

## **Nominated Discussion**

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## **Developed Country's Policy Instruments versus Developing Country's Instruments: Indonesian Perspectives on Integrated Assessment Model (IAM)**

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### **Abstract**

Indonesia as an equatorial, tropical and an archipelagic country consisting of 17,508 islands and a long coastline of about 81,000 km, realized that the impacts of climate change would affect all aspects of life.

Accompanying expanding human settlements in the coastal belt, industrialization, and continued population growth and economic diversification, the development of a simulation model assessing the impact of climate change (in an integrated geographical manner) would provide important inputs for the policy development and decision making process.

This paper outlines some key issues to be considered in the model: its concept, methodology used, parameters used, analytical approach used, policy assessment, and its implications. Not all of these issues identified at the global or regional level are relevant to the Indonesian situation. However the important point to be discussed and to be shared among countries is how the application of scientific findings can assist the development of an integrated assessment model at the national level. From this experience we can learn the shortcomings, existing gaps, and the benefits of using this IAM based policy making.

Further cooperation in developing integrated assessment models should be undertaken to minimize the gap between developed and developing countries' knowledge and capability. And more financial sources from Annex I Countries of the Conference of the Parties of Framework Convention of Climate Change, especially from GEF, should be allocated to strengthen developing countries capabilities.

### **Introduction**

Indonesia as an equatorial, tropical and an archipelagic country consisting of 17,508 islands and a long coastline of about 81,000 km realized that the impacts of climate change would affect all aspects of life.

Accompanying expanding human settlements in the coastal belt, industrialization, and continued population growth and economic diversification, climate change issues have become increasingly important to Indonesia as a nation. These concerns not only focus on the maintenance of ecological processes, but also on resource utilization for sustainable economic development. These issues have led to a growing awareness for the need to improve all management aspects of the environment and its natural resources. This process must incorporate effective data/information inventories, the development of an integrated approach to natural resource and environmental management, and the establishment of cooperation among countries in taking action at both global and national level.

In dealing with global climate change concerns, the government of Indonesia has been anticipating the response through policy development based upon the capability and

limitation in terms of knowledge, funding, and institutional capacity. Programs and projects that incorporate climate change issues and concerns have been, and continue to be implemented, involving key agencies at global, regional, and national level.

In the areas of scientific research, the Ministry of State for Environment has been developing an Integrated Asia-Pacific Model (AIM) for Indonesia, as part of cooperation with National Institute for Environmental Studies (NIES) - Japan. Although this research is still in the preliminary stage, the development of this model will be directed to assist climate change related policies formulation.

### **Policy Basis**

Indonesia has a strong legal basis in developing climate change related policies and instruments:

**1. The Preamble of the 1945 Constitution**, states among other things that the Government of the Republic of Indonesia shall protect the Indonesian people and the entire landmass of Indonesia, and shall advance the general welfare, develop the intellectual life of the nation and contribute to implementation and order in the world which is based upon independence, abiding peace and social justice.

**2. Article 33 Paragraph (3) of the Constitution**, states that: 'Land, water and the natural wealth contained therein shall be controlled by the State and shall be made use of for the people'. This Article clearly gives the mandate for the national development of Indonesia. Humans play a significant role in affecting the climate system through the use of natural resources as part of environmentally sound sustainable development. Therefore it is necessary to develop an inter-relationship between the atmosphere, the earth and water which form the climatic system. The management of climate should be continuously improved to support development in various sectors, such as in agriculture and forestry.

**3. The Decree of the People's Consultative Assembly of Republic of Indonesia No. II/MPR/1993** concerning the State Guideline of Policy, particularly on the Environment and Foreign Relations states, among other things, the following :

- Development in the area of environment is an important part of the ecosystem, functioning as support to the life of all living creatures in the world. Its development should be directed toward the conservation of its functions, which must be in dynamic balance and in accordance with population growth. It also aims to utilize national resources in a sustainable manner, rehabilitate environmental damage, control pollution and promote the quality of environment
- With environmentally-sound sustainable development, the spatial lay out shall be designed to balance the land and water uses, as well as uses of other natural resources, in a dynamic way that encompasses a unified and integrated environmental structure, supported by the development of population growth. The spatial lay out should be managed on the basis of an integrated pattern using regional approaches with consideration of their natural and social characteristics. Land use systems should also be developed to prevent the deleterious use of productive agricultural land which may disturb the ecological balance. In developing the use of water, the focus should be on the continuous provision of adequate and safe drinking water, prevention of flood and drought, prevention of reduced quality of water and conservation of water catchment areas. Any change in function and condition of the environment, together with its effects, should be mitigated carefully so that protective measures can be taken in a timely manner.

