September 2018
Haze risk in Southeast Asia
An insurance solution

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Executive summary

Haze is most often caused by the burning of forest and peat soils. Haze pollution in Southeast Asia is most often caused by the burning of forest and peat soils in Indonesia to clear land for agricultural purposes. Peat fires produce a high concentration of aerosol emissions that pollute the air and reduce visibility for weeks. Haze can adversely impact human health, business operations and daily life. The fires reduce biodiversity and damage Indonesia's agriculture and forestry ecosystem, and give rise to substantial greenhouse gas (GHG) emissions.

The 2015 haze event had a major impact on the environment, health and vulnerable industrial sectors... The thick, sooty smoke from haze often travels across national boundaries. In 2015, a large smoke plume blanketed Equatorial Asia, triggering what is believed to be the biggest haze event on record in the region. Thousands of residents suffered from respiratory ailments and other haze-related illnesses. Normal business operations were also disrupted due to low visibility. Industrial sectors vulnerable to haze pollution, such as tourism, trade and transport, also suffered loss of income and experienced cash flow volatility, even in the absence of any damage to physical assets. The prior significant haze event was in 1997/1998, which triggered substantial but smaller economic losses in the region.

...causing staggering economic losses. This study explores the overall economic impact of the 1997 and 2015 severe haze events across Southeast Asia. The 2015 haze event was one of the costliest disaster loss events ever in the region, on a par with the massive 2004 earthquake and tsunami, based on inflation-adjusted figures. According to Swiss Re Institute estimates, the economic losses caused by the 2015 haze event amounted to more than USD 17.5 billion in Southeast Asia. Roughly USD 15.6 billion of these losses occurred in Indonesia, representing 1.8% of the country's GDP.

An interim insurance solution that covers non-physical damage business interruption (NDBI) could provide financial relief. Haze risk is likely to continue to be a major challenge because of underlying climate and land use trends as well as the intrinsic complexity of haze propagation. More sophisticated haze risk models and improved understanding of haze risk drivers will allow the development of innovative insurance solutions. An interim parametric solution for non-physical damage business interruption (NDBI) could provide financial relief to the sectors impacted by haze events.
Introduction

Agricultural burning of peatland has triggered severe haze outbreaks in Southeast Asia in past decades.

Haze has developed into a peril on its own, based on man-made and natural factors.

Meteorological factors such as El Niño also contribute to haze.

The most severe and costliest haze outbreak occurred in 2015.

Rising population density is likely to trigger higher health, economic and environmental costs.

This paper covers the evolution of haze and its economic consequences.

Over the past two decades, haze has repeatedly struck Southeast Asia, with notable outbreaks recorded in 1997/1998, 2006, 2013, and 2015. Haze is caused by the burning of peat forests in Indonesia, where man-made fires are used to convert land for palm oil plantations and other agricultural purposes. This has had unintended yet severe environmental consequences.

Peatlands contain significant combustible organic material that when burned release fine particulate matter (PM$_{2.5}$) – burnt carbon – that cover large regions of Indonesia. Under certain weather conditions, air quality also deteriorates in downwind countries such as Singapore and Malaysia. Over the past few decades, haze has developed into a unique peril, involving a complex interplay of both man-made and natural factors.

While economic interests often drive peatland burning, meteorological factors such as El Niño also influence the inter-annual variability of burning and associated haze in Southeast Asia. In addition, peatland burning produces excess CO$_2$ that can exacerbate global warming. This may impact the frequency and the severity of future haze events, although the extent remains unclear. It is, however, inherently different from seasonal localised pollution in New Delhi and Northeast China, where ambient pollution is more prevalent.

Haze affects the air quality for weeks. The tourism, transport, construction and trade industries, as well as health and education sectors, incur tremendous costs during haze outbreaks. In 2015, a severe haze occurrence resulted in economic losses of approximately USD 16 billion in Indonesia alone, according to both the World Bank$^1$ and Swiss Re Institute estimates. This exceeded the total value added by the palm oil industry of USD 12 billion in 2015.$^2$ Due to the transboundary nature of haze – ie, small soot particles can be transported in the air over large distances – the neighbouring countries of Malaysia and Singapore were also affected.

