



## Toward clearer skies: Challenges in regulating transboundary haze in Southeast Asia



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### ABSTRACT

Addressing transboundary environmental problems, such as pollution, and climate change, hinge on strategies that often require both mandatory and voluntary participation of affected nations. Using an unprecedented approach, the Singapore government recently passed a Transboundary Haze Pollution Act (THPA) that financially penalizes companies for smoke-haze affecting the city-state but originating from activities outside her political boundaries. This Act may set a precedent for future actions against proximate actors of environmental degradation but is fraught with substantial challenges in implementation. In attempting to hold agri-business companies accountable, the THPA must present indisputable evidence of fire burning activities and positively identify the initiator of these fires. We further argue that small amendments to the THPA, and other similar laws, may result in environmental co-benefits related to carbon emissions, ecosystem services and biodiversity preservation.

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### 1. Transboundary environmental pollution

Environmental pollution transcends political and economic boundaries, especially in light of globalization (Ye and Wei, 2012). Pollution may originate in one country but cause problems in another, reflecting the high connectivity of atmospheric, aquatic and terrestrial environments (Jayakumar et al., 2015). Transboundary environmental pollution originates from various economically driven anthropogenic activities (Naito, 2010). These include industrial discharge or damming of rivers that traverse multiple countries at a location upstream, and consequently affecting downstream countries (Dudgeon, 2000; McCaffrey, 2015), leakage of radioactive material from a nuclear plant in one country may raise serious environmental concerns for an entire region (Van Noorden, 2007), and smoke generated from land

burning activities in one country may affect the regional air quality (Tay, 1998). Transboundary environmental pollution has had significant negative impacts to the biodiversity (Campagna et al., 2011; Dudgeon, 2000), economy (Quah, 2002; Selin et al., 2009), and health of inhabitants (Chiu and Lok, 2011; Marlier et al., 2015; Varady and Mack, 1995) of affected countries.

International negotiations on transboundary environmental issues are becoming increasingly difficult due to disparate interests of participating nations (Seo 2013). Yet, international and regional systems of environmental management and governance are essential to mitigate transboundary environmental pollution (Adger et al., 2005; Kimball, 1999). Environmental governance of transboundary environmental pollution is complex due to the different spatial, socio-political, and temporal scales in which these occur (Dietz et al., 2003; Lemos and Agrawal, 2006). As a result of spatial decoupling of the causes and consequences of environmental pollution, transboundary pollution activities such as the release of industrial waste effluents upstream of an international river or pollution of the regional atmosphere from the use of fire to clear land for agriculture, results in an unequal distribution of costs and benefits for different countries. While

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Principle 21 of the Stockholm Declaration stresses that countries have “the sovereign right to exploit their own resources pursuant to their own environmental policies”, it also states that countries have the “responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction” (United Nations, 1972). Cross-scale governance mechanisms such as regional (e.g., the Convention on the Protection of the Rhine) (European Union, 1999) and international (e.g., the Montreal Protocol on ozone emissions) (United Nations, 1987) treaties have been set up to outline mandatory and/or voluntary measures to ensure polluting countries are accountable in the arena of regional and global environmental health. International environmental law, especially in the past five decades, has evolved to address transboundary environmental pollution by seeking to establish legal principles that make states responsible for activities within their jurisdiction, especially ensuring such activities do not cause harm to the environment of other states (Redgewell, 2015). In this paper, we discuss one such example of environmental law that addresses the issue of transboundary air pollution (or haze) in Southeast Asia.

## 2. The Southeast Asian haze problem

Clearing of tropical forests for large-scale commercial agriculture and medium- to small-scale farming has resulted in significant carbon emissions that contribute to global climate change (Gibbs et al., 2010; van der Werf et al., 2009; Vermeulen et al., 2012). Burning, practiced in many parts of the tropics, is the cheapest and most convenient method of land clearance preferred by smallholder agriculturists and agro-industrial companies alike (Anderson and Bowen, 2000; Ketterings et al., 1999; Siegert et al., 2001). Unregulated land burning for agriculture results in reduced air quality due to emission of hazardous gases and aerosols, forest degradation and habitat loss that negatively impact the provision of ecosystem goods and services (Cochrane, 2003; Heil and Goldammer, 2001; Langmann et al., 2009; Reddington et al., 2014).