- A degraded environment should be rehabilitated to restore its function as a life support system and contributor to people's welfare. Law enforcement to reduce pollution should be improved. Various economic tools can be used to control pollution, by using appropriate technology so that the quality of the environment can be maintained. Infrastructures and facilities for the management of domestic, industrial and hazardous waste should also be improved to ensure the sustainability and the quality of the environment.
- Regional and international cooperation on environmental preservation and protection, as well as participation in international policy and advancement of science, should also be improved for the benefit of sustainable development.
- Relationships with other countries at the regional and international (bilateral and multilateral) levels should be dedicated to the national interest, on the basis of national freedom principles. The relationships should also be dedicated to the national interest, on the basis of national freedom principles. The relationships should also be directed to the achievement of the New World order which is based on freedom, peace and social justice with the main objective of increasing international cooperation, with consolidation and increased participation of the Non-Aligned Movement.

### **Indonesian Strategy and Action Plan Related to Climate Change**

As we are aware that developed and developing countries have difference policy responses in dealing with the climate change due to capability and capacity, the most important point to be discussed and to be shared is on how we define the common targets that accommodate the measurement of each country.

A further important step that had been taken by Government of Indonesia, to build a strong fundamental basis for further responses on climate change, was the signing of, along with more than 150 other countries, the Framework Convention on Climate Change at United Nations Conference on Environment and Development (UNCED) held in June 1992. Furthermore, the Convention had been ratified through an Act of Republic of Indonesia Number 6 of 1994, dated 1<sup>st</sup> August 1994.

Coordination among the institutions within the country has been realized as an important step to deal with the issue of climate change. In 1990, the Ministry of State for Population and Environment (after 1992 changed to be the Ministry of State for Environment) established the Committee on Monitoring and Evaluation Impact of Climate Change to the Environment consisting of representatives from various Government Agencies, Non Government, Organizations (NGOs), as well as from universities represent academic communities. In 1991 the Committee was reviewed and renamed as National Committee on Climate and Environment.

The National Committee has identified three principles as a foundation for the national response strategy to address climate change:

- the national response strategy cannot be separated from the long-term national development strategy i.e. stability, economic growth and equity, which must take into account important aspects of climate change in relation to environmentally sound sustainable development;
- the principles of equity and justice must guide the process of anticipating and assessing impacts; and

- steps must be taken to reduce net emissions from all activities that contribute to greenhouse gases (GHG) emissions, without hampering the national development objectives.

Indonesia as developing country will not apply the reduction of greenhouse gas within the same time-frame as for countries listed in the Annex I. However as part of the commitment, the Government of Indonesia is preparing a National Action Plan which will describe a mitigation and adaptation action plan, and be the basis for the preparation of Indonesia's National Communication required under the Framework Convention on Climate Change.

## **Mitigation Options on Energy Sector**

### *Justification*

Based on the last two decades of Indonesia's economic growth experience, as a developing country, the high economic growth rate of Indonesia will continue in the future until reaching the newly industrialized country level, representing more than 6% annually in the next decade. This high growth rate economic projection will also add to the level of GHG emission in the future.

As a developing country, Indonesia is one of the fast growing countries. The GDP growth in the year 1995 was more than 7 percent; therefore the growth rate of energy consumption in this country also increases, along with the economic growth.

In terms of the controlling of GHG emission due to energy utilization, the mitigation scenario tries to control Indonesia's GHG emissions to at least 10% in the year 2010 and 20% in the year 2020, below the emission level of business as usual (BAU).

