Research Reports

The Indonesian Fires and Haze of 1997: The Economic Toll

by Economy and Environment Program for Southeast Asia (EEPSEA) and the World Wide Fund for Nature (WWF)

This paper presents findings from a study completed in May 1998 by WWF-Indonesia and EEPSEA to assess the economic value of damage caused by the 1997 fires and haze. The work was carried out by EEPSEA and WWF staff and academic researchers in Indonesia, Malaysia and Singapore, with methodological advice from international experts. The study covers the period August - December, 1997. A book-length version of this report ("Indonesia's Fires and Haze: The Cost of Catastrophe") was published by ISEAS and IDRC in August, 1999. Copies can be obtained from ISEAS or IDRC.

This report presents estimates for both fire and haze damage. These are shown in the following tables:

EEPSEA is a development cooperation program supporting research and training in environmental economics in 10 SE Asian countries. Established in 1993, its current sponsors include Canada (IDRC & CIDA), Sweden (Sida), MacArthur Foundation, and the Foreign Affairs Ministries of Denmark, Holland, and Norway.

WWF is dedicated to protecting the world's wildlife and wildlands. The largest privately supported international conservation organization in the world, WWF has sponsored more than 2,000 projects in 116 countries over the past 36 years. WWF directs its conservation efforts toward protecting endangered spaces, saving endangered species, and addressing global threats.

Table 1. Fire and Haze-Related Damages from the 1997 Indonesian Forest Fires (in USD millions)

Fire-related Damages					
Type of Loss	Lost to Indonesia		Lost to Other Countries		Total
Timber	493.7		-		493.7
Agriculture	470.4		-		470.4
Direct Forest Benefits	705.0		-		705.0
Indirect Forest Benefits	1077.1		-		1077.1
Capturable Biodiversity	30.0		-		30.0
Fire Fighting Costs	11.7		13.4		25.1
Carbon Release	-		272.1		272.1
Total Fire	**2787.9**		**285.5**		**3073.4**
Haze-related Damages (summary)					
Type of Loss	Lost to Indonesia		Lost to Other Countries		Total
Short term health	924.0		16.8		940.8
Tourism	70.4		185.8		256.2
Other	17.6		181.5		199.1
Total Haze	**1012.0**		**384.1**		**1396.1**
TOTAL FIRE & HAZE	**3799.9**	**(85%)**	**669.6**	**(15%)**	**4469.5**

Notes:

1. Where Asian currency values were used, they were converted to dollars at the July 1997 exchange rates of USD 1 = Rp 2500 / RM 2.5 / SGD 1.4.
2. Fires and haze affected 5 million hectares in Indonesia and 70 million people throughout the region.
3. Agriculture losses include those to plantations and smallholdings. They do not include possible haze damage via reduced photosynthesis, pollination, and so on.
4. Direct forest benefits include non-timber forest products such as food, local medicines, raw materials and recreation.
5. Indirect forest benefits include storm protection, water supply and regulation, erosion control, soil formation, nutrient cycling and waste treatment.

6. A Capturable biodiversity refers to the potential income lost to Indonesia from international conservation expenditures i.e. the amount that international agencies and NGOs have shown they are willing to pay to conserve tropical forests. It does not reflect the intrinsic value of species whose extinction has been hastened; the potential value of ecotourism or internationally marketed pharmaceuticals; the human cultural diversity of indigenous forest-based cultures; or other benefits too difficult to value. These losses are shared by Indonesia and the rest of the world.
7. Carbon release: Release of carbon from fires will contribute to climate change, which will in turn result in economic damage. This figure reflects the amount of damage that the 1997 release is expected to cause.
8. Haze-related damages not estimated here include long-term health damages, reduced crop productivity, aesthetic value of reduced visibility, avertive expenditures, accidents, loss of life, evacuations, loss of confidence by foreign investors.

Because some damages could not be valued, and because conservative assumptions were used throughout, the estimate is a conservative lower bound figure.

