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Regional Environmental Governance and the Transboundary Haze Problem in Southeast Asia

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Abstract **- Transboundary haze resulting from forest and peatland fires in Indonesia imposes substantial environmental, public health, and economic costs on Malaysia. Despite Indonesia's formal ban on peatland conversion, weak financing, monitoring, and enforcement have limited effective compliance. This paper analyses the haze problem using a game theory framework, modelling Malaysia and Indonesia's interactions as a 'Prisoner's Dilemma' in which each state has incentives to underinvest in mitigation while free-riding on the efforts of others. Such strategic incentives produce a collectively suboptimal equilibrium, explaining the persistence of haze despite shared regional costs. The paper argues that the ASEAN Agreement on Transboundary Haze Pollution (ATHP) can mitigate this dilemma by altering payoffs through cooperation, monitoring, and repeated interaction. Strengthening the treaty's accountability and compensation mechanisms, particularly via increased side payments from Malaysia and the international community, can reduce incentives to defect by lowering Indonesia's compliance costs and increasing the benefits of cooperation. These resources can support joint monitoring, firefighting, peatland restoration, and livelihood alternatives for farmers, while empowering subnational enforcement. By institutionalizing cooperation and enabling credible commitments, the ATHP could transform the strategic environment from non-cooperation to sustained collaboration, offering a feasible pathway to reducing transboundary haze while respecting regional norms of sovereignty.**

Index Terms- **ASEAN Agreement on Transboundary Haze Pollution (ATHP), Collective Action Problem, Game Theory, International Environmental Cooperation, Prisoner's Dilemma, Transboundary Haze Pollution (THP)**

I. INTRODUCTION

Malaysia has been experiencing severe haze pollution for the last four decades, with episodes frequently disrupting public health, economic activity, and daily life (Mai, 2023). The haze is largely caused by peatland and forest fires originating in Indonesia, particularly from the islands of Sumatra and Kalimantan, which consistently account for the highest number of fire hotspots in the region. Scientific research indicates that the majority of these fires are human-induced, rather than natural, and result from deliberate land-clearing practices for agricultural expansion, often using the slash-and-burn method (Guinness et al., 2016; van der Werf et al., 2008).

This phenomenon can be understood in terms of *divergences between private and social costs*. For local farmers and plantation operators in Indonesia, slash-and-burn techniques are inexpensive and efficient, providing immediate financial gains. However, the social costs, including transboundary air pollution, respiratory illnesses, environmental degradation, and economic losses in neighboring countries like Malaysia, are borne collectively and are not internalized by the individuals causing the fires. This divergence creates a classic *externality problem*, in which private incentives conflict with societal welfare, perpetuating the cycle of haze.

While Indonesia has officially banned the conversion of peatlands for farming, the country faces persistent challenges in financing, monitoring, evaluation, and enforcement of the ban. Local communities frequently resist compliance, citing traditional customs, economic necessity, and the cost-effectiveness of slash-and-burn agriculture as justifications for continued burning (Guinness et al., 2016). These factors create a structural and institutional gap: even with legal prohibitions in place, enforcement is weak, and compliance is uneven, allowing haze events to recur with alarming regularity.

The persistence of haze highlights the need for multilevel solutions that address both the immediate environmental impacts and the underlying incentives driving destructive land-use practices. Understanding the problem requires a combination of environmental science, economics, and policy analysis, including the application of game theory to model strategic interactions between affected countries, particularly in the context of transboundary environmental governance. This essay examines the haze problem through such a framework and proposes feasible strategies for Malaysia to mitigate the impacts of Indonesian peatland fires.

II. METHODOLOGY

This paper makes use of game theory, specifically the 'Prisoner's Dilemma' framework, to analyze Malaysia and Indonesia's strategic interactions over transboundary haze. It examines how institutional mechanisms, such as the ASEAN Agreement on Transboundary Haze Pollution (ATHP), can shift incentives toward cooperation and reduce the social and economic impacts of haze.

Game theory is useful for analyzing situations where the actions of multiple actors affect each other's outcomes, particularly when incentives to cooperate or defect exist (Bennette, 1995). In the case of transboundary haze, Malaysia and Indonesia face a strategic interaction: Indonesia can either enforce bans on peatland burning (cooperate) or allow slash-and-burn practices to continue (defect), while Malaysia can either provide financial and technical support (cooperate) or withhold assistance (defect).

This situation mirrors a Prisoner's Dilemma (Snidal, 1985). Both countries will benefit most if they cooperate simultaneously: haze is reduced, mitigation costs are shared, and regional welfare improves. However, each country faces a strong incentive to defect unilaterally. Indonesia may avoid enforcement costs, and Malaysia may avoid providing financial support while still benefiting if Indonesia acts. Mutual defection - Indonesia allowing fires to continue and Malaysia withholding support - produces a suboptimal outcome, with persistent haze and high social costs, even though both would be better off if they cooperated.

