22. Saldiva PH, Pope CA III, et al. Air pollution and mortality in elderly people: a time-series study in Sao Paulo, Brazil. Arch Environ Health, 1995; 50: 159-63.

23. Dockery DW, Pope CA III, et al. An association between air pollution and mortality in six U.S. cities. New Eng J Med, 1993; 329: 1753-9.

24. Pope CA III, Schwartz J, Ransom MR. Daily mortality and PM_{10} pollution in Utah Valley. Arch Environ Health, 1992; 47: 211-7.

25. World Health Organization. Health and environment analysis for decision-making: a methodology for estimating air pollution health effects. Geneva, 1995.

26. Ministry of Health, Indonesia. Haze disaster and health impact in Indonesia. Bi-regional Workshop on the Health Impacts of Haze-related Air Pollution, Kuala Lumpur, June 1998.

27. Ismail S, Yamamura S. Haze monitoring by EMC Indonesia. Bi-regional Workshop on the Health Impacts of Haze-related Air Pollution, Kuala Lumpur, June 1998.

28. Peters A, Doring A, et al. Increased plasma viscosity during an air pollution episode: a link to mortality? Lancet 1997;349:1582-7.

29. Borja-Aburto VH, Loomis DP, et al. Ozone, suspended particulates, and daily mortality in Mexico City. Am J Epidemiol 1997;145:258-68.

30. Lippmann M, Thurston GD. Sulfate concentrations as an indicator of ambient particulate matter air pollution for health risk evaluations. J Expos Analy Envir Epidem 1996;6:123-46.

31. Morris RD, Naumova EN, Munasinghe PL. Ambient air pollution and hospitalization for congestive heart failure among elderly people in seven large US cities. Am J Public Health 1995;85:1361-5.

32. Seaton A, MacNee W, et al. Particulate air pollution and acute health effects. Lancet 1995;345:176-8.

Figure 1
Particle concentrations of sizes $>0.3\ \mu m$ and $>5.0\ \mu m$ measured in 8 sites in Indonesia

