KANTOR MENTERI NEGARA
LINGKUNGAN HIDUP

PREFACE

Indonesia strongly supports the objective of the UNFCCC to prevent the anthropogenic gas concentration in the atmosphere exceeding a level that would endanger the existence of life on earth. Its position is in line with the IPCC findings that global warming is a real threat to human welfare in many ways.

To indicate its firm decision and serious concerns regarding global warming, Indonesia signed the United Nations Framework Convention on Climate Change (UNFCCC) on the June 5, 1992. On August 1, 1994, the President of the Republic of Indonesia approved an the Act of Ratification of UNFCCC Number: 6/1994 (*Undang-undang tentang Pengesahan Konvensi Kerangka Kerja PBB tentang Perubahan Iklim Nomor. 6/1994*). On August 23, 1994, the document was submitted to the Secretary General of U.N. Indonesia is legally included as a Party of the Conference, which imply that Indonesia is bound to the rights and obligations, stipulated in the Convention. One of the obligations is to communicate actions taken to mitigate climate change. In order to properly address climate change issues, State Ministry of Environment established the National Committee on Climate Change. Members of the committee include representative from sectoral departments related to environment.

The current economic crisis in Indonesia affects both micro and macroeconomic variables. The exchange rate influences almost all economic variables. They include the GDP, general prices (inflation), the employment rate, the interest rate, and the wage rate. Since the analysis for this report were conducted using data prior to the crisis, some assumptions become irrelevant to the present conditions. Important points to be noted, therefore, are:

i. Options activities that have large import components, like energy sector mitigation options, are still relevant, but may not be affordable.

ii. Option activities having large domestic components, like mitigation options in the agriculture and forestry sectors, may also be still relevant, since a large part of the domestic component is labor.

iii. Because of hyper inflation, the real GDP decreases. This will change the priority rankings of the mitigation options.

This report is prepared to meet Indonesia commitment as a Party to the Convention. It describes and summarizes the three main items to be included in a national communication, namely, (a) 1994's emission inventory of greenhouse gases and, (b) general description of steps and (c) other important information related to climate change. A national communication document is revised annually in line with the progress made by the country in anticipating, preventing, and minimizing the impact and cause of climate change.

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ACKNOWLEDGEMENTS

The preparation of the Initial Communication was funded by the Global Environmental Facilities, through its implementing agency of the United Nation Development Programme (UNDP) and its support is gratefully acknowledged.

High appreciation goes to all institutions, departments, private sector organizations and NGO's which have provided the necessary input and contributed towards the finalization of this report.

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1.1. Introduction

Indonesia is the largest and widest archipelago country in the world and known as a tropical maritime continent country. It consists of 17,508 islands stretches near the equator from a latitude of 06°08' N to 11°15' S, and a longitude of 94°45' to 141°05 E. It includes 3.1 million km^2 (or 62 per cent) of territorial waters, almost 2 million km^2 (or 38 per cent) of land, and 81,000 km of coastline. The country is divided into 27 provinces, 243 districts, 62 municipals, 3844 sub-districts, and 65,852 villages.

The total population was 165 million in 1985, 183 million in 1990, increase to 191 million in 1994 and passed the 200 million line last February 1997 representing the fourth largest country in the world. The population growth rate was 2.3 per cent during the period of 1971-1980, 1.98 per cent in the period of 1980-1990 and reduced further to 1.66 per cent in the period of 1990-1995. It is projected that with the current growth rate level the population will exceed 300 million by the year 2030.

The Indonesian economy has been growing rather rapidly in the last two decades as a result of political stability, systematic development planning program and more outward looking in economic policy. The Gross Domestic Products (GDP) growth averaging over 7 per cent annually during the period and in 1994 it grew at 7.54 per cent. The Indonesian economic growth rate was definitely much higher than that of most industrialized countries (2.8 per cent) and developing countries (6.6 per cent) in 1994, and it was moderate among the ASEAN countries (between 3.0 and 10.1 per cent). The amount of GDP in current market prices was Rp. 354.6 trillion or equivalent to US$ 164.1 billion at the exchange rate of Rp. 2,161/US$ in 1994. The per capita GDP, therefore, increased accordingly and in 1994 it was reported at Rp. 2,000,600 or US$ 927.7,- that was almost double compared to the 1989 level which was Rp. 958,000.

The Indonesian economic structure has also shifted gradually from traditional sectors (agriculture) to industrial and services sectors. The role of agricultural sector in contributing to the national income in 1980 was 25.7 per cent, which

consisted of Farms and Food Crops 14.5 per cent, Farm Non-Food crops, Estate Crops and Animal Husbandry 6.9 per cent, Forestry and Hunting 2.5 per cent and Fishing 1.8 per cent. The largest contribution to GDP at this time was Mining and Quarrying namely 26.6 per cent followed by The Wholesale and Retailed Trade sector 14.1 per cent and Manufacturing sector 8.8 per cent and other services sectors such as construction, banking, transport and communication, public services 24.8 per cent. Fourteen years later, the composition of sectoral contribution to GDP dramatically changed where Manufacturing Industry sector became a leading sector followed by Agriculture, Trade, Hotel and Restaurant, Banking, Mining and Quarrying, and Services sectors. In 1994, the contribution of Manufacturing Industries was 23.9 per cent, Agricultural sector 17.4 per cent, and Other sectors 58.7 per cent.

1.2. Source and Sink of GHG

Following the IPCC (1996) methodology in calculating the emission and sink of GHG, it was found that in 1994, Indonesia was a net emitter country with a total CO_2 emission amounted to 952,200 Gg. With the assumption that only one third of the area of logged-over forest and agricultural plantation was successfully replanted, total CO_2 removal from the Indonesian forestry sector was only 42 per cent of the total emission. Thus in 1994, net emission of CO_2 already reached 548,353 Gg. Furthermore, total emission of CH_4, N_2O, CO and NO_x was about 4,687; 61; 3,545; and 110 Gg, respectively. The main sources of CO2 emission were forestry and energy sectors. These two sectors contributed for almost 98 per cent of total CO_2 emission. The CO_2 emission from forestry sector was resulted mainly from biomass burning during forest and grassland conversion activities. However, these activities can be expected to cease in the near future due to the limited land available for further conversion and the changing attitude of the people which more environmentally concerned.

Total methane emissions amounted to 4,687 Gg. The main source of methane emissions was agricultural sector (69 per cent). About 71 per cent of CH_4 emission from agricultural sector came from rice fields. For Nitrous oxide (N_2O), total emission was 61.11 Gg. Agricultural sector contributed 86 per cent of the total nitrous oxide emission. Furthermore, forestry and land use change was found to be the highest contributor to CO emission, i.e. 3,545 Gg (90 per cent), while Agricultural sector was 10 per cent. Other minor

gases such as CF_4 and C_2F_6 were produced during industrial processes. The amounts of the two gases emitted from the industrial processes were around 0.31 and 0.03 Gg, respectively.

1.3. General Description of Steps

This Description of Steps documents some policy and programmatic steps, which have been taken by the Government of Indonesia as well as some steps that are considered to be taken in the future to deal with climate change. In the process of development of these steps, Indonesia relies much on the supply of the data available from previous records of important sectors. Numbers of sectors have not been addressed significantly where in the future these sectors will be the focus of the effort to improve in describing the Steps. In addition, the government policy in a broader development may change slightly in relation to climate change due to current political and economic turbulence in the country. These conditions may slightly change the ways how Indonesia will achieve its commitment to global effort to cope with climate change. However, with the available efforts from the National Committee on Climate Change and the international commitment, Indonesia will improve the document as the data, information, and broader policy become available.

In formulating this Description of Steps, several sectors have been selected. These sectors are: *energy, transportation, agriculture, forestry, public health, coastal resources,* and *waste.* These sectors contribute significantly greenhouse gas emission in Indonesia, and accordingly, were the sectors included in the comprehensive inventory on Indonesia's greenhouse gas emission under *Asia Least-cost Greenhouse gas Abatement Strategy,* or ALGAS study.

In developing policies to combat global warming, the government is assisted by a National Committee on Climate Change which consists of representatives from various government agencies, non government organizations, academic, and business communities. The National Committee has identified three principles as the foundation for Indonesia in developing national response strategy to address climate change (Pranoto *et al.* 1997).

The response strategy cannot be separated from the long-term national development strategy i.e. stability, economic growth and equity, which must take into account.

The 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 (GHGs) emissions without hampering the national development objectives. In each sector, the measures selected have to reflect both the interest to mitigate greenhouse gases, and to sustain and further increase Indonesia's economic growth. As such, the country has documented the following initiatives for each sector to accommodate both goals:

Energy:

- Gradual removal of energy market distortions, such as fuel and electricity subsidy.
- Promote use and development of renewable energy, through incentives such as tax breaks for investors on the technology, encouraging research and so on**.**
- Encourage public adoption of energy conservation & efficiency, by adopting techniques such as public campaigns, while at the same time using economic incentives to further promote energy efficiency products and energy conservation practices**.**
- Promote clean and efficient energy use for industry and commercial sectors. Various technologies, for example, clean production, is available to help the industry and commercial sectors become more efficient. Such technologies will be promoted by the government.
- Restructure the price for various energy sources according to the emission and externalities that the energy source emits.

Transportation:

- Promote use of public transportation by increasing the capacity and comfort of the public transportation system in Indonesia. Also, a shift in the transportation policy towards use of electric trains.
- Road pricing & area traffic control system (ATCS) for regularly congested areas which will allow road users to realize the value of that public good.
- Control vehicle emission and promote use of clean fuels through providing incentives for car users who would like to convert their cars to enable them to utilize better and cleaner fuel.

Agriculture:

- Improving technology and information transfer to farmer in order to speed adaptation and innovation and adoption.
- Strengthening research, development, and dissemination of sustainable agriculture practices.
- Supporting research and technology that will ensure that the agricultural sector can deal successfully with the various challenges of the future.
- Promote improved agricultural practices that emit the least amount of greenhouse gases.
- Staple food diversification by promotion of non rice food sources.
- Improve water management in rice production.
- Regionalization of agricultural research and development.

Forestry:

- Improving forest policy and enforcement of stronger regulations in forest management.
- Improving technology and information transfer in order to speed adaptation and innovation and adoption.
- Strengthening research and development of sustainable forest management.
- Review and revise present forest and land management policies to provide stronger and more accountable measures.
- Prevent the occurrence of forest fires through better preparation, especially in the areas prone to forest fires.
- Provide land grants to universities for forestry researches.
- Support research and development of fast growig high quality forest trees.
- Replenish the forests in the rural areas and replant trees in the urban areas.
- Promote low impact logging practices.

Waste:

- Devise an integrated waste management scheme, especially for the urban areas which are still rapidly developing more real estates.
- Encourage and promote waste minimization and clean production in the industry through research and public campaigns.

Coastal Resources:

- Continue and develop the national marine resources evaluation and planning program to include management issues and institutional support to assist the Provincial and District Bappedas to increase the level of community participation in the spatial planning process.
- Continue the national surveying and mapping program as well as develop the national geographic information system in which coastal area and small islands are put as priority .
- Promote the coral reef rehabilitation planning and management, as well as mangrove rehabilitation and management program to piloting community based management of coastal resources as a key initiative to implement coastal zone management plans under the 1992 Spatial Planning Act No. 24.
- Continue promoting and strengthening water resources management with particular emphasis on national networking of hydrology information system, which will link in with other natural resources information system.
- Develop and integrate the nation wide tide gauge station network to enable sea level rise monitoring in the country for a long run period. Vertical datum definition study will be conducted with reference to an absolute International Terrestrial Reference Frame (ITRF) through an international co-operation in the Asia and Pacific region.
- Prepare long term adaptation strategy for the possibilities of sea-level rise due to climate change in the various coastal areas.

Public Health:

- Promote use of environmentally friendly fuels and healthy transportation system.
- Promote healthy environment housing.

- Prepare Environmental Impact Assessment (AMDAL) and its enforcement with attention to climate change impacts for all major development including health services.
- Promote emergency response system for sporadic climate change disaster.

International Cooperation

Adaptation Policies:

- Formulate the Clean Development Mechanism (CDM) to cover insurance policy for adaptation measures.
- Under CDM, link the insurance mechanism with the level of global mitigation efforts.

R&D Policies:

- Continue Cooperation in R and D on Climate Change Science, Economics, and Policy with other countries.
- Initiate R and D on new and renewable energy.
- Initiate South-South cooperation for R and D.

Mitigation Policies

- Follow the "precautionary principles" to mitigate climate change.
- Evaluate existing technology standards.
- Enhance Technology Cooperation.
- Identify voluntary measures that may be committed at the global levels.

1.4. Other Information

The joint efforts between Annex 1 and Non-Annex 1 countries is called Activities Implemented Jointly (AIJ) pilot phase. Under the AIJ pilot phase several projects have been performed as a result of collaboration of the government of Indonesia and the government of Japan, Australia and E-7. Such projects include Paper Sludge & Solid Waste, New Cooling System in Cement Clinker, and the Application of Renewable Energy System to Sustainable Rural Development. Other projects which are expected to be implemented before 2000 are : the Recycling of Solid Waste and Capturing the GHG Emission (CH4) at the Tapioca Starch Plant, Coal Upgrading at Coal Mining and Steam

Fired Power Plant, Solar Energy Desalination at Coastal District, Capturing CO_2 Emission at Steel Plants for Supplying Soft Drinks Industries (Carbonated), Natural Gas Vehicles for Road Transportation, and City Waste Recycling to Energy.

In addition to activities under the AIJ pilot phase, there have been a number of activities dealing with climate change issues. Such activities include Socio-economic Impacts and Policy Responses resulting from Climate Change, Indonesian Small Island Study (Bali Study) on Impacts of Climate Change and Policy Response Options to Mitigate and Adapt Climate Change, Indonesian Country Study (Climate Change in Asia Regional Study on Global Environment Issues), Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS), Response Action Against the Increasing Emission in Indonesia, Climate Change and Forestry Eco-strategy for Terrestrial CO_2 Fixation, Feasibility Study on Sustainable Reforestation of Degraded Grassland, Indonesia Country Study on Climate Change, Establishment of Methodological Framework for Climate Change, National Action Plan and National Communication.

2. NATIONAL CIRCUMSTANCES

2.1. Geography and Climate

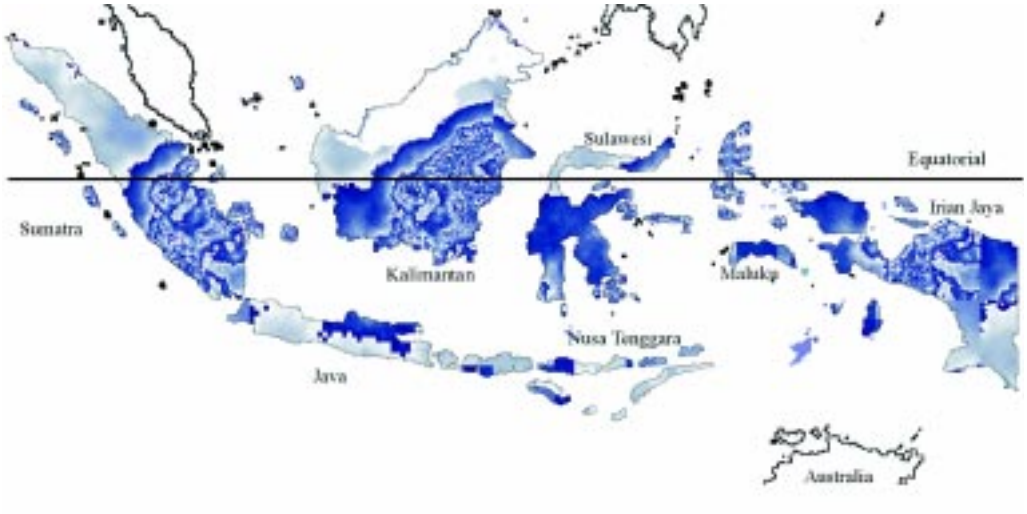
Indonesia, which is located in the tropical belt, is the largest and widest archipelago country in the world and known as a tropical maritime continent country with a coast line length of 81,000 km. It consists of 17,508 islands that stretch along the equator from a latitude 06°08' N to 11°15' S, and a longitude of 94°45' to 141°05' E. It includes 3.1 million km^2 of territorial waters, and 2 million km^2 of land. When the Economic Exclusive Zone (EEZ) of 2.7 million km^2 is included, the total territorial area of Indonesia becomes 7.8 million km^2.

The EEZ is calculated under the United Nation Convention on the Law of the Seas (UNCLOS), 1982, where the outer boundary of 200 miles is measured from baseline or coast line at low tides. Under the UNCLOS, the EEZ of Indonesia is to be utilized for the purpose of exploration, exploitation and management of biodiversity and nonbiodiversity resources, including research and jurisdiction to establish installation or artificial island.

More than 56 per cent of the island are nameless and only 7 per cent are permanently inhabited. Main islands are Sumatra with a total area of 473,606 km^2; Java with a total area of 132,107 km^2; Kalimantan, comprises two-third of the island of Borneo, with a total area of 539,460 km^2; Sulawesi with a total area of 189,216 km^2; and Irian Jaya with a total area of 421,981 $km^{2.}$. A group of much smaller islands that include Nusa Tenggara, Maluku and others can be seen in Figure 2.1.

The whole archipelago is prone to earthquakes and tidal waves. This is due to its position on two shelves, the Sunda Shelf, which is a continuation of the Asian mainland, and the Sahul Shelf, which is part of the foundation of Australia and New Guinea. These two shelves divide the archipelago into three groups of islands. Java, Sumatera and Kalimantan lie on the Sunda Shelf, which begins on the coasts of Malaysia and Indo China. Sea depth on this shelf does not exceed 233 meters. Irian Jaya and the Aru Islands lie on the Sahul Shelf, which also has depth in the order of 233 meters. The group of islands of Nusa Tenggara, Maluku and Sulawesi are located between Sunda and Sahul Shelf, with a sea depth of more than 5,000 meters.

Figure 2.1. Map of Indonesia



The country is predominantly mountainous with approximately 400 volcanoes, of which 100 are active. The two most famous volcanoes, Merapi and Krakatau, located in Java, are considered among the most active volcanoes in the world. Mountains higher than 3,000 meters are found on the Islands of Sumatra, Java, Sulawesi, Bali, Lombok, and Sumbawa. The highest mountain of all is the perpetually snowcapped Mount Jayawijaya at 5,030 meters in Irian Jaya.

Indonesia's natural resources are among the world's richest that include hard-wood forests, flourishing fisheries, as well as significant reserves of minerals, natural gas and oil. Although Indonesia covers only 1.3 per cent of the earth's surface, it includes 10 per cent of the world's plant species, 12 per cent of mammal species, 16 per cent of reptile and amphibian species, 17 per cent of bird species, and 25 per cent or more of the world's fish species.

Statistical data of Indonesia for 1994 (see Table 2.1) shows that land utilization in Indonesia could be classified into Forest areas (69.99 per cent), House compounds and Surroundings (2.60 per cent), Garden/dry field (5.84 per cent), Grassland (0.98 per cent), Dyke (0.21 per cent), Water pond (0.10per cent), Wooded land (4.52 per cent), agricultural plantation (6.78 per cent), and Rice fields/Wetlands (4.39 per cent). The change of land allocation of conversion forest for other production purposes has been reflected in the above figures, however still unaccounted into the other land uses

that amounted 3.98 per cent of Indonesia total area. Permanent production forest is forest that can be harvested regularly for wood logs and is located on relatively flat area; limited production forest is production forest that is located in an area with slope of more than 25 per cent and the number of trees that can be cut down is not more than 10 trees per hectare; while convertible forest is forest land that can be converted to other uses, such as estate plantation, residential area, agriculture, etc. (Gintings and Mile, 1992).

Table 2.1: Distribution of Land Use Type in 1994

No.	Land Use Type	Area (ha)	%
A	Plantation *)		
	- *Tectona grandis*	1,060,858	0.55
	- other than *Tectona grandis*	850,260	0.44
B	Production forest		
	- Limited production forest	29,568,000	15,37
	- Permanent production forest	33,400,000	17.36
	- Convertible	19,039,000	9.90
C	Conservation forest, Parks and Forest reserve	19,153,000	9.95
D	Protection forest	29,592,000	15.38
E	House compound	5,005,739	2.60
F	Garden/dry field	11,244,722	5.84
G	Grass land	1,892,778	0.98
H	Swamp*)	3,193,665	1.66
I	Pond	199,574	0.10
J	Dyke	407,379	0.21
K	Private wood forested land*)	8,691,572	4.52
L	Agricultural Plantation (rubber, palm oil & others)	13,045,811	6.78
M	Rice field	8,437,406	4.39
N	Unaccounted	7,615,766	3.96
	TOTAL	192,401,328	100.00

Source : Minister of Forestry and BPS
*) Data of 1989 / 1990

Java island has always been a major contributor to total Indonesia's rice production. In 1995, for example, from a total production of 49.74 million tonness of rice paddy, around 57 per cent came from Java. This was due to the high productivity and extensive irrigated area in Java.

Due to its location which is in the tropics and at the cross road between two oceans, The Indian and The Pacific, and two continents, Asia and Australia, Indonesia experiences a generally tropical climate with moderate temperature and very high humidity, even during dry months. Indonesia is influenced by the monsoonal winds, where the prevailing winds during each season are opposite. Due to its close position to the equator, Indonesia is not favorable for typhoons or tropical cyclone to develop.

There are two main seasons in Indonesia, namely dry season and rainy or wet season. The dry season, which generally lasts from June to September, is influenced by the Australian continental air masses. The rainy season, however, which is the result of the Asian and the Pacific Ocean air masses, generally lasts from December to March. The rest of the months in between the two seasons which is characterized by irregular weather are known as transition months.