Annual burning events in Indonesia release massive amounts of carbon, averaging 0.049 gigatonnes of carbon per year ( $\text{Gt C yr}^{-1}$ ) in Sumatra and 0.074  $\text{Gt C yr}^{-1}$  in Borneo (van der Werf et al., 2008) which are exacerbated not only during El Niño-Southern Oscillation (ENSO) events, but also interactions between ENSO and other weather systems such as the Indian Ocean Dipole and the Madden-Julian Oscillation (van der Werf et al., 2008). Prevailing northerly winds during the burning season (June–October) transport gaseous emissions and particulate matter, termed ‘haze’, throughout Indonesia, Brunei, Malaysia, Singapore and Thailand and inflict high social and economic costs (Othman et al., 2014). The transboundary haze episodes in these Southeast Asian nations fully emerged on the regional agenda and gained global attention in 1997/1998, when massive forest and peat fires in Indonesia released an estimated 0.95 Gt of carbon into the atmosphere (equivalent to ~15% of mean annual global carbon emissions from fossil fuels) (Page et al., 2002; Turetsky et al., 2015; van der Werf et al., 2010) producing smoke pollution that blanketed the region and severely impacted public health and tourism (Page et al., 2002; Quah, 2002; Tacconi, 2003). Affected countries estimated losses at USD 383 million as a direct result of this episode alone (Glover and Jessup, 1999). In June 2013, the region was again enveloped by a severe haze event for three weeks. Unprecedented levels of smoke and atmospheric particles during this episode caused air quality to reach hazardous levels in Malaysia with Air Pollution Index values of 750 (values above 300 are deemed hazardous) and Singapore with Pollution Standard Index values of 400 (values above 300 are deemed hazardous). At the peak of this episode, many flights were canceled, affected areas in Malaysia were declared states of

emergency, and hundreds of schools in Malaysia and Indonesia were closed (Ramasmay et al., 2013). Remote sensing analysis indicated that 52% of the total burned area (84,717 ha) in Riau fell within concession boundaries of major oil palm and pulpwood companies (Gaveau et al., 2014). Many of these companies are not headquartered in Indonesia but instead have administrative, financial and operational centers in nearby countries such as Singapore and Malaysia.

Attempts have been made to deal with the haze problem at the regional level. The 10 members of the Association of South East Asian Nations (ASEAN) signed the Agreement on Transboundary Haze Pollution in 2002. However, Indonesia’s delay in ratifying the agreement until September 2014, making it the last signatory, signaled its unwillingness to depart from the ‘business as usual’ scenario (Putri, 2014). Moreover, despite improved monitoring technologies (e.g., the Association of Southeast Asian Nations Sub-Regional Haze Monitoring System) and assurances on cessation of burning activities from the Indonesian government, efforts to curb the haze remained limited (Nurhidayah et al., 2014). Previous exhortations from neighboring countries to stop forest fires have been met with rebukes from Indonesia to respect its national sovereignty (Soeriaatmadja, 2014), demonstrating the complex nature of the problem involving politics, economic interests, and the environment. For example, while ‘zero burning’ legislation does exist in Indonesia, explicit allowances are made for local communities to use fire to clear land (Tan, 2015b). Additionally, there exist nationwide prohibitions against starting fires in or developing peat areas that are more than 3 m in depth. An entity found guilty of setting an illegal forest fire could be imprisoned for 5–15 years and fined up to 5 billion Rupiah (about US\$420,000). These are not inconsequential penalties. However, complexities of political governance in Indonesia result in ineffective enforcement of, and compliance with, these laws. Ultimately the success of the ASEAN’s Agreement on Transboundary Haze Pollution depends on Indonesia’s enforcement will and capacity. Until recently, apart from applying diplomatic pressure and providing financial and technical aid to extinguish fires, neighboring countries have been limited in the ways they are able to address the source of the problem (Lohman et al., 2007; Yong and Peh, 2014).

## 3. Thinking out of the tinder box

The Singapore Parliament passed the Transboundary Haze Pollution Act (THPA) in August 2014, which allows for imposing of fines on companies that cause or contribute to transboundary haze pollution in Singapore (Box 1 describes the THPA) (Chua, 2014). The THPA’s centerpiece is a regime of multiple legal presumptions (Singaporean Ministry for the Environment and Water Resources, 2014). First, it provides that if there are maps which show that any land is owned or occupied by a company, it shall be presumed that that company owns or occupies that land. The maps can be procured from a variety of sources: any foreign government, any department or instrumentality of the government of a foreign state, and, any person, company, or entity operating the concession in question, who can be legally compelled to furnish its own maps. Second, if there is serious haze pollution in Singapore and satellite and other meteorological evidence shows that at or about that time, there is a land or forest fire on any land causing smoke that is moving in the direction of Singapore, it shall be presumed that there is haze pollution in Singapore involving smoke resulting from that land or forest fire. This is so even if there may be other fires in adjacent areas at the same time. Third, it shall be presumed that the company that owns or occupies the land in question has engaged in conduct, or engaged in conduct that condones any conduct by another, which caused or contributed to that haze pollution in Singapore.