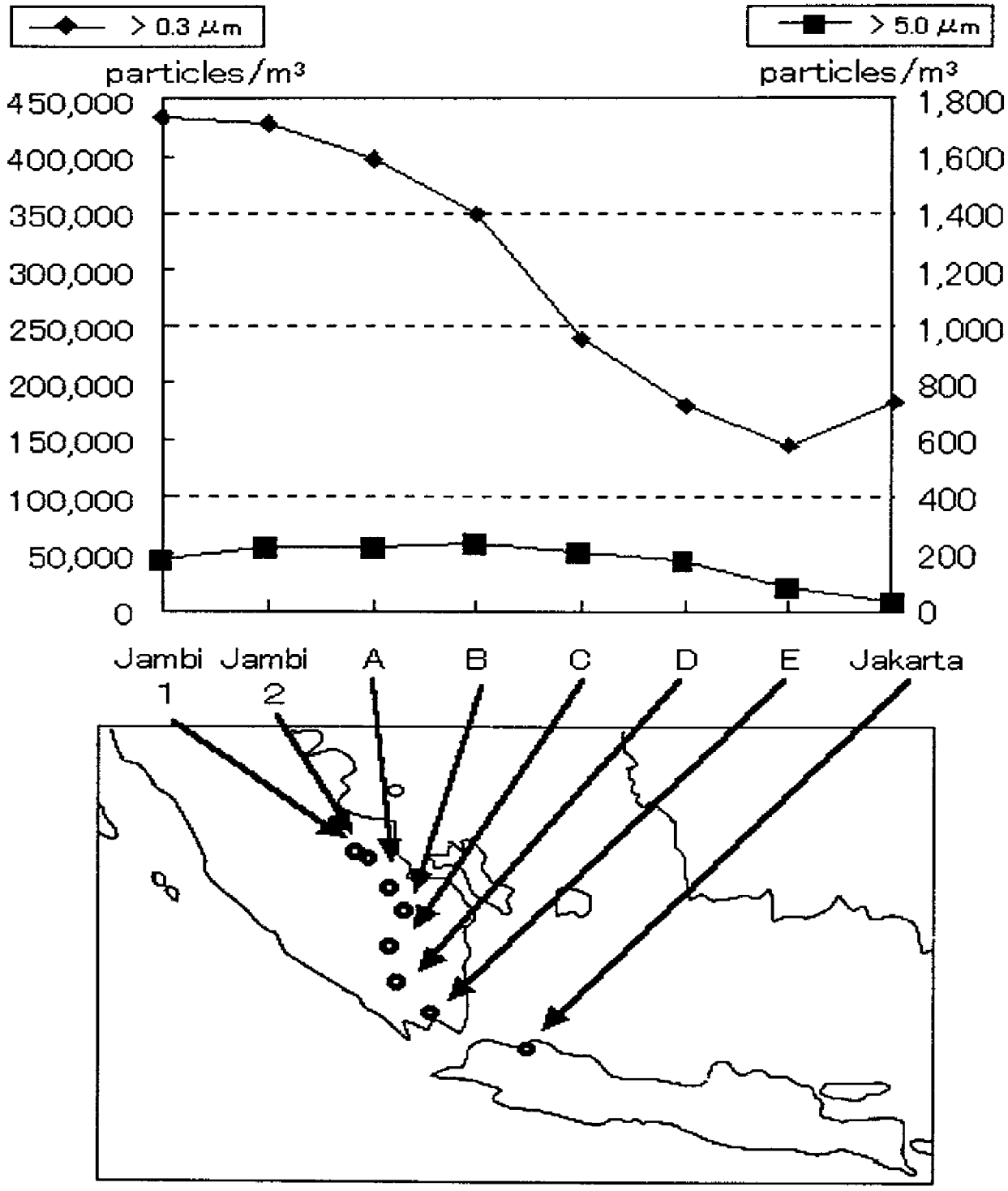

Figure 2
CO and CO_2 concentrations measured in 8 sites in Indonesia

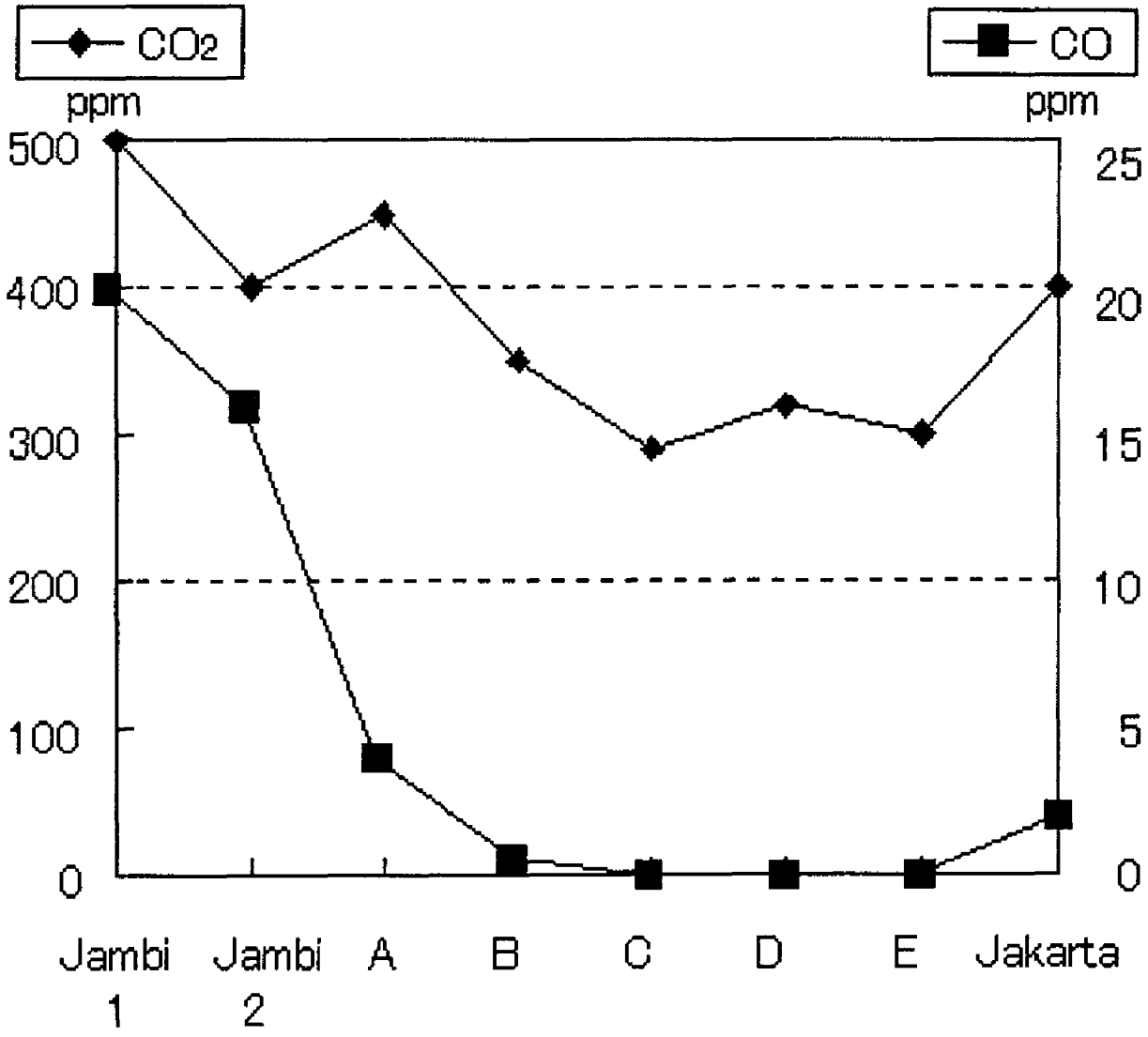

Figure 3
Number of reported hospitalised cases with pneumonia in Central Kalimantan, Indonesia, 1995-1997

