INDONESIA COUNTRY STUDY

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EXECUTIVE SUMMARY

I. INTRODUCTION

The 1997-98 El Niño had significant social and economic implications for Indonesia. A large part of the country suffered from severe drought, resulting in a huge short-fall in rice production that necessitated the import of over five million tons of rice to ensure food availability to the economically weaker sections of the society. In the forestry sector, the effects of large-scale forest fires during 1997-98 were unprecedented, damaging more than 9.7 million ha of forest area (ADB and BAPPENAS, 1999). The smoke and transboundary haze from these fires affected not only Indonesia but also other Southeast Asian countries, in particular Brunei Darussalam, Malaysia and Singapore. In addition to impacts on the agriculture and forestry sectors, the 1997-98 drought and fires also significantly affected other sectors such as transportation, tourism and public health.

Given that the linkage between El Niño events and drought in Indonesia has been well established scientifically, it is important to analyze why this scientific understanding did not translate into effective countermeasures essential to mitigate the worst effects of El Niño 1997-98. This report presents an analysis of the impacts of the 1997-98 El Niño event on Indonesia and identifies lessons learned that will be helpful in dealing with future extreme climate events.

II. SETTING

Indonesia is the largest archipelago in the world, inhabited by nearly 210 million people. Over the past three decades, the country has moved from having an agriculture-based to an industrialized economy. Agriculture’s share of the country’s GDP gradually decreased from 47 percent in 1969 to 33 percent in 1978, 21 percent in 1988, and was around 16 percent in 1998. However, with half of the country’s workforce directly dependent upon it for their livelihoods, agriculture remains an important sector of the economy. Forests and estate crops and related activities also constitute an important sector of the Indonesian economy, both in terms of the percentage share of the GDP as well as in providing employment. By 1996, some 445 logging concessions were operating on 54 million ha of forest land, of which close to 1 million were reported to be logged annually. In 1994, wood and wood products produced about US$ 5.5 billion in export revenue for Indonesia, representing about 15% of total foreign earnings and employing 700,000 people (Sunderlin and Resosudarmo, 1996). Both the agriculture and forestry sectors seem to be highly susceptible to the adverse impacts of climate variability.

III. INDONESIAN CLIMATE AND ITS SENSITIVITY TO ENSO

The climate of Indonesia is generally characterized by two seasons: dry (April to September) and wet (October to March). Based on the number of dry and wet months, the country is divided into 14 agroclimatic zones, of which 11 are considered as sensitive to extreme climate variability since rain fluctuations can upset established cropping patterns.

From 1877 to 1997, 93 percent of the drought years have been linked to El Niño events. Several studies show a clear positive correlation between normalized Indonesian rainfall anomalies and SOI (Southern Oscillation Index). While in El Niño years the onset of the monsoon is later than normal, during La Niña years the onset is earlier in most areas. Therefore, an El Niño event causes delayed planting and consequently delayed and reduced harvest. A La Niña year offers the possibility of advancing the planting season with an early increased harvest, as well as the possibility of planting an additional crop.

Although ENSO influences the climate of the entire Indonesian archipelago, it is important to note that there are discernible regional and seasonal differences. Being in the monsoonal areas, the south and southeast regions of Indonesia, comprising South Sumatra, South Kalimantan, Java, Bali and Nusa Tengara, are relatively more sensitive to ENSO. In these regions, the dry season and transition to wet season are highly influenced by ENSO. It will be important to take these regional and seasonal sensitivities into account when developing focused plans to deal with ENSO-associated consequences.

IV. THE 1997-98 EL NIÑO EVENT

Rainfall Anomalies

The extent of the 1997-98 drought in Indonesia is shown by the 1997-98 annual (March-February) rainfall percentiles calculated from 33 stations (Kirono et al., 1998). Most parts of the country suffered from reduced rainfall, with 13 of the 33 stations having the lowest rainfall on record (on the 0 percentile). The only areas approaching the 50^{th} percentile (near normal) were North Sumatra and Biak. El Niño delayed the onset of rainfall and resulted in frequent dry spells during the 1997 wet season. Both these factors caused delayed planting of wet season paddy, as enough accumulated rainfall was available only in December 1997. In Semarang, Central Java, which is one of the representative stations in the Java rice growing belt, the onset of wet season rains did not occur until 15 November (nearly a month later than normal).

The March-May 1997 rainfall was close to or even above normal across much of the country, but dry conditions prevailing across southern and eastern parts suggested an early retreat of the monsoon. By June-August 1997, the areas with substantial rainfall deficits had spread to western regions except for North Sumatra. The drought reached its peak in September-November 1997, with all parts of the country except Sumatra having extremely low rainfall, and deficits of 400-500 mm being common. By the December 1997 to February 1998 quarter, rainfall was generally close to normal except for pockets in East Kalimantan and Sulawesi, precisely the areas where large-scale forest fires occurred in early 1998.

Impacts on Agriculture and Food Security

Rice production in Indonesia is heavily influenced by the monsoon rain patterns, which have an important bearing on agricultural performance during the main (wet) and secondary (dry) seasons. The wet season normally extends from October to March and produces 60 percent of the country's annual rice crop and half of its maize, soybean and groundnuts. The dry season covers April to September, during which the remaining annual crop is produced.

The rainfall anomalies during wet season 1997-98 caused a decrease in area under rice cultivation by 380,000 ha (3.4% below the previous wet season). Farmers planted maize as a compensatory crop in areas where paddy could not be planted. The switching over to maize was to the extent of 266,000 ha more than the area normally cropped with maize (an 8% increase from the previous wet season). The reduced rice production, coinciding with the economic crisis which began in 1997, led to a 300 percent increase in the price of rice. The Government imported over five million tons of rice to maintain price levels and to ensure the availability of food to the economically weaker sections of the population.

In addition to the reduction in the main season rice crop, secondary season production was affected by the following factors:

1. The delayed harvesting of the main wet season crop during 1997-98, due to the delayed onset of rains, caused a subsequent delay in the planting of the 1998 dry season crop by one to two months, with significant production loss.

2. Grasshopper infestation, which normally affects tree crops, seriously damaged 1998 dry season field crops, particularly in Lampung province, probably because of the destruction of natural grasshopper habitats by serious forest fires in Kalimantan and Sumatra. The problems of pest attack were exacerbated by ineffective control measures, as most farmers could not afford the substantially higher cost of imported chemical pesticides, the price of which was estimated to have increased five-fold over 1997.

3. In addition to ineffective pest control during the dry season, it is estimated that fertilizer application rates were considerably lower and unbalanced, which not only reduced the physiological ability of plants to resist pest attacks but also affected grain formation. Research studies indicate that the potential yield loss due to this factor could be as high as 30 percent.

Impacts on the Forestry Sector

Probably the most disastrous event during the 1997-98 El Niño, one that caught international attention, was the widespread occurrence of forest fires with associated smoke and transboundary haze. The fires were among the most severe in the previous two decades and had a significant socio-economic impact. A study commissioned by ADB and BAPPENAS (1999) estimated the economic cost of the 1997-98 fires and drought to be in excess of nine billion dollars. The 1997-98 fires and the resulting smoke and transboundary haze became a matter of international concern. Besides Indonesia, a number of Southeast Asian countries, in particular Brunei Darussalam, Malaysia and Singapore, were badly affected. The Philippines and Thailand also suffered, though to a lesser degree. The severity and extent of the smoke haze pollution was unprecedented, affecting the health of millions of people across the region. International support had to be mobilized to suppress the fires. The experience underscored the enormity of the problem, leading the ASEAN Environment Ministers to adopt a Regional Haze Action Plan (RHAP) setting out cooperative measures to combat the perils brought by forest and land fires. The scope of the pollution resulting from the fires, especially those from peat soils and cleared conversion forest, shows that the impact was an environmental problem of global dimensions. In 1997-98, the forest and land fires in Indonesia contributed 22 percent of the world's carbon dioxide production. Over 700 million tons of carbon dioxide were released into the atmosphere, elevating Indonesia to being one of the largest carbon polluters in the world.

Responses to the 1997-98 El Niño Event

Forecasts indicating the possible onset of an El Niño event were available to the Indonesian Bureau of Meteorology and Geophysics (BMG) as early as late 1996. BMG incorporated this information into a dry season seasonal climate forecast for the entire country, which was issued to all relevant user departments at national and provincial levels in March 1997. The forecast information was communicated through the existing information network which is utilized for routine administrative functions. No urgency was attached to the timely flow of information from national to provincial to district to sub-district levels of various user departments.

In the agriculture sector, no major interventions were undertaken to manage water resources, plan appropriate agricultural inputs or minimize crop losses. In the forestry sector, following the warning of possible El Niño-induced drought, the Ministers of Environment and Forestry, and a number of provincial governors, called on everyone to be alert and to take action to prevent forest and land fires. However, these warnings were not followed up and fires began to occur in early 1997. There was little evidence of a substantial institutional fire prevention and preparedness program in place. The institutional structure to respond to early warnings and provide information and guidance to field operators about fire forecasts was highly inadequate. There were almost no procedures in place to eliminate or minimize the use of fire during dangerous periods.

V. LESSONS LEARNED

The following lessons can be learned from the experience of the 1997-98 El Niño in Indonesia:

Downscaling Climate Forecasts

1. Even though the teleconnections between local climate and El Niño events are considered strong and reliable for Indonesia, a global ENSO forecast is not directly usable on the ground. The global climate parameters need to be translated into relevant local weather variables (e.g., for rice cultivation, the onset and duration of rainfall in wet season, and number of dry spells in wet season) and related outlooks for various sectors, geographic regions and seasons.

2. The country's past meteorological data needs to be retrieved and its observational network strengthened to support a national climate research agenda to fully understand the implications of the ENSO phenomenon for the local climate in different locations of the country.

Making Climate Forecasts Actionable

3. An inter-disciplinary, multi-institutional climate forecast applications research agenda needs to be developed. BMG and other climate research centers need to establish closer working relationships with a range of intermediaries (such as agricultural, forestry and irrigation research centers), and existing and potential user organizations.

4. Under the climate forecast applications research agenda, there is a need for national researchers to review the impacts of and responses to previous El Niño events in order to identify those impacts that can be attributed to an El Niño event. Based on such studies, El Niño risk maps should be developed for various sectors, regions and seasons.

5. Based on the applications research, forecast products should be tailored to meet the needs of specific user groups. For example, for rice cultivation in a given area, instead of the usual terciles, appropriate forecast parameters may include onset of wet season rains, probability of accumulated (threshold) rainfall of 75 to 100 mm over a period of three weeks, number of dry spells, and termination of wet season rains. Thorough research may indicate that SOI has high correlation with these parameters in some areas and relatively low correlation in others. Such inter-disciplinary research is imperative for developing robust decision-making tools at national and local levels.

6. Although most critical resource sectors deal with different kinds of risks (with probabilities implicit in them) in their normal-time operations, climate forecasts

stated in probabilistic terms are difficult to understand. Greater dialogue among climate forecasters, intermediaries and users will help translate probabilities into concepts more familiar to different sectors. On one hand, this will help in making forecasts more actionable, and on the other, it will assist in making the expectations of users and intermediaries from the climate science community more realistic.

7. There is a need to create a higher level of awareness of the ENSO phenomenon and its impacts among the public and policy-makers. ENSO extremes are here to stay and must be viewed by planners not only as important, but also as the natural flow of the seasons.

8. It is also important, when it comes to potential disasters, that various departments and agencies share information about potential impacts as well as potential preventive, mitigative and adaptive strategies and tactics.

Setting Up Response Systems

9. Based on past experiences and climate forecast applications research, it is necessary to outline specific prevention, preparedness and response strategies that clearly identify institutional responsibilities and implementation inter-relationships.

10. Communication should be strengthened between different agencies at each level (horizontal), and within each agency from national to local levels (vertical). In times of El Niño-related crises, emphasis should be placed on the speedy flow of information between and within different agencies.

11. The 1997-98 fires exposed inadequacies in the forest fire management system in Indonesia. Since then, a number of national, regional and international initiatives have been underway to review and strengthen the Indonesian forest fire management structure. Wide-ranging improvements have been recommended and implemented in regulatory and legislative frameworks as well. The next El Niño event will test the implementation effectiveness of these measures.

12. Given scarce resources, it may be prudent for regional governments to undertake benefit-cost assessments in order to determine the most cost-effective responses to El Niño impacts on the environment and societies.

13. Although in the long run, effective management of the consequences of an El Niño event would require more effective management systems in critical resource sectors even in normal times, in the short term, special institutional arrangements may be required to deal with El Niño events. Such measures may include the establishment of high level task forces assisted by professional working groups at national and provincial levels.

14. There is a need for an explicit commitment of resources to support El Niño management programs.

SETTING

1. What is the socio-economic setting of your country? (Include a brief description of the government mechanisms for dealing with climate-related impacts: the ministries, task forces, and public safety mechanisms etc.)

1.1 General (geography, demography, socio-economic situation etc.)

Indonesia is the largest archipelago in the world, consisting of five main islands and about 30 smaller archipelagos totaling 13,667 islands and islets of which approximately 6,000 are inhabited. The estimated area of the Republic of Indonesia is 5,193,250 sq km, which consists of a land territory of 2,027,087 sq km and a sea territory of 3,166,163 sq km. Indonesia's five main islands are Sumatra (473,606 sq km); Java and Madura (132,187 sq km), the most fertile and densely populated islands; Kalimantan or two-thirds of the island of Borneo (539,460 sq km); Sulawesi (189,216 sq km) and Irian Jaya (421,981 sq km), which forms part of the world's second largest island of New Guinea. The Indonesian archipelago forms a crossroads between the Pacific and Indian oceans and a bridge between the Asian and Australian continents. Because of its strategic position, therefore, Indonesia's cultural, social, political and economic patterns have always been conditioned by its geographic location.

According to estimates provided by the Indonesian Bureau of Population Statistics (BPS), the population of Indonesia in mid-1997 was nearly 210 million. There are large variations in population density across different regions and provinces, with those in Java and Madura the most populated with densities ranging from 500 to 12,440 persons per sq km. Irian Jaya province has the lowest population density, ranging from 4 to 49 persons per sq km.

Over the past three decades the Indonesian economy has moved from being an agriculture-based to an industrialized economy. The share of agriculture in the country's GDP was 47 percent in 1969 (the first day of the first 25-year Development Plan). This share gradually decreased to 33 percent in 1978, 21 percent in 1988 and was around 16 percent in 1998. However, with half of the country's workforce directly dependent upon it for their livelihood, agriculture remains an important sector of the economy. During the 1980s, the agriculture sector grew at the rate of around 4 percent annually, rendered strong support to the growth of the agriculture-based manufacturing industry, and contributed an increasing share to the country's export earnings. The most noticeable achievement has been that by the mid-1980s the country shifted from being the largest rice importer to being self-sufficient in the country's main staple food.

Indonesia ranks third, after Brazil and the Democratic Republic of the Congo, in its endowment of tropical rainforests, possessing 10% of what remains of this resource globally. The approximate distribution of forest cover is Kalimantan (32% of the total), Irian Jaya (30%), Sumatra (21%), Sulawesi (10%), Maluku (5%) and other (2%), from Ministry of Forestry data reported by the World Bank (1990). Spread over about 144 million ha, the area under the jurisdiction of the Ministry of Forestry and Estate Crops (MoFEC) accounts for nearly 75% of the entire land base of the country.

Forests and estate crops (those grown on plantations) and related activities are an important sector of the Indonesian economy, both in terms of the percentage share of the GDP as well as in providing employment. Commercial exploitation of forests has grown rapidly in the last 30 years and Indonesia is now one of the world leaders in the export of tropical timber. By 1996, some 445 logging concessions were operating on 54 million ha of forest land, of which close to 1 million is estimated to be logged annually. This is more than the total area logged in all other Southeast Asian countries combined. In 1994, wood and wood products produced about US$ 5.5 billion in export revenue for Indonesia, representing about 15% of its total foreign earnings and employing 700,000 people (Sunderlin and Resosudarmo, 1996).

