REPORT

BIREGIONAL WORKSHOP ON HEALTH IMPACTS OF HAZE-RELATED AIR POLLUTION

Convened by:
WORLD HEALTH ORGANIZATION
REGIONAL OFFICES FOR SOUTH EAST ASIA AND THE WESTERN PACIFIC

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NOTE

The views expressed in this report are those of the participants in the Bi-regional Workshop on Health Impacts of Haze-Related Air Pollution and do not necessarily reflect the policies of the World Health Organization.

This report has been prepared by the Regional Office for the Western Pacific of the World Health Organization for governments of Member States in the Region and for the participants in the Bi-Regional Workshop on Health Impacts of Haze-Related Air Pollution held in Kuala Lumpur, Malaysia from 1-4 June 1998.
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Key words: Air pollution / Smoke / Fires / Malaysia
Objectives of the workshop

The Bi-regional Workshop on Health Impacts of Haze-related Air Pollution was conducted in Kuala Lumpur, Malaysia from 1 to 4 June 1998 by the World Health Organization Regional Offices for South-East Asia and the Western Pacific.

The objectives of the workshop were:

1. to review and summarize research findings and other relevant information concerning the impacts of haze-related air pollution on health;

2. to identify needs for further technical information and research to support future haze-related decision-making; and

3. to develop draft health impact reduction measures and strategies, addressing intercountry cooperation issues, for consideration by affected countries and external support agencies.

The workshop was attended by 17 participants and five observers from seven countries of South-East Asia and Papua New Guinea; four temporary advisers; ten representatives from seven international partner agencies; and four WHO staff serving as the workshop secretariat. The proceedings comprised presentations of country reports and haze-related health effects research activities by the participants; presentations of working papers by temporary advisers and representatives of international partner agencies; and plenary and group discussions on future research needs, health impact reduction measures, and intercountry cooperation.

The workshop deliberations produced conclusions in the following four major areas:

Conclusions in relation to haze-related air pollution problems and research findings:

1. The haze episodes in South-East Asia in 1997 and early 1998 constituted a substantial health risk to the public.

2. The main constituent of the haze that adversely affects health is particulate matter.

3. From the existing body of knowledge that associates a range of adverse, non-cancer health impacts with urban particulate air pollution mixtures, there is no evidence that particles from different combustion sources have different impacts on health.

4. The risk of long-term health effects due to a single air pollution episode is difficult to detect, but repeated exposures to haze episodes merit attention.

5. To help ensure data comparability, it is desirable that consistent protocols be followed in relation to health effects monitoring, ambient air quality monitoring, and data analysis.

6. There are a number of valuable health-related research studies currently being carried out in the region.
Conclusions in relation to further research needs:

In addressing priority environmental health research needs, underlying emphasis always needs to be placed on research and public health monitoring capacity building. The priority needs identified in the region include:

(7) Research on new mitigation approaches:

- assessment the feasibility of different arrangements for "haze shelters"
- evaluation of the most effective approaches to management of a future haze emergency in terms of arranging transport to "haze shelters" for vulnerable groups, and other mitigation methods;
- evaluation of the effectiveness of remaining indoors; and
- evaluation of the effectiveness of early health care interventions, as well as public information and awareness efforts, in reducing health impacts.

(8) Research on the impacts of the 1997 haze, primarily using data that has been routinely collected:

- evaluation of short-term health impacts, including the identification of susceptible population groups;
- a regional study of short-term health impacts using standardized methodologies and routinely-collected data;
- assessment of any long-term effects in selected groups of exposed people in areas where comprehensive mortality and morbidity data are continuously maintained and
- identification of sources of particulate air pollution exposure, especially the relative contributions of biomass and motor vehicle-related urban air pollution mixture sources.

(9) Future research requiring the development of substantial new data:

- an assessment of the real effectiveness of the use of dust masks by the general population;
- an investigation of the availability of alternatives to masks which could be effective as personal protective equipment in mitigating health impacts;
- the delineation of the health impact mechanisms associated with biomass air pollution; and
- an evaluation of the impact of specific pollutants on health (e.g., specific aspects of particulate composition, polycyclic aromatic hydrocarbons, and volatile organic compounds).
Conclusions in relation to health impact reduction measures/strategies:

Priority emphasis must be given to preventing and extinguishing fires.

(10) With regard to air quality monitoring and episode forecasting, from the health sector's perspective, information on the nature and extent of human exposure to environmental pollutants is essential to impact assessment.

(11) With regard to environmental control, for rural areas, individuals should reduce their level of physical activity and use masks when outdoors in the absence of other available measures. If possible, the infiltration of outdoor air should be reduced by closing windows, doors, etc.

(12) With regard to personal protection, properly sized and fitted respirators can provide protection for essential workers who must remain outdoors for extended periods of time during haze episodes. However, the use of masks for the general population should be the lowest priority in terms of health mitigation measures.

(13) Public health monitoring needs to be considered as a routine component of health sector operations during and after haze episodes.

Conclusions in relation to intercountry and interorganizational cooperation and coordination:

(14) Intercountry cooperation needs to be implemented through existing regional coordination mechanisms.

(15) Areas in which regional cooperation is suggested include the following:

- the development of air pollution epidemiology guidelines to harmonize research methodologies and data collection and analysis;
- the implementation of joint studies on the health impacts of the 1997 haze, including the assessment of needs for air quality monitoring data from a public health point of view;
- the strengthening of human resources and national capacity in air pollution epidemiology and air pollution and public health monitoring;
- the establishment of a regional information clearing house on haze-related health impact research; and
- the organization of regional forums and participation in international meetings.

(16) Proposals for specific projects in the above areas of cooperation will be prepared by participants from countries with interest and expertise.

(17) International and bi-lateral partner agencies are encouraged to take up and support, in a coordinated fashion, the issues reflected in the deliberations of this meeting and summarized in these conclusions.
I. INTRODUCTION

1.1 Background information

From late July to the beginning of October 1997, several countries of South East Asia experienced severe smoke pollution, locally known as haze, induced by uncontrolled forest fires mainly in the Indonesian states of Kalimantan and Sumatra. The affected areas included Brunei Darussalam, Indonesia, Malaysia, southern Philippines, Singapore, and southern Thailand. Forest fires occur every year as bush burning for land clearing is practised in the region. However, the 1997 haze episode was unprecedented in terms of both the level and coverage of air pollution, due to severe regional drought caused by the El Niño phenomenon. These meteorological conditions made fire fighting extremely difficult. Consequently, the haze subsided only after the arrival of the monsoons and a change in wind direction which occurred in mid-to-late October.

During the haze episodes, the governments concerned increased their health and air quality monitoring efforts, and the WHO Regional Offices for South-East Asia and the Western Pacific, along with many other external support organizations, collaborated with the Governments of Indonesia and Malaysia in undertaking rapid situation assessments and providing technical advice. During the peak period of the haze in September 1997, the ambient air pollution concentrations in Sarawak, Malaysia, reached a level more than ten times normal and respiratory-related hospital admissions also increased sharply. Although this type of information clearly indicated adverse health effects from the haze, it was not possible, at the time, to make more quantitative assessments of likely short- and long-term health effects. This was due in part to the lack of complete technical information, especially baseline health statistics in Malaysia and reliable air quality data in Indonesia. As a result, the Malaysian Government embarked on a research programme to generate some of the necessary technical information with the support of WHO. Preliminary research findings from the two initial projects were available in the second quarter of 1998. These projects will be completed by the end of the year. A similar course of action was also taken by other neighbouring countries, but the results of such research efforts have not been compiled to date, and areas of further research have not been clearly identified.

Because of its regional nature and technical complexity, the haze problem requires an intercountry approach to implementing measures to prevent and minimize the associated pollution problems and protect people from adverse health impacts. Because these measures need to be based on the results of sound scientific studies, and, insofar as possible, available before the onset of the next potential haze period in July 1998, a biregional workshop was proposed to bring together researchers and technical government officers concerned with air pollution and its health effects from the haze-affected countries of the WHO South-East Asia and Western Pacific Regions.

1.2 Objectives

It was expected that at the end of the workshop, participants would have:

1) reviewed and summarized research findings and other relevant information concerning the impacts of haze-related air pollution on health;

2) identified needs for further technical information and research to support future haze-related decision-making; and

3) developed draft health impact reduction measures and strategies, addressing intercountry cooperation issues, for consideration by affected countries and external support agencies.
1.3 Participants

The workshop was attended by 17 participants who are researchers or technical government officials concerned with air pollution and its health effects and are in the position to advise government decision-makers on technical measures to prevent and minimize negative health impacts of haze. The participants were from Brunei Darussalam, Indonesia, Malaysia, Papua New Guinea, the Philippines, Singapore, and Thailand. In addition, four temporary advisers, ten organization representatives (from the Asian Development Bank, the Japan International Cooperation Agency, the United Nations Development Programme, the United Nations Environment Programme, the US Centres for Disease Control and National Oceanographic and Atmospheric Agency and the World Meteorological Organization), and five observers from Brunei Darussalam, Malaysia and Singapore attended the workshop. Four WHO staff served as the workshop secretariat. A list of participants, temporary advisers, representatives, observers and secretariat members is given in Annex 1.