According to Boerema early in this century, the seasons of Indonesia can be divided into three distinct types namely: monsoonal type which is characterized by one peak of monthly rainfall and influenced by Asian winter monsoon; double equatorial rainy season type which is characterized by two peaks of monthly rainfall and influenced by the passage of the sun across the equator twice a year; and local type being characterized by one peak influenced by Australian winter monsoon. These different rainfall types, specifically characterize the following rainfall regions of Indonesia: Kalimantan, Sumatra except the northern coastal strip, Irian Jaya except the south-eastern region, central part of Sulawesi, Halmahera and Aru islands of Maluku, and south-western Java have relatively high annual rainfall with a range of 2,500 and 4,000 mm. The remaining part of Indonesia possesses either a semi-arid or a monsoonal climate; driest part is found in Nusa Tenggara with an annual rainfall of ranging from about 700 mm to more than 1000 mm (MoF and FAO, 1991). However, most of Indonesian regions have annual rainfall of more than 2000 mm with a national annual average of about 2600 mm. These relatively high humidity and rainfall play an important role in inhibiting any climate change hazards.

Automatic Weather Station

Average temperature in Indonesia fluctuates very slightly across the whole archipelago, but varies by elevation only. Average temperature in the coastal plains, inland and mountain areas, and higher mountainous areas are 28^0C, 26^0C, and 23^0C, respectively. The maximum and minimum temperatures decrease at a rate of 0.6 ^{o}C and 0.5 ^{o}C per 100 m increase in altitude, respectively. Monthly variation of relative humidity during wet season is between 75 per cent and 85 per cent and during dry season is below 60 per cent. Sun shine duration varies from 4.3 to 8.4 hour per day while radiation intensity varies from 270 to 565 cal cm^{-2} day^{-1}.

2.2 Population

Indonesia is currently the fourth most populous nation in the world, after China, India and the United States. The total population was 183 million in 1990, increased to 191 million in 1994. The growth rate of the population was 2.3 per cent during the period of 1971-1980, decreased to 1.98 per cent during the period of 1980-1990, and 1.66 per cent in the period of 1990-1995. It is projected that Indonesian population will exceed 300 million by the year 2030.

Indonesia was considered very successful economically in its national development program, including in alleviating poverty. In 1970's around 60 per cent of its population (or some 70 million people) were in absolute poverty. By 1990, the number of the poors had dropped to about 27 million, or only 15 per cent of the population. In 1994 the figure dropped further to 25 million or 13 per cent of the population.

Life expectancy in 1971 was 45.7 years and approaching 63.5 years in 1995, while adult illiteracy rate dropped from 39 per cent in 1971 to 16 per cent in 1990 and to 13 per cent in 1994.

Urban areas have been growing very rapidly during the last two decades. Urbanization is highest in Java island where nearly two-thirds of Indonesian population live. In 1970, urban population was still less than 15 per cent and subsequently increased to 22.4 per cent in 1980 and reached 34.3 per cent in 1994. It is estimated that the figure may reach 50 per cent by 2020.

Unemployment rate continuously decreases from 34 per cent in 1960 to 9 per cent in 1996. It is a drastic figure, but there is disguised unemployment particularly in rural areas with high density of population and in urban area for unskilled labors and in informal sector. Transformation of labors is also taking place. In 1969, 64 per cent of the labor force was in agriculture sector, and in 1994 it decreased to 51 per cent.

2.3 The National Policy Structure on Climate Change

The protection of the functional capacity of the atmosphere is an environmental issue of primary importance to Indonesia and other countries. The atmosphere has multiple functions which makes it a vital life support system of the earth. While there is still a certain degree of uncertainty concerning the extent of detrimental effects of changing atmospheric composition due to accumulation of air pollutants in the atmosphere, many governments, including Indonesia have adopted and ratified a series of International agreements, such as the 1985 Vienna Convention for the Protection of the Ozone Layer, the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, and the 1992 United Nation Framework Convention on Climate Change.

The capacity of the atmosphere to function as a vital life to support system of the earth is dictated by its composition, and the net change in composition of the atmosphere is a function of the accumulation of spent resources released as air pollutants from resources used in anthropogenic activities. The key strategies chosen to protect the atmosphere are to control the choice of natural resources, the rate of use of natural resources, and the choice of technology for the use of natural resources. These factors together should reduce the rate of generation of spent resources, particularly those resources that have the potential to release emissions into the atmosphere.

The signatories of the UNFCCC in Rio de Janeiro in June 1992 recognized that climate change is potentially threat to the world's environment and to economic development. Given the risks and their socioeconomic implications, Indonesia has been undertaking activities to anticipate, mitigate and prepare for future climate changes.

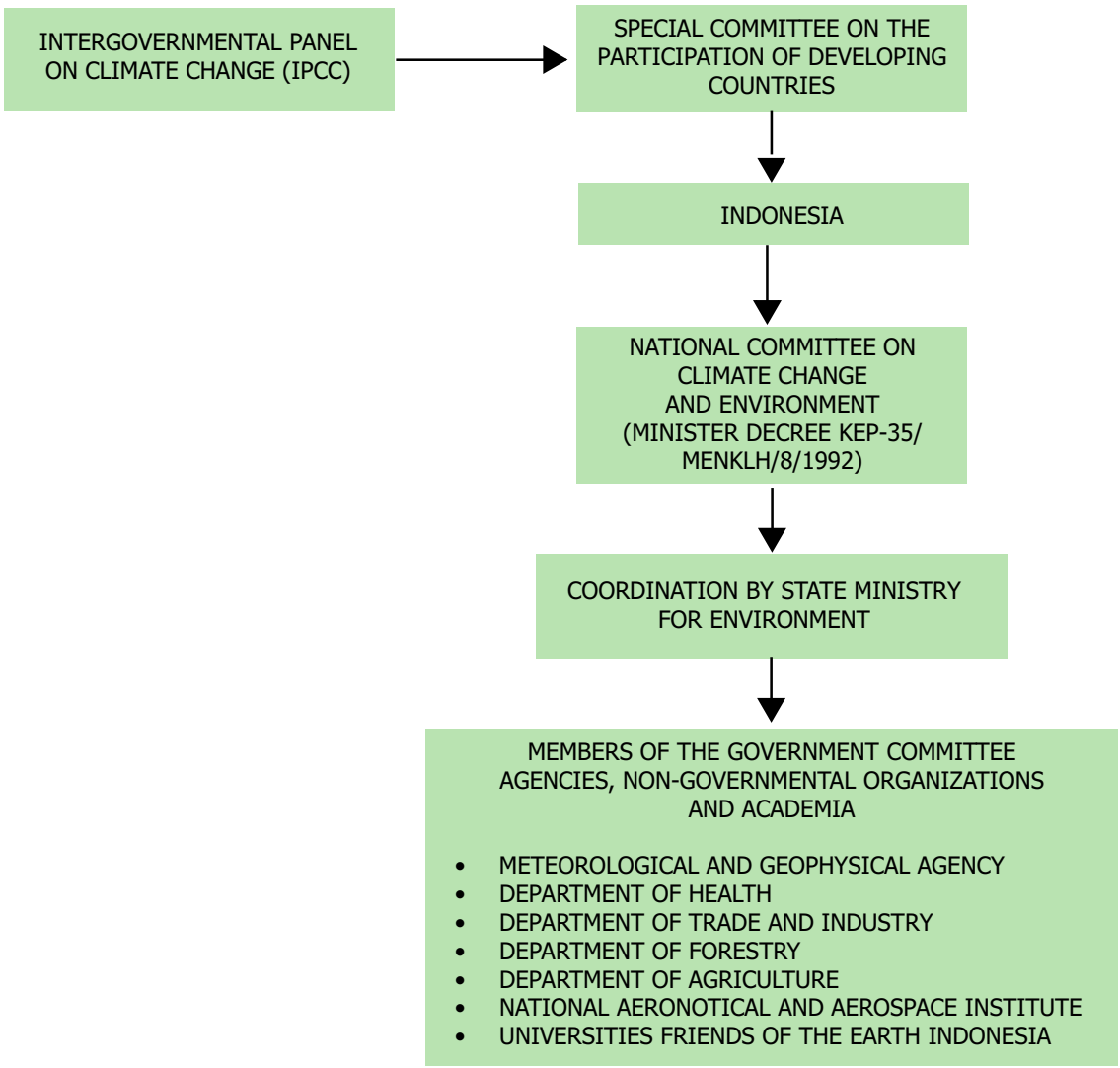


Figure 2.2. Institutional linkage of State Ministry for Environment

To anticipate and deal with issues associated with climate change, Indonesia has established a National Committee on Climate Change and Environment. The national committee has been further divided into three working groups, where each working group has specific responsibilities and sub-committees (see Fig. 2.2 and Fig.2.3)

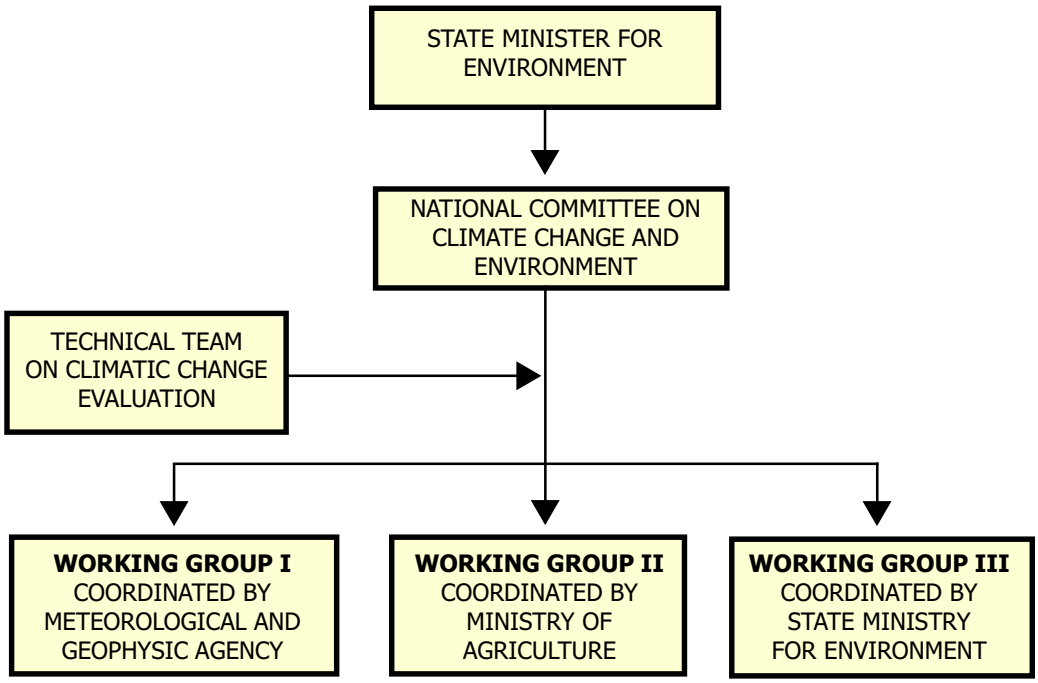


Figure 2.3. National Organizational Structure on Climate Change

There are number of Acts/Decrees which are either directly or indirectly associated with atmospheric pollution and natural resource management. Some of more recent legislation is directly related to Global Climate Change, which has become an increasingly important concern of the government of Indonesia, whereas others are indirectly related:

1. Act No.6/1996, regarding the ratification of the United Nations Framework on Climate Change.
2. Presidential Decree No. 23/92 concerning the ratification of Vienna Convention for Protection of the Ozone layer as adjusted and amended by the second meeting of the parties, London, June 1990.
3. Act No. 24/1992 concerning spatial use management.
4. Act No. 23/1992 concerning health.
5. Act No. 12/1992 concerning crop culture system.
6. Presidential Decree No. 43, 1991 concerning energy conservation.
7. Act No. 5/1990 concerning natural resource conservation and ecosystem management.
8. Act No. 17/1985 concerning the ratification of the United Nations Convention on the Law of the Sea.

1. Act No. 9/1985 concerning fisheries.
2. Act No. 5/1983 concerning the Exclusive Economic Zone of Indonesia.
3. Act No. 4/1982 concerning the basic provisions for the management of the Environment.
4. Act No. 1/1973 concerning the continental shelf of Indonesia.
5. Act No. 5/1967 concerning the basic provision for forestry.

2.4 The Economy

2.4.1 National Income

The Indonesia's economy grew very rapidly during the last two decades as a result of political stability, systematic planned development program and more outward looking in economic policy. The Gross Domestic Products (GDP) growth averaging over 7 per cent annually during the period and in 1994 it grew at 7.54 per cent. The Indonesia's economic growth rate was definitely much higher than most of industrial countries (2.8 per cent) and developing countries (6.6 per cent) in 1994, and it was moderate among the ASEAN countries (between 3.0 and 10.1 per cent). The amount of GDP in current market prices was Rp. 354.6 trillion or US$ 164.1 billion at the exchange rate of Rp. 2,161/US$ in 1994. In contrast, the population growth rate gradually decreased from above 2.0 per cent in the period of 1971-1980 to 1.66 per cent during 1990-1995. The per capita GDP, therefore, increased accordingly and in 1994 it was reported at Rp. 2,000.6,- thousand or US$ 927.7,- that was almost double compared to the 1989 level, Rp. 958.6 thousand.

The economic structure has also shifted gradually from traditional sectors (agriculture) to industrial and services sectors. The role of agricultural sector in contributing to national income in 1980 was 25.7 per cent consisting of Farms and Food Crops 14.5 per cent, Farm Non-Food crops, Estate Crops and Animal Husbandry 6.9 per cent, Forestry and Hunting 2.5 per cent and Fishing 1.8 per cent. The largest contribution to GDP at this time was Mining and Quarrying namely 26.6 per cent followed by The Wholesale and Retailed Trade sector 14.1 per cent and Manufacturing sector 8.8 per cent and other services sectors such as construction, banking, transportation and communication, public services 24.8 per cent. Fourteen years later, the composition

of sectoral contribution to GDP dramatically changed where Manufacturing Industry sector became a leading sector followed by Agriculture, Trade, Hotel and Restaurant, Banking, Mining and Quarrying, and Services sectors. In 1994 the contribution of Manufacturing Industry was 23.9 per cent, Agricultural sector was 17.4 per cent, and Other sectors was 58.7 per cent. The macroeconomic indicators of Indonesia in 1994 are summarized in Table 2.2

Table 2.2 Macroeconomic Indicators of Indonesia

Indicator	1994
1. Gross Domestic Product (GDP)	
~ Rupiah (trillion)	354,6
~ US $ (billion)	164,1
2. Per capita GDP	
~ Rupiah (thousand)	2.004,6
~ US $	927,7
3. GDP by Sector (per centage)	
~ Agriculture	17,4
~ Manufacturing Industry	23,9
~ Others	58,7
4. GDP Annual Growth (per centage)	7,54

Source : BPS

2.4.2 Regional Economic Disparity

One of the crucial issues in the Indonesian economy is unevenly distributed income among people and regions/provinces. Java island that is only 7 per cent of the total country territory and lack of natural resources is occupied by almost 58 per cent of the total country population. Other islands such as Sumatra, Kalimantan and islands in the eastern part of Indonesia, by contrast, have abundant natural resources, but much less people. Population in Java is much denser than that of Sumatra, Kalimantan, Sulawesi and other eastern part of Indonesia. The regional income of the provinces in

Java are generally much higher than the outside Java provinces. In 1994, the provinces of Jakarta, West Java, Central Java, Jogjakarta and East Java have regional income (in trillions Rupiah) of 58.8, 62.4, 39.3, 4.9 and 57.1, respectively. Provinces outside Java possess abundant natural resources and mining deposits such as Aceh, North Sumatra, Riau, South Sumatra and East Kalimantan, and have relatively higher regional income compared to other provinces. In 1994 the GDP of these provinces were 11.2, 21.7, 18.2, 12.1, and 19.2 trillion Rupiah, respectively, whereas the GDP of the other provinces were generally under 8 trillion Rupiah, particularly the eastern part of Indonesia.

The economic disparity among those provinces based on per capita regional GDP, however, is not pronounced. The per capita regional income of the densely populated provinces of Java averagely 1,4 million Rupiah except Jakarta 6.1 million Rupiah. The similar figures reported for other provinces, except South Sulawesi and other smaller provinces such as Lampung, Nusa Tenggara provinces, East Timor and Central Sulawesi which had per capita income under I million Rupiah in 1994. The economic growth among provinces did not also show significant differences ranging 6 to 10 per cent annually in 1994, except the provinces of Aceh and Riau which grew at 1.3 per cent and 4.2 per cent a year. Summarized figures of GDP, per capita GDP and economic growth by province are given in Table 2.3.

2.4.3 Effects of Monetary and Economic Crisis on Climate Change

Recent monitory crisis that hit Indonesia since the second half of 1997 had caused a lingering economic crisis and its recovery is hardly occuring in the near future. The national economic growth had dropped from the average 7 per cent to less than 0 per cent in 1998 and 1999 with soaring inflation rate. This economic crisis has dwindled the financial capacity of most of the national economy, the government dan private sectors alike, and Indonesian commitment on participation in the climate change issues is very much determined by the available external supports.

Table 2.3 Gross Domestic Product by Provinces 1994

Province	Current Market Price (Billion Rp)	Per capita GDP (thousand Rp)	Annual Growth (%)
1. Aceh	11,244	1,448	1.31
2. North Sumatra	21,680	1,792	9.48
3. West Sumatra	7,208	1,529	7.45
4. Riau	18,223	1,773	4.19
5. Jambi	2,911	1,140	8.17
6. South Sumatra	12,103	1,402	7.41
7. Bengkulu	1,793	1,099	6.10
8. Lampung	6,533	893	7.13
9. Jakarta	58,785	6,097	5.97
10. West Java	62,400	1,401	7.04
11. Central Java	39,304	1,170	6.96
12. Jogyakarta	4,882	1,503	8.11
13. East Java	57,146	1,573	7.23
14. Bali	6,491	2,133	7.51
15. West Nusa Tenggara	2,961	767	7.45
16. East Nusa Tenggara	2,458	651	8.55
17. East Timor	604	694	9.95
18. West Kalimantan	6,050	1,568	7.54
19. Central Kalimantan	3,657	2,114	7.92
20. South Kalimantan	5,435	1,781	8.63
21. East Kalimantan	19,171	4,046	10.43
22. North Sulawesi	3,216	1,169	7.73
23. Central Sulawesi	2,114	986	7.48
24. South Sulawesi	8,738	1,092	7.67
25. South East Sulawesi	1,510	903	6.57
26. Maluku	2,787	1,284	6.52
27. Irian Jaya	5,369	2,578	7.53
Total	374,775	1,642	6.97

Source : BPS

2.4.4 Labor Force and Education

The number of Indonesia's labor force in 1994 reached a total of 85.7 million where 95.7 per cent of them were employed. Labor force is defined as population aged 10 years and above who are working and looking for job. Almost half of them (46.1 per cent) were employed in agricultural sector mainly in small-holder agriculture as daily paid labor or family worker. Manufacturing sector in the same

period employed 13.2 per cent and the other 40.7 per cent went to other economic sector such as construction, trade and services sectors.

The education participation rate in 1994 was 95 per cent for Primary, 75 per cent for Lower Secondary, 49 per cent for Upper Secondary School, and 13.0 per cent for higher education.

Tabel 2.4 Labor Force and Education

Indicator	1994
Labour force (million)	85,7
% in Agriculture	46,1
% in Manufacturing	13,2
% employees	95,7
Crude Educational Participation Rate (CPR)	
Primary	94,83
Lower secondary	75,64
Upper secondary	49,00
Tertiary	13,00

Source : BPS

2.5 Agriculture and Forestry

In 1996, total agricultural production contributed 16.5 per cent of the GDP (Indonesian Statistics, 1996) and grew at a rate of 4.6 per cent annually over the past decade. Agricultural based industries contributed another 18.4 per cent of the GDP, and contributed 19.5 per cent and 5 per cent to the total export for primary agriculture and for agroindustry, respectively. In addition, agriculture sector still absorbs more than 50 per cent of total employment.

Activities in agriculture consist of five sub sectors; i.e., annual food crops, estate crops, livestock, forestry and fisheries. Food crops farming is the most important for its contribution to the GDP of agriculture (48.6 per cent in 1996). It also has important role in rural economy; particularly in Java Island, where more than 60 per cent of the Indonesian population live and about 70 per cent reside in rural areas. Main food crop planted in the country is rice, while cassava, soybean, corn, groundnut, and other food crops are considered as secondary crops. Intensive farming systems are mostly found

in Java, where rice farmers usually plant twice a year followed by a secondary crop in irrigated rice field. The total area of farmland has decreased from 18.35 million hectares in 1983 to 17.85 million hectares in 1993, with more than 8 million hectares of rice fields. The number of farmers households with farmland less than 0.5 hectare had increased from 9.53 million (1983) to 10.94 million (1993). The most serious impact is the reduction of technically irrigated rice fields from 5.72 million hectares (1983) to 5.24 million hectares (1993), mostly in Java, with an annual reduction of 50 thousand hectares as a direct consequence of recent rapid development. The national average of rice productivity is 4.3 ton/ha. Rice self-sufficiency was achieved in 1984 when Indonesia produced 25.9 million tonnes of rice; however, with population increase, continuous decrease of rice field, and repeated harvest failures due to prolonged El Nino year droughts, Indonesia has been forced to import a large amount of rice from year to year during the last few years.

The second most important sub sector in agriculture is estate crops, which contributes 16.10 per cent to agricultural GDP. The estate crops consist of rubber, coffee, oil palm, coconut, tea, cocoa, pepper, cashew, and sugarcane. They are planted mostly outside Java Island. These estate crops have significant contribution in gaining foreign exchange from non oil products, because most of them are export commodities.

In the western part of Indonesia, farmers usually adopt the so called modern farming system; while in the eastern part, pastoral system is more commonly adopted which produces the necessary livestock products. The contribution of livestock and poultry to agricultural GDP was 10.59 per cent in 1996. The large animal such as cow and buffalo are most important source of meat and milk. The trend of livestock population were very slowly increasing from about 10 million (1989) to 11 million (1994) for non-dairy cattle and for dairy cattle from 200 thousands (1989) to about 350 thousands (1994). To fulfil the demand of meat, the government needs to import about 15 per cent of the national demand. Poultry has significant role in the substitution of meat consumption, and its population had grown substantially to more than 5 per cent a year during the last decade, reaching a population of 230 million in 1993.