Regardless of the long term impact on the climate, future episodes are expected to trigger higher health, economic and environmental costs for Indonesia and neighbouring states due to rising population density in impacted areas. Alerted to the gravity of the situation, authorities have responded by setting up regional haze monitoring and prevention initiatives, which will take time to fully implement. So far, risk financing options to mitigate the growing economic impact of haze have not been considered. Insurance could emerge as a viable solution in the interim to close the financing gap until the root causes are addressed.

In this paper, we will discuss the evolution of haze as a peril and short/medium term trends (5 to 10 years), as well as evidence of the economic consequences of haze. Lastly, we will explore the viability of insurance solutions, as well as potential moral hazard and political considerations.

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$^2$ Ibid.
Haze: a man-made or natural peril?

Peatland burning started with intensive land use development in Indonesia. Fires in Indonesia are driven by complex interactions between climate, land cover and land use management. The latest research suggests that transboundary haze is a unique peril, involving a mutually reinforcing combination of man-made and natural factors. For example, records since the 1960s show that severe fires had not occurred in Indonesia prior to intensive land use development, including the proliferation of palm oil estates and timber plantations.\(^3\)

Changes in land use practices have made peatlands more prone to conflagration. Tropical peatlands in their pristine state were protected from conflagration as the high porosity of surface peat layers helped to sustain a high water table, with wet dense organic layers serving as a natural fire barrier. Intervals between fires were often long enough to allow forests to naturally recover.\(^4\) However, in recent decades, human activities, such as the drainage and logging of peatlands to create farms and plantations, have reduced tree canopy and have created a drier and more flammable environment, thereby increasing the frequency of fires.

Fires that have been extinguished at the surface can spread through underground pathways. As the peatland drains and the soil degrades, highly combustible surface peat is exposed and fires that have been extinguished at the surface can spread to adjacent areas through underground pathways. Sub-surface fires may smoulder for months or even years, and are hard to extinguish without the help of monsoon rains.

Human activity has contributed to the surge in peatland fires. Man-made factors play an important role in setting the conditions for forest fire ignition. The surging global demand for valuable commodities, such as palm oil and timber, is driving intense deforestation, conversion and drainage of peatland for agricultural purposes in Indonesia (see Figure 1) and the corresponding increase in forest fire occurrences.

![Figure 1](https://pdfs.semanticscholar.org/b523/4a7745f6f9abbd42fe04bc41af9c37e6501.pdf)

Palm oil and wood pulp production in Indonesia, 1990 – 2014, million tonnes

Source: FAO

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The influence of El Niño Southern Oscillation (ENSO) and other climate modes
In addition, meteorological factors can influence the initiation, intensity and duration of fires. The climate of Sumatra and Kalimantan (i.e., those areas of Indonesia most prone to fire activity) is governed by climate cycles such as the El Niño Southern Oscillation (ENSO) or the Indian Ocean Dipole (IOD). Haze tends to be considerably more severe during dry years associated with El Niño cycles. In fact, two of the most severe haze events of 1997/1998 and 2015 have coincided with two of the strongest El Niño events on record (see Figure 2).

The warmer and drier-than-normal conditions associated with El Niño in the region exacerbate the impact of haze outbreaks through: 1) increasing burn potential of dried out vegetation, 2) higher atmospheric haze concentration through reduced rainfall, and 3) transporting emissions from source regions (Central to South Sumatra) to neighbouring high population density hubs such as Singapore and West Peninsular Malaysia through a strengthening of prevalent South West wind patterns that take hold during the haze season (see Figure 3).  

Figure 2
Sea surface temperature anomaly in El Niño regions 3 and 4

Figure 3
Fire emissions and mean 0–1 km vector winds in Equatorial Asia in July – November, 2006

Source: NOAA


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https://pdfs.semanticscholar.org/f30a/1acd5f52d78ac061de3d263fa9cf47000dc.pdf
Apart from the ENSO and IOD cycles, local and more frequent meteorological phenomena, such as monsoonal wind flows, sea breezes and tropical cyclones, can play a significant role in determining the transport pathway of haze. For example, Singapore experienced a short but severe haze event in June 2013, a year without regional climate anomalies and away from the typical September to October haze window. The event was unusual as it was caused by stronger westerly winds blowing smoke from Central Sumatra’s Riau province towards West Peninsular Malaysia and Singapore.