1.4 Organization

The workshop programme is given in Annex 2, and a list of documents distributed during the workshop in Annex 3. The documents include country reports on the 1997 haze episode and haze-related research prepared by the participants, and working papers prepared by the temporary advisers and a representative from the World Meteorological Organization. Copies of these papers can be obtained on request from the WHO Regional Office for the Western Pacific.

The officers of the workshop were selected as follows:

Chairperson
Professor Muhamad Awang, Malaysia

Vice-Chairperson
Dr Hadi M. Abednego, Indonesia

Rapporteur
Dr Shanta C. Emmanuel, Singapore

The technical sessions of the workshop started with a review of working papers, country reports and papers on haze-related research activities, presented by the temporary advisers and participants. These presentations and discussions addressed the first objective of the workshop.

A plenary discussion on further research needs, a group discussion on health impact reduction measures and strategies, and another plenary discussion on intercountry cooperation were organized to address the second and third objectives. After these discussions, overall workshop conclusions were drawn by the participants.

1.5 Opening remarks

On behalf of the WHO Regional Director for South-East Asia and himself, Dr S.T. Han, WHO Regional Director for the Western Pacific, welcomed all the participants to the workshop. His opening speech focused on haze and its impacts on health of people in the region. The dry conditions in South-East Asia and Papua New Guinea in 1997 and early 1998 had helped to spread forest fires. Smoke resulting from the fires covered the region from July to October 1997 and early 1998, exposing a large number of people to the associated air pollutants. He noted that outpatient visits in Malaysia during the peak haze period had increased, and that a number of questions regarding the haze have been posed by the public and decision-makers to the scientific community.

Various groups in the region had began studies to address these questions, but these research efforts have not been fully coordinated to date. Dr Han hoped that the workshop would provide a useful forum to compile the findings of current research efforts on health impacts of haze and discuss regional coordination in the field. He thanked the Malaysian Government, through the Environmental Health Research Centre in the Institute for Medical Research, Ministry of Health, for hosting the workshop, and wished the participants fruitful discussions. The full text of Dr Han's opening speech is given in Annex 4.
Honourable Dato’ Chua Jui Meng, the Minister of Health, Malaysia welcomed the participants to his country. He stated that Malaysia had received a great deal of negative publicity on haze in 1997 along with other neighbouring countries in South-east Asia. He indicated that much of this publicity exaggerated the situation and that there was a need for more research and scientific information on health and other effects of the haze to clarify the situation and support reasonable action. Dato’ Chua indicated that, although the number of respiratory disease related hospital visits increased during the peak month of September 1997, the monthly average was not significantly higher than usual. Nevertheless, he agreed that more detailed studies needed to be carried out to determine the health risks associated with the haze, and looked forward to the outcome of the workshop. He thanked WHO for selecting Malaysia as a venue for this important workshop, and wished the participants every success in their deliberations.

2. PROCEEDINGS

2.1 Country reports

Participants from seven countries presented reports. They described the 1997 haze episode in terms of the levels of air pollution and health impacts experienced, measures taken to respond to the problems and post-haze activities.

The country reports demonstrated that air pollution levels observed in South-East Asia in the 1997 and 1998 haze periods were significantly higher than generally accepted ambient air quality standards and guidelines. Particulate matter in the haze was substantially higher than other measured gaseous air pollutants, indicating that the type of air pollution of greatest concern come from the forest fires. Health impact surveillance and studies showed that respiratory-related hospital visits increased in the most heavily impacted areas during the peak episode periods, the frequency of attacks among selected asthmatic children in Malaysia also increased, and lung function among a study group of school children in Malaysia was decreased. Governments generally stepped up their air quality monitoring and health impact surveillance efforts, and provided public information on haze and health protection measures. They also initiated various research activities during and following the haze. A summary of country reports is given in Annex 5.

2.2 Summary of background papers and discussions

2.2.1 Overview: Health effects of air pollution from biomass burning

Dr Michael Brauer, University of British Columbia, Canada, presented an overview of health effects of air pollution from biomass burning. A review of the exposure and health impacts literature, as well as the initial evaluation of the available air monitoring data from the 1997 haze episode, indicates that the pollutant that most consistently increases in association with biomass smoke is particulate matter.

Studies of wildland fire-fighters, an occupational group exposed to high levels of biomass smoke, clearly indicate an association between exposure and acute effects on respiratory health. Long-term effects, lasting for a 3-6 month fire-fighting season, have also been observed in most studies, although these effects appear to be relatively small and may be reversible. Fire-fighters are an extremely fit and healthy group and cannot be considered representative of the general population. Accordingly the demonstration of health effects in this occupational group indicate the plausibility, but not the magnitude, of an association between biomass smoke exposure and adverse effects in the general population. The health effects of biomass smoke inhalation have also been documented in developing countries, where women and children spend many hours cooking over unvented indoor stoves. Infant children would also be exposed in many instances. Approximately 50% of the world’s population uses biomass fuels for cooking and/or heating. In particular, exposure to smoke from cooking fires has been identified as a risk factor for acute respiratory illness, the leading cause of
infant mortality in developing countries. In addition, the women who are cooking are also at risk for chronic respiratory diseases. As these exposures last for 20 or more years, they are likely to be much more hazardous than those associated with relatively brief haze episodes. However, the studies conducted in developing countries indicate the serious consequences of exposure to high levels of biomass smoke.

Many recent studies have also indicated that levels of air pollution currently measured in most urban areas in the world are associated with a range of adverse health outcomes. The most significant finding of these studies is the association of particulate air pollution with increased daily mortality. These studies have been conducted in a variety of locations, using a variety of study designs. Nearly all studies indicate an association between particulate air pollution and increased risk of death, primarily in the elderly and individuals with pre-existing respiratory and/or cardiac illness. Recent studies have also suggested an association between particulate air pollution and infant mortality. Increased numbers of hospital admissions and emergency room visits have also been associated with short-term increases in the levels of particulate air pollution. These data strongly suggest that particulate air pollution from any combustion source, including that produced during forest fires, is associated with a whole range of adverse health outcomes.

Specific studies of exposure to biomass smoke indicate a consistent relationship between exposure and increased occurrence of respiratory symptoms and respiratory illness, as well as decreased lung function. These studies have mainly been focused on children, although the few studies which evaluated adults showed similar results. A limited number of studies indicate an association between biomass smoke exposure and increased number of visits to hospital emergency rooms. There are also indications from several studies that asthmatics are a particularly sensitive group. There is little reason to expect that biomass smoke particulate would be any less harmful than other combustion-source particles and it is prudent to consider that haze exposure will also be related to increased mortality. The studies of mortality and particulate air pollution do not show a threshold concentration at which effects are not observed.

Nearly all of the studies of biomass smoke health effects conducted in North America evaluated impacts of concentrations which were much lower than those associated with the 1997 South-East Asia haze episode. Similarly, these studies involved exposure durations which were of comparable length to those experienced in South-East Asia. Based on these studies it is reasonable to expect that the South-East Asian haze episode resulted in the entire spectrum of acute impacts, including increased mortality, as well as seasonal effects on lung function, respiratory illness and symptoms. It is not possible at this time to determine the long-term effect, if any, from a single air pollution episode, although repeated yearly occurrences of haze should be cause for serious concern. Chronic (several years) exposure to particulate air pollution in urban areas, at much lower levels than experienced in South-East Asia in 1997, has been associated with decreased life expectancy and with the development of new cases of chronic lung disease.

There have not been enough studies conducted to evaluate the consistency of any increased risk for different particle sources. While biomass smoke is potentially carcinogenic, the available, although limited, data on biomass smoke and cancer do not indicate an increased risk even at high levels of exposure. This evidence includes studies of long-term exposure to high levels of biomass smoke from domestic cooking in developing countries. Evidence of a relationship between urban particulate air pollution and lung cancer is also limited, but is suggestive of a small, but measurable, increased risk. The cancer potency of biomass smoke would probably be much less than that of motor vehicle exhaust fumes.

2.2.2 Air pollution epidemiology - research methods

Dr Tord Kjellstrom, University of Auckland, New Zealand, presented a paper on epidemiological methods of air pollution research. Using examples from past episodes of severe air pollution in Europe and the USA, the importance of routinely monitored mortality and morbidity data in order to identify health effects was highlighted. Studies comparing populations with different average air pollution exposure levels (ecological studies) and studies comparing the same population
at different times with varying air pollution levels (time-series studies) have been used to quantify the health risks.

These population-based study designs may be affected by confounding variables and inaccurate exposure estimates. Individual-based study designs can overcome these problems. Such designs include panel studies, cohort studies and case-control studies. The best information for decision-making will be provided by a combination of different study types.

The key elements of linking air pollution measurements to human exposure assessment and health effects were presented. Differences between indoor and outdoor levels of air pollution need to be considered. In addition, personal exposures and the risk of health effects may vary more within a population than between populations. Potential confounding factors always need to be considered, even if all of them cannot be measured. These factors include age and sex, which are also characteristics of particularly susceptible groups. Infants and the elderly have been the most affected according to the available epidemiological studies and rural women may have an additional risk due to indoor air pollution from smoky cooking fires. Men may have an additional risk due to a higher prevalence of tobacco smoking. The design of future studies of the health effects of haze need to take these issues into account.

