulting from industrial activity with a particular emphasis on cement industry; (2) to estimate the size of abatement potential from the industry sector as a contribution to Indonesia's national commitments to reduce GHGe, with a particular emphasis on the cement industry; (3) to incorporate the industry sector's emission reduction efforts into the national economic development plans; (4) to position the cement industry as a priority for action in the short and medium-terms; and (5) to identify technologies, programs, and funding required to support activities that can reduce GHGe from the industry sector.

The National Industry Development Policy established in Presidential Decree No. 28/2008 is aimed at strengthening the competitiveness of the manufacturing industries as a driver of economic growth. Indonesia's industry sector is intended to become "world class" – supported by "macro economic stability, qualified public institutions" and "an improved industry structure". In 2000 greenhouse gas emissions (GHGe) from manufacturing industries have been the 9th largest source of GHGe in Indonesia (excluding LULUCF) [SNC.]. Based on the National Analysis of Industrial Development Policies incorporated into Presidential Decree no. 28/2008 the national policy target for economic growth in the industry sector is set to 7.5% in 2025. Hence GHGe are expected to grow accordingly, if no GHGe mitigation measures and policies are implemented.

In late September 2009, the Ministry of Industry decreed that GHGe reductions from the cement industry are a priority for Indonesia's industry development for the next 20 years. Indonesia is joint 10th largest cement producer in the world (2005) with Thailand producing 37megatonnes p.a.] The Indonesian government predicts the gross domestic product (GDP) to grow 7% p.a. for the following years with the cement industry rising in proportion to that figure. The largest Indonesian cement manufacturers and the Indonesian Cement Association (ASI) plan therefore internally with a cement industry growth rate of 5% - 8% p.a. until 2025. Accordingly cement production is projected to increase from 33.92 megatonnes in 2005 to 74.13 megatonnes in 2020 and to 123.47megatonnes in 2030. These facts, combined with the cement companies' sophisticated level of environment management, the cement industry's commitment on international level and the significant emissions reduction potential, make the Indonesian cement industry the priority industry in this Industry Sector Roadmap.

Other key industries of the Industry Sector Roadmap are iron & steel, pulp & paper, textile and chemicals production.

In 2007, the global steel production was 1,351million metric tonnes. The biggest steel producers were China (37%), EU-25 (15%) and Japan (9%). The World Steel Association ranked Indonesia as the 37th

among the world's major steel producing countries in that year. Since the country imported almost as much as it produced according to the same statistic, Indonesia was furthermore counted as the 12th largest net importer of steel worldwide in 2007

In 2007, 71 steel producers were operating in Indonesia with a total production capacity of 15.4 megatonnes of steel p.a. The Ministry of Industry projects steel production to rise up to 77 megatonnes p.a. in 2025. Greenhouse gas emissions from the energy intense production process (especially from heating the furnace) will rise accordingly.

Pulp and paper production is a highly diverse, increasing global industry and belongs to the energy-intense industries. In 2003, developing countries produced 26% of paper and paperboard and 29% of global wood products [IPCC. 2007]. 81 pulp & paper companies operate in Indonesia with a total production of 17megatonnes of pulp & paper in 2007. Based on Ministry of Industry forecasts for pulp & paper production will rise up to 55 megatonnes in 2025. Critical issues in pulp & paper production are the sustainable management of forest resources. The industry is heavily dependent on forest resources as a raw material, the large amounts of freshwater, which are needed in the production process, and furthermore emissions from energy generation, wastewater and solid waste [United Nations Environment Programme, 2007, Global Environment Outlook 4, Environment for Development. WBCSD. 2003].

The textile industry belongs to the less energy-intensive industry, but runs one of the longest production chains in manufacturing industry. The fragmentation and heterogeneity of its outputs makes it difficult to classify industrial practices and to compare Indonesian practices with international norms. In Indonesia the textile industry ranks among the most important industries due to its size, encompassing more than 4000 medium- and large-scale textile factories, with a vast amount of GHGe from electricity use. GHGe from textile production are expected to increase by approximately 50% until 2025, if the industry continues to produce with the currently used old and inefficient technology. The textile industry faced various economic barriers, which inhibited the substitution of inefficient technology and the implementation of energy efficiency measures. Textiles belong to the 5 major export products with a growth rate of 5.5% in 2008. Due to the weak demand on the export market, banks began to be more selective in extending credits. Although in 2008 they showed stronger confidence in textile industry especially after the government offered incentives for export oriented industries, some banks do not risk to provide credits anymore for the textile industry.

The chemical industry is highly diverse with thousands of companies producing tens of thousands of products and belongs to the energy-intense industries worldwide with a high contribution to global GHGe. According to the International Energy Agency (IEA) the share of industrial energy used for ammonia, ethylene, propylene and aromatics production (worldwide) has increased from 6% to 15% between 1971 and 2006 [IEA. 2007] and hence belongs to the top energy consumers in industry nowadays.

Among the different groups of chemical producers the key sub-sector for the Indonesian Ministry of Industry is the petrochemical industry. Currently the Indonesian petrochemical industry's share of

world's petrochemical industry's total production is around 0.5% to 1.5%. Although domestic demand is large and growing, it cannot met by domestic production alone. Therefore a high volume of products is imported. The Ministry of Industry sets targets for developing the petrochemical industry in its National Industrial Development strategy. Despite the planned economic development of the petrochemicals industry, energy conservation targets have also been set. Having not only industrial sub-sectors e.g. fertilizer industry, which operate the latest available technology in their production process, but also companies running old machinery, the Ministry of Industry estimates the energy conservation potential in the petrochemical industry in Indonesia to be 12% to 17%. Data to access the current situation and the progress regarding GHGe mitigation of Indonesian chemicals producers is not available to the required extent though.

Each industry has its own metrics for measuring environmental performance. IEA suggests (especially for the priority industry – cement) the indicator *CO_2 emission intensity,* which describes the CO_2 emissions per tonne of cement produced [IEA. 2007]. It must be noted that the specific CO_2 emissions per tonne of product are heavily influenced by different factors. The most important of these factors are the specific energy consumption, the fuel mix used to provide the required energy, emissions from chemical reactions/ industrial processes and industrial wastewater.

In the case of cement the influencers are specific energy consumption, fuel mix and the clinker content in cement. With an average emission intensity of 0.83t CO_2/t cement, Indonesia ranks behind countries/ regions like Brazil (0.65t CO_2/t cement), Western Europe (0.70t CO_2/t cement) and Japan (0.73t CO_2/t

Figure 12 Examples of Emission Intensity in Cement Production

cement), but produces still less emission intense then China (0.90t CO_2/t cement), India (0.93t CO_2/t cement) and the United States of America (0.94t CO_2/t cement) [IPCC. 2007, ECOFYS. 2009, SNC.].

For the oher priority industries emission intensity cannot be identified exactly, but bears a large potential for improvement according to the Ministry of Industry.

11.2 Mitigation Potentials

The technical opportunity for mitigation emissions from manufacturing processes can be divided into three, currently proven categories [WBCSD. 2007]:

- Energy efficiency –reducing energy consumption such as lighting, motor efficiencies, air-conditioning and fuel in machinery;
- Alternative fuels – biomass as agricultural waste, fuel crops, municipal and industrial waste, including hazardous wastes. Opportunities exist where large scale agricultural waste sources are within proximity to factories with guaranteed supply and close to large cities supply municipal solid waste; and
- Blending materials, which is cement industry specific – using substitutes for clinker (including recycled concrete, fly-ash).

Accordingly four scenarios have been developed in this Industry Sector Roadmap. These scenarios have

Table 21 Description and Assumptions Used for Cement Industry Scenarios

	Description	Assumptions
Scenario 1: Business-As-Usual	No change in cement production process takes place but demand rises at 4.5% to 6.0% p.a.	Average clinker-to-cement-ratio: 0.90t clinker/ t cement (2008)
Scenario 2: Energy-Efficiency	Reduce energy use by approximately 4% p.a. in 2030	Emission from fossil fuel combustion for heat production, grid- and self-generated electricity decrease by 0.4% p.a.
Scenario 3: Alternative-Fuel	Use of alternative fuels is increased up to 30% of the total average fuel mix in 2030	Emission factor from fossil fuel combustion for heat production during clinker making decreases from 0.298t CO_2/ t clinker in 2008 to 0.216t CO_2/ t clinker in 2030
Scenario 4: Blended-Cement	Clinker content in cement is reduced	Reduction of the average clinker-to-cement-ratio (in t clinker/ t cement): from 0.90 (2008) to 0.87 (2014), 0.85 (2020), 0.80 (2025), 0.75 (2030)

been tailored for the cement industry first. In a later stage the developed strategies will be replicated for other key industries.

To achieve the above goal of GHGe mitigation, a focused cooperation between industry and government is key, along with effective government regulation, policies and their enforcement. Generally speaking a blend of policy approaches is required to make suggested scenarios feasible and to achieve both short and longer-term emission reductions. Some policies when implemented may not directly create behaviours that reduce emissions, but they will improve the likely success of other policies in reducing emissions. Other policies again will be slow to achieve emission reductions but will be necessary to achieve a genuine shift to a domestically responsive and internationally competitive low-carbon industry sector into the future.

The first step to be taken to achieve any abatement targets is the involvement and agreement of all stakeholders in the process.

A. Negotiate and Agree Climate Change Cooperative Agreements (2010 – 2014)

The Cooperative Agreement would set out the roles, responsibilities and expectations of each party over the period of the agreement including an agreed emission reduction goal. This helps build certainty for the parties and assists with measurement, reporting and verification (MRV) of abatement activities from manufacturing industries, especially cement industry.

Energy-Efficiency-Scenario

Knowledge of energy efficiency technologies and their practical application in the Indonesian cement industry is very limited, creating a barrier for cement industry technical staff working cooperatively with "energy audit experts".

On top of this most energy efficiency technology, equipment and services are imported so the local "promotional" activity for these technologies into the marketplace is currently limited. Proposed policies to remove these barriers are:

B. Require the implementation of no-regrets activities from Energy Savings Plans (2015 – 2020)

C. Capacity-build Energy Services Companies (ESCO)s for supporting the cement industry, other heavy manufacturing industries and the government with policy development, program delivery for eco-efficiency, energy audits and -services (2010 – 2014)

Provided that the Energy-Efficiency-Scenario can be implemented successfully and in time, GHGe from energy use in non-kiln operations could be reduced by cumulative 7.16megatonnes CO_2 between 2010 – 2020 (1.27%) and cumulative 32.19megatonnes CO_2 between 2010 – 2030 (2.30%) compared to Business-as-Usual.

Alternative-Fuel-Scenario

Regional demand for agricultural biomass waste, the missing economic incentive to find alternative uses for municipal solid waste and import levies on e.g. tyres or other materials, which are assumed to be hazardous waste in Indonesia but not in other countries, create a limited supply of alternative fuels. Proposed policies to assure the supply are:

D. *Review waste policy – increase landfill levies over time and make it viable to create new resource streams for municipal, agricultural and industrial waste (2015 – 2020)*

E. *Review hazardous waste register and permit requirements for the cement industry (2010 – 2014)*

F. *Provide a supportive export and import tariff for waste products to be used as alternative fuel in industry sector (2015 – 2020)*

Provided that the Alternative-Fuel-Scenario can be implemented successfully and in time, GHGe from fossil fuel used in the kiln processes could be reduced by cumulative 17.45megatonnes CO_2 between 2010 – 2020 (3.10%) and cumulative 73.75megatonnes CO_2 between 2010 – 2030 (5.27%) compared to Business-as-Usual.

Blended-Cement-Scenario

It is noted that Indonesia has one of the highest average clinker/cement content in the world (95%) and this is largely due to the failed attempt in the mid-1990s to introduce a range of blended cements to the market, without proper quality controls, marketing and training. Given that the majority of emission abatement opportunity is from reducing the amount of clinker used in cement through blending, not over specifying concrete quality/characteristics for the respective job could be a demand-led way of reducing cement industry emissions. This would need to be supported through an awareness raising initiative with the construction industry. Proposed policies to support the increase of demand for blended cement are:

G. *Review and set new cement performance standards - to avoid over specification of cement strength for use, and therefore reduce overall demand for clinker content (2015 – 2020)*

H. *Review national building codes – require a minimum recycled concrete content for new cement/ Green government procurement (2015-2020)*

Provided that the Blended-Cement-Scenario can be implemented successfully and in time, GHGe from clinker production could be reduced by cumulative 18.50megatonnes CO_2 between 2010 – 2020 (3.29%) and cumulative 108.62megatonnes CO_2 between 2010 – 2030 (7.76%) compared to Business-as-Usual.

Supportive policies required for all scenarios

The proposed measures support all mentioned scenarios and could also be incorporated in the Climate Change Cooperative Agreements:

I. Create a robust system of data measurement, reporting and verification – to improve investment certainty (2010 – 2014)

J. Inform about Best Available Technology (BAT) and assist BAT installation for new cement plants (2015 – 2020)

K. Introduce an Award System for specific savings in GHGe across the (target) industries (2010 – 2014)

Financial Assistance

To finance GHGe abatement initiatives of key industries assistance is required by the financial sector. In the case of financing energy efficiency technologies and services, performance based contracting via, ESCOs might become a superior policy measure[29]. This would build capacity in the private energy services sector and creates a new form of specific risk-managed financing for energy saving measures. The following instruments could be applied for the mentioned GHGe abatement scenarios:

L. General Finance Instruments for upfront capital

M. Indonesian Climate Change Trust Fund (ICCTF)

. i. Soft-loans/interest free

. ii. Contestable grants

N. Accelerated depreciation/ Reduced tax on energy-conserving technology

O. Flexible Mechanisms (PoA/CDM)

Figure 20 shows an ambitious but achievable abatement goal using the three scenarios described above without any major technological advancement (i.e. carbon capture and storage). It is assumed that the price of fossil fuel energy rises quicker than that of biomass and that the price of CERs and other tradable carbon commodities increase over this period, further driving efficiency demands, alternative fuels and blending practices in the cement industry.

In the coming years, other industries will emerge as players in reducing Indonesia's industrial GHGe. Even though the current priority is the cement industry, iron & steel, pulp & paper, textiles and chemicals

[29] Performance-based energy services are where a third-party undertakes an energy audit, develops and energy savings plan and then finances the purchase, installation and often management of the energy saving equipment. The loan is financed via the cost savings accruing from the energy savings resultant from the installation and operation of the energy savings measures. This process transfers nearly all the risk to the ESCO and makes wide-scale roll out of energy saving technologies and systems commonplace in the industrial market. In order to build a robust ESCO industry, initial government assistance is required (procurement of services, underwriting loans etc.)

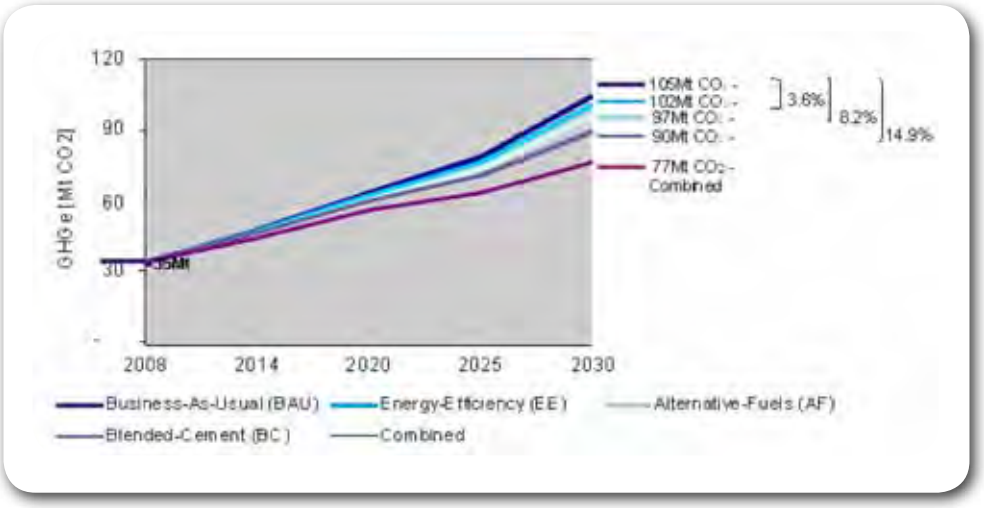


Figure 19 Cement Industry -
Total Estimated Abatement Potential 2008 - 2030

will emerge as the major industrial contributors to GHGe without actions to modernise and roll out eco-efficiency measures. Steps must be taken now to ensure that these industries are ready for the challenge of rapidly reducing their respective greenhouse gas impact as they grow and modernise their equipment over the next few years. In depth roadmapping for these industries will take place either in future reviews of this Industry Sector Roadmap or in the scope of a future development of Nationally Appropriate Mitigation Actions (NAMA).