By framing the problem as a Prisoner's Dilemma, game theory highlights why cooperation does not naturally occur and underscores the importance of institutions and incentives, such as the ASEAN Agreement on Transboundary Haze Pollution (ATHP), to transform the strategic environment and promote sustained cooperation.

III. MALAYSIA, INDONESIA, AND THE PRISONER'S DILEMMA

In a Prisoner's Dilemma, the payoffs are deliberately ordered to reflect the incentives facing rational, self-interested actors. In the context of transboundary haze (TBH) between Malaysia and Indonesia, the Prisoner's Dilemma can be framed using a points system to reflect the outcomes of 'cooperation' or 'defection'.

The highest payoff, 4 points (T - *Temptation to Defect*), occurs when one country defects while the other cooperates. For example, Indonesia may profit from land clearing for palm oil while Malaysia bears the environmental and economic costs of the haze.

Mutual cooperation yields 3 points *(R - Reward for Mutual Cooperation*), where both countries implement haze-control measures, resulting in improved air quality, reduced health risks, and minimized economic losses.

If both countries defect, each receives 2 points (*P - Punishment for Mutual Defection*), reflecting the scenario in which neither enforces regulations, causing severe haze and significant harm to both nations.

Finally, the lowest payoff, 1 point (*S - Sucker's Payoff*), arises when one country cooperates while the other defects. In this case, Malaysia may invest in haze control, but if Indonesia continues burning, Malaysia bears most of the environmental and economic burden while Indonesia gains the short-term benefit.

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Fig.1. Prisoner's Dilemma Matrix

	Indonesia Cooperates (C)	Indonesia Defects (D)
Malaysia Cooperates (C)	3, 3 → Both enforce haze controls, reduced haze, shared health and economic benefits	1, 4 → Malaysia enforces controls, Indonesia profits from land clearing; Malaysia bears most cost
Malaysia Defects (D)	4, 1 → Malaysia profits from land clearing while Indonesia bears the haze cost	2, 2 → Both ignore haze regulations; severe haze spreads, both suffer economic and health losses

The inequality represented as T (4) > R (3) > P (2) > S (1) captures the essence of the Prisoner's Dilemma and explains why the dilemma exists. This inequality demonstrates the tension between short-term self-interest and long-term collective benefit, which is the core of the dilemma - defecting may seem rational individually, but cooperation is better for both overall, though risky if the other defects.

IV. FROM DEFECTION TO COOPERATION: HOW MULTILATERAL ENGAGEMENT COULD RESOLVE THE DILEMMA

This model in game theory illustrates why rational actors might fail to cooperate, even when cooperation would lead to a better collective outcome. The concept of a *Nash equilibrium* is central here: it describes a situation where neither player can improve their outcome by unilaterally changing their strategy (Bennett, 1995). In the classic prisoner's dilemma, mutual defection is the Nash equilibrium because each actor fears being exploited if they cooperate while the other defects, even though mutual cooperation would be collectively better.

Multilateral engagement and treaties help resolve the prisoner's dilemma by changing the incentives and expectations that drive defection (Ohlin, 2012). Treaties provide credible commitments, legally obliging countries to certain behaviors, while monitoring and enforcement mechanisms increase the cost of defection. Additionally, treaties often create repeated interactions between countries, where cooperation is more beneficial in the long term. By reducing the risks and increasing the rewards of cooperation, treaties can shift the Nash equilibrium from mutual defection to mutual cooperation.

The transboundary haze (TBH) problem between Malaysia and Indonesia provides a suitable example. The haze results primarily from forest fires in Indonesia, often used for land clearing, which negatively affects Malaysia. Without a treaty, Indonesia gains from cheaper land-clearing while Malaysia suffers, creating a classic prisoner's dilemma where both countries might 'defect' by pursuing their short-term self-interest. However, an international treaty can alter the payoff structure by imposing penalties on Indonesia for fires and providing financial support for sustainable land use. This makes defection less profitable and cooperation more attractive, effectively changing the payoff matrix so that both countries benefit from working together. As a result, mutual cooperation becomes a new Nash equilibrium, and both Malaysia and Indonesia are incentivized to act in ways that reduce haze and improve long-term outcomes.

Some experts suggest that treaties do not work as they lack suitable enforcement mechanisms to ensure that all stakeholders are adhering to the rules (Hoffman et al,2022). It is also difficult to get complete buy-in from all parties who could renege on credible commitments. Monitoring and evaluation according to treaty protocols are complex considering countries have different standards of measurements, different social norms, and differing opinions on how to solve the problem (Ibid).