2.2.3 A morphological study of the small airways in patients with respiratory diseases in areas with air pollution

Dr Mitsuru Tanaka, Tokyo Medical College, Japan, presented a paper on small airways of patients with respiratory diseases in Japan. He stated that one of the most important areas of research on haze is to grasp changes in peripheral airway lesions in bronchial asthma, chronic bronchitis, bronchiolitis, etc. induced by inhalation of air pollutants. The ultra-thin bronchofiberscope will play an important role in determining the condition of peripheral airway lesions.

2.2.4 Regional transboundary smoke and haze in South-east Asia

Dr John Miller, Environment Division, World Meteorological Organization, presented the global weather monitoring programme and the collaboration of his Organization with Member States in South-East Asia. He described the locations of meteorological stations in the region participating in the global weather monitoring programme, and the nature of transboundary movement of the regional haze. He also discussed the workshop on regional transboundary smoke and haze in South-East Asia which was conducted by the World Meteorological Organization in Singapore from 2 to 5 June 1998.

2.2.5 Haze-related research: outline of research and findings

Participants from Indonesia, Malaysia, Singapore and Thailand presented past and current haze-related health impact research in their countries. They described the methodologies used in these studies and the results or preliminary findings. The studies include analysis of morbidity and mortality data, assessment of small particulate matter exposure outdoors and indoors, health effects of haze on children, analysis of outpatient visits and hospital admissions, and a public perception survey. A total of 15 studies which specifically addressed health impacts of haze-related air pollution and 10 other related studies were identified. A list of these research studies is given in Annex 6.

2.2.6 Plenary discussion on further research needs

Future research needs were discussed and prioritized considering the contribution of research first to the development of policy relating to air pollution episodes within South-East Asia and second to the general and global understanding of the health impacts of biomass air pollution. This prioritization is based upon the most critical knowledge gaps: consideration of the available information from the literature; the time-frame required to generate policy-relevant results; and the scarcity of research funding. The research needs were generally divided into those activities utilizing existing data and those requiring the generation of new data. There was a clear consensus that efforts should be directed toward studies utilizing existing data sources. Among the outcomes of such...
studies would be the identification of deficiencies in available health impact or air quality data. There was also a clear expression of a need for research training in data analysis of environmental exposure-response relationships (applied statistics, epidemiology), as well as source apportionment of particulate matter. Additionally, an important research need not directly related to health impacts was the identification of more effective ways of controlling or extinguishing peat fires. The future research needs which were identified are listed below in order of priority.

(1) Studies using existing data

- evaluation of short-term health impacts associated with the 1997/1998 episodes, including the identification of susceptible population groups;
- a regional study of short-term health impacts associated with the 1997/1998 episodes using standardized methodology and routinely-collected data, including the identification of the size of the exposed population within the region; and
- the apportionment of sources of particulate air pollution exposure, especially the relative contributions of biomass and motor vehicle or urban air pollution mixture sources. A related research need is a more detailed understanding of the composition of biomass particulate.

(2) Studies requiring new data

- What is the effectiveness of advising the public to remain indoors? What is the impact of outdoor particulate on indoor air in various building types?
- What is the real effectiveness of the use of dust masks by the general population (considering factors such as compliance of individuals in wearing masks, the fitting of masks, the effectiveness of the various types of masks that are available, the use of education to improve mask effectiveness)?
- What is the effectiveness of early health care intervention, as well as public information and awareness in reducing more severe health impacts?
- What alternatives to masks are available which could be effective as personal protective equipment in mitigating health impacts?
- What is the mechanism of health impacts associated with biomass air pollution?
- What are the impacts of specific pollutants (specific aspects of particulate composition, polycyclic aromatic hydrocarbons, volatile organic compounds) on health.

2.2.7 Group discussions on health impact reduction measuresestrategies

Priority emphasis must be given to elimination of the source of the air pollution, which in this case is extinguishing fires or preventing their occurrence. Incentives to reduce the use of fire as a land-clearing method should be introduced. Where appropriate, controlled burning can be conducted. It is recommended that political and economic pressure be increased to reduce the occurrence of fires and to extinguish any fires that are started as quickly as possible. Specifically, education and enforcement activities should be intensified during periods of drought.

Despite efforts to prevent and control fires it is acknowledged that other measures may be necessary to help mitigate public health impacts should fires and associated haze continue to occur within the region. The participants were divided into three groups, and discussed (1) air quality monitoring, forecasting and warning; (2) environmental control and personal protection measures; and (3) public health monitoring. The results of the group discussions were as follows:
(1) Air quality monitoring, forecasting and warning

Although the coverage and quality assurance aspects of air quality monitoring programmes among the participating countries are in different stages of development, the current capabilities in each country can be summarized as follows:

<table>
<thead>
<tr>
<th></th>
<th>Brunei Darussalam</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Singapore</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring</td>
<td>C</td>
<td>C + M</td>
<td>C</td>
<td>C + M</td>
<td>C + M</td>
<td>C + M</td>
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<tr>
<td>Operation</td>
<td>G</td>
<td>G</td>
<td>P</td>
<td>G</td>
<td>G</td>
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</tr>
</tbody>
</table>

C = Continuous; M = Manual; G = Government; P = Private sector

With regard to the reporting of data, the frequency or averaging time in some cases is based on instrument readings. It should be based on the frequency or averaging time used in each country’s ambient air quality standards or “WHO guidelines”. Different countries use different reporting formats. The following table shows a summary of the reporting formats:

<table>
<thead>
<tr>
<th></th>
<th>Brunei Darussalam</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Singapore</th>
<th>Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index (API or PSI)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Concentrations</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Because the predominant pollutant of concern in haze is PM10, the high index values reported are directly related to PM10 concentrations. However, it should be noted that health effects research on air pollution requires actual concentrations, and the ambient air quality standards in most countries are based on concentrations rather than indices. Therefore, concentration values need to be readily available.

For the monitoring of haze, priority should be given to PM10, followed by other criteria pollutants (i.e. CO, NO, SO, O, lead). In countries with available resources, PM2.5 monitoring should be included as a priority. Other pollutants, such as PAHs (polycyclic aromatic hydrocarbons), should be included only after the monitoring of PM10, PM2.5 and other pollutants has been established.

Regarding forecasting, there is currently no reliable system of air quality forecasting in use in Southeast Asian countries. Weather and atmospheric forecasts are carried out by the meteorological services. Air quality forecasting systems should be improved to benefit the work of the environmental and health departments. It is suggested that health and environmental sectors should work closely with the World Meteorological Organization at the international level.

Each country has already devised its own warning or air pollution alert system. These systems should be used in a flexible manner and adapted to specific local needs.

(2) Environmental control and personal protection measures

In rural areas, individuals should reduce the level of physical activity and use masks in the absence of other available measures. If possible, the infiltration of outdoor air should be reduced by closing windows, doors, etc. However, this must be combined with the elimination of indoor sources of pollution such as tobacco smoking and cooking with biomass fuels. In severe episodes, evacuation to non-affected areas should be considered (combined with monitoring and forecasting systems).
protected area with air conditioning and filtration, such as one room in a school, should be set up in each area for those at risk during the most severe episodes.

In urban areas, individuals without access to air-conditioned areas should reduce their level of physical activity. They should also identify an air-conditioned area with convenient access where they can seek refuge during severe episodes. If possible, the infiltration of outdoor air should be reduced by closing windows, doors, etc., provided indoor particulate sources are minimized. For those with air conditioning, effective particulate air filters should be added. Portable air cleaners that are adequately matched to the specific indoor space should be used where affordable and where no air-conditioning is available.

Public places to be used as clean air refuges should be identified for use by high-risk population groups during severe episodes. To make this feasible, it is recommended that the relocation of individuals to such locations be made by health care providers. These clean air refuges need to be supplied with beds, food, etc.

The use of personal protective equipment, such as masks of all types, should be the lowest priority in terms of health mitigation measures. Despite the high efficiency of particle filtration by many masks, effectiveness decreases when worn by the general population (due to erratic use, fitting problems, etc.). There are many types of masks available with differing efficiencies. They need to be replaced frequently, and they often provide wearers with a false sense of security.

Masks should be distributed to essential outdoor workers if there are no other means of protection available. If masks are to be used, they should be distributed with information and education on the proper use of masks and on their expected effectiveness.

(3) Public health monitoring

The discussion focused on four key issues concerning the use of public health monitoring in the mitigation of the health effects of haze pollution:

- the objectives of such monitoring;
- which health variables to monitor;
- which population groups to monitor; and
- how to disseminate monitoring results.

One of the prime objectives of monitoring is to keep the health authorities informed on the occurrence of acute health effects in the exposed population. This important in order to provide reassurance to the public if in fact no increase in morbidity or mortality can be established. It is also of importance for the preparation of advice to vulnerable groups concerning preventive and protective actions, such as seeking medical advice for early treatment of relevant symptoms in asthmatics. The health authorities can also use the results of health monitoring to assess the need for extra stocks of drugs or extra staff in hospitals. Visits to clinics or emergency departments are the easiest to monitor on an ongoing basis. Routinely collected hospital data is usually based on information at discharge, which will create delays in reporting. To make hospital data more timely, a method to capturing admissions to hospital needs to be devised. Similarly, mortality data may have significant time delays, as many of the elderly people dying during haze episodes may die at home and the reporting of the death to authorities may not be required by law to be immediate. Public health monitoring during a haze episode will also provide the foundation for later epidemiological analysis of the short-term and long-term health effects of the haze. Such analysis is essential in developing properly protective air quality guidelines.