Table 22 Activities of Industry Sector

Category	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information and Knowledge Management	Measurement, reporting and verification of GHGe data at a plant level from the cement industry	Measurement, reporting and verification of GHGe data at a plant level from the cement industry	Measurement, reporting and verification of GHGe data at a plant level from the cement industry	Measurement, reporting and verification of GHGe data at a plant level from the cement industry
	Enhance technology research, development and deployment	Enhance technology research, development and deployment	Enhance technology research, development and deployment	Enhance technology research, development and deployment
	Award System for specific savings in GHGe across the (target) industries	Award System for specific savings in GHGe across the (target) industries		
	Study on the potential and supply of waste as alternative fuel for cement industry			
	Study on a supply network system of waste to be used as alternative fuel in cement industry			
	Study and issuance of a standard/ policy for supply and pre-treatment of raw material for cement blending			
	National communications campaign to encourage the use of blended cements	National communications campaign to encourage the use of blended cements	National communications campaign to encourage the use of blended cements	National communications campaign to encourage the use of blended cements

Category	2010-2014	2015-2019	2020-2024	2025-2029
Planning and Policy, Regulation and Institutional Development	Climate Change Cooperative Agreements	Climate Change Cooperative Agreements	Climate Change Cooperative Agreements	Climate Change Cooperative Agreements
	Government support for building local institutional capacity in policy development and program delivery for eco-efficiency, energy audits, energy services	BAT for new cement plants	BAT for new cement plants	BAT for new cement plants
	Capacity-build Energy Services Companies (ESCO)s for servicing the cement and other heavy manufacturing industries	No-regrets implementation of energy audits/savings plans	No-regrets implementation of energy audits/savings plans	
	Review of hazardous waste register and permit requirements for the cement industry	Review of waste policy – increase landfill levies over time and make it viable to create new resource streams for municipal, agricultural and industrial waste	Review of waste policy – increase landfill levies over time and make it viable to create new resource streams for municipal, agricultural and industrial waste	Review of waste policy – increase landfill levies over time and make it viable to create new resource streams for municipal, agricultural and industrial waste
		Review and set new cement performance standards - to avoid over specification of cement strength for use		
	Review of National Building Codes	Review national building codes – require a minimum recycled concrete content for new cement/ „Green“ government rocurement of blended cement		
		Provision of supportive export/ import levy for waste products		
	Climate Change Cooperative Agreements	Climate Change Cooperative Agreements	Climate Change Cooperative Agreements	Climate Change Cooperative Agreements
	Government support for building local institutional capacity in policy development and program delivery for eco-efficiency, energy audits, energy services	BAT for new cement plants	BAT for new cement plants	BAT for new cement plants
Implementation and Control with Monitoring and Evaluation	Measurement, reporting and verification of GHGe data at a plant level from the cement industry	Measurement, reporting and verification of GHGe data at a plant level from the cement industry	Measurement, reporting and verification of GHGe data at a plant level from the cement industry	Measurement, reporting and verification of GHGe data at a plant level from the cement industry
		Reward efforts to cut greenhouse emissions; removing subsidies for damaging activities	Reward efforts to cut greenhouse emissions; removing subsidies for damaging activities	Reward efforts to cut greenhouse emissions; removing subsidies for damaging activities
		Facilitation and investment on a supply network system of waste to be used as alternative fuel in cement industry	Monitor supply network system of waste to be used as alternative fuel in cement industry	

12

MITIGATION IN THE ENERGY SECTOR

12.1 Emission Status

The GHG emissions from energy consumption in 2005 can be further categorized into 5 main sub sectors as illustrated in Figure 24 below. The contribution of those three fossil energy resources to GHG emissions is as tabulated in Figure 25 which shows that the coal share is steadily increasing over the period of projection. Thus, to reduce or at least to maintain this level, a special attention shall be focused on power sector as this sector will be the major consumer of coal, commencing in 2010 when new coal-fired power plants come online as part of the Accelerated 10,000 MW Power Program Phase I. Although the coming Accelerated 10,000 MW Power Program Phase II will accommodate more renewable energy, in particular geothermal power plants, the contribution of coal-fired power plants will be substantially high, which is at around 4,000 MW. Therefore, if there is no specific measure applied on the development of those coal-fired power plants, such as the usage of supercritical boiler and/or the introduction of carbon capture and storage (CCS), the level of CO_2 emission will definitely increase significantly in the coming years.

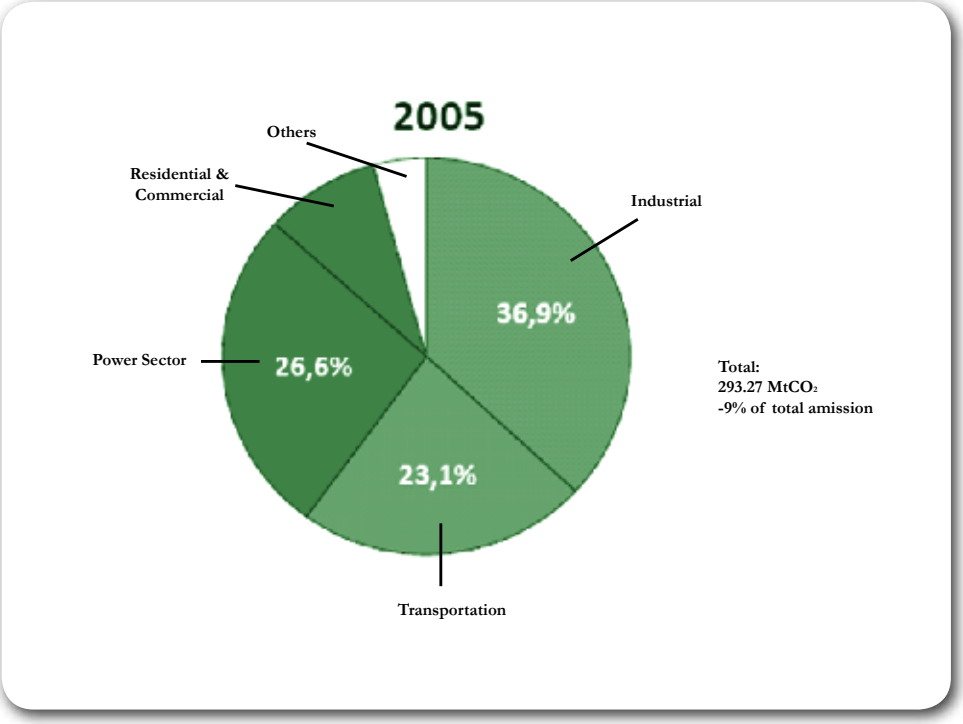


Figure 24 GHG Emissions by Sectors in Energy Sector
Source: Handbook of Energy and Economic Statistics of Indonesia 2006.

Figure 25 Estimated GHG Emissions from Fossil Fuels

12.2 Mitigation Potentials

In line with the above concerns and the national development planning priorities, the first batch of measures will focus on a set of priority sectors. These "priority sectors" are divided into mitigation and adaptation priorities, with the energy sector falling into the mitigation category. In mitigating climate change in the energy sector, Indonesia needs to properly address its heavy reliance on fossil-based fuels. The GHG emissions from the energy sector must be managed as this sector is crucial to the development of the Indonesian economy, both for earning export/foreign exchange (forex) revenue and for fulfilling the need for domestic energy.

The energy sector consists of four major sub-sectors, namely transportation, industry, electric power and commercial & residential, yet the scope of this report will cover only the electric power sector, including its primary energy supplies. Therefore, the emphasis is on the identification of the preferable technology and policy portfolios for CO_2 mitigation options described, in combination with the primary energy supplied, technologies applied, carbon value and financing required for power plant within the Java–Bali and Sumatera Power System. An extensive modeling exercise was therefore undertaken to examine the impact of various policy measures on the introduction of future power plants in order to achieve

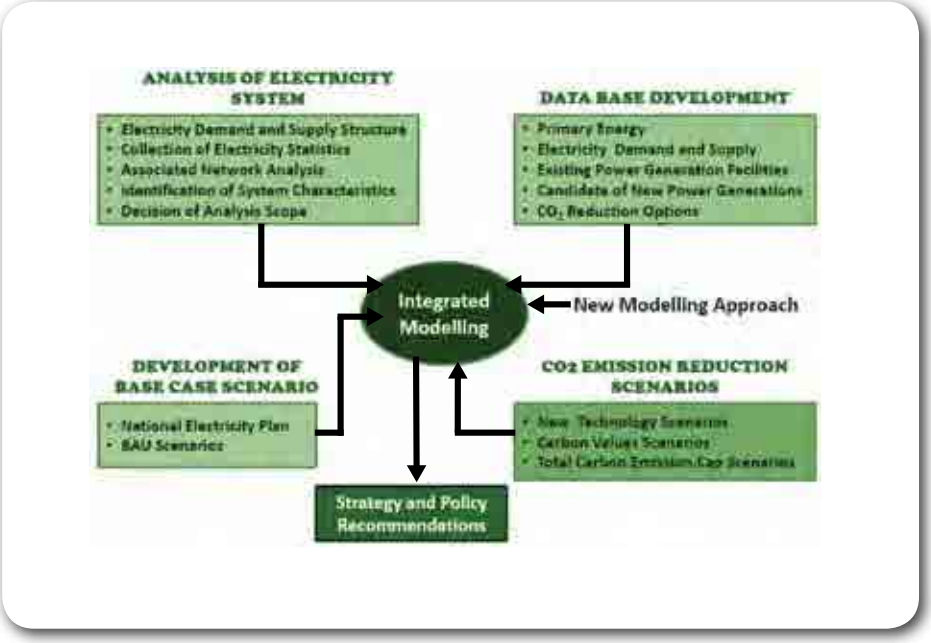


Figure 22 Integrated Modeling for Power Sector Scenarios
Source: Situmeang (2009)

Table 23 Proposed Scenarios for the Study

	Description of Scenarios
Base-case Scenario	This scenario is developed based on a projected level of future emissions against which reduction by project activities might be determined, or the emissions that would not occur without policy intervention as defined IPIECA or in UNFCCC Resource Guide for preparing the National Communications of Non-Annex I Parties). Thus it is prepared by using free optimization based on least cost principle.
RUPTL Scenario	Only technologies either current in 2009 or included in the Master Plan for Electricity Supply (RUPTL) 2009 - 2018 Plan were included. Current trend for renewable (mainly geothermal) introduction was reflected in the model. Constraints for some technologies were set according to the resource limit and geographical limit.
Total Carbon Emission Cap with New Technologies and with/without NPP Scenario	Four likely and speculative new technologies using coal and gas were added to the Base-case scenario for application with in the life time considered in the mode. Retrofitting is also included in this scenario as well as CCS in these new technology variants. Yielded total carbon emission caps, such as 10, 20 and 30 percents compared to base-case scenario level were imposed on the RUPTL scenario with New Technology and with/without Nuclear Power Plant (NPP). Effect of total carbon emission caps was analyzed when higher generation limit was set on geothermal power plant.
Carbon Value Scenario	Various carbon values (USD 25 and 50/(tCO_2) were imposed for both the Base-case scenario and the Total Carbon Emission Cap with New Technologies and with/without NPP Scenario.

significant CO_2 emissions reduction, is as shown in the figure below (Situmeang, 2009).

The proposed CO_2 reductions scenarios in the Power Sector are shown in Table 22 above. The results

obtained are outlined along with recommendations for future activities that BAPPENAS might undertake to assist the Indonesian government in establishing a sustainable energy portfolio within the power generation sector. This is to be integrated and included in the National Medium-term National Development Planning 2010 – 2014 document (Bappenas, 2009).

The simulation results of the integrated model with the proposed scenarios can be compared amongst the Base-case, RUPTL and Total Carbon Cap with New Technology with/without NPP as follows:

A. Java-Bali Power System

1. On Base-case scenario, total accumulated CO_2 emissions for long-term projection from 2009 to 2020 is 1,796 $MtCO_2$, while CO_2 emissions increase by about 285% in 2020 that is from 83 $MtCO_2$ in 2009 to 236 $MtCO_2$ in 2020. The total investment required is estimated at USD 50,311 millions.

2. On RUPTL scenario where the government intervention is counted through the introduction of geothermal and hydro power plants, the total accumulated CO_2 emissions reduction projection from 2009 to 2020 is found to be about 106.21 $MtCO_2$, and in year 2020 the emissions is estimated at 215.6 $MtCO_2$, a reduction of about 21.4 $MtCO_2$ (9%) from the Base-case scenario. To achieve such a scenario, additional investment required is projected at about USD 4,460 million with its abatement cost of USD 22.45/tCO_2

3. On New Technology scenario with the introduction of CCS proposed at PLTU Indramayu and PLTGU Muara Tawar, the total accumulated CO_2 emissions reduction for long-term projection from 2009 to 2020 is about 157.9 $MtCO_2$ (~ 9%). While for the year 2020, the CO_2 emissions reduction is projected ats about 40.2 $MtCO_2$ (17%) out of Base-case scenario with a total investment required at about USD 52,785 million and its abatement cost of USD 23.44/tCO_2

4. On the New Technology + 4,000 MW Nuclear Power Plant (NPP) with the introduction of CCS, the total accumulated CO_2 emissions reduction for long-term projection from 2009 to 2020 is estimated at 198.4 $MtCO_2$ (~ 11%). For the year 2020 per se, the CO_2 emissions reduction is projected at about 62.4 $MtCO_2$ (26.4%) out of Base-case scenario. Again, to achieve this scenario, a total investment of

Figure 27 Emission Reduction and additional investment in Java-Bali Power System in 2020 based on New Tech and New Tech with NPP scenarios

about USD 68,282 million with its abatement cost of USD 33.74/tCO_2 is required.

When taking into account carbon values of USD 25/tCO_2 and USD 50/tCO_2, the following changes will be seen in the Carbon Value scenarios' projection

1. On carbon value of USD 25/tCO_2 scenario, the total accumulated CO_2 emissions reduction projection from 2009 to 2020 is about 347 $MtCO_2$ (~ 19%) and for the year 2020, the emissions reduction projection is about 88.4 $MtCO_2$ (~ 37%) out of Base case scenario. Total investment required to achieve this scenario is about USD 67,515 with its abatement cost of USD 72.93/tCO_2
2. On carbon value of USD 50/tCO_2 scenario, the total accumulated CO_2 emissions reduction projection from 2009 to 2020 is about 527 $MtCO_2$ (~29%) and in the year 2020, the emissions reduction projection can be expected to reach about 129.7 $MtCO_2$ (~54%) out of base-case scenario. Total investment required is about USD 84,199 million with abatement cost of USD

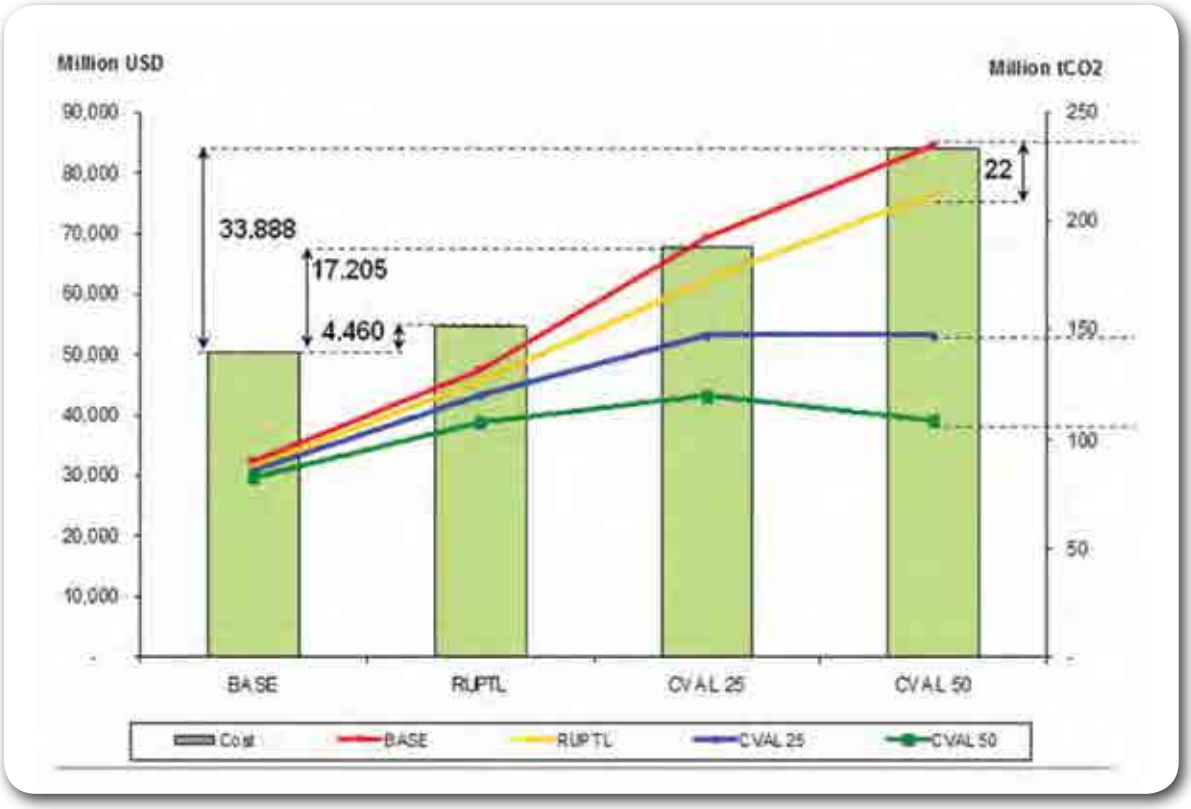


Figure 28 Emission Reduction and Additional Investment in Java-Bali Power System in 2020 based on carbon value scenarios

76.48/tCO$_2$.

B. Sumatera Power System

The simulation results of the integrated model with the proposed scenarios can be compared amongst the Base-case, RUPTL and Total Carbon Cap with New Technology, as follows:

1. On Base-case scenario where additional conventional coal-fired steam power plant of 2,400 MW (Subcritical), Combined cycle of 800 MW and LNG-fired combined cycle of 800 MW by 2020 will result in the total accumulated CO_2 emissions for long-term projection from 2009 to 2020 at around 216.3 MtCO$_2$. The CO_2 emissions increase by about 300 % in 2020, which is from 9.38 MtCO$_2$ in 2009 to 28.75 Mt CO_2 in 2020. The total investment required is estimated at USD 8,945 million.