**Box 1.** Key features of the Singapore Transboundary Haze Pollution Act (2014).

*Liability:* There are criminal and civil liabilities for an entity that engages in conduct or condones another's conduct, which causes or contributes to haze pollution in Singapore. In addition, there is liability for an entity which participates in the management of a second entity (e.g., a subsidiary or a linked concern) if the latter engages in conduct or condones another's conduct which causes or contributes to haze pollution in Singapore.

*Burden of proof and rebuttable presumptions:* A series of rebuttable presumptions aim to overcome the burden of proof for the prosecution. First, companies will be presumed to own or occupy lands if there are maps showing that they own or occupy the lands in question. Second, if there is haze pollution in Singapore and there is, at or about the same time, a land or forest fire on any land situated outside Singapore, it will be presumed that the haze involves smoke from that land or forest fire if satellite, wind and other meteorological information show that the smoke is moving in the direction of Singapore. This is so even if there may be other fires on other lands at or about the same time. Third, where the first and second presumptions are satisfied, it will be further presumed that the owner or occupier of the land in question has engaged in conduct, or engaged in conduct that condones any conduct by another, which caused or contributed to that haze pollution in Singapore. The burden is on the entity to disprove any of these presumptions.

*Extraterritoriality:* The Act claims to apply to any entity anywhere in the world whose conduct affects Singapore's air quality. It is based on extraterritorial environmental legislation found in other countries such as the United States. In practice, though, it is likely to be used against entities with a link to Singapore, e.g. a Singapore subsidiary of an Indonesian plantation company (the subsidiary being incorporated and having a presence in Singapore, but owning or operating the land in question)

*Fines:* Up to SGD 100,000 (USD 79,900) for each day there is haze pollution in Singapore, capped at SGD 2 million. An additional fine of up to SGD 50,000 per day if the Singapore Director-General of Environmental Protection supplies a written request for fire-prevention activities (e.g., deploying fire-fighting personnel, discontinue burning, or submission of an action plan) and this request is not acted upon. Entities can be liable for civil penalties, with no stated maximum penalty, if a plaintiff sustains personal injury or death attributable to the conduct of the entity that contributes to haze pollution.

The Act was passed on 5 August 2014 and is available on this website: <http://www.parliament.gov.sg/sites/default/files/Transboundary%20Haze%20Pollution%20Bill%2018-2014.pdf>

The entity or company concerned can deny each of these presumptions but in each case, it will bear the burden of proving the contrary. Further, the THPA extends liability to any entity that participates in the management or operational affairs of another (second) entity, exercises decision-making control over the latter's business decision pertaining to land that it (the second entity) owns or occupies outside Singapore, or exercises control over the second entity at a level comparable to that exercised by a manager of that entity. This is designed to target parent or holding companies that have subsidiaries or related entities that are owners or occupiers of land and that engage in an offending conduct on the ground.

#### 4. Challenges of the approach

Singapore therefore utilizes its judicial system to hold the business sector, in this particular instance, pulpwood and oil palm

companies (Sizer et al., 2013), accountable for transboundary pollution originating outside of, but affecting, Singapore. In targeting fires within company concession boundaries, the Singapore government is selective in flexing its pressure points by basing legal action on well-defined and measureable indicators (e.g., air quality in Singapore, wind direction in the region, fires on the ground) that can be remotely monitored by Singaporean government agencies. The greatest advantage of the THPA, thus, may be that the Singapore government engages directly with local and foreign entities that contribute to transboundary haze pollution, and applies liability when there is sufficient evidence to deduce causality. However, substantial challenges exist toward successful implementation of the THPA: (i) obtaining indisputable evidence of fire burning activities, (ii) resistance from entrenched economic interests in plantation development and (iii) political hurdles in implementing transboundary laws.

