



*Strengthening local capacity
in the economic analysis
of environmental issues*

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The Health Impact of Haze: A Valuation Study from Malaysia

Haze caused by forest fires is a recurring air pollution hazard in Malaysia (as it is in much of Southeast Asia). Despite the negative impact this problem has on the environment, on people's health and on the economy, the implementation of the various regional anti-haze policies has been frustratingly slow. To try and provide more of an economic impetus for action, an EEPSEA study from Malaysia has assessed the value of the health impacts caused by haze pollution in Kuala Lumpur and adjacent areas in Selangor state.

The study is the work of a team led by Jamal Othman from the School of Economics at the Universiti Kebangsaan Malaysia. It found that the health impact (inpatient cases) of the haze in the study area was worth at least MYR 273,000 (USD 91,000). It also shows that the haze places significant demands on hospital resources. In light of these findings, the study concludes that the national health costs of the haze are significant and recommends that action should be taken by governments across the region to impose substantial disincentives on local and foreign firms caught contributing to the haze.



A summary of EEPSEA Research Report No. 2015-RR4: 'Economic Valuation of Health Impacts of Haze Pollution in Malaysia' by Jamal Othman, Mazrura Sahani, Mastura Mahmud, and Md. Khadzir Sheikh Ahmad. Comments should be sent to: Jamal Othman, School of Economics, Faculty of Economics and Management, Universiti Kebangsaan Malaysia, Bangi, Malaysia. Email: jortman@ukm.edu.my, j_othman@yahoo.com

The haze challenge in Malaysia

Haze is a regular phenomenon in Malaysia – one that has been largely attributed to forest fires in Indonesia. Episodes of severe haze have occurred throughout the last few decades. The worst episode occurred in 1997, when practically the whole of Malaysia was engulfed by thick smog for almost six months. In the last few years, the most notable haze episodes took place in August 2005 and August 2006.

Given the scale of the problem, the Association of Southeast Asian Nations (ASEAN) has drawn various anti-haze agreements and action plans. In 2003, ASEAN produced the *Guidelines for the Implementation of ASEAN Policy on Zero Open Burning*. This provides for the establishment of an *ASEAN Coordinating Centre for Transboundary Haze Pollution Control* to facilitate cooperation related to haze pollution emanating from land and forest fires. Given these significant moves – and the tenacity of the haze problem – it is clear the challenge facing the region is not a lack of anti-haze plans, but how to implement existing plans effectively.

The health impact of the haze

Haze from open burning contains concentrated particulate matter (PM₁₀) that is hazardous to health, especially to the lungs, heart, circulatory system, and eyes. It has been linked to at least 14 different illnesses and health complaints.

Despite the problems that it can cause, there have been relatively few comprehensive studies on the economic value of the health impact of the haze in Malaysia. Such valuations are, however, vital, as they will allow the haze hazard to be compared to other social or environmental problems and will therefore help policymakers to

address the root causes of haze and to develop appropriate mitigation strategies.

To help provide this much needed information, the study examined the linkage between air pollution, haze-related illness and socio-demographic variables (such as age) amongst inpatients in hospitals in selected areas of Peninsular Malaysia.

The study location and scope

The study area encompassed Kuala Lumpur (Federal Territory) and selected regions within the adjacent state of Selangor (the districts of Klang and Kuala Selangor). As of 2010, the population of this area was about 7.2 million, representing some 25% of the total population of Malaysia.

Kuala Lumpur is about 40 km to the west of Klang. Both Klang and Kuala Selangor districts are situated along the coast of Selangor facing the Straits of Malacca. They are thus relatively close to hot spot areas (where forest fires are common) in Sumatra, Indonesia.

The study assessed patients in seven of the 11 public hospitals within the chosen areas. The study looked at all respiratory and cardiovascular patients who were treated and admitted to these hospitals in 2005, 2006, 2008, and 2009. These years were selected because they allowed the study to capture the main haze episodes of 2005 and 2006 and to compare them with 'normal' years when there were no major haze incidents. This approach avoided the need for a separate non-haze area to be studied as a control.