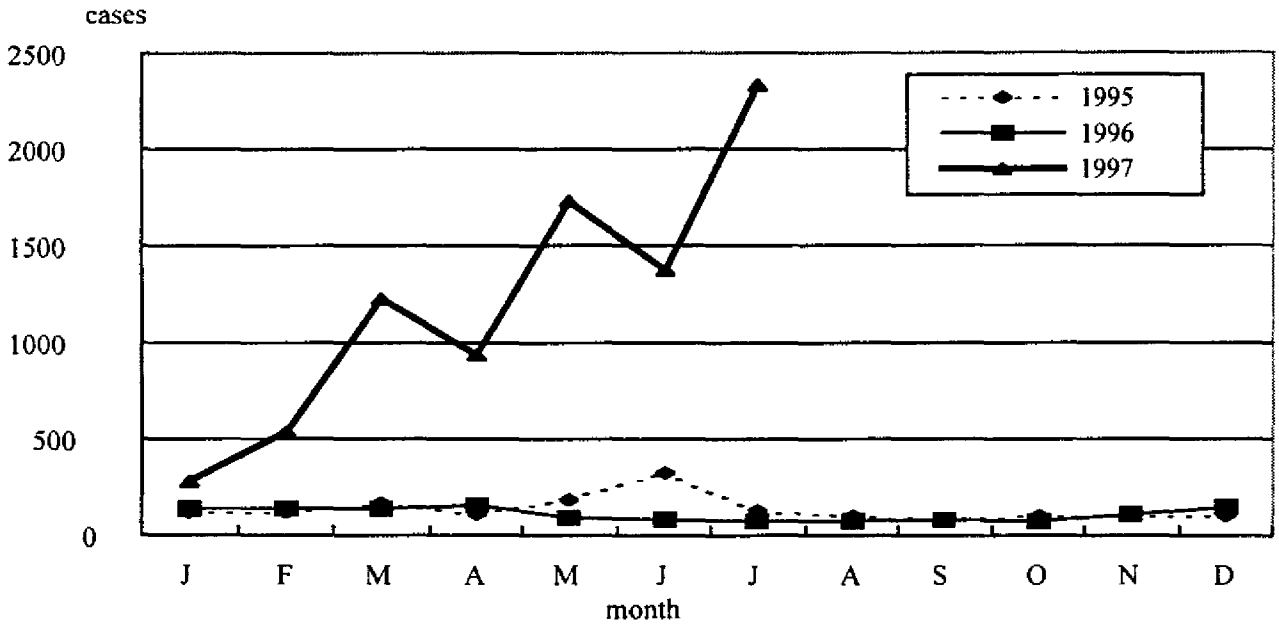

Figure 4
Lung function tests for persons with respiratory symptoms

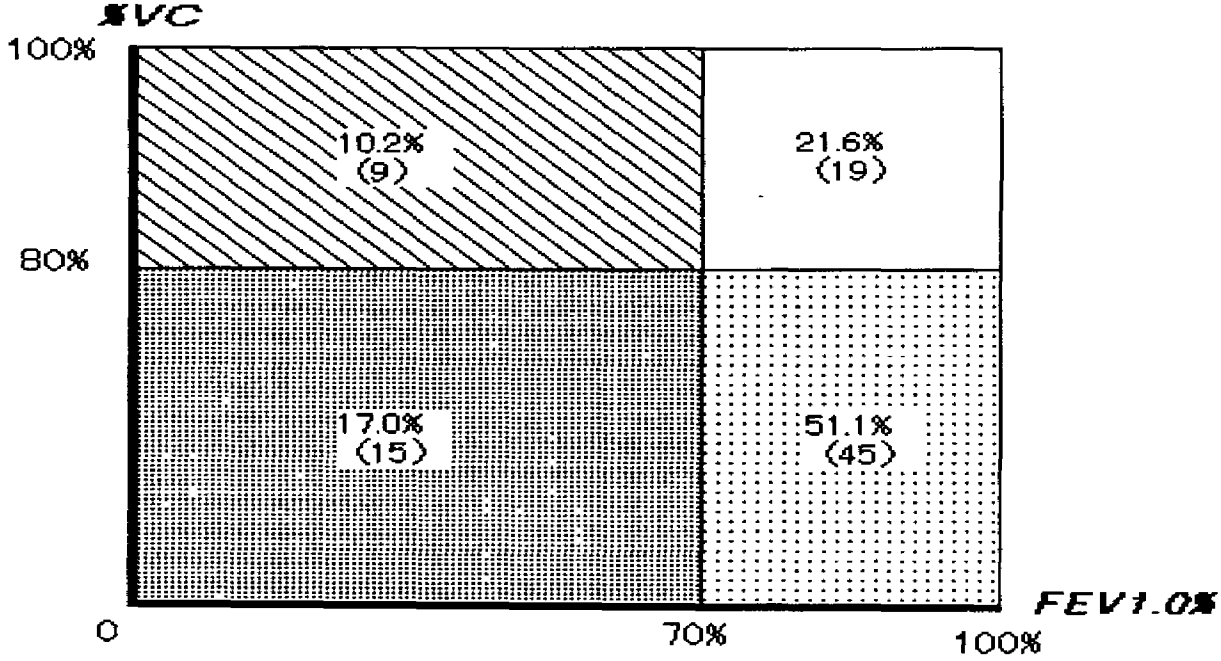

Table 1
Air pollutants measured in 3 sites in Jambi, Indonesia, 3-5 Oct, 1997

	Site 1	Site 2	Site 3	Unit	PSI
SO_2	0.01	0.01	0.01	Ppm	18
NO_2	0.01	0.02	0.004	Ppm	-
O_3	0.03	0.03	0.06	Ppm	54
CO	20	20	20	Ppm	247
PM_{10}	1684	1635	1864	g/m^3	1584

Table 2
Concentrations of inorganic ions in suspended particulates

Sample no		Cl^-	NO_3^-	SO_4^{2-}	NH_4^+
I	$\mu g/m^3$	4.98	5.23	37.98	0.69
	mg/g dust	4.09	4.30	31.19	0.57
II	$\mu g/m^3$	3.07	4.68	46.85	0.76
	mg/g dust	2.62	4.00	40.05	0.65