Similar to livestock and poultry, fishery sub sector which consists of marine and inland fisheries contributes around 10.3 per cent to the agricultural GDP. Fishery has high potential to be developed in Indonesia, for its rich marine resources with a very long coastal areas. In the future, fishery may be expected to become a leading sub sector

in view of its contribution to the national GDP. At present, technology seems to be the main constraint in developing marine fishery. Part of the reason, currently more than 80 per cent of boat used in marine fishery are relatively very small and only operate close to coastal area (this is equivalent to less than 40 per cent of Exclusive Economic Zone which can be exploited).

Indonesia forest has been considered second only to Brazil as the most important world heritage of tropical forest. There are two types of forest in Indonesia, i.e., a non convertible forest and a convertible forest, with a total area of 140 million hectares. A non convertible forest consists of protection forest, park and reservation forest, limited production forest, and fixed production forest. The non convertible forest covers 85.4 per cent of the total forest area. The convertible forest is to be allocated for other development production purposes, such as agriculture, estates, transmigration and settlements. The forestry sector has a 3.74 per cent contribution to the national GDP in 1996; with a breakdown of 1.48 per cent from primary industries and 2.26 per cent from secondary industries.

In the development context, every Five Year Development Plan (Repelita) focuses on specific aspect of forestry, in accordance with the national focus. The main focus was on the promotion of forest utilization in the outer islands during Repelita I (1969-1973) and Repelita II (1974-1978); rehabilitation, conservation, and reforestation in Repelita III (1979-1983); balancing of utilization and conservation in Repelita IV (1984-1988); and sustainable management of forest resources along with strengthening related institutions in Repelita V (1989-1993). The Repelita VI (1994-1998) had a focus on maintaining conservation and sustainability of forest function, prioritizing conservation of natural resources and environmental issues, hydrologic functions, and promoting job opportunities to forest communities. Forest management must include land rehabilitation, conservation and sustainability of forest functions.

2.6 Energy

On a global perspective, 85 per cent of the world consumption of primary energy at the end of the second century is supplied by fossil fuels, namely oil (40 per cent), coal (25 per cent), and natural gas (20 per cent). The remaining is fulfilled by hydro and nuclear energy. In the year 2000, it is estimated that the world demand for energy increases 34 times than that of mid 1970s. Significant increases come from the East Asian (and to some extent from Southeast Asian) countries up to approximately 56 times (Pertamina, 1997).

The world oil and natural gas reserve was estimated 990 billion barrels in early 1990's. One half of the reserve was located in the middle east countries (Saudi Arabia, Iran, Irak, and Kuwait). Indonesia has approximately 9.5 billion barrels of potential oil reserve in 1994. This volume had decreased to about 9.1 billion barrel in 1995. Indonesian oil reserve from 1991 to 1995 is presented in Table 2.5.

Table 2.5 Oil Reserve in 1991 - 1995 (in billion barrels)

Year	Real	Potential	Total
1991	6.0	5.0	11.0
1992	5.8	5.5	11.3
1993	5.6	4.8	10.4
1994	5.2	4.3	9.5
1995	5.0	4.1	9.1

Source : Dir.Gen. Oil and Natural Gas of Indonesia (1996)

Different condition occurs for Indonesian natural gas reserve, where in 1994 it contained 114.8 trillion cubic feet (Tcf) and increased to 123.6 Tcf in 1995. Table 2.6 shows the changes from 1991.

Table 2.6 Natural Gas Reserve in 1991 - 1995 (in 10^{12} cubic feet)

Year	Real	Potential	Total
1991	65.4	38.9	104.3
1992	64.4	37.3	101.7
1993	67.5	46.7	114.2
1994	68.9	45.9	114.8
1995	72.27	51.3	123.6

Despite of Indonesian hydrocarbon reserves mentioned above, its oil and, especially natural gas production has been increasing steadily since 1991. This is partly due to the transformation of Indonesian policy in economic development, from agricultural based economy in 1970s to industrial based economy in 1990s. Table 2.7 presents conditions of oil and natural gas production from 1991 - 1995.

Table 2.7 Oil and Natural Gas Production

Year	Oil & Condensate (10^3 Barel / day)	Natural Gas (MMSCFPD)
1991 - 92	1,567	6,827
1992 - 93	1,507	7,142
1993 - 94	1,534	7,686
1994 - 95	1,613	8,187
1995 - 96	1,607	8,307

Source : Pertamina (1997)

Production of oil and condensate in Indonesia for 1992-1993 was 3.8 per cent lower than 1991-1992. In the following two years 1993 - 1995, however, daily production increased to 1.8 per cent and 5.1 per cent consecutively, before it dropped slightly in 1995-1996. The increase of natural gas during the period was 4.6 per cent, 7.6 per cent, 6.5 per cent, and 1.5 per cent, consecutively.

The production of oil and natural gas comes from two sources, land and off-shore. The production from off-shore wells are presented in Table 2.8. It is shown that oil production from off-shore fields decreased with respect to time. In 1994-1995, oil production from off-shore fields was 598.1 million barrels of oil per day (MBOPD), and decreased by 4.3 per cent and 2.6 per cent in the following two consecutive years.

Table 2.8 Oil and Natural Gas Production from Off-shore Fields in 1994 - 1996

Year	Oil Production (MBOPD)	Natural Gas Product. (MMSCFPD)
1994 - 95	598.1	1,890.0
1995 - 96	572.2	2,122.7
1996 - 97	557.1	2,312.4

Source : Pertamina (1997)

On the contrary, production of natural gas from off-shore fields showed steady increase for the same period, i.e. 12.3 per cent in the fiscal year 1995 - 1996, and 8.9 per cent in the following year.

Despite of decreasing production, Indonesia receives higher revenues from the total oil and natural gas production. In the fiscal year 1994-1995, Indonesia receives revenue in the amount 13 547.40 billion Rupiah. This revenue increased by 18.6 per cent in 1995-1996. For both fiscal years Indonesia received higher revenues than targeted as can be seen in Table 2.9.

Table 2.9 Revenue Receives from Oil and Natural Gas in 1994 - 1996 (in billion Rupiah)

Year	Target	Real	%
1994-95	12,851.20	13,537.40	105.35
1995-96	13,275.60	16,054.70	120.93
1996-97	27,390.40	-	-

Source : Pertamina (1997)

In Table 2.10. the production of natural gas in Indonesia is compared to its utilization. Except a slight drop in the year of 1992, it can be said that the percentage of utilization against production increased with respect to time. If it is used as an indicator for clean-atmosphere industrial activity, then, Indonesian natural gas production has become more efficient and contributes to keep the atmosphere clean. The percentage of utilization is 91.76 per cent in 1991 and decreased in 1992, before its efficiency increased again to 93.83 per cent in 1994.

Table 2.10 Comparison of Natural Gas Production against its Utilization in 1991 - 1995

Year	Production (10^9 cube feet)	Utilization (10^9 cube feet)	Utilization (%)
1991	2,461.83	2,258.88	91.76
1992	2,582.64	2,365.26	91.58
1993	2,661.88	2,450.99	92.08
1994	2,941.62	2,760.08	93.83
1995	2,999.23	2,839.40	94.68

Source : Pertamina (1997)

In Indonesia, the primary energy supply are dominated by oil products, biomass, and natural gas (Table 2.11). The contribution of coal to the energy supply is relatively small. In the last 10 year, the share of oil consumption has been declining; but there was significant increase in the role of natural gas and coal in the energy supply.

The primary supply included any activity for domestic supply either before or after transformation, import, export and international bunker. Transform-ation is any activities to convert primary to secondary energy. The activity can be done with/ without physical change of the energy form, such as oil refinery, LPG refinery, LNG refinery, electric generation, city gas refinery, gasification/liquefaction and other transformation. The input of this activity has a negative sign; while, the output has a positive sign. Own use and losses are included own used in the field, transformation and distribution, and any losses in every activities.

The total final consumption consists of final energy use and non-energy use. The final energy use is divided into three sectors, i.e. industry, transportation, and residential & commercial. The non-energy use is any use for feed stock or chemical, such as natural gas for feed stock of fertilizer industry and coal for reductor in metal industry. Statistical difference is the difference between total final consumption and supply energy. It is also taking into account transformation, own use and losses. Theoretically, there are no differences between supply and consumption. However, the difference is present due to the changing of stock in which the data is difficult to obtain.

Liquid Natural Gas Refinery Plant

Table 2.11 Energy Balance 1994 (Baseline) in million BOE

	Coal	Crude Oil	Oil Prods	Natural Gas	LPG	Hydro Power	Geo-Thermal	Electri-city
Production	43.40	530.70		325.00		17.30	1.70	
Imports	5.00	45.70	23.80		0.00			
Exports	(17.90)	(286.50)	(0.10)	(191.30)	(22.20)			
International Bunker			(4.70)					
Stock change	n.a.	n.a.	n.a.		n.a.			
Primary Supply	30.40	289.80	19.00	133.80	(22.20)	17.30	1.70	
Refineries		273.60	188.90	0.00	2.80			
Power Plant	(16.90)		(28.20)	(2.00)		(17.30)	(1.70)	23.10
Others			(0.00)	(42.50)	20.60			
Transformat.	(16.90)	(273.60)	160.60	(44.50)	23.40	(17.30)	(1.70)	23.10
Own Use & Losses	(0.10)	(1.00)	(4.10)	(87.40)	(0.00)			(4.40)
Statistic Diff.	(4.80)	(15.20)	1.10	41.70	1.50			(0.00)
Final Consumption	8.60		174.30	43.60	2.70			18.70
Final Energy Usage	8.30		174.30	22.70	2.70			18.70
Industry	8.30		46.60	22.70	0.80			10.50
Transporta.	0.00		81.80	0.00	0.00			0.00
Res.+comm	0.00		46.00	0.00	1.90			8.20
Non Energy Usage	0.30			20.90	0.00			

Source: Planning Bureau, Department of Mining and Energy, 1995.

2.7. Coastal and Marine Resources

Traditionally and as supported by the natural conditions that are dominated by cosatal and marine ecosystems, Indonesia enjoys the benefit of coastal and marine resources. Many of the recent development activities take place in coastal areas with the development and establishment of major cities and the concentration of population around the cities. Population growth, export demand, and per capita consumption increase the use of coastal and marine resources. In 1992, fish production reached 3.5 million tonnes, equaling 53 per cent of the maximum sustainable yield (MSY) of 6.6 million tonnes per year. It is predicted that by the year 2000, this will increase to 4.25 million tonnes and by 2020, to 6.04 million tonnes. On the other hand, this will also cause an increase in pollution. Waters off the Surabaya coast show the existence of large volumes of domestic and industrial waste, and the water quality was reported to be the second most polluted in Indonesia after the Jakarta Bay. However, the coastal communities have not

yet gained any significant benefit from development in these areas. On the contrary, other communities and agencies from locations far from the coast tend to enjoy the benefits. Therefore, the development of coastal villages should pay more attention to the regional social, economic, cultural and environmental conditions.

Source: Biodiversity Action Plan for Indonesia

In Indonesia there are 116 small islands and groups of small islands which are ecologically susceptible, particularly because of environmental and climate change, including global warming and natural disasters. The potential result is a decrease in the number of living organisms, plants, animals and human beings, which inhabit the islands. Small islands typically have large numbers of endemic species, and high level of biodiversity consisting of valuable and protected species.

Indonesian waters are frequently navigated by both foreign and national container ships and fishing boats. Law enforcement officers face problems preventing these ships traffic, which is protected by agreements. Relatively week control in eastern part of Indonesia creates other problems in dealing with the frequent violations, such as disposal of toxic and hazardous waste and trespassing in the catchment zone of various biotic and abiotic resources.

This situation requires better management of coastal and marine resources, especially institutional integrity and competence, so that the resources found in these areas may become prime products in the national development into the future.

The following Program Areas have been designated to deal with the above issues:

A. Integrated Planning and Resource Development in Coastal Zones;
B. Monitoring and Protecting Coastal and Marine Environment;
C. Sustainable Utilization of Coastal and Marine Resources;
D. Enhancing and Empowering Coastal Communities;
E. Sustainable Development of Small Islands;
F. Maintaining Security of the Exclusive Economic Zone (EEZ);
G. Managing the Impacts of Climate Change and Tidal Waves.

3. INVENTORY OF GREENHOUSE GAS EMISSION AND REMOVAL

3.1. National Greenhouse Gas Emission - Overview

Indonesia has developed inventory of the most significant greenhouse gas for 1994 (Table 3.1). Greenhouse gases included in the inventory are CO_2, CH_4, N_2O, NO_x, and CO. Most sectors considered by IPCC are covered in the inventory. In developing the inventory, the 1996 IPCC Methodology were used.

The accuracy of estimating the emission and removal of the GHGs from the atmosphere largely depends on the availability and accuracy of the activity data and emission factors. Among the main three sectors (energy, agriculture and forestry), forestry is the sector with highest uncertainty whereas energy sector is lowest. In 1990 inventory, it was reported that Indonesian forest was a net sink, however, with improvement of activity data as well as emission factors, Indonesian forest is becoming net emitter. However, the magnitude of the net emission still depends on assumptions used in defining area of logged-over forest under growing stage. Since the forestry sector is a significant contributor to the emissions and removal of carbon dioxide, the reliability of activity data and emission factors of this sector need to be verified and improved with more measurements.

In addition to the availability and accuracy of activity data and emission factors, the reliability of the GHG inventory of forestry sector also depends on the methodology used in the analysis. In the 1996 IPCC methodology, carbon emission flow in soil has been included. However, data required for the analysis is hardly available, therefore, the estimation of carbon flow in the soil is not included. In addition, the present IPCC methodology does not include emissions from decaying of past years forest products (inherited emission). This type of emission may also have a significant contribution and therefore in the future needs to be considered. All harvested woods is assumed to be emitted to the atmosphere at the time of harvesting. In fact, some of woods may be converted into long life products where the emission takes place after some time depending on the life of the product. Thus, in order to increase the accuracy of the GHG inventory in forestry sector, activity data, emission factors and methodology need to be improved.

Table 3.1 shows that in 1994, Indonesia was a net emitter country. Total CO_2 emission amounted to 748,607 Gg. With assumption that only one third of area of logged-over forest and agricultural plantation was growing, total CO_2 removal of Indonesian forest was 52 per cent of the total emission. Thus in 1994, net emission of CO_2 was about 383,881 Gg. Furthermore, total emission of CH_4, N_2O, CO and NO_x were about 6,409; 61; 11,966; and 928 Gg respectively. The main source of CO_2 emission was from forestry sector and energy sector. These two sectors contributed to about 97 per cent of total CO_2 emissions. The CO_2 emission from forestry sector resulted mainly from burning of biomass during forest and grassland conversion activities.

Total methane emissions in Indonesia for 1994 amounted to 6,409 Gg (Table 3.1). The main source of methane emissions is agricultural sector (51 per cent). About 70 per cent of CH_4 emission of agricultural sector came from rice field. For Nitrous oxide (N_2O), total emission was about 61.11 Gg. The majority of nitrous oxide emission was from agricultural sector comprising 86 per cent of the total nitrous oxide emission. Furthermore, energy combustion were found to be the highest contributor to CO emission, i.e. 8,422 Gg (70 per cent), while land-use change & forestry and Agricultural sector was 27 per cent and 3 per cent, respectively. Other minor gases such as CF_4 and C_2F_6 were produced from industrial processes. The amount of the two gases emitted from the industrial processes were about 0.31 and 0.03 Gg, respectively.

An overall assessment of Indonesia's contribution to radiative forcing from greenhouse gas emission is derived using Global Warming Potential (GWP). GWP is defined as the time-integrated commitment to climate forcing from the instantaneous release of 1 kilogram of a trace gas expressed relative to that from 1 kilogram of carbon dioxide. The magnitude of the GWP is, however, sensitive to the time horizon over which the analysis is conducted (i.e. the time period over which the integral is calculated). For example, GWP of methane is about 63 for a time horizon of 20 years, about 21 at a time horizon of 100 years and about 9 at a time horizon of 500 years. In this context, a time horizon of 100 years was used.

Table 3.1 Summary of the Base Year (1994) Indonesia's Greenhouse Gases Inventory

Sources and Sinks	Uptake (Gg)	Emission (Gg)				
	CO_2	CO_2	CH_4	CO	N_2O	NO_x
1. All Energy (Fuel Combustion + Fugitive)		**170,016.31**	**2,395.73**	**8,421.50**	**5.72**	**818.30**
A. Fuel Combustion		*170,016.31*	*357.56*	*8,421.50*	*5.72*	*818.30*
1. Energy and Transformation Industries		50,702.24	0.77	8.50	0.28	95.60
2. Industry		50,014.38	2.29	21.20	0.23	120.70
3. Transport		47,047.16	7.49	2,654.00	0.44	456.00
4. Small Combustion in Residential and Commercial		22,252.53	347.01	5,737.80	4.77	145.90
B. Fugitive Fuel Emissions		**2,038.17**	*0.00*	*0.00*	*0.00*	
1. Solid Fuels			20.40			
2. Oil and Natural Gas			2017.77			
2. Industrial Processes			**19,120.00**	**0.51**		**0.01**
3. Agriculture			**3243.84**	**330.73**	**52.86**	**18.77**
A. Livestock			947.21		0.00	
B. Rice Field			2280.90			
C. Agircultural Soils					52.34	
D. Prescribed Burning Savanna						
E. Burning of Agric. Residues			15.73	330.73	0.52	18.77
4. Land use Change and Forestry	**403,846.00**	**559,471.00**	**367.00**	**3,214.00**	**2.52**	**91.26**
A. Changes in Forest & Other Woody Biomass Stocks	334,239.00	198,994.00				
B. Forest and Grassland Conversion		303,237.00	367.00	3214.00	2.52	91.26
C. Abandonment of Managed Lands		69,607.00				
D. Forest Fire			57,240.00			
5. Waste/Landfill				**402.00**		
6. INDONESIA	**403,846.00**	**748,607.31**	**6,409.08**	**11,966.23**	**61.11**	**928.33**
7. Biomass			**124,417.15**			
8. International Bunker			**1,684.35**			

Note : Biomass and International Bunker are not included in the calculation of national emission

CO_2 is the most important greenhouse gas in terms of its contribution to increase radiative forcing. CO_2 was responsible for 83 per cent of the radiative forcing from greenhouse gases in 1994 (Table 3.2) while CH_4 contributed 15 per cent. Contributions of other gases to increase radiative forcing were not significant.

Table 3-2. Greenhouse Gas Emissions of CO_2-equivalent Basis Using a 100-year Time Horizon (1994 GWPs)

Gas	Emissions (Gg)	GWPs	CO_2 equivalent (Gg)	Percentage of Total CO_2 equivalent Emission
CO_2	748,607.31	1	748,607	82.77
CH_4	6,409.08	21	134,591	14.88
N_2O	61.11	310	18,944	2.09
CF4	0.31	6500	2,015	0.22
C2F6	0.03	9200	276	0.03
Others				
CO	3,544.73			
NO_x	110.03			
TOTAL			904,433	100

Figure 3.1 and 3.2. illustrate the share of sectors to the total CO_2 and CH_4 emissions, respectively, while Figure 3.3 illustrates sectoral emission in CO_2 equivalent. Land use change and forestry was responsible for more than 60 per cent of the forcing in 1994, while energy contributed about 25 per cent. Worksheets and summary of 1994 inventory for all sectors are presented in Appendix A-E.

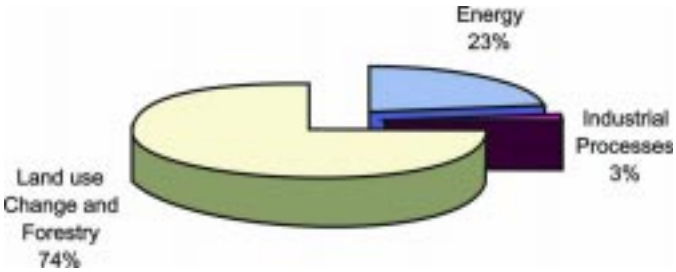


Figure 3.1. Percentage Share of Three Main Sectors to the Total CO_2 emissions-1994

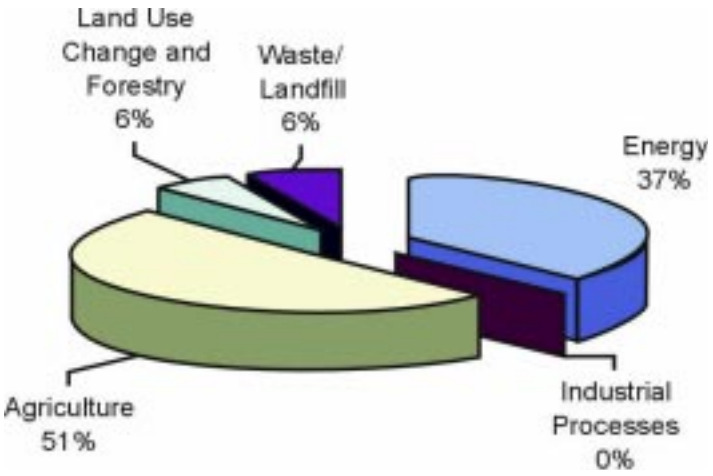


Figure 3.2. Percentage Share of Various Sectors to the Total CH_4 emissions-1994

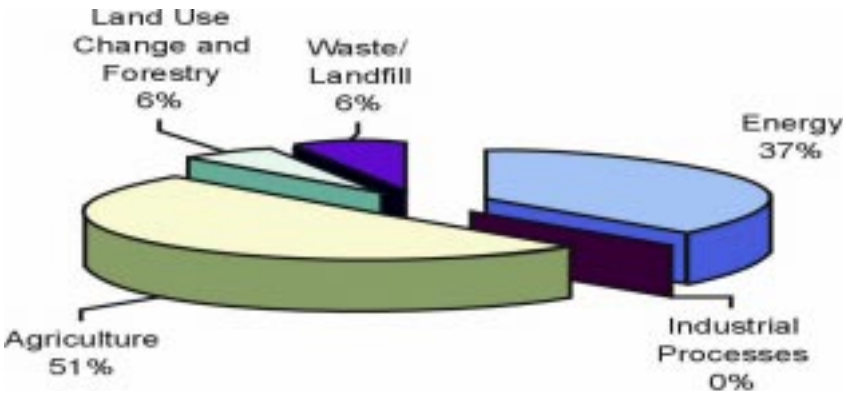


Figure 3.3. Sectoral Emission as a Percentage of Total Emission-1994 (CO_2-eq.)