Merdeka Square in Kuala Lumpur in February 2005.
(Photo credit: Casz D under creative commons license at www.flickr.com)



Information on health and air quality

Information on health issues was obtained from the participating hospitals. Although data was only available from these public hospitals and clinics, the study's analysis took into account the fact that some people would visit private hospitals to seek treatment for haze-related illnesses. It also took into account the fact that not everyone whose health was affected by the haze would visit a medical center at all and that many would opt for self-treatment.

Information on air quality was obtained from continuous air quality monitoring stations located close to the selected study hospitals (these stations are run by Alam Sekitar Malaysia Sdn. Bhd.). This was done with assistance from the Department of Environment. It was assumed that the air quality data collected from the monitoring station closest to the sampled hospitals would be relevant for the patients treated in these hospitals. The air pollution data comprised mean daily ambient concentrations of particulate matter less than 10 microns (PM_{10}) in $\mu g/m^3$, alongside relevant data on other pollutants. Information was also obtained on Air Pollution Index (API) levels.

A key step in the study's analysis was the calculation of a dose-response coefficient for haze. This allowed an estimate to be made of the impact that a change in haze levels would have on inpatient numbers. The study used

the Cost-of-Illness approach to estimate the economic value of the impact of haze on health. To calculate the economic value of each inpatient case the researchers used the average wage rate (which was obtained using a survey). Presuming an average inpatient stay of two days, the value of each case was estimated at MYR160.

Haze levels and patient numbers

For all the four study years, average daily levels of PM_{10} and API were $54.6 \mu g/m^3$ and 50.1 (*Upper Moderate* category), respectively. There were 535 hazy observations (or 19 hazy days per year on average) in which the API level was at least 76 (*Lower Moderate* category). The weighted mean PM_{10} for days that were entirely hazy was $134 \mu g/m^3$. For normal days this mean was $50.2 \mu g/m^3$. There was no clear association between PM_{10} and API levels and the location of the selected hospitals.

During hazy days, average daily inpatient rates rose very substantially from 0.41 (its level on normal days) to 0.53, representing an increase of 90 cases or 31%. When API was within the *Good* to *Unhealthy* range, each hospital in the study saw about nine cases of haze-related illnesses daily. When API deteriorated to a *Unhealthy* to *Very Unhealthy* level, the mean number of cases went up to 12 (33%). However, the number of cases declined unexpectedly to ten when API was in the *Hazardous* category. It is thought that this

decline was because residents who had been affected by the haze were taking precautionary measures and staying in their homes to avoid exposure to dangerous levels of pollution.

The study found that, annually, the haze episodes led to an increase of 1,707 inpatient cases for the entire study area, or 2.4 cases per 10,000 of the population. This translates to an average increase of 142 cases monthly or 4.7 daily, each year, for the entire study area.

Who was most affected?

Of the 14 types of illness associated with air pollution, five were particularly prevalent. These were: pneumonia, ischaemic heart diseases, acute upper respiratory tract infections, asthma, and hypertensive diseases. These five illness represented about 63% of total inpatient cases (for all illnesses) when API was in the *Good* and *Moderate* categories. Pneumonia and ischaemic diseases ranked consistently as the first and second highest in terms of inpatient illnesses, respectively, for all API categories. Mean cases of hospital admissions due to asthma especially saw a pronounced jump – by 62% when API moved from the *Unhealthy* to the *Very Unhealthy* range.

For all study years, the mean number of daily inpatient cases (per 10,000 of the population) was highest for semi-urban area (0.325), followed by urban (0.293) and rural area (0.202). This suggests that the

Table: Inpatient cases per 10,000 population across API categories

API category	Obs.	Mean API	Mean PM_{10} ($\mu g/m^3$)	Inpatient cases		
				Min.	Max.	Mean
Good (API = 0-50)	5282	40.23	39.21	0	1.203	0.276
Upper Moderate (API = 51-75)	4422	58.49	63.43	0	1.547	0.303
Lower Moderate (API = 76-100)	425	83.60	111.63	0	1.184	0.309
Unhealthy (API = 101-200)	90	118.5	177.07	0	1.037	0.340
Very Unhealthy (API = 201-300)	7	241.9	390	0	0.790	0.349
Hazardous (API = >301)	13	352.6	426	0.074	0.617	0.318
Overall	10,239	54.6	51.1	0	1.547	0.289