Table 3
Concentrations of carcinogenic substances in suspended particulates

	Jambi	Jakarta	Molecular weight
Particle ($\mu g/m^3$)	1707	167	
Fluoranthene	16.7	0.255	202.3
Pyrene	21.1	0.396	202.3
Triphenylene	20.2	0.411	228.3
Benz(a)anthracene	16.8	0.438	228.3
Chrysene	41.7	0.910	228.3
Perylene	2.60	0.219	252.3
Benzo(e)pyrene	14.7	1.22	252.3
Benzo(b)fluoranthene	15.1	1.62	252.3
Benzo(k)fluoranthene	6.45	0.793	252.3
Benzo(a)pyrene	15.3	1.05	252.3
Indeno(1, 2, 3 – cd) pyrene	11.1	2.24	276.3
Benzo(ghi) perylene	12.8	1.78	276.3
Dibenz(a, c) anthracene	0.428	0.158	278.4
Dibenz(a, h) anthracene	0.823	0.120	278.4
Benzo (b) chrysene	1.66	0.164	278.4
Coronene	0.914	0.121	300.4
Dibenzo(a, e) pyrene	3.15	-	302.4
Air volume (m^3)	565	1,995	
Collected amount of particles (g)	0.9646	0.333	
Sampling time (hours)	5.2	23.8	

Table 4
Prevalence and severity of reported symptoms which developed after exposure to the haze

Symptoms	n	%	mild	moderate	severe
Eye irritation	425	78.9	276	135	14
Cough	415	77.0	231	155	29
Sneezing	385	71.4	286	94	4
Headache	331	61.5	199	119	14
Fatigue	280	52.0	206	67	7
Running nose	272	50.5	171	93	8
Sputum	253	47.0	175	67	11
Breathless (walking)	239	44.4	155	77	8
Sore throat	234	43.5	152	74	9
Breathless (during hard work)	192	35.7	109	71	12
Chest discomfort	175	32.5	109	59	6
Fever	161	29.8	107	49	4
Anorexia	151	28.0	108	39	4
Insomnia	129	23.9	84	38	7
Nausea	126	23.3	101	23	2
Palpitation	121	22.5	88	33	0
Abdominal pain	121	22.4	88	28	4
Depression	95	17.7	55	32	8
Wheezing	78	14.5	45	25	8
Dizziness	22	4.1	1	17	5
Diarrhoea	16	3.0	12	4	1

Table 5
Changes in general health condition of respondents by age

Age group	Worst	Worse	Unchanged	Better	Total
0-15 years	13 (5.0)	154 (59.2)	38 (14.6)	55 (21.2)	260 (100)
16-59 years	18 (9.8)	137 (74.5)	24 (13.0)	5 (2.7)	184 (100)
≥ 60 years	10 (17.2)	34 (58.6)	14 (24.1)	0 (0)	58 (100)
Total	41 (8.2)	325 (64.7)	76 (15.1)	60 (12.0)	502 (100)

Figures in brackets denote per cent

SMOKE EPISODES AND ASSESSMENT OF HEALTH IMPACTS RELATED TO HAZE FROM FOREST FIRES: INDONESIAN EXPERIENCE

Yudanarso Dawud

The Indonesian Association of Pulmonologists
Persahabatan Hospital
Jalan Raya Persahabatan
Jakarta Timur 13230
Indonesia

INTRODUCTION

Uncontrolled forest fire in Indonesia has caused smoke pollution in the country as well as other countries in this particular part of the world. The haze episodes in the Southeast Asian region constituted a substantial health risk to the public in 1997 and early 1998 This was evidenced by widespread increases of health-related ambient air quality standards and guidelines for particulate matter. In 1997, in relation to clinical indicators of health, this risk was reflected in increased respiratory-related hospital visits in the most heavily impacted areas during the peak period of the haze.

Forest fires have been occuring almost yearly, especially during the dry season, at certain locations in Indonesia including Kalimantan, Sumatera, Java, Sulawesi, Maluku and Irian Jaya. From July to the beginning of October 1997, smoke haze from uncontrolled forest fires had spread throughout some neighbouring countries such as Brunei Darussalam, Malaysia, Southern Philippines, Singapore and Southern Thailand. The Coordinator Minister of Social Welfare of Indonesia declared these uncontrolled forest fires, especially in Sumatera and Kalimantan, as national disaster.

In a WHO meeting on the health impacts of haze in June 1998, it was mentioned that the severity and extent of the smoke haze pollution were unprecedented, affecting an area with a population of 300 million people across the region. It was also stated that at least 20 million Indonesians were affected by the haze from forest fires. The actual amount of economic losses suffered by countries during this environmental disaster were enormous and are yet to be fully determined. The countries most affected were Indonesia, Malaysia and Singapore as they had experienced extended period of high particulate levels and severe reduction in visibility. Among the important sectors severely affected were air and land transport, shipping, construction, tourism and agriculture-based industries. The haze pollution had also resulted in considerable public health impacts, and the long-term health effects are yet to be determined.

From the public health aspect, the disastrous forest fires lead to a negative influence on the ecological system and the health status of the community in the affected area since air, water and soil were significantly polluted. The acute and chronic effects of haze include elevated morbidity and mortality of respiratory diseases.