3.2. 1990-1994 Emission and Removal of GHG from Main Source and Sink

3.2.1. Carbon Dioxide (CO_2)

Carbon dioxide emission accounts for a greater part of the greenhouse gas emissions in Indonesia. This gas contributes about 83 per cent of the total emission of greenhouse gases, calculated as GWP (Table 3.2). The emission data for carbon dioxide for the energy sector may be regarded as having high reliability. Whereas, for forestry sector the reliability may be much less and can be rated as having low reliability.

In estimating CO_2 emission from energy sector, two approaches were used. In the first approach, the CO_2 emission is calculated using IPCC Reference Approach and in the second approach, it is calculated using IPCC Tier 1 methodology or sectoral approach. The results show that total CO_2 emission calculated using *Reference*

Approach is much higher than the total CO_2 emission calculated using *Sectoral Approach* (Table 3.3). The statistical difference between the two approaches is more likely due to uncounted energy consumption and energy losses that were not registered within any sector. Statistical difference occurs because of limited information on some non-energy use such as oil products for plastic and pesticide industries and other energy in small industries. There is also some energy losses in energy stock piling, transportation or difficulties in estimating transmission.

Based on the results presented in Table 3.3, during the period of 1990-1994 the total CO_2 emission from the whole energy sector including biomass in residential sector increased with a growth rate of about 5 per cent per year. However, the CO_2 emission from biomass was almost half of the total emission. Total CO_2 emission from fuels combustion, excluding biomass, increased from 128,398 Gg to 170,016 Gg or increased by about 7.3 per cent per year. In comparison with CO_2 emission from forestry sector, the emission from energy sector is small. Unlike energy sector, the rate of CO_2 emission from forestry sector was up and down following the fluctuation of wood harvesting rate, forest conversion rate and forest fire.

In estimating CO_2 removal by Indonesian forest, several assumptions were used. The critical assumption is in defining the forest area under succession and community plantation area under growing stage. In developing 1990-1994 inventory, it was assumed that production forests under succession was one third of the total logged-over forest, while in the community plantation it was only half of the total area.

Suralaya Steam Power Plant

Table 3.3. Emissions of Carbon Dioxide in 1990-1994 (Gg)

Category	1990	1991	1992	1993	1994
CO_2 Emission (I+II+III)	665,929.63	765,956.30	732,326.15	614,316.22	748,607.40
I. Energy (B)	128,398.19	140,410.40	149,925.55	158,321.85	170,016.31
A. Reference Approach	156,492.70	174,150.50	186,633.70	193,483.30	203,592.30
B. Sectoral Approach (Tier-1)	128,398.19	140,410.40	149,925.55	158,321.85	170,016.31
Industry	36,953.41	39,902.76	42,975.57	46,371.50	50,014.38
Transport	34,588.32	37,580.82	39,881.09	42,007.57	47,047.16
Residential/commercial	19,555.26	20,150.30	21,346.25	21,548.75	22,252.53
Energy Industry	37,301.20	42,776.52	45,722.64	48,394.03	50,702.24
Statistical Discrepancy (A-C)	28,094.51	33,740.10	36,708.15	35,161.45	33,575.99
II. Industrial Processes	14.29	14.69	15.58	17.36	19.13
Mineral Product	8.44	8.61	9.28	10.22	11.83
Chemical Industry	4.88	4.79	4.75	4.91	4.88
Metal Product	0.97	1.29	1.55	2.23	2.42
III. Forest & Land Use Change	523,241.44	610,855.90	566,820.60	438,634.37	559,471.09
Forest Harvesting	196,771.28	190,358.12	199,006.40	119,890.58	198,993.64
Forest and Grassland Conversion	320,051.12	377,908.89	357,545.31	300,351.90	303,237.35
Forest Fire	6,419.04	42,588.89	10,268.89	18,391.89	57,240.10
Information Note					
Biomass	113,831.50	116,218.40	119,043.40	122,084.70	124,417.10
International Bunker	2,038.11	1,038.38	1,205.02	1,482.44	1,684.35
O_2 Removal					
Forest and Land Use Change	335,102.61	354,309.00	371,081.79	388,574.62	403,846.64

Changes in this assumptions will have significant impact on net emission. If it was assumed that all trees in logged-over production forests were growing, Indonesian forest became net sink (Table 3.4). Therefore, improvement of this type of activity data is very important.

Table 3.4. Net CO_2 Emission (Gg) from Forestry Sector in 1994

Assumption Portion of Area of Community plantation at growing state	Portion of area of logged-over forests at growing state			
	1	1/2	1/3	1/4
1	-79,579	30,281	66,901	85,211
½	9,144	119,004	155,624	173,934
1/3	38,719	148,579	185,199	203,509
¼	53,506	163,366	199,986	218,296

In comparison with other studies (ALGAS 1998, US-CS 1996; SEI 1992 and 1993; JEA 1992), the present CO_2 emission estimate is higher while, the CO_2 removal is lower. Carbon emission estimates from other studies range from 41 to 163 Tg and carbon uptake estimates range from 187 to 337 Tg. The differences were due to the difference in activity data, emission factors, assumptions and methodology used in the analysis. However, all other studies indicated that in 1990 Indonesian forest was a net sink.

3.2.2. Methane (CH_4)

Methane (CH_4) emission from energy combustion is more affected by temperature in the demand devices such as stove, kiln, or boiler instead of its content in the fuels. The emission occurrs because of the incomplete combustion of hydrocarbon in fuel. Within fuel sources, biomass that consists of fuel wood and agricultural waste is the major contributor of CH_4 emission. Since most of biomass is used for cooking in residential sub-sector, this sub-sector has the highest rate of CH_4 emission relative to other sub-sectors. During 1990-1994 (Table 3.5), total CH_4 emission increased with a growth rate of 2.33 per cent per year. More than 97 per cent of the CH_4 emission was contributed by residential sub-sector. In the residential sub-sector, CH_4 emission increased with a growth rate of 2.26 per cent per year while biomass contributed more than 99 per cent of the CH_4 emission. The high CH_4 emission was not only caused by the high biomass consumption, but it was also due to the high CH_4 emission factor of biomass used for calculating the emission based on the IPCC guideline. Biomass consumption in residential sub-sector was high, because biomass was used as main fuel for cooking in rural area as most of the population in Indonesia still live in rural areas. Kerosene was the second largest CH_4 emission contributor in the sub-sector.

Transportation sub-sector was the second largest contributor of CH_4 emission constituting about 2.10 per cent of the total CH_4 emission in 1994 and for comparison the 1990 emission was 1.73 per cent. Emission of CH_4 in this sub-sector increased rapidly with a rate of 7.41 per cent per year during 1990-1994 period. The emission was mainly contributed by gasoline comprising more than 77 per cent in 1994 (78 per cent in 1990) of the CH_4 emission. While, diesel oil only contributed 22 per cent during 1994 (21 per cent in 1990). Avtur used by airplane contributed less than 1 per cent of CH_4 emission.

Table 3.5. Emissions of Methane 1990-1994 (Gg)

	1990	1991	1992	1993	1994
Energy Activity	325.23	332.69	341.18	350.12	357.55
Industry	1.61	1.81	1.90	2.03	2.29
Transport	5.62	6.07	6.42	6.67	7.49
Residential/Commercial	317.37	324.06	332.03	340.47	347.01
Electricity Generation	0.62	0.76	0.83	0.95	0.77
Fugitive Sources	1,562.56	1,778.35	1,881.10	1,939.96	038.16
Industrial Processes	0.46	0.43	0.32	0.46	0.51
Forest and Land Use Change	414.87	544.56	487.63	349.09	367.27
Agriculture	2,793.42	3,202.16	3,217.59	3,232.67	3,243.81
Waste	371.34	378.56	386.05	393.83	401.92

Emission of CH_4 produced from industrial and electricity generation sub-sector was less than 1 per cent during 1990-1994 period but their growth rates were relatively high. Industrial sub-sector had a growth rate of 9 per cent per year while electricity generation sub-sector had a growth rate of 7 per cent per year during the period.

Methane emission from fugitive sources is resulted from anthropogenic activities either intentionally or unintentionally. The activities are mining or production, processing, transport or transmission and storage of fuels such as coal, oil, and gas. Methane (CH_4) emission is the most dominant GHG emission from fugitive sources. During 1990-1994 period (Table 3.5), CH_4 emission from fugitive sources increased with a rate of 7 per cent per year. Most of CH_4 emission from fugitive sources came from natural gas production and process. Coal mining and process also contributed to the total CH_4 emission from fugitive sources. Emission of CH_4 from coal activities increased very rapidly with a growth rate of 32 per cent per year caused by the rapid increase in coal production. Oil mining and refining consisted of crude oil while condensate production had the least CH_4 emission in the fuel production. On the average, CH_4 emission from these activities was less than 1 Gg.

In industrial processes, CH_4 is produced during the process of producing carbon black and methanol. These industries produced a total of almost 0.46 Gg of CH_4 emission in 1990 and then decrease or increase slightly. This was mainly due to the change in methanol production in Indonesia. At present, Indonesia has one methanol factory, i.e. at Bunyu island, Kalimantan.

In forestry sector, methane emission tended to decrease due to the decrease in rate of forest conversion during the period (Table 3.5). Whereas, emission from waste tended to increase at a rate of 2 per cent per year following the rate of increase of urban population.

As indicated in Table 3.1. and 3.5., rice cultivation is the main contributor of CH_4 emission in Indonesia where water management plays important role in controlling the emission as well as determining crop yield. Water management is categorized into six systems as shown in Table 3.6. Three types of irrigation are technical irrigation, semi-technical irrigation and simple irrigation. Technical irrigation system is constructed by government and furnished with watergate and a more advanced water-use measuring system, while semi-technical irrigation system is also constructed by the government which is furnished with watergate without water-use measuring system. On the other hand, simple irrigation is neither equipped with watergate nor measuring system and it can be constructed by government.

Rice fields that rely their supply of water from rainfall are defined as rainfed. Rainfall can also be the main supply for "others" category (Table 3.6), that includes rice grown in upland. Rice grown in tidal swamp areas is found mostly in Sumatra and Kalimantan.

Considering that more than 50 per cent of total area of rice fields in Java, where technical irrigation is mostly available, the main emission of CH_4 is in the island. Since rice fields in Java tend to decrease in last few years, the contribution of rice field to the total methane emission may decrease in the future. Moreover, as most of irrigation system in Java is technical irrigation, effort to reduce CH_4 emission through water management is possible.

Table 3.6. Area of Rice Field in Indonesia by Water Management and Number of Planting

No	Water Management	Planting (times/year)	1990	1991	1992	1993	1994
			Area (ha)				
1	Technical irrigation	1	333,790	369,407	342,991	344,931	385,475
		2	1,616,602	1,480,566	1,569,126	1,676,266	1,645,267
2	Semi-technical irrigation	1	258,136	254,025	217,990	230,789	234,338
		2	761,946	795,019	707,470	674,829	659,719
3	Simple irrigation	1	727,318	678,575	639,826	620,852	642,644
		2	960,210	1,080,571	1,092,961	1,049,125	1,014,741
4	Rainfed	1	1,861,087	1,866,336	1,837,066	1,758,843	1,691,256
		2	310,914	294,623	377,188	360,095	447,544
5	Tidal/swamp	1	435,504	446,005	511,373	460,112	448,627
		2	45,758	69,661	80,260	71,505	80,041
6	Others	1	1,039,610	1,049,553	1,020,161	1,161,057	1,065,578
		2	67,280	181,189	75,318	82,451	122,176
	TOTAL		8,418,155	8,565,530	8,471,730	8,490,855	8,437,406

3.2.3. Nitrous Oxide (N_2O)

In energy sector, nitrous oxide (N_2O) is produced from fuels combustion, microbial activities in de-nitrification and nitrification. However, information on the quantity and the share of each activity is very limited and uncertain. The N_2O emission from fuel combustion is not only affected by Nitrogen (N) content on the fuel, but also by temperature and combustion process. Table 3.7 shows that total N_2O emission from energy combustion increased at a growth rate of 3 per cent per year from 1990 to 1994. Residential/commercial sub-sector was the most dominant on emitting N_2O. Emission of N_2O from this sub-sector was mainly contributed by biomass combustion. The annual N_2O emission from residential/commercial sub-sector during 1990-1994's period was more than ten times higher than emission from transportation sub-sector, and about thirteen times higher than emission from industrial sub-sector.

During 1990-1994's period, N_2O emission in the transportation sub-sector increased with a rate of about 8 per cent per year. The high growth rate of the N_2O emission was caused by a high growth rate of fuel consumption associated with the increase of vehicle number. The N_2O emission in transportation sub-sector was mostly contributed by diesel fuel and gasoline combustion. They counted to more than 83 per cent of the total N_2O emission in the sub-sector during that period.

Table 3.7. Emissions of Nitrous Oxide 1990-1994 (Gg)

	1990	1991	1992	1993	1994
Energy Activity	5.08	5.27	5.43	5.59	5.73
Industry	*0.15*	*0.18*	*0.19*	*0.20*	*0.23*
Transport	*0.33*	*0.35*	*0.38*	*0.40*	*0.44*
Residential/Commercial	*4.36*	*4.45*	*4.57*	*4.68*	*4.77*
Electricity Generation	*0.24*	*0.28*	*0.30*	*0.31*	*0.28*
Industrial Processes	0.01	0.01	0.01	0.06	0.01
Forest and Land Use Change	2.85	3.74	3.35	2.4	2.52
Agriculture	53.03	52.71	55.75	54.73	52.86

In the industrial sub-sector, steam coal consisting of bituminous and sub-bituminous coal became the main contributor of N_2O emission. It was caused by a high amount of coal consumption in industrial sub-sector especially for cement industries. In addition, fuel oil and diesel oil also significantly contributed to the total N_2O emission in this sub-sector.

Kamojang Geothermal Power Plant

Electricity generation sub-sector contributed to the total N_2O emission from energy combustion. Most of N_2O emission in the sub-sector generated from steam coal combustion. During 1990-1994's period, steam coal combustion contributed more than 55 per cent of the total emission in electricity generation with a growth rate of 5.37 per cent per year. The total N_2O emission from diesel oil increased with a growth rate of 4.4 per cent per year, while from fuel oil it decreased with a rate of 7.74 per cent per year. Natural gas was the least contributor of N_2O emission in the sub-sector. However, the N_2O emission from natural gas increased rapidly with a growth rate of 74 per cent per year during the period.

Similar to methane, emission of nitrous oxide in forestry sector also tended to decrease due to the decrease in rate of forest conversion during the period (Table 3.7).

3.2.4. Other Gases

The emissions of other minor gases (NOx, CO, CF_4 and C_2F_6) are not substantial. The variation CO and NO_x emission from forestry sector is similar to the change in CH_4 and N_2O emission. CF_4 and C_2F_6 emissions from Aluminum industries were relatively constant over the 1990-1994 period (Table 3.8).

Table 3.8. Emissions of Other Minor Gases 1990-1994 (Gg)

	1990	1991	1992	1993	1994
Forest and Land Use Change					
NOx	103.09	135.31	121.17	86.74	91.26
CO	3,630.12	4,764.87	4,266.77	3,054.51	3,213.60
Agriculture					
NOx	17.41	17.47	19.85	20.36	18.77
CO	306.45	307.6	349.37	358.41	330.37
Industrial Processes					
CF_4	0.27	0.25	0.26	0.29	0.31
C_2F_6	0.03	0.03	0.03	0.03	0.03

3.3 Projection of Greenhouse Gas Emission and Removal

For Indonesia, two important greenhouse gases are CO_2 and CH_4. In energy sector, CO_2 mainly comes from fossil energy combustion process while CH_4 comes from energy production process particularly in the coal mining both underground and open pit mining, oil and gas mining. In non-energy sector, CO_2 emission is mainly from forest and grassland conversion while CH_4 is from rice paddy.

Projection of GHGs emission is assessed based on demand and supply projections. Several studies have been carried out to develop the GHGs emission projections, namely, ALGAS Study (1998), US-Country Study (MSE, 1996), UNEP-RISO Study (MSE, 1998a) and BPPT-KFA-Juelich Study (1993). Unlike other studies, in the ALGAS Study the projection of GHG emission from energy sector was carried out using a system dynamic model of energy-economy environment developed by Indonesia (CRE-ITB). The present projection from energy sector is developed using MARKAL model.

3.3.1 Energy Sector

Projection of the greenhouse gases emission from energy sector is calculated for both national and sectoral level. For national level, the estimation of emission uses IPCC reference approach and for sectoral (industry, transportation, and residential-commercial) uses Tier 1 with IPCC default uncontrolled emission factor. The projection considers energy consumption projection considering the growth rate of gross domestic product.

The Statistical Bureau of Indonesia (BPS) reported a 6.6 per cent of real GDP growth rate for 1997. However, in 1998, GDP growth rate decreased sharply to –12 per cent due to economic, social and political crisis. In the subsequent years, as Indonesian economy, social and politics get improvement, the GDP growth rate is assumed to increase to 3 per cent in 2002, 4.8 per cent in 2003 and 5 per cent in 2004. In 2009, real GDP growth may drop again due to the shift from oil exporting country to the net oil importing country. The real GDP growth will approach the normal level of 5-6 per cent after 1012.

3.3.1.1 Energy Supply Projection

Under baseline scenario, no effort to reduce the GHG emissions, the overall final energy supply will increase at an average rate of 2.79 per cent per year in the period between 1995-2025 (population growth rate is assumed to be 1.5 per cent per year). By sector, the residential, commercial and government (RESCOM) sectors were the largest share in the total final energy supply of the country in 1995 (Table 3.9). The industry sector was the second largest while the transport sector was the smallest. The share of the transport sector will exceed that of the industry in 2025. This is due to faster annual growth rate of the transport sector's final energy supply as compared to the industry growth rate (3.86 per cent versus 3.37 per cent).

The average annual growth rate of final energy supply of the RESCOM sectors is 1.07 per cent, which is lower than total consumption (2.79 per cent).

Table 3.9. Sectoral Final Energy Supply/Consumption (Baseline Scenario)

Final Energy Supply (PJ/year)								Growth Rate
	1995	2000	2005	2010	2015	2020	2025	%/year
Industry	1,232.29	1,211.71	1,369.68	1,606.83	2,051.08	2,588.60	3,334.64	3.37
Coal	176.69	197.38	244.81	291.10	415.02	539.36	746.72	4.92
Electricity	203.07	216.38	253.91	334.11	441.94	576.36	725.79	4.34
Natural Gas	400.05	396.95	435.46	502.90	599.88	722.46	899.53	2.74
Refinery Product	312.77	253.72	247.28	248.90	310.42	391.70	499.60	1.57
Biomass	139.71	147.28	188.22	229.82	283.82	358.72	463.00	4.07
Transportation	748.62	753.79	834.03	1,046.42	1,358.18	1,775.70	2,333.55	3.86
CNG & LPG	0.00	3.16	7.48	17.32	41.19	94.28	147.75	16.63
Electricity	1.02	1.04	1.15	1.47	1.99	2.78	3.81	4.49
Refinery Product	747.60	749.59	825.40	1,027.63	1,315.00	1,678.64	2,181.99	3.63
Resid.-Commers.	1,358.98	1,417.19	1,505.20	1,600.18	1,707.43	1,816.84	1,951.57	1.07
Biomass	962.56	1,004.89	1,034.90	1,071.47	1,103.12	1,126.42	1,161.65	0.63
Gas (City Gas)	0.62	1.82	2.44	3.19	4.21	10.89	10.99	10.06
Electricity	94.96	121.33	159.24	208.13	281.92	375.30	438.91	5.24
Refinery Product	300.83	289.14	308.61	317.38	318.17	304.22	340.01	0.41
Solar Heater and PV	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-.00
Total.Consumption	3,339.89	3,382.69	3,708.91	4,253.43	5,116.69	6,181.13	7,619.75	2.79

Source: *Computer Print out* MARKAL Model, BPPT

Share of coal to the total energy consumption may increase in the future (Fig.3.4) due to diversification to coal & gas, and the scarcity of oil reserves. Natural gas with a low specific carbon content has a potential to be candidate as primary energy supply. Nevertheless, the share of natural gas to the total energy consumption is relatively constant.

The use of CNG and LPG may increase rapidly on condition that their price is competitive with other Petroleum refined products as a result of the government energy policy to encourage use of CNG as fuel for commercial vehicles.

CNG has been used in major cities such as Jakarta and Surabaya. However,the consumption is so small that it can be considered to be negligible. However, the supply of CNG & LPG may reach 94.28 PJ in 2020 and 147.75 PJ in 2025. Assuming these projections hold, the government needs to anticipate this growth through enhancing the development of CNG pumping stations (SPBG) and conversion kit industries.

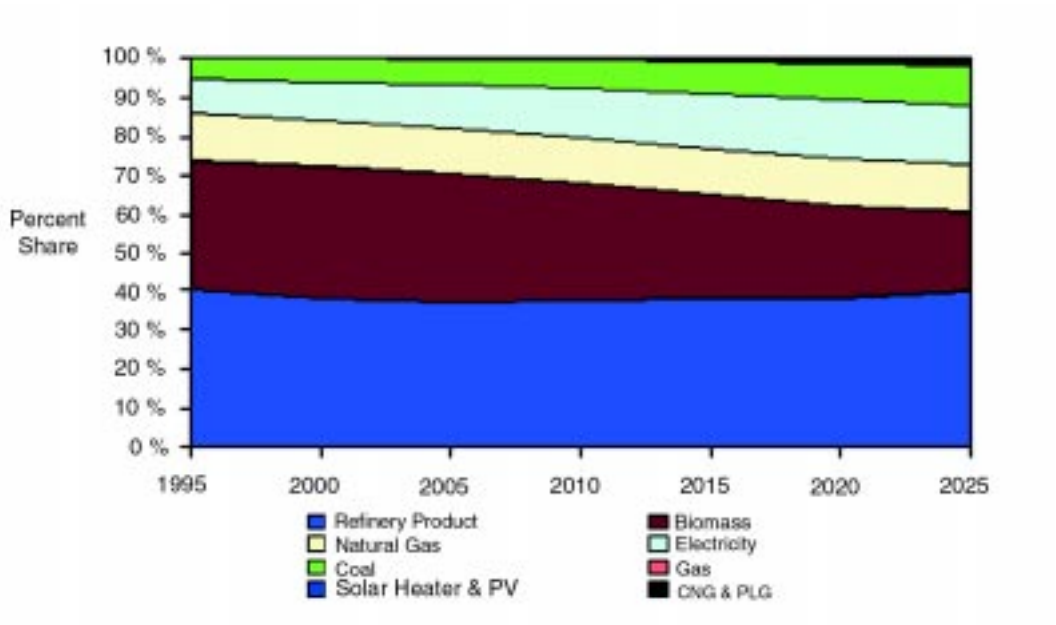


Figure 3.4. Share energy sources to the total energy consumption.