The health variables to monitor should first of all include data that can be routinely collected from the health services (ideally both public and private) and official records. This includes outpatient visits, emergency room visits, discharges from hospitals (and admissions, if possible),
length of stay in hospitals and mortality. To the extent possible the information should include the diagnosis, using the ICD code, but if this is not available even the total numbers per day for major groups of diagnosis (e.g. trauma cases and non-trauma cases) would be informative. It may be possible to complement the routinely collected data with daily information on the use of nebulizer facilities, or the use of specific drugs by asthma patients, or the establishment of “panels” of asthma patients reporting on symptoms and drug use each day during and after the haze period.

The monitoring may focus on population groups at particular risk or with particularly high exposure. Infants, the elderly and people with pre-existing lung disease are at highest risk. The monitoring data should therefore, as a minimum, include age and sex information, so that age and sex specific numbers of cases and rates in the population can be calculated. The groups with pre-existing disease would need to be defined from patient registers in hospitals or medical practitioners offices. Special “panels” may be defined, as mentioned above. Obviously, the sector of the population with high haze exposure should be the target for monitoring, and, if feasible, comparisons with populations with low haze exposure could be monitored to give up-to-date assessments of the specific haze effect. Such comparisons may best be carried out in selected populations groups from whom information can be collected without major cost (e.g. staff in the health services or selected government departments).

The assembly of monitoring data, its analysis and its presentation is important in order to convert the raw data into meaningful information. The presentation of the data can be pre-formatted to facilitate daily reporting to decision-makers and the public, as appropriate. The information should be clear and simple, so that misinterpretation is avoided. To the extent possible, the reporting should highlight the extent to which preventive advice is followed and the impact of this advice and the other actions of the health sector.

2.2.8 Plenary discussion on intercountry cooperation

The participants discussed and identified potential areas of intercountry cooperation among the countries of South-East Asia. They also discussed the countries or institutions that could lead the implementation of the identified regional activities, and agreed that proposals would be prepared for those activities. The identified areas of regional cooperation and the countries or institutions that are willing to prepare proposals are as follows:

- the development of air pollution epidemiology guidelines to harmonize research methodologies and data collection and analysis (University of Auckland, contact person Dr T. Kjellstrom);
- the implementation of joint studies on the health impacts of the 1997 haze, including the assessment of needs for air quality monitoring data from a public health point of view (Singapore);
- the strengthening of human resources and national capacity in air pollution epidemiology and air pollution and public health monitoring (National University of Malaysia, University Putra Malaysia);
- the establishment of a regional information clearing house on haze-related health impact research (Environmental Health Research Centre, Malaysia); and
- the organization of regional forums and participation in international meetings (e.g., the WHO forest fire guideline meeting in Lima, Peru, 3-7 August 1998; and ICOH 2000, the meeting of the International Commission on Occupational Health, in Singapore in the year 2000) for presentation and discussion of research findings.

There was general agreement among the participants that in implementing these activities, existing regional coordination mechanisms (e.g., the ASEAN Regional Task Force on Haze), should be fully informed through appropriate channels of communication (e.g. national haze committees). It was also suggested that international partner agencies should be encouraged to support, in a
coordinated fashion, the proposals and issues reflected in the deliberations of this workshop. Such support should be provided not only from an emergency response point of view, but also from the long-term perspective of promoting and protecting health.

3. CONCLUSIONS

3.1 Conclusions in relation to Objective 1: Review of haze-related air pollution problems and research findings

(1) The haze episodes in the South-East Asia constitute a substantial health risk to the public. In 1997 and early 1998, this was evidenced by widespread exceeding of generally recognized 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 affected areas during the peak episode periods; in increased frequency of attacks among asthmatic children comprising a Malaysia study group; and in reported persistent decreases in lung function among another study group of school children in Malaysia. The full impact of the haze episodes on more severe outcomes such as mortality have not been determined to date.

(2) The main constituent of the haze that adversely affects health is particulate matter. Based upon the extensive literature regarding the health impacts of air pollution, these particles, at the ambient concentrations levels observed in Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore and Thailand during the 1997 and 1998 episodes (measured as PM10 - particles that are 10 microns or less in diameter), have in the past in other air polluted areas been associated with:

- increased daily mortality;
- increased hospitalization;
- increased visits to emergency rooms;
- increased respiratory symptoms;
- exacerbation of asthma and COPD; 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 cardiac illness.

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

(4) The risk of long-term health effects due to a single air pollution episode is difficult to detect, but repeated exposures to haze episodes merit attention. Existing data indicate that the potential carcinogenicity of biomass particulate is low relative to particulate emissions from diesel-fueled motor vehicles. Human epidemiological studies have not indicated 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 episodes.

(5) To help ensure data comparability, it is desirable that consistent protocols be followed in relation to health effects monitoring, ambient air quality monitoring, and data analysis. While the various countries of the region are moving in this direction, much work remains to be done to develop a comprehensive network that adequately supports decision-making.

(6) There are a number of valuable health-related research studies currently being carried out in the region. In order to provide timely information for decision-making and to help ensure the most judicious use of limited research funds, it is important that these studies be completed as expeditiously as possible, formalized in terms of the development of consensus on their outcomes, and regularly published as part of a comprehensive information sharing strategy.

3.2 Conclusions in relation to Objective 2: Identification of further research needs to support haze-related decision-making

In addressing priority environmental health research needs, underlying emphasis always needs to be placed on research and public health monitoring capacity building. The priority needs identified in the region include:

(1) Research on new mitigation approaches:

- assessment of the feasibility of different arrangements for "haze shelters" (in private homes, schools, hospitals, old age homes, and appropriate public buildings) and the actual haze protection provided by different approaches to air filtration, sealing of rooms, etc.;

- evaluation of the most effective approaches to management of a future haze emergency in terms of arranging transport to "haze shelters" for vulnerable groups, provision of masks to key outdoor workers, and other mitigation methods;

- evaluation of the effectiveness of remaining indoors, including an assessment of the impact of outdoor particulates on indoor air concentrations in relation to various building types; and

- evaluation of the effectiveness of early health care interventions, as well as public information and awareness efforts in reducing health impacts.

(2) Research on the impacts of the 1997 haze, primarily using data that has been routinely collected:

- evaluation of short-term health impacts, including the identification of susceptible population groups;

- a regional study of short-term health impacts using standardized methodologies and routinely-collected data (including, for example, remote sensing data, ground-based air monitoring data and GIS information on population density), focusing on the identification of the size of the exposed population within the region, their exposure levels, and changes in hospital admission rates and mortality;

- assessment of any long-term effects in selected groups of exposed people in areas where comprehensive mortality and morbidity data are continuously maintained, this could focus on people who developed symptoms or more severe disease during the haze, comparing their subsequent health status with comparison groups without symptoms and/or without haze exposure; and

- identification of sources of particulate air pollution exposure, especially the relative contributions of biomass and motor vehicle-related urban air pollution mixture sources.
(3) Future research requiring the development of substantial new data:

- An assessment of the real effectiveness of the use of dust masks by the general population, including consideration of the compliance of individuals in wearing masks, the fitting of masks, the effectiveness of the various types of masks that are available and the use of education to improve mask effectiveness;

- an investigation of the availability of alternatives to masks which could be effective as personal protective equipment in mitigating health impacts;

- the delineation of the health impact mechanisms associated with biomass air pollution; and

- an evaluation of the impact of specific pollutants on health (e.g. specific aspects of particulate composition, polycyclic aromatic hydrocarbons, and volatile organic compounds).

3.3 Conclusions in relation to Objective 3: Development of health impact reduction measures/strategies

Priority emphasis must be given to preventing and extinguishing fires.

While controlled burning, where appropriate, may still be conducted, incentives to reduce the use of fire as a land-clearing method should be introduced. Political and economic measures should be implemented as soon as possible to further encourage the use of environmentally sound land management practices; to reduce the occurrence of fires; and to extinguish the fires that are currently burning. In addition, education and enforcement activities should be intensified during periods of drought.

Despite the best efforts to prevent and control fires, other measures may be necessary to help mitigate public health impacts should fires and associated haze continue to occur within the region.

(1) In relation to air quality monitoring and episode forecasting:

From the health sector's perspective, information regarding the nature and extent of human exposure to environmental pollutants is essential to impact assessment. It is recognized that the technology for measuring and estimating ambient pollutant levels and their geographical distribution is rapidly changing. Standard monitoring protocols need to be used by all countries to enhance data comparability and facilitate human exposure assessment; and data analysis and presentation formats need to be harmonized and easily understood. Of particular concern is the lack of consistency among the various air quality indexes used by various countries. This impedes intercountry comparability. In relation to the haze situation, the reporting of actual particulate concentrations (e.g. PM10 and PM2.5 values) would facilitate health impact assessment.