INDONESIA AT A GLANCE

Indonesia is the largest archipelago in the world with a total population of more than 200 million people living in an area of 1.9 million km^2. It consists of five major islands; ie. Sumatera, Kalimantan, Java, Sulawesi and Irian Jaya, and more than 17,000 small islands. Rapid increase in population, industrial development and transportation has caused considerable pressure on the Indonesian environment, and pollution of air, water and ground resources has potential effects on human health.

Indonesia is a rich country in term of natural resources. Agriculture, forestry and fisheries are still the main sources of economic growth. However, due to its location near the Western Pacific region. Indonesia is directly affected by the El Niño phenomenon. Observations over the past several decades have showed that, during El Niño events, most parts of the country received below normal rainfall. This has considerable

environmental impact as common forestry and agriculture practices will exacerbate the problem of smoke and fires.

Fires in Indonesia have resulted in human exposure to levels of air pollutants far in excess of those stipulated in the WHO guidelines. Chemical pollutants such as SO_2, NO_x, O_3 CO and respirable fine particulate are harmful to human health. Air quality monitoring data (PSI or pollutant standards index) obtained from various institutions during the peak haze period showed that in areas close to the fires, the levels of air pollutants were 4-8 times higher than the values which have a significant health impact. Data collected through active surveillance from September to November 1997 in eight provinces showed increases in the incidence of bronchial asthma and ARI (acute respiratory infection). According to the Indonesian Central Bureau of Statistics, among 12,360,000 people affected by the haze in 1997, there were about 1,802,340 cases of bronchial asthma, bronchitis and ARI.

In several provinces, the total suspended particulate (TSP) threshold limit of 260 $\mu g/m^3$ was exceeded; eg. in West Sumatera, by 5 - 10 times; in Riau, by 0.8 - 7 times; in South Sumatera, by 3.5 - 8 times; in West Kalimantan, by 0.5 - 7.3 times; and in Central Kalimantan, by 0.5 - 15 times.

SMOKE CHARACTERIZATION

Biomass smoke contains a large and diverse number of chemicals, many of which have been associated with adverse health effects. A summary of the major biomass pollutants is given by Brauer (see page 253). These include both particulate matter and gaseosus compounds such as carbon monoxide, formaldehyde, acrolein, benzene, nitrogen dioxide and ozone. Particulate matter is itself a complex mixture which is associated with a wide range of health effects. Elevated concentrations of particulate matter are consistenly observed in situations where biomass material is burned. Exposures to high concentrations of carbon monoxide and other pollutants are highly variable and occasionally observed in individuals such as wildland firefighters and people who cook with biomass fuels. Based on literature review as well as initial evaluation of the available air monitoring data from the 1997 haze episode, the air

pollutant parameter most consistently elevated in association with biomass smoke is particulate matter.

Monitoring and managing the environmental impact of smoke from forest fires has been given the priority by the government of Indonesia even though air quality monitoring data are still limited due to lack of sampling devices and scarcity of other resources. Air quality monitoring stations are located in the capital cities of all 27 provinces and operated by Environmental Impact Management Agency (BAPEDAL), Ministry of Health, Ministry of Transportation, local government etc. All heads of provincial health office are requested to monitor air pollutants of forest fires; ie. SO_2, CO, NO_x, O_3, and total suspended particulate matter (TSP), and send the results weekly to the Ministry of Health. However, due to lack of equipment and high operational budget, most of the provincial health offices are capable of monitoring only TSP which is a more important health hazard. Currently, the Environmental Management Center (EMC) at BAPEDAL is developing a simplified air quality monitoring method. With EMC coordinating the air quality monitoring in other sectors, appropriate data could be provided to assess the health risk of smoke haze.

Access to appropriate and accurate data is essential to guide the Ministry of Health in its immediate response and for future planning. Extensive TSP data are provided by the Ministry of Health and the Department of Meteorology and Geophysics. Unfortunately, this data cannot be directly used to assess the respirable particulate content of the air. To solve this problem, the Director of Environmental Health, Ministry of Health, has developed temporary guidelines on how to calculate and convert from TSP value to particulate matter 10 μm in diameter. Since November 1997, the Ministry of Environment has issued a new regulation on air pollutant standards index similar to the PSI used in most countries of the Association of Southeast Asian Nations (ASEAN).

The air quality monitoring data collected by the Directorate General of Communicable Disease Control and Environmental Health (CDC&EH), Ministry of Health (MOH), from provincial health offices showed different peak PSI in different areas at different time periods. The

findings are compiled in Table 1 from which the peak periods in different provinces can be inferred:

North Sumatera: peak period occurred in the first week of October 1997. TSP levels were more than 3 times higher, while other parameters were below the standard values.

West Sumatera: peak period occurred at the second week of October 1997. TSP value was more than 10 times, while NO_x was more than 2.5 times the standard in the last week of September 1997.

Riau: peak period occurred in the last week of September 1997 with TSP value more than 7 times the standard. In the last week of November 1997, TSP value was still more than twice the standard.

Bengkulu: peak period occurred in the last week of October 1997, but the TSP value was below and CO slightly above the respective standards.

South Sumatera: peak period occurred in the first week of October 1997 with TSP value more than 8 times and NO_x slightly above the respective standards.

Jambi: peak period occurred in the second week of October 1997 when the TSP value was more than 15 times above the standard. However, the NO_x level was below the standard.

West Kalimantan: peak period occurred in the last week of September 1997 with TSP value more than 7 times the standard. At the end of October 1997, TSP value was still more than twice the standard.