The recent development process has placed increasing demands on the outer islands where most of Indonesia's forest and land resources are. These closed canopy forests account for over half of all forested area in Southeast Asia, and more than 95% of the forests of Indonesia. They serve both productive and protective roles in the country. Yet in the 1980s, programs were sponsored by the government to put massive tracts of land into production, promoting a rapid growth in local land use and the exploitation of timber and other forest products. The result has been a sharp increase in the rate of deforestation and an uneven land use (World Bank, 1990). Over the last few decades, the industrial policy has been such that large numbers of sawmills and pulp mills have been established, whose timber requirements exceed the capacity for sustainable forest utilization in the areas where they are located (ADB, 1999).

In the last few years, the economic crisis has led to profound changes affecting the forest sector and land use in general. A complex interplay of market demand, wood supply and fluctuating prices governs the state of the commercial timber sector. Depressed markets in early 1998 had led to a situation of near-bankruptcy in the wood processing industry. However, regional demand for Indonesian wood is now expected to surge following a Chinese policy to severely restrict logging. In the aftermath of the 1997-98 fires, the likely result will be increased damage in production forests and unauthorized logging in protected forests.

The conversion of forest land to agriculture also poses a threat to natural forest cover and forest-dependent peoples. Earnings from oil palm plantations, cocoa and coffee on newly cultivated land are strong, because of low production costs and high international prices. Indonesia is the world's second largest producer of natural rubber and palm oil, the world's third largest producer of coffee, and fourth largest producer of cocoa. Such plantations may only be established on lands designated for conversion to agriculture. *There is a natural temptation in such circumstances to burn degraded production forests,* *where the potential for earnings is low, in order to force a reclassification to conversion forest. This is leading to pressure on the regulatory authorities, notably MoFEC.*

The 1997-98 forest and land fires in Indonesia (and related transboundary haze throughout Southeast Asia) were among the most severe forest fires in the last two decades. A number of initiatives have been undertaken to assess the extent of damage, understand the causes, and evolve strategies to establish effective fire management systems to prevent the recurrence of such large-scale fires. Most studies raise questions about the sustainability of the current forest management practices in Indonesia. They link vulnerability of Indonesian forests to fundamental issues of forest management and the role of communities, local government and the private sector. A more detailed discussion on these issues is presented in later sections of this report.

1.2 The Climate of Indonesia

The Indonesian climate is generally characterized by two seasons: wet and dry. The spatial and temporal distribution of rainfall is governed by monsoons. The wet season starts rather abruptly when the northwest monsoon reaches Indonesia. This occurs in late August in the northwest part of Indonesia and later (December) in the southeastern part. The dry season starts more gradually, first in the southeastern part of Indonesia, but later also in the northwestern sections of the country. The time of monsoon onset broadly determines the length of wet and dry seasons. The early onset and late withdrawal of the monsoon results in a lengthy wet season. Conversely, late onset and early withdrawal of monsoon entails a relatively short rainy season and a longer dry season. The approximate times of monsoon onset and withdrawal in various regions of Indonesia are shown in Table 1.

Table 1: Onset and Withdrawal of Monsoon in Various Parts of Indonesia

Regions	Onset	Withdrawal	Length of Wet Season (months)
North Sumatra	Late August	June	9
Southeastern Sumatra	First week of September	June	8
West Java	October-November	May	7
Central Java	November	April	6
East Java	November-December	April	5
Bali NPT	December	March	4

Source: Based on agro-climatic maps of Java, Sumatra, Sulawesi, Kalimantan, Maluku, Irian Jaya and Bali

1.3 *The Agroclimatic Zones of Indonesia*

Under rain-fed conditions, Indonesian farmers depend almost completely on precipitation for crop cultivation. From a crop production perspective, if the amount of water required for wetland rice cultivation is at least 150 mm, then a mean monthly rainfall of 220 mm is required to satisfy this need.[1] Similarly, a mean monthly rainfall of at least 120 mm is needed to satisfy a 70 mm consumptive demand for secondary crops.

These considerations have led to the following definitions:[2]

- A wet month has a mean monthly rainfall of at least 200 mm.
- A dry month has a mean monthly rainfall of less than 100 mm.

Based on these definitions, the following classifications are made:[3]

Zone A has more than nine consecutive wet months. In this zone, wetland rice can be cultivated at any time of the year.

Zone B has seven to nine consecutive wet months. Two wetland rice crops can be cultivated in this zone.

Zone C has five to six consecutive wet months. In this zone, two rice crops can be cultivated only if the first rice crop is planted (or sown) as a dry land crop (Gogorancah system).

Zone D has three to four consecutive wet months. Only one wetland rice crop is generally possible in this zone.

Zone E has less than three consecutive wet months. In such areas, wetland rice cultivation is not recommended unless additional water from irrigation systems is available.

These five zones are further subdivided based on the length of the dry season:

Subzone 1 has less than two dry months. In such areas, no restrictions are expected with regards to availability of water.

Subzone 2 has two to three dry months. In such areas, careful planning is required to grow crops throughout the year.

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[1] The 70 mm difference is to take into account the water unavailable to the rice crop due to evaporation to the atmosphere as well as percolation into the soil.
[2] The wet and dry months are defined to reflect critical minimum water required for rice crops.
[3] Based on the work of the Central Research Institute for Agriculture, Bogor.

Subzone 3 has four to six dry months. A fallow period is part of the rotation system because of water constraints.

Subzone 4 has seven to nine dry months. Only one crop can be successfully cultivated since the remainder of the year is too dry.

Subzone 5 has more than nine consecutive dry months. Areas in this subzone are generally not suitable for any cultivation of arable crops.

Combinations of the above classifications define the agroclimatic zones (Table 2). For example, A1 means nine consecutive wet months and less than two dry months. This classification system leads to 18 agroclimatic zones, of which 12 can be identified in Indonesia.

Table 2: Percentage Occurrence of Different Agroclimatic Zones in Indonesia

Agro-climatic Zone	A1	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3
Sumatra	24	46	1	6	9	0	10	2	0	0	2	0
Sulawesi	1	21	4	10	11	4	10	8	4	12	11	4
Java	4	16	7	0	25	14	0	5	20	0	0	9
Kalimantan	40	50	1	8	7	0	3	1	0	5	1	0

Source: Central Research Institute for Agriculture, Bogor, Indonesia

In general, A and B zones are considered climatically stable where two paddy crops are possible. *However, from C to E agroclimatic zones are climate sensitive as rain fluctuations can upset the established cropping pattern. The crop production in these zones is influenced by extreme climate events.*

While in El Niño years the onset of the monsoon is later than normal, during La Niña years the onset is earlier than normal in most areas. Therefore, an El Niño event causes delayed planting and consequently delayed and reduced harvest. A La Niña year has the potential for an advanced planting season and an early increased harvest, as well as freeing land for one additional crop. The La Niña forecast, therefore, assumes significant importance in planning and restructuring of cropping patterns to gain advantage from increased precipitation and to minimize damage.

1.4 Climate Prediction in Indonesia

The Bureau of Meteorology and Geophysics (BMG) is the main agency responsible for producing climate forecasts in Indonesia. Prior to 1997, the BMG generally issued weather forecasts keeping in view meteorological parameters. From 1997 onwards, the BMG has taken the initiative to establish a broad-based National Seasonal Forecasting Working Group drawing upon expertise from various sectors. This Working Group comprises the BMG, Bureau of Assessment and Application of Technology (BPPT), the National Space Center (LAPAN), the Agriculture Research Institute and the Water Resources Management Research Institute.

The Working Group draws upon forecast information from the International Research Institute (IRI) and obtains inputs from the ASEAN Specialized Meteorological Centre, BOM Australia and the UK Meteorological Office to prepare seasonal forecast guidance that includes:

- Seasonal monsoon onset forecast indicating the dates of onset with ten-day intervals for 102 meteorological regions across the country.
- Monthly rainfall forecast for the 102 meteorological regions.
- Seasonal cumulative rainfall status for the entire season for the 102 meteorological regions.

Institutionally, BMG is part of the Ministry of Transportation. BPPT and LAPAN are both under the Ministry of Science and Technology.

1.5 Disaster Management in Indonesia

The sixth Five-Year Development Plan of Indonesia *(Repelita VI)* has specifically identified disaster management as a priority action area. *Repelita VI* emphasizes the need to pursue disaster management in its full range – prevention, preparedness, relief, rehabilitation and reconstruction – on a cross-sectoral basis with emphasis on community level understanding and action to reduce the risk of any kind of disaster. The plan identifies a range of action areas to strengthen disaster management in the country. The need for integrated and coordinated measures to be taken before, during and after a disaster, and established "non-structural" coordination mechanisms at national, provincial and district levels is also recognized. Such mechanisms are described in the following sub-sections.

National Level

At the national level, coordination of the various departments and agencies involved in disaster management is to be accomplished through the National Disaster Management Coordinating Board (BAKORNAS *Penanggulangan Bencana*). Established and reconstituted by a succession of Presidential Decrees (*Keppres No. 256/1996, Keppres No. 28/1979, Keppres No. 43/1990*), BAKORNAS PB operates under the chairmanship of the Coordinating Minister for People's Welfare and includes on its Board the Ministers of

Social Affairs, Home Affairs, Public Works, Health and Transport, the Commander of the Armed Forces, the Director General for Social Assistance in the Ministry of Social Affairs, and the Governors of disaster-affected provinces.

Similar disaster management task forces exist at the provincial (SATKORLAK PB) and district levels (SATLAK PB) that operate under the aegis of BAKORNAS PB. The responsibilities of BAKORNAS PB include:

- formulation of policies and programs for integrated, coordinated and sustainable disaster prevention and management;
- coordination of prevention efforts before, during and after disaster events;
- preparation of guidelines for integrated planning;
- coordination of inter-agency cooperation between government and non-government agencies at national and international levels; and
- coordination of collection and distribution of aid for disaster victims.

It is noteworthy that until recently, neither the Environmental Impact Protection Agency (BAPEDAL) nor MoFEC were represented on the Board of BAKORNAS PB. However, both agencies are now represented, wherein MoFEC deals with fire suppression issues and BAPEDAL represents concerns related to public education, awareness generation and policy reform.

Provincial Level

At the provincial level, coordination is accomplished through the Office of the Governor who chairs the SATKORLAK PB, which has provincial level representatives of the departments that are represented in BAKORNAS PB.

District Level

At the district level, similar arrangements exist where the SATLAK PB carries out mobilization of the above-mentioned representative offices. However, unlike BAKORNAS PB and SATKORLAK PB, these are more operational units and constitute the primary mechanism for disaster management in the provinces. The responsibilities of SATLAK PB include:

- implementation of disaster management at local level through the use of local people, facilities and resources; and
- implementation of prevention measures in cooperation with municipality administrations through education, training and better preparedness.

1.6 Forest Fire Management System

At the national level, the main operational responsibility for forest fire management seems to lie outside the core disaster management structure of the country and within the purview of MoFEC and the Ministry of Environment (BAPEDAL). BAKORNAS PB, the national focal point for disaster management, does not have an ability to establish permanent links with field fire-fighters. However, with the recent inclusion of MoFEC and BAPEDAL on its Board, BAKORNAS PB has a greater role to play in fire prevention and suppression issues. MoFEC possesses extensive power over private concessionaires in terms of activities that such companies are required to implement for planning, preparation, detection, suppression and rehabilitation of fires and fire areas. The regulatory framework defining the respective roles of MoFEC and BAPEDAL in forest fire management is complex and requires streamlining. At the district level, mainstream disaster management activity seems to converge with fire prevention and suppression activity where SATLAK is mobilized through the provincial fire centers. With the inclusion of MoFEC and BAPEDAL on the Board of BAKORNAS PB, there seems to be some streamlining of fire prevention and suppression functions at the national level. However, this is not likely to translate automatically into better fire prevention and suppression at the local level. *The financial crisis at all levels of the government and the prevailing political uncertainties are major impediments.*

1.7 Other Departments and Agencies Responsible for Dealing with Climate-related Impacts

The Agency for the Management of Agricultural Production (BIMAS) under the Ministry of Agriculture is responsible for better management of agricultural production, whereas the Agency for National Logistic Management (BULOG) coordinates efforts for ensuring food security in Indonesia. The Water Reservoir Authority under the Minister of Public Works is responsible for coordinating countermeasures taken in anticipation of floods. This agency also works with the Weather Modification Unit of BPPT to produce artificial rain to reduce the impact of drought. The Ministry of Health is responsible for surveillance of weather conditions with regard to conditions favorable for the outbreak of epidemics and other diseases.

2. What are the climate-related and other natural hazards affecting your country? (List them in order of concern.)

The islands of the Indonesian archipelago are prone to many different kinds of natural hazards: floods, droughts, landslides, volcanic eruptions and agricultural pest outbreaks.

2.1 Floods

Among climate-related hazards, the greatest risk to life, property and the environment is from flooding that affects some part of the country every year. Two main types of floods *(banjir)* occur regularly: rainwater floods and storm surges.

Rainwater floods are caused by heavy rainfall occurring over floodplain and terrace areas during the wet season. However, the transitional periods between the wet and dry seasons in this region, the so-called inter-tropical convergence zone (ITCZ), may bring additional rainfall. Inter-monsoon rains are frequently stronger than the monsoon rains proper. The worst flood ever recorded in Indonesia happened in 1861 in Eastern Java, when four days of continued rain caused some rivers to swell 12-18 m above their mean level. Plantations and gardens were destroyed, irrigated rice fields *(sawah)* washed away, and fields and pastures in the plains were covered with mud and rubble, in some places one meter deep. Fortunately, not all floods reach such catastrophic proportions, mainly because island watersheds are relatively small. Yet the consequences of many minor disasters are still serious, especially since flooding always brings significant disruption to economic activity and everyday life.

The second type of flooding that brings devastation to Indonesian coastal regions are the so-called storm surges, or raised sea levels, caused by a combination of low barometric pressure and strong onshore winds. They cause sudden, but temporary, flooding along the coast with seawater or brackish estuarine water for a few kilometers inland. Many settlements in low-lying coastal regions, that are also the most heavily populated, are the primary victims of storm surges. The mitigation measures they require differ from those occurring on river floodplains, so they can almost be viewed as two kinds of natural hazards.

2.2 Droughts

The southern and eastern parts of Indonesia are relatively more drought-prone than the northern and western parts.[4] The prolongation of a dry season, particularly during El Niño years, causes serious drought in these areas. Annually, on average, 280,000 hectare under paddy cultivation are affected by drought to varying degrees. Nearly 160,000 farm households are vulnerable to these periodic droughts. Even during La Niña years (generally characterized by more than average rainfall), localized droughts affect 30,000 to 80,000 hectare under paddy cultivation. During El Niño years, widespread droughts affect 1 to 3 million hectare under paddy cultivation. The shifting of cultivation of crops from paddy to secondary crops, and resorting to migration, are the usual coping strategies to tide over drought-induced distress. Besides agricultural droughts, shortage of potable water supply and related public health problems are the usual anticipated crises. Table 3 shows paddy cultivation area affected by floods and droughts during the period 1988 to 1997.

[4] Based on length of dry and wet seasons, Indonesia is divided into 12 agro-climatic zones. Of these, three zones are considered climatically stable for paddy cultivation. The rest are considered climate sensitive as the rain fluctuations can upset the established cropping pattern. Most of these areas lie in Java and Sulawesi. It is noteworthy that nearly three-fourths of Java Island, that accounts for 60% of the country's rice production, is sensitive to climate variability.

2.3 Landslides

Among Asian countries, Indonesia is particularly vulnerable to landslides because of mountainous topography in many regions and a large number of active volcanoes (mudflows or lahars). The former type is almost exclusively linked to precipitation. Chronic landslides that creep imperceptibly in the dry season would suddenly increase their speed in the rainy season. Agricultural practices (e.g., through deforestation and farming of hill slopes) contribute to the landslide problem, especially in Java, the country's most populous island.

2.4 Volcanic Eruptions

The Indonesian archipelago is one of the most active volcanic regions of the world, with more than 120 volcanoes. The country heads the list of world regions at high risk of explosive eruptions. If a map of active volcanoes is superimposed on population density maps, Indonesia, together with Japan, emerges as the area with highest volcanic risk. About ten percent of the Indonesian population lives in the vicinity of active volcanoes, and about three million people live in the actual danger zones.

