Transboundary Haze from Indonesia: Reducing the effects of PM2.5 from Slash-and-Burn culture

University of Warwick, 2021

Image 1: Slash-and-Burn in Indonesia in 2016

Image 2: Lack of Visibility in Singapore in 2019 due to SEA haze

Target Recipient: Ministry of Environment and Forestry and Ministry of Health in Indonesia

Ministry of Environment and Forestry is in charge of managing the islands that are currently biodiversity hotspots, and can address the lack of effective governance on sustainable cultivation. Ministry of Health can address the lack of education on the dangers of inhalation of haze. Both ministries needs to work collectively to address the governance failure of Slash-and-Burn cultivation.

Executive Summary

Transboundary haze in South East Asia has been affecting the lives of many for decades. Slash-and-Burn culture is still practiced despite the establishment of national and international recommendations. High concentration of PM2.5 penetrates the alveoli causing lung complications. Indonesia's Environmental laws has failed to execute effectively due to weak law enforcement and corruption. RSPO focuses on the business sector, limiting demands of unsustainable palm oil, however their focus on large scale companies reduces local participation. Difficulty in establishing transboundary governance. Strong company-to-community relationships benefits implementation of community governance. Tax and fines needs strong establishment to prevent large companies from unsustainable cultivation, reducing the risk of forest fires. Licensing is needed to prevent further corruption. Reactive short-term policies like mask laws should be implemented to reduce health risks. Close monitoring AQI recommended. Through schools and media, education about S&B, haze and health will ties all recommended governance. The research in this brief references the 1997, 2013, 2015 and 2019 haze seasons.

Foundational Science: Discussion & Analysis

1. *Chemistry of the Indonesian haze*

Transboundary haze from Indonesia has been an issue for decades, affecting many countries in South East Asia (SEA). Despite being an anthropogenic issue, aerosols like particulate matter (PM) impacts the climate system and affects human health.[1] Isoprene is the most abundant volatile organic compounds (VOC) emitted by plants[2], which interacts with secondary gas such as surface ozone to create haze.[3]

2. *Slash and Burn Culture*

SEA haze holds high concentration of PM2.5, caused by Slash-and-Burn (S&B) method of cultivation.[3] Farmers use S&B culture to clear forest and land, which increases soil nutrients from ashes. This causes a sudden increase in phosphorus, a nutrient that helps increase crop productivity, through ashes and phosphorus fixation.[4] This results in shortened annual cropping periods and a decline in soil fertility after repeated burns.[4]

3. *Dispersion of Haze*

Transboundary haze takes effect due to monsoon seasons in SEA. Summer monsoon season has stronger transport energy[5], which results in most transboundary haze to happen during the summer. El Niño modulations may also impact the longevity and concentration of haze through "[weakened] aerosol dispersion and exacerbate haze pollution".[5 p178]

4. *Chemical effects of haze and other aerosols*

Chemicals, aerosols alongside PM are released into the atmosphere through S&B cultivation. The biomass emissions from unsustainable cultivation and forest fires that follows holds chemicals that are unhealthy for humans and other biotic and abiotic compounds.[6] Common chemicals found in peat fire samples and background PM2.5 samples are aluminium, lead, titanium, vanadium and magnesium.[6] PM2.5 particles from Indonesia's peat fires "contains a complex mixture of aggregates of organic and inorganic compounds"[6 p572] like carbonaceous materials, hydrocarbons, endotoxins, and toxic trace metals like copper, chromium and iron. Inhaling them may cause cancer and other respiratory diseases like asthma and bronchitis. [7]

5. *Forest Fires and its effects*

Forest fires, as a result of uncontrolled burning, results in other environmental issues like "deforestation, soil erosion and degradation, global warming, threats to biodiversity"[7 p1], and drought.[8]