'Wicked problems' are hard to define precisely and are continuously evolving making it hard for policy responses to address them in their entirety (Howes et al, 2024). As in the case of the haze pollution, complicated further by its international dimensions, a number of stakeholders are involved (nations, business interests, farmers, land-holders etc.) who all have competing interests, making any solution only a temporary one (Ibid). The divergence between public and private costs of clearing forests and conversion of peatlands for agriculture create perverse incentives

to free-ride whereby vested interests are unwilling to forego their damaging ways due to the potential economic benefits (Ibid). This exacerbates the prisoner's dilemma, i.e. in the pursuit of personal gains, large costs accrue at a collective or societal level.

However, these criticisms can be addressed by realigning the treaty in a way that encourages participation and compliance with its core tenets. To address externalities occurring within national borders, governments enact and enforce laws to ensure compliance, something that cannot be deployed at the international level considering a lack of a global government. In the case of international environmental problems such as the transboundary haze (TBH) issue, game theory offers possible solutions to analyze choices and their payoffs (Ibid).

The externality in this case is that local farmers and plantations in Indonesia, in pursuit of their own economic benefits, are practicing unsustainable methods of agriculture that are damaging health, economies and environment across the region (Guinness et al,2016). This is largely a unidirectional externality in the sense that there is one polluter (Indonesia) and multiple victims (Malaysia, Singapore etc). As governments emulate the complex set of rules required to govern a nation, so do treaties provide a framework of rules that can be applied to regulate interactions between nation states and hold stakeholders accountable (Howes et al, 2024). Treaties can modify the payoff structure in a manner that punishes free-riding and rewards responsible behavior. Thus, by reconfiguring the costs/benefits, a treaty largely takes away from the temptation to defect from the optimal course of action (Ibid). Furthermore, well-designed treaties serve to influence global norms and guide collective action towards mutually beneficial outcomes due to pressures of international acceptance.

V. POLICY DISCUSSION: STRENGTHENING THE '*ASEAN TRANSBOUNDARY HAZE POLLUTION AGREEMENT (ATHP)'* TO ADDRESS THE TBH CRISIS

Treaty design is vital to increase the participation of stakeholders. While the problem might be a regional one, solutions lie in domestic responses. The Treaty should not be tough on Indonesia but rather encourage its population to recognize the mutual long-term benefits that emerge from sustainable methods of farming. This essay argues for increasing side-payments from Malaysia and the international community to strengthen combined capacities to monitor and extinguish forest fires, to support peatland restoration, and incentivize Indonesian farmers/businesses to forego slash-and-burn techniques. According to the victim-pay-principle (Howes et al, 2024) Malaysia needs to increase its funding commitments to Indonesia rather than impose penalties that cause the Indonesian government and public to perceive the efforts to be unfairly targeting them. After all, the economic and health damages suffered by Malaysia are more than the funding that it needs to provide to address the issue at its source (Guinness et al, 2016; 4).

Furthermore, while some protocols in the ATHP are top-down (such as the ban on conversion of peatlands for agriculture), there is scope to strengthen the bottom-up measures that educate and empower locals to monitor and address the problem of peatland fires. It is essential for Malaysia and regional players to stick to their financial commitments under the treaty to improve Indonesia's ability and willingness to design and meet credible commitments. It can be useful to connect the TBH issue with global warming such that more funding is provided from regional bodies and international organizations along with the necessary technological upgrades required for Indonesia to meet its commitments. It took twelve years for Indonesia to finally ratify the treaty in 2014, the delay largely due to national sentiments of being targeted as well as lobbying activities of vested commercial interests (Ghani et al, 2017). Hence, it is prudent to bolster the existing treaty rather than design a new one.

The ATHP is designed to improve inter-state cooperation towards effective implementation of strategies to monitor, prevent, and mitigate TBH pollution (ASEAN Secretariat, 2002). It encourages technological solutions such as satellite mapping and early warning systems. It encourages national governments to strengthen regulatory approach to meet their obligations (Ibid). A common critique is that, keeping in line with the 'ASEAN way', it lacks any provisions for international monitoring and inspection (Tacconi et al., 2008). However, this is important consideration that is useful to generate local-buy in (Robertua & Sigalingging, 2019). Adequate funding can help local populations adopt cost-effective methods to cultivate their lands and combat forest fires, and develop norms and local capacities to trace and penalize habitual wrongdoers.