Table 3: Paddy Cultivation Area Affected by Flood and Drought 1988-97 (hectare)

Year	Flood		Drought		Remarks
	Partial Damage	Total Damage	Partial Damage	Total Damage	
1988	130,375	28,934	87,373	15,115	La Niña
1989	96,540	13,174	36,143	2,116	
1990	66,901	9,642	54,125	9,521	
1991	38,006	5,707	867,997	192,347	El Niño
1992	59,360	9,615	42,409	7,267	
1993	78,480	26,844	66,992	20,415	
1994	132,973	32,881	544,422	161,144	El Niño
1995	218,144	46,957	28,580	4,614	La Niña
1996	107,385	38,167	59,560	12,482	
1997	58,974	13,787	504,021	88,467	El Niño
Average	**98,714**	**22,571**	**229,162**	**51,349**	

Source: Directorate of Crop Protection, Ministry of Agriculture, Government of Indonesia

2.5 Agricultural Pest Outbreaks

Around 200,000 hectare of paddy cultivation area are vulnerable to agricultural pest attacks annually.

3. What was the level of scientific research in your country relating to El Niño?

Since 1864 when climate observations in Indonesia began, a number of Dutch, Australian, Japanese and Indonesian meteorologists have carried out extensive research on climate behavior in the Indonesian region. Some of the publications emanating from these efforts have been referred to in the Teleconnections section of this report. Soon after the Walker Circulation was identified as an important climate phenomenon governing atmospheric circulation, research began on ENSO's impacts on the Indonesian regional climate. Since the 1930s, attempts have been made to understand the impacts of ENSO on Indonesia's climate. However, most of the research activities have been confined to understanding the impact of ENSO on the Indonesian regional atmospheric circulation patterns and its impact on rainfall behavior in different parts of the country. No appreciable research activities seem to have been undertaken on application of climate forecasts in decision-making and resource management.

4. Identify and document (with citations, if possible) the historical interest, if any, in the country (popular, political, media etc.) in El Niño before the onset of the forecast and/or impact of the 1997-98 event.

Even in the early phases of global research on El Niño, it was known that it has a significant impact on rainfall in Indonesia. Therefore, there has always been considerable interest in establishing a relationship between ENSO and the physical climate of Indonesia. Since the mid-1980s, efforts have been made to use ENSO as a predictor for anticipating rainfall variability in Indonesia.

The following are a few examples of publications related to ENSO and its impact on Indonesia:

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Lennertz, R., and K.F. Panzer. 1984. Preliminary Assessment of the Drought and Forest Damage in Kalimantan Timur. Trans-migration Area 8 Development Project (TAD). Report of the Fact Finding Mission. Samarinda, Indonesia.

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McBride, J., Drosdowsky, W., Kirono, D., Dodo Gunawan, Soetamto and Winarso, P. 1998. Inter-annual Variability of the Indonesian Monsoon. Abstracts, International Conference on Monsoon and Hydrologic Cycle. 22-25 April. Kyongju, Korea.

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Nicholls, N. 1983. The Southern Oscillation and Indonesian Sea Surface Temperatures. *Mon. Wea. Rev*., 112: 424-432.

Nicholls, N. 1993. ENSO, Drought and Flooding Rain in Southeast Asia. In *Asia's Environmental Future: The Search for Sustainability*, H. Breakfield and Y. Byron (eds). Oxford University Press and United Nations University Press. Kuala Lumpur.

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Oldeman, L.R. 1975. An agroclimatic map of Java. *Contributions from the Central Research Institute for Agriculture*, 13: 1-22. Bogor, Indonesia.

Philander, S.G.H. 1983. El Niño Southern Oscillation phenomena. *Nature*, 302: 295-301. U.K.

Quinn, W.H., D.D. Zopf, K.S. Sort, and T.R.W. Kuo Yang. 1978. Historical trends and statistics of the Southern Oscillation-El Niño and Indonesian droughts. *Fishery Bulletin*, 76: 3. U.S.A.

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Stone, R. 1996. Prediction of global rainfall probabilities using phases of the Southern Oscillation Index. *Nature*, 384: 252-255.

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1997-98 EVENT

1. Trace the flow of information on the 1997-98 El Niño within your country, using the following guidelines:

a. When did the various agencies first hear about this developing El Niño?
b. Where did the information come from?
c. When did they first hear it would be a strong event? From whom?
d. Which agencies first received the information?
e. Were these the appropriate agencies to first receive the information?
f. How was the information obtained?
g. How was the information transmitted?
h. How did the media first report the developing El Niño?
i. How did the media cover the event over time? (Quote headlines, names of radio stations, TV programs etc., with dates.)
j. Was the 1997-98 El Niño compared with any previous events?

[NB: During the course of this study, it proved difficult to find answers to questions related to information flow and to support them with concrete evidence. This section is mostly based on discussions with senior officials who were in key positions in both climate information producer agencies as well as user departments.]

In October 1996, the Climate Variability Branch of the Indonesian Agency for Application and Assessment of Technology (BPPT) received information from NOAA on the possible onset of El Niño in early 1997. This information was shared with the Indonesian Bureau of Meteorology and Geophysics (BMG) in November 1996. Some of the reports (e.g., UNDP, 1998) indicate that in December 1996, BMG alerted government departments about the possibility of an El Niño-related drought in the following year. In March 1997, BMG received information about the possibility of a strong El Niño event from NOAA, the IRI and the ASEAN Specialized Meteorological Center (ASMC). BMG incorporated this information into its dry-season climate forecast for the entire country, which was issued to all relevant user departments at the national and provincial levels in March 1997. The forecast information was communicated to various user departments at various levels through the existing information flow network, which is utilized for routine administrative functions. *No urgency was attached to the timely flow of information from national to provincial to district to sub-district levels of various user departments.*

2. Before the mention of the 1997-98 El Niño, when was the previous mention of El Niño in the media?

No information could be accessed in this regard.

TELECONNECTIONS

1. What are the scientific views on the existence and strength of El Niño teleconnections in your country?

The linkage between El Niño events and drought in Indonesia has been well authenticated scientifically. Early documentary evidence of this linkage may be found in the works of Dutch meteorologists such as Braak (1919, 1929) who, reporting dry-season smoke haze, showed that it became particularly pronounced during anomalously dry periods. Berlage (1927) was another who linked extremes of Indonesian rainfall to variations of the Southern Oscillation. More recently, Nicholls (1981, 1983), Hackert and Hastenrath (1986), Hastenrath (1987) and Yamanaka (1998) are among authors who have cited evidence demonstrating the interplay between El Niño and Indonesian drought and, consequently, the occurrence of fires and associated haze.

During those earlier times, of course, the relationship was not specifically related to El Niño, then regarded as a local phenomenon affecting principally Peru and its fishing industry. The realization of its global impact is comparatively recent, perhaps in part as a result of the 1982-83 El Niño. The generalized global effect of El Niño on rainfall is shown in Figure 1.

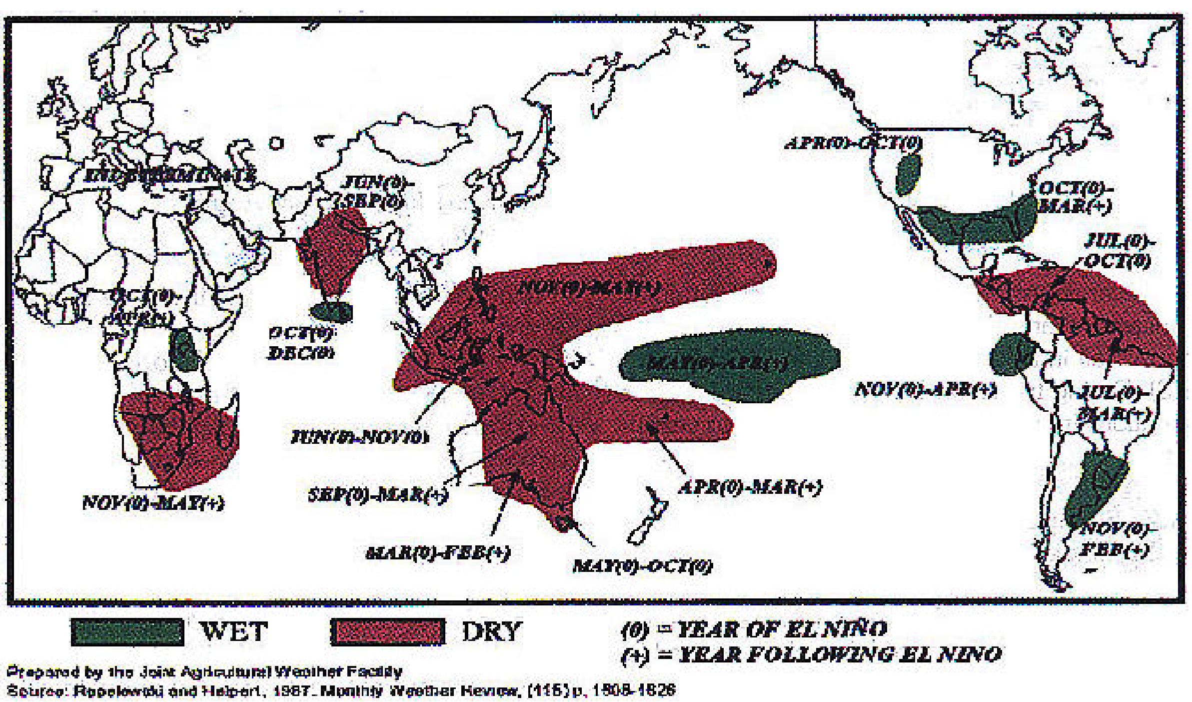


Figure 1: Effect of El Niño on Rainfall

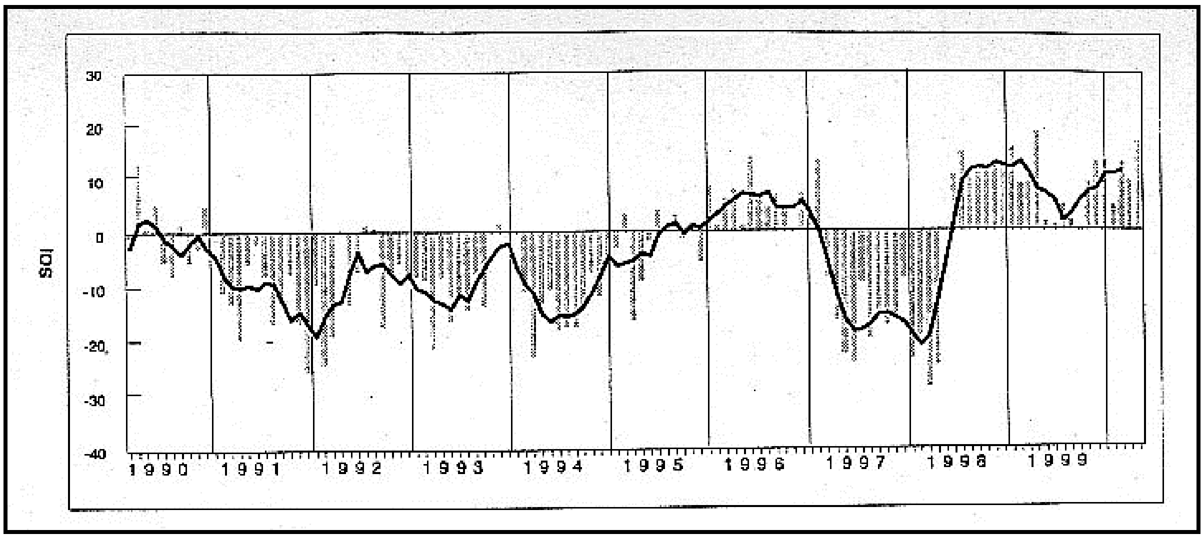
Climate observations in Indonesia began in 1864 and the occurrence of El Niño events from 1844 to 1998 is shown in Table 4.

Table 4: El Niño and Drought Events in Indonesia 1844-1998

1844-1896		1902-1998	
Drought Year	**El Niño Onset Year**	**Drought Year**	**El Niño Onset Year**
1844 - 45	1844	1902 - 03	1902
1845 - 46	1845	1905 - 06	1905
1850 - 51	1850	1913 - 14	1914
1853 - 54	None	1918 - 19	1918
1855 - 56	1855	1823 - 24	1923
1857 - 58	1857	1925 - 26	1925
1864 - 65	1864	1929 - 30	1929
1873 - 74	1873	1932 - 33	1932
1875 - 76	1875	1935 - 36	None
1877 - 78	1877	1940 - 41	1939
1881 - 82	1880	1941 - 42	1941
1883 - 84	None	1944 - 45	1943
1884 - 85	1884	1945 - 46	1946
1888 - 89	1887	1953 - 54	1953
1891 - 92	1891	No data	1954 - 1975
1896 - 97	1896	1976 - 77	1976
		1982 - 83	1982
		1986 - 87	1986
		1991 - 92	1991
		1994 - 95	1994
		1997 - 98	1997

Source: Quinn (1978), National Development Planning Agency (BAPPENAS), 1999

Of 28 drought years[5], 20 were associated with strong ENSO events. Of the remaining eight, six accompanied weak El Niños. Thus 93 percent of drought years over a period of 120 years were linked to El Niño events. There is some indication of more frequent and severe droughts since 1960 but further research is needed to confirm this. However, Table 4 provides strong documentary evidence of the link between El Niño and Indonesian drought and fire. Although fire information is limited prior to 1982, all instances of widespread fire activity were associated with strong ENSO events. Furthermore, official figures indicate a relationship between the level of the Southern Oscillation Index (SOI) and the area of forest burnt. In seasons when the SOI remains above –10 the area is relatively small; when the SOI falls below –10 the area burnt appears to increase dramatically.[6] Figure 2 shows the values of the SOI over the period from 1990 to the present.



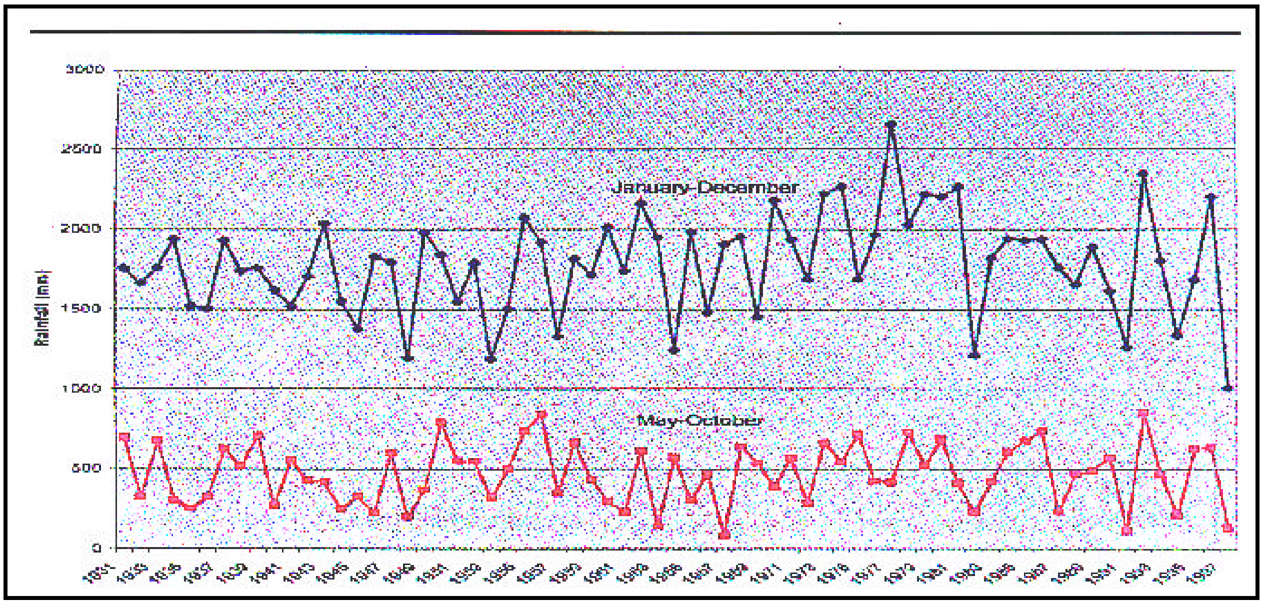
Source: BMG, Indonesia

Figure 2: Southern Oscillation Index 1990-1999

[5] During the course of this study, the team did not find a clear definition of meteorological, hydrological or agricultural drought utilized in Indonesia. Generally, a particular year is categorized as a drought year if there are large-scale crop failures (i.e., an agricultural drought).