2. On RUPTL scenario where the government intervention is counted through the introduction of geothermal and hydro power plants, the total accumulated CO_2 emissions reduction projection from 2009 to 2020 is about 46 MtCO$_2$ (~ 21%). For the year 2020, emissions reduction is projected at about 7 MtCO$_2$ or about 9% out of Base-case scenario with additional investment required at about USD 769 million and abatement cost of USD 8.28/tCO$_2$

3. On New Technology scenario with the introduction of CCS proposed at PLTU in South Sumatra

will result in total accumulated CO_2 emissions reduction long-term projection from 2009 to 2020 is about 46.9 $MtCO_2$ (~22%). In particular for the year 2020, the CO_2 emissions reduction projection is about 8 $MtCO_2$ (~ 28%) out of Base-case scenario with the required total investment at about USD 9,856 million or additional investment at about USD 911 million and abatement cost of USD

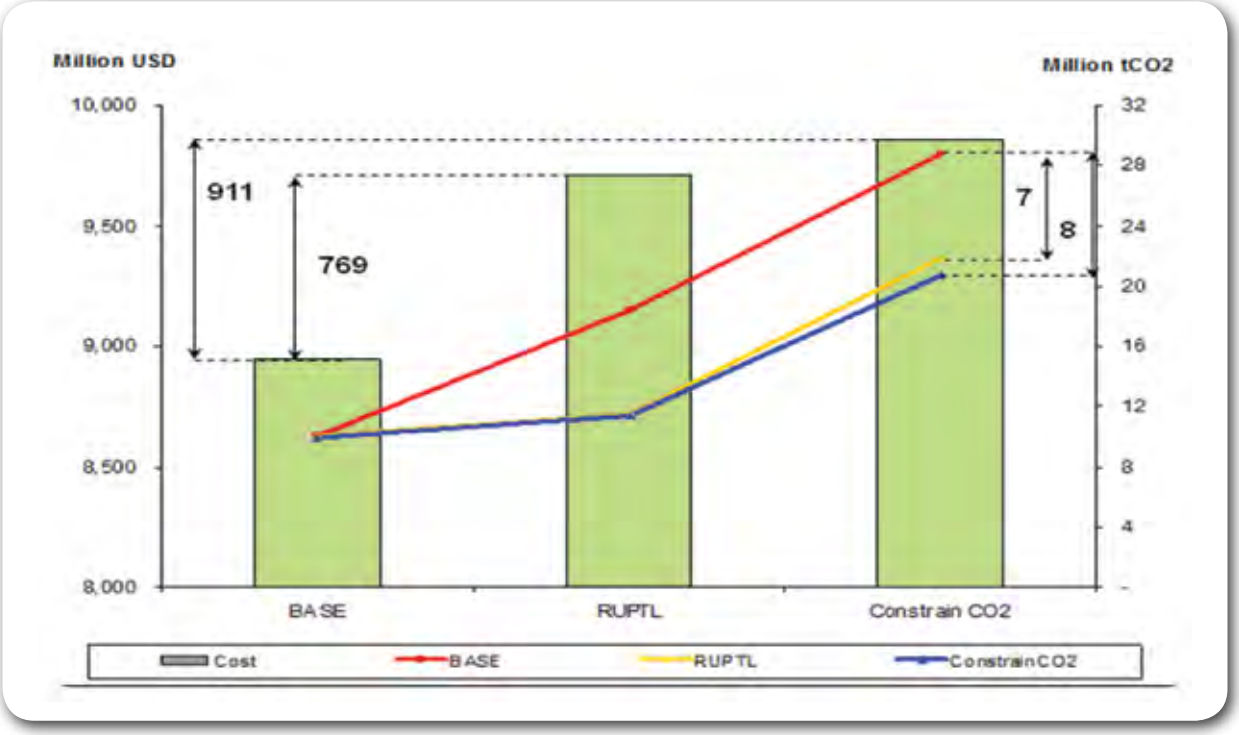


Figure 29 Emission Reduction and additional investment in Sumatera Power System in 2020 based on New Tech (constrain) scenarios

18.88/tCO_2

When taking into account carbon values of USD 25/tCO_2 and USD 50/tCO_2, the following changes will be seen in the Carbon Value scenarios' projection

1. On carbon value of USD 25/tCO_2 scenario, total accumulated CO_2 emissions reduction projection from 2009 to 2020 is about 69.9 $MtCO_2$ (~ 32%) and particularly in 2020 emissions reduction projection is about 10.7 $MtCO_2$ (~ 37%) out of Base case scenario. The required total investment is estimated at USD 9,714 with abatement cost of USD 18.53/tCO_2.
2. On carbon value of USD 50/tCO_2 scenario, total accumulated CO_2 emissions reduction projection from 2009 to 2020 is about 81.4 $MtCO_2$ (~38%) and particularly in 2020 emissions reduction projection can be expected to reach about 12 $MtCO_2$ (~ 42%) out of base-case scenario. The required total investment is about USD 9,865 million with abatement cost of USD 17.86/tCO_2.

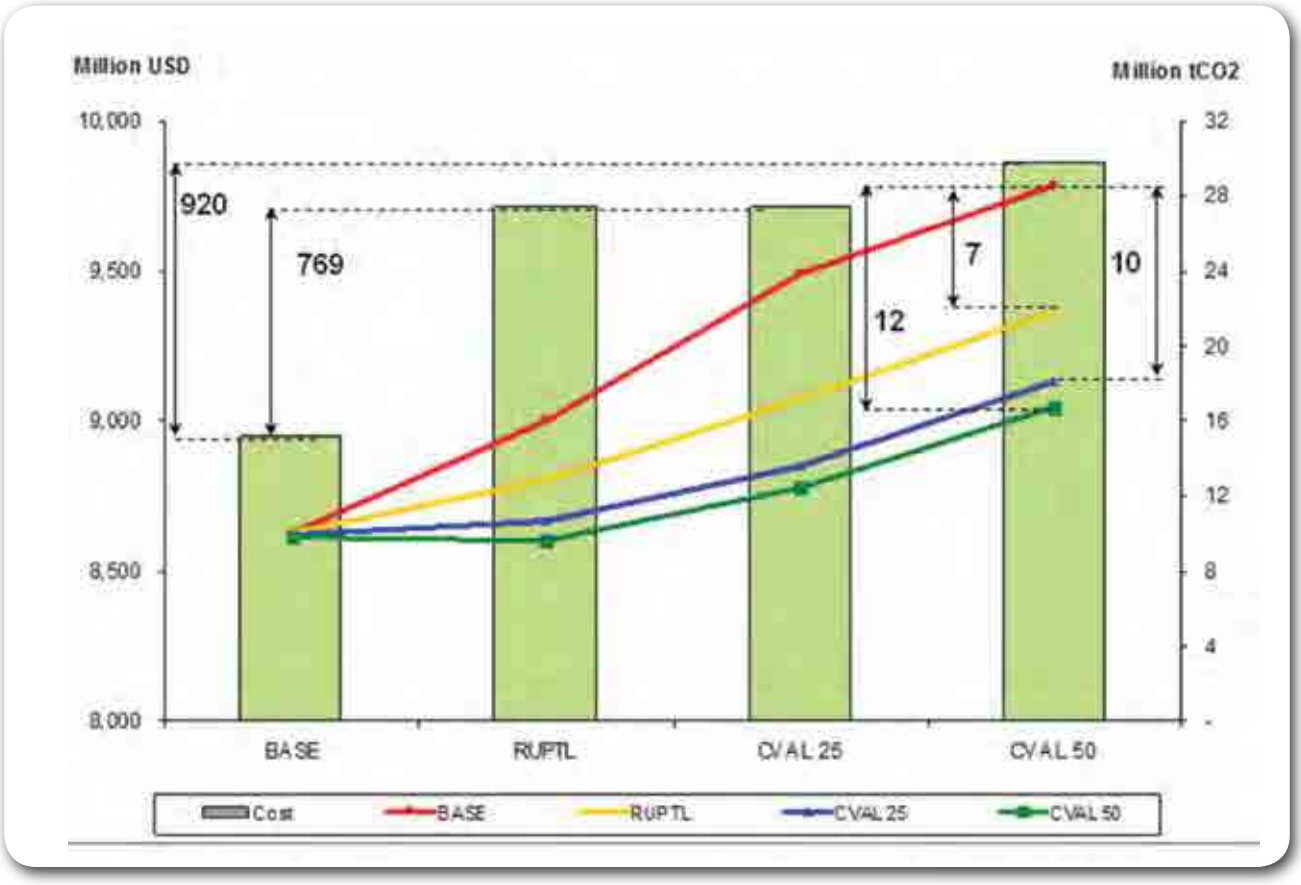


Figure 30 Emission Reduction and Additional Investment in Sumatera Power System in 2020 based on carbon value scenarios

Table 24 Activities of Energy Sector

Category	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information and Knowledge Management	Energy Conservation Partnership through energy audit services for industry and construction	Formulation of renewable energy technology information	Preparation of competence standard of Energy Manager	
	Development of *Clearing House* as information center on energy conservation	Socializing policies on gas flaring to stakeholders	Promotion and preparation for energy saving labelling procedure for home appliances	
	Increasing public awareness through diffferent methods			
Planning and Policy, Regulation and Institutional Development	Education and training on energy efficiency and conservation			
	Formulating Ministerial Decree on gas flaring utilization in Production Sharing Contract			
	Formulating Ministerial Decree on gas flaring utilization as part of field's Plan of Development (POD)			
	Formulating technical regulation on gas flaring.			
	Search for funding and technical assistance to implement small-scale gas flaring projects			
Implementation and Control with Monitoring and Evaluation	Village electrification program based on renewable energy	Development of Energy Independent Village based on BBN and non BBN	Power plant facilitation program based on renewable energy	
	Development of biogas for domestic use	Development of geothermal	Development of biomass turbin for rural areas	
	Substituting fossil fuel (BBM) with natural gas (BBG) or nuclear energy (BBN)	Carry out several short listed gas flaring projects		
	Accelerating the development of natural gas infrastructure.			

13

MITIGATION IN THE WASTE SECTOR

13.1 Emission Status

The population of Indonesia in 2005, as the baseline year, was 218.8 million (BPS, 2006). In that year, the average amount of municipal solid waste produced per capita was 0.6 kg/capita/day for urban areas and 0.3 kg/capita/day for rural areas. Thus, total municipal solid waste was about 33.5 Mt.

In 2005, 50% of solid waste in urban areas was collected and transported by the Local Government Authorities. The distribution of collected waste was as follow: (1) 45% was processed in open landfills (i.e., open dumping); (2) around 3% of the total material was recovered as inorganic waste; (3) about 1% was composted as organic waste; (4) approximately 5% of the total waste was burned; (5) and around 0.5% was sent to sanitary landfill where biogas was produced and captured. The rest of the waste was managed by the communities themselves in which it was produced. The distribution of locally-managed wastes was as follows: (1) around 3% of the total material was recovered as inorganic waste; (2) about 1% was composted as organic waste; (3) up to 5% of the collected wastes were burned; (4) about 1% was discharged into the rivers and other surface channels; and (5) and nearly 40% was buried. In rural areas, 20% of solid waste was collected and transported by Local Government and the remaining 80% was managed by the communities in which it was produced.

The solid waste sector is an important source of greenhouse gas emissions. In Indonesia, emissions from solid waste disposal are predicted to reach approximately 43 Mt in 2010; most of these emissions arise from waste that is processed by the open dumping method. In managed and unmanaged landfills, anaerobic degradation of organic material occurs, leading to substantial CH_4 emissions.

13.2 Mitigation Potentials

Based on the disposition of wastes described above, the BAU scenario was formulated based on the assumptions shown in the table below (Table 25).

Table 25 Assumptions Used in the Business as Usual (BAU) Scenario

Waste Management Component	Assumptions Used
1)Solid waste collection and transportation by local government	For urban areas: • 50% of total solid waste was collected and transported by local government. • Level of local government service increases 2% per year from 2005 and reaches 80% of total solid waste in 2020. • Beginning in 2020 the level of service increases 1% annually reaching 90% of total solid waste in 2030. For rural areas: • 20% of total solid waste was collected and transported by local government. • Level of local government service increases 0.5% per year from 2005 and reaches 32.5% of total solid waste in 2030.
2)Waste reduction	• No waste reduction at the source/household in urban area. Thus, urban solid waste generation increases from 0.6 kg/person/day in 2005 to 1.2 kg/person/day in 2030. • No waste reduction at source/household in rural area. Thus, rural solid waste generation increases from 0.3 kg /person/day in 2005 to 0.55 kg /person/day in 2030.
3)Final Processing	• The final disposal method both in urban and rural areas is open dumping. Open dumping in urban area affected about 50% of total waste in 2005, increasing to nearly 90% in 2030. • Open dumping in rural area was about 8% in 2005, increasing to 13% in 2030.
4)Other waste management activities	For urban areas: • About 25% of solid waste was buried by the community in 2005; this fraction decreases to 5% in 2030. The fraction of solid waste dumped into rivers and surface channels was 1% of total waste in 2005 and decreases to 0.2% in 2030. For rural areas: • About 28% of solid waste was buried by the community in 2005 and decreased to 23.63% in 2030. As for the waste which is dumped to the river is 12% in 2005 and decreased to 10.13% in 2030.

The characteristics of solid waste are quite different in urban and rural areas of Indonesia. To identify the potential for mitigation of GHG emissions from solid waste disposal, scenarios were constructed for

both urban and rural areas. The results are illustrated in the following tables. The scenarios are as follows:

Urban Area:

1) Open Dumping scenario. This scenario describes the current situation, which relies primarily on open dumping as the method for final processing of solid wastes.

2) Waste Reduction at the source scenario. This scenario relies upon methods for reducing waste generation at the source, including by conducting public awareness-raising campaigns and strengthening the capacity of local institutions to help citizens reduce the amount of plastic, paper, etc. that they generate each day.

3) 3Rs and Composting scenario. This scenario applies the principles of the 3Rs (reduce, reuse, recycle) along with composting at the solid waste collection station and at the final processing station.

4) Conversion to Sanitary and Controlled Landfill without landfill gas (LFG) collection scenario. This scenario converts open dumping sites to sanitary and controlled landfills without utilizing CH_4 the potential for LFG collection from landfills and conversion of the gas to electrical energy.

5) Conversion to Sanitary Landfill with LFG collection scenario. This scenario converts open dumping sites to sanitary landfills including the installation of a facility for collecting LFG and converting the collected methane (CH_4) to electrical energy.

Rural Area:

1) Burned and dumped scenario. This scenario describes the current situation in most rural areas of Indonesia, in which solid waste is burned and dumped in any available location.

2) Waste reduction at source scenario. This scenario relies on reducing the amount of waste generated at the source.

3) 3Rs and Composting scenario. This Scenario combines the widespread application of composting technology with reliance on the principles of the 3Rs that are described above.

For each scenario, the system mitigation cost is calculated based on the level of investment required and the projected operational and maintenance costs. The interest rate used is 12%/year. The Abatement Cost of the Emissions Reduction Scenario (ACERS) is calculated on the basis of the following equation (Situmeang, 2009).

$$\text{ACERS} = \frac{[\text{NPV (Total Cost of BAU)} - \text{NPV (Total Costs of ERS)}]}{[\text{NPV (Total Emission of BAU)} - \text{NPV (Total Emission of ERS)}]}$$

$$\frac{[\text{NPV (Total Cost of BAU)} - \text{NPV (Total Costs of ERS)}]}{[\text{NPV (Total Emission of BAU)} - \text{NPV (Total Emission of ERS)}]}$$

ACERS = Abatement Cost the Emissions Reduction Scenario
NPV = Net Present Value
ERS = Emission Reduction Scenario

Table 26 illustrates the results for each of the scenarios described above.

Table 26 Emission Reduction under Different Scenarios

No.	Year	BAU (Gg CO_2 eq.)	Emissions Reduction in Each Scenario (Gg CO_2 eq.)			
			Source Reduction	3R + Composting	SL + CL	SL + LFG
Urban Area:						
1	2010	44,437	1,270	18,274	4,443	18,488
2	2015	59,851	2,993	22,696	4,392	24,980
3	2020	78,326	5,222	27,374	3,752	33,902
4	2025	108,768	17,798	40,945	3,867	47,894
5	2030	134,320	22,387	39,371	3,151	60,131
Rural Area:						
No.	Year	BAU (Gg CO_2 eq.)	Reduction (Gg CO_2 eq.)			
			Source Reduction	3R + Composting		
1	2010	27,329	2,391	7,278		
2	2015	30,943	4,698	7,835		
3	2020	34,090	6,882	7,806		
4	2025	36,578	8,849	7,505		
5	2030	38,590	10,601	7,015		

Table 27 Abatement under Different Scenarios from Waste Sector Urban and Rural Areas.

(a) Urban Area

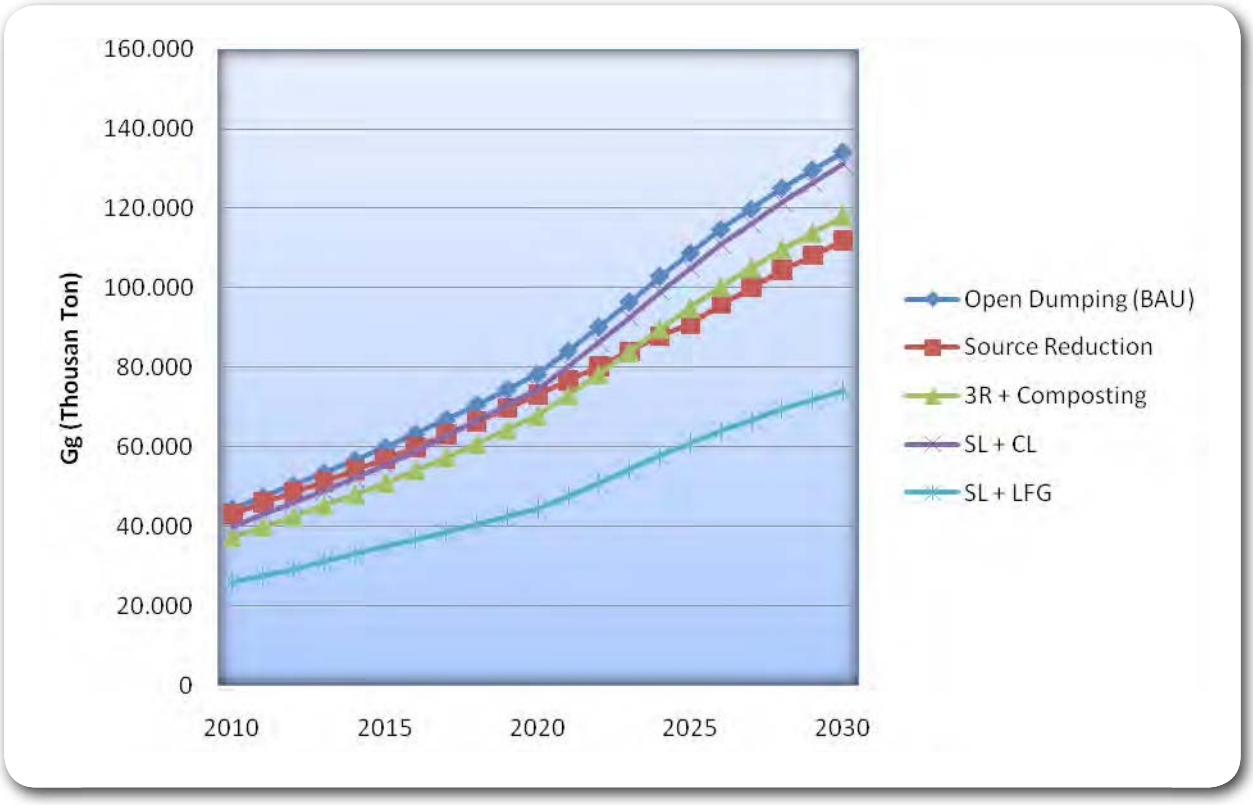
Scenarios	Period	Cumulative Emission Reduction (Mt CO2)	Total Cost of Mitigation (billion USD)	Sysstem Abatement Cost (USD/t CO_2)	Emission Reduction Compared to BAU (%)	Policies Required
Source Reduction	2010 – 2020	17.73	0.13	7.61	5.12%	(1) Carry out a complete inventory study of GHG from the waste sector, accompanied by a systematic GHG reduction plan. (2) Apply infrastructure development policies of source reduction and regulation of solid waste, supported by applied technology research and development.
	2010 – 2030	45.14	0.13	2.90	11.30%	
3R + Composting	2010 – 2020	143.56	0.16	1.14	37.32%	(1) Carry out a more complete inventory study of GHG from the waste sector , accompanied by a systematic GHG reduction plan. (2) Develop and implement environmental policies based on the principle of 3Rs (reduce, reuse, recycle) and encourage increased composting for waste management. (3) Apply the principles of the 3Rs and build a composting center in every city/regency in Indonesia.
	2010 – 2030	211.17	0.33	1.57	35.58%	
SL + CL	2010 – 2020	28.94	0.96	33.34	7.07%	(1) Carry out a more complete inventory study of GHG from the waste sector, accompanied by a systematic GHG reduction plan. (2) Apply infrastructure development policies for conversion of open dumping to sanitary and controlled landfills, supported by the applied technology research and development. (3) Apply waste management in the TPA final disposal stage, converting sites from open dumping to controlled landfills in small and medium-sized cities; and to sanitary landfills in large cities and metropolitan areas.
	2010 – 2030	35.77	1.57	43.84	4.74%	
SL + LFG	2010 – 2020	159.18	1.49	9.35	42.28%	(1) Carry out a more complete inventory study of GHG from the waste sector, accompanied by a systematic GHG reduction plan. (2) Apply infrastructure development policies for conversion of open dumping to sanitary landfill and install LFG collection equipment with and associated electric power plant, supported by applied technology research and development. (3) Apply Waste management in the final processing stage, converting sites from open dumping to sanitary landfills (4) Improve methods of waste gas management (landfill gas - LFG) both in the collection and combustion stages and throughout the process of converting LFG to electricity.
	2010 – 2030	243.67	2.27	9.33	43.46%	