Table 2. Haze-Related Damages from the 1997 Forest Fires (detailed) (in millions)

	Indonesia		Malaysia		Singapore		Total
Damage	Rp	USD	RM	USD	SGD	USD	USD
Short-Term Health Damages	2,310,000	924	20.1	8.0	12.5	8.8	940.8
Industrial Production Losses	U	U	393.5	157.4	N	N	157.4
Tourism	176,000	70.4	318.5	127.4	81.8	58.4	256.2
Airline & Airport Losses	44,000	17.6	.5	.2	9.7	6.9	24.7
Fishing Decline	U	U	40.6	16.2	N	N	16.2
Cloud Seeding	U	U	2.1	.8	N	N	.8
Total	2,530,000	1,012	794.3	310.0	104.0	74.1	**1,396.1**

Notes:

N = negligible or not applicable
U= unknown: data unavailable
small discrepancies in totals reflect rounding
* July 1997 Exchange Rates: USD 1 = Rp 2500 / RM 2.5 / SGD 1.4

Damages excluded: long-term health damages, reduced crop productivity, aesthetic value of reduced visibility, avertive expenditures, accidents, loss of life, evacuations, loss of confidence by foreign investors.

DISCUSSION OF FINDINGS

1. *The total damages from fires and haze (nearly $4.5 billion):*
   - exceed the damages assessed for purposes of legal liability in the Exxon Valdez and Bhopal disasters combined;
   - exceed the amount of funds needed to provide all of Indonesia's 120 million rural poor with basic sanitation, water and sewerage services;
   - are more than double the total foreign aid received by Indonesia annually;
   - are equivalent to about 2.5% of Indonesia's GNP;
   - were suffered largely by Indonesia itself.
2. *For haze damages alone ($1.4 billion):*
   - The resources lost to Malaysia as a result of the haze could have financed all of the federal government's social programs for the last three years.
   - Malaysia's expenditures on cloud seeding alone would have been enough to establish a 320 ha. nature park and maintain it for 15 years.
   - Singapore's tourism losses alone could have fully funded the country's Community Chest, comprising 50 charities and benefitting 180,000 people, for three years.
   - Indonesia could have used its lost resources to provide basic sanitation, water and sewage services for 40 million people (about 1/3 of the country's rural poor).
   - The total losses to the 3 countries from haze could have financed the provision of such services to 56 million Indonesians.
3. Tourism accounts for a large share of losses. These losses are in foreign currency and are acutely felt during the current financial crisis.
4. Losses beyond these may be incurred in the future. For example:
   - People may suffer long-term health damage, including increased risk of cancer.
   - Tourists and foreign investors may begin to associate the region with pollution, resulting in future losses of hard currency.
   - El Nino may perpetuate drought conditions well into 1998. The last El Nino of comparable intensity occurred in 1982/83. In that episode, fires in the second year were comparable in scale to those in the first. If that pattern is repeated, the 1998 damages could be as severe as those of 1997.

RECOMMENDATIONS

Droughts that increase the hazard of massive uncontrollable fires are likely to recur. Some evidence suggests that El Nino events are becoming more frequent. To avoid a repetition of the 1997 disaster, the Indonesian government, supported by the international community, should:

1. Declare a moratorium on the current project to drain and convert 1 million hectares of peat forest to rice cultivation. Fires on these former wetlands have been the most difficult to extinguish and have created haze laden with sulphuric acid.
2. Clarify land ownership laws that encourage people and companies to clear land as a way of

staking a claim.

3. Enforce existing laws that regulate the use of fire for land clearing.
4. Make full and prompt use of fire monitoring data provided through regional and international programs to identify and prosecute those responsible for illegal burning.
5. Change policies that keep the prices of wood to processing mills low, providing little incentive to protect standing timber or to sell scrap wood rather than burn it.
6. Lengthen the term of leases of forest land to timber companies, which currently leave little incentive to manage forests sustainably. These should be coupled with strict enforcement of regulations governing forestry practices.
7. Investigate no-burn methods for land clearing. A recent WWF study shows this to be a promising option, although its environmental impacts also need to be assessed.
8. Reduce targets for planned forest conversion and instead establish new plantations in unused Aalang alang at grasslands, of which Indonesia has several million hectares.

RESEARCH METHODS

A) General Considerations

All values are:

a) Calculated first in local currency.

b) In present value terms. (i.e. many losses occur one time only; others recur. Income streams or environmental services that could provide recurring benefits are converted to a one-time only [present value] equivalent.)

c) In net terms. (i.e. damages are net benefits foregone. Net benefit = gross value of the foregone good or service minus the cost of producing or extracting it. This is equivalent to value added; or profit minus normal rate of return to capital; or economic rent.)

d) Attempt to approximate consumer surplus foregone, rather than actual expenditures. (e.g. some people were able to obtain medical treatment or evacuate an affected area. Other people were similarly affected but were unable. Actual expenditures for treatment are therefore extrapolated to the entire affected population.)