In the baseline scenario, the use of heat from co-generation system is not considered. The most probable industries that will apply co-generation system are paper and sugar industries.

3.3.1.2 Projection of CO_2 Emission at National Level

Based on optimal energy activities, carbon dioxide emission in 1995 estimated using Reference Approach is about 229 Tg (million ton) and will reach 680 Tg in 2025 (Table 3.10). Thus, rate of increase of CO_2 emission is 3.7 per cent per year. In comparison with the growth rate of the primary energy supply, the rate is higher about 0.5 per cent. It indicates that Indonesia energy activities will consume more fossil energy.

In 1995, petroleum was the major contributor, which contributed almost 60 per cent of the total CO_2 emission, followed by natural gas (26 per cent) and coal (18 per cent). In 2025, coal will contribute 55 per cent of the total CO_2 emission, while petroleum and natural gas decrease to 34 per cent and 14 per cent respectively.

When biomass is taken into account, CO_2 emission became 335 Tg in 1995. Due to a lower biomass consumption growth, contribution of CO_2 emission from the biomass decreases gradually, from about 30 per cent in 1995 to about 20 per cent in 2025.

Table 3.10. CO_2 Emission Projection from Energy Activities

	1995		2000		2005		2010		2015		2020		2025	
	Tg	%	Tg	%	Tg	%	Tg	%	Tg	%	Tg	%	Tg	%
Coal	41	17.8	63	27.2	78	31.1	105	35.1	178	45.1	283	53.2	374	55.0
Natural Gas	61	26.5	64	27.7	74	29.8	81	27.1	85	21.5	86	16.1	98	14.3
Petroleum	136	59.6	114	49.2	108	43.2	126	41.9	148	37.3	183	34.4	234	34.4
Stock in Product	-9	-3.8	-9	-4.1	-10	-4.1	-12	-4.1	-16	-4.0	-20	-3.8	-26	-3.8
Total	229		232		249		300		395		532		680	
BIOMAS	106	31.7	120	34.2	128	33.9	138	31.5	145	26.8	153	22.3	165	19.5
Total + Biomass	335		352		378		438		540		685		845	

3.3.1.3 Projection of CO_2 Emission at Sectoral Level

The sectoral CO_2 Emission of Indonesia is shown in Table 3.11. The table shows that the CO_2 emission from all sectors continue to increase. Until 2005, there is no substantial CO_2 production, the emission of the Industry, RESCOM and Power Plant sectors are more less similar. But after 2005 the main producer of CO_2 emission will be dominated by power generations, because the annual growth rate of energy consumption in the demand sector will be lower than the annual growth rate in the supply sector. Fossil fuel, especially coal, the main CO_2 emission producer in the power sector is rapidly growing. During 1995-2025, the average growth rate of CO_2 emission from power generation is 5.1 per cent per year. Similar to the power generation sector, transportation, industry, and energy industry sectors will have relatively high average growth rate (see Table 3.11). The share of total CO_2 emission released by transportation and power plant sectors increase, while industry, energy industry, residential and commercial sectors decrease. In 1995, the share of

total CO_2 emission from industry, transportation, power plant, industry energy, and residential and commercial sectors were 28.5 per cent, 23.9 per cent, 22.4 per cent, 15 per cent and 10.1 per cent, respectively, while their shares become 21 per cent, 24.9 per cent, 40.9 per cent, 9.4 per cent and 3.7 per cent, respectively in 2025.

Table 3.11. Total of CO_2 Emission (Tg)

Sector	Total Emission Carbon Dioxide (CO_2)							Growth Rate
	1995	2000	2005	2010	2015	2020	2025	%/year
Industry	61.53	58.18	66.29	73.17	90.88	108.92	141.26	2.4
Res.&Comm.	21.86	21.05	22.48	23.10	23.17	22.41	24.98	0.4
Transport	51.47	54.91	60.92	76.07	98.82	127.96	167.58	3.4
Powerplant	48.38	53.69	65.76	90.40	151.93	219.57	275.06	5.1
Energy Industry	32.49	39.87	30.44	34.93	26.88	47.54	63.43	1.9
Total	215.73	227.70	245.89	297.67	391.68	526.40	672.31	3.3
Biomass	119.10	124.29	131.72	139.84	148.61	158.48	172.51	1.1

Source: MARKAL Model Output, BPPT

3.3.1.4 Projection of CH_4 Emission

The sectoral CH_4 emission of the energy activities is shown in Table 3.12. The overall CH_4 emission increases from 2,400 Gg in 1995 to 2,754 Gg in 2025 at an average growth rate of 0.65 per cent per year. By type of emission source, fugitive emission accounts for the largest part of the overall CH_4 emission of energy activities.

Table 3.12. Total of CH_4 Emission (Gg)

Sector	Total of Methane Emission (CH_4)							Growth Rate
	1995	2000	2005	2010	2015	2020	2025	%/year
Industry	3.28	3.85	6.13	7.30	9.48	13.13	16.70	5.58
Power Plant	0.78	0.67	0.83	1.10	1.78	2.46	3.06	3.86
Res.&Com.	333.76	343.05	347.64	365.02	383.42	391.87	424.11	4.66
Transportation	7.19	8.95	7.76	12.06	12.77	20.56	22.39	0.80
Fugitive	2,054.91	2,117.27	2,337.96	2,394.65	2,307.46	2,238.14	2,287.44	0.36
Total CH_4	2,399.92	2,473.79	2,700.32	2,780.13	2,714.91	2,666.16	2,753.70	0.46

Source : MARKAL Model Output, BPPT

3.3.1.5 Projection of N_2O emission

The sectoral N_2O emission of energy activities is shown in Table 3.13. The overall N_2O emission will increase from 5.70 Gg in 1995 to 12.85 Gg in 2025 at an average growth rate of 2.75 per cent per year. RESCOM sector was the main source of N_2O emission in 1995, contribution from other sector was small. In 2025, most of N_2O emission will mainly come from RESCOM, industry and transport sector.

Table 3.13. Total of N_2O Emission (Gg)

Sector	Total of Nitrous Oxide Emission (N_2O)							Growth Rate
	1995	2000	2005	2010	2015	2020	2025	%/year
Industry	0.89	0.90	1.19	1.36	1.78	2.29	3.03	4.17
RESCOM	4.04	4.17	4.30	4.46	4.61	4.69	4.83	0.60
Power Plant	0.29	0.45	0.36	0.59	0.59	1.04	1.01	4.25
Transport	0.48	0.66	0.81	1.19	2.07	3.16	3.98	7.31
Total N_2O Emission	5.70	6.18	6.66	7.60	9.05	11.18	12.85	2.75

The total N_2O emission in the country as compared to CH_4 emission is very small (Figure 3.5). However, the annual average growth rate over the period increases faster than CH_4. The RESCOM sector is the main producer of N_2O. It is caused by a high consumption of biomass. In addition, biomass has an emission factor almost 2 – 7 times higher than other fuels.

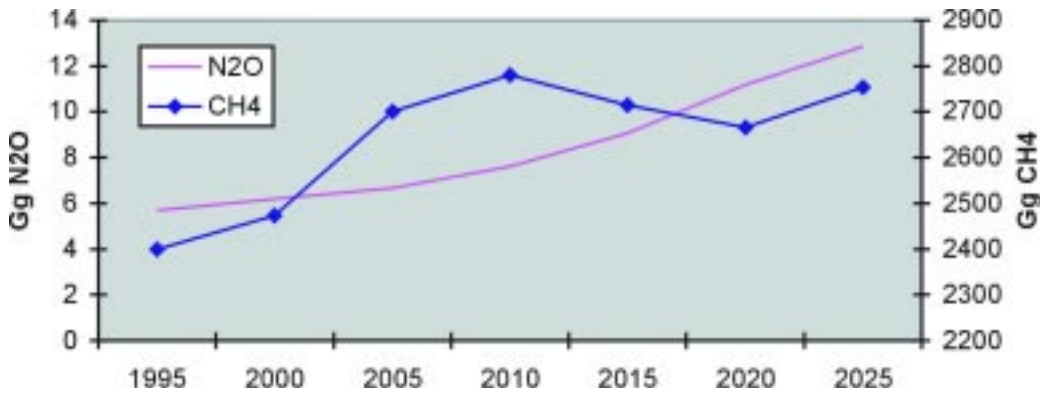


Figure 3.5 Comparison of Total CH_4 and N_2O Emissions

3.3.2. Forestry

Projection of GHG emissions and uptake from forestry sector is made based on two scenarios. The difference between the two scenarios is in mean annual biomass increment. In the first scenario, mean annual biomass increment (MAI) of trees of all species under category of forest plantation and timber estate is assumed to increase by about 25 per cent in the period between 2001-2010 and by about 50 per cent in the period between 2011-2020. In the second scenario, mean annual increment of all trees in all forest categories is assumed to be constant. Other assumptions are the same for the two scenarios, namely:

1. Annual rate of planting tress as well as forest conversion and forest harvesting varies between decades and type of activities (Table 3.14).
2. Area of forest fire is assumed to be constant.
3. Round wood production is assumed to increase from 26,127,874 m^3 in 1990 to 26,656,000 Mm^3 in 2000, 35,659,000 m^3 in 2010, and 51,558 Mm^3 in 2020.
4. Total consumption of traditional fuel wood is assumed to follow the round wood production, i.e. 1.78 * round wood production +120 Mm^3. A value of 120 Mm^3 of fuel wood is supplied from non-forest resources (MoF and FAO, 1990).

Source: Biodiversity Action Plan for Indonesia

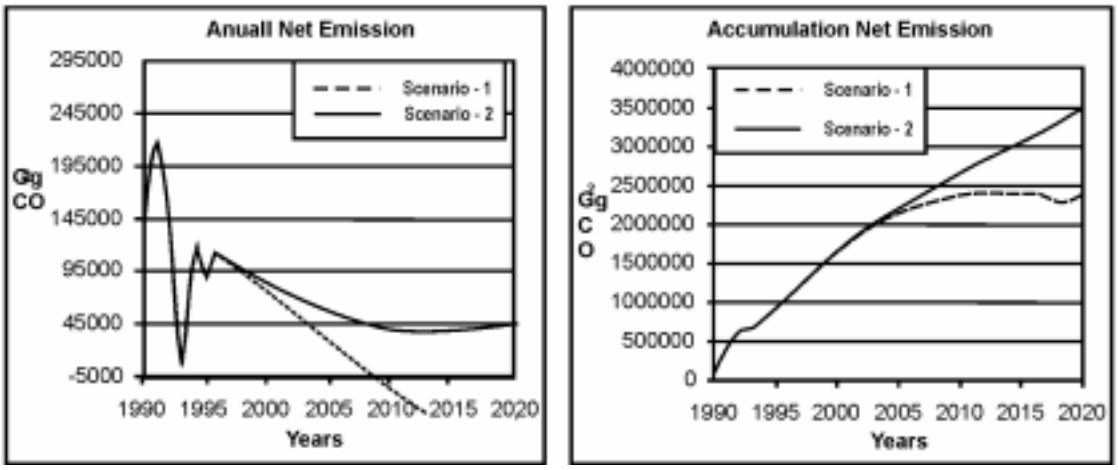
The two scenarios indicate that net carbon emission from forestry sector would decrease. Scenario-1 shows that Indonesian forest still net emitter in 2020 while scenario-2 indicates Indonesian forest becomes net sink in 2015 (Figure 3.6a). It means that efforts to increase MAI is important for increasing sink capacity. However, increasing MAI by 50 per cent from the current practice is not easy to achieve. Therefore, the most possible effort to increase sink capacity is by increasing rate of planting in bare land either through reforestation or afforestation program. In addition, reducing impact logging and enhance natural regeneration are also potentially important.

Table 3.14 Assumption Used in Developing Projections of Carbon Emission and Uptake

Assumptions	1997-2000	2001-2010	2011-2020
Rate planting (ha/year)			
Reforestation	75,000	100,000	200,000
Afforestation	100,000	150,000	200,000
Timber Estate	200,000	200,000	128,000
Community plantation	6,700	6,700	6,700
Survival Rates (%)			
Reforestation	38.5	50	75
Afforestation	67.5	75	90
Rate of forest harvesting for wood production (ha/year)	1,048,647	1,222,232	1,755,89
Changes in forest conversion rate (ha/year)			
Transmigration	56,000	0	0
Agriculture	9,750	9,900	9,900
Shifting cultivation*	-2250	-1200	-3700

Note: * Negative indicates that rate of forest conversion due to the activity decreases

Cumulatively, total net carbon emission in the period between 1990 and 2020 for scenario-1 and scenario-2 were 657 (equivalent to 2,410 Tg CO_2) and 954 Tg (equivalent to 3,500 Tg CO_2) respectively (Figure 3.6b).



(a) (b)

Figure 3.6 Projection of (a) Annual Net Emission and (b) Cumulative Net Emission in the Period of Between 1990-2020 from Forestry Sectors.

3.3.3. Agriculture and Waste

For rice field cultivation and livestock, baseline projection of GHG emissions is made without GHG mitigation action. The assumptions are presented in Table 3.15 and 3.16. Methane emission from rice field will increase at a rate of 1.8 per cent per annum while that from livestock is 3.4 per cent per annum. The projection of methane emission from rice field and livestock is presented in Table 3.17.

Table 3.15 Assumptions Used in Making Projections of Methane Emission from Rice Fields

1	Only methane emission taken into account in calculation.
2	The methane emission is calculated from projected harvested area and average methane emission per ha per year.
3	The projection of harvested area is based on projection rice demand and average productivity of land from 1990-2020.
4	The growth of rice demand follows the growth of population, that is 1.5 per cent per year
5	The growth rate of average productivity of land is projected 0 per cent, because the positive growth of land productivity of intensification is compensated the negative growth of extensification.
6	The average productivity of rice field is predicted 4 tonnes/ha.
7	The average methane emission for rice field is 0.188 tonne/ha.

Table 3.16 Assumptions Used in Making Projections of Methane Emission from Livestock

1	Only dairy, non-diary cattle and buffalo taken into account in calculation.
2	Only methane emission taken into account in calculation.
3	The methane emission is calculated from projected livestock population and average methane emission per head per year.
4	The projection of livestock population is based on the projection of meat demand and average meat productivity of livestock from 1990-2020.
5	The growth rate of average productivity of livestock is projected 0.3 per cent per year, because of livestock intensification and genetic improvement.
6	The growth rate of meat and fresh milk demand follows the growth of population, and the fulfillment of the demand come from cattles, buffaloes, goats, sheep, swine and poultry. The growth rate of dairy cattles, non dairy cattles and buffaloes are predicted 7.9 per cent, 2.4 per cent and 0.9 per cent respectively.
7	It is not all of increasing meat demand is fulfilled by domestic production but also by import. The growth rate of import is assumed the same with growth rate of average productivity. So, it compensated to each other.
8	The average productivity of meat is 140 kg/head for cattle and 150 kg/head for buffalo. The average productivity of fresh milk is 1600 litters per head per year.
9	Sources of methane emissions from livestock's consist of enteric fermentation and manure management. The total emissions are 63.49, 46.04 and 57.00 kg/head/year for dairy cattle, non dairy cattle and buffalo respectively.
10	Every unit of farm is assumed consist of 10 heads of livestock.

Table 3.17 Projections of Methane Emissions (Gg)

	Year				
	1990[1]	1994	2000[1]	2010[1]	2020[1]
Methane emission (tonne CH_4)	1,976.62	2,280.90	2,265.07	2,628.71	3,050.72
Methane emission (tonne CH_4)	687.34	937.70	854.63	770.20	1,406.76

Source: ALGAS (1998)

Projection of methane emission from waste is assumed to follow the growth of population (ALGAS, 1998). With an averaged annual increase of 2.51 per cent, methane emission from waste will increase from 287 Tg in 1990 to 605 Tg in 2020.

4. GENERAL DESCRIPTION OF STEPS

4.1 Measures to Limit Emission and Enhance Sink

In developing policies to combat global warming, the government has identified three principles as the foundation in developing national response strategy to address climate change, namely (Pranoto *et al.* 1997): (1) the response strategy cannot be separated from the long-term national development strategy, which must take into account environmentally sound sustainable development; (2) the principles of equity and justice must guide the process of anticipating and assessing impacts; and (3) steps must be taken to reduce net GHGs emissions without hampering the national development objectives.

4.2. Sectors Policy Measures and Steps

4.2.1. Energy

Policy measures on energy sector will covers: gradual removal of energy market distortions, promotion the use and development of renewable energy, encouragement of public adoption of energy efficiency, the use of clean and efficient energy for industry and commercial sectors, and restructure the price for various energy sources.

Based on the GHG inventory, the priorities in the energy sector will focus on improving the efficiency and efficacy of energy utilization through regulations. This utilization will look at the three sub-sectors of the energy sector: power generation, commercial and residential, and industry. In principle, these efficiency improvements are based on measures aimed at both the supply and demand side of the energy market.

Gradual Removal of Various Subsidies*.*

In the past, the policy of subsidizing fuel and electricity appropriated to help economic growth and to sustain inflation; it has been aimed at sustaining inflation and it has also created economic distortion in the energy market. Henceforth, the government has decided to gradually correct market distortions created by these subsidies.

Phase out fuel and electricity subsidies

To allow energy users realize the true cost of energy, the government determines to adjust administered prices of fuel with the aim of gradually removing the subsidies for both fuel and electricity.

Promote Use of Renewable Energy

Indonesia's energy policy priorities stated that the development of energy resources must pay attention towards the conservation of the energy resources. Among those priorities is the development of renewable energies which are economically sound, technically feasible, socially acceptable and do not harm the environment. The government is committed to promote and further develop renewable energy, especially given the depletion of Indonesia's oil reserve. This commitment is implemented in the following measures:

*Provide incentives for imports and use of renewable energy technologies***.** To respond promptly the need for renewable energy, the government will provide easy entrance of renewable energy technologies into the country. The government will also construct pertinent regulations that can induce imports, use, and technology transfer of renewable energy technologies using various instruments such as tariff reduction, tax breaks, proper land regulations, or other incentives.

Suralaya Steam Power Plant

*Encourage research and development of local renewable energy technologies***.** In addition to absorbing foreign renewable energy technologies, Indonesia must also be able to develop its own technologies. Henceforth, the government will prepare Research and Development program for renewable energy. Researches will include efforts to map renewable energy resources and implement pilot projects of renewable energy power sources.

Researches also include survey, develop, and implement various technologies such as geothermal, microhydro, solar cells, wind, biomass, ocean waves. The government will also provide research grants for any organizations who are interested in applying and developing renewable energy alternatives.

Encourage use of renewable energy through public campaigns and an integrated renewable energy information system. The government will encourage the use of renewable energy through the development of public campaigns and an information system. The government will set up a body that will act as a clearinghouse to provide public information on the relevant information on renewable energy power sources.

Prepare the integration of the renewable energy technologies into the existing power grids. The government will also prepare the application and integration of renewable energy power technologies to the existing power sources. In the short term, the integration plan will apply to geothermal power sources. In the long term, similar plans will apply to biomass, solar and wind power.

Encourage and increase private sector involvement in producing power, with a priority on renewable energy sources. The government will also encourage the private sector involvement, especially small scale power producers, in providing power based on renewable energy sources. Thus, programs that will increase private sector involvement in the power sector will be developed. One of such program is called PSKSK program (*Pembangkit Skala Kecil Swasta dan Koperasi/Small Scale Private Power Generator and Cooperatives*).

Promote Public Adoption of Energy Conservation & Efficiency

In addition to supplying new and cleaner energy, measures must also be put in place to ensure efficient use of energy. Other mitigation options will not be optimal unless energy use is at its most efficient level. This gain in efficiency can be reflected in financial terms. The government is fully committed to promote the adoption of energy conservation & efficiency, The measures are as follow:

Provide incentives for investment in energy efficient products. The government will encourage the production of appliances and products that are energy efficient, and that can provide substantial energy savings. The government

will also introduce a scheme that will assist companies investing in energy efficient appliances and technologies in the form of tax incentives and soft loans. This scheme will also include, public information and assistance package to help companies step-by-step through the bureaucracy.

Encourage public adoption of energy conservation & efficiency through well-researched public campaigns. Public campaigns are very important in ingraining behavioral change. As such, public campaign is very crucial in promoting energy efficiency among common people. Hence, the government will utilize this tool with care. The government is committed to support well designed public campaigns by NGOs or other agencies. The government will also support this campaign along with the sub-provincial government who has the access all the way to the grassroots.

Energy labeling and standardization scheme for appliances entering the market. The government will also draft an energy labeling scheme that will apply to all appliances entering the market. This scheme will enable customer to choose the most energy saving products while at the same time, providing incentives for manufacturers who have developed energy saving appliances.

Promote Clean and Efficient Energy for Industry and Commercial Sectors.

Developing cleaner and more efficient industrial and commercial sector is a significant investment for the Indonesian environment. Therefore, the government intends to promote clean and efficient energy use for the industry and the commercial sector.

*Encourage the use of natural gas as a source of energy for the industry***.** The emission of the natural gas is the cleanest compared to other fuels, and, if the environmental cost is taken into account—is much cheaper than oil fuel. The government will encourage the usage of natural gas in the industry by encouraging the development of the needed infrastructure that will support the distribution of natural gas to the industry.

*Mandatory energy audit for industry and commercial sectors***.** Given that the industry and the commercial sectors are among the ones who use energy the most, the government intends to ensure that they use the energy efficiently. The government will introduce a mandatory regulation that will require industries and commercial buildings to have an energy audit as part of its feasibility study. The certificate of compliance will become a prerequisite for starting up new businesses or setting up new commercial buildings.