(b) Rural Area

Scenarios	Period	Cumulative Emission Reduction (Mt CO2)	Total Cost of Mitigation (billion USD)	Sysstem Abatement Cost (USD/t CO_2)	Emission Reduction Compared to BAU (%)	Policies Required
Source Reduction	2010 – 2020	17.73	0.13	7.61	5.12%	(1) Carry out a complete inventory study of GHG from the waste sector, accompanied by a systematic GHG reduction plan. (2) Apply infrastructure development policies of source reduction and regulation of solid waste, supported by applied technology research and development.
	2010 – 2030	45.14	0.13	2.90	11.30%	
3R + Composting	2010 – 2020	143.56	0.16	1.14	37.32%	(1) Carry out a more complete inventory study of GHG from the waste sector , accompanied by a systematic GHG reduction plan. (2) Develop and implement environmental policies based on the principle of 3Rs (reduce, reuse, recycle) and encourage increased composting for waste management. (3) Apply the principles of the 3Rs and build a composting center in every city/regency in Indonesia.
	2010 – 2030	211.17	0.33	1.57	35.58%	
SL + CL	2010 – 2020	28.94	0.96	33.34	7.07%	(1) Carry out a more complete inventory study of GHG from the waste sector, accompanied by a systematic GHG reduction plan. (2) Apply infrastructure development policies for conversion of open dumping to sanitary and controlled landfills, supported by the applied technology research and development. (3) Apply waste management in the TPA final disposal stage, converting sites from open dumping to controlled landfills in small and medium-sized cities; and to sanitary landfills in large cities and metropolitan areas.
	2010 – 2030	35.77	1.57	43.84	4.74%	
SL + LFG	2010 – 2020	159.18	1.49	9.35	42.28%	(1) Carry out a more complete inventory study of GHG from the waste sector, accompanied by a systematic GHG reduction plan. (2) Apply infrastructure development policies for conversion of open dumping to sanitary landfill and install LFG collection equipment with and associated electric power plant, supported by applied technology research and development. (3) Apply Waste management in the final processing stage, converting sites from open dumping to sanitary landfills (4) Improve methods of waste gas management (landfill gas - LFG) both in the collection and combustion stages and throughout the process of converting LFG to electricity.
	2010 – 2030	243.67	2.27	9.33	43.46%	

The estimated GHG emissions reductions from the waste sector are illustrated in the figure below for each scenario:

(a) Urban



(b) Rural

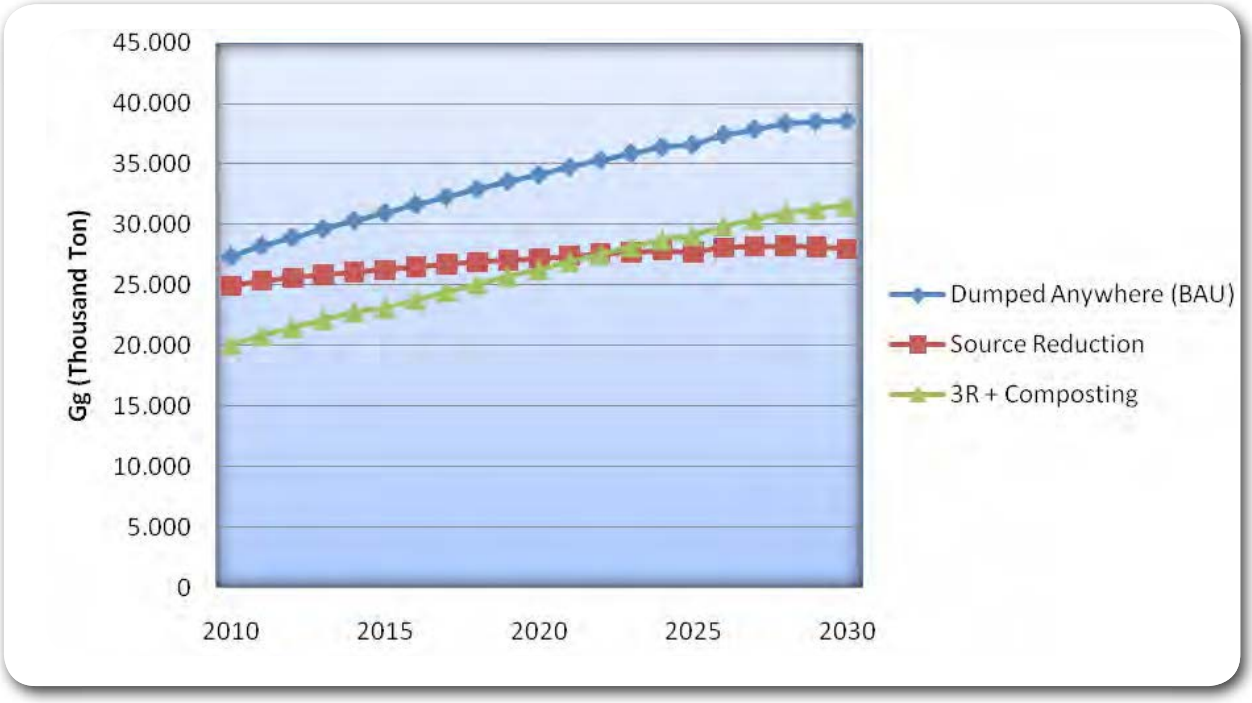


Figure 32 GHGs Emissions in several Scenarios (a) Urban and (b) Rural

Domestic solid waste in Indonesia can be mitigated through the following alternative strategies:

- Performing a more complete GHG inventory of the solid waste sector along with systematic plans to reduce GHG emissions;
- Applying environmental-friendly infrastructure development policies in the waste sector, supported by environmental-friendly technology research and development;
- Developing environmental policies based on the principle of the 3Rs (reduce, reuse, recycle) and applying these principles in the waste management sector;
- Developing a sustainable infrastructure (i.e., maintaining balance among the 3 development pillars, which are economy, social and environment) by decreasing GHG emissions and increasing carbon absorption;
- Providing infrastructure development in waste sector which focuses on capacity building, human resources and institutions. This includes improving competency and independence of regional governments to stimulate environmentally-friendly infrastructure development and encourage the role of private sectors and society;
- Developing the waste management technology which is environmental-friendly and adaptive to the conditions that will result from climate change;
- Developing the Extended Producer Responsibility implementation for B3 waste producers andimporters;
- Developing the technology for quality improvement in landfill management:
  - *Controlled Landfill* (CLF) for small and middle cities,
  - *Sanitary Landfill* (SLF) for big cities and metropolitans
  - Termination of Open Dumping

The proposed programs for the waste sector are illustrated in the table below (Table 28). The breakdown of the programs into the five-year period is available in the Roadmap report of waste sector.

Table 28 Activities of Waste Sector

Category	Activities	2010-2014	2015-2019	2020-2024	2025-2029
Data, Information, Knowledge Management		Green House Gasses (GHG) Inventory and redution potential studies from solid waste factor			
Planning and Policy, Regulation and Institutional Development		Strengthening of approach in environmental policies for waste management and standardization (stepwise approach).	Development in funding source and pattern in waste management	Law planning involving public private partnership in waste management	
		Creation of Norm, Standard, Procedure and Criteria(NSPK) and Norm, Standart, Guideline, Manual (NSPM) in waste sector	Waste regulator product development by regency/city government based on NSPK		
		Issuance of waste development control by regency/city government based on NSPK	Funding sources development and investment pattern in waste management		
		Finalizing policies in waste sector	Waste management development by regency/city government based on NSPK		
		Providing waste surveillance guidelines			
		Provision of technological aid, technological guidence, and companionship (SSK) in waste management			
Implementation and Control with Monitoring and Evaluation			Funding sources monitoring and development and investment pattern in waste management	Waste development management product monitoring and evaluation by regency/city government based on NSPK	Waste development management product monitoring and evaluation by regency/city government based on NSPK
			Waste development management product monitoring by regency/city government based on NSPK	Designing law involving public private partnership in waste management	Law implementation evaluation involving public private partnership in waste management
	Waste infrastructure preparation/ maintenance/ development and Waste transportation facilities	Sumatera: 41 Regencies/Cities Java, Madura, Bali: 42 Regencies/Cities Kalimantan: 41 Regencies/Cities Sulawesi: 39 Regencies/Cities Nusa Tenggara: All Regencies/Cities Maluku: 11 Regencies/Cities Papua: 13 Regencies/Cities	Sumatera: 86 Regencies/Cities Java, Madura, Bali: 65 Regencies/Cities Kalimantan: 15 Regencies/Cities Sulawesi: 31 Regencies/Cities Nusa Tenggara: All Regencies/Cities Maluku: 7 Regencies/Cities Papua: 17 Regencies/Cities	Sumatera: 41 Regencies/Cities Java, Madura, Bali: 42 Regencies/Cities Kalimantan: 41 Regencies/Cities Sulawesi: 39 Regencies/Cities Nusa Tenggara: All Regencies/Cities Maluku: 11 Regencies/Cities Papua: 13 Regencies/Cities	Sumatera: 86 Regencies/Cities Java, Madura, Bali: 65 Regencies/Cities Kalimantan: 15 Regencies/Cities Sulawesi: 31 Regencies/Cities Nusa Tenggara: All Regencies/Cities Maluku: 7 Regencies/Cities Papua: 17 Regencies/Cities
	Final Disposal Area, CDM preparation	Sumatera: 6 Metropolitan Cities Java, Madura, Bali: 12 Metropolitan Regencies/ Cities	Sumatera: 2 Metropolitan Cities Java, Madura, Bali: 5 Metropolitan Regencies/Cities	Sumatera: 3 Big Cities Java, Madura, Bali: 15 Metropolitan Regencies/ Cities	Sumatera: 3 Big Cities Java, Madura, Bali: 4 Metropolitan Regencies/ Cities
	Waste management facilities	Sumatera: 411 unit Java, Madura, Bali: 411 unit Kalimantan: 411 unit Sulawesi: 411 unit Nusa Tenggara: 411 unit Maluku: 411 unit Papua 411 unit	Sumatera: 453 unit Java, Madura, Bali: 453 unit Kalimantan: 453 unit Sulawesi: 453 unit Nusa Tenggara: 453 unit Maluku 453 unit Papua : 453 unit	Sumatera: 498 unit Java, Madura, Bali: 498 unit Kalimantan: 498 unit Sulawesi: 498 unit Nusa Tenggara: 498 unit Maluku: 498 unit Papua: 498 unit	Sumatera: 548 unit Java, Madura, Bali: 548 unit Kalimantan: 548 unit Sulawesi: 548 unit Nusa Tenggara: 548 unit Maluku: 548 unit Papua : 548 unit
	Integrated Waste Disposal Area, 3R development	Sumatera: All Regencies/Cities Java, Madura, Bali: All Regencies/Cities Kalimantan: All Regencies/Cities Sulawesi: All Regencies/Cities Nusa Tenggara: All Regencies/Cities Papua: All Regencies/Cities	Sumatera: All Regencies/Cities Java, Madura, Bali: All Regencies/Cities Kalimantan: All Regencies/Cities Sulawesi: All Regencies/Cities Nusa Tenggara: All Regencies/Cities Maluku: All Regencies/Cities Papua: All Regencies/Cities		

14

MITIGATION MATRIX

In order to have a synoptic view on the mitigation scenarios, costs, policies and actions, Table 29 below depicts these in a mitigation matrix. The selection of the priority scenarios of each sector which entered the table was done on the basis of overall GHG emission reductions potential, cost of mitigation and alignment with sectoral development objectives.

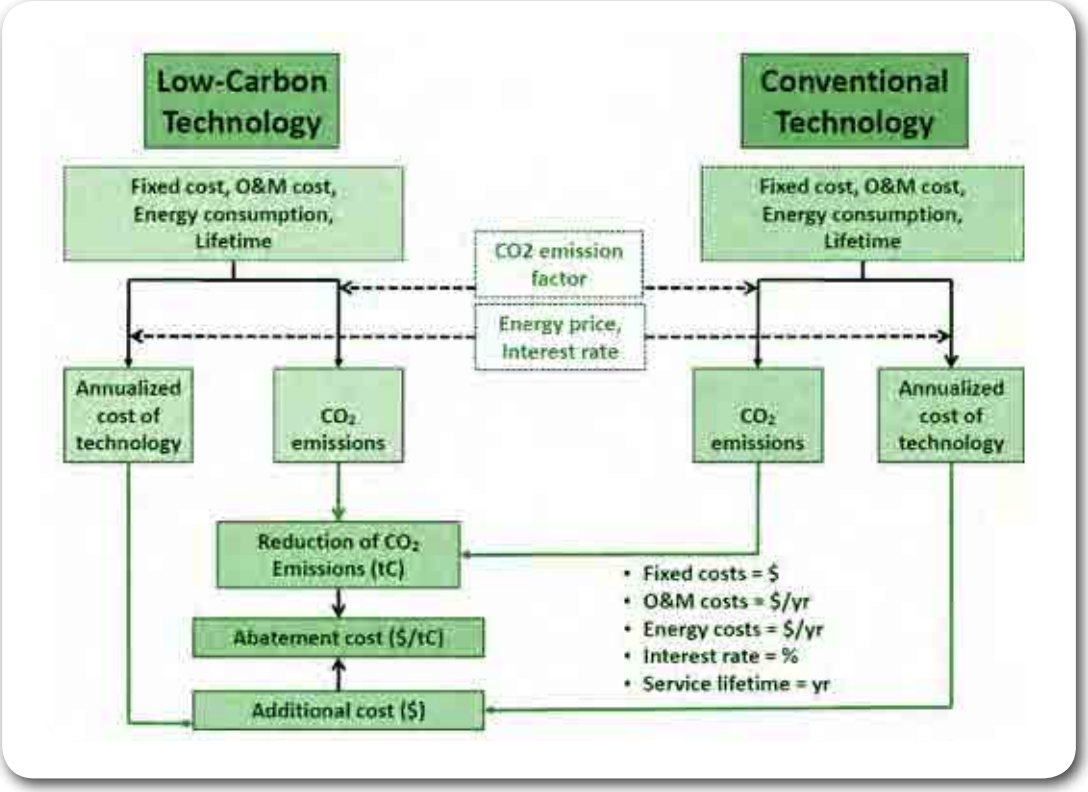


Figure 32 Method applied to calculate the system abatement costs (Situmeang, 2009)

The amount of GHG emissions reductions are given in cumulative figures to show the complete mitigation potential. Costs of actions differ significantly across the sectors, so that a ranking becomes necessary in order to weigh impacts on the economy against achievements in terms of GHG emissions reductions.

The Table 29 depicts the mitigation options according to these two main criteria, overall amount of GHG emissions reduced and abatement costs (reference year 2020). The target year of 2020 was selected for principally three reasons, related to obtaining reliable results from the mitigation scenarios (limiting uncertainties), serving as guidance to establish the national emission reduction path as a main part of the implementation of the presidential decree re 26 % and 41 % as a national emission reduction target, and also in line with the timeframe of the IPCC global mitigation actions related to GHG emissions trajectories (Fourth Assessment Report WG III)

Table 29 Matrix of Sectoral Mitigation Actions Until 2020

Sector / scenario	Cumulative BAU ($MtCO_2$)	Cumulative Emission Reduction ($MtCO_2$)	Total Mitigation Cost [billion USD]	System Abatement Cost [USD/tCO_2]	% of Emission Reduction each sector	Required Policy Measures and Instruments
Energy (Java-Bali) / RUPTL	1713	106.21	53.776	22.45	6.20%	Presidential Decree No 5/2006 Optimizing Energy Mix Scenario the government intervention is counted through the introduction of geothermal and hydropower plants
Energy (Sumatra)/ RUPTL	206.93	45.97	9.714	8.28	22.22 %	
Industry/ Cement	562.95	43.15	0.47	10.89	7.66 %	Reducing the clinker content in produced cement Review and set new cement performance standards Eco-label cement products Lead by example – government procures blended cement Review national building codes National communications campaign to encourage the use of blended cements Increase government support for building local institutional capacity in policy development and program delivery for eco-efficiency, energy audits, energy services.
Transport/ Modal Shifting	917.1	91.4	2.01*	22.0**	10.0 %	Three Plus (3+) transport policies including: Urban Transport Improvement (Public Transport, Non Motorised Transport, Campaign/ Education Programs, Congestion Charging/ Road Pricing, Parking Management, Bus Modernisation, Traffic Impact Control and Integrated Land Use and Transport Planning), Freight Transport (Promote Modern Logistic System and Truck Modernisation), Efficiency Technology (CO2 Emission Standard for Car and Motor Cycle, Fuel Efficient Government Fleets, Mandatory Inspection and Maintenance, Car Labelling and Training Program for Smart Driving) and Biofuel (Low Carbon Quota, Fuel Taxation and Vehicle Taxation based on Emissions)
Waste/ Electrical Generation from Sanitary Landfill in Urban	378.1	159.2	1.49	9.35	42.1 %	Converting 30 sites of open dumping to sanitary landfill sites each year and develop electricity generator facility from Sanitary Landfill Development and enforcement of environmentally based infrastructure policies for the waste sector Capacity development for human resources and institutions on local governemnt level Partnerships with and involvement of the private sector and civil society on LG level
Waste/3R and Composting in Rural	200.5	50.4	0.81	16.10	24.8 %	Develop the implementation of environmental policy for the principle of 3R (reduce, reuse, recycle) and composting in waste management. Development of 3R and composting center in every regency in Indonesia.
Forestry (LULUCF) and peatland	14,738.0	3,937.0	0.34	7.8	26.7 %	Law enforcement and best management practices in existing land under production use including forests and agriculture crops. Peat land rehabilitation and prevention of uncontrolled fire. Revision of land allocation, forest conversion and land swaps, possibly using REDD as an incentive, that direct future development away from peat lands. SFM – Law enforcement and sustainable forest management will depend on the consistency of national policies to protect forests and the development of forest management units at local level. These combined efforts will enhance forest carbon stock in protected and production forests with forest cover. REDD - Avoiding emissions linked to planned deforestation. Plantations - Increasing carbon sink capacity thanks to plantations on non forest cover lands would add another 37 MtCO2/year from 2010 to 2019.
Total	**18,716.6**	**4,433.3**	**68.6**	**13.8**	**23.7 %**	**Note:** The total emission reductions and associated abatement costs are based on conservative and most cost efficient scenarios. The amount of emission reductions can be increased if different scenarios are chosen (see full ICCSR sector reports).