**Efforts and challenges to mitigate haze risk**

Concerned by the deteriorating air quality associated with successive haze events, ASEAN governments have initiated haze monitoring, fire-fighting, and peatland restoration efforts through the 2002 transboundary haze pollution agreement (THPA) that has since been ratified by Indonesia. The main challenges in tackling the forest fires and ensuing haze are as follows:

**Enforcement challenges**

Landholders are unlikely to use alternative methods to clear peatlands as burning is significantly cheaper than mechanical methods. In addition, the long drainage canals created in the peatlands act as important pathways of transport in rural areas. As such, the shift away from fire-based land clearing practices will be heavily dependent on the success of enforcement measures put in place. The application of laws preventing illegal burning may continue to be thwarted by jurisdictional ambiguity surrounding enforcement (i.e., conflicting communal laws versus national regulations). While palm oil companies that are certified by the Roundtable on Sustainable Palm Oil (RSPO) have pledged to abstain from using fire for land management, these pledges are not legally binding.

An important precedent was set in 2015, when the Supreme Court of Indonesia affirmed the decision of lower courts, convicting and levying a hefty fine on a palm oil company for burning more than a thousand hectares of peatland in Tripa Sumatra. However, broader enforcement will remain a challenge as it is difficult to determine culpability due to ill-defined boundaries between individual estates, as well as limitations in identifying the precise source of fires from satellite imagery.

**Restoration efforts will not come overnight**

Following the 2015 haze event, Indonesia made a commitment at the Paris climate talks to restore 2.4 million hectares of degraded peatland within five years, primarily administered through the Peatland Restoration Agency or ‘Badan Restorasi Gambut’ (BRG). As degraded peatland is dry and highly flammable, restoration involves ‘rehydrating’ it to its saturated original state. Restoration can be accomplished through canal blocking, water management, as well as re-vegetation and re-zoning of peatlands within designated protected zones. This plan to restore peatlands must strike a balance between environmental concerns and the economic growth generated from the palm and timber industries. This challenging task is further complicated as Indonesian peatlands are remote and rely heavily on cooperation from local communities in the management process. Because rural communities have previously relied on shift cultivation for economic sustenance, they are poorly incentivised to support restoration efforts.

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9 Ibid.

Damp peat fires tend to burn at low temperatures and often go undetected.

Fires are transforming peatlands into a CO₂ source from a CO₂ sink.

Population growth and development will play a major role in the conversion rates of forests.

**Unique characteristics of peatland fires**

Dry peat fires, once ignited, are extremely difficult to extinguish as they tend to burn at low temperatures and can smoulder for weeks or months, often undetected within the subsurface peat layers. Also peat fires can undergo spontaneous combustion if conditions are sufficiently dry. They can migrate through subsurface channels away from the initial source and reignite weeks later in a different location.

In addition, peatland fires can have implications for global warming. Peatlands are wetland ecosystems in which the accumulated plant material represents an important “carbon sink”. When drained or burned, however, the stored carbon is released into the atmosphere adding more greenhouse gases. Increase in the depth of peat combustion can alter the function of peatland within the ecosystem and make peatland a source of carbon (see Figure 4). From a climate perspective, the impact of this in the overall carbon cycle is still not fully known. The incidence of fire ignition and fire severity may also increase with a more volatile ENSO cycle. Haze, which started predominantly as a man-made peril, is gradually becoming a unique peril increasingly influenced by natural factors.

Regardless of how climate change may influence haze manifestation in the future, the unique characteristics of peat fires suggest that the effectiveness of the efforts to combat haze will be limited in the near to medium term. In addition, the global demand for commodities such as palm oil will continue to increase in the future with rising standards of living and population growth, according to Ruth DeFries of the Earth Institute at Columbia University. As a result, this could continue to cause peat fires and with them, haze.

**Figure 4**

Reduced carbon absorption capacity of Southeast Asian peat forests due to land degradation


13 Quotation from Ruth S DeFries, Professor of Sustainable Development, Columbia University.
Modelling the Southeast Asia haze phenomenon

Public interest in understanding haze events is growing.