##### 4.1. Indisputable evidence on fire burning activities

Successful implementation of the THPA is reliant on accurate spatial information on the location of fire and the perpetrator responsible for starting the fire. While current technology allows for the location of fire events to be identified within concession maps (Gaveau et al., 2014; van der Werf et al., 2010), it is still inadequate in addressing actors responsible for starting the fire (World Resources Institute, 2014). The level of accuracy of these concession maps is contentious due to a lack of coordination among district, provincial and central government authorities (Wollenberg et al., 2008). Approximately 5.8 Mha or 10.2% of industrial concessions from oil palm, logging, pulpwood, and coal mining industries in Indonesia overlap, making it difficult to attribute fire events to respective industries or specific companies (Abood et al., 2014). The situation is compounded by failure of Indonesia to develop a single, consistent map of land concessions throughout the country (Ewing and McRae, 2012). Different ministries (e.g., the Ministry of Forests, Ministry of Environment, Ministry of Agriculture, and Ministry of National Development Planning) have historically developed different maps, highlighting a lack of inter-ministerial coordination. The fact that these maps are still presently used in such a manner may point to competing interests and competition for resources and influence between different government agencies. Mapping has become more complex over the past two decades as political decentralization has driven greater concession-granting power to local levels of government (Barr et al., 2006). Consequently, there would be uncertainty if Singapore enters into evidence, maps that are contested during prosecution. Uncertainty can be avoided by compelling these companies to furnish maps that they themselves use. Prosecutors may presume that any area stated to be within a company's map boundaries to be owned or occupied by that company. This scenario in turn, could compel such companies to further obfuscate their own maps by qualifying vast areas as being 'contested', especially if these companies are operating alongside local communities who dispute the boundaries and encroach on the companies' land.

In such situations, companies could still be held responsible under the THPA unless they prove that instigators of offending conduct acted without their knowledge or consent, or contrary to their wishes or instructions. The THPA further stipulates that this defense is unavailable if: (a) the instigator is an employee or agent of the companies, or is engaged, directly or indirectly, by the companies to carry out any work on land that they own or occupy, or (b) the instigator has customary rights to the land and who has an agreement or arrangement with the companies relating to farming or forestry operations with respect to the land.

Furthermore, despite fires occurring within the boundaries of a company's concession, the causes may be external. Spatial analysis of burnt areas in Riau during the June 2013 haze event showed 60% of burnt areas within company concessions (50,248 ha or 31% of total burned area) were being illegally occupied by local communities (Gaveau et al., 2014). Community encroachment into these areas may be the result of unresolved land disputes or social conflicts (Ekadinata et al., 2013; Suyanto et al., 2004). By law, lands within concessions are leased to companies for agro-industrial development, but in reality, these areas may fall under customary land ownership for local communities or contested for livelihood activities. As a result of unclear land tenure and overlapping land rights, ownership within concession boundaries is questionable and attribution of fire events on these lands becomes challenging.

In order to prosecute, the THPA must identify landowners and prove beyond doubt the perpetrator of the fire. Ownership and occupation are not straightforward legal concepts in Indonesia. Rights to the land may include the right to farm or operate plantations, to extract minerals found under the surface, or to harvest produce. Such rights may co-exist alongside the local communities' customary rights to the land. To take into account such realities, the THPA extends the definition of "owner" to include not just a person who holds a valid lease, license, permit, concession or other similar authorization, but also one who has an agreement or arrangement with another person who has a customary right under local law with regards to the land, and the agreement or arrangement relates to any farming or forestry operations to be carried out by any person in respect of that land. Consequently, a company that operates on customary lands in such fashion will still fall within the THPA's ambit, even if the actual farming or forestry operations are carried out by other parties. This will cover the common situation where a concession holder typically buys the harvest from adjoining customary lands that have been set aside for local communities to conduct farming.

Due to the depth of peat deposits in Indonesia, fires that occur on peatlands can burn below the surface and may originate elsewhere from where the fire emerges above ground (Ballhorn et al., 2009; Sargeant, 2001). Accurately attributing cause of fires to actors in this landscape requires significant forensic efforts, and will prove highly challenging for successful implementation of Singapore's THPA. Present remote sensing capabilities are limited on this front, and data misinterpretations may mislead adjudication efforts.

The difficult question of sovereignty persists, since such monitoring and enforcement efforts on Indonesian territory cannot be carried out by foreign countries, but by Indonesia alone. Ultimately, Indonesian enforcement and prosecution action on the ground will matter most in resolving the problem at its core, together with cooperative mechanisms among regional states (including provision of financial and technical assistance). The true value of Singapore's unilateral action via the THPA lies more in exerting pressure on Indonesia to take greater action of its own. It will answer the Indonesian argument that victim states should look at their own companies first, which is exactly what Singapore is proposing to do with its THPA. In this manner, the THPA complements and reinforces the ASEAN Agreement on Transboundary Haze Pollution, which lays down obligations on individual states to tackle the fires and to cooperate with other states.