*Notes: *= not included negative cost, **=land transport cost*

Key recommendations for mitigation

- Taking all sectors and key programs together, Indonesia has the potential to reduce GHG emissions significantly at an order of magnitude of 4,433.3 Mt CO2-e cumulatively through the year 2020. Costs of actions differ significantly across the sectors, so that a ranking becomes necessary in order to weigh impacts on the economy against achievements in terms of GHG emissions reductions; the amount of emission reductions can be increased if different scenarios are chosen (see full ICCSR sector reports).
- For all sectors, the establishment of a national GHG inventory and monitoring system is a precondition;
- The forest sector represents the largest potential to reduce GHG emissions at rather low costs, however to tap that potential, activities have to be applied in the right mix in order to effectively deviate from the business as usual scenario;
- In order to lower CO_2 emissions significantly relative to the business-as-usual scenario, it is essential to reinforce and enhance sector-specific institutional and human capacities.
- Cross-sectoral issues, as identified by the forest sector team, need to be addressed in order to ensure effectiveness of mitigation actions economy-wide;
- While it is important to come to a sound understanding of abatement costs across sectors, it will be equally important to carefully assess barriers to policy implementation in each priority sector. Only on this basis can an adequate mix of policy measures be developed.

15

CROSS-CUTTING ISSUES OF NATIONAL IMPORTANCE

A number of cross-cutting issues arise from the impact of climate change on Indonesia. These will be highlighted in this chapter.

15.1 Food Security

Global warming and climate change in tropical zones are predicted to lessen the productivity of food production if no adaptation strategies are implemented (IPCC, 2007), thus having severe implications on global food security (Torriani et al, 2007). It is predicted that agricultural productivity in Indonesia will decrease 15 – 20% by 2080 as a result of global warming (Cline, 2007). According to Tschirley (2007), the lessening of agricultural production may reach 20% if temperature increases more than 4°C. Peng et al (2004) specify that a decrease in rice production of up to 10% may be experienced for every 1°C of temperature increase.

The impacts of temperature increase on rice plantation are threefold (Handoko et al, 2008), namely: i. Increase of *Evapotranspiration* will reduce water levels in the irrigation systems, thus reducing the area of rice fields that can be served, ii. Hastened ripeness will shorten plant life; and iii. Increased plant respiration will decrease productivity. The area occupied by rice plantations will shrink 3.3% in Java and 4.1% in other islands by 2050 due to temperature increase. The decrease in rice production due to hastened ripeness is predicted to reach between 18.6 – 31.4% in Java and 20.5% on other islands. Meanwhile, the decrease in rice production due to increased plant respiration is predicted to reach between 10.5 – 19.94% in Java and Bali, and 11.7% in other islands.

In addition to the direct impacts of global warming, agricultural production may be indirectly affected by an increase in pests due to extreme events. Wiyono (2009) identified the increasing occurrences of flooding resulting in the increase of golden snail populations, which threaten rice plantation. Moreover, rice fields that are flooded during rainy seasons are subsequently more prone to brown bug outbreaks, as happened after La Nina in 1998.

The Roadmap chapter on water resources identifies several risks associated with climate change impacts as discussed above. The region of Java and Bali, which is the main producer of rice for the nation, is a region with extremely high risks of water shortage, flooding and drought. As projected by the scientific-based report, the occurrence of extreme climate events will increase in frequency and intensity, which could cause more severe and frequent flooding and drought. This will make rice fields more prone to hazards, especially if it is topped with the outbreak of pests.

Figure 33 Risks of Water Shortage, Drought and Flooding

Before taking into consideration the impacts of climate change, current land conversion practices (from rice fields to non-agricultural use) will lead to an annual decrease 0.77% in rice plantations areas by 2025; the rice production in each district in Indonesia will decrease between 42,500 – 162,500 tons (Boer, 2008). If sea level rise due to climate change is taken into consideration, as has been identified and reported by the Roadmap of Marine and Fisheries chapter, it is predicted that Java will loose approximately 113,000 – 146,000 hectares of rice fields, 16,600 – 32,000 hectares of horticultural land and 7,000 – 9,000 hectares of hard crop land in 2050 (Handoko et al, 2008). Currently strong waves from the ocean have caused storm tides flood in some coastal areas, such as the northern coast of Java, which threatens the production of rice in some farming areas. The activities in coastal fish and shrimp farming areas will also be affected by sea level rise and storm tides flood caused by extreme wave Figure 34 below illustrates several areas with risks of sea level rise, tides, ENSO, and storm surge in 2030. The northern coast of Java is the area with high risk, while the eastern coast of Sumatera, southern coast of Papua and some parts of Kalimantan coasts are areas with medium risk.

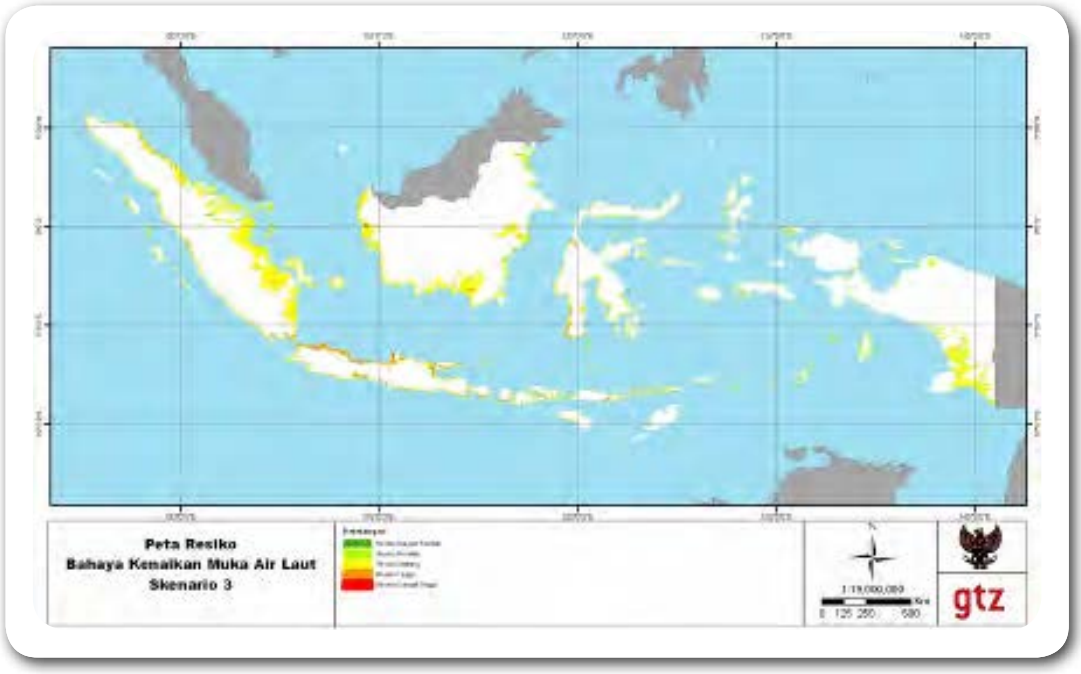


Figure 34 Risks of Sea Level Rise, Tides, ENSO, and Storm Surge

As a result of climatic factors and decreasing rice fields due to land conversion, Indonesia will face a major problem of food scarcity in the future as illustrated in Figure 35. Without climate change adaptation measures, it is estimated that in 2050 the national production of rice will decrease between 20.3 – 27.1%, corn will decrease by 13.6% and soy will decrease by 12.4%, compared to 2006 production (Handoko et al, 2008). Indonesia will become a net importer of rice and other staple foods forever if the decrease in food production happens as predicted. It will indeed be detrimental for the balance of trade and will weaken the economy. The decrease in food production may also lead to food scarcity, which is a threat to national security. Thus it is important that the recommended activities for climate change adaptation in each sector outlined above are included in the national development plans.

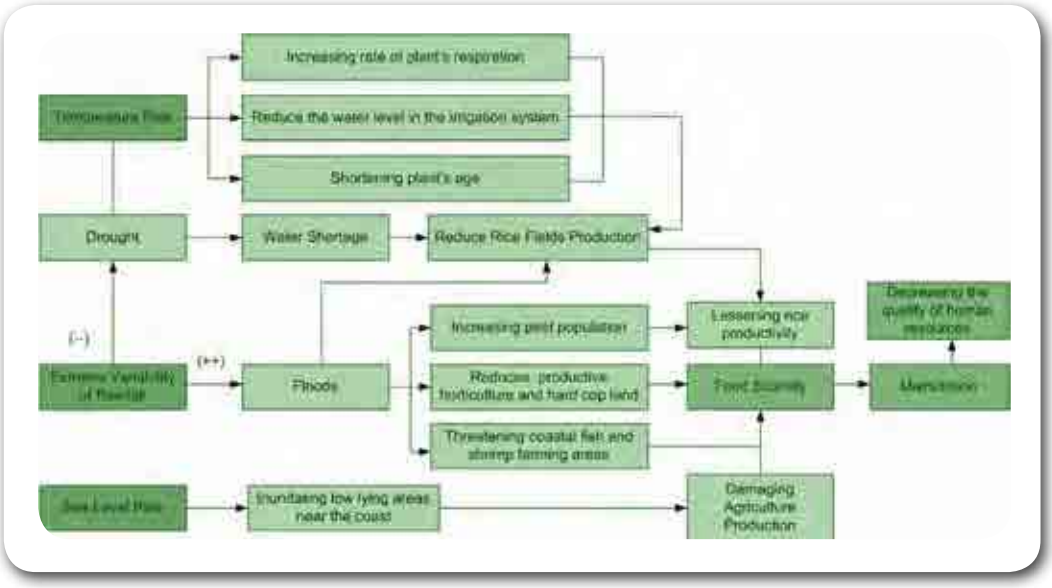


Figure 35 Inter-connecting Impacts of Climate Change Resulting in Food Scarcity

15.2 Degradation of Natural and Built Environment

Increase Risk on Forest Fire

Environmental degradation that has occurred in either the natural ecosystem or the built environment might get worse when the climate change impacts do happen as predicted. One of the environmental problems which could be worsened by climate change is the increase risk of forest fire. We can recall the events of forest fires that hit Indonesia in 1997 and 1998. Although it was conceived that the major factors causing the fires were human activities such as land clearing by burning (Schweithelm, 1998), the unusual drought that was carried over by El Nino made it difficult to extinguish the fires since rain was not coming to relieve while human efforts could not handle hundred thousand, even million hectares of fires at the same time.

Besides burnt forests and the loss of biodiversity, the haze resulted from the fires has been associated with several transportation accidents due to poor visibility. A ship collision in the Malacca Strait which killed 29 people and a commercial airline crash in north Sumatra which costs 222 people are believed to be climate related accidents. Respiratory problem was considered the most important impact that many people suffered during the forest fires. This was not only perceived by people in Borneo or Sumatra where the fires took place, but also in neighboring countries, such as Malaysia, Singapore and Brunei. This health alert is so important because the exposure to acute air pollution increases the probability of premature death in vulnerable groups such as asthmatics, people with chronic lung or heart disease, and young and old pneumonia patients (Schweithelm, 1998).

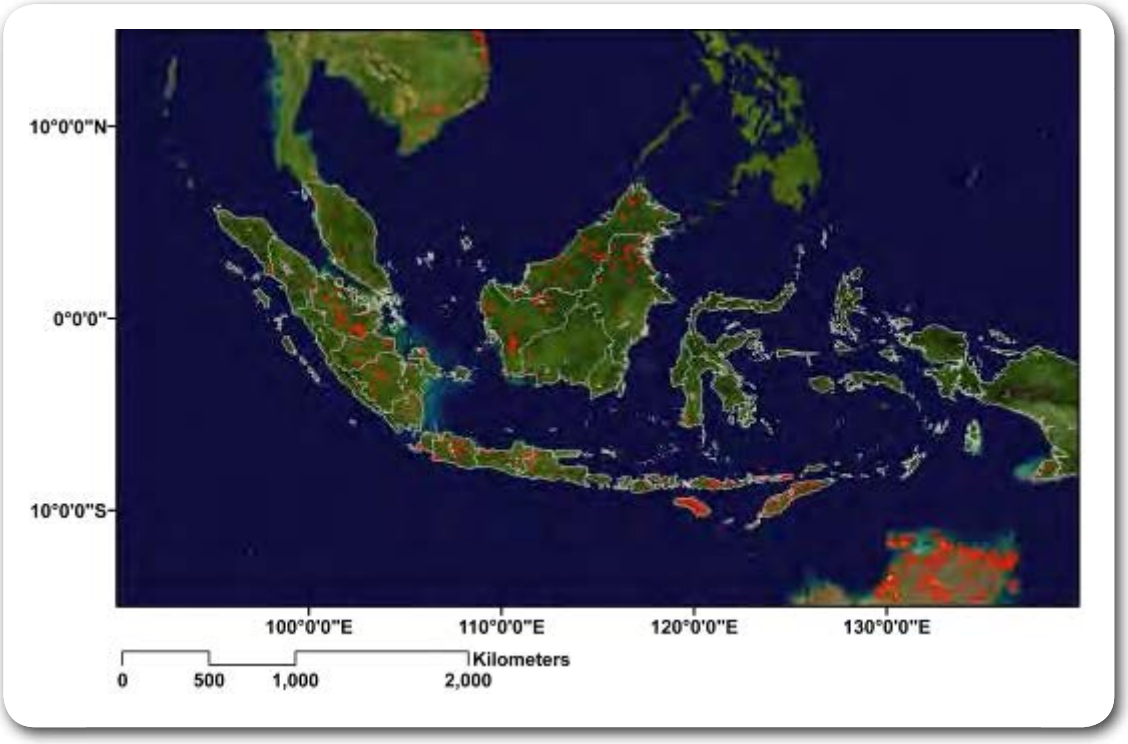


Figure 36 Location of Hotspots during 1997-1998 Forest Fires

More than that, schools, businesses and airports had to be closed which in turn damaged the local economy. Almost all economic activities were paused, including tourism, which caused double hit to people which had already suffered from the Asian monetary crisis around the same time. Even the plantation firms have to cease the operation and prove that they were not guilty, otherwise their licenses were revoked. The cost of haze was estimated to be approximately US$1.4 billion, divided into the three countries. Indonesia paid the highest, US$1 billion, where 90% of it went to short-term health costs borne by people made ill by the haze and to run government clinics and hospitals which treated them. Malaysia lost US$300 million or more due to industrial production losses and lost tourism revenues, while Singapore lost US$60 million from tourism revenues as well.

Besides the cost of haze, the cost of fires damage itself was estimated to be over US$3 billion. This includes: US$493 million in timber; US$470.4 million agriculture (plantations and smallholdings); US$705 million in direct forest benefits (non-timber products such as food and raw materials); US$ 1.077 billion in indirect forest benefits related to hydrology and soil conservation; US$30 million in capturable biodiversity; US$ 272.1 million for carbon release (gases that contribute to climate change); and US$13.4 million for fire fighting costs (IFFM, 1998). This suggests that the cost of forest fires is very dear and Indonesia needs to prevent it from happening again.

The projection of future ENSO completed for the ICCSR, as synthesized in Section 3 above, has predicted long El Nino that might occur more often between 2010 and 2030. This long El Nino could poses major risks to the forests if activities of land clearing by burning that triggered the hotspots as occurred in 1997

and 1998 fires are still practiced on the ground. Therefore it is necessary to have programs that will curb activities such as land clearing by burning forests for plantation, logging or farming.

Threats on Biodiversity

Biodiversity contributes significantly to almost all aspects of people's livelihoods and well-being. Biodiversity also provides a much wider range of services, many of which are currently degraded, such as coral reefs and mangroves that protect coastlines. Therefore, it is obvious that if the products and services that are provided by biodiversity are not effectively managed, future options will become ever more restricted. Poor people tend to be the most directly affected by the deterioration of ecosystem services, as they often live in places most vulnerable to ecosystem change. Current losses of biodiversity are restricting future development options. A large number of species have gone extinct in recent history or are threatened with extinction, reductions in populations are widespread and genetic diversity is widely considered to be in decline. Current loss of biodiversity on land and in the world's fresh and marine waters is more rapid than at any time in human history. As seen in Table 31, climate change also could cause additional pressures on biodiversity change. In turn, it could change in resource availability, the characteristics of protected areas, and resilience of ecosystems.