The question of the adequacy of existing air quality monitoring networks and episode forecasting in relation to health impact assessment needs cannot be fully answered in the absence of a thorough analysis of the 1997 haze episode that focuses, among other things, on identifying air quality-related information gaps.

(2) In relation to environmental control:

For rural areas, individuals should reduce their level of physical activity and use masks when outdoors in the absence of other available measures. If possible, the infiltration of outdoor air should be reduced by closing windows, doors, etc. However, this must be combined with the elimination of indoor sources of pollution such as tobacco smoking and cooking with biomass fuels. In severe episodes evacuation to non-affected areas should be considered (combined with monitoring and forecasting systems). Pending the results of a feasibility study, a "haze shelter" with air conditioning and filtration, such as one room in a school, should be set up in each area for those at risk during the most severe episodes.
For urban areas, individuals without access to air-conditioned areas should reduce their level of physical activity. Where feasible, individuals should identify an air-conditioned area with convenient access where they can seek shelter during severe episodes. If possible, the infiltration of outdoor air should be reduced by closing windows, doors, etc., provided indoor particulate sources are eliminated. For those with air conditioning, effective particulate air filters should be added. Portable air cleaners that are adequately matched to the specific indoor space should be used if they are affordable and if no air conditioning is available.

Public places which can serve as “haze shelters” should be identified for use by high-risk population groups during severe episodes. To make this feasible, it is recommended that the relocation of individuals to such locations be made by health care providers. These “haze shelters” need to be supplied with appropriate resources such as beds, food, etc.

(3) In relation to personal protection:

Properly sized and fitted respirators can provide protection for essential workers who must remain outdoors for extended periods of time during haze episodes. However, the use of masks for the general population should be the lowest priority in terms of health mitigation measures. Although many masks have a high particle filtration efficiency, their effectiveness decreases when worn by the general population (due to fitting problems, inconsistent use, etc.). Masks with adequate filtration are relatively expensive and need to be replaced frequently. Masks provide wearers with a false sense of security. Despite these problems, masks should be distributed to essential outdoor workers if there are no other means of protection available. If masks are to be used, it is essential that their distribution be combined with education on proper use and expected effectiveness.

(4) In relation to public health monitoring:

Public health monitoring needs to be considered as a routine component of health sector operations during and after haze episodes, because: it provides valuable information on acute health impacts; it can guide immediate health advice to vulnerable groups; and it can guide the daily planning of health service response to the haze. Such monitoring also provides the foundation for epidemiological studies that can characterize the health impacts in more detail, which will help in developing future air quality guidelines. Standardized approaches to public health monitoring need to be developed, addressing issues such as: the development of appropriate health indicators; the priority population groups to monitor (such as infants, the elderly, and groups with particularly high exposures); the exposure information that is required to assess health impacts; the mechanisms for translating public health monitoring data into useful decision-making information and for distributing that information in a timely manner to the appropriate decision-makers.

3.4 Conclusions in relation to intercountry and interorganizational cooperation and coordination

Intercountry cooperation needs to be implemented through existing regional coordination mechanisms (e.g. the ASEAN Regional Task Force on Haze), and the need for close interorganizational cooperation at the regional level (particularly among international and bi-lateral organizations) was highlighted.

(1) Areas in which regional cooperation is suggested include the following:

- the development of air pollution epidemiology guidelines to harmonize research methodologies and data collection and analysis;

- the implementation of joint studies on the health impacts of the 1997 haze, including the assessment of needs for air quality monitoring data from a public health point of view;

- the strengthening of human resources and national capacity in air pollution epidemiology and air pollution and public health monitoring;
• the establishment of a regional information clearing house on haze-related health impact research; and

• the organization of regional forums and participation in international meetings (e.g. the WHO forest fire guideline meeting in Lima, Peru, 3-7 August 1998; and ICOH 2000, the meeting of the International Commission on Occupational Health, in Singapore in the year 2000) for presentation and discussion of research findings.

(2) Proposals for specific projects in the above areas of cooperation will be prepared by participants from countries with interest and expertise.

(3) International and bi-lateral partner agencies are encouraged to take up and support, in a coordinated fashion, the issues reflected in the deliberations of this meeting and summarized in these conclusions. Such support should be provided not only from an emergency response point of view, but also from the long-term perspective of promoting and protecting health.
# INFORMATION BULLETIN NO. 2

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ANNEX 2

PROGRAMME OF THE WORKSHOP

1 June 1998 (Monday)

0830 - 0900 Registration

0900 - 0930 Opening ceremony
   - Opening address
     by Dr S.T. Han, Regional Director, WHO Regional Office for the Western Pacific
   - Welcome address
     by Honourable Dato' Chua Jui Meng, Minister of Health, Malaysia

0930 - 1000 Group photograph and tea/coffee break

1000 - 1015 Introduction to the workshop (objectives, programme, and administrative briefing, self-introduction of participants, designation of officers of the meeting)
   by Dr H. Ogawa, Regional Adviser in Environmental Health, WPRO

Objective 1: Review of haze-related air pollution problems and research findings

1015 - 1100 Overview: Health effects of air pollution from biomass burning
   by Dr M. Brauer, Temporary Adviser

1100 - 1130 Air pollution epidemiology - research methods
   by Dr T. Kjellstrom, Temporary Adviser

1130 - 1200 A morphological study of the small airways in patients with respiratory diseases in areas with air pollution
   by Dr M. Tanaka, Temporary Adviser

1200 - 1230 Regional transboundary smoke and haze in South-east Asia
   by Dr J. Miller, Representative from World Meteorological Organization

1230 - 1330 Lunch break

1330 - 1600 Country reports on the 1997 haze
   - Brunei Darussalam
   - Indonesia
   - Malaysia
   - Papua New Guinea
   - Philippines
   - Singapore
   - Thailand

1600 - 1630 Reception (High Tea)
Annex 2

2 June 1998 (Tuesday)

0830 - 1000  Haze-related research: outline of research and (preliminary) findings
- Indonesia
- Malaysia

1000 - 1030  Coffee/tea break

1030 - 1130  Haze-related research: outline of research and (preliminary) findings
- Singapore
- Thailand

1130 - 1230  Summary of research efforts and findings and discussion
Facilitated by Temporary Advisers and Secretariat

1230 - 1330  Lunch break

Objective 2: Identification of further research needs to support haze-related decision-making

1330 - 1500  Plenary discussion on further research needs
Facilitated by Temporary Advisers

1500 - 1530  Coffee/tea break

1530 - 1630  Plenary discussion (continued)

3 June 1998 (Wednesday)

0830 - 0930  Summary of further research needs and discussion
Facilitated by Temporary Advisers and Secretariat

0930 - 1000  Coffee/tea break

Objective 3: Development of health impact reduction measures/strategies

1000 - 1230  Group discussion
- Air quality monitoring/forecasting and warning
- Public health impact monitoring and warning
- Environmental control and personal protection measures

1230 - 1300  Lunch break

1300 - 1500  Group discussion (continued)

1500 - 1530  Coffee/tea break

1530 - 1630  Presentation of group discussions
4 June 1998 (Thursday)

0830 - 0930  Summary of health impact reduction measures/strategies and discussion
             *Facilitated by Temporary Advisers and Secretariat*

0930 - 1000  Plenary discussion on intercountry cooperation
             *Facilitated by Temporary Advisers and Secretariat*

1000 - 1030  Coffee/tea break

1030 - 1200  Conclusions
             *Facilitated by Temporary Advisers and Secretariat*

1200 - 1230  Closing
ANNEX 3

LIST OF DOCUMENTS DISTRIBUTED DURING THE WORKSHOP

**Working papers**

WPR/EHH/EHE(0)(1)/98.2 Overview: Health effects of air pollution from biomass burning by Mr Michael Brauer

WPR/EHH/EHE(0)(1)/98.3 Air pollution epidemiology - research methods by Professor Tord Kjellstrom

WPR/EHH/EHE(0)(1)/98.4 A morphological study of the small airways in patients with respiratory diseases in areas with air pollution by Professor Mitsuru Tanaka

**Country reports**

WPR/EHH/EHE(0)(1)/98/INF./1 Brunei Darussalam by Dr Hajah Rahman Binti Hiji Mohd. Said

WPR/EHH/EHE(0)(1)/98/INF./2 Indonesia by Dr Hadi M Abednego, Dr Artisman Nukman, Dr Tjandra Yoga Aditama, Dr Bambang Guntur Hamurwono, Dr Frans Suharyanto

WPR/EHH/EHE(0)(1)/98/INF./3 Malaysia by Professor Mohammed Awang, Dr Jamal Hisham, Dr Iylen Benedict, Dr Mazrura bt. Sahani, Dr Kumarjothy

WPR/EHH/EHE(0)(1)/98/INF./4 Papua New Guinea by Mr Masu William Maru

WPR/EHH/EHE(0)(1)/98/INF./5 Philippines by Dr Critinia Dablo, Mr Cesar S. Siador

WPR/EHH/EHE(0)(1)/98/INF./6 Singapore by Dr Shanta C. Emmanuel Dr Ooi Peng Lim

WPR/EHH/EHE(0)(1)/98/INF./7 Thailand by Dr Kanchanasak Phonboon
Publications/handouts

1. A Cohort Study on Health Impacts of Haze from Forest Fires, National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia, Jakarta

2. Haze Monitoring by Environmental Management Centre (EMC) Indonesia, Ir. Sachrul Ismail, Head of EMC, Sombo Yamamura, JICA Chief Advisor for EMC

3. Indonesia Research Overheads Notes

4. Perangkaan Penting Malaysia (Vital Statistics Malaysia), Department of Statistics, Malaysia


6. Parameters in the Haze Monitoring Plan, by Environmental Management Centre

7. Questionnaire “A Cohort Study on Health Impacts of Haze from Forest Fires


9. Environmental Studies to Control the Atmospheric Environment in East Asia, M.B. Awang, Department of Environmental Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

10. Opening Speech by Dr S.T. Han, Regional Director, WHO Regional Office for the Western Pacific

11. JICA Comments

12. NEPC - Information Bulletin on Air Pollutants (Policies)


OPENING SPEECH

Opening speech by Dr S.T. Han, Regional Director of the WHO Regional Office for the Western Pacific at the Bi-regional Workshop on Health Impacts of Haze-related Air Pollution, Kuala Lumpur, Malaysia, 1-4 June 1998

On behalf of the WHO Regional Director for South-East Asia and myself, I wish to welcome all of you and am pleased to address the opening of this workshop on the health impacts of haze-related air pollution. I would also like to thank the Ministry of Health of Malaysia for hosting this important meeting.