Central Kalimantan: peak period occurred at the end of October 1997 with TSP value more than 15 times and CO more than 8 times the respective standards. As for other parameters such as SO_2 and NO_x, peak period was in the first week of October 1997, when the levels were more than 4 times the respective standards. At the end of October 1997, TSP value was still about 13 times above the standard.

South Kalimantan: peak period for TSP and CO value occurred at the last week of September 1997, with values almost 4 times to 15 times

respectively, above the standard. On the first week of October 1997, the CO level was close to 29 times the standard. At the end of October 1997, TSP value was about 13 times above the standard.

East Kalimantan: peak period for CO value occurred at the second week of October 1997 when it reached more than 2.6 times the standard. In the third week of October, TSP was more than 1.3 times the standard while the other parameters were below the standard. At the end of October 1997, TSP value was still more than 1.3 times the standard.

Maluku and Irian Jaya: very limited air quality data were available.

The Ministry of Health reported that there was an increase in the number of cases of respiratory diseases such as upper respiratory tract infection (URI) and asthma, in Pontianak and West Kalimantan. However, there was no significant increase in skin and eye diseases.

At the beginning of February 1998, forest fires started again in east Kalimantan, central Kalimantan and Maluku.

HEALTH IMPACTS

The WHO biregional meeting on health impacts of haze-related air pollution at Kuala Lumpur in 1998 concluded that the main constituent of the haze that adversely affects health is fine particulate matter. Based on extensive literature review regarding the health impacts of air pollution, the ambient concentration levels of PM_{10} (i.e. particles that are 10 microns or less in diameter) observed in Brunei Darussalam, Indonesia, Malaysia and Singapore during the 1997 and 1998 haze episodes are associated with:

- increased daily mortality;
- increased hospitalization;
- increased visits to emergency rooms;
- increased respiratory symptoms;
- exacerbation of asthma; and
- decreased lung function.

These impacts have been observed, primarily in the elderly, the very young and in individuals with pre-existing respiratory and/or cardiovascular illness.

From the existing body of knowledge that associates a range of adverse health impacts with urban particulate air pollution mixtures, there was no evidence that particles from different combustion sources have different impact on health. While particles generated by natural processes such as volcanic eruptions and wind-blown soil appeared to have less impact on health, there is little reason to expect that biomass smoke particles would be less harmful than other combustion-source particles. Available data strongly suggest that combustion-source particulates, including those produced during forest fires, are associated with a wide range of adverse health outcomes.

The risk of long-term health effects due to a single air pollution episode is difficult to detect, but repeated exposures to haze may result in a wide range of adverse health outcomes and hence merit our attention. Existing data indicate that the potential carcinogenicity of biomass particulates is low relative to particulate emissions from diesel-run motor vehicles. Epidemiological studies have not demonstrated an increased risk of lung cancer in individuals with lifetime exposure to higher levels of biomass particulate than those measured in the 1997 and 1998 haze episodes. Therefore, the risk of cancer associated with biomass air pollution episodes may be considered as low relative to other enviromental risk factors.

The most significant immediate health impact of haze disaster observed in the affected areas in Indonesia are acute respiratory infection (ARI), bronchial asthma, diarrhoea, eye irritation, and skin disease. Comparing the data obtained from September 1997 to June 1998 with those obtained during the same period in 1995 and 1996, the number of ARI cases was generally below the average in some provinces, but it increased by 1.8 times in South Kalimantan province, and 3.8 times in South Sumatera. For other provinces, a significant increase occurred from October to November 1997. The number of ARI cases declined in parallel with the decrease in the incidence of forest fires. The health

impact during the haze disaster in eight provinces is shown in Tables 2 and 3.

Medical experts of the Japan Disaster Relief Team (JDR) conducted field surveys to assess the enviromental and health effects on the people affected by the haze in Indonesia. They found not only increased hospital visits and admissions for conjunctivitis, bronchial asthma and pneumonia in the affected areas, but also increased severity of these medical conditons. Through community surveys, many symptoms of respiratory and digestive problems were reported within one month after the occurrence of the haze, and people with poor respiratory functions were also detected. The elderly and young children appeared to be more vulnerable in this hazardous situation.

Another survey conducted by a team from the Indonesian Association of Pulmonologists (East Java Branch), at the city of Samarinda (highly polluted area with NO_x 140 $\mu g/m^3$ and TSP 438 $\mu g/m^3$) and Bontang (relatively low polluted area with NO_x 36 $\mu g/m^3$ and TSP 198 $\mu g/m^3$) in central Kalimantan. No statistically significant difference was observed in the prevalence of bronchitis & bronchial asthma as well as the lung function parameter (FEV_1) among 127 high school students examined. There were significant differences in FVC and PFR in the male population. Seven out of 9 subjects who had obstructive changes showed signs of bronchial hyperreactivity.

Another team from the Indonesian Association of Pulmonologists conducted a survey at Palembang (South Sumatera) and Jambi. The TSP level at Palembang between 25 September to 4 October 1997 was around 1.047 - 4.86 mg/m^3; NO_x, 0.03 – 0.11 ppm; and SO_2, 0 – 0.19 ppm. Of the 212 patients examined, 158 (74.5 per cent) had no prior history of respiratory problems. Among the sample population, 81 per cent had complaints of cough; 24 per cent, dyspnoea; and 19 per cent, phlegm. However, from those who had a prior history of respiratory problems, 83 per cent complained of cough; 72 per cent, dyspnoea; and 29.6 per cent, wheezing.