The risk profiles of haze exposure can be developed via common statistical approaches, although there are limitations.

The use of bio-chemical transport models can help determine how fire emissions are transported.

Given that haze events can have dire economic, health and environmental consequences in Southeast Asia, public interest in the haze phenomenon is growing. With recent advancements in data capture, and a better understanding of the key drivers of transboundary haze, regional haze risk profiles can be captured via statistical and dynamical means as outlined below:

**Pure statistical models**

Using historical air pollution measurements such as PM$_{2.5}$ and PSI (Pollution Standard Index) data at various sites of interest, the risk profiles of haze exposure can be developed via common statistical approaches, such as extreme value analysis. However, this approach suffers from a number of limitations, including short historical records, variations and/or inconsistencies in measurement techniques, as well as limited geographical applicability of results since haze concentrations tend to have significant spatial variability. Some of these limitations can be addressed through the use of proxies for haze concentrations with longer historical records, such as visibility, rainfall relative humidity and surface air temperature.

**Dynamic methods**

An alternative modelling framework involves the use of bio-chemical transport models to determine how fire emissions from burning sites (hereafter referred to as the 'source' sites) are transported to other regions of interest (hereafter referred to as 'receptor' sites), including locations with key population and economic density such as Kuala Lumpur, Singapore and Jakarta. There are several advantages of this approach compared to the statistical approach detailed above. Apart from geographical scalability, such a framework enables the identification of key source regions that contribute disproportionately to haze exposure at impacted receptor regions. This framework also allows for the incorporation of projected land-use changes into the near future and their impact on haze. While the dynamical approach is more complex and is more computationally challenging, the approach can be summarised as outlined below:

**Mapping transport pathways of haze from source to receptor sites**

To model the transport of emissions from source regions to key receptor sites such as Singapore, Kuala Lumpur and Jakarta, the GEOS-CHEM atmospheric chemical transport model has been used by a select group of researchers, including Swiss Re’s collaboration partners who are part of the atmospheric chemistry group at Harvard University. GEOS-CHEM (see Figure 5) is driven by NASA meteorological data (GEOS-5) and fire emission satellite imagery.$^{14}$ This model requires intensive computational resources, as it involves a large number of complex equations to represent atmospheric chemistry processes. For example, the model is able to project haze concentration values in Singapore based on the intensity of fires burning in Sumatra and the underlying weather conditions.

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Modelling the Southeast Asia haze phenomenon

Figure 5
Schematic of the GEOS-CHEM atmospheric chemical transport model

Source: Loretta J. Mickley, Harvard University

Figure 6
Time series of reported, observed and reconstructed haze severity indices in Singapore

The reconstructed data set correlates well with local reports of haze.

The graph above shows the observed and reconstructed haze severity indices in Singapore by the Harvard atmospheric chemistry modelling group using a range of methods. The reconstructed data set correlates well with local reports of haze incidents text-mined from historical newspaper archives.
Assessing the economic impact of past haze events

The severe financial fallout of the 2015 haze outbreak makes assessing the economic impact of severe haze recurrence crucial.

The 2015 haze event cost Indonesia an estimated USD 15.6 billion.

Estimated economic impact

The fires over the periods April 1997 – May 1998 and June – October 2015 burned 9.8 and 2.6 million hectares, respectively, causing severe losses to agriculture, forestry and the ecosystem. The financial fallout extended well beyond the environment, including widespread disruption to a range of industries across Southeast Asia. This section attempts to quantify the overall economic cost of fire and haze for these two major outbreaks including non-tangible losses. The analysis builds on the estimation models in some previous publications, including reports from the Asian Development Bank (ADB, 1999), the Institute of Southeast Asian Studies (ISEAS) and the International Development Research Centre (IDRC, 2006), as well as the World Bank (2016). The aim is to formulate a unified estimation framework for both events by reconciling different methods in the literature, as well as shed light on other occasional haze events and identify future trends.

This study reveals that, at historical prices, the 1997/98 event cost Indonesia an estimated USD 9.2 billion, while the 2015 event cost USD 15.6 billion (1.8% of annual GDP). The transboundary haze also cost Malaysia and Singapore USD 926 million and 897 million, respectively, in 2015, representing 0.3% of each country’s annual GDP.