As you are acutely aware, several countries of South-east Asia were covered by haze for much of the period from July to October 1997. The haze has recurred in 1998 in some parts of the Region. This morning, I will focus on the haze and its impacts on health and the quality of life of people in the Region.

The so called "El Niño" phenomenon struck the Pacific in 1997 and has continued into 1998. It brought drought to parts of Southeast Asia and Papua New Guinea, while in other parts of the world, it caused flooding and storms. The dry conditions in Southeast Asia helped to spread forest fires to locations which are not easily accessible to fire fighters. In some cases, the peat in the rainforests has been burning at a depth of almost two meters and this cannot be easily controlled. While some forest fires result from natural causes or accidents, the majority are started by farmers for land clearing purposes. This long-standing practice must be restricted in order to reduce the number of forest fires. WHO advocates prevention of pollution and source control if at all possible. Our eventual goal must be the elimination of all man-made forest fires.

Air pollution associated with the haze caused an estimated 20 million people in Indonesia to suffer from respiratory problems. Outpatient visits in Kuching, Sarawak increased by two to three times during the peak period. Respiratory disease outpatient visits to Kuala Lumpur General Hospital increased from 250 to 800 a day. The most vulnerable groups were found to be children, the elderly and people with pre-existing respiratory problems. Decision-makers and the general public asked numerous questions about the haze, not all of which could be easily answered by the scientific community. These questions included:

- What are the constituents of haze which adversely affect health?
- Are Air Pollution Index readings correct? What do they mean in terms of health effects?
- Will there be any long-term health effects?
- What can the general public do to protect their health?
- How much safer is staying indoors compared to being outdoors?
- Are air-conditioners and air cleaners effective in filtering particles?
- What kind of mask is best, and how should it be used?

Although some of these questions could be answered qualitatively, more precise scientific information is required. Other questions could not be answered with confidence. During the 1997 haze, various groups in the Region began studies on the acute and long-term health effects of the haze. WHO continues to collaborate with Member States in these efforts. We recognize, however, that these current research efforts will not be able to answer all the questions concerning the haze. This workshop provides us with an opportunity to review past and continuing research, to summarize the findings of research conducted so far; and to identify further research needs.

As you explore these areas, I hope you will keep in mind the kinds of questions posed to the scientific community by decision-makers and the general public. You will also discuss and develop a set of health impact reduction measures and strategies. Hopefully, your efforts will contribute to a more coordinated...
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approach to haze-related health impact research, and to more aggressive implementation of prevention and mitigation measures in the Region.

Finally, I would like to refer briefly to our host for this workshop. Following the first national conference on environmental health research in April 1994, the Malaysian Government established an Environmental Health Research Centre within the Institute for Medical Research in September 1996. Since the 1994 national conference, WHO has worked closely with the Government in developing the Centre. During the 1997 haze episode, the Centre played an important role in coordinating research efforts on the health effects of haze-related air pollution in the country. I congratulate the Centre on taking such an active role and appreciate its hosting of this biregional workshop.

I trust that you will have fruitful discussions during the course of the workshop and I look forward to the outcome of your deliberations. For those of you visiting Malaysia, please enjoy your stay here. With these brief remarks, I now declare the workshop open.

Thank you.
ANNEX 5

SUMMARY OF COUNTRY REPORTS

Brunei Darussalam

Since 1982, several episodes of haze have occurred in the country. The haze episode of 22-30 September 1997, although air pollution levels were not recorded, was clearly worse than the previous episodes. From February to April 1998, during which the dry weather prevailed, the Pollution Standard Index (PSI) readings exceeded 100 and climbed as high as 250, causing the disruption of daily activities, closure of schools and changes in government working hours. Morbidity surveillance by the Ministry of Health indicated increases in hospital visits during the peak haze months.

The government actions taken to respond to the haze include:

- the establishment of a National Committee on Haze in September 1997;
- the development of a National Action Plan with health guidelines;
- the fighting of local fires; distribution of respiratory masks for school children;
- the installation of one fully equipped air monitoring station and eight PM10 monitoring stations;
- the promulgation of more stringent law on open burning;
- the provision of public information and education through a Haze Information Centre and pamphlets;
- a stock of emergency supplies; and
- cooperation with other neighbouring countries through regional coordinating mechanisms.

Indonesia

The 1997 forest fires covered 12 provinces of Indonesia in the islands of Sumatra, Kalimantan, Maluku and Irian Jaya, burning an estimated 165,000 hectares. During the peak haze period of September and October 1997, significant increases in asthma, bronchitis and ARI were observed in 8 provinces. About 1,800,000 cases of these diseases were reported among the estimated 12,360,000 persons affected by the haze. Under the Coordinating Minister of Social Welfare measures were undertaken to reduce and mitigate the impact of the fires with the cooperation of neighbouring and other countries which provided technical and material support in fire-fighting, air quality monitoring and personal protection measures. During the peak period of air pollution in the first week of October, total suspended particulate (TSP) levels exceeded the national standard by 3-15 times. In Jambi, North Sumatra, and Central and South Kalimantan, the TSP values were 15 times the national standard during the second week of October 1997. No active PM10 monitoring was available during the haze period.

In order to increase the awareness of the community and minimize the health impact of the haze, provincial health offices were instructed to monitor air quality, strengthen the surveillance of haze-related diseases, distributed masks to high risk group and alerted private and government health services to provide 24-hour services. In addition, guidelines were developed for health personnel to respond to haze related emergencies, and a study on the long-term health effects initiated, and an information and early warning system set up for future haze disasters. In February 1998 a joint Ministry of Health-WHO training programme on PM10 air quality monitoring was conducted for provincial health personnel as part of the process of establishing a PM10 monitoring system for early warning and disaster preparedness in the event of another haze episode.
Annex 5

Malaysia

The 1997 haze occurred between August and October with the highest Air Pollution Index (API) of 850 observed in Kuching, Sarawak. Health surveillance data collected in Klang Valley showed increases in cases of upper respiratory tract illness, asthma and conjunctivitis in association with API values. A haze struck Miri, Sarawak in February and March 1998 with the highest recorded API reading of 649 on 30 March. There was a definite increase in the cases of upper respiratory tract illness associated with increased API values.

The activities carried out to respond to the haze episodes include

- the setting up of the Ministry of Health haze operations room in September 1997;
- the implementation of health surveillance;
- the provision of health guidelines;
- the provision of public information through media;
- participation in interagency collaboration through the National Haze Committee; and
- the preparation and implementation of the Standard Operating Procedures for response to haze.

Papua New Guinea

During the latter part of 1997, the haze problem affected some parts of Papua New Guinea. Because of the prevailing wind conditions at that time, it is believed that much of the pollution contributing to this problem came from forest fires in Indonesia and bush fires in Australia. In addition, the problem was made worse by some bush fires in Papua New Guinea itself. The fires in Papua New Guinea were more troublesome than what would normally be expected because of the significant drought conditions that existed in the country. During the month of September, the severity of the haze problem was reflected in the cancellation of about 50 per cent of the commercial airline flights.

Although no ambient air quality measurements were available, during the peak haze period, visibility in the city of Port Moresby (which was considered the worst area) was about one kilometer. Also, although no special health impact surveillance effort was undertaken, anecdotal evidence suggests that there was an increase in the incidence of respiratory-related disease problems. Analysis of routinely collected health data, however, did not indicate a statistically significant increase in the level of these diseases.

Because of the relatively minor impact of the haze problem in Papua New Guinea, mitigation measures undertaken by the Government focused on education and information dissemination activities designed to minimize traditional slash and burn practices among subsistence farmers. Overall, the concerns for the future relate more to the adverse impacts of the El Nino phenomenon (e.g., the severe drought conditions and associated shortages of food and safe drinking water) than to a repetition of the haze problem.