In cases where it was not feasible to conduct new surveys, the benefit transfer (BT) approach were used. This involves the transfer of values from existing studies to the new study site, with appropriate adjustments for the size of the affected area, income levels and other factors.

Various BT values and other adjustment factors are mentioned below. These are derived from various sources, including World Bank and the ADB Workbook on Economic Evaluation of Environmental Impacts (1996). Wherever possible, BT values were a reality-checked against local conditions.

Valuation is not appropriate or adequate for depicting the significance of some damages. Some of these issues are:

- Magnitude of damage relative to ability to bear its cost: wealthy people can sustain larger losses than very poor people, so dollar figures are not necessarily a good measure of suffering.
- Valuing loss of life is difficult and controversial. In this study, we assume that such losses are significant but incalculable.

In some cases, anecdotes or boxes about critical damage incidents will supplement the aggregate values in the final report.

B) Estimation Methods for Haze Damages

This section outlines a common methodology prescribed for the three country studies. Methods were adapted to local conditions and data availability in each country during application; the adjustments are described in detail in the country reports.

The period covered was August 1 - October 31, 1997. In principle, the study should compare the situation with and without haze. In practice this involved a comparison of August-October, 1997 to a normal August-October. The values used here were either: (a) Aug-Oct, 96; (b) average of Aug-Oct over the past 5 years; or (c) projected trend of Aug-Oct over past 5 years, depending on what was most appropriate in a given case.

Care was taken to separate the effects of the haze from those of the drought and the ASEAN financial crisis.

1. Short-term Health Costs: Adjusted Cost of Illness Approach

Three steps to obtain an adjusted COI are outlined below:

a) Estimate treatment cost

(i) Estimate hospital and clinic admissions for haze-related ailments per 10,000 population for Aug-Oct 97. Use haze-related ailments as defined by each country's health service. If there is no such definition, use the Malaysian definition: upper respiratory ailments, asthma, bronchitis & conjunctivitis.

(ii) Estimate same for Aug-Oct 96 or average of Aug-Oct. over previous 5 years.

(iii) Subtract ii) from i) to get excess admissions.

(iv) Adjust for affected but untreated population. The ratio of untreated to treated case varies from country to country but is in the range of 3 or 4 to 1. The ratio for each country can be found in standard health sector studies by WB or ADB.

(v) Adjust for treatment costs beyond hospital visits (mainly medicines). As per (iv), there is a standard adjustment factor that varies by country.

(vi) A shadow price i.e. add the value of any government subsidies for treatment. Alternatively, use the price of a visit to a private clinic.

(vii) If necessary, extrapolate to area outside that where hospital data were collected (use visits per 10,000 ratio in (i)).

(viii) If possible, get cross-section data on affected & unaffected areas as a check on time series in (i).

(xi) get adult/child breakdown on hospital data. This will not be used in valuation of treatment costs, but in estimating lost workdays below.

These steps were modified for individual countries, depending on data constraints. For Singapore, they were followed largely as outlined. In Malaysia, data on hospital/clinic admissions were matched with pollution levels to produce a dose-response function. This was extrapolated to areas of Malaysia where data on admissions were unreliable. The dose-response function was also transferred to Indonesia, where a map of cumulative haze intensity was overlaid on a population map to estimate the number of people exposed to haze pollution of various levels.

b) Estimate workdays lost

Use hospital/clinic visits by adults (men & women) as a proxy for workdays lost. Adjust visits to workdays lost by a factor suggested by local doctors.

If feasible, adjust for any double counting, if people frequently go first to clinic and then to a hospital on the same day for the same sickness episode. This would not necessarily affect treatment cost, but would affect workdays lost.

Multiply each workday lost by the average or minimum daily wage (depending on which is most suitable in a given country. Say which one you used.) Do this for all adults, male & female. (If employees continue to receive wages while home sick, workdays lost are considered a loss to employer.)

c) Adjust COI for discomfort (to approximate WTP)

Add (a) treatment cost + (b) workdays lost to get (c) cost of Illness (COI).

Cost of illness has been found to seriously underestimate total damage from an illness, as measured by an individual's willingness to pay (WTP) to avoid it. (This is because in spite of treatment and sick leave, the individual still suffers discomfort.) The ratio of WTP to COI varies with the ailment. Some ranges of values can be found in ADB Workbook (1996), p. 188. For asthma, it is about 2:1.