[6] Although there seems to be a correlation between SOI and forest area burned, it cannot be concluded that El Niño is the most significant causative factor of these fires. In the aftermath of the 1997-98 fires, a number of initiatives were undertaken that identified underlying social, economic and institutional causes. The complex interplay of these underlying causes has led to large-scale forest fires in El Niño years during the last two decades. Historical records from the late 19th century and early part of the 20th century indicate that while there were droughts during El Niño years, there were scarce incidents of forest fires.

Prior to 1950, pioneering work on climate anomalies, inter-annual rainfall variability and seasonal forecasting was carried out by Berlage (1972, 1934), De Boer (1947) and Euwe (1949). Nicholls (1981) demonstrated that fluctuations of early wet season rainfall at a number of Indonesian locations could be predicted from prior observations of atmospheric pressure anomalies which were, in turn, related to anomalies in sea surface temperatures. Similarly, Hastenrath (1987) showed that the inter-annual variation of Jakarta rainfall could, to a large extent, be predicted from earlier pressure anomalies at Darwin. These teleconnections are clearly linked to ENSO. In this connection, it is interesting to examine Jakarta annual rainfall variations and for the dry season over the years from 1931 to 1997 (Fig. 3). The linkage between periods of drought and El Niño years is clearly apparent.



Source: BMG, Indonesia

Figure 3: Variation in Annual Rainfall (January-December) and Dry Season (May-October) in Jakarta from 1931 to 1997

More recently, data from 157 stations for the period 1961-90 have been used to study the onset and withdrawal of the rainy season, its late onset and decreased rainfall in El Niño years, and other aspects of the Indonesian rainfall regime (Yamanaka, 1998). This study shows a clear positive correlation between normalized Indonesian rainfall anomalies and the SOI.

Currently, a number of studies are in progress by scientists from both national and international agencies to explore possible correlations as predictive indicators in seasonal forecasting (see McBride et al., 1998; Kirono et al., 1998). Results suggest that there is an impressive degree of agreement among scientists working on Indonesian rainfall variability, both in relation to its links with ENSO and to the spatial coherence of the ENSO signal in the area.

It is important to note that although ENSO influences the climate of the entire Indonesian archipelago, there are discernible regional and seasonal differences. The long-term mean seasonal rainfall in the southern part of Indonesia is generally less than that in the northern part. In the western part, i.e., over Sumatra and Kalimantan islands, the variation of total rainfall from one season to another season is quite low. Most of these areas are defined as non-monsoonal where the rainfall exceeds 450 mm in any consecutive three months (BMG, 1991), which is the minimum rainfall required to sustain a paddy crop. Being in the monsoonal areas, the southern and southeastern regions of Indonesia, comprising South Sumatra, South Kalimantan, Java, Bali and Nusa Tengara, are relatively more sensitive to ENSO. In these areas, among all seasons, dry season and the transition to wet season are highly influenced by ENSO.

The SOI has a strong degree of persistence, such that it tends to retain the same value over the following months. Thus, once an ENSO event is established, its persistence from one season to another can be used as a tool to predict seasonal rainfall. Following the methodology applied to Australia by McBride and Nicholls (1983), maps of lag correlation have been produced between the SOI and Indonesian rainfall in the following season. It is established that the greatest simultaneous relationship with SOI is for both June-July-August and September-October-November rainfall. Three-month lag correlation between SOI and these two seasonal rainfalls is of value for predicting the possible rainfall pattern. The seasons with their relative sensitivity to ENSO are shown in Table 5.

Table 5: Relative Sensitivity of Seasons to ENSO

Months/Season	Correlation with SOI in Previous Quarter
Mar-Apr-May/transition to dry season	Low
Jun-Jul-Aug/dry season	High
Sep-Oct-Nov/transition to wet season	High
Dec-Jan-Feb/wet season	Nil

Source: Kirono et al., 1998

BMG's forecasts for the onset of dry and wet seasons exhibit a high level of skill. However, the skill in forecasts of rainfall distribution during the seasons is moderate. *It would be important to take regional and seasonal sensitivities into account, while developing focused plans to deal with ENSO-associated consequences.*

2. If known, what were the climate-related anomalies and impacts of the 1982-83 event in your country?

The analysis of rainfall data (Table 6) during 1982-83 indicates that the end of the dry season during 1982 was delayed by about 20 days with no significant rainfall for four to five months in the main paddy-producing regions. The 1982-83 wet season was delayed by about 30-40 days. The impact of dry and wet seasons on paddy crop was well pronounced.

Table 6: Rainfall at Selected Stations in Rice-Producing Areas 1982-1983 (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
West Java												
Jatiwangi												
30 yr. average	(461)	(405)	(264)	(264)	(159)	(83)	(59)	(30)	(43)	(109)	(259)	(417)
1982	538	612	245	310	90	20	2	1	0	55	40	379
1983	360											
Central Java												
Tegal												
30 yr. average	(369)	(307)	(243)	(129)	(117)	(84)	(62)	(39)	(46)	(52)	(120)	(253)
1982	403	346	274	236	12	55	2	6	0	21	14	62
1983	472											
East Java												
Madiun												
30 yr. average	(273)	(271)	(264)	(232)	(156)	(78)	(43)	(25)	(27)	(79)	(191)	(243)
1982	118	183	330	259	0	0	3	0	0	0	NA	196
1983	284											
Bali												
Denpasar												
30 yr. average	(334)	(276)	(221)	(88)	(75)	(70)	(55)	(43)	(42)	(106)	(168)	(298)
1982	334	267	145	53	2	1	0	3	0	1	79	35
1983	146											
South Sulawesi												
Ujung Pandang												
30 yr. average	(714)	(515)	(423)	(154)	(95)	(65)	(32)	(14)	(11)	(45)	(183)	(581)
1982	648	482	434	109	77	6	0	0	0	0	30	323
1983	348											

Source: USDA, 1983

|——| Denotes dry season

In the main producing areas of Java, the 1982 dry season crop was planted in April-May more or less on schedule, but started to suffer from water shortage as the season progressed. During this season, there was a reduction of harvested area of more than 10 percent for East, Central and West Java, as compared to the previous dry season.

Because of the late arrival of the monsoon at the end of 1982, delays in planting occurred for the wet season rice, which was in the ground by the end of December instead of early November. The compression of the 1983 wet season harvest (April) put extreme pressure on the overall harvest, milling and storage system.

During 1982-83, paddy production was 31.7 million metric tons against the expected production of 34.3 million tons, entailing a loss of 2.6 million tons. Farmers switched from paddy to maize, a more drought-resistant crop, when the first signs of the drought occurred. A 56 percent increase in maize production partly offset the fall in the 1983 wet season rice crop. However, the per capita food production index declined from 136 in 1981 to 131 in 1982. The loss of 340 lives was reported and damage was estimated at US$ 500 million.

Another, in some ways even more serious, impact of the 1982-83 El Niño, was the fires that ravaged the tropical forests in East Kalimantan and adjacent parts of Malaysian Sabah. The fires, which damaged 3.6 million hectare in Kalimantan and another one million hectare in Sabah, burned for almost three months. Twenty-three percent of the area affected was primary forest, 40 percent logged forest, 24 percent secondary forest and areas of shifting cultivation, and the remaining 16 percent peat swamp forest.

The annual average rainfall of more than 2,000 mm is normally sufficient to make the forests almost invulnerable to drought. However, the lack of rain in 1982-83 caused evergreen trees to shed their leaves, resulting in a build-up of dry litter on the forest floor. The common practice of deliberately starting fires to clear land for agriculture may have caused them to spread rapidly through the litter. Forest logging areas also suffered badly because organic debris from the logging was left on the forest floor. The drought also resulted in the drying out of areas of peat swamp forest which, once ignited, burned in great, slow underground fires. Studies have revealed that only 11 percent of undisturbed forest was burnt, indicating that human activities such as logging and land clearance by subsistence farmers were the primary causes of the fires.

Smoke pollution from the fires brought hazards and health problems to a wide area, spreading 1,500 km westwards to reach the Malaysian peninsula. It was sufficiently dense to reduce visibility to levels requiring the closure of airports and ports. Respiratory, eye and other health disorders affected large numbers of the population in the smoke-shrouded areas.

While Indonesia's intensively developed agricultural system recovered fairly quickly from the El Niño drought, the delicate ecosystem of the East Kalimantan tropical forests would take much longer to return to a normal state.

3. What were the climate-related physical and social impacts of the 1997-98 El Niño in your country? (Include agriculture, health, water supply, migration etc.)

The 1997-98 El Niño has been described as the most important climate event of the twentieth century. Global in impact, it brought loss of life and destruction of private and public infrastructure, affected food production and storage, and caused outbreaks of disease. Indonesia was not spared.

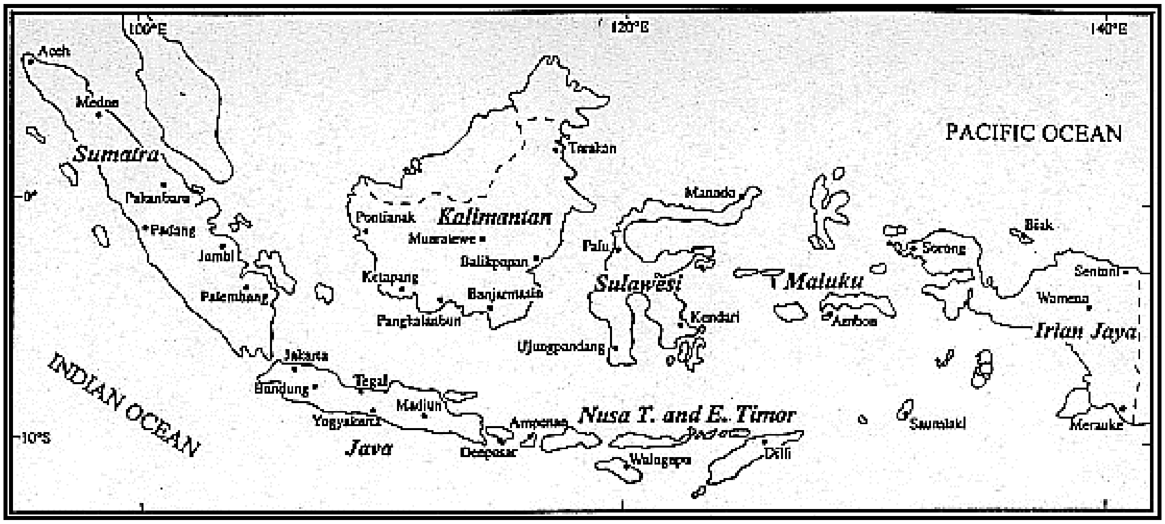
Table 7 shows the SOI values in 1997-98 and indicates how the negative values built up from March 1997 onwards. In January 1998, the WMO El Niño Update (No. 3) categorized the current event as the strongest El Niño on record. With higher temperature rises than previously recorded, it developed rapidly throughout the central and eastern tropical Pacific Ocean during April and May 1997, reaching its strongest intensity by June. In the second half of the year, the episode became even more intense than the major El Niño of 1982-83. By January 1998, the volume of El Niño's warm water pool had decreased by about 40 percent from its maximum in early November 1997. However, this warm pool had so much energy that it was expected to continue to dominate world climate patterns until mid-1998. The same WMO Update also suggested that the forest fires in Indonesia that had spread smoke and haze throughout Southeast Asia since August 1997 were due in part to El Niño's impact on the region (see below).

Table 7: Values of Troup's Southern Oscillation Index (SOI) (Darwin) for 1997-98

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	+4	+13	-8	-16	-22	-24	-9	-20	-14	-17	-15	-9
1998	-24	-19	-29	-25	0	+10	+15	+10	+11	+11	+13	+13

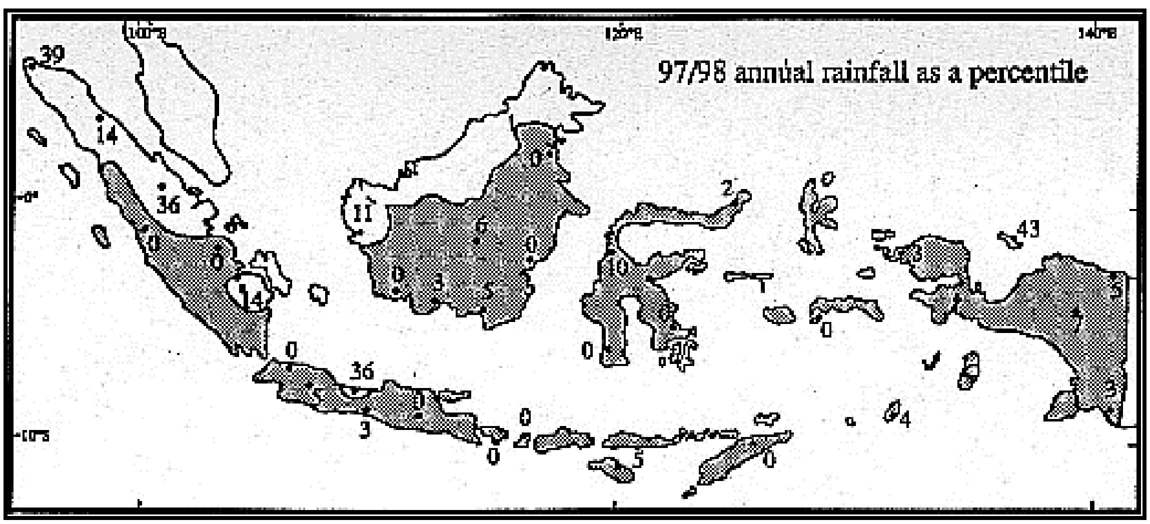
Source: BMG, Indonesia

The extent of the drought in Indonesia is shown by the 1997-98 annual (March-February) rainfall percentiles calculated from 33 stations (Kirono et al., 1998). It is clear that all areas suffered from reduced rainfall, with 13 of the 33 stations having the lowest rainfall on record (on the 0 percentile). The only areas approaching the 50^{th} percentile (near normal) were North Sumatra and Biak. Interestingly, 75 percent of the stations reported lower rainfall during the 1997-98 drought than during the 1982-83 drought. The analysis carried out by Kirono et al. is shown in Figures 4 and 5.