Philippines

The long dry period caused by the El Nino phenomenon affecting the Asian region, particularly during the months of August and September 1997, aggravated forest fire problems in Indonesia and raised concern in the Philippines about the possibility of the significant transboundary movement of the associated air pollution. The Philippines joined other ASEAN countries in monitoring haze and related air pollution. In September, the Department of Environment and Natural
Resources (DENR) created the Haze Task Force, composed of representatives from various government agencies. The agencies involved are the DENR, Environmental Management Bureau, the Department of Health, the Department of Science and Technology-PAGASA, the Metropolitan Manila Development authority, the Department of Interior and Local Government and the Department of Trade and Industry. The responsibilities of the task force were/are:

- to monitor the movement of haze caused by forest fires in Indonesia and will serve as the official source of information on haze-related issues;
- to determine the health hazards accompanying such degree of haze density and accordingly take care of announcing the same to the public, including mitigation measures through bulletins and the print media; and
- to coordinate with other government agencies as may be required.

The impacts of the haze from forest fires in Indonesia were noted primarily on the southern islands of Palawan and Mindanao. While no specific ambient air quality measurements of fine particulate matter were available, the visibility in these areas was reduced to about 4-5 kilometers for several days. No particular health directly related to the haze problem was noted.

In January 1998, the Haze Task Force formulated the national Haze Action Plan in accordance with the request of the Regional Haze Task Force for ASEAN. The Philippines has participated in the series of ministerial and Regional Task Force meetings on the haze problem in Singapore, Malaysia and Brunei. In addition, a comprehensive information campaign on haze and related air pollution, emphasizing prevention, control and protection measures, is planned.

**Singapore**

There are 15 air quality monitoring stations throughout the country. Of these 12 are ambient stations and three roadside stations. During the 1997 haze period, the Pollution Standard Index (PSI) was over 100 for 12 days with the highest reading of 138. About 94% of haze particles were found to be less than 2.5 μm in diameter. Health surveillance showed a 30% increase in hospital attendances for all haze-related illnesses. An increase in PM10 levels from 50 μg/m3 to 150 μg/m3 was significantly associated with 12% increase in cases of upper respiratory tract illness, 19% increase in cases of asthma, and 26% increase in cases of rhinitis. No significant increases in hospital admissions or mortality were observed.

Health advisories were given to the public, and a National Haze Task Force was established. A National Haze Action Plan was prepared, which would be activated when the 24-hour PSI level exceeds 50. The action will be stepped up when the PSI level reaches 200.

**Thailand**

The haze from the Indonesian forest fires were observed in the Southern provinces of Thailand on 22 September 1997 with a sudden increase in daily PM10 concentration of 20 μg/m³ in the city of Hatyai. The first peak haze episode lasted from 22 to 29 September with a maximum peak of 211 μg/m³ followed by a second haze peak episode during 6-8 October. Although forest fires continued in Indonesia, there was no significant transboundary haze episode after these two periods.

Because of the abrupt nature of the haze and lack of experience by the authorities, the response to the haze episode occurred relatively late. In response to public demand for local air quality data, the initial emphasis of the response was on monitoring air quality rather than on prevention and mitigation measures. Ordered by the Cabinet, the Ministry of Health set up a coordinating centre for public support and appointed its committee on 3 October 1997. A total of 140,000 masks were distributed in all southern provinces in early 1997. The committee appointed a
Annex 5

subcommittee on public information and risk communication as well as to advice on protection measures. A set of guidelines for public support during haze was produced covering such aspects as air quality monitoring, health risk communication and public advice on protection measures as well as the roles of different agencies in public support. Advice on protection measures covered suggestions for susceptible population groups and the general population. Guidelines were produced for assessing public health impacts in province.

Subsequent post-haze activities included the generation of air quality monitoring and meteorology data for haze warning system. A multidisciplinary retrospective study to evaluate changes in meteorological conditions, air quality and health effects, and a study on the records of outpatient visits and inpatient admissions in Hatyai indicated increases in respiratory illnesses related to the haze.
LIST OF RESEARCHES ON HEALTH IMPACTS OF HAZE RELATED AIR POLLUTION

**BRUNEI DARUSSALAM**

<table>
<thead>
<tr>
<th>Study</th>
<th>Objectives</th>
<th>Target Population</th>
<th>Study Areas</th>
<th>Health Effect End Point</th>
<th>Exposure Variables</th>
</tr>
</thead>
</table>
| Surveillance of haze-related illnesses during the 1997 haze | • Assess the observed health effects of haze | • Out-patient attendance at four government hospitals in all districts (Covers 80% of all out-patient attendance in the country) | • RIPAS Hospital, Brunei/Muara Dist.  
• SSB Hospital, Belait Dist.  
• Tutong Hospital, Tutong Dist.  
• PIHM Hospital, Temburong Dist. | Out-patient attendance for haze-related illnesses:  
• ARI  
• Conjunctivitis  
• Pneumonia  
• Influenza  
• Bronchitis, Emphysema and Asthma | • PM10 levels from all four districts from 25/9/97 |

<table>
<thead>
<tr>
<th>Confounding Factors</th>
<th>Study Design</th>
<th>Timeframe</th>
<th>Results to Date</th>
<th>Contact Person(s)</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| • None | • Retrospective analysis of routine out-patient morbidity data from all four hospitals for 1997 | • On-going to include early 1998 haze surveillance data | • Increased rate of attendance observed for Sept. 1997  
• Main age group affected - 15-44 years old  
• Main increase attendance observed for ARI | Dr Hjh Rahmah binti Hj Mohd. Said, Disease Control Unit, Ministry of Health  
Phone: (673)2-381640 ext. 7702  
Fax: (673)2-381980 or (673)2-380687  
Email: rahmahms@brunet.bn  
comomoh@brunet.bn | • Preliminary results presented at the KL workshop |
### Study Objectives

A cohort study on health impacts of haze from forest fires

Retrospective study (secondary data)

#### Study Areas

- Jambi province
- East/South Kalimantan
- Non-haze control area

#### Target Population

- Children under 5 years
- 15-45 years (productive age group)
- The elderly >65 years
- Pregnant women
- Livestock animals

#### Health Effect End point

- Respiratory complaints
- Lung functions
- Respiratory diseases (COPD, etc.)
- Condition of babies
- Histopathology on lungs and URT

#### Exposure Variables

- People in exposed areas and people in non-exposed area
- Livestock in exposed area

<table>
<thead>
<tr>
<th>Confounding Factors</th>
<th>Study Design</th>
<th>timeframe</th>
<th>Results to Date</th>
<th>Contact Person(s)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>Longitudinal</td>
<td>5 years (1998-2003)</td>
<td>None December 1998 (Preliminary)</td>
<td>Dr Guntur Bambang Harnurwono, National Institute of Health Research, Ministry of Health, Jakarta Phone: (021)4244693 Fax: (021)4244693 Email: <a href="mailto:umar_fahmi@hotmail.com">umar_fahmi@hotmail.com</a></td>
<td>Field investigation to begin</td>
</tr>
</tbody>
</table>
### Study Objectives

- **Effects of haze on mortality**
  - Determine the daily mortality in Kuala Lumpur, Kuching and Kota Bharu hospitals
  - Determine ambient air pollutant levels during the study period
  - Determine the trend and causes of deaths
  - Evaluate the relationship between mortality and air pollutants

### Target Population

- All deaths in these hospitals

### Study Areas

- General Hospital Kuala Lumpur
- Sarawak general Hospital
- Hospital Kota Bharu
- Hospital Universiti Sarawak Malaysia

(Total daily death for Kuala Lumpur)

### Health Effect End Point

All causes of deaths focusing on:
- Non-accident and non-poisoning deaths
- Haze related diseases (e.g. respiratory and cardio-vascular)

### Exposure Variables

- PM10
- SO2
- CO
- NO2
- O3

### Confounding Factors

- Smoking
- Occupational exposure
- Specific epidemic patterns?

### Study Design

- Retrospective epidemiology
- Time series

### Timeframe

1/1/97-31/12/97

### Results to Date

Descriptive results

### Contact Person(s)

Dr Mazrura bt. Sahani Institute for Medical Research, Ministry of Health
Phone: (03) 4402469
Fax: (03)2920475
Email: mazrura@imr.gov.my

### Remarks

- Preliminary results presented at the KL workshop
<table>
<thead>
<tr>
<th>Study</th>
<th>Objectives</th>
<th>Target Population</th>
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<th>Health Effect End Point</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Effect of haze on lung function of children</td>
<td>Determine the effect of haze on lung function parameters</td>
<td>Elementary school children</td>
<td>Kuala Lumpur</td>
<td>FEV1, FVC, FEF25-75</td>
<td>PM10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confounding Factors</th>
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<th>Results to Date</th>
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<th>Remarks</th>
</tr>
</thead>
</table>
| Indoor pollution    | Cohort/prospective | 1996-1998 | Data analysis   | Dr Jamal H. Hisham  
National University 
Malaysia, Kuala Lumpur  
Phone: (03)9733333  
ext.2519  
Fax: (03)9737825  
Email:   
jamalhas@medic.ukm.my | Preliminary results presented at the KL workshop |
<table>
<thead>
<tr>
<th>Study</th>
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<th>Health Effect End Point</th>
<th>Exposure Variables</th>
</tr>
</thead>
</table>
| Effect of haze on asthmatic children | • Study the relationship between asthmatic attacks and air pollutants | • Asthmatic children | • Klang Valley | • Asthmatic attack (frequency) | • PM10  
• CO  
• SO2  
• NO2  
• O3 |