#### 4.2. Entrenched economic interests in plantation development

Indonesia's complex land-use regulations and overlapping central, provincial and district level governance may complicate and delay prosecution of foreign entities based there (Indonesian

Center for Environmental Law, 2008). The prevalence of local benefit capture by local authorities and elites from agribusiness development may result in reluctance of local authorities to help prosecute individuals and companies contributing toward transboundary haze pollution (Varkkey, 2012). Moreover, perverse incentives are institutionalized in local legislation favoring the conversion of forests for plantation development (Butler, 2014; Irawan et al., 2013). Often, district authorities rule in favor of plantation companies and plantation developers despite fire events or other forms of environmental transgressions within their concessions due to patronage politics between them (Bell, 2014; McCarthy et al., 2012; Varkkey, 2012). In fact, patronage networks among some Malaysian and Singaporean oil palm firms with Indonesian provincial and district officials have been singled out as one of the drivers of transboundary haze pollution (Varkkey, 2012). To a certain extent, the Singapore THPA is an appropriate measure since it recognizes foreign investors as a driver of transboundary haze and penalizes these entities for any fire events occurring within their concession boundaries. In light of entrenched economic interests by local authorities for plantation development, the THPA may face resistance from local authorities to be transparent about plantation company operations within their provinces, especially companies that have no direct financial links with Singapore. This is made still more complicated by emergence of medium-sized operators and small-scale landholders that have contracts with large international firms but whose activities are more difficult to assess and penalize (Ewing, 2013).

#### 4.3. Political hurdles in implementing transboundary laws

Tan (1999) made the case of holding the Indonesian government accountable for failing to control the fires that precipitated the transboundary haze in 1997–98. The geo-political constraints of bringing an action against Indonesia under international law, however, are immense. It is highly unlikely that Indonesia will submit to the jurisdiction of the International Court of Justice or any other dispute resolution mechanism. It is equally unlikely that states in the region will risk political and economic ties with the regional economic giant that is Indonesia, to pursue an action before an international tribunal (Tan, 1999, 2015b). Resultantly, such a case did not materialize, but in 2002 the ASEAN Haze Agreement was crafted to present a framework for cooperative mechanisms among ASEAN nations to effectively deal with transboundary haze incidences (Tan, 2015a). Over the next decade, the Agreement was found to exert little authority in reducing the occurrences of regional haze events (Tan, 2005). Significant pathologies within the Agreement worked toward compromising its effectiveness, including weak obligations relating to requesting and receiving assistance, monitoring, reporting, exchanging information and conducting research to the complete absence of enforcement and liability provisions and compulsory dispute resolution mechanisms (Tan, 2005, 2015b). Thus, the distaste with which ASEAN Member States perceive to be 'confrontational' methods of dispute resolution, and their prevailing instinct to uphold the principle of non-interference or non-intervention in the internal affairs of Member States led to ineffective sanctions and non-enforceability (Tan, 2005).

The enactment of the THPA by Singapore demonstrates a unilateral measure from the Singaporean government in an attempt to hold industrial stakeholders accountable for land burning activities in Indonesia (Tan, 2015b). Implementing the THPA and penalizing the plantation industries responsible may be politically sensitive since the same industries contribute to the economic development and revenue of both Singapore and Indonesia (Varkkey, 2012). Proper implementation of the THPA



would require accurate spatial concession maps, which have been in the past, withheld by the Indonesian government. In meetings described as 'tense', the Indonesian government resisted and raised legal obstacles to the sharing of map information. The Indonesian Environment Minister argued that the freedom of information law of Indonesia prohibited the public disclosure of such information. It was further claimed that data that could reveal the country's natural resources wealth, such as forested areas, could not be made public under Indonesian law (Tan, 2015a).