GHG emissions of the energy system are as follows: CO<sub>2</sub> emission from the utilization of energy in Indonesia increase from 150 million tones in 1990 to around 200 million tones by the year 1993. Oil combustion accounted for approximately 60% of the total CO<sub>2</sub> released, followed by natural gas (30%), and the remainder released from utilization of coal.

### *Mitigation Options*

#### **1. Conservation and Efficiency of Energy Use**

- Energy conservation in heavy consuming industries (cement, fertilizer, steel industry, etc.) and transportation sector
- Disseminating information on energy conservation (for industry, transportation, commercial and household)
- Training on procedures for improving efficiency of energy use
- National energy conservation campaign

#### **2. Application of Clean Energy Technology**

- Application of small hydro-power (in Java)
- Development of geothermal, clean coal technology (integrated coal gassification combined cycle and circulating fluidized bed combustion)
- Application of C.N.G.

#### **3. Alternative Energy**

- Application of Solar energy
- Research and development of renewable energy such as wind, biomass, wave, etc.
- Technical guidance regarding new and alternative energy

#### **4. Public Awareness**

- Improvement of public awareness and public participation to reduce greenhouse gas effect. I.e. in energy efficiency, electric switch, and bulb use.

#### **5. Transfer of Technology**

- Establish collaboration for technology transfer, energy efficiency, energy alternatives, and emission reductions in the transportation sector.

#### **6. Action Plan**

- Campaign to increase public and private sectors awareness at central and local level
- To take action in reducing the potential increase of GHGs in Indonesia from industrial development, forest management, energy sector, transportation sector, using AIJ - Pilot Phase
- To strengthen research capabilities

### **Mitigation Options on Non-Energy Sector: Forestry**

#### *Basic Forestry Strategy*

Indonesia will play a proper role in combating the effects of climate change without further delay, based on the best available knowledge, as long as this is a global problem which must be 'dealt with' in an equitable manner. Initially, the highest priority should be put to review existing policies with a view to minimizing conflicts with the goals of climate change strategies.

#### *Formulation of strategies to reduce CO<sub>2</sub> emissions from land-use changes*

Forest land use changes that cause CO<sub>2</sub> emissions are, among, others, are the development of estate crops, transmigration and related infrastructure, shifting cultivation, forest fire, illegal logging, mining, urban development and so forth. The policy responses to be formulated are as follows:

##### **1. Developing a detailed forest inventory and monitoring system**

The first priority of response actions should be given to the development of detailed forest inventory and monitoring systems, in order to enable accurate estimations of CO<sub>2</sub> emissions. Considering the global importance of the forests in Indonesia, such an inventory and monitoring system should be established by making use of available advanced technology such as Geographical Information System (GIS), Remote Sensing System, etc.

##### **2. Making so-called Sustainable Land Use Plan**

Based on the accurate estimation of CO<sub>2</sub> emissions, a comprehensive sustainable land-use plan should be made, taking into account the reduction of CO<sub>2</sub> emissions as well as protecting the sustainability of the environment. In order to use this plan practically, all kinds of development activities should be determined based on this land-use plan. The existing deforestation activities, including logging, transmigration, shifting cultivation, and so forth, need to be reviewed based on the sustainable land use plan mentioned above.

## *Basic strategy for enhancing the role of CO<sub>2</sub> sinks*

### **1. Strategic action for forest management**

- To establish realistic forest management planning and to implement programs with a genuine environmental orientation considering the role of forests as CO<sub>2</sub> sink; Strategic action to increase research, monitoring and analysis of forests;
- To establish an adequate database of nature, extent, and character of the forest lands and resources e.g., utilizing Remote Sensing Systems and GIS;
- To establish appropriate ecological monitoring systems considering characteristics of the Indonesian forest;
- To examine and to establish the methodology for measurement of CO<sub>2</sub> uptake by Indonesian forests, in accordance with forest ecological methodology;
- To improve forest fire management such as fire detection; forest fire protection systems and methods; rehabilitation of fire-burned areas; survey and rehabilitation of grasslands; establishment of forest meteorology stations; as well as training for more qualified personnel.