A report from the Provincial Health Office in Jambi showed that there was an increase of 51 per cent for respiratory diseases in that area during the haze period. Bronchial asthma constituted 78 per cent of the respiratory diseases among patients treated at Jambi and Palembang. On the whole, 70 per cent of the patients with respiratory diseases reported that their symptoms worsened during the haze period. Data from the hospitals in Jambi showed two to four fold increase in mortality rate compared to the previous months. The main causes of death were respiratory failures in patients with advanced tuberculosis, severe chronic bronchitis, severe pneumonia and lung cancer.

STEPS TAKEN TO MINIMISE HEALTH IMPACTS

In order to minimise the health impacts of the haze from forest fires, campaigns to increase awareness of the community were undertaken by various institutions in the country, including the Directorate-General (DG) of Communicable Disease Control (CDC) and Environmental Health (EH) and health professional associations.

The Director-General of CDC & EH instructed the provincial health offices to:

- monitor air quality daily;
- strengthen surveillance activities for ARI, asthmatic bronchitis and eye irritation;
- protect the community, especially the high-risk groups (babies, the elderly, pregnant women), by introducing and distributing masks;
- alert local government and private health sectors to provide 24-hour services; and
- in case of emergency, the local authority could immediately decide to close down schools and offices activities and to selectively evacuate the high-risk groups to safer places.

Health profesional associations such as the Indonesia Medical Association, the Indonesian Pulmonologist Association, and the Environmental Health Association were involved in various activities such as provision of health services and health education in the affected areas. The Indonesian Association of Pulmonologists has contributed in the following activities:

- developed guidelines for physicians in handling cases with respiratory problems due to the haze from forest fire;
- sent a health team to the affected areas in Jambi and Central Kalimantan;
- conducted a small scale survey on the impact of haze on respiratory health; and
- developed a proposal for cohort study on the long-term impact on respiratory health of the community exposed to the haze (see Annex).

Other activities initiated by various non-government organisations included:

- distribution of masks to high risk groups;
- co-ordination with other sectors under the National Board for Disaster Management at central level as well as at provincial and district levels; and
- development of information system and early warning system for health impact during haze disaster.

The haze from forest fires in Indonesia had substantial impact on public health and the ecology in the affected areas. A lot more should be done to characterise the smoke composition, and its impacts on health, as well as its social and economic activities. It is important that the Indonesian Association of Pulmonologists plays an active role, especially in the health sector, by conducting research, strengthening capabilities of physicians, and producing guidelines for medical doctors and other health profesionals.

Annex

PROPOSAL FOR A COHORT STUDY ON LUNG AND RESPIRATORY TRACTS OF HUMANS DUE TO HAZE OR SMOKE FROM FOREST FIRES

Introduction

Forest fires that occurred in certain locations in Indonesia produced impacts which were not only felt in Indonesia, but also in the South East Asian region. Haze, produced by biomass burning, can cause lung and respiratory disorders and decreased lung functions; e.g. acute respiratory infection and acute excacerbation of asthma and chronic obstructive lung disease. It is still a big question as to whether the haze from forest fires can cause lung-cancer. However, acute or chronic exposure may influence the morbidity and mortality due to the haze-related respiratory tract diseases.

A study on the health effects of exposure to biomass-haze has been conducted before, but the period of exposure was relatively short compared to the situation in 1997. Based on the observations made, it was felt that a cohort study should be carried out to determine the short-term and long-term effects on the respiratory tracts following exposure to haze from biomass burning.

Objectives

- to study the effects of exposure to biomass-haze in relation to the pattern of lung and respiratory diseases;
- to evaluate the short-therm and long-term effects of haze on the respiratory tract;
- to develop an applicable but sensitive and valid for the detection of and monitoring for the pathogeneses of lung and respiratory diseases; and
- to provide training for professional health workers for the purpose of conducting the appropriate tasks.

Material and Methods

Material

- Sample size for a cohort (prospective) study
  (in each province of Sumatera and Kalimantan)

  a. Specific groups:

     Exposed group
     Junior high school students ≥ 13 years (100 persons)
     Elderly people (≥ 50 years) (100 persons)

     Non-exposed group
     Junior high school students ≥ 13 years (100 persons)
     Elderly people (≥ 50 years) (100 persons)

  b. Community (≥ 15 years and ≥ 50 years) (2 x 500 persons)
     (assumed that the sample changes every year)

     - Acute infection of upper respiratory tract
     - Acute exacerbation of asthma
       Chronic obstructive pulmonary disease (COPD)
       Mortality pattern due respiratory disease

- Equipment

  - Stethoscope (4 units)
  - Tensimeter (4 units)
  - Spirometer (8 units)
  - Oxymeter (4 units)
  - Peak flowmeter (60 units)

Methods

The measurements of lung and respiratory disorders; examinations of several kinds of diseases.