In addition to the above political challenges, the extra-territorial clause of the THPA may present another hurdle for Singapore in the successful implementation of this law. Extra-territorial legislation against individuals or companies engaged in transboundary pollution is rare (Tan, 2015b). Where they exist, the reach of the legislation is not particularly contentious, since they typically target companies of the legislating state. To the extent that the THPA targets companies incorporated in Singapore with operations in Indonesia, there would be little controversy since these are Singapore entities or citizens. What is unusual is that the THPA also claims jurisdiction over non-Singapore entities operating outside Singapore, i.e., companies or individuals with little or no link to Singapore such as Indonesian or Malaysian companies operating in Indonesia. This extra-territorial clause of the THPA appears to derive some inspiration from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a piece of legislation in place in the United States of America; a federal law that authorizes federal natural resource agencies, states, and private individuals, to recover natural resource damages caused by releases of hazardous substances. In 2006, CERCLA was used in the case of *Pakootas v. Teck Cominco Metals Ltd* (Tan, 2015b) in which a Canadian lead–zinc smelter discharged hazardous untreated effluents into the Canadian portion of the Columbia River, which subsequently carried the effluents southward into the U.S. state of Washington. While the extra-territorial clause of CERCLA was discussed during the deliberations of the *Pakootas* case, it was found that the release of hazardous substances occurred within the U.S. and therefore involved a domestic, as opposed to extra-territorial, application of CERCLA. In this instance, the court was concerned that the application of the extra-territorial clause would be problematic as it interfered with the principle of comity of nations. The concern also relates to problems that might arise if other countries sought reciprocal extra-territorial jurisdiction over polluting activities of American companies. In a similar way, the extra-territorial clause of the THPA will raise problems of comity between Singapore and Indonesia, a political decision Singapore has to accept with the implementation of this law.

## 5. Potential resolutions

The challenges faced by the THPA reveal the context of land use development history and entrenched economic and political interests under which the Southeast Asian haze phenomenon is embedded in. Resolution of this phenomenon goes beyond implementing the THPA and encompasses advancements in fire detection technology, Indonesia's political will and action, as well as aligning sustainable policies for long-term plantation development; we discuss them further below.

(1) Resolution of dynamics responsible for recurrent and worsening peatland fires cannot rely on concession maps and fire hotspot data alone. There is a need to refine the spatial data on two fronts: by improving land use maps to distinguish areas occupied by the company and small farmers within concession boundaries; and to ascertain the origin of fire events through

monitoring of daily hotspot data and charting of fire progression maps (Fletcher et al., 2014). The THPA will benefit greatly if investments were made to embark on robust models that consider haze trajectory dispersal and plume movements. Mapping technologies can be concentrated in districts and provinces (e.g., Riau, Jambi, South Sumatra) already identified as high risk fire occurrence areas (Reddington et al., 2014). Such efforts would help to provide reliable information needed for the THPA to become an effective prosecuting tool. However, greater on-the-ground presence, as well as coordination between governments and different stakeholders, is needed to accomplish this.

- (2) Recent prosecutions in Indonesia of corrupted officials who received bribes from plantation companies indicate Indonesia's toughened stance toward those who breach environmental laws (Siswo, 2014). The merger of the Ministry of Forestry and the Ministry of Environment and the subsequent appointment of a new minister further indicates political reorganization which could alter old patronage networks between agribusiness firms and government officials (Murdiyarso, 2014). Indonesia's president plans to step up efforts to protect Indonesia's peatlands through the implementation of stronger regulations and a thorough review of licenses previously granted to companies that subsequently converted peatlands into monoculture plantations (Manibo, 2014). Efforts by Indonesia to curb corruption consequently create less convoluted land concession strategies and enforce protection of peatlands. Most importantly, these are the very factors in which Singapore has limited ability to impact, yet are vital to the success of the THPA. These efforts may signal a strategic shift in regional plantation investment and development. If implemented successfully, it may signify a new method in tackling other regional environmental problems such as the expansion of rubber plantations in Indo-China (Warren-Thomas et al., 2015).
- (3) On a more pro-active front, both Indonesian and Singaporean governments could consider greater regulation of new oil palm and pulpwood investments. Given the risk of fire and haze events are highly correlated with the development of peatlands for oil palm and pulpwood plantations (Sizer et al., 2013), and that peat fires are expected to occur even in non-drought conditions due to degradation of peatlands (Gaveau et al., 2014), there is a real sense of urgency to protect peatlands as a pre-emptive measure to stop the haze. Proposals to develop peatlands should be scrutinized through mandatory social and environmental impact assessments prior to land acquisition and development. In Indonesia, an impact assessment process or AMDAL is mandatory at the planning stage of each plantation development project (McCarthy and Zen, 2010). These assessments must identify social and environmental risks such as potential land tenure conflicts with local communities as well as the further degradation of peatlands; these factors can be included in the overall cost–benefit analysis of investing in plantation development. Such state imposed regulations on oil palm and pulpwood plantation investments could be incorporated into the guidelines of sustainability reports, the latter having just been made mandatory for all companies listed on the Singapore Stock Exchange (Cheam, 2014). In reality, many of these social and environmental considerations overlap with sustainability guidelines under multi-stakeholder organizations such as the Roundtable of Sustainable Palm Oil and the Forest Stewardship Council, as well as zero-deforestation commitments voluntarily made by some multinational companies (Climate and Land Use Alliance, 2014; United Nations, 2014). The above state regulations from Singapore can be useful in reining in companies which do not participate in such sustainability