*Tax incentives for commercial building owners who comply with an energy-conservation standard for buildings***.** The government will introduce tax incentives measures

for building owners who comply with the energy conservation standard set. This regulation will be complementary to the mandatory regulation on energy audit.

*Promote efficiency techniques—such as clean production—in the industry and help the industry develop such technology in their individual plants***.** Clean production will help the industry save energy and material, while at the same time reduce emission. The effort to promote clean production in Indonesia has been initiated since 1994. This was followed by an organized effort 1996, through a joint forum known as *the Roundtable Conference on Production Efficiency Through Pollution Prevention (KMB-EP3).* This effort was successful in introducing this new concept to the industry. Henceforth, the government will encourage the promotion of clean production in the industry by supporting any efforts to develop and apply such a technology in the industries. Further, clean production technologies to accommodate the need of Indonesian industrial community will be developed.

Restructure the Prices of Energy

Gradually, energy price need to be restructured, to enable the price to reflect the actual cost of the energy (taking environmental cost into account) and to distribute energy use evenly across time (and space).

*Restructure the tariff & tax schemes for fuel and other energy sources to account for its emission potential***.** Once the market distortions caused by the energy subsidy has been relieved, then gradually the price of energy should be adjusted to account for its emission. As a middle term initiative, a pricing scheme that will take into account the emission of each type of energy will be introduced. This will be done by making a cross subsidy from the rent acquired by selling dirty fuels, to subsidize clean fuels. As the clean fuels become more popular, the cross subsidy will gradually be removed, while the dirty fuel will also be phased out.

*Restructure the electricity tariff scheme***.** The State Electricity Company (PLN), has taken the step to differentiate the tariff for various customers, namely the residential, commercial and industry. The government, intends to take this a step further by restructuring the tariff scheme based on usage time. Usage during peak hours should be

lessened by increasing the tariff during those hours. As such, users can regulate electricity use more evenly.

4.2.2 Transportation

Policy measures in transportation will covers: promotion use of public transportation, road pricing for regularly congested area, and control vehicle emission and promotion the use of clean fuels.

Transportation sector poses additional problems of air pollution and loss of productivity due to traffic congestion. Therefore alleviating the transportation problem will provide added benefits on top of the benefits from the mitigation of GHG.

Realizing the need to deal with the problem of air pollution in general, and of transportation in particular, the government has initiated a Blue Sky Program (*Program Langit Biru*), which is aimed to control air pollution and return the quality of the ambient air needed for all living creature. This program, seek to control emission from both moving sources (transportation) and idle source (residential, commercial and industry). In principle, the measures of this sector will focus on (1) alleviating the burden of traffic by increasing the capacity of the public transportation and encouraging the use of public transportation and (2) internalizing the cost of emission through levies and incentives.

Promotion the Use of Public Transportation

Public transportation will alleviate the burden of many of the roads congested by private cars, especially in big cities. Promoting and supporting public transportation will help reduce the congestion, and in turn will reduce the amount of fuel wasted during the many long waits in a traffic jam. There are two approaches to tackle wasted fuels in transportation, i.e. diversification of energy source and energy efficiency use.

Increasing the capacity, ease and comfort of public transportation. The government intends to gradually increase the capacity of the currently congested public transportation. Furthermore, additions to the bus armada throughout the country will help alleviate the traffic congestion and reduce productivity loss due to traffic jams. Efforts to increase the capacity of these public transportation include the provision of tax incentives for mass transportation projects.

Shift the focus of the transportation development policy towards use of electric trains. Electric train produce less emission than vehicles such as buses and private cars. Therefore, the government intends to shift the focus of the transportation development

Table 4.1 Time Frame For The Energy Sector Policy

POLICY	Short term (1-5 years)	Medium term (5-20 years)	Long term (> 20 years)
Gradual removal of various subsidies	· Gradually phase out subsidies for fuel and electricity (short to long term)		
Promote use and development of renewable energy	· Incentives on import of renewable energy technologies. · Encourage and increase private sector involvement in producing power, with a priority on renewable energy sources.	· Encourage research and development of local renewable energy technologies (short to medium term) · Encourage use of renewable energy through public campaigns and an integrated renewable energy information system. (short to medium term)	· Prepare the integration of the renewable energy technologies into the existing power grids (short to long term).
Encourage public adoption of energy conservation & efficiency	· Tax and other incentives for investment in energy efficient products. · Public campaigns on energy conservation & efficiency. · Energy labeling & standardization scheme.	Energy standardization for appliances	
Promote clean and efficient energy use for industry and commercial sectors	· Encourage use of natural gas as a source of energy for industry.	· Mandate energy audit for industry and commercial sectors (medium to long term). · Tax incentives for commercial building owners who comply with the energy conservation standard. · Promote efficiency technique (such as clean production) for industry.	
Restructure price for various energy sources	· Restructure tariff scheme for electricity based on usage time.	· Restructure tariff & tax schemes for fuel and other energy sources to account for its emission potential.	

policy from building the infrastructure for automobiles towards building the infrastructure for electric trains. Moreover, public campaigns for promoting the use of electric trains will be conducted. Road pricing schemes will also favor use of electric trains, using the levies from these road pricing schemes to cross subsidize the cost for these electric trains.

Road Pricing

As a public property, road often causes market failure. One way to deal with this public property is by attaching a price, which will affect how the users of the road behave. Furthermore, it will distribute road users along both time and space.

Applying road pricing scheme & area traffic control system (ATCS) on certain congested areas during peak hours. Since congestion will waste fuel resources, road pricing scheme needs to devised to distribute the flow of traffic evenly. To regulate inflow from outside Jakarta into Jakarta in the morning, and the outflow in the evening, the government along with the freeway administrators will increase inflow toll price into the city during morning, and outflow toll price during the evening. Simultaneously, carpooling will be encouraged and promoted through incentives. Within the city, mandatory pricing scheme in the form of stickers or three in one regulations will be applied on highly congested areas such as the Central Business District.

Control Vehicle Emission and Promote Use of Clean Fuels

The main cause of adverse air pollution is the number of vehicles and the amount of emission each contributes. Worse, most of these emissions come from public transport vehicles such as public buses and taxis and thus, the emissions are very bad. In its commitment to make the Blue Sky Program successful, the government will attempt to minimize the amount of emission by imposing mandatory smog check certification, and by promoting the use of clean fuels.

Mandatory certification of smog check for all vehicles when paying for the annual motorized vehicle taxes. A mandatory regulation requiring all vehicles to pass an emission or smog check before paying the annual taxes will be drafted. The mechanism will be conducted as a Unified Administration System Under One Roof (SAMSAT/*Sistem Administrasi Manunggal Satu Atap*). The government will then elect a set of privately owned repair shops as certifying agencies for these smog tests.

Table 4.2 Time Frame For The Transportation Sector Policy

POLICY	Short term (1-5 years)	Medium term (5-20 years)	Long term (>20 years)
Promote use of public transportation	· Shift the focus of transportation policy development policy towards the development of electric trains.	· Increase the capacity, ease and comfort of the public transportation system through added infrastructure (medium to long term).	
Road pricing for regularly congested areas	· Road pricing on heavily congested areas, especially in within the cities (short to medium term).		
Control vehicle emission and promote use of clean fuels	· Promote and accelerate programs of conversion to cleaner fuels.	· Mandate smog check certification for all registering vehicles.	

Promoting conversion to clean fuels. The government intends to promote the conversion from dirty fuels to cleaner fuels. These measures will include incentives in the form of reduced vehicle taxes for those vehicles using cleaner fuels such as unleaded gasoline. On the other hand, the tax for those with dirty fuels will be increased to provide a cross-subsidy for the clean fueled vehicles. The further accelerate the process, the customs tariff for fuel conversion devices will be reduced and eventually eliminate. The local government has initiated a program "Segar Jakartaku!" that aims to reduce dangerous emission through usage of clean fuels. Similar programs will be initiated by the government in other areas prone to dangerous emissions from dirty fuels.

4.2.3 Agriculture

Agriculture is still the key sector of Indonesia's economy, contributing about 17 per cent of GNP, providing employment to some 50 per cent of the labor force and generating about 54 per cent of the non oil export. Food crops contributing 52 per cent of the agricultural GNP with rice as the staple food accounts for 60 per cent of the crops. However, with steady decrease in labor forces and limited suitable lands, agriculture development shifted more toward estate crops. With main crops that consist of palm-oil, rubber, coffee and tea, the estate crops areas in the last decade increase by 4 per cent annually compared to less than 1 per cent for rice and other food crops. Intensive cropping of rice and other annual crops are mainly in over-populated Java where irrigation facilities exist. While estate crops are mainly in outer islands of Sumatra, Kalimantan and Sulawesi. High competition with industry and services for resources in Java imply toward development of agriculture with less labor requirement such as perennial crops and more efficient water uses in paddy cultivation. These will steadily shifted agriculture further from source toward sink of greenhouse gases. Other important agriculture enterprise as important source of greenhouse gases is livestock. With decreasing available lands, animal husbandry moves closer to the markets in peri-urban areas. Based on economic and environmental considerations, there will be great opportunity for improved management application. However, animal and rice production also produce methane. Agriculture is estimated to produce 3.363 Tg of CH_4 annually, where 75 per cent was emitted from the rice fields (ALGAS, 1997).

These high emissions are mainly as the result of inefficient agricultural practices. Over-irrigated rice fields, and poor livestock feeding practices other than wasting re-

sources also cause more CH_4 emission. Furthermore, increasing demand for rice will expand rice planting, which in turn increase the emission of CH_4. Therefore, to cater the basic needs of the people and reducing CH_4 emission, the government decides to implement the following policy measures: improving technology and information transfer to speed adaptation. Innovation and adoption; strengthening research, development, and dissemination of sustainable agriculture practices; and supporting research and technology that will ensure the agriculture sector can deal successfully with the various challenges of the future.

Promotion of Improved Agricultural Practices

In most cases excessive CH_4 emission from agriculture is the results of poor agricultural practices. Several better practices with more efficient uses of resources that emit less CH_4 without decreasing yield have been identified.

Encourage improved agricultural practices through public campaign and develop a public information network for agriculture technology. In the ALGAS Study (1997), the research community has identified several livestock management and farming practices that are more efficient, cost effective, and socially acceptable without reducing yield. In livestock management, the use of high quality forage such as legumes, and the use of rumen modifier to improve the feed quality of local crop residues have been identified as methane reducing measures. In paddy rice cultivation, controlled irrigation will reduce CH_4 emission and maintain productivity. While the technological options for agriculture have been identified, the dissemination of the technology to the farmer nation-wide need to be further accelerated. The government is committed to promote better agricultural practices by conducting nation-wide campaigns in collaboration with the provincial and local governments.

Improvement of Water Management in Rice Cultivation

With increasing competition with non-agriculture water uses, more efficient water utilization in agriculture is a logical option. Intermittent irrigation and conjugative water uses will be widely adopted when water is scarce. Expansion of '*gogo rancah'* rice planting system for dry areas, where rice is sowed in commencing rainy season and become flooded later will also be pursued.

Regionalization of Agricultural Research and Development

Agricultural information institutes has been merged with agricultural research institutes in the regions to become Assessment Institute for Agriculture Technology. This regionalization is expected to speed the dissemination of agricultural technology through local specific adaptation and collect feed back from the farmers to facilitate adoption.

Development of National Renewable Resources Database and Analytical Tools.

National renewable resources are poorly understood because less and fragmented efforts in the past in the resource inventory. To support sustainable development proper understanding of the resource and computerized database with user friendly analytical tools are required.

Food Diversification

Except in the eastern and southeastern parts of the country, rice is the staple food of most Indonesian. Benefited from the green revolution with progress in rice cultivation technology, currently almost all Indonesian eat rice. However, increasing population that consume high quantity of rice, become a burden, not only because of the ever increasing CH_4 emission, but also because of limited available land and water for rice cultivation. Therefore, promotion of non-rice food alternatives, such as potatoes, corn, or yams and sago is imperative.

Promote food diversification through public campaigns. People opt for rice as staple food because it is ubiquitous and easy in preparation. With increasing demand and limited capacity in catering the requirement, promotion of other staple food is imperative. Given the history of past existence of other staple food in various regions of Indonesia, development of food technology from different food sources is the logical way to promote acceptability.

Support research on appropriate staple foods for local conditions. The government will also support any effort in the development of food technology from various alternative food sources in every region of Indonesia. With diverse local conditions e.g., traditional farming practices, level of education, and environmental condition in the Indonesian archipelago, no single food substitute is appropriate for all provinces in Indonesia.

Table 4.3 Time Frame For The Agriculture Sector Policy

POLICY	Short term (1-5 years)	Medium term (5-20 years)	Long term (> 20 years)
Improving technology and information transfer to farmer in order to speed adaptation and innovation and adoption	· Promote improved agricultural practices · Improved water management in rice cultivation	· Develop improved rice cultivars that emit less CH_4	· Diversification of staple foods
Strengthening research, development, and dissemination of sustainable agriculture practices	· Regionalization of agricultural research and development · Strengthening agricultural research with advance education and training	· Application of regional resource analysis for sustainable agriculture development	
Supporting research and technology that will ensure that the agricultural sector can deal successfully with the various challenges of the future.	· Development of national renewable resource database · Development of resource analytical tools	· Support research on appropriate staple foods for local conditions	

4.2.4 Forestry

The Indonesia's huge tropical forests absorb great amount of CO_2. The growth of Indonesian forests provide a sink that sequesters CO_2 at the rate of 686,790 Gg annually. However, forestry and land use change contributes the highest amount of CO_2 emission compared to other sectors. It accounts for 42.5 per cent of the total baseline emission of GHG in Indonesia (ALGAS, 1997).

The problem of greenhouse gas emission from the forestry sector more than just problems of land use change. Forest fires are another thorn in the flesh of emission mitigation in Indonesia. In principle, the mitigation and adoption policies on forestry will focus on protecting the present forest from rent seeking behaviors through a stronger regulatory framework, preventing the occurrence of forest fires by better preparation, replenishing the thinning forests and replanting the trees in the urban areas. Furthermore, the policy measures on forestry sector will covers: (1) improvement of forest policy and enforcement of stronger regulations in forest management; (2) improvement of technology and information transfer in order to speed adaptation, innovation and adoption; and (3) strengthening research and development of sustainable forest management.

Revise Present Forest and Land Management Policies to Incorporate Stronger Measures Against Irresponsible Behaviors

Greenhouse gas emission from the forestry sector comes from land use change, by burning them. Such a method poses a very high risk, and has been banned by the government since 1995. However, weak enforcement has allowed these practices to continue. Therefore, the government has decided to take strong steps prevent further rent seeking behaviors that will jeopardize the precious resource.

Implement performance bonds and reduce land conversion targets to environmentally sustainable level. In order to protect its tropical forest, the government will implement performance bonds. To further reduce land conversion targets and protect the environment, the government is committed to review and, if necessary, raise the stumpage fee.

Provide a stronger regulatory framework in dealing with issues of land clearing and irresponsible logging, including implementation rules for the new

*environmental law***.** The government will draft a stronger regulatory framework that will enable local and provincial government to act on illegal land clearing activities. This revision will minimally include:

(a) Accountability clauses on the part of both the forest concession owners and the local government in the preservation of the forest.
(b) Strict penalties towards forest concession owners who broke the law.
(c) Forest concession owners are responsible for the reforestation of the forests.

Additionally, the Government will also draft and establish implementation rules for these laws, due on the end of 1998.

(d) Restriction of tree harvesting and forest conversion in upland areas, stepping up enforcement of laws concerning logging concessions and other upland land use, increasing monitoring activities, establishing fuelwood plantations, improving soil conservation techniques, and upgrading water management structures to control water flows are option to prevent soil erotion.

Strengthen the infrastructure of the Environmental Impact Management Agency (BAPEDAL). The Environmental Impact Management Agency is the primary agency for the operational aspects of environmental policy in Indonesia. Therefore, the Environmental Impact Management Agency at central, regional, and local levels will receive further support for its operation. Furthermore, forestry resources information in geographic information systems is urgently needed.

Prevent the Occurrence of Forest Fires

One major source of CO_2 emission in the forestry sector comes from forest fire, caused by careless application of fire in land clearing. This careless application of fire, combined with the weak enforcement of forestry and land management policies, has caused many forest fire of a catastrophic size, notably in 1991, 1994, and 1997. This fire has also inflicted various harms—financial and otherwise—to people from Indonesia and the neighboring countries.. Thus, the government is committed to prevent the occurrence of similar accidents through (a) utilization of early warning systems in the provinces that prone to forest fires, (b) development of integrated system to deal with forest fires,

(c) preparing local communities to fight the fire, and (d) requiring forest concessionaires to have a fire fighting task force.

Develop and implement Early Warning Systems in areas prone to forest fires. The government will develop early warning systems that will be implemented in the areas prone to forest fires. This will involve an installation of sub-regional monitoring systems that can monitor the forest area continuously and predict potential fire outbreaks in that area.

Coordinate the Armed Forces and local communities to deal with forest fire on different areas. Local communities often have the know-how to deal with forest fire, but lack the resources to douse huge fires. Therefore, the Armed Forces will collaborate with local and provincial government to coordinate training on how to extinguish fires in specific soil and terrain conditions.

Require forest concessionaires to have a fire fighting task force to immediately deal with problems of forest fire. The government will introduce a regulation that each forest concession owner to have a fire fighting task force which can deal with problems of forest fire immediately. The fire fighting task forces are responsible in maintaining communication and should be well trained to response to early warning signals.

Provide Land Grants to Universities for Forestry Research

Many forestry colleges and universities have personnel and capacities in conducting forestry researches. However, few have land and forested areas to carry out the researches. By providing them with land grants, it is expected to further develop technology in and as an example of good forest management in the areas.

Support Research and Development of Fast Growing High Quality Forest Trees

The existing national and international forestry researches in the country along with the Indonesian Institute of Sciences has initial works in propagation of fast growing trees by employing biotechnology. Further application of the technology has the potential in the development of fast growing high quality forest trees.

Promotion of Low Impact Logging

Logging practices has destroyed saplings and many underbrush species as well as epiphytes on the trees. Low impact logging will prevent further losses of precious species that enrich the diversity of tropical rain forest.

Reforestation of Damaged Forests and Development of Parks and Urban Forests

The cost of forest fires has been the destruction of a significant area of tropical forests. Meanwhile, the development in the urban areas has sacrifices many of the green trees. The government has seen the importance, and is committed, to replenish the forests in these areas where the forests were harvested or burnt during the fires, and to regreen the urban areas, providing more comfort for its inhabitants.

Reforestation of deforested areas. A large size of the tropical forests was damaged as a result of the 1997 forest fires. To replenish those forests will require between twenty to fifty years. The government will have to find tree species that have high economic and social values, conserving soil and water quite well and have a high annual growth rate. Researchers have found the types of species appropriate for such a purpose. Henceforth, once the fire has been completely extinguished, the government will immediately start its reforestation.

Development of parks and urban forests. The air quality of the urban areas can be improved by planting more trees. The growing trees will absorb the gases emitted by the city activities. The government has showed its commitment to improving the ambient air in the urban areas by the "One Million Trees" program (*Program Sejuta Pohon)*, a program to plant an additional one million trees in the urban areas.

4.2.5 Waste

With the rate of 2.48 liter/capita/day, the amount of waste generated is quite high. This rate implies that the population of over 400,000 generally produces waste more than 1,000 m^3 a day. Such accumulation of waste, if not handled thoroughly, will surely create health and other environmental hazards. Waste is therefore an important problem to tackle. The government will deal this problem at both ends, waste management techniques at the end of pipe waste minimization.

Table 4.4 Time Frame For The Forestry Sector Policy

POLICY	Short term (1-5 years)	Medium term (5-20 years)	Long term (> 20 years)
Improving forest policy and enforcement of stronger regulations in forest management	Review and revise present forest and land management policies to provide stronger and more accountable measures Implement performance bonds and reduce land conversion to environmentally sustainable level. Provide a stronger regulatory framework in dealing with issues of land clearing and irresponsible logging, including enforcement of the new environmental law.		
Improving technology and information transfer in order to speed adaptation and innovation and adoption	Prevent the occurrence of forest fires through better preparation Develop and implement Early Warning Systems in areas prone to forest fires Replenish the forests in the rural areas and replant trees in the urban areas	Require forest concessionaries to have a fire fighting task force to deal with problems of forest fire. Promote low impact logging	Parks development in urban areas
Strengthening research, development of sustainable forest management	Provide land grants to universities for forestry research Support research and development of fast growing high quality forest trees	Reforestation of trees in damaged areas. Regreen of the urban areas.	

Integrated Waste Management Scheme

Waste are collected and transported by government agency to the dump areas. However, some wastes remain for a period of time. Problems occurred due to the lack of an integrated waste management scheme.

Revise the blueprint of an integrated waste management scheme for the urban and rural areas. The government revise the design of the blueprint for an integrated waste management scheme. This scheme will incorporate the new development in the urban areas, and will also apply alternative waste disposal methods, such as burning and composting.

Disseminate information through local channels of the appropriate waste disposal techniques that will be in line with the integrated waste management scheme. After the development of waste management scheme, local governments will disseminate the information through public channels. The government and non-government bodies will work together to deliver the information all the way to the grassroots.

Mandatory waste management scheme for newly built real estates. The rapid development of real estates has added the amount of waste. Thus, a waste management scheme is required as part of the feasibility study of a proposed real estate.

Waste Minimization in the Industry

Waste minimization, aims to introduce more efficient technologies and approaches to industrial practices. It will reduce excessive use of resources, conserve the environment, and reduce pollution. The efforts towards waste minimization has been initiated in 1994. As such, the government will further promote these efforts by providing the regulatory framework to support waste minimization.

Encourage further researches on industry-specific waste minimization technologies in Indonesia, especially for small and medium scale industries. Waste minimization has not been developed to its maturity in Indonesia. Further researches and applications of waste minimization techniques to specific industries are still lacking. Given that more than 50 per cent of the industries in Indonesia are medium to small scale industries, priority will be set to develop technologies that can be applied to these industries.