Source: Kirono et al., 1998

Figure 4: Locations and Names of the Indonesian Rainfall Stations Used for Analysis



Source: Kirono et al., 1998

Figure 5: 1997-1998 Annual Rainfall as a Percentile

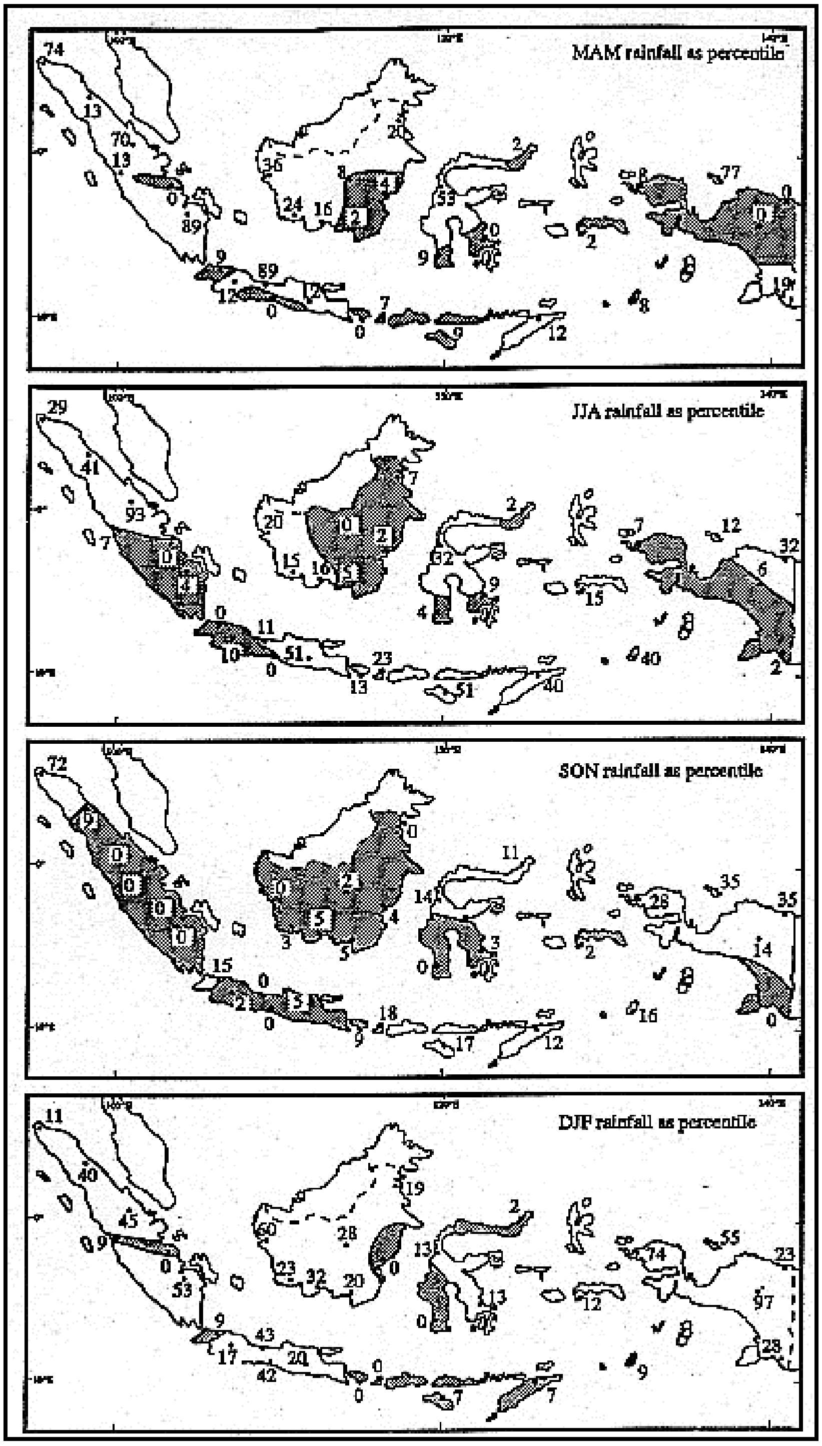
During 1997-98, El Niño delayed the onset of rainfall and resulted in frequent dry spells. Both these factors caused delayed planting of wet season paddy, as enough accumulated rainfall was available only in December 1997. Table 8 provides information on the dates of rain onset and days of dry spells in Semarang, Central Java, one of the representative stations in the rice-growing belt in Java.

Table 8: Dates of Rain Onset and Days of Dry Spells in Semarang, Central Java 1981-1997

Year	Date of Onset of Rain	Days of Dry Spells		
		October	November	December
1981	2 Oct	6	10	4
1982	7 Nov	21	6	4
1983	2 Oct	14	6	7
1984	2 Oct	5	-	4
1985	22 Oct	15	5	5
1986	11 Oct	11	-	4
1987	8 Nov	14	8	2
1988	-	-	-	-
1989	2 Oct	13	3	4
1990	-	-	-	-
1991	15 Oct	14	-	5
1992	3 Oct	4	8	12
1993	19 Oct	7	7	7
1994	18 Oct	10	5	3
1995	4 Nov	-	2	2
1996	-	8	4	3
1997	15 Nov	21	18	4

Source: BMG, Indonesia

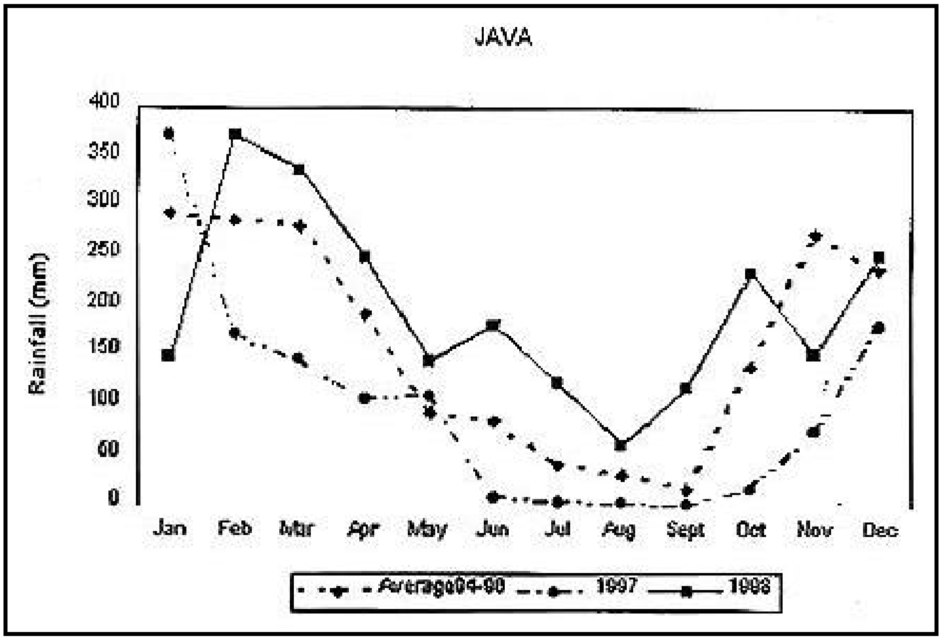
The seasonal distribution of rainfall anomalies during 1997-98 is shown in Figure 6. The March-May 1997 rainfall was close to, or even above, normal across much of the country, but dry conditions prevailing across the southern and eastern parts suggested an early retreat of the monsoon. By June-August, the areas with substantial rainfall deficits had spread to western areas except North Sumatra. The drought reached its peak in September-November, with all parts of the country except Sumatra having extremely low rainfall, deficits of 400-500 mm being common. By the December to February quarter, rainfall was generally close to normal except for pockets in East Kalimantan and Sulawesi, precisely the areas to which fires returned early in 1998.



Source: Kirono et al., 1998 (MAM = March, April, May, JJA = June, July, August, etc.)

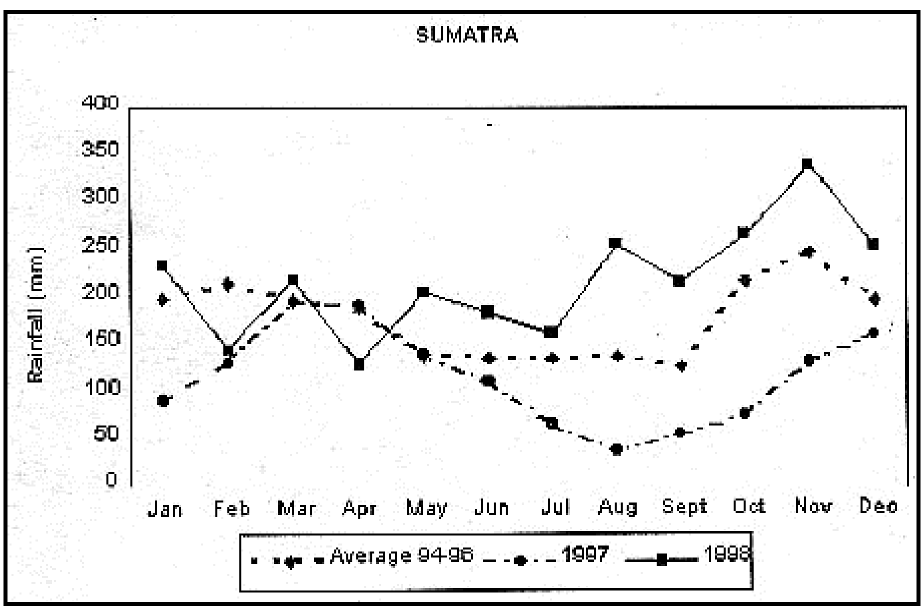
Figure 6: Seasonal Variation in Rainfall 1997-1998

The month-wise distribution of rainfall in most areas of Java, Sumatra and South Sulawesi indicates the occurrence of below-normal rainfall during 1997-98 (Figures 7-9).



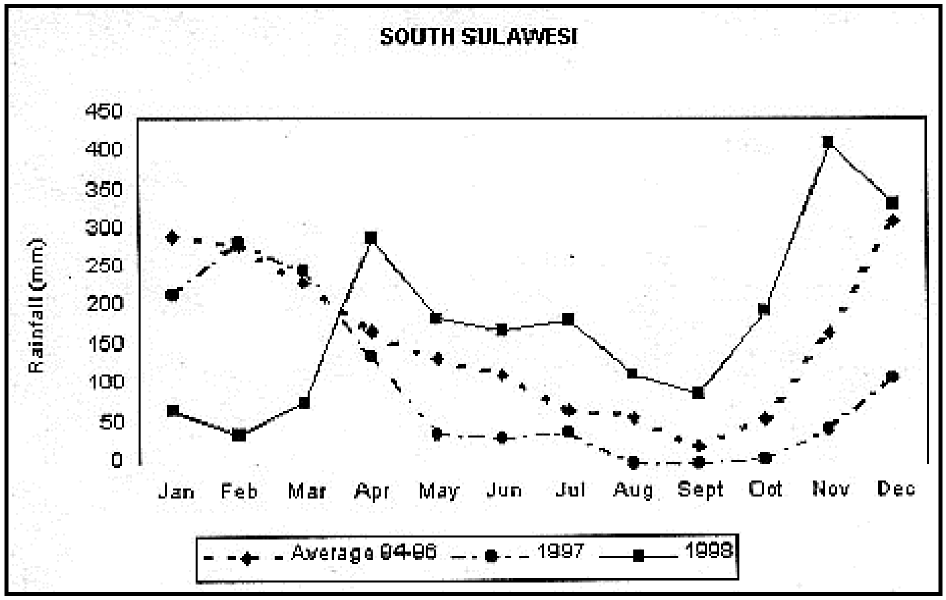
Source: FAO, 1998

Fig. 7: Monthly Rainfall Distribution in Java



Source: FAO, 1998

Fig. 8: Monthly Rainfall Distribution in Sumatra



Source: FAO, 1998

Fig. 9: Monthly Rainfall Distribution in South Sulawesi

The rainfall anomalies mentioned above affected crop production in Indonesia. The paddy crop production is heavily influenced by the pattern of monsoon rains, which have an important bearing on performance during the main (wet) and secondary (dry) seasons. The wet season normally extends from October to March and produces some 60 percent of the country's annual rice crop and half of its maize, soybean and groundnuts. The dry season covers April to September, during which most of the remaining annual crop is produced.

During wet season 1997-98, there was a decrease of 380,000 ha under paddy (3.4% from the previous wet season). In areas where paddy could not be planted, farmers planted maize as a compensatory crop. The switching over to maize crop was to the extent of 266,000 ha (an 8% increase from the previous wet season) over and above the normal area under maize crop.

In addition to reduction in the main season rice crop, the 1998 second season production was affected by these significant factors:

- In 1997-98, the sequence of the planting and harvesting operations was seriously disrupted. Consequently, harvesting of the main wet season crop, which had already been reduced by the drought, was not completed until much after the normal period of March-April. Planting of the dry season crop therefore was delayed by between one to two months, and in turn suffered productivity loss.

- Grasshopper infestation, which normally affects tree crops, seriously affected 1998 dry season field crops, particularly in Lampung province, probably because of the disruption of their natural habitat due to serious forest fires in Kalimantan and Sumatra. Black bug, an insect seen only since the 1997 season, affected field crops. The problems of pest attack were exacerbated by ineffective control measures, as most farmers could not meet the substantially higher cost of imported chemical pesticides, the price of which was estimated to have increased five-fold over 1997.

- In addition to ineffective pest control during the dry season, it is estimated that fertilizer application rates were considerably lower and unbalanced, mainly as much less potassium chloride (KCl) was used than required. For example, in West Java, the use of potassium fertilizer in 1997-98 was around 7 percent of that in 1995-96 and 15 percent of 1996-97. Lower use of KCl in particular not only reduced the physiological ability of plants to resist pest attacks but also affected grain formation. Research studies indicate that the potential yield loss without the application of recommended doses of potassium fertilizers could be as high as 30 percent.

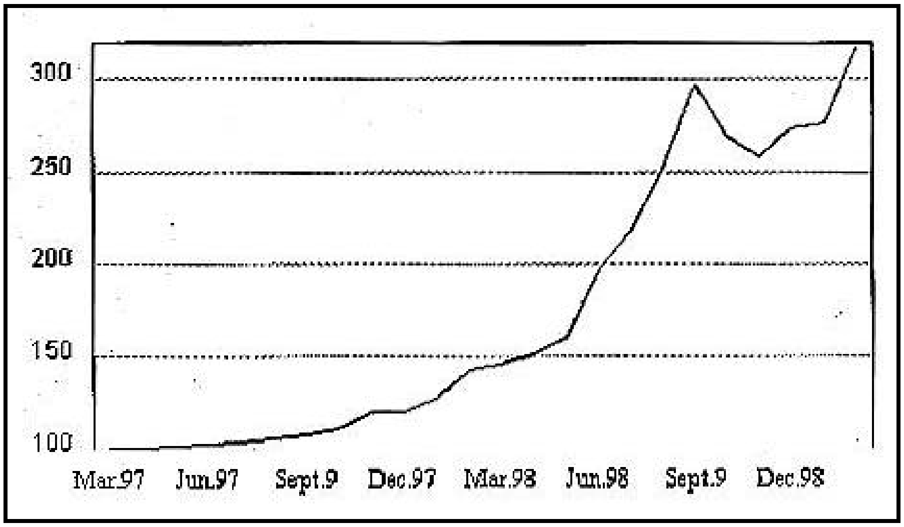
The details of paddy production in the last five years are shown in Table 9. This table shows that there was a reduction of around 5 million metric tons due to an ENSO related drought in 1998.

Table 9: Paddy Harvested Area, Yield Rate and Production in Indonesia 1994-98

Year	Harvested Area (ha)	Yield Rate (Q/ha)	Production (tons)	Annual Growth (%)	Climate
1994	10,733,830	43.45	46,641,524	-3.20	El Niño
1995	11,438,764	43.49	49,744,140	6.65	Normal
1996	11,569,729	44.17	51,101,506	2.73	La Niña
1997	11,140,594	44.32	49,377,054	-3.37	El Niño
1998	10,680,898	43.34	46,290,461	-6.25	El Niño

Source: BPS, Indonesia

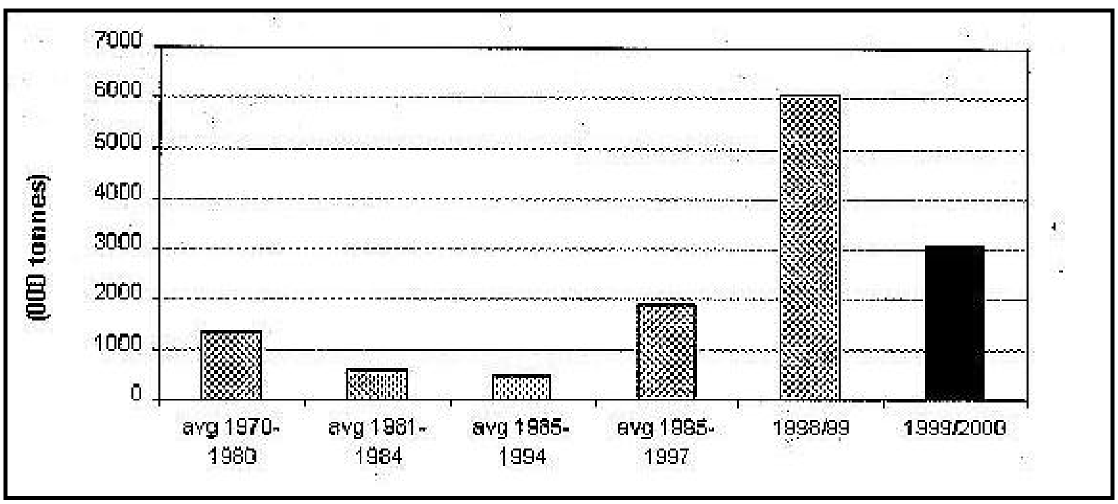
The reduced production, allied with the economic crisis which began in 1997, led to a 300 percent increase in the price of food grains (Figure 10).



Source: BPS, Indonesia

Figure 10: Rice Price Levels 1997-98

The Government found itself obliged to import over five million metric tons of rice to maintain price levels and to ensure the availability of food to the economically weaker sections of the population. The details of rice imports in the last three decades are shown in Figure 11.