The ATHP has established an ASEAN Transboundary Haze Pollution Control Fund with the intent "to sponsor sustainable development initiatives in high-risk fire areas" (Guinness et al, 2016; 13). Contributions to the fund are voluntary and have usually fallen short thereby making it difficult for Indonesia to fund its strategies (Sunchindah, 2015). Malaysia can increase its contribution to the fund considering TBH costs it millions every year (Ho, 2019). It can also increase sources of funding by utilizing a provision that enables financial institutions and international donor organizations to make contributions (ASEAN Secretariat, 2002). Indonesia has also established the Peatland Restoration Agency which aims to rehabilitate converted peatlands and maintain them by building suitable infrastructure (Tri et al, 2021). The credible commitment from Indonesia can be in the form of progress reports on peatland restoration programs in exchange for receipt of disbursements from the fund.

Malaysia also has the creative option to expand beyond engaging only with of engaging directly with local Indonesian villages and communities through bilateral Memorandum of Understanding (MoU). A precedent for this option exist i.e. in 2008, the Malaysian government entered into an MoU with the Riau province in Indonesia to encourage responsible practices and improve indigenous capacity to fight forest fires (Jakarta Globe, 2009).

To buttress the treaty, regional nations have agreed to set-up a joint haze monitoring system (HMS) that uses data from satellites and maps to identify plantations/land-owners responsible for fires (Bloomberg, 2013). This effort requires participating nations to share accurate land-use maps. Some parties have insisted on complete transparency whereas Indonesia insists that only information regarding violations should be shared publicly (Ibid). This sticking point has prevented the HMS from reaching its true potential. The victim nations can drop the complete transparency stipulation to get Indonesian buy-in on an important pathway. In return, the credible commitment expected of Indonesia is to provide accurate maps under its "one map initiative" (Toha & Collier, 2015).

Funds could be utilized for equipping the Regional Disaster management Agency (BPBD) in Indonesia with better firefighting equipment (Nurhidayah, 2019). The reciprocal commitment that Indonesia could make is to deploy BPBD immediately rather than wait for emergency status to be declared by national government. Additionally, different responses must be calibrated to address different kinds of offenders. Large plantations ought to be fined heavily if satellite data confirms that fires originated in their properties before spreading elsewhere. The amount collected in fines can be reinvested in maintaining local infrastructure. On the other hand, small farmers and landholders who lack the knowledge and capacity to address complex issues must be incentivized through agricultural grants and subsidies financed through the Fund to shift to paludiculture (more suitable for growing particular crops in wet peatland soil) and agroforestry (Ibid). It is also vital to utilize funds to make it more cost-effective for farmers to use methods other than slash-and-burn (Carmenta et al., 2021).

An important hindrance to deploying successful strategies is the corruption plaguing the Indonesian bureaucracy, particularly the forest departments (Guinness et al, 2016). Malaysia has two options to influence change. Fund disbursement can be made contingent upon demonstrable reforms in the forestry sector. Lastly, as a complementary measure to the Treaty, Malaysia can domestically prosecute large Malaysian corporations that operate in Indonesia and

contribute to the problem (Mai, 2023). This will send a clear message to Indonesia that all partners are willing to do the needful to address a common regional problem.

CONCLUSION

Ultimately, the goal of strengthening the ASEAN Transboundary Haze Pollution (ATHP) agreement is to create a sustainable and cooperative framework that addresses the root causes of the haze crisis. This requires a multifaceted approach: educating local populations in Indonesia and providing them with viable alternatives to earn a livelihood, thereby reducing reliance on practices such as slash-and-burn land clearing; empowering multiple levels of government in Indonesia to enforce the protocols under the treaty effectively; and incentivizing both large-scale plantations and smallholder farmers to prevent further conversion of peatland forests. Such incentives could encourage the adoption of peatland forest restoration, agroforestry, and responsible agricultural practices, which not only mitigate haze emissions but also promote long-term environmental sustainability. In this regard, increasing side payments under the existing treaty, while promoting a bottom-up approach to accountability and community engagement, can help overcome local resistance and implement measures that are both equitable and transformative.

To ensure these strategies are evidence-based and effective, further research is needed in several key areas. Studies should explore the most cost-effective and culturally appropriate livelihood alternatives for local communities, as well as the socioeconomic impacts of shifting from traditional land-clearing practices to sustainable methods. Future research could also examine the enforcement capacity of local governments, identifying gaps in monitoring, compliance, and cross-border coordination. Additionally, evaluating the long-term ecological and economic benefits of peatland restoration and agroforestry could strengthen the case for expanded incentives and investments. By combining policy innovation with rigorous research, Malaysia and ASEAN can work toward a treaty framework that not only reduces transboundary haze but also fosters regional cooperation, sustainable development, and environmental stewardship for future generations.

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