Table 16 Impacts on biodiversity of major pressures and associated effects on ecosystem services and human well-being (Adopted from UNEP, 2007)

Pressures	Impacts on biodiversity	Potential implications for ecosystem services and human well-being
Habitat conversion	▪ Decrease in natural habitat ▪ Homogenization of species composition ▪ Fragmentation of landscapes ▪ Soil degradation	▪ Increased agricultural production ▪ Loss of water regulation potential ▪ Reliance on fewer species ▪ Decreased fisheries ▪ Decreased coastal protection ▪ Loss of traditional knowledge
Overexploitation	▪ Extinctions and decreased populations ▪ Alien species introduced after resource depletion ▪ Homogenization and changes in ecosystem functioning	▪ Decreased availability of resources ▪ Decreased income earning potential ▪ Increased environmental risk (decreased resilience) ▪ Spread of diseases from animals to people
Climate change	▪ Extinctions ▪ Expansion or contraction of species ranges ▪ Changes in species compositions and interactions	▪ Changes in resource availability ▪ Spread of diseases to new ranges ▪ Changes in the characteristics of protected areas ▪ Changes in resilience of ecosystems

Threat on Built Environment

Threats to our environment as the result of climate change do not only happen to the natural ecosystem but also to our built environments. Recently many regions in Indonesia experienced the worst flooding more often than usual. These phenomena have been caused by combination of forest degradation and recent changes of precipitation level which is higher than normal.

According to analysis and projection of climate change in Indonesia prepared for the ICCSR, the average rainfall for year 2010 until 2020 shows a decline in rainfall for January and an increase of rainfall for December and February in most of the areas in West Java and East Java. Only in some areas on northern coast of Central Java there are increases of rainfall for both January and February. As previously mentioned, rainfall changes are considered as significant when it is in the range or exceed the range of

25-50 mm. Therefore, it is expected that in the near future, more severe floods would be happening. As an example, bigger floods would be routinely occurring in most of the areas in West Java and East Java in February. The floods could cause losses to our rural areas and, even more, to urban areas. If in rural areas the floods mainly cause the damage to agricultural production such as rice fields or other crops. Most recent tragedy of landslides triggered by high intensity of rainfall occurred in last February of 2010 in the Tenjolaya Village, Southern Bandung of West Java. This disaster caused around 45 casualties and 936 persons evacuated in temporary shelters. Similarly, the unusual rate of rainfall in February of 2010 has also flooded four urban districts of the Bandung Regency, West Java and it was considered as the worst flood within the last 10 years in the region. Each year, the Industrial Zones in the Southern Bandung are flooded and caused billion rupiahs lost. In urban areas the floods also could cause damage to properties and to lives as well. Rapid urban development in line with economic growth and population pressures has been the major force behind land conversion from non-built up to built up areas in our cities, which makes the capacity of the open space to absorb run off water during rain substantially reduced.

Coupled with narrowing rivers and channels due to squatter development as well as deficiency in the drainage system, our cities are already very vulnerable during rainy season. For example, Jakarta experienced the worst flood in February 2007, which inundated 75% of the area, killed more than 80 people, damaged thousands of houses, and hundred thousands of refugees (Nurbianto, 2007). What has happened in Jakarta will be worsened when the increase of precipitation level in February as predicted in the ICCSR scientific report does occur. It will affect many cities in Indonesia, especially the cities and towns on the northern coast of Java, the urban concentration of our population. Floods become inevitable in those areas during rainy season and it would cause lives and damage to properties either buildings or other belongings. Floods will also cause damage to urban infrastructures, especially the transportation network. Moreover, as discussed in the Roadmap for health sector, major outbreaks of water-borne diseases might easily occur during or after the floods, such as diarrhea, leptosclerosis or dengue fever. With the prediction of sea level rise in some parts of northern coast of Java as well as eastern coast of Sumatera, major urban disasters associated with prolonged inundation during rainy season would eventually happen in our major coastal cities before the end of the 21st century. Therefore some strategic measures to anticipate the worst scenario of flooding and inundation, especially in urban areas, are urgent to be included in the national disaster mitigation plans.

Climate change may also affect our coastal areas. As reported in the Roadmap of Marine and Fishery sector, the climate change phenomena such as the sea level rise or the increase of sea surface temperature are predicted to cause hazards to the coastal and marine ecosystems. While the increase of sea surface temperature would cause coral bleaching, the sea level rise would inundate certain low-lying areas especially near the coastline in northern part of Java as well as eastern part of Sumatera. Another impact of sea level rise would be the inundation of small islands, in which if located on the outer part of our sea border would make those islands disappeared. This would be a national security issue for Indonesia. Indonesia had lost small islands such as Sipadan and Ligitan Islands to Malaysia due to border dispute few

years ago. Thus it is a great concern for Indonesia if it has to loose other small islands on the border with neighboring countries due to sea level rise. Therefore some strategic measures to avoid the lost of other small islands are needed. These inter-connecting impacts of climate change that will further deteriorate natural and man-made environment are illustrated in the chart below.

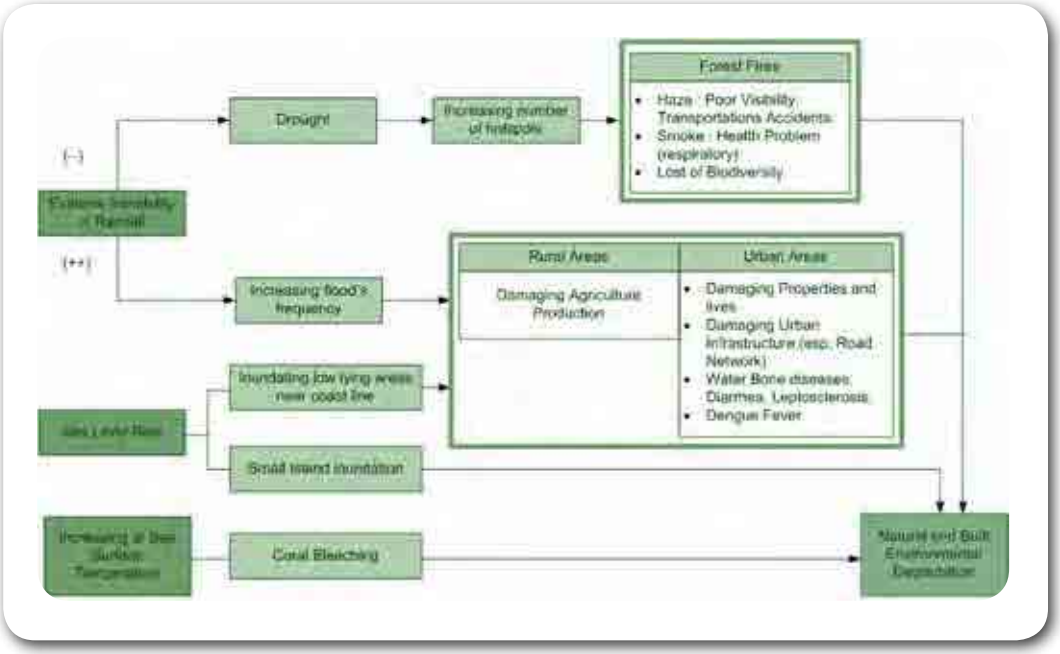


Figure 37 Interconnecting Impacts of Climate Change Resulting in Natural and Built Environmental Degradation

15.3 Cross sectoral issues with the forest sector

The roadmap identified three sectors with major influences on mitigation efforts in the forestry sector, i.e., agriculture, energy and mining[30] as depicted in Table 31. Without addressing these cross sectoral issues properly, mitigation efforts as described in the three scenarios in the forestry sector are at risk.

Table 31 Cross sectoral issues with an influence on climate change mitigation in the forestry sector

Sector	Effect on mitigation
Agriculture	Policy synchronization needed with a view to expansion of agricultural land and palm oil plantation as well as other sources of bio fuel for enhancement of sinks and reducing emissions from deforestation
Mining	Open mining in the forest area
Energy	Forest conversion to increase alternative energy supply (geothermal) in forest areas

In the light of climate change mitigation efforts and to overcome these cross sectoral issues, the existing regulations[31] can indeed serve to synchronize the activities so it can achieve more efficient and effective program implementation. For several development purposes of strategic importance which have to use some of the forest area, then this has to be compensated with other areas by renting and releasing forest area. In case of non compliance this can cause a further significant increase of emissions from the forestry sector. Since the current set of regulations both in the forestry as well adjacent sectors have been made without consideration of climate change issues, more analysis of regulations and policies and respective implementation might be appropriate.

[30] Other sectors have influences as well, and are listed in more detail in the forest sector roadmap document.

[31] Law No. 41 Year 1999 (basic forestry regulation), Law No. 5 Year 1990 (natural resources and ecosystem conservation), Law No. 26 Year 2007 (spatial planning)

16

CONCLUSION AND RECOMMENDATIONS

Indonesia has been playing an active role in international negotiations on Climate Change, including as the host for the 13th Conference of the Parties to the UNFCCC, held in Bali, during December 2007. The Bali Conference led to the Bali Action Plan, which will continue to guide the next phase of international negotiations on climate change. Since mitigation of CO_2 emissions and adaptation and of climate change impacts must be integrated into national development plans, Indonesia needs to mainstream climate change into the nation's development planning processes. Thus the ICCSR is essential as a guideline for all development sectors to plan their future programs.

The Indonesia Climate Change Sectoral Roadmap is arguably the first of its kind in the world. It includes some important breakthroughs in terms of approach, scope, and time horizon. The Roadmap started with scientific basis reports on the projection of climate change phenomena that might occur in Indonesia during the 21st century. These projections of climate change impacts were used by each of the ministerial and sector expert teams (i.e. water, marine and fisheries, agriculture, and health, etc.) as the basis for risks assessments and the foundation for planning Indonesia's adaptive responses to the risks of climate change. Meanwhile, the projection of CO_2 emissions by other sectors (e.g., energy, transportation, industry, forestry, and waste) was used to develop strategies for mitigation of CO_2 emissions. Through bottom-up processes that included focus group discussions with stakeholders in each sector, the Roadmap team generated an integrated response strategy for each sector covering the full period from 2010 to 2030

16.1 Conclusions and recommendations to address vulnerability and adaptation

A scientific basis for the Roadmap has been provided through a rapid scientific study of climate change impacts on Indonesia, an analysis of global observational data, and a combination of global climate model (GCM) outputs. Results of observational data analysis indicate that a certain degree of climate change has occurred in Indonesia. The impacts of these changes are already visible in terms of temperature increase and changing precipitation patterns. Projections of near and farther future climate impacts show some potential hazards in terms of increasing temperature and increasing or decreasing rainfall with larger variability. Sea level rise is also a serious climate hazard for Indonesia that has been identified and projected to occur in the Indonesian seas with ramification due to more frequent extreme climatic events.

Results of this scientific study are, however, still quite rudimentary in terms of completeness of data and methodology. Among other things, climate projection using the global model output for climate projection over Indonesia may not be sufficient and quantitative formulation of uncertainties has not been carried out. Therefore, more serious concerting efforts are needed to develop a comprehensive report on climate change in Indonesia based on the best available expertise. This recommendation envisages the publication of a report that may look like "Future Climate Change in Indonesia: The Physical Science Basis". The existence of a respected, domestic, scientifically sound source of climate information seems to be crucial to develop "climate literacy" among people of various competences, especially those who are involved in the political decision-making processes.

In order to have a clear strategy for national development during the next 20 years, the ICCSR sets several

targets set for each five-year period. These include:

1. By 2015 we hope that advanced research on the impacts of climate change and the mapping of local vulnerabilities will be available to support the establishment of a robust information system for adaptation. Meanwhile, we also expect that the national inventory of CO_2 emissions will be refined so that a more clear and complete picture of national emissions will emerge;

2. Since the institutional capacity of national ministries and agencies to anticipate climate change impacts will be strengthened by year 2015, we expect that climate-proof policy-making process and regulations will be put in place by 2020. Meanwhile, we are determined that Indonesia's aggregate emissions of greenhouse gases will decrease by up to 26% from the projected "business-as-usual" trajectory to 2020, mainly through the application of Indonesia's own domestic resources.If additional financial resources become available from international sources, Indonesia could reduce it GHG emissions by up to 41%, relative to the "business-as-usual" scenario;

3. By 2025, we expect that all national development processes will include consideration of CO_2 emissions reduction opportunities and the measures to adapt to the unavoidable impacts of climate change.Meanwhile, we are also determined to increase the use of renewable energy resources and other forms of alternative energies as well as to reduce the use of non-renewable fuels such as oil and coal by 2025;

4. Then in 2030, we hope that the risks from climate change impacts on all sectors of development will be significantly reduced, through concerted efforts to raise public awareness, strengthen institutional capacity, improve knowledge management, and develop adaptive technologies as elements of balanced and sustainable development. In the meantime, we also expect that all sectors that contribute to greenhouse gas emission will transiton to implementing a low-carbon development strategy.

As a national effort to manage the risks of climate change, the Roadmap sets up three categories of activities in each development sector, as follows:

- Category 1. Data, Information and Knowledge Management (KNOW-MANAGE)
- Category 2. Planning and Policy, Regulation and Institutional Development (PLAN-PRIDE)
- Category 3. Plans and Programs Implementation and Control with Monitoring and Evaluation (ICON-MONEV)

In order to allocate national resources efficiently and effectively to achieve Indonesia's national development objectives over the next 20 years, each category has been given a different weight for each five-year period.

From the various risk/vulnerability assessments to climate change, including the ones which were conducted for the Indonesia Climate Change Sectoral Roadmap (ICCSR), it has become clear that formulation of adaptation strategies and action plans should be based solidly on modern risk assessment

techniques. This is to prevent over-adaptation, mal-adaptation and under-adaptation (Australian Government, 2005). Risk assessment techniques can characterized by their scope of impact as either macro, meso and micro assessments. A macro level assessment conducted for the ICCSR was intended to help in formulating national strategies and programs. For example, areas characterized by extreme or high risk of water shortage due to climate change were identified all over Indonesia Therefore, priority programs for adapting to water shortage need to be focused on those areas. However, to identify more precise action such as whether a specific dam should be built in a particular area to manage the risk of water shortage or not, a more detailed micro-assessment at local level must be conducted.

By procedure, risk assessment is preceded by hazards assessment. In the context of climate change, hazards assessment is to project future change of temperatures, rainfall, sea level rise and extreme climatic events. For projecting such changes, bottom up analysis (trend from observational data) and top down analysis (down scaling from global model) are applied. For either approaches, Indonesia is still facing the challenges on providing time series observational data (bottom up) and discovering the most suitable global climate model representing Indonesia's climate condition to be down scaled to national and local level.

Therefore it can be concluded that for adaptation programs in the National Medium-term Development Plan (RPJMN) 2010-2014 need to be focused on strengthening the capacity of data, information, climate modeling and risk assessment. In addition, in this period, serious attention should be dedicated to capacity development such as adjustment of regulation and enhancement of human resources capability. However, programs on adaptation implementation should also begin from the planning term of 2010-2014, although the proportion of resources allocation will be still smaller. Once the capacity of information system and research on climate change is established by 2015, the proportion of the resources for adaptation actions will be increasingly bigger starting from the RPJMN 2015-2019 onward.

From the macro level of risk assessment on water sector, marine and fisheries sector, agriculture sector and health sector, it shows that the Northern Coast (Pantura) of Java may be considered as the most vulnerable region to climate change impacts. Similarly, Suroso and Sofian (2009) also concluded that many key infrastructures, densely populated areas, paddy fields, fishponds, industrial sites, tourism sites would be exposed to multiple stressors from climate change. Such findings lead to the need to urgently respond with appropriate adaptation actions. For an example, fisherman villages along the northern coast of Jakarta have routinely experienced disaster from high tide waves. The disturbance has also been experienced by harbors located along the Northern Coast of Java. For an example, the distribution of goods and services to and from the Tanjung Mas Port, Semarang experienced trouble in May 2009 due to seawater inundation which was complicated by land subsidence. It means that even though appropriate adaptation action has to be preceded with risk assessment at micro level, we should not be prevented to begin with adaptation action from now on.

We realized that the climate change phenomena may pose some threats to our nation, such as on food security, natural and man-made environmental degradation, and as an archipelagic nation: the national security, if we loose our remote, small islands on the border. Therefore it is important that the concerted efforts to adapt and mitigate the climate change impacts as proposed in the Roadmap to be implemented. In order to have effective implementation of the Roadmap, other efforts may be required and they have not been specifically mentioned in the Roadmap, i.e.:

- We need to seriously think about the management of our land use in order to avoid more land use conversion to built-up areas that will be threatening our farms and forests;
- We also need to control the distribution of our population so that overpopulation is not occurring in our coastal cities;
- In order to do that we will need to make some revisions on our spatial plans, either the national spatial plan, the major islands spatial plans, the provincial spatial plans, or the local spatial plans, aiming at reducing the rate of land conversion and population growth, especially in the coastal areas;
- Moreover, we will need to think seriously about the protection of national strategic areas, such as the capital city, special economic zones, small and remote islands, etc., from environmental deterioration.

All of these efforts must be done so that we can optimize our natural resource management but at the same time preventing hazardous effects of the climate change on the people, the natural and built ecosystems, including important infrastructures. The Roadmap serves as the guidance for Indonesia to reduce the risks from climate change impacts.

Nevertheless, as we developed the Roadmap we encountered some challenges that should be take into consideration as we progress, namely:

- Due to data availability and the variety of process in each sector, we have different quality of Roadmap of each sector;
- Institutional coordination between ministries and agencies is not easy to be done, thus the integration of sectoral programs into national multi-sectoral programs have not been clearly defined.

Finally, we also envisage another challenge that we may encounter in diffusing the national roadmap into the local level in the context of decentralization, as some functions and authorities of most development sector have been devolved to local governments. Partnership between central, provincial and local governments will be required to ensure that the nationally concerted efforts for climate change adaptation and mitigation will be owned by all level of governments.

16.2 Conclusions and recommendations to address mitigation

- Taking all sectors and key programs together, Indonesia has the potential to reduce GHG emissions significantly at an order of magnitude of 4,433.3 Mt CO2-e cumulatively through the year 2020. Costs of actions differ significantly across the sectors, so that a ranking becomes necessary in order to weigh impacts on the economy against achievements in terms of GHG emissions reductions; the amount of emission reductions can be increased if different scenarios are chosen (see full ICCSR sector reports).

- The scenarios in the mitigation matrix were selected based on abatement costs and cumulative GHG emissions reductions. They represent a suite of possible mitigation actions that can achieve a 26.7 % cut in GHG emissions, compared to the BAU scenario. It seems important to note that this BAU scenario of the climate change roadmap does not correspond to the entire national BAU, since the focus was laid on the most important mitigation sectors and activities[32].