Source: BPS, Indonesia

Figure 11: Rice Imports in Indonesia 1970-99

An equally disastrous impact of the 1997-98 El Niño, one that caught international attention, was the widespread occurrence of forest fires with associated transboundary haze. The fires were among the most severe in the previous two decades and had a significant socio-economic impact. A study made by the Asian Development Bank (1999) covering East Kalimantan and Riau estimated that the average loss for each community household member was Rp 13,704,800. Table 10 shows the estimated extent of the spatial damage caused by the 1997-98 fires.

Table 10: Estimated Extent of Spatial Damage by Fire in 1997-98 ('000 ha)

Island	Montane Forest	Lowland Forest	Peat and Swamp Forest	Dry Scrub and Grass	Timber Plantation	Agriculture	Estate Crops	Total
Kalimantan		2,375	750	375	116	2,830	55	6,501
Sumatra		380	300	260	70	670	60	1,740
Java		25		25		50		100
Sulawesi		200				200	1	401
Irian Jaya	100	300	400	100		100	3	1,003
Total	**100**	**3,280**	**1,450**	**760**	**186**	**3,850**	**119**	**9,745**

Source: National Development Planning Agency (BAPPENAS), Indonesia, 1999

As mentioned above, the 1997-98 fires and the resulting smoke and transboundary haze rapidly became a matter of international concern. Besides Indonesia, a number of Southeast Asian countries, in particular Brunei Darussalam, Malaysia and Singapore, were badly affected; the Philippines and Thailand also suffered, but to a lesser degree. The severity and extent of the smoke haze pollution was unprecedented, affecting the health of millions of people across the region. International support had to be mobilized to suppress the fires. This experience underscored the enormity of the problem, leading ASEAN Environment Ministers to adopt a Regional Haze Action Plan (RHAP) setting out cooperative measures to combat the perils brought by forest and land fires.

Apart from agriculture and forestry, the 1997-98 drought and fires caused economic losses to Indonesia in other sectors such as health, transportation, tourism and fire-fighting costs. Estimates of these losses are summarized in Table 11. These estimates total about US$ 9 billion, but do not include losses to other countries that resulted from the transboundary haze.

The scope of the pollution resulting from the fires, and especially that from peat soils and cleared conversion forest, clearly shows that the impact is an environmental problem of global dimensions. The Indonesian fires of 1997-98 accounted for 22 percent of the world's carbon dioxide production, an injection of more than 700 million tons into the atmosphere.

In its 1998 World Disasters Report, the International Federation of Red Cross and Red Crescent Societies (IFRC) quoted the 1997 loss of life in Indonesia as 1,262 dead, compared to an annual average of 848. These figures cover all disasters and are not El Niño-specific. Another source (NOAA-OGP) placed the number of people affected at 40 million. It also stated that from August-September 1998 the number of families affected by food shortages was expected to reach 17 million by the year-end, with inflation reaching 80 percent. No later figures are available to substantiate these projections.

Table 11: Summary of the Economic Cost of the 1997-98 Drought and Fires

	Estimated Economic Losses (US$ million)		
Sector	**Minimum**	**Maximum**	**Mean**
Agriculture			
- Farm crops	2,431	2,431	2,431
- Plantation crops	319	319	319
Forestry			
- Timber from natural forest (logged and unlogged)	1,461	2,165	1,813
- Lost growth in natural forest	256	377	316
- Timber from plantations	94	94	94
- Non-timber forest products	586	586	586
- Flood protection	404	404	404
- Erosion and siltation	1,586	1,586	1,586
- Carbon sink	1,446	1,446	1,446
Health	145	145	145
Transmigration and buildings and property	1	1	1
Transportation	18	49	33
Tourism	111	111	111
Fire-fighting costs	11	12	12

TOTAL	**8,869**	**9,725**	**9,298**

Source: National Development Planning Agency (BAPPENAS), Indonesia, 1999

The severity of the impact of the 1997-98 El Niño on Indonesia presents a compelling reason for the country to make full use of current abilities in seasonal forecasting as a means of ensuring food security and to combat other adverse consequences of drought. The complexities of the legislative and other arrangements for the management and exploitation of Indonesia's forests will not make it easy to reduce the vulnerability to continued, periodic outbreaks of fire, especially during El Niño events. For its own development, and for the security of neighboring nations in Southeast Asia, it is imperative that every opportunity be taken to introduce viable policies and practices that will contribute to the prevention of a repeat of the scope of the 1997-98 disasters.

4. What is the reliability of those attributions to the impact of El Niño?

There is no doubt that El Niño 1997-98 had a major impact on the rainfall regime in various parts of Indonesia. This has been discussed at length in the previous section on physical and societal impacts. The rainfall percentiles calculated by Kirono et al. (1998) cover 33 rainfall stations across the entire country and show reduced rainfall in all areas. This analysis clearly indicates that for most of the country, rainfall anomalies can be safely (and reliably) attributed to El Niño.

The societal impacts were felt mainly in the agriculture and forestry sectors. However, these impacts (and related secondary impacts on public health and tourism) cannot be attributed solely to the El Niño event. While it did produce conducive conditions for adverse impacts to manifest in both these sectors, the Southeast Asian economic crisis played a major role in aggravating this situation.

In previous drought years, even in the absence of a climate-related warning system, the agriculture sector has shown a certain inherent resilience to climate variability. As the first signs of an impending drought begin to manifest during a wet season, farmers switch to more drought-resistant crops. In such years, the reduction in rice production is offset to a significant extent by increase in the production of secondary crops. This was clearly evident during the 1982-83 El Niño event, when maize production increased by 56 percent. However, this adjustment requires easy availability of and access to important agricultural inputs such as fertilizers, pesticides and seeds. During 1997, the economic crisis led to devaluation of the Indonesian Rupiah. As a result, the prices of fertilizers and pesticides that are mostly imported inputs increased almost five-fold. This resulted in reduced access to these agricultural inputs and adversely affected the resilience of the agriculture sector. The increase in the maize production was only about eight percent, which was not enough to offset the effects of the fall in rice production.

The reduction in rice production was also worsened by the decreased access to agricultural inputs. In the Indonesian case, agricultural research (FAO, 1998) shows that 30% of the yield can be attributed to agricultural inputs and the rest to other factors. This means that in addition to the climatic factors, decreased access to agriculture inputs would have significantly affected the rice production in Indonesia. At the same time, the increase in the market price of rice provided an incentive for farmers to increase production. However, in the wake of the economic crisis, decreased purchasing power, combined with increase in market prices of agricultural inputs, prevented farmers from capitalizing on these incentives. It is clear that the economic crisis significantly aggravated the impacts of El Niño on the agriculture sector, but it is difficult to separate out its impacts from that of the El Niño.

In the forestry sector, the effects of large-scale forest fires during 1997-98 were unprecedented. Analysis of the SOI during past El Niño years, and forest area burnt in those years, indicates that there seems to be a correlation between the two (UNDP, 1998). However, it would be inappropriate to assume that this is a causative correlation. The occurrence of forest fires is primarily linked to inadequacies in the current forest management practice. It has been scientifically demonstrated beyond any reasonable doubt that fire has been part of the natural ecosystem in Indonesia for many thousands of years. But it is clear that fire, as a part of human action, has not previously been applied to the environment with the same vigor evident in the last two decades. As population levels have increased and shifted, there has been a rapid change in land use and this has brought with it a different application of what has been a strong rural fire culture. The primary undisturbed forest is inherently fire resistant and is naturally subjected to incursion by fire at long intervals, but the disturbance caused by human activities or previous fires can significantly increase the forest’s vulnerability to fires. The causes of the 1997-98 fires can be broadly divided into three distinct but interrelated categories:

1) weaknesses in policy and regulatory framework;
2) local conflicts between forest communities and private concessionaires; and
3) degradation of forest environment as a result of large-scale logging and uncontrolled and unplanned conversion to commercial plantations.

It is clear that large-scale forest fires occurred because El Niño-related drought conditions impacted an increasingly vulnerable forest environment. However, the factors contributing to the build-up of this vulnerability are not climatic but social, economic and political.

RESPONSES

a. Were any government reports or statements issued before the impacts of the 1997-98 El Niño appeared?

No government report or statement is available with regard to the impact of the 1997-98 El Niño before its onset.

b. Were any reports issued after the impacts appeared?

While there are a number of reports available on El Niño's 1997-98 impacts in Indonesia, the following two are comprehensive:

1) Land and Forest Fires: Impacts, Factors and Evaluation of Efforts (September 1998), prepared by the State Ministry for Environment of the Government of Indonesia in collaboration with the United Nations Development Program.
2) Planning for Fire Prevention and Drought Management (April 1999), prepared by ADB in collaboration with the National Development Planning Agency (BAPPENAS) of the Government of Indonesia.

c. What were the major responses to the event?

No major intervention was undertaken to minimize crop losses or manage water resources. The major responses in relation to the management of forest fires are given below.

3.1 Pre-Fire Information Management

The BMG and LAPAN had warned about a possible El Niño-induced drought as early as the end of 1996. This was followed up by the State Minister for Environment and the Minister of Forestry, and a number of governors, who called on everyone to be alert and to take action to prevent forest and land fires. However, that warning was not followed up, and fires began to occur in early 1997 and were reported on 22 February 1997.

The technical guidelines prepared by the National Coordinating Center for Fire Control were not applied keeping in view the weather data provided by BMG on local conditions. In 1997, only the IFFM-GTZ made a fire prediction covering the area from Balikpapan to Samarinda. The general criticism of fire danger predictions was that they did not take into consideration the social aspects and human interactions with the environment.

3.2 Information Management during the Fires

There was little evidence of a substantial institutional prevention and preparedness program in place. There was an inadequate structure to respond to early warnings and to provide information and guidance to the field operators about fire forecasts. There is a top-down structure that is partially developed but does not function adequately because of breakdowns in the communication chain between the national, sub-district and village levels.

In terms of an organized prevention program, there are no procedures in place to eliminate or minimize the use of fire during dangerous periods. For example, there is no system of permits to regulate fire use in normal times or in high-risk periods. A decree was issued to stop the use of fire through 1997 and the early part of 1998. A decree on the use of fire for land clearing was cancelled in 1997 by another decree (No. 152/Kpts/DJ/-IV/1997). The latter decree reinstated a former ban on land clearing.

The following factors reduced the efficacy of fire control by the National Centers:

- Lack of expertise in data collection and analysis;
- Lack of planning;
- Lack of time for data analysis and interpretation;
- Incompatible data;
- Lack of socio-economic data;
- Scale differences in maps obtained from various sources;
- No ground truth and feedback from affected areas to provincial and national centers; and
- Lack of involvement of local communities.

Due to severe constraints during pre-fire and during-fire information management efforts, the opportunity, e.g., earliest warning of potential problems, provided by ENSO's lead-time could not be used. A summary of the efforts taken by Government agencies to manage fire is shown in Table 12. It could be seen that with the increase of the SOI index, the number of hotspots, an indicator of fire severity, had also increased. However, response efforts could not match the magnitude of challenges posed by forest fires due to policy and institutional inadequacies.

Table 12: Government Fire Management Efforts

Month	SOI Index	No. of Hotspots	Key Response Activities
December 96	0	>100	BMG indicates possibility of El Niño-induced drought
January 97	3.5	>100	President warns of danger of drought
February 97	5.0	>100	BAPEDAL begins detecting, monitoring and analyzing fires
March 97	9.6	>100	
April 97	15.0	>100	Media asked to cooperate
May 97	7.0	200	BMG warns of El Niño, and State Minister of Environment discusses fires with provinces, government agencies and public
June 97	20.0	300	
July 97	15.0	650	
August 97	15.0	850	State Minister of Environment confirms increasing numbers of hot spots in Sumatra and Kalimantan
September 97	15.0	1200	First sign of uncontrolled fires
October 97	22.0	1100	Minister of Agriculture gives instructions about land clearing BAKORNAS declares disaster President proclaims disaster
November 97	24.0	400	Minister for Environment reports haze decreasing
December 97	24.0	>100	

Source: National Development Planning Agency (BAPPENAS), Indonesia, 1999

d. Identify (with citations, if possible) the extent of national research in the past 20 years in your country on:

1. **El Niño**
2. **Climate-related hazards**

e. Identify (with citations, if possible) any international research about the impact of El Niño events on your country

Please refer to the section titled Setting.

f. Is there a national plan to respond to disasters?

6.1 Overall Coordination

The Government of Indonesia deals with the impact of El Niño events through the National Coordinating Board for Disaster Management (BAKORNAS PB). This Board coordinates all the activities of ministries, departments and agencies concerned with ENSO impacts. Similar institutional arrangements operate at provincial and district levels.

6.2 Agriculture and Food Security

- The Agency for the Management of Agricultural Production (BIMAS) is responsible for the improved management of agricultural production.
- The Agency for National Logistic Management (BULOG) has been assigned the responsibility for coordinating action to ensure national food security in Indonesia.

6.3 Water Resources

The Water Reservoir Authority under the Ministry of Public Works is responsible for actions to monitor possible flood and drought and for the reduction of their impacts. The Agency for the Application and Assessment of Technology (BPPT) includes a Weather Modification Unit, the task of which is to conduct artificial rain operations.

6.4 Forest Fire Management

Before 1997, forest fire management was undertaken by the Directorate of Forest Protection (Sub-directorate of Forest Fire, with two divisions – The Prevention Division and The Fire Suppression Division).

The 1997-98 El Niño revealed that these institutional arrangements were not effective, especially in dealing with the haze. In order to institutionalize coordination among the agencies concerned, Indonesia established forest and land fire organizations at national, provincial, district, sub-district and field levels. Further details of these organizations may be found in the first part of this report under Setting.

6.5 Public Health

The Ministry of Health is charged with monitoring weather and climate conditions likely to encourage the spread or growth of diseases.

6.6 Public Awareness

Television, radio and newspapers are the principal means of ensuring that the public is kept aware of adverse weather or climate conditions.

The responses to the 1997-98 El Niño engendered by the management and coordination arrangements then in force have already been described above.

6.7 National Plan

As recorded above, arrangements exist for disaster management at national, provincial and district levels. The BAKORNAS PB, the National Coordinating Board for Disaster Management, has been established and reconstituted by a series of Presidential decrees. Its responsibilities include:

a. Formation of policies and programs for integrated, coordinated and sustainable disaster prevention and management;
b. Coordination of prevention efforts before, during and after disaster events;
c. Preparation of guidelines for integrated planning;
d. Coordination of inter-agency cooperation between government and non-government agencies at national and international levels; and
e. Coordination, collection and distribution of aid for disaster victims.

This high level Board, with its wide-ranging responsibilities, operates under the chairmanship of the Coordinating Minister for People's Welfare and includes the Ministers of Social Affairs, Home Affairs, Public Works, Health and Transport, and the Commander of the Armed Forces, the Director General for Social Assistance in the Ministry of Social Affairs, plus Governors of disaster-affected provinces.

What is not clear is whether a detailed national plan covering all types of disasters has been compiled and enshrined in the appropriate legislation, so that it provides the essential authority for active measures before, during and after a disaster. This point needs clarification. A national plan for forest fire management was developed after the 1997-98 El Niño. Given the importance attached to fire disasters, and the fact that the plan for fires was drawn up only recently, this strongly suggests that no overall plan for all disasters exists.

g. Is El Niño explicitly considered to be a disaster in your country?

Please refer to the section titled Forecasting by Analogy.

FORECASTING BY ANALOGY

1. If a perfect forecast had been available as early as October 1996, knowing what is now known about the actual impact, what could have been done differently:

a. **about information flow?**
b. **about preparing for the forecast impacts?**

2. What are the realistic obstacles that might have prevented these theoretical actions being taken?

As El Niño influences on Indonesian climate are well established, the availability of a perfect forecast as early as October 1996 could have provided at least nine months' lead-time to plan for and manage ENSO-related disasters. The contours of ENSO impacts could have been visualized on the basis of past ENSO episodes, and available resources could have been mobilized to manage ENSO-related natural hazards.

In Indonesia, the length of the dry season determines the severity of droughts and forest fires. The onset dates of wet and dry seasons determine the length of the dry season. El Niño lengthens the dry season and shortens the wet season. The skill of the forecasters at BMG is satisfactory to predict the onset of wet and dry seasons in Indonesia. The ability to forecast the crucial parameter of the onset dates of wet and dry seasons could have been fully exploited to manage the potential impacts of ENSO.