### **2. Strategic action for greening and reforestation**

- To promote vital 'greening' and 'reforestation' programs not only in remaining critical areas to be planted, but also in potential areas such as degraded land or alang-alang grassland;
- To improve silvicultural technology such as development of proper cultivator, soil rehabilitation, appropriate land selection and improvement of agronomic techniques;
- To establish improved systems for greening and reforestation;
- To promote improved sustainable forestry activities, which are harmonized with agriculture and community life, such as agroforestry.

### **3. Strategic action for industrial timber plantation**

- To establish forest inventory systems in order to monitor and evaluate growth and yields;
- To prepare and to implement a detailed long-term plantation plan in order to meet future industrial or domestic wood demand and in order to increase biomass as carbon sink;
- To implement research programs such as tree improvement, fire protection, growth and yield, control of pests and diseases, tending, silvicultural techniques and agroforestry;
- To promote community participation in plantation activities.

### *The Existing Program*

The management authority for the development of the forestry sector is the Department of Forestry. The existing plan of actions of the Department of Forestry, in accordance to the

strategic action mentioned above, are afforestation and reforestation, agroforestry, natural regeneration, the management of protection and conservation forests. The existing programs of the Department of Forestry could be considered as mitigation options on forestry sector, especially on rehabilitation and protection.

### **Mitigation Option on Non-Energy Sector : Agriculture**

#### *Justification*

Anthropogenic sources of greenhouse gases (GHG) from non-energy sectors are mainly land-use change, forestry, and agriculture. Methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) are important GHGs emitted from non-energy sectors. CH<sub>4</sub> mainly originates from livestock by enteric fermentation, manure management, and rice cultivation.

The total land area of Indonesia is 190.95 million ha, of which 58.5 million ha are devoted for agriculture, and about 50 million ha of this for upland crops. Wetland rice covers an area of 8.227 million ha, or 4.8 % of the total land area. However, the harvested area of wetland rice in Indonesia (1990) was about 9.377 million ha, of which 55 % are located in Java island. The total production of wetland rice was 42.75 million tons, of which around 60.4 % were produced in Java Island, where irrigation systems are well developed.

Based on data of harvested wetland rice areas and their rice production in Indonesia, the wetland rice harvested area in Indonesia is increasing with a rate of 106 thousand ha/year. Harvested areas of wetland rice in 1950 were 4.781 million ha and became 9.377 million ha in 1990, an average increase around 1.8 % per year.

Types of fertilizer used in Indonesia includes urea, phosphate, ammonium sulphate and potassium chloride. Most of these fertilizer are used in food crops (mainly wetland rice) and estate crops. Nitrogen fertilizers (as a source of N<sub>2</sub>O) considered were: urea and ammonium sulphate. The use of fertilizers in 1990 totalled 3,120,833 tons of urea and 632,044 tons of ammonium sulphate. There is no data available on the use of organic fertilizer (manure) in Indonesia. This type of fertilizer is widely used where domestic livestock population are high, as on Java Island.

Livestock in Indonesia is classified into four groups i.e. large ruminants (dairy cattle, non-dairy cattle, and buffalo); small ruminants (goat and sheep); non-ruminants (horse and pig); and poultry (chicken and duck).

#### *Greenhouse Gases Emission from Agriculture*

Methane (CH<sub>4</sub>) is an important greenhouse gas (GHG). In terms of radiative forcing, methane is the second most important GHG after carbon dioxide (CO<sub>2</sub>). The total global annual emission of CH<sub>4</sub> is about 515 Tg, 70 % of which is from anthropogenic sources. Out of the 70 %, 40 % or 205 Tg is from agricultural related activities, namely biomass burning, animal wastes, rice cultivation, and enteric fermentation.

Rice fields are considered one important sources of methane emissions into the atmosphere, as is the world's growing population of domestic livestock. Methane concentrations in the atmosphere may steadily increase in the future since the increasing population requires more food, and development of agricultural lands will be extended even to the areas which require large quantity of fertilizer inputs, while the existing cultivated lands are subjected to greater burdens of industrial development and expansion.



The main sink for atmospheric methane is its reaction with troposphere radicals. It is estimated that OH radicals destroy 85% of methane emitted into the atmosphere. The other process that remove methane is in dry soils through oxidation by methanotrophic bacteria.