This adjusted COI, for lack of a better term, is the value to be used for short- term health damages. These are the short-term health damages only. Long-term, cumulative damages are not valued.

d) Haze-related Production Losses: These could include rural & urban activities such as reduced crop yields resulting from reduced sunlight. In practice, the only losses measurable were: a) foregone profits in Malaysia from fishing due to reduced visibility (fishing days foregone multiplied by expected profit per day); b) reduced industrial & commercial activity due to the 10 day state of emergency on Kuching (% of GNP foregone).

e)Tourism Losses: Estimate reduced tourist arrivals from non-ASEAN sources (to control for effect of 97 ASEAN economic crisis): compare Aug-Oct 97 to normal Aug-Oct.

4. Airline and Airport Losses: To obtain the losses incurred from airport closures due to poor visibility, one would need data on canceled flights, expressed in mileage lost, multiplied by the airline's average profit per mile. To this should be added any profits foregone from operation of the airports themselves.

C) Estimation Methods for Fire Damages

The estimation methodology consists essentially multiplying the area burned in August - December, 1997 and multiplying those by per hectare values for various vegetation types and land uses. The per hectare values are taken from existing data on Indonesia and, failing that, from comparable ecosystems elsewhere with appropriate adjustments. Economic damages are in net terms (i.e. profit foregone, not total revenue foregone). Discounting of future costs was done at a rate of 10%.

1. Area Burned: Estimates are based on a total area burned of 5 million ha., distributed as follows: 20% forest, 50% agriculture/plantation, 30% other (unproductive). These figures are derived primarily from satellite mapping studies of Sumatra and Kalimantan by the National University of Singapore's Centre for Remote Imaging, Sensing and Processing (CRISP), with adjustments by EEPSEA and WWF for areas burned outside those provinces.

2. Timber: Timber values take into account estimates of timber stock by the government of Indonesia, as well as growth estimates of forests and net international prices. A net price of $50/m3 was used. This was cross-checked with an alternative estimation method based on land values and found to yield consistent results.

3. Agriculture: Two key variables that enter into this calculation are the agricultural land value and the production lost in terms of years of output. Differences in productivity between plantations and smallholdings were factored in. We have assumed that, after burning, full agricultural productivity would be re-established in 3 years, with partial productivity being re-established in years 1 and 2 after the burns. This is consistent with average productive cycles of mixed crops (combination of annuals and perennials and tree crops).

4. Direct Forest Services: A Benefit Transfer approach was used, drawing on average world values of tropical rainforest ecosystems, applying them only to the forest area in the sample (i.e. 1 million ha.). The principal source was Costanza et al (Nature, 1997). Values for culture, timber and climate control/regulation and genetic resources were removed to avoid double counting with independent estimates described elsewhere. This yielded a net value lost of $530/ha./yr. It was assumed that non-timber forest products would be re-established over a period of 5 years.

5. Indirect Forest Services: A similar procedure to that described for Direct Forest Services was applied and yielded a net value lost of $1481/ha./yr. It was further assumed that the losses applied only to the area 'effectively burnt' of forest which, consistent with the 'combustion factor' in CRISP estimates, was 50% of actual forested area. It was assumed that indirect forest services would be re-established over 2 years.

6. Biodiversity Losses: The approach used here is to value capturable biodioversity from Indonesia's perspective. It is not the full value of international value of biodiversity. The figure takes a value of $300/km2/yr. as an average of values found from various studies of willingness to pay to preserve tropical rainforest of various qualities.

7. Fire Fighting Costs: This includes all documented costs for fire-fighting beyond normal year's expenses. It includes contributions of personnel and cash from within and outside Indonesia.

8. Carbon Release: Carbon dioxide and methane emission estimates in the CRISP study were increased by the ratio of total area burned (5 million ha.) to area assessed by CRISP (4.56 million ha.). Such emissions increase global warming, which in turn is assumed to cause economic damage. Previous studies for the Intergovernmental Panel on Climate Change have put a value of up to US$30 on the damage caused by a ton of carbon emitted; figures up to this amount are commonly used in international negotiations. In this study, a conservative figure of $10/ton was used.

FURTHER INFORMATION

A book length report will be published after September 1998. For further information on this study, contact:

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