In October 1996, as soon as ENSO forecast information was available, an exercise could have been carried out to map potential impacts of the impending El Niño on various sectors, regions and seasons. The translation of ENSO forecast information into local weather variables and, in turn, their impacts on bio-physical parameters, could have resulted in an impact forecast product for various regions. Sharing the impact forecast product with all user departments and agencies of both national and provincial governments through a participatory process could have helped enlist their cooperation and refine the impact forecast product for contingency action plan preparation.

Keeping this approach in view, cost-benefit scenarios could have been developed indicating the cost of intervention measures for implementing contingency action plans as well as the cost of the non-implementation of such plans in the months to come. The cost-benefit analysis of the potential impacts of ENSO could have motivated decision-makers to commit resources for implementing contingency action plans. An ADB study estimates the plan implementation cost to be around US$ 45 million as against the total damage cost caused by El Niño of around US$ 9.5 billion.

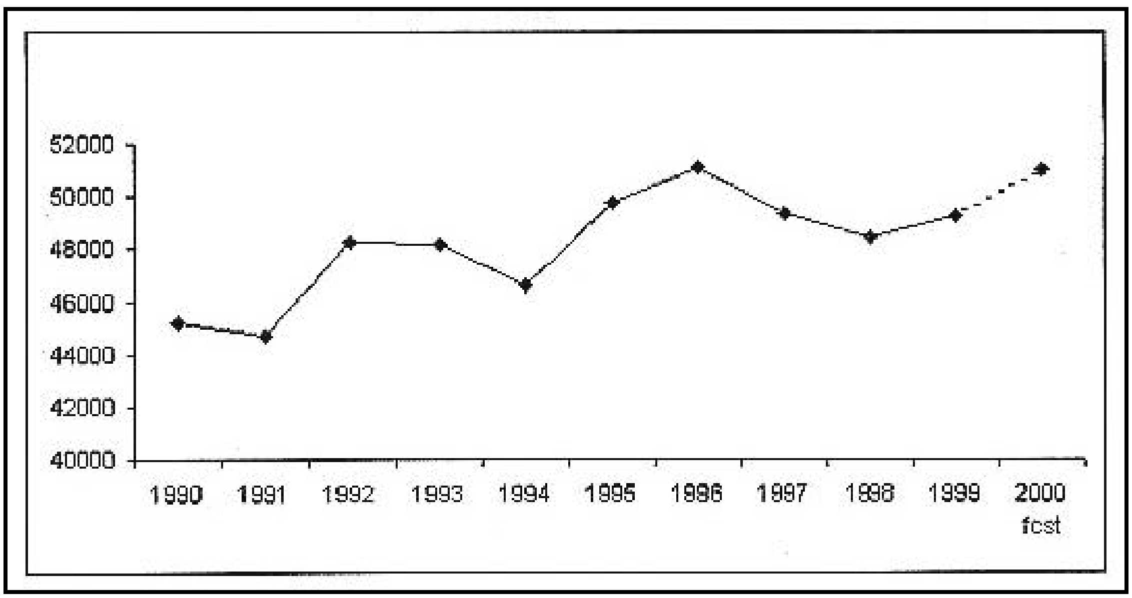
The generation of an impact forecast product and its dissemination to all stakeholders could have been done through a well-thought-out information, education and communication strategy to influence end-users to modify their behavior for managing climate variability situations.

As El Niño was expected to last for about 15 months, from March 1997 to May 1998, a graduated response system with a dynamic decision-making process could have been put in place to undertake corrective measures, depending upon the behavior of weather variables.

The possible El Niño management strategies for managing the two major disasters associated with El Niño 1997-98 – agricultural drought and forest fires – are given below.

2.1 Agriculture Sector

With the exception of 1995-96, weather conditions during the 1990s were largely unfavorable for crop production. This had increased risks in small-holder agriculture, especially for single crop farmers in eastern Indonesia. The details of paddy production since 1990 are shown in Figure 13. It may be seen that El Niño in 1991 and 1994 had caused paddy crop losses from 1.5 to 3 million metric tons in relation to trend-level production. As the crop yields were stagnating during the 1990s, the Indonesian government was forced to import rice to ensure food security.



Source: FAO, 1999

Figure 13: Indonesia Paddy Production (‘000 tons)

As of October 1996, there was an imperative need to anticipate paddy crop losses to the extent of a minimum of 3 million metric tons based on 1991 and 1994 El Niño impact trends. This situation could have prompted decision-makers to prepare contingency action plans, keeping in view the following three approaches: A. a compensatory cropping program; B. an alternate cropping strategy; and C. an irrigation management policy.

A. Compensatory Cropping Program

This has two dimensions. One is to try to compensate for the crop loss in the most severely affected areas (MSA) by intensifying the production program and increasing yields in the most favorable areas (MFA) where there were expectations of good rainfall and the availability of assured irrigation sources. The second is to make up the crop loss in the same area by using up short duration cultivators.

B. Alternate Cropping Strategy

This strategy involves the shifting of crops that could be grown on the availability of soil moisture under less than normal conditions. Farmers in Indonesia usually adopt this strategy by replacing paddy crop with maize and other secondary crops. The success of this strategy could depend on government intervention to provide input and market support to farmers.

C. Irrigation Management Policy

In Indonesia, three million hectare of area are cultivated through assured irrigation sources. One million hectare out of three million are, however, vulnerable to water stress during El Niño years. There was a need to develop water budgeting approaches in each vulnerable reservoir system in order to prioritize water use needs. In these areas, the provision of minimum irrigation to the critical crop growth stages could have increased the areas under cultivation.

The above-mentioned approaches needed to be matched with the irrigation potential and agro-climate zoning maps (refer to Tables 1 and 2) to develop suitable cropping patterns, keeping in view El Niño influences on rainfall patterns in various regions. Tables 14 and 15 show the approaches for integrating agro-climatic zoning and irrigation status maps to suggest possible crop calendars, taking into account the El Niño factor.

Table 14: Onset and Withdrawal of Monsoon in Various Parts of Indonesia

Regions	Onset	Termination	Length of Wet Season (months)
North Sumatra	Late August	June	9
Southeastern Sumatra	First week of September (October)	June	8 (7)
West Java	October (November)	May	7 (6)
Central Java	First week of November (last week of November)	April	6 (5)
East Java	November (December)	April	5 (4.5)
Bali NPT	November (December)	March	4 (3.5)

Figures in brackets denote El Niño influence – mean value. Source: Based on agroclimatic maps of Java, Sumatra, Sulawesi, Kalimantan, Maluku, Irian Jaya and Bali.

Table 15: El Niño and Possible Rescheduling of Cropping Pattern in Indonesia

Type of Irrigation	Normal Cropping Pattern	Suggested Cropping Pattern				
		Type I	Type II	Type III	Type IV	Type V
Semi-technical[7] Irrigation	Paddy	Paddy	Paddy	Secondary	Secondary	Paddy
	Paddy	Paddy	Paddy	Paddy	Paddy	
	Fallow	Paddy	Secondary	Paddy		
Technical Irrigation	Paddy	Paddy	Paddy	Secondary	Paddy	Paddy
	Paddy	Paddy	Secondary	Paddy	Paddy	
	Secondary	Paddy	Paddy	Paddy		
Non-technical Irrigation	Paddy	Paddy	Paddy	Secondary	Secondary	
	Secondary	Paddy	Paddy	Paddy	Secondary	Secondary
	Fallow	Secondary	Fallow	Fallow		
Rain-fed	Paddy	Paddy	Paddy	Secondary	Secondary	Secondary
	Fallow	Paddy	Secondary	Paddy		*

Note: Type I Rainfall extending up to 7-9 months
Type II Rainfall extending 7-8 months
Type III Rainfall extending 6-7 months
Type IV Rainfall extending 4-6 months
Type V Rainfall extending less than 2-4 months
* Rainfall less than 2 months

[7] The technical and semi-technical irrigation systems are classifications adopted by Indonesian authorities. While in technical irrigation the entire irrigation system, including the main canal, secondary canals and the tertiary canals which feed individual farm fields, are controlled by the Government, in semi-technical irrigation only the main and secondary canal systems are controlled by the Government. Farmers control the tertiary canals feeding individual farm fields.

The adoption of a contingency crop plan along the above lines would have minimized paddy crop losses to a considerable extent, with effects on the concomitant import requirements of rice. The resilience of agriculture during El Niño could have absorbed the shock of the economic crisis, instead of aggravating it.

In fact, at the end of the El Niño period in May 1998, the government prepared an agricultural production plan to boost rice production and minimize imports. The salient features of the plan were:

- A credit line of 400 billion Rupiah (US$ 40 million) on soft-loan terms for farm inputs. As a result, credit coverage is estimated to increase from 3 percent to 25 percent of area planted.
- Continuation of fertilizer subsidies.
- A target area of 2.3 million hectare for enhanced production, through intensive extension, credit and subsidy to increase cropping intensity (CI) and yields, specifically to increase the CI on 376,000 hectare from 100 to 200 percent and from 200 to 300 percent on 124,000 hectare.

Had the Indonesian government implemented the above plan in October 1996, instead of May 1998, taking into account the contingency crop planning approaches discussed here, the reduction of food grain production could have been restricted significantly and the importation of rice could have been reduced by that extent.

2.2 Forest Fire Management

Information relating to the details of forest fire events and their impacts, as well as response efforts by the Indonesian Government in the past two decades, is shown in Table 16.

The analysis of the above situation in October 1996 could have indicated the possible strengths and weaknesses of fire management efforts in Indonesia. It may be seen that the government could have drawn on the experiences of managing previous El Niño-associated fires and prepared a detailed fire information system, fire preparedness program and action-oriented fire suppression program. The details of such programs are given in Tables 17-19.

Table 16: Pre-1997-1998 Forest Fire Impacts and Responses

Fire Event	Affected Regions	Impacts	Responses	Events-induced Policy and Institutional Changes in their Aftermath
1982-83	East Kalimantan	3.6 million hectare	- No original attempt to suppress fires. - Rains in May 1983 suppressed fires.	- Promulgation of forest fire prevention and suppression guidelines. - Establishment of special fire mitigation task force. - Forest fire control center at provincial level. - Command post at regency level. - Task force at district and sub-district levels.
1987	Almost everywhere	61,962 hectare	- Although fires were detected as early as July 1987, no concrete steps were taken until September 1987. - Water bombing attempted. - Efforts ineffective.	Proposals for establishment of: - Forecasting and warning. - Involvement of communities. - Prohibition of uncontrolled fire during dry season initiated but not implemented.
1991	23 provinces	500,000 hectare Haze spread up to Singapore by September 1991	- Indonesia sought foreign assistance for fire control. - Canadian team of experts. - Australia fire assessment teams.	- Special body with a mandate to develop standard operating procedure for fire prevention. - Creation of sub-directorate for fire prevention and suppression under the Directorate of Fire Protection. - Pilot projects by GTZ in East Kalimantan and the European Union in South Sumatra. - USAID training program. - JICA fire prevention system.
1994	24 provinces	4.8 million hectare Trans-boundary haze	- Indonesia sought foreign assistance. - Cloud seeding. No clouds to seed. Efforts failed. - Fire fighting techniques like aerial water bombs were ineffective, involving high cost.	- Establishment of National Centre for Forest and Land Fires Management in 1995 by MoF. - The Agency for Environmental Impact Assessment established a National Coordinating Team for Land Fires (TKNPKL). - TKNPKL developed an early warning system and produced a fire danger map as a tool for fire management.

Source: Ministry of Environment, Government of Indonesia

Table 17: Programs for Development of Fire Information System

Program	Objective	Area	Time Frame	Institutions
Development of an integrated, compatible and systematic fire information system	- Availability of on-time, appropriately targeted and con-sistent information on fire - Capacity to disseminate fire information in a format understood by the public and decision-makers	National level, fire-prone provinces and *kabaputens*	Oct 96- Mar 97	TKNPKHL/MoE, BOPKHL, BMG, LAPAN, BPN, Bakosurtanal, provincial and *kabupaten* govt., NGOs, companies
Establishment of data and information processing center	- Information availability for decision-makers	National, provincial and *kabupaten* levels	Oct 96- Feb 97	BAKORNAS PB, MoFP, BOPKHL, TKNPKHL, IFFM, FFPCP, FFPMP, ITTO-IPB, YSA-Unpar, provincial and *kabupaten* level agencies
Establishment of satellite image receiver and GIS system	- Availability of satellite and geo-graphic data to monitor environ-mental conditions and fire distribution	National, provincial and *kabupaten* levels	Oct 96- Mar 97	TKNPKHL, BOPKHL at the national, provincial and *kabupaten* levels
Development of information network	- Availability of data and information - Establishment of transparent and objective information exchange activities between the government, NGOs, the private sector and the general public	Integrated from the national level up to the community level	Oct 96- Jan 97	MoFP, BAKORNAS PB, TKNPKHL and BOPKHL at all levels, BMG, LAPAN, Bakosurtanal, BPN, companies, NGOs, research institutions, IFFM, FFPMP, FFPCP, ITTO-IPB, TSA-Unpar, weather stations in airports, communities

Table 17: Programs for Development of Fire Information System (continued)

Program	Objective	Area	Time Frame	Institutions
Development of fire information maps (including digital maps) consisting of fire risk, fire danger, priority area, fire distribution and fire history maps	- Enhanced monitor-ing capacity - Enhanced capacity to determine fire location and intensity - Enhanced capacity to determine priority locations - Reference of prio-rity areas for rehab-ilitation programs	National up to *kabupaten* level	Oct 96- Mar 97	TKNPKHL, MoFP, BAKORNAS PB, MoA, MoTrans, Ministry of Mines and BOPKHL at all levels, BAPPENAS, BAPPEDA, Bakosurtanal, universities, international agencies
Human resources development for information system: - Training on fire information management at the national, provincial and *kabupaten* levels - Training on operation of satellite image system - Training for analysts and programmers	- Availability of trained personnel for information system management at all levels ✍Enhanced capacity in data analysis and interpretation	National up to *kabupaten* level	Oct 96- Mar 97	BOPKHL, MoFP, TKNPKHL at all levels, training and education institutions, universities, IFFM, FFPCP, international donors, NGOs

Table 18: Fire Preparedness Programs

Program	Objective	Area	Time Frame	Institutions
Development and socialization of early warning procedures for all segments of the society	- Increased preparedness among companies, communities, NGOs and government	Rural and urban settlements in fire and non-fire regions	Oct 96	MoFP, provincial and *kabupaten* govt., M. of Trans., MoA, BAKORNAS PB, Mawil Hansip
Development and activation of early warning and early action systems, including distribution of hot spot information	- Detection of hot spots and immediate reporting - Immediate localization and control of fire	All fire areas	Oct-Nov 96	MoFP, BAKORNAS PB, Mawil Hansip, provincial and *kabupaten* govt., BMG, LAPAN, IFFM, FFPCP, FFPMP, TKNPKHL, MoA, MoE/ BAPEDAL, BOPKHL
Training of fire fighting units, forest rangers, communities, local NGOs in strategies and techniques for fire management	- Increased preparedness and technical capacity in fire management	Districts in fire areas, simultaneously all over the country	Oct-Jun 97	MoFP, BOPKHL, BAKORNAS PB, TKNPKHL, international organizations
Prepare distribution channel for and supply of logistics for fire suppression	- Increased preparedness of infrastructure and facilities for fire suppression	All fire control centers at fire-prone *kabupatens* and provinces	Oct 96-Jan 97	MoFP, BAKORNAS PB, BOPKHL, provincial and *kabupaten* govt., Mawil Hansip, HPH/ HTI and plantations, NGOs and communities

Table 18: Fire Preparedness Programs (continued)