- Analyzing the matrix of mitigation actions, it can be understood that the forest sector (including peat) features by far the biggest potential in terms of GHG emissions reduction and associated costs. In this sector, at a given budget and cost level it depends crucially on the right mix of activities for mitigation in the forest sector, namely Forest management units (including management of natural forests and forest rehabilitation), peatland management and plantations. To tap the large potential to reduce GHG emissions and to effectively deviate from the business as usual scenario, activities have to be applied in the right mix.

- Subsequently, the waste sector offers considerable potential to reduce GHG emissions (above all if the mitigation costs are concerned), followed by the industry (cement), power sector (Sumatra, Java-Bali systems) and transport, which features the highest mitigation costs, but significant potential in terms of GHG emissions.

- For more ambitious emissions cuts, further scenarios and actions can be realized, when chosing for example the Carbon value scenario at 50 USD t CO_2 (Sumatra power sector) or the combination of energy efficiency, alternative fuel and blended cement in the cement sector over the respective sector scenarios in the mitigation matrix above.

- To illustrate, the Carbon value scenario at 50 USD t CO_2 (Sumatra power sector) would lead to a cumulative emission reduction of 81,4 Mio t CO_2 (i.e., an additional 35,43 Mio t CO_2) and the combined cement sector scenario to a reduction of 43 Mio t CO_2, which supersedes the reductions achieved in the blended cement scenario by 24 Mio t CO_2.

[30] For example the power sector excludes all regions besides Jawa-Bali and Sumatra, and agriculture (paddy cultivation, livestock) were not considered, among others.

- For all sectors, the establishment of a national GHG inventory and monitoring system is precondition measure the success of mitigation actions towards achieving the emission reduction target of - 26 % as declared by the Indonesian president.
- In order to deviate successfully from the business as usual scenario, sector specific development of institutional and human capacities in order to safeguard implementation and overcome the barriers is indispensable.
- Cross sectoral issues, as identified by the forest sector, need to be addressed adequately by policy makers in order to safeguard effectiveness of the mitigation actions as listed in the mitigation matrix.
- While it is important to come to a sound understanding of abatement costs across sectors, it will be equally important to carefully assess *barriers* to policy implementation in different areas. Only on this basis, an adequate mix of policy measures can be developed.

REFERENCES

Australian Government, Department of the Environment and Heritage Australian Greenhouse Office, 2005. *Climate Change Risk and Vulnerability.* (http://www.greenhouse.gov.au/)

BAPPENAS. 2007. National Long-Term Development Plan (RPJPN) 2005-2025

BAPPENAS. 2008. National Development Planning: Indonesia Responses to Climate Change.

BAPPENAS, 2009. Reducing carbon emissions from Indonesia's peat lands – Interim report of a multi-disciplinary study.

BAPPENAS. 2009. Medium-Term National Development Planning 2010-2014.

Boer, R. 2008. *Pengembangan Sistim Prediksi Perubahan Iklim untuk Ketahanan Pangan*. Laporan Akhir Konsorsium Penelitian dan Pengembangan Perubahan Iklim Sektor Pertanian, Balai Besar Litbang Sumberdaya Pertanian. Jakarta: Badan Litbang Pertanian.

Boer, R. 2009. *Impacts of Climate Change in Agriculture*. Country case study submitted to International Food Policy Research Institute, Washington, DC. (Un-published report).

Badan Pengkajian dan Penerapan Teknologi. 2009. *Technology Need Assessment (TNA).* Badan Pengkajian dan Penerapan Teknologi. Jakarta.

Damanhuri, Enri. 27th-29th October 2009. *Some Principal Issues on Municipal Solid Waste Management in Indonesia.* 1st Expert Meeting on Waste Management in Asia-Pacific Islands. Tokyo.

Departemen Kelautan dan Perikanan. 2005. Strategis Pembangunan Kelautan dan Perikanan tahun 2005-2009. http://www.dkp.go.id

ECOFYS. 2009. ECOFYS International BV by order of Agence Française de Développement (AFD). "Introduction to a green house gas emission reduction scheme in the cement sector in Indonesia", PCMANL084568.

GOI, 2010. *Rencana Aksi Nasional Gas Rumah Kaca* (draft, March 2010).

Handoko, I., Y. Sugiarto, dan Y. Syaukat. 2008. *Keterkaitan Perubahan Iklim dan Produksi Pangan Strategis: Telaah kebijakan independen dalam bidang perdagangan dan pembangunan*.. Bogor, Indonesia: SEAMEO BIOTROP.

IEA. 2007. International Energy Agency (IEA). "Tracking Industrial Energy Efficiency and CO2 Emissions - Energy Indicators".

Integrated Forest Fire Management. 1998. IFFM/GTZ Interim Report. http://www.iffm.or.id.

IPCC. 2007. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. "Climate Change 2007: Mitigation", [B. Metz, O.R. Davidson, P.R. Bosch, R.

Dave, L.A. Meyer (eds)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. XXX pp.

IPCC. 2007. Climate Change 2007 - The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the IPCC. Cambridge: Cambridge University Press.

Kim HY, Horie T, Nakagawa H and Wada K (1996). *Effects of Elevated CO_2 Concentration and High Temperature on Growth and Yield of Rice*. II. The Effect on Yield and Its Components of Akihikari Rice. Japanese Journal of Crop Science 65, 644-651.

LPEM UI. 2009. *Economic Impact of Cilmate Change*. Jakarta

MA. 2005. Ecosystems and Human Well-being: Scenarios: Findings of the Scenarios Working Group of the Millennium Ecosystem Assessment Working Group. Island Press, Washington, DC

Mahasenan, Natesan, Steve Smith, Kenneth Humphreys, and Y. Kaya. 2003. "The Cement Industry and Global Climate Change: Current and Potential Future Cement Industry CO2 Emissions". Greenhouse Gas Control Technologies - 6th International Conference. Oxford: Pergamon. pp. 995–1000. ISBN 9780080442761.

Minister for Agriculture Regulation No. 26/2007 on Guidelines of Plantation License.

Minister for Agriculture Regulation No. 47/2006 on Guidelines for Agriculture Cultivation in Highlands.

Ministry of Forestry. 2006. Rencana Pembangunan Jangka Panjang Kehutanan Tahun 2006-2025. Ministry of Forestry. Jakarta.

Ministry of Forestry. 2007. *Road Map Revitalisasi Industri Kehutanan Indonesia*. Ministry of Forestry. Jakarta.

Ministry of Forestry2009a: National Strategy Reducing Emissions from Deforestation and Forest Degradation in Indonesia, Readiness Phase (Draft)

Ministry of Forestry, 2009b. Statistik Kehutanan Indonesia 2008, Forestry Statistics of Indonesia 2008 ISBN : 979-606-073-6.

MoFor 2008, IFCA 2007 Consolidation Report : Reducing Emissions from Deforestation and Forest Degradation in Indonesia.

Nurbianto, B. 2007 "Floods biggest challenge for Fauzi" *The Jakarta Post*, December 15, 2007.

Peng, S. et al. 2004. *Rice yields decline with higher night temperature from global warming*. Proceeding of National Academy of Sciences of the United States of America.

Peraturan Menteri Pertanian No. 14/PL.110/2/2009 tentang Pedoman Pemanfaatan Lahan Gambut untuk Budidaya Kelapa Sawit.

Robledo, C. & Forner, C. 2005. Adaptation of forest ecosystems and the forest sector to climate change. Forest and Climate Change. Working Paper No. 2. FAO

SBSTA. 2009. UNFCCC. "Second Synthesis Report on Technology Needs Identified by Parties not Included in Annex 1 to the Convention – Note by the Secretariat", 29-May-2009, presented at SBSTA 13th Session, Bonn 1 – 10 June-2009.

SNC. 2009. "Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC)". Republic of Indonesia.

Sakamoto, K in ADB. 2009. (forthcoming) *Innovative financing of low-carbon and energy efficient transport.*

Saunders, M. A. and Lea, A. S. 2008. *Large Contribution of Sea Surface Warming to Recent Increase in Atlantic Hurricane Activity*. Nature Vol.45 doi: 10.1038/nature06422.

Schweithelm, J. 1998. *The Fire This Time: An overview of Indonesia's Forest Fires in 1997/1998*. Discussion Paper. WWF Indonesia.

Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC). 2009.

Situmeang, Hardiv. 2009. *NAMAs and Its Linkages at National Level*, presented at FGD Perubahan Iklim Sektor Energi, Industri dan Limbah, Jakarta, 28 August 2009.

Sofian, I. 2009. *Kajian Dasar Akademis (Scientific Basis) : Analisis dan Proyeksi Perubahan Iklim di Indonesia.* Tim Roadmap Bappenas-GTZ. Jakarta.

Suroso et.al. 2009. *Vulnerability Of Small Islands To Climate Change In Indonesia: A case study of Lombok Island, Province of Nusa Tenggara Barat.* Proceeding International Seminar On "Climate Change Impacts On Water Resources And Coastal Management In Developing Countries". Manado

Suroso, Djoko S. A. and Sofian, Ibnu. 2009. *Vulnerability of the Northern Coast of Java, Indonesia to Climate Change and the Need of Planning Response*. Proceeding Positioning Planning in the Global Crises, International Conference on Urban and Regional Planning. Bandung: 12-13 November 2009.

Technology Need Assessment. Indonesia, MoE and BPPT, 2009.

Timmermann, A., M. Latif, A. Bacher, J. Oberhuber, E. Roeckner, 1999, Increased El-Niño, *Nature*, 398, 694-696.

Torrence, C. and G. P. Compo., 1999, A Practical Guide to Wavelet Analysis, *Bulletin of the American Meteorological Society*, 79, 1:61–78.

Tschirley, J. 2007. *Climate Change Adaptation*: Planning and Practices. Powerpoint keynote presentation of FAO Environment, Climate Change, Bioenergy Division. Rome: 10-12 September, 2007.

United Nations Environment Programme, 2007, Global Environment Outlook 4, Environment for Development.

WBCSD. 2003. Jaakko Poeyry Consulting in cooperation with the World Business Council for Sustainable Development (WBCSD): "Summary of international pulp and paper industry structure and best practice".

WBCSD. 2007. World Business Council for Sustainable Development – Cement Sustainability Initiative. "Sectoral Approach - Briefing Note", as presented to the COP 13 Bali Conference.

Wiyono, S., 2009. *Organisme Pengganggu Tanaman dan Perubahan Iklim*. Makalah FGD Sektor Pertanian, Jakarta, 24 April 2009.

http://www.usaid.gov/our_work/crosscutting_programs/water/docs/coastal_adaptation/chapters_1-3.pdf

Van der Werf, G. R, Dempewolf, J, Trigg, S. N, Randerson, J. T, Kasibhatla, P. S, Giglio, L, Murdiyarso, D, Peters, W, Morton, D. C, Collatz, G. J, Dolman, A. J and DeFries, R. S. 2007. Climate regulation of fire emissions and deforestation in equatorial Asia.

Worldsteel. 2009. World Steel Association (formerly: International Iron and Steel Institute). "World Steel in Figures 2009". ISSN 1379-9746.

Unofficial translation

STATE MINISTRY NATIONAL DEVELOPMENT PLANNING / HEAD OF NATIONAL DEVELOPMENT PLANNING AGENCY

COPY

STATE MINISTRY OF NATIONAL DEVELOPMENT PLANNING / HEAD OF NATIONAL DEVELOPMENT PLANNING AGENCY DECREE

NUMBER KEP.44/M.PPN/HK/09/2009

ON

ESTABLISHMENT OF INDONESIA CLIMATE CHANGE TRUST FUND (ICCTF)

STATE MINISTRY OF NATIONAL DEVELOPMENT PLANNING / HEAD OF NATIONAL DEVELOPMENT PLANNING AGENCY,

Whereas:

a. That, the government of Indonesia has to implement the objective of “Low Carbon Development” to make steadily achieve economic growth slightly high with low carbon emission rate, and at the same time increase capacity to adapt climate change impacts.

b. That, in order to implement the above objective mention in point a, the government of Indonesia needs to open innovative alternatives to bridge international fund resources with national investment;

c. That, in order to implement coordination, synergy, and synchronization of international grants/loans, and to do monitoring and evaluation of implementation of donor supports intensively to increase capacity of government of Indonesia in managing impact of climate change effectively and efficiently, and able to become an example of a fund alternative for climate change mitigation and adaptation conducted by government transparently and responsibly, it is a need to establish an Indonesia Climate Change Trust Fund (ICCTF);

d. That, based on considerations mentioned in point a, b, and c above, it is a need to issue a State Ministry of National Development Planning / Head of National Development Planning Agency Decree on Establishment of Indonesia Climate Change Trust Fund (ICCTF);

e. That, government staffs whose name are mentioned in the Annex of this decree is capable of and suitable with requirements to implement tasks as a member of Steering Committee, Technical Committee, and Secretariat of the Indonesia Climate Change Trust Fund (ICCTF);

In accordance with:
1. Law No. 6 of 1994 on Ratification of the United Nations Framework Convention on Climate Change (Official Gazette of the Republic of Indonesia 1994 Number 42, Supplement of Official Gazette of Republic of Indonesia Number 3557);
2. Law No. 17 of 2003 on the State Finance (Official Gazette of the Republic of Indonesia 2003 Number 47 and Supplement of Official Gazette of the Republic of Indonesia Number 4286);
3. Law No. 17 of 2004 on Ratification of Kyoto Protocol to the United Nations Framework Convention on Climate Change (Official Gazette of the Republic of Indonesia 2004 Number 72, Supplement of Official Gazette of the Republic of Indonesia Number 4403);
4. Law No. 1 of 2004 on the State Treasure (Official Gazette of the Republic of Indonesia 2004 Number 5, Supplement of Official Gazette of the Republic of Indonesia Number 4355);
5. Law No. 25 of 2004 on National Development Planning System (Official Gazette of the Republic of Indonesia 2004 Number 104, Supplement of Official Gazette of the Republic of Indonesia Number 4421);
6. Government Regulation No. 2 of 2006 on Procedures for the Procurement of Loans and/or Grants and On-Lending and/or On-Granting (Official Gazette of the Republic of Indonesia 2006 Number 3, Supplement of Official Gazette of the Republic of Indonesia Number 4597);
7. Presidential Regulation No. 9 of 2005 on Status, Task, Function, Organizational Structure, Authority, Administration of the Ministry of State and Non-Departmental Government Institution that have revised couple times, the last revision is Presidential Regulation No. 20 of 2008;
8. Presidential Regulation No. 82 of 2007 on National Development Planning Agency;
9. Decree of the State Ministry of National Development Planning / Head of National Development Planning Agency No. PER. 005/M.PPN/10/2007 on Organization and Administration of the State Ministry of National Development Planning /National Development Planning Agency;

BE IT HEREBY RESOLVED:

To enact: DECREE of STATE MINISTRY OF NATIONAL DEVELOPMENT PLANNING / HEAD OF NATIONAL DEVELOPMENT PLANNING AGENCY ON ESTABLISHMENT OF INDONESIA CLIMATE CHANGE TRUST FUND (ICCTF).

FIRST: Establish Indonesia Climate Change Trust Fund, later on it is called ICCTF, with its members as listed in the Annex of this Ministry Decree.

SECOND: ICCTF consist of a Steering Committee, a Technical Committee, and a Secretariat.

THIRD: The Steering Committee responsible for:

a. Develop a concept of guidance and supervise Ministries that their main tasks and function relate with climate change in the coordination process of sustainability of ICCTF;
b. Coordinate implementation of guidance of Ministries that their main tasks and function relate with climate change;
c. Enact technical guidance of ICCTF implementation on mechanism of fund distribution, procedures for Trustee procurement, main tasks and function of Technical Committee, Secretariat, auditor and other units established for ICCTF;
d. Enact criteria of mitigation and adaptation activities that can be funded by ICCTF based on guidance of Ministries that their main tasks and function related with climate change for prioritized activities proposed by Ministrries/Institution;
e. Decide and enact activities proposed by Ministries/Institutions and can be funded by ICCTF;
f. Call Development Partners/Donor and/or other stakeholders related with climate change and implementation of ICCTF when needed;
g. Prepare and develop Steering Committee's report to Ministries that their main tasks and functions related with climate change on implementation of tasks, at least once in a year, and any time when needed by the Ministries;
h. For efficiency and to accelerate implementation of ICCTF, the Steering Committee may conduct technical consultations;
i. Before finishing ICCTF Trustee procurement, the Steering Committee may have an Interim Trustee;

FOURTH : Technical Committee responsible for:

a. Provide technical inputs to the Steering Committee in a process of sustainability of ICCTF;
b. Coordinate monitoring and controlling and escorting implementation of guidance of Steering Committee;

c. Develop technical guidance for implementation of ICCTF on mechanism of fund distribution, procedure for Trustee procurement, main tasks and function of Technical Committee, Secretariat, auditor and other units established for the ICCTF;
d. Create activities and/or technical units priority needed for smoothing activities in the ICCTF;
e. Develop criteria for activities that can be funded by ICCTF based on guidance of Steering Committee for priority window;
f. Conduct technical assessment and analysis on proposed activities sent by Ministries/Institutions;
g. Propose technical recommendations on proposed activities sent by Ministries/Institutions and can be funded by ICCTF to the Steering Committee;
h. Prepare and develop Technical Committee reports sent to Steering Committee about implementation of technical tasks, at least every 4 (four) months and any time asked by Steering Committee.

FIFTH: Secretariat responsible for:

a. Help preparing documents/materials and proposals sent by Ministries/Institution systematically to be funded by the ICCTF to be able to be technically evaluated and analyzed by Technical Committee;
b. Help implementation of Steering Committee's and Technical Committee's tasks in preparing documents for developing policy recommendations;
c. Help Steering Committee on procuring technical consultants to support Steering Committee;
d. Manage Secretariat business tasks.

SIXTH: All cost needed in order to implement tasks of Steering Committee, Technical Committee, and ICCTF Secretariat, are charged to the Budget of the State Ministry of National Development Planning/BAPPENAS.

SEVENTH: This decree is in effect since enacted.

Enacted in Jakarta on
3rd September 2009
State Minister of National Development Planning /
Head of National Development Planning Agency
(signed)

Paskah Suzetta

Annex
Decree of State Ministry of National Development Planning / Head of BAPPENAS
No. KEP. 44/M.PPN/HK/09/2009
Date : 3rd September 2009

STRUCTURE OF MEMBER OF THE INDONESIA CLIMATE CHANGE TRUST FUND

A. Steering Committee

Chairmen: Secretary of State Ministry of National Development/Main Secretary of BAPPENAS.