Methane is the most important GHG produced by the agricultural sector and is responsible for the emission of 3,649.2 Gg, which represents 72.15 % of the national methane emissions. Management of domestic livestock and animal manure contributes 23.7 % of the methane emission from agricultural activities.

Rice cultivation is the largest emitter of methane with 2,758.0 Gg, which represents 75.6 % of methane emission from agriculture. Field burning of agricultural waste generated around 26.8 Gg of methane, which represents 0.007 % - a negligible source.

Livestock is generally considered important by Indonesian farmers to support their household income. In farming systems, agricultural by-products could serve as livestock feeding. On the other hand, animal waste is utilized as organic fertilizers to increase crop production.

Estimated methane emissions from domestic livestock in 1990, comprising enteric fermentation and manure management, are 763. Gg and 100.6 Gg respectively. The greatest methane emitter was from non-dairy cattle, which generated 479.0 Gg (which represents 55 % of the total methane emission from domestic livestock).

Table 1: GHG emission from Agriculture in Indonesia, 1990 (Giga gram)

Source	CH <sub>4</sub>	N <sub>2</sub> O	CO	NO <sub>x</sub>
Wetland rice	2,758.00	-	-	-
Fertilizer use	-	24.70	-	-
Crop residue burning	26.80	0.63	546.40	22.83
Domestic livestock	864.40	-	-	-
Total	3,649.20	25.33	564.40	22.83

Wetland rice is a major source of methane emissions in food crop agriculture. The direct measurement of methane emissions in Indonesia were started in 1992. Most of the studies aimed to know the effect of widely grown rice varieties, soil type, water management, organic matter application, and growing season, on methane emission rates from wetland rice agriculture.

Based on methane emission factors obtained by direct measurements, the total estimated methane emission from rice field with different irrigation type is 2,758.0 Gg. Based on default values, methane emissions from rice field are 3,826.2 Gg.

The burning of agricultural residues in the rice fields also generates methane emissions to atmosphere, to the amount of 26.8 Gg. The use of fertilizer in agriculture contributes nitrous oxide emission to the amount of 24.70 Gg.

### *Methane Sinks*

Results from a study conducted by Murdiyarso and Husin (1995) show that all land-use types being studied consumed methane or act as sinks of methane. Methane sink strengths in all land use types fall in the range of between 0.01 and 0.12 mg/m<sup>2</sup>-hr or between 2.4 and 28.8 h/ha-day, with an average of 14.4 g/ha-day. Dry land area in Indonesia, which has the

potential to absorb methane, is estimated at about 142 million ha. Based on this data, it is estimated that Indonesian dry soils can consume methane at approximately 746 Gg/year.

### *Vulnerability Assessment*

Using the GISS transient climate model, the scenarios of climate in the decades of 2010, 2030, and 2050, are estimated. A large decrease in both grain and biomass yields was obtained, as simulated, using the climate scenarios of the decades 2010, 2030, and 2050.

Except for solar radiation in the decade 2010, all the climatic variables, as simulated by the three GCMs, increase from the current condition. Higher increases in solar radiation and temperature were produced by the GISS model and higher increases in rainfall produced by the UKMO model. The smallest increase is in solar radiation for Mojosari area (that increases by 0.11 MJ/m<sup>2</sup> or 0.9 %) as simulated by GFDL and the highest is in rainfall for Pusakanegara (that increases by 59.1 mm or 91.7 %) as simulated by UKMO model.

The DSSAT crop model predicted lowland rice yield quite well for different management options, with a coefficient of determination value of 87 %. Limited experiment data, covering standard management practices for a sufficient span of time, restrain the model validation for the changing climate.

The rice crop model predicted yield reductions of about 1 % annually in East Java, and less in West Java, because of possible climate change in the future. Since high temperature and CO<sub>2</sub> concentration favor rice growth, development of more tolerant varieties probably can compensate the yield reductions due to climate change in the future. Higher yield losses is predicted because of inter-annual climate variability. Because the dry spell threat is more imminent and frequent, a short-term climate prediction for the tropical region is urgently needed to improve preparedness.