initiatives. However, for middle-level investors and smallholders developing plantations over peatlands (Ekadinata et al., 2013; Gaveau et al., 2014), bottom-up initiatives and market incentives are needed (Godar et al., 2014). Some possibilities include providing agricultural incentives (e.g., inputs, higher prices) to smallholders who practice zero-burning land clearance techniques, and cultivating grassroots involvement to develop commitment toward sustainable development and forest protection at village and district levels (Yong and Peh, 2014).

## 6. Environmental considerations for the THPA

The main premise of the THPA is to decrease pollution levels from transboundary haze since these episodes lead to lost income opportunities and impacts to human health in Singapore. As it stands, the THPA does not focus on environmental impacts as such. Impacts to the environment from burning and haze events are staggering in scale (Tacconi, 2003). Burning results in losses and fragmentation of terrestrial habitats, with severe repercussions to terrestrial wildlife in affected areas (Cheyne, 2008; Kobayashi et al., 2004). Smoke pollutants alter atmospheric biomes, change weather patterns, and cause unintended cascading impacts on freshwater and marine systems (Hammen, 2007; Jaafar and Loh, 2014; Radojevic and Tan, 2000). Despite fundamental shifts in ecosystem functions as both direct and indirect consequences of burning (Posa et al., 2011; Yule, 2010), environmental issues have taken a backseat to those on regional economies and human health.

The THPA and future approaches (e.g., memorandum of understanding between Malaysia and Indonesia (Carvalho, 2014)) can benefit from more effectively incorporating ecosystem services principles into their haze response strategies. As presently constructed, there are a number of shortcomings on this front that warrant attention. Here we highlight how some of the penalties that can be formulated to improve the environmental applicability of the THPA, and for supporting future initiatives to tackle similar transboundary environmental problems caused by the private sector in other settings (Table 1).

(1) Penalty proportional to extent of environmental damage – In the THPA, transgressors found guilty will be fined up to SGD 100,000 per day (capped at SGD 2 million, Box 1). The daily penalty rate was revised; during the planning stages, the proposed sum was originally set at a one-time fixed penalty of SGD 300,000–450,000. When a higher penalty quantum was suggested, Singapore's Minister for Environment and Water Resources Vivien Balakrishnan cautioned against overstepping during the initial efforts of the THPA, as these businesses will suffer both monetary losses and reputational damages to the image of the companies involved (Letchumanan, 2015). The final agreed sum of SGD 100,000 per day (capped at SGD 2 million) is thought to be a sufficient deterrent against transboundary transgressions. However,

we posit that the fixed penalty sum does not take into consideration the extent of damage of the fires, just the event of fire use, and may therefore not adequately deter burning of large expanses of land. A higher minimum base penalty and increasing the amount proportional to burnt area will likely send a stronger signal on containing the extent of environmental damage caused by the fires. As measuring the extent of burnt area in the tropics is subjected to moderate levels of uncertainty (Giglio et al., 2010), a first step approach could be to increase fines based on the lower estimate of burnt area measured.