Table 1

<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td></td>
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<td>Transportation</td>
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<tr>
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<td>22</td>
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<tr>
<td>– Seaport</td>
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<td>Tourism</td>
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<td>146</td>
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<tr>
<td>Health</td>
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</tr>
<tr>
<td>Total</td>
<td>9,240</td>
<td>238</td>
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</table>

Source: Swiss Re Institute

Our estimates of the total cost are conservative, as many long-term environmental and health costs are not represented in the calculation. Forestry losses, for example, can persist for a number of years following a fire event due to the time required for reforestation. Aside from the immediate health impact, prolonged exposure to multiple haze episodes may also adversely impact health and lead to costs that are not immediately reflected in the post-event losses. To this end, studies have examined the impact of long-term health costs and mortality risks, but their findings remain inconclusive. In addition, as people’s awareness of healthcare increases, governments’ costs to implement haze prevention measures and improve social welfare are expected to rise.

Nevertheless, these losses make the 2015 haze outbreak one of the costliest disasters in Indonesia. As the losses were mostly uninsured, this shows that the protection gap is large. By comparison, the direct damage from the massive 2004 earthquake and tsunami – also largely uninsured – amounted to USD 12.2 billion. The 2015 haze event also exceeds the total value added by the palm oil industry of USD 12 billion that year, proving that any short-term economic profits from land clearing practices for a select few are eclipsed by the economic costs of fires and haze for the community.

The estimated environmental losses from the fires accounted for the majority of the costs. Other sectors vulnerable to air pollution include tourism, transport, trade and education. Due to the transboundary nature of haze, neighbouring countries also experienced widespread disruption in a range of industries. During past haze events, Malaysia and Singapore have had to deal with school closures, airport closures, flight delays/cancellations, a decline in tourism, outdoor event cancellations, reduced outdoor construction activity, and a decline in outdoor food and beverage sales. Individual losses of this nature often go unreported as they are small and stem from disparate sources across a broad region, but their cumulative impact through the haze season can be significant.

Due to advances in technology, most of the vehicles and much of the infrastructure have been adapted so that they still function even if visibility is reduced (as is the case during a haze event), leading to fewer fatalities and higher operational efficiency. For example, Singapore’s Changi airport introduced measures to allow aircraft to land when a runway’s visual range is more than 300 meters. However, economic activities are becoming increasingly interconnected and, as such, more prone to disruptions in terms of severity and unit cost of damages. The economic threat posed by future haze occurrences is expected to increase, requiring a concerted effort across regional governments to better manage this risk.

Methodology for estimating economic losses

Agriculture

Losses to agricultural products come directly from the reduction of available land due to fire-burned areas and indirectly from the fall in plant productivity due to drought and haze. To assess the lost productivity of food crops (mainly rice), an analysis of historical output is undertaken, and model extrapolation is applied and compared with actual production. For estate crops (including palm oil, rubber and coconut), areas burned are retrieved and re-establishment losses are calculated.

Forestry

Our analysis of the impact on forestry consists of direct loss to timber burned on forest land, non-timber forest products (NTFPs) and indirect causes. Estimates of the value of lost timber are based on assumptions about stocking rates, average harvesting years of logging and the net commercial price of timber. It is difficult to attain price statistics for other non-tradable NTFPs, such as bushmeat, medicinal plants, honey and rattan, which bring significant benefits to rural households, so a “benefit transfer” method as described in the ADB (1999) report is used. Also, many natural forests play a key role in protecting areas from floods, controlling soil erosion and preserving habitats. Such losses from fire should also be reflected.

Environment

The damage of fire and haze to the environment represents the biggest cost. Carbon emissions resulting from the fire on peatlands due to high carbon sink reached approximately 691 million tonnes in 1997/98 and 217 million tonnes in 2015. Biodiversity was also facing challenges due to land clearing and sustained exposure to haze, as the genetic diversity of creatures in forests and swamps contributes to increasing agricultural yields, developing disease-resistant pharmaceuticals and promoting tourism.