- History of illness by ordinary and structurized questionnaire

- Physical examination

- Measurements of lung function by using spirometer and peak-flowmeter (taken every year including period free of forest fire). The parameters will include:

    - VC
    - PVC
    - FEV_1
    - PFR

- Chest X-ray will be taken every year

- For specific small groups, examinations will be performed in more detail such as:

    - Fiberoptic bronchoscopy
    - BAL (Broncho-alveolar lavage)
    - Oxymetry
    - Bronchodilator test

Table 1
Weekly air quality data (μg/m^3) in some affected areas in Indonesia, Sept-Nov, 1997

Province	Parameter	24-28 Sept	29 Sept-4 Oct	5-11 Oct	11-18 Oct	19-25 Oct	26 Oct – 1 Nov
North Sumatera	Total dust	-	96-770	-	120-122	-	-
	SO_2	154.3	14-80	-	0.01-0.014	-	-
	NO_x	-	1.88	-	-	-	-
	CO	-	-	-	-	-	-
West Sumatera	Total dust	1,300-1,900	-	1,000-2,800	-	-	-
	SO_2	-	-	-	-	-	-
	NO_x	99.65-223.74	-	75.21-135.37	-	-	-
	CO	-	-	-	-		
Riau	Total dust	1,600-1,900	230-970	180-370	160-620	300-820	270-580
	SO_2	-	-	-	-	-	-
	NO_x	-	-	-	-	-	-
	CO	-	-	-	-	-	-
Jambi	Total dust	1,613.2-3,404.1	1,804.9-3,939 9	94.4-3,939.9	-	-	-
	SO_2	-	-	-	-	-	-
	NO_x	102.92-218.75	83.61-127 8	69.3-218.75	-	-	-
	CO	29,755.58-30,900.02	-	29,755.7-30,900.15	-	-	-
Bengkulu	Total dust	-	181.60	104.11-190.15	137 11-190.15	130-204,67	106
	SO_2	-	-	-	-	-	-
	NO_x	-	-	5.45	2.44	4,577.8	-
	CO	1,444.45	1,430.35-2,288.9	2,288.9	-	-	-
South Sumatera	Total dust	904-1,890	1,047-2,111	-	-	-	-
	SO_2	-	183.11	-	-	-	-
	NO_x	-	94.07-131.61	-	-	-	-
	CO	-	-	-	-	-	-

Table 1 (cont'd)
Weekly air quality data ($\mu g/m^3$) in some affected area in Indonesia, Sept-Nov, 1997

Province	Parameter	24-28 Sept	29 Sept-4 Oct	5-11 Oct	11-18 Oct	19-25 Oct	26 Oct - 1 Nov
West Kalimantan	Total dust	904-1,890	161-1,218	122-242	180-381	341-556	-
	SO_2	-	-	-	-	-	-
	NO_x	-	-	-	-	-	-
	CO	-	-	-	-	-	-
Central Kalimantan	Total dust	500-1,310	130-981	180-4,090	1,020	2,850-3,280	-
	SO_2	817	604.3-1,097.3	30.16-322.6	-	-	-
	NO_x	230	1,097.3	22.13-126.7	-	-	-
	CO	1,144.45	1,144.45-2,288.9	1,444.5-18,311.2	-	2,889 -9,155.6	-
South Kalimantan	Total dust	454-991	46-678	-	-	-	-
	SO_2	77-120	90-122	-	-	-	-
	NO_x	9.4-658.01	338.43-1,662.06	-	-	-	-
	CO	11,444.5-33,662.4	-	-	-	-	-
East Kalimantan	Total dust	-	333-833	66-321.1	32.6-346.5	-	-
	SO_2	-	-	1.05-6.02	8.11	-	-
	NO_x	-	6.02-11.09	10.15-17.11	0.37-23.69	-	-
	CO	-	3,662.24-4,577.8	4,511.4-5,998.06	3,951.56	-	-

Note :

Standard of TSP : 260 $\mu g/m^3$

Standard of SO_2 : 260 $\mu g/m^3$

Standard of NO_x : 92.50 $\mu g/m^3$

Standard of CO : 2,260 $\mu g/m^3$

Table 2
Number of cases of asthma, bronchitis, acute respiratory infection (ARI) and deaths in 8 provinces in Indonesia, September-November 1997

Province	Population at risk	Asthma	Bronchitis	ARI	Death
Riau	1,701,000	41,028	7,995	199,107	75
West Sumatera	2,411,000	58,164	11,332	282,087	106
Jambi	1,478,000	35,650	6,947	172,926	65
South Sumatera	2,355,000	56,803	11,069	275,535	104
West Kalimantan	1,478,000	44,574	8,686	216,216	74
Central Kalimantan	716,000	17,574	3,366	83,772	29
South Kalimantan	1,733,000	41,800	8,145	202,716	69
East Kalimantan	118,000	2,846	555	13,806	5
Total	12,360,000	298,125	58,095	1,446,120	527

Source: Directorate-General, Communicable Disease Control & Environmental Health, Ministry of Health, Indonesia

Table 3
Estimated health and social impacts during the haze episode in 8 provinces in Indonesia, September-November 1997

Province	Population at risk	No. of out-patient visits	No. of in-patient	No. of lost working days	No. of days with limited activities
Riau	1,701,000	5,018	2,177	336,670	654,885
West Sumatera	2,411,00	7,112	3,086	477,197	928,235
Jambi	1,478,000	4,360	1,892	292,533	569,030
South Sumatera	2,355,000	6,948	3,015	466,114	906,675
West Kalimantan	1,478,000	5,452	2,366	365,765	711,480
Central Kalimantan	716,000	2,112	917	141,714	275,660
South Kalimantan	1,733,000	5,112	2,218	343,004	667,205
East Kalimantan	118,000	348	151	23,355	45,430
Total	12,360,000	36,462	15,822	2,446,352	4,758,600

Source: Directorate-General, Communicable Disease Control & Environmental Health, Ministry of Health, Indonesia