### *Action Plan*

Some approaches for reducing methane emission from flooded rice cultivation involve modifying growing practices. The modifications include fertilizer applications and water management. The reduction of methane emission from domestic livestock generally focus on options of improving production efficiency.

#### **1. Rice cultivation**

Two of the most promising approaches under introduction are changes in nutrient management and water management practices.

#### **2. Nutrient management**

Fertilizer applications, especially nitrogen fertilizers, are sources of N<sub>2</sub>O emission i.e. urea and ammonium sulphate. Some methods of fertilizer applications being introduced are :

- **Balance fertilizer** Fertilizer application based on plant requirement related to soil fertility. The key strategy of use of 'balanced fertilizer' policies is to avoid the excessive use of fertilizer, especially nitrogen fertilizers.
- **Urea briquette** Instead of crystal form, urea is applied in the form of briquettes. This has some advantages such as slow release and greater efficiency, thus reducing fertilizer cost by lowering the dosage of nitrogen fertilizer. Therefore it will reduce N<sub>2</sub>O emissions.

### 3. Water management

A movement for water use efficiency was launched nationally in the middle of 1996. Farmers used to flood the rice crop excessively, even though efficient water use has been introduced some years ago. Intermittent draining of ricefields during the growing period, or between cropping season, will likely reduce methane emissions from rice cultivation.

### 4. Livestock

**Improved nutrition** Nutrient improvement in livestock has been practiced, especially in dairy farming, by providing additional animal protein feed. This nutrient improvement will reduce emission amounts by enhancing animal performance including weight gain, milk production, and reproductive performance.

**Genetic improvement** Artificial insemination and embryo transfer have been practiced to improved genetic characteristics for the purpose of producing better offspring. The increases in reproductive efficiency will significantly reduce methane emission.

**Manure management** Manure management system facilities influence methane emissions. Recovery of methane produced by manure management is more preferred to be use in household purposes. On the small scale, some dairy farms are producing compost by mixing the manure with EM bacteria.

### Issues in Developing Integrated Assessment Models in Indonesia

In developing integrated assessment models in Indonesia the key important issues below should be considered. They are :

- **Data availability and integration.** Table 2 presents a partial summary of the databases presently found in Indonesia, that have relevance to Indonesia's IAM. These various databases have usually been developed with one primary end-user in mind, that usually being the agency which initially requested that the data be compiled. As more data is required to effectively assist in the identification and development of policies and programs, more agencies are establishing databases to manage their information requirements. All too often, however, there is replication of information, and even more disconcerting is the inability to share data already collected among agencies because of inconsistent database formats. In order to become more cost effective and efficient, it is important that efforts be made to both integrate and coordinate the collecting and sharing of information to address many environmental issues, and in this case IA modeling can be effectively addressed.
- **Integrated Model for implementation at national level.** Not all of the issues identified at the global or regional level are relevant to the Indonesian situation. However the important point to be discussed and to be shared among the countries is on how the application of scientific findings can assist the development of integrated assessment models at the national level.
- **Social economic consideration.** Each country has different social economic conditions. Indonesia has a population of more than 200 million, representing a lot of cultural diversity within which value systems exist which should be considered in the model.
- **Policy linkage for implementation.** Sometimes scientific findings are almost not applicable for policy formulation in the decision making process, due to the complexity of parameters to be considered and the time frame for decision-making. It would be useful if the model used in the policy formulation considered these limitations whilst utilising the scientific findings.