Trade

When fires spread in Indonesia, domestic and international trade activity was adversely impacted due to inaccessibility to the affected provinces. We estimated the reduction of exports and imports values in fire-exposed provinces (mainly Kalimantan and Sumatera), taking into account fluctuating global macroeconomic conditions.

Emergency response

Indonesia is required to dedicate significant resources to fight against fires, and has sought the help of Malaysia to carry out cloud-seeding operations during hazy days. International aid is also included in this category.

Education

Haze can lead the government to announce public school closures or suspend outdoor activities. We obtained the data for number of schools closed from various resources, and estimated the total loss based on country-level per unit productivity.

Transportation

Low visibility during haze events affects the transportation industry, particularly those related to air and sea transportation. Flights are often cancelled, delayed, or diverted, and in some cases airports are shut down. Marine shipping can also be affected due to difficulties encountered at major ports.

Tourism

The tourism industry is also adversely affected when air pollution increases. We model the economic cost by comparing linearly-implied tourist numbers with actual visits,19 and then assume a certain average expenditure and profit margin per visitor.

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19 The 1997/98 haze episode coincides with the Asian financial crisis within the region. As a result, the reduction in tourist visits originated from Asia is discounted by 50% to distinguish its effect from haze.
Assessing the economic impact of past haze events

Health

The economic impact of haze on residents’ health is difficult to quantify given its broad scope, latent implications, and limited data availability. We seek to achieve an estimate by researching three aspects: lost productivity due to mortality, medical treatment cost for respiratory infections, and individuals’ willingness-to-pay (WTP).

1) We only estimate the effect of lost productivity by assuming an average of 20 years lost production and discounting to present day values.20

2) During days with high PM$_{2.5}$ or PSI readings, acute respiratory infections increased. Medical treatment including out-patient, in-patient and self-treatment, as well as lost working days were taken into account.

3) Besides medical treatment, the literature suggests that people are willing to pay more than the direct medical cost for the prevention of pain, suffering, and discomfort. As for the case of asthma, this ratio falls within a range of 1.2.

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20 Our calculation of lost productivity is not an estimate of the value of life, nor does it take into consideration the long-term mortality implications, as most studies analysed the impact of haze on mortality at a lagged effect across South East Asian countries.
Insuring haze

Addressing and mitigating losses due to haze

ASEAN nations, in particular Indonesia, have a vested interest in combating haze as this issue has international significance due to the transboundary nature of haze and its greenhouse impact, which places Indonesia’s Conference of the Parties (COP) commitments in regard to global warming at risk. Indonesia’s ratification of the 2002 transboundary haze pollution agreement (THPA) is a significant political development in the battle against haze. However, while the THPA outlines guidelines for monitoring, coordination, information-sharing and prevention mechanisms, it does not address other avenues such as risk financing.

Despite policy efforts and commitment to tackle the issue, underlying climate and land use trends coupled with the intrinsic complexity of haze propagation and fire suppressions suggest that haze will continue to be a threat in the near to medium term. Because communities will remain exposed to future (and potentially more severe) bouts of haze, key stakeholders should start to explore various risk management options, including risk financing alternatives. Insurance as a risk financing tool should be considered in the interim. Alternatively, stakeholders can also consider setting up an insurance pool to finance the deployment of carbon sinks in other regions to offset the impact of the forest fires.

Insurance as a prevention mechanism

A recent discussion note by Christopher Lim from the Rajaratnam School of International Studies suggests that haze insurance could be used as a powerful policy tool. He notes that if forest fires are designated as a negative externality in palm oil production costs, then the government could make the purchase of insurance mandatory during the provision of land concessions to large plantation estates.21 As a result, individual firms would be disincentivised to light fires as it would attract premium rate hikes. Despite its potential utility as a policy instrument, this scheme does not come without implementation challenges or moral hazard risk. To illustrate, if policies are mispriced (ie, too cheap), firms may decide that burning remains the more economical option, defying the principles of the scheme. Additionally, due to ill-defined boundaries between individual estates, it will be difficult to identify the source of fires from satellite imagery and assign culpability even if closely monitored.