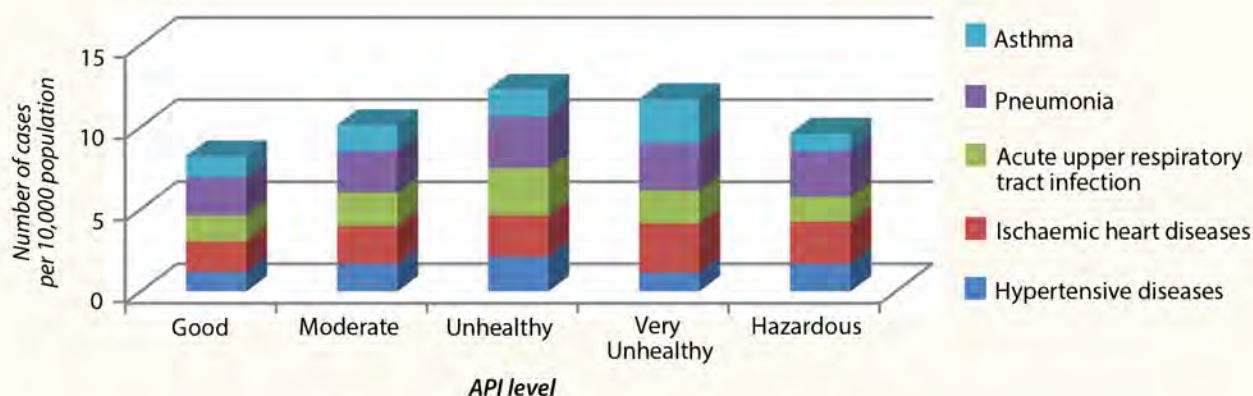


Figure 1. Cases of major illness across API categories

urban-based population is more susceptible to the impact of haze.

One of the most striking observations made by the study was that young adults made up the highest number of cases during a haze event. This was explained by the observation that young adults (the group that makes up the majority of Malaysia's working population) tend to be more involved in outdoor activities and are therefore at a greater risk of being affected by the haze.

The health cost of the haze

The study estimated a dose-response coefficient of between 0.001 and 0.008 for the PM_{10} variable (depending on the calculation method used). The 0.001 figure suggests that when there is a 10-unit increase in PM_{10} , the number of daily inpatient cases in government hospitals for every 10,000 people will rise by 0.01.

Based on calculations using this range of coefficients and the value of a two-day hospital stay (MYR 160), the study estimated that the annual damage to people's health in the study area was worth MYR 273,000 (USD 91,000). This averages to MYR766 (USD 256) per day or MYR14,368 (USD 4,789) per hazy day.

The study shows that, should the haze trend of 2005-2009 continue, hospitals will have to provide an additional 180 extra beds a day during a haze episode. Overall, in terms of physical resources and healthcare provision, this increase in the requirement for beds is equivalent to the daily resources (physical and manpower) of at least one small to medium public healthcare facility in Malaysia. It is clear that, unless something is done, the haze will cause resource allocation difficulties for some hospitals, which could potentially harm patients.

The need for action

The study acknowledges that its estimates for the economic impact of haze are rather small in both absolute and relative terms. However, it also notes that the value, which relates only to the designated study area and for inpatient cases only, is most likely an underestimate. This is due to the fact that hospitalization rates dropped quite substantially when API readings went beyond the *Very Unhealthy* category (as explained above). It also notes that extreme haze may result in a variety of other impacts (e.g., on tourism, business and transportation) all of which have significant social and economic costs. Taking these

factors into account, the study concludes that total damages due to haze are very substantial.

Taking into account the significant impact of the haze on people's health, on health care resources, and on the Malaysian economy, the study recommends that international legislation should be drawn up to demand that Indonesia pays appropriate compensation. It is hoped that such a move would make the country enact and enforce laws and regulations that would force local and foreign firms caught causing the haze to act in more socially and environmentally responsible ways.

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