<table>
<thead>
<tr>
<th>Confounding Factors</th>
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<th>Remarks</th>
</tr>
</thead>
</table>
| • Diet/Nutrition  
• Smoking parents  
• Indoor pollution | • Time series | • June 1994-December 1994 | • Reports and publications in journals | Dr Zallina Hashim  
Universiti Putra Malaysia, Selangor  
Phone: 03-9486101 ext. 2519  
Fax: 03-943-6257  
Email: zailina@medic.upm.edu.my | • Results presented at the KL workshop |
### Study Objectives

<table>
<thead>
<tr>
<th>Study Areas</th>
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<th>Health Effect End Point</th>
<th>Exposure Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klang Valley</td>
<td>Klang Valley residents</td>
<td>PM10 and PM2.5 exposure concentrations, Respiratory symptoms</td>
<td>PM10, PM2.5</td>
</tr>
</tbody>
</table>

### Study Design

<table>
<thead>
<tr>
<th>Confounding Factors</th>
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<th>Results to Date</th>
<th>Contact Person(s)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupational, Smoking</td>
<td>Cross-sectional</td>
<td>1998</td>
<td>Preliminary data collection</td>
<td>Dr Jamal H. Hisham National University Malaysia, Kuala Lumpur Phone: (03)9733333 ext.2519 Fax: (03)9737825 Email: <a href="mailto:jamalhas@medic.ukm.my">jamalhas@medic.ukm.my</a></td>
<td>Preliminary results presented at the KL workshop</td>
</tr>
</tbody>
</table>
## Study Objectives

### Target Population
- Occupants in buildings in Klang Valley (e.g. houses, offices, shops)

### Study Areas
- Klang Valley

### Health Effect End Point
- PM10 and PM2.5 exposure concentrations

### Exposure Variables
- PM10
- PM2.5

## Confounding Factors
- Ventilation
- Cleaning habits
- Location
- Indoor sources (e.g. carpets, stoves, pets)
- Type of house

## Study Design
- Cross-sectional

## Timeframe

## Results to Date
- Indoor conc. > outdoor conc.
- High floor conc. > lower floor conc.
- Preliminary data collection

## Contact Person(s)
Dr Zailina Hashim
Universiti Putra Malaysia, Selangor
Phone: 03-9486101 ext. 2519
Fax: 03-943-6257
Email: zailina@medic.upm.edu.my

## Remarks
- Preliminary results presented at the KL workshop
<table>
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<tr>
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<th>Exposure Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance at out-patient departments (OPD) and accident and emergency (A&amp;E) departments in Sarawak</td>
<td>• Monitor attendance of haze-related diseases • Correlate the OPD attendance with Air Pollutant Index (API)</td>
<td>Population of Sarawak</td>
<td>Sarawak State</td>
<td>• Upper respiratory tract infection • Bronchitis • Asthma • Conjunctivitis</td>
<td>• API</td>
</tr>
</tbody>
</table>

**Confounding Factors**
- Infections
- Smoking

**Study Design**
- Time series

**Timeframe**
- 5/8/97-31/12/98

**Results to Date**
- Apparent correlation between API and haze related diseases

**Contact Person(s)**
Dr Supramaniam Kumarajothy
Sarawak State Health Department, Kuching
Phone: 08-225-6566 ext. 506
Fax: 08-2424959
Email: kumarajothy@sarawak.health.gov.my

**Remarks**
- Preliminary results presented at the KL workshop
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<tbody>
<tr>
<td>Effects of haze on birth outcome</td>
<td></td>
<td></td>
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<td>Dr Superamaniam Kumarajothy Sarawak State Health Department, Kuching Phone: 08-225-6566 ext. 506 Fax: 08-2424959 Email: <a href="mailto:kumarajothy@sarawak.health.gov.my">kumarajothy@sarawak.health.gov.my</a></td>
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<td>Admissions for cardiovascular and respiratory disease to Sarawak General Hospital during haze</td>
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| Nation-wide surveillance of haze-related diseases | Determine:  
- Baseline cases of respiratory and cardio-vascular diseases  
- Regional variation of these diseases  
- Severity of these diseases by length of hospital stay and use of bronchodilators  
- Correlation between API and age specific diseases | Whole population | Whole country | Upper respiratory tract infection  
Bronchitis  
Asthma  
Conjunctivitis | API  
PM2.5 |

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</table>
| Smoking  
Infections | Time series | 19/8/97-31/12/98 | No increase in respiratory cases nation-wide for period 19/8/97-31/12/97 | Dr Iyen Benedict Disease Control Division, Ministry of Health, Kuala Lumpur  
Phone: 03-2540088 ext. 203  
Fax: 03-2543366  
Email: iylen@dph.gov.my | Preliminary results presented at the KL workshop |
### Study Objective

**Target Population**

- Determine public awareness of haze in Malaysia
- Determine age-specific/gender-specific awareness of haze in Malaysia

### Study Design

- **Timeframe**: November 1997
- **Results to Date**: Report to be available

### Contact Person(s)

Dr Ismail Samad  
Disease Control Division, Ministry of Health, Kuala Lumpur  
Phone: 03-2540088 ext. 203  
Fax: 03-2543366  
Email: ismail@dph.gov.my
### Study Objectives

**The effect of haze (PM10) on the utilization of health care facilities for and mortality from haze-related conditions**

Determine the relationship before, during and after the 1997 haze, between ambient air quality and the following:

- Outpatient attendances at government polyclinics
- Accident and emergency (A&E) departments attendances
- Country-wide hospital admissions
- Country-wide mortality for selected haze-related conditions

### Target Population

- Whole population

### Study Areas

- Whole country

### Health Effect End Point

- Conjunctivitis
- Acute upper respiratory tract infection
- Rhinitis
- Bronchitis
- Eczema
- Asthma
- COPD
- IHD/AMI
- Pneumonia
- Emphysema

### Exposure Variables

- Haze duration
- PM10 levels

### Confounding Factors

- Unidentified factors that may produce haze-related complaints, such as viral epidemics
- Natural cyclical variations of health utilization
- Media-generated public and physician awareness

### Study Design

- Time series

### Timeframe

- 1 year

### Results to Date

- 30% increase in use of out-patient facilities
- 5-10% increase in use of A&E
- No obvious increase in hospital admission
- No obvious increase in mortality

### Contact Person(s)

Dr Shanta C. Emmanuel,
Family Health Service,
Ministry of Health
Phone: (65)325-9042
Fax: (65)323-5363
Email: emmanuel_shanta@moh.gov.sg

### Remarks

- Results presented at the KL workshop
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| Health impacts from 1997 haze in southern Thailand | - Quantitatively evaluate short-term health effects during 1997 haze | - General population  
- Under 5 years  
- Over 60 years | - All 14 southern provinces, Hatyai | - Morbidity of 4 groups  
- Mortality of non-trauma | - PM10 monitoring sites and estimates |

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| - Seasonal  
- Temporal | - Retrospective descriptive time series | - 6 months | - Elevated and widespread short-term respiratory and cardio-vascular health effects observed during 22-29 Sept. 1997  
- Approximately 20,000 visits and 1,000 admitted cases | Dr Kanchanasak Phonboon, Health Systems Research Institute, Nonthaburi  
Phone: (02)951-1286  
Fax: (02)951-1295  
Email: kpvu@hsr.int.hsri.or.th | - Results presented at the KL workshop |
<table>
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<tr>
<th>Country</th>
<th>Study Title</th>
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</tr>
</thead>
</table>
| Malaysia| On-going project on air pollution and haze funded by the Ministry of Science, Technology and the Environment (Oct. 1997-September 2000)  
- Identification and quantification of natural and man-made atmospheric pollutants  
- Effects of air pollution and haze on animal and aquatic life  
- Effects of air pollution and haze on agricultural crops and forest species  
- Effects of air pollution and haze on human health  
- Effects of air pollution and haze on economics | University Putra Malaysia  
Contact: Prof. M.B. Awang, Dean, Faculty of Science and Environmental Studies  
Phone: (03)9486646  
Fax: (03)9432508  
Email: awang@fsas.upm.edu.my |
| Malaysia| Effects of biomass burning in South East Asia on meteorological conditions in Malaysia  
Source apportionment in Malaysia using aerosol samples collected during haze and non-haze periods | Malaysian Meteorological Service  
Contact: Dr Lim Joo Tick and Ms Leong Chow Peng |
| Malaysia| Forest fires monitoring and assessment of damages using high spatial resolution spot satellite data | Malaysian Centre for Remote Sensing  
Contact: N.N. Mahmood |
| Malaysia| Characterization of haze pollutants | University of Malaya  
Contact: Assoc. Prof. Dr Nik Meriam Sulaiman,  
Department of Chemical Engineering |
| Philippines| Study on PAHs in Metro Manila | Environmental Management Bureau, Department of Environment and Natural Resources and Department of Health  
Contact: Mr Cesar S. Siador, Jr., Environmental Management Bureau  
Phone/Fax: (632)9283773 |