**Table 2: Partial summary of databases relevant to integrated assessment model.**

Name of Agency	Database	Type of Data	Format	Data Acquisition	Coverage	Scales
BAKOSUT-ANAL	National Topographic Database	Topographic base maps, thematic maps, aerial photographs, satellite imagery	Digital and hard copy	Variable	National Provincial Local	1:250,000
	Geographic Marine Resources Information System (GMRIS) (under development)					1:50,000
						1:25,000
Ministry of environment (MLH)	Balance Sheet for Environment Quality (NKLD),	Environmental statistical data, environmental projects, river water quality, industrial waste water, forest and land use management	Hard copy Reports	On-going	National Provincial Local	1:1000,000
	Environmental Donor Assistance Database (EDAD),					1:500,000
	Marine Biodiversity Database (CEPI),					1:250,000
	Coastal Environmental Management Planning Project (CEMP)					1:100,000
National Agency for Space and Aeronautics (LAPAN)	Remote Sensing Data Bank	Satellite imagery (LANDSAT-TM, SPOT-HRV, ERS-1 SAR, NOAA-AVHRR, GMS-SVISCAR)	Hard copy and digital data	On-going	National Provincial Local - Research Study Sites (Makassar Strait, Banda Sea, Pelabuhan Ratu, Jakarta Bay, Pulau Seribu)	1:250,000 1:25,000
Directorate General for Fisheries	-----	Statistical data Thematic maps	Hard copy	On-going	National Provincial Local	1:1000,000 1:250,000
Agency for Assessment and Application of Technology (BPPT)	Marine Resources Evaluation Planning (MREP) Database	Satellite imagery Digital maps Statistical data	Digital and hard copy data	On-going	Provinces Special Marine Areas (Makassar Strait, Lombok Strait, Timor Gap)	1:1000,000 1:250,000 1:50,000
National Agency for Meteorology and Geophysics (BMG)	-----	Currents, tides, water temperature, waves, seismic activity	Tabular data, daily forecasts	On-going	National Provincial	1:1000,000

**Table 2: Ctd. Partial summary of databases relevant to integrated assessment model.**

Name of Agency	Database	Type of Data	Format	Data Acquisition	Coverage	Scales
National Agency for Meteorology and Geophysics (BMG)	-----	Currents, tides, water temperature, waves, seismic activity	Tabular data, daily forecasts	On-going	National Provincial	1:250,000 1:50,000 1:25,000
Indonesian Institute of Sciences (LIPI)	National Biodiversity Database (coral reef ecology, mangrove ecosystem, soft bottom communities) (under development)	Rare and endemic species, natural ecosystems	Manual and computer files	NBD Pilot Areas by 1993-1994	National Regional Biodiversity Centers	1:1,000,000 1:250,000 1:100,000
Directorate General of Forest Protection and Nature Conservation (PHPA), Asian Wetland Bureau	Wetland Database (WDB)	Site and habitat data: value assessment, species, land use, physiography, species dictionaries	Hardcopy	On-going, regular updating	Sumatra	Various (70 sites)
World Wide Fund for Nature (WWF)	MASS Database	Species distribution, abundance, habitat requirement, protected areas	Hardcopy	On-going	National Provincial Bio-unit	Various
Hydro-Oceanographic Service (DISHIDROS)	-----	National charts and navigational data	Hardcopy maps	On-going	Indonesian territorial sea and EE Zone	1:100,000 1:250,000

### Follow Up Activities and Future Direction

The adoption of integrated assessment models as a scientific basis for climate change related policy is important in helping developing countries in the context of global climate change negotiations, as part of the commitment to be implemented in each country. Due to the gap between developing and developed countries in developing models, some sort of activities should be initiated as a further stage to bring in scientific findings into the policy decision making process. These activities should accommodate each country's measurement on the basis of their capability in terms of knowledge, social economic condition, and other relevant value to be put in to the model.

The proposed activities to be considered are as follows :

- Extent the existing IAM development expands into broader activities, involving keys institution within the country in any region, and are not limited to research groups but also the institutions that have a role in policy implementation.
- Development of IAM's standard methodology, concept, parameters used, analytical approach, and policy assessment, to be used by developing countries for policy decision-making process simulations.
- Exchange the expertise through various scientific fora, such as workshop, training, etc.
- Initiate various projects in developing IAMs specific to the in-country problems that impact on the region.

## **Conclusion**

Developed and developing countries have different policy responses in dealing with climate change, due to differences in capability and capacity. The most important point to be discussed and to be shared, is on how we define the common targets that need measurement in each country.

The development of IAMs should be directed to minimize gaps between developed and developing countries' knowledge and capability. This could be done through cooperation involving not only the research community, but also the policy maker institutions that have a role in policy formulation and implementation. The extensive effort in developing this cooperation requires funding support for its implementation. More financial sources should be allocated from Annex I Countries of the Conference of the Parties of Framework Convention of Climate Change, especially from GEF to strengthen developing countries' capabilities.