Promote waste minimization through public campaign, and eventually through regulations and incentives. Meanwhile, the government will further promote waste minimization to the industries. As the technologies become more developed, the government will introduce regulations that will provide incentives, such as tax breaks, for industries that have applied waste minimization techniques. The government will also encourage, and eventually mandate, starting industries to include waste minimization as part of its feasibility studies.

4.2.5 Coastal Resources

Prepare and develop a long term monitoring and prepare a long term adaptation strategy for the possibilities of sea-level rise due to climate change in the various coastal areas

Indonesia has around 110 million people living in the coastal area, and therefore, is vulnerable to the effects of sea level rise. The socio-economic impact of even a very small rise in the sea level could be devastating. Furthermore, sea level rise will also threaten seaports, beach resorts, tourism and coastal fisheries. Mangrove forest and coral reef are also vulnerable to sea level rise.

Development of a Long Term Monitoring Infrastructure of Sea Level Rise

Indonesia with one of the longest coastline in the world is necessary to anticipate sea level rise monitoring in a long term period using mapping and GIS methodology as well as in situ monitoring using tide gauge recording system in some selected points in Indonesia.

Continue the national base mapping program and national geographic information infrastructure

Base maps are important to provide basic information about the earth surface and topography. The availability of a sufficient base maps is very important to enable generate a reliable computer based geographic information system. The present priority set in the future five year base mapping program will be to finalize base mapping of 1:25.000 scale for certain island.

Table 4.5 Time Frame For The Waste Sector Initiatives

POLICY	Short term (1-5 years)	Medium term (5-20 years)	Long term (> 20 years)
1. Devise an integrated waste management scheme		Revise the blueprint of an integrated waste management scheme for the urban and rural areas. Disseminate information through local channels of the appropriate waste disposal techniques that will be in line with the integrated waste management scheme. Mandatory waste management scheme for newly built real estates.	
2. Encourage and promote waste minimization and clean production in the industry	Encourage further researches on industry-specific waste minimization technologies in Indonesia, especially for small and medium scale industries (*short to medium term*). Promote waste minimization through public campaign, and eventually through regulations and incentives.		

Develop and integrate the nation wide tide gauge station network for long term sea level rise monitoring. At present there are about 53 tide gauge stations distributed in the Indonesian archipelago to monitor sea level rise. Future development of these tide gauge stations will be integrated with other tide gauge station network in the Asia and Pacific region, nd also with vertical reference system into an International Terrestrial Reference Frame (ITRF).

Prepare a Long Term Adaptation Strategy for Coastal Areas

Necessary steps must be prepared to anticipate the possibilities of sea level rise in the various coastal areas in Indonesia.

Conduct thorough and comprehensive studies of the characteristics of the various coastal areas and the various impacts of climate change to these areas. The Government will assess the extent of the damages of sea level rise to the different coastal areas, and will do research pertaining to the characteristic and impacts of sea level rise to the various coastal areas.

Prepare one of the three adaptation strategies—retreat, accommodate and protect—appropriate to deal with the problems of specific coastal areas. The government conduct joint efforts to help manage the impacts of sea level rise to the various coastal areas. For those areas requiring a retreat response. The government will also prepare and plan a migration strategy that will have only a slight impact to the livelihood of the communities affected.

Inform the local communities of the dangers of certain areas through public campaigns, and issue residential ban on certain coastal areas. The government will conduct a public information campaign, explaining the dangers of certain coastal areas and explaining the government programs to migrate local residence to a different location. Following the migration, the government will then issue residential ban on various coastal areas that are prone to the impacts of sea-level rise.

Promoting an Integrated Coastal Zone and Marine Management (ICZM)

With consider to some coastal and marine projects, it is necessary to promote an integrated coastal zone and marine management in anticipating the impact of sea level rise. Necessary management approach must be prepared in the various coastal and marine areas.

Continue and develop the national marine resources evaluation and planning program (MREP). Increasing the level of community participation in the spatial planning process by improving public awareness and incorporating the issue of climate change in the regional development planning. *Promote the coral reef rehabilitation planning and management, as well as mangrove rehabilitation and management program.* Piloting community based management of coastal resources as a key initiative to implement coastal zone management plans, and integration of sea level rise issue in relation to the planning of coral reef and mangrove and rehabilitation as part of coastal resources.

Continue promoting and strengthening water resources management. This is done with particular emphasis on national networking of hydrology information system, which will link in with other natural resources information system.

4.2.6 Public Health

Indonesia has demonstrated her strong commitment to contribute to mitigate and to adapt to climate change by a supportive policy in public health. This contribution requires understanding that state of health of the human being should be considered as a holistic and cross sector approach. The state of health is not merely the physical, mental, social well being but also free from infirmary.

Climate change has direct and indirect impacts on the status of public health. Several disease have association with climate change, while other diseases have indirect caused by climate change such as nutritional related diseases due to changes in food intake and production patterns. Policy measures to deal with public health will covers: (1) promotion use of environmentally friendly fuels and healthy transportation system; (2) promotion of healthy environment housing; and (3) promotion of emergency response system for sporadic climate change disaster.

Promotiom use of environmentally friendly fuels and healthy transportation systems

With provision of healthy public transportation, use cleaner fuels (less GHGs emission) and cleaner vehicle conditions will help healthier public transportation. This includes efforts to encourage the use of better public transportation to satisfy the need while maintaining environment clean.

Promotion of healthy environment housing

Development of real estate and housing complex in the coastal and water-front should be limited to reduce of climate change severely impact to inland environment due to sea level rise, the greater erosion of high rainfall upstream which will inundate the low land coastal areas with water causes flood.

Preparation of Environmental Impact Assessment (AMDAL) and its enforcement with attention to climate change impacts for all major development including health services

For all major development, AMDAL is a necessity as a tool to guide the management and operation of such facility beyond its compliance for providing AMDAL document. The AMDAL document should also be available for public. This should also covers health sector such as hospitals and other health care facilities.

Promotion of emergency response system for sporadic climate change disaster

The government must be able to anticipate climate change phenomenon to happen. Therefore the government is in preference to activate a coordinating body to deal with climate change phenomenon such as flood and drought..

Develop emergency response system

In response to possible natural disaster caused by climate change, the relevant governmental body is established to handle issues related to natural disaster. This institution will put a standard operating procedure, which will be responsive and capable to cope with climate change disaster phenomenon.

4.3 International Cooperation

Indonesia demonstrated its strong commitment to contribute the global efforts in climate change by signing the Framework Convention on Climate Change in June 1992, and ratifying it in August 1994. Most recently, Indonesia has also signed the Kyoto Protocol. In the long term, Indonesia's priority internationally reflects its domestic priorities: adaptation, research and development, and mitigation. In the short term, the priorities include institutional development and community outreach.

4.3.1. Adaptation

Policy measures in dealing with adaptation to climate change will cover: (1) formulation of the clean development mechanism (CDM) to cover insurance policy for adaptation measures; and (2) Under CDM, link the insurance mechanism with the level of global mitigation efforts.

Indonesia will actively contribute to formulate the Clean Development Mechanism (CDM) under the Kyoto Protocol. A global insurance policy, funded and administered through CDM, may be developed further to cover the damages. Since the severity of the damage is a direct function of the mitigation measures taken globally, the policy should take into account the extent of the mitigation policy by the industrialized and developing countries alike.

Table 4.6 Time Frame For The Coastal Resource Adaptation Policy

POLICY	Short term (1-5 years)	Medium term (5-20 years)	Long term (> 20 years)
Development of a long term monitoring of sea level rise	Provision of medium scale digital maps and DTM of Java, Bali, NTB, NTT, Timtim and South Maluku to enable various GIS based studies on sea level rise impact Provide sea level observation data and coastline maps for sea level rise study	Continuation and extension of provision medium scale digital maps for Sumatra, Kalimantan and Sulawesi. Continue to study and provision sea level data of Indonesian water and coastline maps	Sea level observation and coastline mapping: analysis and evaluation.
Prepare a long term adaptation strategy for the possibilities of sea-level rise due to climate change in the various coastal areas	· Conduct thorough and comprehensive studies of the characteristics of the various coastal areas and the various impacts of climate change to these areas	· Prepare one of the three adaptation strategies —retreat,, accommodate and protect— appropriate to deal with the problems of specific coastal areas. · Inform the local communities of the dangers of certain areas through public campaigns, and issue residential ban on certain coastal areas.	
Promote an integrated coastal zone and marine management (ICZM)	· Conduct thorough and comprehensive studies to piloting community based management of coastal resources as a key initiative to implement coastal zone management plans.	·	

Table 4.7 Time Frame For The Public Health Sector Initiatives

POLICY	Short term (1-5 years)	Medium term (5-20 years)	Long term (> 20 years)
Promote use of environmentally friendly fuels and healthy transportation systems			
Promote healthy environment housing	Prepare Environmental Impact Assessment (AMDAL) and its enforcement with attention to climate change impacts for all major development including health services		
Promote emergency response system for sporadic climate change disaster		Develop emergency response system	

4.3.2 Research and Development (R and D)

The policy measures to deal with research and development will cover: (1) continuation cooperation in R and D on climate change science, economics and policy with other countries; (2) Initiation R and D on new and renewable energy; and (3) initiation south-south cooperation for R and D.

The shift of the negotiation from scientific to economics creates a need to analyze the macro- and micro- economic studies on the impacts of climate change, the adaptation and mitigation measures, on the Indonesian economy. Capacity to manage more advanced research -micro and macro levels- will be improved. The result of the studies will be utilized to determine Indonesia's position in the international negotiation. The fields that need R and D cooperation will need to be explored further to include potential adaptation and mitigation measures. Therefore, the cooperation for R and D should be limited to the technical research but also development of technologies, mechanisms, strategies, and policy to cope with Climate Change.

South-south cooperation globally, or regionally in Southeast Asia, on climate change adaptation and mitigation measures will be enhanced. This cooperation will aim at exchanging information on the impacts of climate change mitigation and adaptation policies on developing country economies, and to evaluate the existing technological standards. The South-south cooperation will include international workshops and joint efforts for key G-77 countries to reach their economic and development goals yet take actions to adapt and mitigate Climate Change on their respective countries. The policy of R&D therefore will cover: Continue cooperation in R AND D on climate change science, economics and policy with other country, initiate R and D on new and renewable energy and initiate South-South cooperation for R and D.

4.3.3 Mitigation

The policy of mitigation option in Indonesia will covers several aspects as follow: (1) Following the "precautionary principles" to mitigate climate change; (2) evaluation of existing technology standards; (3) enhancing technology cooperation;

and (4) Identification of voluntary measures that may be committed at the global levels.

Greenhouse gas emissions from Indonesia was only accounted for roughly 2 percent of the approximately 30 billion tons of carbon dioxide from industrial processes and land-use change in the world in 1990. Indonesia's contribution to the world's emissions, therefore, is likely to increase. Emissions from land-use change is expected to decrease whereas emissions from industrial processes are to increase rather significantly.

Top priorities in the mitigation option will include actions that have significant local benefits, regardless of climate change, in parallel with the priorities set in the mitigation section of this Action Plan. Energy efficiency, renewable energy development in remote regions, better agricultural practices (high yield less methane emission), Improving Forest and Land Management Policies to Incorporate Stronger Measures Against Irresponsible Behaviors, and reduction of local air pollution & better waste management in urban centers in Indonesia are exemplary of these actions. Projects that may be suitable for CDM will be identified, after a set of fair criteria developed in CDM.

Currently, Indonesia holds a position that developing country's contribution, to abating climate change should be undertaken on a voluntary basis. Indonesia will evaluate the most plausible extent of this commitment, taking into account the precautionary principles, and how CDM can be formulated to facilitate such a commitment.

4.3.4 Institutional & Network Development

The policy measures in conducting institutional and network development will covers several aspects such as: (1) Developing and strengthening the national committee on climate change to serve as the contact point for domestic and international climate change cooperation; (2) strengthening government and non government institutions who have strategic roles in adapting and mitigating climate change; (3) developing a clearinghouse mechanism utilizing advanced and appropriate information system technologies; and (4) enhancing cooperation with existing global, regional, and national governmental and non-governmental institutions on climate change.

The National Committee includes prominent persons from relevant government and non-government institutions in Indonesia. Currently, the National Committee is an ad hoc institution with rather infrequent meetings among its members. While its daily operation is still a part of the State Ministry for the environment.

Periodic meetings of the Committee will strengthen Indonesia's negotiating strategy. The Committee will host a roundtable, which consists of various stakeholders of climate change including private sector and the public. In addition, the National Committee will establish a clearinghouse function by utilizing internet. Information from various governmental and non-governmental institutions will be stored in formats most accessible in the Internet.

The active role National Committee on Climate Change becomes very crucial to facilitate the process of strategic yet quality plans and actions. Therefore, the established and strengthened National Committee on Climate Change will facilitate these institutions to link with other institutions deal with climate change globally. This action will assure effectiveness of the implementation of the action plans on climate change in Indonesia.

4.3.5 Community Outreach

The policy should be implemented in concerning community outreach among other are: (1) Launching campaign programs and (2) Developing multimedia presentation.

A campaign program to educate the public on issues related to climate change will be formulated, designed, and launched. A committee will be formed to formulate the best strategy for outreach, consisting of NGO community, especially the Indonesian Climate Action Network, the Consumer Organization, and the media.

5. OTHER INFORMATION

Indonesia as one of the Non-Annex 1 country is not yet compulsory to conduct greenhouse gas emission mitigation. This country is participating in climate change issues on voluntary basis.

At the first Conference of Parties in Berlin in March 1995, a pilot phase up to the year 2000 was adopted. The joint efforts between Annex 1 and Non-Annex 1 countries is called Activities Implemented Jointly (AIJ) pilot phase, in lieu of Joint Implemented (JI), which is valid for the cooperation between Annex 1 countries only.

To follow up the above mentioned decision, the Environment Agency Government of Japan and the International Environmental Technology Center of the United Nations Environment Programme (UNEP/IETC), organized the first workshop on Transfer of Environmentally Sound Technologies (EST) and Activities Implemented Jointly (AIJ) in Osaka, Japan from 19 to 21 June 1996. In this workshop the Indonesian private sector was invited to participate.

The chief of Indonesian delegation, presented his key note address on ' Indonesia's Climate Change Strategy'. In the closing note, he requested the workshop to facilitate the preparation of AIJ guidelines during COP2; to continue the ASIA-PACIFIC regional forum to share AIJ experiences; to set up a net work for information dissemination, training and education on the development of EST; to encourage financing from different sources to support AIJ.

A National Strategy – Action Plan of Climate Change has been issued recently by State Ministry for Environment (May 1994).

5.1. Participation In AIJ Pilot-Phase Projects

5.1.1. Seven Steps To Be Taken for AIJ - Pilot Phase Formulation

1. Project identification and project preparation;
   a. Prepare a study to collect information, to set up base line level of the GHGs emissions level.
   b. Identify the potential AIJ Project within a specific target.

   c. Write the project profile that includes the policy, socio-economic and environmental factors.
   d. Develop criteria for project selection.
2. Project planning and design;
   a. Decide project area, size.
   b. Formulate project objective: short term, long term
3. Assess the implication of the AIJ project into economic and trade business, besides the social impact;
4. Proceed with integrated EIA and feasibility study;
5. Design the standard operation procedure for AIJ project implementation start with project preparation, project planning, implementation, post AIJ pilot phase, and follow up target for bigger investment project;
6. Do project monitoring for AIJ project performance;
7. Do project evaluation to improve the project planning, design, and achievement before being expanded into bigger investment to meet the emissions target for a selected sector, i.e.: energy, industry, transportation, forestry, agriculture, etc.

5.1.2. Prerequisites of AIJ-Pilot Phase Project in Indonesia

1. The MOU should be obeyed the dictates of the 'Joint Statement of Intent between the Government of Indonesia and Australia concerning Cooperation on AIJ-Pilot Phase Activities for the Mitigation of GHG's and legally binding to the Article 4.2 (a) of the UNFCCC.
2. The progress, in certain period, and the final result of the project should be reported to the Indonesian focal point of the UNFCCC for formal report to the secretariat.
3. The final report of the project in Energy sector (include Energy Efficiency and Renewable Energy Sectors) should state clearly, at least, the points below:
   - Baseline of emission level and expectation/projection of emission level with and without project;
   - How much GHG emission could be reduced by the project;
   - The timeline of the project;

4. The final report of the project in non-energy sector (include forestry and agriculture sectors) should state clearly, at least, the points below:
   - ¨ Baseline of sink or absorption level in the project site and expectation/projection of sink level with and without project;
   - ¨ How much GHG could be absorbed by the project;
   - ¨ The timeline of the project;
5. The project opportunity should be checked:
   - ¨ Funding resource:
     - bilateral: should be Annex I Country of the UNFCCC
     - multilateral: GEF
     - if 'private sector to private sector partnership': should be looked for the appropriate process for bankable projects.

5.1.3. Collaboration with Japan:

Japan as one of the Annex 1 country had committed in the Kyoto Protocol in December 1997 to reduce the GHG emissions during the period 2008-2012 in the amount of 6 per cent below 1990's total emissions level. This is the lowest figure compare to USA (7 per cent) and EU (8 per cent) commitments.

Further, Japan through NEDO has officially advised the Indonesian government that their capability to reduce GHG emission only 4.2 per cent for the period. Based on their calculation, to achieve cost effectiveness, they will request the developing countries to do a favor for Japan's credit the balance commitment 1.8 per cent.

The Japanese government and the private sector as well are very concern about their obligation on GHG emission reduction, which is shown by their prompt action to offer grants and soft loans, even though the MOU between both countries has not been concluded to date. Since December 1997, Japanese private sector has awarded 2 grants. Prior to awarding the commercial grant to one selected paper and pulp manufacture located in Bekasi (West Java) in the amount of US $ 9 million, the New Energy and Industrial Technology Development Organization (NEDO) in cooperation with the State Ministry of Environment of the Republic of Indonesia organized AIJ Round-Table on Energy and Industry Sector on February 19, 1998 in Jakarta. The

objective of this Round-Table discussion was to disseminate the policy undertaken by MITI/NEDO with regards to developing AIJ pilot phase projects under the UNFCCC.

The important part from the summary of this Round-Table discussion included: 'In view of the fact that AIJ between Annex 1 and Non-Annex 1 parties were not mentioned in the Kyoto Protocol, it is highly important for Indonesia and Japan to decide the fate of the future course of AIJ between the two countries. Indonesia position regarding the AIJ-Pilot Phase is very supportive as long as it does not become a tool for relocating industry and technology, which is not efficient or not environmentally sound technology from developed countries.

It is important in providing assistance to Indonesia, especially, in the process of projects identifications and the design in order to ensure that AIJ projects enhance national sustainable development in Indonesia.

Examples of specific topics discussed include model project for utilization of paper sludge and solid waste and new cooling system in a cement clinker production are shown in Table 5.1 and 5.2.

Table 5.1 Waste Recycling for Steam Generation Project

Project title	Objectives	Instrument	Target	Energy saving	Implementation
Paper sludge & Solid waste Location : Pt. Fajar Surya Wisesa Bekasi, West Java	To contribute to The efficient use of energy and the protection of the Environment in INDONESIA.	Installing incinerator Capacity : 100 BD ton/day	GHG emission Reduction 91.000 tons CO 2 PER YEAR	9.000 tons Per year Crude oil EQUIVALENT	Status Equipment Partially at Plant site (US $ 2.6 MILLION)
Funding : grant from Japan US$ 8 - 9 millions					

Remarks :

1. Local funding to be provided by pt. Fajar surya wisesa approximately us $ 3.3. Million
2. How the government will implement to the host company on the following matters :
   2.1. Depreciation of the equipment
   2.2. Tax on new asset
3. The boiler will only produce steam approximately 16.8 tons per hour.
   It is only 12 per cent of the total steam requirement, based on 500.000 tons per year production capacity of the packaging paper plant. It is not economise if the host company has invest by themselves.

Table 5.2 Recovery Waste Heat from Kiln Project

Project title	Objectives	Instrument	Target	Energy saving	Implementation Status
New cooling system in cement clinker Production (CSCC) Location : PT. SEMEN CIBINONG Narogong, West Java	To contribute to The efficient use of Energy and the Protection of the Environment in Indonesia	Installing new Cooling system A high performance Kiln burner and Total advanced Control system	GHG emission Reduction : 52.000 tons CO_2 / year (37 kgs CO_2 Per ton cement).	100 kcal for each Kilogram Clinker	Engineering Design

REMARKS :

1. MOU between NEDO (Japan) and MOIT / PT. Semen Cibinong (Indonesia) was signed on August 10, 1998.
2. The equipment will commence operation by the end of 2000.
3. MOIT and PT. Semen Cibinong are not allowed to expose the performance of this new equipment to the third party at least for 10 years.
4. The equipment has been installed at cement plant in Japan, but still in the demonstration stage.
5. No constraints in local funding, since the amount is very small.

5.1.4. Collaboration with Australia

The MOU between Indonesia and Australia, which include the environmental sector, was signed in October 1996. To follow-up this agreement the Department of Primary Industries and Minister of State for Environment conducted ' Workshop on Activities Implemented Jointly (AIJ) ' in July 1997.

During this workshop the Australian Government issued a guidelines: 'The Australia Activities Implemented Jointly (AIJ) Pilot Initiative'.

This pilot initiative will assess the potential of AIJ to:

- Facilitate cost affective Greenhouse Gas emissions abatement, especially in the Asia-Pacific Region;
- Enhance Australian trade and investment link environmental technology and service areas;
- Facilitate cooperation with developing countries to address climate change;
- Encourage investment in capital, technologies and know-how in developing countries;
- Advance to more developed form of AIJ.

The Australian government will open the participation from the developing countries to both private sector and the government agency which has ratified to the UNFCCC.

In particular, the initiative is likely to focus largely on project in the Asia-Pacific region that reflect our proven Expertise and Technology such as:

- Energy Technologies and Management;
- Renewable Energy Sources;
- Efficient Power Generation and Distribution;
- Capture and Use Methane and Sink Enhancement;

The only one implementation of this pilot initiative in Indonesia as shown in Table 5.3 is the Application of Renewable Energy System to Sustainable Rural Development'. The total grant awarded is A$ 240,000 and the greenhouse gas emission reduction is estimated based on diesel oil is 86 tons CO_2 per year. The partnership of this project : CASE (Australia) and BPTTG-LIPI (Indonesia). This project has been in operational stage since September 1998.