Insurance as an interim risk financing solution

For sectors that do not possess a vested interest in the lighting of forest fires, but are impacted by its fallout, an insurance-based solution may provide sought after economic relief. Naturally, this will require pricing of the underlying haze risk, which is now made possible thanks to advances in data capture and an improved understanding of the underlying drivers of haze risk. What remains difficult is the quantification of losses arising from haze exposures.

When haze is localised at its source, it has the potential to spread throughout Southeast Asia with potentially severe financial consequences for neighbouring countries. In particular, commercial sectors can suffer loss of revenues and increased cash flow volatility, even in the absence of physical damage to assets. Events, natural or not, that cause non damage business interruption (NDBI) can result in significant economic damages to businesses. However, these events have traditionally been difficult to insure, mitigate, or hedge through other products, posing a clear protection gap issue. Because it is difficult to quantify losses from haze outbreaks to the corporate sector, an indemnity-based product may not be feasible. Instead, a parametric solution may be more appropriate – where the vendor and purchaser agree ahead of time on ‘trigger’ terms and conditions as well as payout amounts.

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## Insuring haze

<table>
<thead>
<tr>
<th>Parametric insurance solution payouts are based on pre-defined metrics and not on actual losses.</th>
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<tbody>
<tr>
<td><strong>Parametric insurance against haze risk</strong></td>
</tr>
<tr>
<td>Parametric or index-based solutions are structures that pay out pre-arranged sums when pre-defined conditions are met. Payouts are based on exceeding the threshold values of one or several pre-defined metrics (i.e., the “trigger”) and not on the actual losses that a policyholder has experienced. Parametric solutions can take the form of an insurance or a financial derivatives contract. This makes parametric solutions particularly suitable for haze risk since an independent haze index supported by the government can be used, as is the case in Singapore.</td>
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<tr>
<td>The biggest advantages of parametric triggers are their clarity and neutrality, providing a quick, pre-agreed payout without a claim investigation, or issues with sub-limits, or investigations into extent of loss. Parametric insurance removes ambiguity from the process and gives the customer certainty of liquidity. An expedited cash payment following a damaging event that results in business interruption makes these solutions particularly attractive in managing earnings volatility.</td>
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<tr>
<td>While there will be a degree of basis risk associated with parametric products – e.g., the payout based on the index measurement does not match the actual losses – this risk is arguably outweighed by advantages such as contract certainty and speed of payout. In particular, smaller businesses, without deep reserves to weather a downturn in revenue associated with a prolonged haze event, would benefit tremendously from an emergency injection of liquidity.</td>
</tr>
<tr>
<td>Parametric insurance is highly adaptable. At a sovereign level (i.e., ASEAN), a scheme could be established with a risk pool dedicated to provide fire-fighting, relocation, or health care resources targeted at rural communities most impacted by the fires and haze. These schemes have been highly effective in coping with large-scale restoration post-disaster and channelling funds to the most vulnerable parties. This was demonstrated most recently through the World Bank-sponsored Caribbean Catastrophe Risk Insurance Facility (CCRIF) in the aftermath of Hurricane Maria.</td>
</tr>
<tr>
<td>Another potential insurance solution could involve financing a carbon offset plan.</td>
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<tr>
<td>Given the sheer scale of carbon emissions associated with a peat-fire event, another potential insurance solution could involve financing a carbon offset plan should forest fires burn out of control in the future. The global community has a vested interest in ensuring the management of carbon emissions. As such, a carefully considered co-insurance scheme sourcing contributions from the international community could be devised to address this risk and prevent global warming from accelerating to dangerous levels.</td>
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</tbody>
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Aside from the public domain, the parametric structure could also be leveraged to provide cover for individual firms in private sectors spanning tourism, trade, construction and transport industries in Indonesia and neighbouring countries. The flexible nature of parametric solutions means that individual sectors or even firms will be able to optimise their insurance coverage as they learn from past loss experience and look to invest in business continuity planning. Importantly, such products would not simply redress economic losses, but also yield intangible social benefits, such as allowing construction workers to go home during bad haze days, or subsidise haze-related expenses such as the purchase of air purifiers and filtration masks.

In conclusion, when applied intelligently, an insurance solution should not be viewed as a ‘pay-to-pollute’ scheme laden with moral hazard, but instead form an integral part of effective haze management.