Deputy 1: Deputy of Natural Resources and Environment Division, State Ministry of National Development Planning/BAPPENAS.

Deputy 2: Director General of Loan Management, Ministry of Finance.

Deputy 3: Head of National Council on Climate Change.

Members:

1. Deputy of Division of Coordination of Economic and International Funding Cooperation, State Ministry of Economic Affair.
2. Deputy of Division of Development Funding, State Ministry of National Development Planning/BAPPENAS;
3. Deputy of Division of Infrastructure, State Ministry of National Development Planning/BAPPENAS;
4. Deputy of Division of Economic, State Ministry of National Development Planning/BAPPENAS;
5. Deputy of Division of Regional Development and Autonomy, State Ministry of National Development Planning/BAPPENAS;
6. Deputy of Division of Poverty, Employment, and Small Medium Business, State Ministry of National Development Planning/BAPPENAS;
7. Deputy of Division of Human Resources and Culture, State Ministry of National Development Planning/BAPPENAS;
8. Deputy of Division of Development Performance Evaluation, State Ministry of National Development Planning/BAPPENAS;

9. Director General of Finance, Ministry of Finance;
10. Director General of Budgeting, Ministry of Finance;
11. Director General of State Treasure, Ministry of Finance;
12. Head of Fiscal Policy Agency, Ministry of Finance;
13. Secretary General, Ministry of Finance.

B. Technical Committee

Chairman : Director of Environment, State Ministry of National Development Planning/BAPPENAS;

Deputy 1 (also a member): Director of Financing/Treasure System, Ministry of Finance.

Deputy 2 (also a member): Director of International Fund Multilateral, State Ministry of National Development Planning/BAPPENAS;

Members :

1. Director of Budget II, Ministry of Finance.
2. Derector of International Loan and Grant, Ministry of Finance.
3. Director of Evaluation, Accounting and Settlement, Ministry of Finance.
4. Assistant Deputy for Climate Change Control Issue, State Ministry of Environment;
5. Secretary of Forestry Research and Development Agency, Ministry of Forestry;
6. Head of Planning Biro, Ministry of Energy and Mineral Resourses;
7. Head of Planning Biro, Ministry of Agriculture;
8. Head of Planning Biro, Ministry of Forestry;
9. Head of Planning Biro, Ministry of Marine and Fishery;
10. Head of Planning Biro, Ministry of Public Work;
11. Head of Planning Biro, Ministry of Transportation;
12. Head of Planning Biro, Ministry of Industry;
13. Head of Center for Climate Change, The Agency for Meteorology, Climatology, and Geophysics;
14. Director of Economic and Environment Development, Ministry of Overseas Affair;
15. Director of Facilitation of Spatial Planning and Environment, Ministry of Home Affair;
16. Head of Planning and International Cooperation Biro, National Land Agency;
17. Director of International Cooperation Bilateral, State Ministry of National Development Planning/BAPPENAS;
18. Director of Forestry and Water Resource Consevation, State Ministry of National Development Planning/BAPPENAS;

19. Director of Food and Agriculture, State Ministry of National Development Planning/BAPPENAS;
20. Director of Marine and Fishery, State Ministry of National Development Planning/BAPPENAS;
21. Director of Planning for Extending Development Fund (?),State Ministry of National Development Planning/BAPPENAS;
22. Director of Energy Resources, Minerals, and Mining, State Ministry of National Development Planning/BAPPENAS;
23. Director of Energy, Telecomunication, and Information, State Ministry of National Development Planning/BAPPENAS;
24. Director of Transportation, State Ministry of National Development Planning/BAPPENAS;
25. Director of Irrigation and Irrigation infrastructure (?),State Ministry of National Development Planning/BAPPENAS;
26. Director of Spatial Planning and Land (?),State Ministry of National Development Planning/BAPPENAS;
27. Head of Law Biro, State Ministry of National Development Planning/BAPPENAS;
28. Head of Law Biro, Ministry of Finance.
29. Head of Planning, Organization and Administration, State Ministry of National Development Planning/BAPPENAS;

C. Secretariat

Chairman: Head of Sub Directorate for Climate and Weather, Directorate of Environment, State Ministry of National Development Planning/BAPPENAS;
Deputy: Head of Sub Directorate Conservation and Development of Forest Service, Directorate of Forestry and Water Resources Conservation, State Ministry of National Development Planning/BAPPENAS;

Members:

1. Head of Planning, Program and Budget Division, Biro for Planning, Organization and Administration, State Ministry of National Development Planning/BAPPENAS;
2. Head of Regulation Development Division (?), Biro of Law, State Ministry of National Development Planning/BAPPENAS;
3. Head of Finance, General Biro, State Ministry of National Development Planning/BAPPENAS;

State Minister of National Development Planning /
Head of National Development Planning Agency
(signed)
Paskah Suzetta

KETUA HARIAN
DEWAN NASIONAL PERUBAHAN IKLIM

Our Ref. : E-03/EC-NCCC/01/2010
Subject : **Indonesia Voluntary Mitigation Actions**

Jakarta, January 30th 2010

To.
Mr. Yvo de Boer
Executive Secretary
United Nations Framework Convention on Climate Change
P.O. Box 260124 D-53153 Bonn-Germany

Dear Mr. de Boer,

With reference to my letter dated 19 January 2010, I have the honor to reiterate Indonesia's association with Copenhagen Accord that in our view served as a very important milestone in our common endeavor in addressing the challenges of climate change.

For information to the UNFCCC Parties, please find the information of our voluntary Mitigation Actions, in the format set forth in Appendix II of the Copenhagen Accord, as follow:

Nationally Appropriate Mitigation Actions	Emission Reduction
The Reduction will be achieved, inter alia, through the following action: 1. **Sustainable Peat Land Management** 2. **Reduction in Rate of Deforestation and Land Degradation** 3. **Development of Carbon Sequestration Projects in Forestry and Agriculture** 4. **Promotion of Energy Efficiency** 5. **Development of Alternative and Renewable Energy Sources** 6. **Reduction in Solid and Liquid Waste** 7. **Shifting to Low-Emission Transportation Mode**	**26 % by 2020**

Please rest assure of our continued support on the implementation of the Accord and its call for further deliberations of the negotiations under the UNFCCC and its Kyoto Protocol.

Yours sincerely,

Rachmat Witoelar
Executive Chair
National Council on Climate Change

PRESIDENTIAL REGULATION OF THE REPUBLIC OF INDONESIA
NUMBER 71 YEAR 2011

ON
THE IMPLEMENTATION OF
NATIONAL GREENHOUSE GAS INVENTORY

BY THE GRACE OF GOD ALMIGHTY

PRESIDENT OF THE REPUBLIC OF INDONESIA,

Considering :

a. that increased concentrations of greenhouse gases in the atmosphere has caused global warming that triggered global climate change which can degrade the quality of the environment;

b. that by ratifying the United Nations Framework Convention on Climate Change, Indonesia participated actively together with other members of the international community in an effort to prevent the rising concentrations of greenhouse gases in the atmosphere;

c. that in accordance with Article 63 paragraph (1), paragraph (2), and paragraph (3) of Law No. 32 Year 2009 on the Environmental Protection and Management, the central government, provincial and district / city has a duty and authority to conduct a greenhouse gas inventory;

d. that based on the considerations as specified in the points of letter a, b, and c it is necessary to enact the Presidential Regulation on the Implementation of the National Greenhouse Gas Inventory;

In view of :

1. Article 4 paragraph (1) of the 1945 Constitution of the Republic of Indonesia;

2. Law...

2. Law No. 6 Year 1994 on the Ratification of the United Nations Frameworks Convention on Climate Change (State Gazette of the Republic of Indonesia of the Year 1994 under No. 42, Supplement to the State Gazette of the Republic of Indonesia under No. 3557);
3. Law No. 17 Year 2004 on the Ratification of Kyoto Protocol to the United Nations Frameworks Convention on Climate Change (State Gazette of the Republic of Indonesia of the Year 2004 under No. 72, Supplement to the State Gazette of the Republic of Indonesia under No. 4403);
4. Law No. 32 Year 2004 on the Local Government (State Gazette of the Republic of Indonesia of the Year 2004 under No. 125, Supplement to the State Gazette of the Republic of Indonesia under No. 4437) as amended several times, lastly by Law No. 12 Year 2008 (State Gazette of the Republic of Indonesia of the Year 2008 under No. 59, Supplement to the State Gazette of the Republic of Indonesia under No. 4844)
5. Law No. 31 Year 2009 on Meteorology, Climatology and Geophysics (State Gazette of the Republic of Indonesia of the Year 2009 under No. 139, Supplement to the State Gazette of the Republic of Indonesia under No. 5058);
6. Law No. 32 Year 2009 on Environmental Protection and Management (State Gazette of the Republic of Indonesia of the Year 2009 under No. 140, Supplement to the State Gazette of the Republic of Indonesia under No. 5059);

HAS DECIDED...

HAS DECIDED:

To enact : THE PRESIDENTIAL REGULATION ON THE IMPLEMENTATION OF NATIONAL GREENHOUSE GAS INVENTORY.

CHAPTER I

GENERAL PROVISIONS

Article 1

In this Presidential regulation, meant by:

1. Climate change is the change in the climate caused either directly or indirectly by human activities so as to cause global change in the atmospheric composition and in the natural climatic variability observed in a certain comparable period of time.
2. The Greenhouse Gasses hereinafter referred to as GHG are the gasses contained in the atmosphere both naturally and anthropogenically which absorb and re-emit infrared radiation.
3. GHG Inventory is an activity to obtain data and information about the level, status and trend of change of GHG emissions periodically from various emissions by sources (source) and removal by sinks (sink) including carbon stock.
4. GHG emissions are the discharge of GHGs into the atmosphere in a certain area at a certain period of time.
5. GHG removals are the removal of GHGs in a certain area at a certain period of time.

6. Carbon stock . . .

6. Carbon stock is the amount of carbon that accumulated in carbon pools on land and sea in a certain period of time.
7. Activity data is the amount of quantitative activity or human activity which can release and/or absorb GHGs.
8. Emission factor is the amount of GHG emission released into the atmosphere per unit of certain activity.
9. Removal factor is the amount of GHG in the atmosphere removed per unit of certain activity.
10. The level of GHG emissions is the amount of annual GHG emissions.
11. The level of GHG removals is the amount of annual GHG removals.
12. The GHG emission status is the condition of GHG emission in a certain comparable period of time based on the GHGs calculation using consistent method and emission factor/removal.
13. The Report for National Communication on Climate Change (National Communication) is the report prepared by the Government of Indonesia as the obligation of States Parties that ratified the United Nations Framework Convention on Climate Change.
14. Mitigation of Climate Change is the effort to control and to reduce the risks of the impacts of climate change through activities that may reduce the emissions and/or increase the removal of GHGs from various emissions sources.
15. Minister is the Minister who performs government affairs in the field of environmental protection and management.

16. Related . . .

16. Related Minister and/or Head of Non-Ministry Government Institution are the Head of Ministry and/or Institution which scope, duties and responsibilities in accordance with the legislation regulation.

CHAPTER II

OBJECTIVES

Article 2

Implementation of the National GHG inventory aims to provide:

a. Periodic information about the level, status and trend of change of emission and removal of GHGs including carbon stock at national, provincial and district/city level.

b. Information on GHG emissions reduction achievement from national climate change mitigation activities.

CHAPTER III

PROCESS AND CALCULATION PROCEDURE OF GHG INVENTORY

ARTICLE 3

(1) GHG inventory conducted by way:

   a. Monitoring and data collection of emissions sources and removal of GHG including carbon stock, as well as determination of emission and removal factor of GHGs.

b. Calculation of emission and removal of GHGs including carbon stock

(2) The calculation of emission and removal of GHGs including carbon stock is reported in the form of the level and status of GHG emissions.

(3) GHG inventory as specified in the paragraph (1) is conducted at the emission source and removal including carbon stock that includes:

a. Agriculture, Forestry, Peat land and other Land Use.

b. Production and Use of energy comprise the following matters:

1. energy generation;

2. industry;

3. transportation;

4. household;

5. commercial; and

6. agriculture, construction and mining.

c. Industrial Process and Product Use

d. Waste Management.

(4) The Minister may determine other source other than as specified in the paragraph (3) after coordinating with relevant Minister and/or Head of Non-Ministry Government Institutions.

(5) GHGs as specified in paragraph (1), paragraph (2) and paragraph (3) comprise the following compounds:

a. carbon dioxide (CO_2).

b. methane (CH_4).

c. dinitro oxide (N_2O)

c. dinitro oxide (N_2O).

d. hidrofluorocarbon (HFCs).

e. perfluorocarbon (PFCs)

f. sulfur hexafluoride (SF_6).

Article 4

(1) The calculation of emission and removal of GHGs including carbon stock is conducted by way:

a. Using activity data at each of the emissions sources and its removal including carbon stock;

b. Using activity data in the same year;

c. Using local emission factor and removal factor.

(2) In the case of unavailability of local emission factor and removal factor as specified in the paragraph (1) letter c, the calculation of emission and removal of GHGs including carbon stock could use the emission factor and removal factor from the international agreement.

(3) The result of emission and/or removal of GHGs calculation as specified in the paragraph (1) are used to calculate the GHG emissions reduction achievement from national climate change mitigation activities.

Article 5

Toward the activity data, emission factor and removal factor, calculation of GHGs emission and removal level conducted by way:

a. Uncertainty analysis.

b. The selection of methodology used.

c. Quality control to ensure the accuracy and completeness of data.

d. Quality assurance by reviewing GHG inventory application procedure.

e. Data documentation and information including archiving.

f. Determination of the most significant sources to assist the allocation of resources to improve the implementation inventory.

CHAPTER IV

VERIFICATION

Article 6

(1) Toward the GHG inventory process and result, including GHG emissions reduction achievement from national climate change mitigation activities is verified.

(2) The regulation about verification as specified in the paragraph (1) is further regulated by Minister Regulation.

CHAPTER V

DUTY AND AUTHORITY

Article 7

(1) The Minister responsible for:

a. Establishing guidelines for the implementation of GHG inventory.

b. Coordinating the implementation of GHG inventory and emission and removal of GHG trend of change including carbon stock at national level.

c. Implementing the monitoring and evaluation towards GHG inventory processes and results.

(2) The Minister conducts coordination in the preparation of reports for National Communication on Climate Change.

(3) The Minister submits reports for National Communication to the government representative assigned as National Focal Point at the United Nations framework Convention on Climate Change.

Article 8

(1) Related Minister and/or of Non-Ministry Government Institutions related to the scope of GHG inventory as specified in Article 3 paragraph (3), responsible for:

a. Conducting the GHG inventory

b. Arranging a trend of change of emission and removal of GHGs including carbon stock in accordance with the scope of duties and authority.

c. Developing inventory methodologies and emission factor or removal of GHG in coordination with the stakeholders.

(2) In performing the duties as specified in paragraph (1), Related Minister and/or Head of Non-Ministry Government Institution assign the responsible party to conduct the GHG inventory in the institution work unit in accordance with its authority.

Article 9

(1) The Governor responsible for:

a. Performing GHG inventory at the provincial level; and

b. Coordinating the implementation of GHG inventory at the district and city.

(2) In performing the duties as specified in paragraph (1), Governor appoint a local technical implementation unit which scope of duties in the field of environment.

Article 10

(1) Regent and Mayor are responsible for GHG inventory implementation at the district and city.

(2) In performing duties as specified in paragraph (1), Regent and Mayor appoint a local technical implementation unit which scope of duties in the field of environment.

Article 11

Implementation of GHG inventory conducted by related Minister and/or Head of Non-Ministry Government Institutions, Governor, Regent, and Mayor based on guidelines established by the Minister as specified in Article 7 paragraph (1) letter a.

CHAPTER VI

REPORTING

Article 12

(1) Regent and/or Mayor report the result of GHG inventory to the Governor periodically, once (one time) a year.

(2) Governor reports the result of GHG inventory from district and/or city to the Minister once (one time) a year.

Article 13 . . .

Article 13

(1) Related Minister and/or Head of Non-Ministry Government Institutions reports the result of GHG inventory to the Minister once (one time) a year.

(2) Minister reports the result of GHG inventory to the Coordinating Minister for People's Welfare.

Article 14

(1) GHG inventory report is published periodically in accordance with national needs, international needs, and the need for preparation of National Communication on Climate Change Report as specified in the Article 7 paragraph (2) which is coordinated by the Minister.

(2) The report as specified in paragraph (1) is used as policy formulation materials and national climate change mitigation activities evaluation including National Action Plan for Greenhouse Gas Emissions Reduction (RAN-GRK).

Article 15

(1) All business actors that are potentially cause emission and/or removal of GHGs, obligate to report data related to GHG inventory to the Governor and Regent/Mayor in accordance with their authority once a year.

(2) Limitation of business actors that obligate to report data related to GHG inventory as specified in the paragraph (1) are regulated by Minister Regulation.

Article 16

Further provisions regarding the reporting of the GHG inventory implementation as specified in the Article 12, Article 13, Article 14, and Article 15 are regulated by Minister Regulation.

CHAPTER VII

GUIDANCE

Article 17

(1) The Minister and related Minister and/or Head of Non-Ministry Government Institution to provide guidance in order to the GHG inventory implementation to the provincial and district/city government and stakeholders.

(2) The Governor provides guidance in order to coordinate the GHG inventory implementation to district/city local government and stakeholders.

(3) Further regulation about guidance as specified in the paragraph (1) and paragraph (2) is regulated by Minister Regulation.

Article 18

(1) Each GHG inventory implementer must meet the criteria and standard of competency of GHG inventory

(2) The criteria and standard competency as specified in the paragraph (1) is regulated by Minister Regulation

CHAPTER VIII

FINANCING

Article 19

All necessary expenses for the implementation of this Presidential regulation are charged to the State Revenues and Expenditures Budget (APBN), Regional Revenues and Expenditures Budget (APBD) and/or other legal and unbinding sources in accordance with the prevailing laws and regulations.

CHAPTER IX . . .

CHAPTER IX

CLOSING

Article 20

This Presidential Regulation comes into force as of the date of enactment.

Enacted in Jakarta

On October 5, 2011

PRESIDENT OF THE REPUBLIC OF INDONESIA

[Signed]

DR. H. SUSILO BAMBANG YUDHOYONO

True copy of the original

Deputy Minister for People's Welfare

Secretariat of the Cabinet of RI

[Signed]

Agus Sumartono, S.H., M.H