Table 5.3 Hybrid Renewable Energy System Project

Project title	Objectives	Instrument	Target	Energy saving	Implementation Status
The application of Renewable energy System to Sustain-able rural Develop-ment. Demo hybrid system Location : District government Waimena, West Irian	Rural electrification And the protection Of environment in Indonesia	Installing hybrid System with total Capacity : 159 kwh/ day Consisting : * Photovoltaig * Micro-hydro * Wind-turbine * SCADA (super visory control and data acquisition)	GHG emission Reduction 86 tons CO_2 Per year	-	Commence Operational in September 1998.
Funding : Grant from Australia AUS$ 240.000					

Remarks :

1. MOU between case (Australia) and BPTTG-LIPI (Indonesia) has not been signed yet.
2. Local funding (in-kind) approximately 40 per cent of the total grant.
3. Infrastructure and the quality of human resources are very limited.
4. District government has to be encouraged to support this environmental project.
5. Public awareness has to be intensified.

In addition, Australia has awarded another grant to BPPT for conducting research in the coal technology at power plant, which is called: Integrated Drying Gasification Combined-Cycles (IDGCC). This technology is still in demonstration stage in Australia.

The first AIJ project funded by Australia was consistent with the statement of the former Minister of State for Environment as documented in the agreement between Australia and Indonesia on Climate Change, as follows: ' Renewable energy technologies could provide cost-effective access to energy, particularly in remote areas in place of conventional sources of energy such as diesel. Indonesia is also committed to improving the thermal-efficiency of coal fired power stations.'

Further, related to the last part of the above-mentioned statement, the State Ministry for Environment has pursued PT. PLN to implement at their steam-fired power plant at Suralaya (3,400 MW). It has potential to reduce CO_2 emission approximately 3 million tons per annum.

5.1.5. Collaboration with E-7:

The E-7 is not a government, but the association of the electric utilities located in 6 countries, members og G-7 as follows:

- Electricity de France (EDF) – French
- ENEL s.p.a. (NEL) – Italy
- Hydro Quebec (HQ) – Canada
- Kansai Electric Power Company (KANSAI) – Japan
- Ontario Hydro (OH) – Canada
- Southern California Edison (SCE) – USA
- Tokyo Electric Power Company (TEPCO) – Japan
- RWE AG – Germany

The title of the AIJ pilot phase project implemented in Indonesia is called: Renewable Energy Supply Systems (RESS) in Indonesia. The objective of this project is to supply electric current to community in the remote areas in Nusa Tenggara Timur (NTT), and simultaneously to protect the environment in Indonesia.

The initial planning was to install 1.000 units Solar Home System (SHS) 2 Hybrid System (HS) and 5 Mini Hydro Power Station (MHP). Later the SHS is reduced to 175 units only, MHP reduced to 3 units and HS become 1 unit.

5.1.6. Renewable Energy Supply System (RESS)

A. Solar Home Systems (SHS) = 175 units

   In the standard case, one 50 W_p-SHS per household will be installed. It is assumed, that electricity generated in SHS will substitute the kerosene consumption for lighting. Surplus electricity will be utilized completely for additional lighting or, in a variant, substitute diesel generate and stored electricity. As results of the Statistical Household Income Survey in the potential candidate villages show, it seems possible to assume further operation of kerosene lamps (or candles) to a certain degree, once electricity is available. Assuming a remaining kerosene consumption of 20 per cent of the previous amount, a CO_2-offset per SHS within the range of 418 kag/a (522 kg/a - 418 kg/a) would result from the kerosene substitution.

B. Micro Hydro Power Plants = 3 units

   Detailed information concerning the refurbishment of the Waikelosawa plant is available, the calculations are based on a capacity of 15 kW_{el}. Operation is assumed to commence in January 2000. The corresponds to the latest estimations of the resident project manager from the E-7 project office in Kupang. A yearly serviceable time of 7440 hours was assumed, which is a usual figure for a hydroelectric run-of-river-station utilizing a quite steady stream flow like the one at the Waikelosawa site. As a result, the electricity generated is expected to be within the range 97 MWh/a, substituting diesel generated electricity.

   The capacity and the annual generation of the other plants will be as follows: Bokin 12 kW; Tendan Dua 69 kW; and Taba 50 kW.

C. Hybrid System = 2 units

   The HS plant will have a capacity of 21.8 kW PV and 10 kW wind generator. The annual generation is assumed 42 - 45 MWh/a.

Table 5.4 Renewable Energy Supply System (RESS) Project

Project title	Objectives	Instrument	Target	Energy saving	Implementation Status
- The application of renewable energy system to sustain able rural deve lopment. Hybrid system location : pro- vincial govern ment Nusa Tenggara Timur (NTT).	Rural electrification And the protection Of environment in Indonesia	Installing stand Alone electricity Supply facility using Renewable energy. Consisting : 175 units Solar Home System : 10 kw, 3 units Mini Hydro power station 131 kw, 2 unit Hybrid System 31.8 kw	Ghg emission Reduction : 1230 tons CO_2 / year.	-	Under Construction
Funding : Grant from E-7 US$ 3.4 million					

Source: Renewable Energy Supply System Report

5.2. Potential Of AIJ Pilot Phase In 2000

In searching the private sector to participate in the AIJ pilot phase, the Indonesian Chamber of Commerce and Industry disseminated the opportunity to obtain grant or soft-loans offered by Annex-1 countries in newsletter ' Kadin Buletin' in December 1998. Starting February 1999, several applications have been submitted to the State Ministry for Environment and are being processed at the Minister Office.

One exceptional project, which was initiated by NEDO (Japan), is feasibility study had been completed on March 17, 1999. It is very promising AIJ pilot phase project, which is called: ' The Recycling of Solid Waste and Capturing the GHG Emission (CH_4) at The Tapioca Starch Plant.' The summary of this project is shown in Table 5.5.

It is realized there are problems on the low survival rate of reforestation and afforestation and high rate of forest degradation. However, these problems could also become a potential for carbon sink. With proper sustainable forest management, adaptation of forest product technology and appropriate techniques for reforestation and afforestation there are possibilities and potential for considerable amount of biomass growth, maintenance and carbon storage. These opportunities should be investigate further as potential activities for AIJ and future CDM Pilot Phase or even more as a CDM Project Base carbon credit.

The activities on AIJ and CDM Pilot Phase should be directed to empowering local communities and be driven directly or indirectly to local community participation in order to enhance their likelihood. These additional advantages will guarantee the possibilities for successful program implementation to meet the objectives of UNFCCC for sustainable development.

The other projects which are expecting to be implemented before 2000 as follows:

1. Coal upgrading at coal mining and steam fired power plant (Table 5.6);
2. Solar energy desalination at sea shore district (Table 5. 7);
3. Capturing CO_2 emission at steel plants for supplying soft drinks industries (carbonated);
4. Natural Gas Vehicles (NGV) fuel for road transportation (Table 5. 8);
5. Municipal Waste Recycling to Energy at Bantar Gebang Bekasi, West Java.

There have been two types of financial assistance given to Indonesia, i.e. grants and soft loans. Private sector, both from the donor and the host country, has been actively involved, although they have to be endorsed by the government. So far, there have been some problems identified in the implementation of climate change related to project funded by developed countries, both in financing and transferring the technology, which are going to be discussed subsequently.

Table 5.5 Waste Recycling and Emission Capturing Project

Project title	Objectives	Instrument	Target	Energy saving	Implementation Status
Waste recycling and Emission capturing. Location : Tapioca starch plant Ponorogo - East Java	To contribute to the Efficient use of energy And waste material For cattle feed and Simultaneously the Protection of the Global environment	Installing incinerator For solid waste and Uasb unit for emission (ch_4) capturing. Capacity	Ghg emission Reduction : … … … . Tons CO_2 / year	-	Feasibility study Completed in March 1999

Table 5.6 Coal Moisture Control Projects

Project title	Objectives	Instrument	Target	Energy saving	Implementation Status
Coal upgrading Location : 1). PT. Tambang Batubara Bukit Asam Tanjung Enim South Sumatera 2). Suralaya steam power plant (PT. PLN). Suralaya, West Java	To contribute the Efficient use of energy And protection of Global environment.	Installing coal Drying plant. Capacity : 1). 0.7 million ton coal per year 2). 9.5 millions tons coal per year	Ghg emission Reduction : 1). 0.2 million ton CO_2 per year 2). 3 millions tons CO_2 per year.	Heat recovery From steam Turbines (co - generation)	1). Submitting application for feasibility study. 2). Pursuing PT PLN.

Table 5.7 Solar Energy Desalination Project

Project title	Objectives	Instrument	Target	Energy saving	Implementation Status
- Solar Energy Desalination Location : Tanjung Priok North Jakarta District	To Produce Fresh Water From Sea Water And To Protect Under Ground Sources To Avoid CO_2 Emission.	Installing Fresh Water Generator And Solar Water Heater Capacity : 40 Tons / Day	GHG Emission Avoided : ..... Tons CO_2 / Year	-	Collecting More Information From Denmark

REMARKS :
1. Some people in Tanjung Priok are used to utilize seawater for bathing.
2. The fresh water generator has to be imported from Denmark.
3. The solar water heater, particularly its panel has been manufactured locally.
4. One unit solar water heater, capacity 150 liter hot water (70^0 c) is able to avoid 3 tons CO_2 per year

Table 5.8. Energy Efficiency Projects

Project title	Objectives	Instrument	Target	Energy saving	Implementation Status
Natural Gas ehicles (Ngv) Refueling Station And Conversion Kit Locations : * Jabotabek * Medan * Surabaya * Bandung * South & East Kalimantan * North & South Sumatera	To Contribute To The Efficient And Cleaner Use Of Energy On The Transportation Sector And The Protection Of The Environment In Indonesia.	Establishing Refueling Station And Installing Conversion Kit. Total Refueling Station : 36 Total Conversion Kit : 10.000 Units	GHG Emission Reduction : ……Tons CO_2 Per Year. Reduce Fuel Expenses 45 %.	-	Submitting Application To The National Planning Board. Miyasawa Plan.
Funding : grant / soft - loan US $ 32.8 million Feasibility study : US $ 100,000 - 150,000					

5.3. Financial Sources and Constraints

5.3.1. Grants

P.T. Fajar Surya Wisesa (FSW) a pulp and paper manufacturer has been awarded a grant by NEDO of Japan to build an incinerator for treating sludge and solid waste. NEDO would provide all the equipment necessary for the operation of the incinerator. The problem occurred when the host – company was required to provide counter – fund to cover the contractions and other additional cost. During the severe economic crisis Indonesia is facing, P.T. FSW found it to be very hard to provide approximately 30 per cent of the total investment for facilities.

However, other cases of foreign grant projects to mitigate greenhouse gas emissions showed no such problem since the counter fund in rupiah were not as much as in the first case. Similar to the first case, the donor country provided all the equipment while the host company/agency had to provide other cost. Fortunately, for the full operation of the equipment, it did not require major additional investment. An equipment for waste heat recovery was granted to PT Semen Cibinong while the Australian Government in cooperation with LIPI (Indonesian Institute of Sciences) provided rural electrification utilizing solar energy and winds energy in Wamena, Irian Jaya. E – 7, a group of seven international electricity utility companies founded in 1992, also funded the establishment of 200 Solar Home Systems 1 unit Hybrid Systems and 3 units Mini Hydropower Stations for rural electrification in East Nusa Tenggara.

Since the mechanism of financial assistance involves not only the funding agency and the executing agency (host company) but also several governmental agencies from both countries, there have been some complaints about bureaucracy problem that could delayed the implementation of the projects. Government agencies still need more information of climate change issue and this new source of funding for environmental projects.

Another type of financial assistance from multilateral source like GEF (Global Environmental Facilities). Projects on climate change are eligible to apply for GEF grants. However, of all the activities funded by GEF / SGP (Small Grants Program) to Indonesia during 1992 to 1998, only 5 per cent was in the field of climate change.

Since the assistance usually involves transferring equipment to the host company, the ownership of the new equipment is questionable. If the host company officially owns the equipment, it has to be responsible for some obligations, such as depreciation of the equipment and tax on new asset. It means that the production costs of the host company will increase .

Summary of climate change related projects in Indonesia and some possible international sources of funding for renewable energy project as shown in Table 5. 9.

Table 5.9. Sources Of Funding For Renewable Energy Projects

Funding Agency	Type Of Financial Assistance	Address
E & Company	* Small Grants * Financial Intermediary Service * Equity & Debt Investment Capital	383 Franklin Street Bloomfield, New Jersy 7003 Tel. (201) 680-9100 Fax. (201) 680-8066 Email : energy@ix.netcom.com
Environmental Enterprises Assistance Fund (EEAF)	Equity & Debt Capital (US$ 150,000 - $ 22,5 Million)	1901 North Moore, Suite 1004 Arlington, Virginia Tel. (703) 522-5928 Fax. (703) 522-6450 Email : eeaf@igc.apc.org
Export Import Bank of the United State (EXIM)	* Credit Insurance Against Political and Commercial Risk * Leasing Program (Operating and Financing Leases) * Tied - Aid Capital Projects Fund * Working Capital Loan Guarantee	811 Vermont Ave, NW Washington, DC 220571 Tel. (202) 566-8981 Fax. (202) 566-7524
Global Environment Facility (GEF)	Investment Project Grants and Concessional Funds	The World Bank GEF Administrator 1818 H Street, NW Washington, DC 20433 Tel. (202) 473-1053 Fax. (202) 477-0551
International Bank for Reconstruction & Development (World Bank)	* Investment Loant and Credits to Developing Countries	World Bank Infrastructure, Energy & Environment Division 1818 H Street, NW Washington, DC 20433 Tel. (202) 473-2469 Fax. (202) 477-3285
International Development Agency (IDA)	* Debt Financing	World Bank Infrastructure, Energy & Environment Division 1818 H Street, NW Washington, DC 20433 Tel. (202) 473-2469 Fax. (202) 477-3285

International Finace Corporation (IFC)	* Feasibility Study Assitance * Mobilization of Debt & Equity Through Project Loan Syndication * Project Finance (Fund Establishment Currently Under Investigation)	18501 Street, NW Room 13131 Washington, DC 20433 Tel. (202) 473-1926 Fax. (202) 477-0365
International Fund for Renewable Energy & Energy Efficiency (IFREE)	* Pre-Investment Funding Program (US$ 50,000)	727 15th Street, NW, 11th Floor Washington, DC 2005 Tel. (202) 408-7916 Fax. (202) 371-5116 Email : ifree@ifree.org
Multilateral Investment Guarantee Agency (MIGA)	* Guarantee Program	1818 H Street, NW Washington, DC 20527
Overseas Private Invesment Corporation (OPIC)	* Project Financing Through Direct Loans * Project Financing Through Loan Guarantees * Political Risk Insurance * US $ 50 Million Global Environment Emerging Markets Fund guaranty in partnership with Global Environment Management Corporation (clean energy, water treatment, waste management, air pollution control)	1100 New York Avenue, NW Washington, DC 20527
Renewable Energy Project Support Office (REPSO)	* Pre - Investment Study Financing (US $ 5100,000)	Winrock International Renewable Energy & Environment Program 1611 North Kent Street, Suite 600 Arlington, Virginia 22209 Tel. (703) 525-9430 Fax. (703) 243-1175
US Trade & Development Agency (TDA)	* Feasibility Study Grants (< US $ 2 Million)	1621 North Kent Street Rosslyn, Virginia 22209 Tel. (703) 875-4357 Fax. (703) 875-4009 Email info @ tda.gov

5.3.2. Soft – loans

While the Indonesian government hopes that the financial assistance should be in the form of grants, thus would not divert resources for national development, there was an offer from Japan to soft loans for climate friendly projects. Mitsui & Co. Ltd. found a program called Special Yen – Credit providing fund of 7 billion US dollars annually with an interest rate only 0.75 per cent p.a. for a period of 40 year with 10 years grace period. No projects from Indonesia have been approved yet as they are still in the application stage.

However, the Indonesian Government still expects that feasibility study of the proposed project could be funded in the form of grants.

5.4. Transfer of Technology Constraints

5.4.1. High Cost

Choosing the right technology for the project could be very complicated. It is expected the technology should be the Best Available Technology (BAT) so that Indonesia will not become a waste bin for old, inefficient technologies, no longer being used by donor countries. However, modern and sophisticated technologies usually expensive, thus unaffordable for the host country to provide the counter funds or it might burden the country if the fund is a loan. The technology may also be too expensive for the donor country to fund.

Continuity of the equipment should also be considered when determining the appropriate technology. Modern and expensive equipment usually requires high operation and maintenance cost, including expensive spare part especially if they have to be imported. The financial assistance usually does not cover the operation and maintenance costs.

Some technologies on climate change are to be able to reduce substantial amount of greenhouse gas emission. However, care should be taken to assess performance of the equipment thoroughly. It may cause other type of environmental impacts, whether it is global or local impact. For example, constructing incinerator for solid wastes reduce methane emission but it produces carbon dioxide, which is another type of greenhouse gas emission. Therefore balancing the trade – off should be decided cautiously.

Financial assistance should not be limited to transferring foreign technologies. Many local technologies developed by local research institution are worth to be developed as they can also contribute to reducing greenhouse gas emission.

5.4.2. Adaptation capability of the host companies

Technology transfer should mean not only transferring 'hard' technologies but also 'soft' technology. Intensive training and workshop to the host companies, especially to the future operators, are necessary to familiarize them with the new equipment. If the user of the new technology is a community, for example solar home system units, special training program for the community is necessary for them to become familiar to the new equipment.

5.5. Other Activities Related to Climate Change Issues

In addition to activities under the AIJ, there have been a number of activities dealing with climate change issues; most of activities are in the form of studies with emphasis to anticipate adverse impacts of climate change to society. Several agencies, national and international, provide support in the execution of the activities. Table 5.10 provides list of projects related to climate change which have been coordinated by the State Ministry of Environment. The main objectives of the projects may be classified into: (1) Capacity Building; (2) Raising Awareness; (3) Methodological Development; (4) Vulnerability and Adaptation Assessment; (5) Development of Inventory and Mitigation Analysis; and (6) Policy Analysis.

Considering current condition such as lack of experts on assessment of forest and land use change, lack of methodology on inventory which is suitable for Indonesia condition and verifiable data for inventory, there is a need to develop database system for all aspect of emission and removal from all sectors. Further development is needed to establish a clearing house on data and information related to climate change issues.

To enable the above requirements a scientific base for inventory especially for sector with high uncertainties such as forest, land use, and land use change should also be developed. It is strategic for Indonesia as a developing country, which is highly dependent on natural resource exploitation for national development especially on mining, energy, agriculture and forestry.

Table 5.10 List of Projects Related to Climate Change Funded by International Donor Agencies.

Project and duration	Funding source	Implementing Agency	Report published	Scope
Socio-economic Impacts and Policy Responses resulting from Climate Change-Southeast Asia (1988-1992)	UNEP	Ministry of Environment	Socio-economic Impacts and Policy Responses Resulting from Climate Change: a Regional Study-Southeast Asia	· Institutional capacity building · Policy/economic analysis
Indonesian Small Island Study (Bali Study) on Impacts of Climate Change and Policy Response Options to Mitigate and Adapt Climate Change (first phase completed – 6 month project, 1995)	UNEP	Ministry of Environment in collaboration with Bogor Agriculture University and Udayana University	Not available at the moment	Institutional capacity building Research and monitoring Information exchange
Indonesian Country Study (Climate Change in Asia Regional Study on Global Environment Issues) (1992-1993)	ADB	Ministry of Environment in collaboration with ADB	Climate Change in Asia: Indonesia Climate Change in Asia: Executive Summary	National Plan/Strategy Institutional capacity building Policy/economic analysis
Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS Project) (1995–1997)	GEF/UNDP-ADB	Ministry of State for Enviroment in cooperation with theCenter for Environmental Studies, IPB	Indonesian ALGAS-Report, 10 Technical Reports, Leaflet and Pocket Book on Public Awareness	Capacity building National Plan Inventory (Emissions,Sinks) Mitigation (costing)-study
Response Action Against the Increasing Emissions in Indonesia (1991-1992)	Japanese Government	OECC in cooperation with Ministry of Environment	The Study on the Response Actions against the increasing Emissions of Carbon dioxide in Indonesia: Final Report	Capacity building Emissions/Sinks (CO_2)

Climate Change and Forestry, Ecostrategy for Terrestrial CO_2-fixation (1992-1993)	Norwegian Government	Directorate for Nature Management of Norway in cooperation with Ministry of Environment	Climate change and forestry Indonesia, Ecostrategies for terrestrial CO_2 - fixation	Emissions/Sinks (from forest sector) National plan/ strategy development
Feasibility study on Sustainable reforestation of degraded grassland in Indonesia (1995-1996)	Norwegian Government	Directorate for Nature Management of Norway in cooperation with Ministry of Environment	Feasibility Study on Suistanable Reforestation of Degraded Grassland in Indonesia	Emissions/Sinks (CO_2)
Indonesia Country Study on Climate Change (1994 – Present)	USAID & US-EPA	Ministry of Environment in collaboration with US Country Studies Management Team	Inventory of Greenhouse Gases Emissions and Sinks in Indonesia. Vulnerability and Adaptation Assessment of Climate Change Mitigation Assessments of Climate Change	National Plan Inventory Emissions/Sinks Vulnerability and impact assessment Adaptation Study Mitigation Study Education and Training
Establishment of Methodological Framework for Climate Change (1996-1998)	UNEP/RISO	Ministry of State for Environment in collaboration with the Center for Environmental Studies IPB, Center for Forest Research and Development, and Agency for the Assessment and Application of Technology (BPPT)	Economic of Greenhouse Gas Limitations-Phase I : Establishment of Methodological Framework for Climate Change	Integrate MARKAL Model for Energy and Forestry Sectors
National Action Plan (1998)	UNDP	Ministry of State for Environment in collaboration with Yayasan Pelangi	National Action Plan on Climate Change	National Action Plans
National Communication (1998-1999)	UNDP	Ministry of Environment	-	National Communication under the UNFCCC