Program	Objective	Area	Time Frame	Institutions
Preparation of health posts and rescue teams, including paramedics in *puskesmas*	- Increased preparedness in managing possible health impacts - Prevent increase of fire and haze victims	All districts in fire-prone areas	Oct 96-Jan 97	BASARNAS, BAKORNAS PB, BOPKHL, MoH/ *Dinkes*, MoFP, NGOs. communities, *puskesmas* and hospitals, companies
Coordination on strategic form-ulation of resource mobilization, including emergency action plan	- Increased understanding of and synergy in fire management operations	Fire control centers in fire-prone provinces and *kabupatens* and nationally	Oct-Dec 96	BAKORNAS PB, MoFP, TKNPKHL, BOPKHL, provincial and kabupaten govt., BMG, LAPAN, MoH, MoS, NGOs, compa-nies, BASARNAS
Volunteer mobilization for fire management operation	- Preparedness of volunteers for fire management	All districts in fire-prone areas	Oct 96-Jan 97	SATKORLAK/ SATLAK PB, BOPKHL, Dinhut, Mawil Hansip, NGOs

Table 19: Fire Suppression Programs

Program	Objective	Area	Time Frame	Institutions
Activation of operational plan and procedures for fire suppression	- Unity, integration and synergy among the institutions and personnel in fire suppression	All fire suppression operation areas, at the national, provincial, district and local levels	Feb-Mar 97	BAKORNAS PB, MoFP, TKNPKHL/ MoE, BMG, LAPAN, BOPKHL, SATKORLAK/ SATLAK PB, NGOs, fire fighting units, companies, local communities
Activation of hot spot monitoring system based on fire danger maps	-Effective fire fighting team mobilization -Effective fire data processing and reporting	All fire control centers in fire areas	Feb-May 97	BMG, LAPAN, TKNPKHL, MoFP, BAKORNAS PB, BOPKHL, and local units, FFPCP, IFFM, FFPMP
Mobilization of fire fighting units, trained volunteers and other elements for fire suppression	-Localzation and control of fire in a given area	All fire areas after fire reports are received and locations are determined	Feb-Mar 97	BAKORNAS PB, MoFP, SATKORLAK/ SATLAK PB, NGOs, fire fighting units, companies and local communities
Collection and distribution of logistics for fire fighting team and volunteers	-Effective fire control operation -High morale and spirit of firefighter teams	All fire areas	Jan 97	BOPKHL, SATKORLAK/ SATLAK PB, provincial and *kabupaten* govt., MoFP, MoH/ Dinkes, MoS/ Dinsos, private sector, NGOs, local communities
First aid for fire and haze victims	-Prevention of death -Control of casualty numbers -Protection against long-term health impacts	All fire areas	During the course of uncontrolled fire	SAR team, MoH/ Dinkes team, NGOs and communities, *puskesmas* and hospitals, Red Cross

The preparation of the above-mentioned action programs for fire management, taking into account a lead-time of nine months from October 1996 to June 1997 could have been possible had the following steps been taken:

1. A national level El Niño Task Force, under the chairmanship of the President, to provide direction and coordinate the activities of all concerned departments.
2. A professional Working Group to provide technical assistance for the production of tools and methods like preparation of fire danger maps, management information systems and the like.
3. A Provincial Task Force, under the chairmanship of the Governor, to provide necessary direction and coordination of activities of all concerned in provincial and district level agencies.

These national and provincial level organizational structures could have assisted the resource requirements for the implementation of a fire management action plan and could have mobilized resources from within the country and obtained resources from international agencies, to put in place an effective fire suppression program as early as April 1997.

3. Can El Niño considerations be added explicitly to national disaster plans?

El Niño causes both negative and positive influences on the established socio-economic system of Indonesia. While 93 percent of the El Niño years are associated with drought, seven percent of the El Niño years were reported to have had no such clear linakges. Hence, not every El Niño event automatically causes droughts. Moreover, in the agro-climate zones such as A and B where heavy rainfall is expected and the climate is stable, climate resources during El Niño years, such as plenty of sunshine hours, could provide a potentially favorable environment for crop productivity. Hence, the El Niño phenomenon needs to be treated as separate from other natural disasters, and there is a need to develop a distinct El Niño management manual for dealing with El Niño-related climate variability.

4. Identify the strengths and weaknesses in the way your country responds to El Niño-related climate anomalies.

Indonesia has a rich experience of confronting and coping with El Niño-related natural hazards. Databases such as agro-climatic maps and fire danger maps are available for use. Also, the country has rich traditional knowledge in dealing with El Niño-related crises. However, the following structural, technical and financial constraints were proven to be obstacles in effectively managing El Niño-associated climate variability and impacts during 1997-98.

4.1 Structural Constraints

There are no fully integrated El Niño management systems apparent in Indonesia. Such systems need to be developed with great care to avoid excessively large and cumbersome systems and those that do not fit the sociological characteristics of the Indonesian people. Appropriate and unique systems are the essential need. The current massive government re-structuring from a highly centralized system to a dynamic, functional de-centralized system could provide an opportunity to develop the required organizational and management information system to take advantage of El Niño forecast information that will deal with climate variability at the provincial and district levels.

4.2 Technical Constraints

Mechanisms exist in Indonesia for the transmission by meteorological agencies of short- and medium-range forecast information to the forecast user organizations. The long-range climate forecast information is also routinely transmitted by the meteorological organization to user organizations. As long-range forecasts are of a probabilistic nature based on global ENSO indices, user organizations are unable to utilize the forecast information for the benefit of end-users at the local level.

Lack of intermediate (regional or local) interpretation of a global ENSO forecast into locally usable information for the benefit of end-users proved to be a formidable barrier to incorporating probabilistic forecast information into decision-making processes. There is a need to address this critical gap in understanding by identifying a suitable institutional mechanism which would process ENSO forecast products and translate them into usable information, thereby enabling the user organization to deliver them to end-users.

The institutional interpretation of long-range ENSO forecast information could be undertaken by applied research institutions, namely BPPT, the National Space Center (LAPAN), Agro-climate Research Centre (Bogor), Water Resources Management Center (Bandung), and universities, societal communication research agencies and extension support agencies. These institutions could act as intermediary links between meteorological service providers and user organizations for processing, refining and translating long-range forecast products into locally usable information in order to enable sector organizations to apply them to decision making.

These institutions could be associated with the preparation of physical templates for consequence analysis, keeping in view different ENSO scenarios and potential impacts on homogenous micro-climatic zones. Capacity building of intermediate research institutions through technical assistance could go a long way towards the efficient functioning of these institutions in Indonesia.

4.3 Financial Constraints

The absence of an explicit commitment of resources for dealing with El Niño management programs proved to be a serious constraint for managing El Niño-associated crises.

5. Did the 1997-98 El Niño have any influence on your country's response to the forecast in early 1998 of an expected La Niña event?

There is substantial evidence that the impact of the 1997-98 El Niño served as a "wake-up call" for Indonesia. One indication of this may be seen in the widespread concern over the environmental degradation and threat to food security posed by ENSO events. When international and regional climate forecast models gave warnings of an expected La Niña, serious attention was given to its likely impact, bearing in mind the environmental conditions consequent to the 1997-98 El Niño, and also the inter-linked effect of the Asian economic crisis.

Based on global indicators of La Niña, the Indonesian Meteorological Agency (BMG) issued a forecast on 4 September 1998 that in the 1998-99 wet season, almost the entire country of Indonesia would experience high rainfall. The BMG commented that the likely rainfall for each month was likely to be up to the extent of 115% of the long-term mean rainfall for 102 meteorological districts. Organizations like the Ministry of Agriculture and the Ministry of Water Resources perceived that La Niña would induce serious flooding. Media reports also described La Niña as a flood-inducing agent.[8]

5.1 Action Taken by Government Agencies

On the basis of forecasts, the climate-sensitive sector organizations prepared contingency plans. Information obtained from the Ministry of Water Resources and the Ministry of Agriculture is summarized below.

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[8] The Jakarta Post, 5 September 1998: Agency forecasts heavy rains, warns of floods. Heavy rains are expected to fall on the country from this month until early next year, the Meteorology and Geophysics Agency (BMG) said here on Friday. It warned of possible floods and an adverse effect on harvests as a result of above-average precipitation, which is expected to last for between three and eight months depending on the region. The reason for the expected high rainfall, according to the agency's head Sri Diharto, could be the La Niña weather phenomenon, although, he added, it was still too early to be certain. "We will issue warnings once we have established if La Niña really has arrived", Diharto said in a news conference. Diharto said he hoped the relevant government agencies would begin to draft contingency plans for severe weather immediately. He said that public work offices should identify areas prone to flooding and help residents to prepare themselves and protect their crops and homes. He also said that agricultural offices should disseminate recommendations on crop planting patterns. "It's unlikely that this year's La Niña will be as strong, but *Allahu Akbar* (Allah is Great), who knows", he said.

The Jakarta Post, 10 September 1998: Minister warns of La Niña-induced floods. The government has warned that La Niña-induced floods will threaten many Indonesian provinces, even as it admitted that the country has poor flood control contingency plans.

Ministry of Water Resources

The Ministry of Water Resources, on the basis of rainfall probabilities, identified as high flood-risk zones, 15 out of 27 provinces in the country: Riau, South Sumatra and Lampung provinces of Sumatra Island, all provinces of Java and Nusa Tengara regions, and South and East Kalimantan and Central Sulawesi provinces. These provinces constitute around 60% of the country's surface area. The Ministry of Water Resources established task forces in 15 provinces to prepare contingency plans to enhance preparedness and emergency planning. The budgetary resources were augmented to the extent of 130% of the normal allocation, and all the task forces were authorized to invest in flood preparedness activities. A mechanism was established at the central government level to monitor disaster preparedness activities. This was the first time disaster preparedness activities were strengthened on the basis of a La Niña forecast, i.e., in August 1998, five months before the peak flood season.

Ministry of Agriculture

The Ministry of Agriculture, based on historical data relating to flood impacts, categorized provinces and districts as high-risk, moderate-risk and low-risk zones, and sent a communication to field agricultural extension agencies through the provincial departments to monitor these areas and undertake suitable measures in case of the occurrence of floods leading to crop damage.

5.2 Impact Pre-assessment Mission

In collaboration with NOAA/OGP and BAKORNAS PB of the Government of Indonesia, ADPC fielded a mission to Indonesia to carry out an impact pre-assessment of likely scenarios. The key objectives of this short mission were to:

a. Make a rapid assessment of the implications of La Niña 1998-99 for Indonesia, with a focus on two main sectors of the economy: agriculture and food security, and natural resources and the environment.

b. Make broad country-wide recommendations to mitigate the impacts of the increased risk of disasters, and to maximize the potential benefits of the early onset of rains and of increased precipitation.

The mission studied historical data relating to La Niña impacts and found that La Niña provided a favorable climate for Indonesia by advancing the wet season and reducing the duration of the dry season, thereby enhancing rice production. The mission also found that only around 40,000 hectare out of the 11 million hectare of cropped area suffered total damage due to floods during past La Niña episodes. The mission, after discussions with farmers and experts, concluded that La Niña could provide a favorable climate and flood damages were likely to be insignificant. The mission recommended that rice production could be increased by:

- Enhancing rice yield potential;
- Increasing crop intensity through re-structuring of the cropping pattern; and
- Expanding the cropping area into idle fallow lands under rice cultivation.

The mission was of the view that the paddy production level during 1998-99 could go up to the 1996 production level of 51.1 million metric tons, compared to 46.39 million metric tons in 1997-98, by undertaking the following measures:

1. Incorporating La Niña forecast information into the country's agricultural development planning for the year 1998-99.

2. Introducing an emergency rice production program by the government with adequate incentives for farmers to be able to obtain agricultural inputs and take advantage of La Niña-induced increased precipitation.

3. Ensuring short training programs are organized in a timely fashion to enable agricultural extension workers to use and disseminate La Niña forecast information for agricultural purposes. This will help to provide farmers with information on appropriate cropping patterns and agricultural inputs.

4. As a follow-up to the above, preparing and disseminating location-specific contingency crop plans to enable farmers to plant and to implement an appropriate cropping schedule.

5. Establishing an effective coordination mechanism at each reservoir project level to regulate the release of water, keeping in mind updated La Niña forecast information.

The mission noted that the Government had a plan to import 3.2 million metric tons of rice for the fiscal year 1999-2000 (April 1999 to March 2000). The mission recommended that the Government should consider modifying the rice import plan, as the plan was prepared without taking into consideration the La Niña-associated climatic conditions in the 1998-99 wet season.

5.3 Actual Impacts

Flood Incidence

The flood had affected a total of 39,780 hectare of irrigated paddy fields, inundating some 5.5 km of national roads, 15.5 km of provincial roads, 60 km of local roads, and some 56 km of village roads. The water level in the inundated area was recorded in the range of 15 cm to 2 meters. Six people were killed in flood incidents. The provinces which were not considered as flood-risk zones, like South Sulawesi, were affected by floods. As against the forecast, which indicated that about 46% of Jakarta could be inundated by floods, the flood impact was confined to a few pockets.

The overall impact of flooding was insignificant. Hence, resources committed for flood preparedness proved to be fruitless. The Ministry of Water Resources, with hindsight, became skeptical about utilizing La Niña forecasts issued by the meteorology department (BMG).

Crop Production

In consonance with the assessment of the ADPC mission, farmers took advantage of the early onset of rain, and the prevalence of high prices for paddy motivated them to increase the area under paddy to more than that of a normal year. Consequently, there was a significant increase in paddy crop production.

In February 1999, because of the advanced and enhanced harvests, the price of paddy fell from around Rp 4,000 to around Rp 800 per kilogram. Panic selling of paddy by farmers at throw-away prices was reported. When the distress sale reports came from many regions of Java, the government approved Rp 778 billion (about US$ 91 million) to provide credit to village cooperatives and non-government organizations for use in procuring rice from local farmers to stabilize the price of paddy at Rp 1,520 per kilogram. The government also decided to modify and reduce the import of rice in order to arrest further price drops.[9]

5.4 La Niña Lessons Learned

Documentation, retrieval and analysis of past climate and disaster events data could have prevented the anticipation of 50% of the country likely to be flooded and the committing of huge resources for flood preparedness. Never in the past La Niña years had 50,000

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[9] The Yahoo (Internet) News Asia, 5 March 1999: Indonesia Re-schedules Rice Imports to Ease Local Rice Price. The State Logistics Agency (BULOG) said on Thursday, it would re-schedule deliveries of rice to be imported this year to ease pressures on the price of locally produced rice. Industry and Trade Minister Rahardi Ramelan, who is also BULOG's chairman, said the agency would adjust the scheduling and destinations of the import deliveries to protect the local market. "In certain areas, rice delivery will be delayed until the closing of the harvesting season in April, and we will also unload some of the rice at areas that do not harvest this year", the Jakarta Post quoted Rahardi as saying. The re-scheduling of the planned rice imports was needed to protect rice farmers from drastic falls in the price of rice in the local market", he said.

The Indonesian Observer, 6 April 1999: RI to stop importing rice by 2000: Official. State Minister for Food and Horticulture AM Saefuddin said, Indonesia will no longer import rice by the year 2000. "If the natural condition remains like the current condition, then by February 2000, Indonesia will no longer need to import rice", he said, following a hand-over of cheap rice packages to fishermen in Ancol, North Jakarta yesterday. His prediction is based on the fact that the current domestic rice procurement has increased continuously during the present harvest time. In March this year, the realization of rice procurement is expected to reach over 450,000 tons, and in April is expected to reach the biggest amount of 600,000 tons.

hectare of paddy cultivation area (out of a total of 11 million hectare) been completely damaged by floods in any one year in Indonesia.

While farmers had taken advantage of early rains to increase paddy production, government agencies did not take anticipatory action. Had the government based its decisions on this La Niña forecast, it could have committed resources to farmers by providing them to cooperatives to buy paddy from farmers. The government could have also reduced its imports to prevent the flooding of imported rice into the market.

The direct application of global ENSO parameters to local decision making poses serious difficulties. Policy-planners and end-users were not able to utilize information, like the SST index and thermocline depth in the tropical Pacific, for making resource management decisions. Clearly, the local decision-makers' interest is to know the specific impacts attributable to precursor, growth and decay phases of ENSO on southeast and northwest monsoons and their impact on lowland and upland crops in a particular season. They judge the events from the socio-economic and environmental impacts that can be attributed to ENSO parameters in their particular area.

Hence, there is a need to downscale and desegregate the specific impact of ENSO parameters on monsoon patterns, and the impact of monsoon pattern on local climate and weather variables, and on a given socio-economic system in a particular area. The disaggregation of ENSO-associated potential impacts on a temporal and spatial basis would provide better resolution to climate forecast products to enable decision-makers and end-users to undertake pro-active response measures.

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