- (2) Penalty based on sensitivity and value of the damaged ecosystem – In the THPA, penalties assume homogeneous habitat and ecosystem service values. We recommend future initiatives to adjust penalties with these factors considered. For example, the haze episode of June 2013 revealed that burning of degraded peatlands, a carbon-rich ecosystem, accounted for more than 80% of the fires (Gaveau et al., 2014). Burning of peatlands also releases a higher level of particulate matter into the atmosphere (Kim et al., 2014). In addition to the base penalty, added penalties can consider the level of particulate matter recorded in Singapore. These emissions can be calculated based on established global systems (e.g., Monitoring Atmospheric Composition & Climate; <https://www.gmes-atmosphere.eu/>) which calculate daily biomass burning emissions and transport of air pollution. Similarly, penalties should be meted out in a decreasing order based on how sensitive these ecosystems are to fire: peat swamp forests, primary forests, selectively logged forests, secondary forests, and shrub or grasslands.
- (3) Penalties received are channeled to problem resolution – We recommend future initiatives to appropriate a fixed proportion of penalties received toward ecosystem restoration, fire monitoring, or funding initiatives for fire brigades. This system is fiscally appropriate since it reacts to problems as they arise (generating funds to alleviate) or become ameliorated (with no further funding needed). As most of the fire hotspots occur in remote areas, considerable effort and resources are required to mobilize prevention and preparedness measures in Indonesia. Hence, pre-emptive measures such as seasonal forecasting of fires should be part of the overall strategy to manage fires in Indonesia. For example severe fire events have been recently demonstrated to be predictable months in advance using state-of-the-art seasonal rainfall forecasts for Indonesia (Spessa et al., 2014). Seasonal forecasting of fire risk could be further improved by using standard fire danger rating systems, such as the Canadian Fire Weather Index (FWI) (Field et al., 2014) which have been modified to estimate fire and haze occurrences for Western Indonesia (de Groot et al., 2005; Field et al., 2004). Such techniques can be incorporated into the IndoFire platform which is a real-time online tool established by the Australian government for monitoring hotspots in Indonesia (IndoFire, 2015).

**Table 1**  
Recommendations for regulation of transboundary environmental problems.

Characteristic of the THPA	Shortcoming	Recommendation	Other related systems
Single and fixed penalty	Penalty not associated to extent of damage	Penalty proportional to area damaged	Acid rain, watershed management, fisheries quota, land development
Homogeneous ecosystem value	Penalty not associated to ecosystem value	Penalty proportional to habitat complexity and ecosystem services rendered	Coastal management, watershed management, land development
No regulation for new businesses	Risk of businesses not assessed	Impose mandatory environmental impact assessments	Coastal management, watershed management, land development
Penalties not channeled to resolve source of problem	Undermine acceptability of the law	Penalties used for restoration and monitoring efforts	Acid rain, watershed management, fisheries quota, land development, coastal management

## 7. Conclusion

Transboundary environmental problems are difficult to resolve due to disputes over territorial sovereignty and placing the onus of environmental protection on economically beneficial industries in the offending country. Self-interests and fear of challenging other nations' right to economic development often result in little action toward addressing an international environmental problem. By recognizing its own agribusiness sector, in particular the oil palm and pulpwood industries, as part of the problem and taking legal action against polluting companies in Indonesia, Singapore's THPA is making a regional environmental problem tractable by subjecting these companies to its judicial system. Although the Singapore THPA is clearly written to protect its citizens from haze originating in Indonesia (for example, legal action could only be taken when haze from Indonesia's land reaches Singapore), Indonesia would reap substantial environmental and health co-benefits as corporations would be more vigilant in preventing fires. The clause for civil liabilities under the THPA further provides a potential opportunity for other affected parties to hold polluting companies responsible for any personal injury, physical damage or economic loss incurred. The THPA therefore, could hold businesses accountable for extraterritorial environmental degradation that imposes significant costs to society. The THPA as it stands, however, is fraught with limitations. In reality, on the ground resistance from economic beneficiaries and supporters of plantation development will pose a challenge to the implementation of the THPA. Additionally, prosecution of perpetrators responsible for fires hinges on accurately identifying these entities, a challenge introduced by land conflicts in Indonesia and unreliability of land-use maps. We recommend that localized land-use maps are improved and more research conducted in monitoring and analyzing fire hotspot trends. Recent overhaul in jurisdiction and management of forest resources and forestry within the Indonesian government lends further hope of reducing burning and transboundary haze (Yong and Peh, 2014).

In addition, by incorporating environmental clauses such as ensuring that the penalty is proportional to the area burnt, and pegging the penalty amount to value of the ecosystem damaged, the THPA designed primarily to reduce haze pollution can coincidentally recognize ecosystem services. We recommend that a portion of penalties obtained be channeled into ameliorating and preempting the problem, such as investing in fire brigades and fire monitoring systems.

Regional momentum observed in attempting to combat transboundary haze is evident from the passing of the THPA in Singapore, and the climate in Southeast Asia is ripe for discussions on transboundary haze considering positive recent events in Indonesia (e.g., ratifying the agreement, cabinet shake-up) (Yong and Peh, 2014). Resultantly, for the first time in two decades, there exists a possibility of addressing drivers of fire events in Indonesia in a practical manner. Singapore has taken on a bold legal stance toward the transboundary haze with the passing of the THPA.

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