5a. *Deforestation*

Deforestation is a threat to biodiversity (especially in Sumatra) as Indonesia is a biodiversity hotspot, with several endemic species.[7] Its biodiversity is complex, with more redundancy and stronger resistance. Epidemic species such as the Orangutans (*Pongo abelii, Pongo pygmaeus, Pongo tapanuliensis*) and Binturong (*Arctictis binturong*) becomes vulnerable to extinction as their habitat decays.[9,10,11,12]

5b. *Soil degradation*

Heat exposure from high intensity fires changes soil properties, replacing hydroxyl ions by sudden increase of phosphorus.[4] Heat exposure increase soil erosion and lowers long-term productivity.[7] The soil gets less fertile over time as phosphorus availability decreases after multiple Slash-and- Burns (S&Bs).[7] The increase acidity of the soil

increases phosphorus sorption.[7] “Exposing soil directly to weather elements such as wind, rain and sunlight”[7 p5] catalyses the erosion to runoff, potentially contaminating and acidifying bodies of water such as rivers and lakes.

5c. *Drought and Desertification*

Reducing forest canopy creates higher ground temperatures and lower humidity[7], which leads to seasonal drought in large parts of SEA.[8] Reduced precipitation as wind carries particulate matter instead of water vapour or moisture.[5] Desertification resulted from top soil decrease, as top soil nutrient decrease and increase acidification.[7] Higher soil temperatures as a result of drought and desertification releases nitrogen and increase biomass decomposition, affecting the stability of the environment.[7] El Niño is suspected to amplify drought effects.[13] This ultimately leads to global warming through reduced forest cover and lack of precipitation.

Assessment of Existing Governance

A recommended criteria for alternatives to Slash-and-Burn programme (ASB) includes: 1) profitability, 2) security of farmer and company, 3) respecting labour constraints, and 4) agronomically sustainable.[14] These criteria allows a sustainable option with the consideration of economic stability and farmers’ physical wellbeing. Further criteria includes methods that addresses global concerns, such as climate change, biodiversity and public concerns and objectives.[14] However, most existing governance relies on bans, convictions and reducing the demand from unsustainable farming practices rather than providing alternatives. I will address 3 types of interventions- national law, Roundtable of Sustainable Palm Oil (RSPO), and other transboundary/international environmental legislations.

1. Indonesia’s Environmental Law

The 1997 Environmental law is deemed ineffective due to 1 conviction out of 176 violators.[13] The law criminalises anyone who causes significant environmental pollution and damage.[15] Leeways found in article 35 which protects farmers engaging with illegal environmental pollution on behalf of a third party.[15] This loophole allows many businesses and companies to get away with hiring external local farmers for S&B due to the difficulty of tracing.

The 2009 Environmental law repeals the 1997 law. However there are no significant changes to methods of tackling pollution. Changes through introducing licensing to tamper the environment and mitigation.[16]

Despite the finality of a legislated law, weak law enforcement creates opportunities to benefit from illegal activities resulting in unstable communities, a lack of trust within communities and straining company-community relationships.[17] This causes an increase of domestic enforcement; police and local authorities arrested more individuals for being “suspected of starting fires”.[13 p232] Lack of administrative and executive enforcement creates confusion on handling violators.

Corruption is a key factor in the failure of these laws. This encourages S&B due to “low pay, a desire for side-line benefits or high cost and difficulty of monitoring and enforcing laws”.[7 p4]

2. RSPO

The Roundtable of Sustainable Palm Oil (RSPO), as the first non-profit organisation focused on sustainable palm oil worldwide, developed a set of principles and criteria for a product to be produce Certified Sustainable Palm Oil (CSPO).[18] Businesses will comply with criteria for a publicly renowned and trusted certification to boost sales.

As a voluntary agreement, negotiation takes place with document imprecision.[19] Despite localising attempts, conflicts arise between efficiency for conservation and inclusiveness of farmers/businesses.[19] Unclear guidance results in the continuation of S&B.

RSPO focuses on large corporations, disregarding environmental impacts from small-scale farmers.[19] Criterias are “too high a cost for the grower and too low a premium from the corporations” [19 p441], resulting in neither parties participating. Low cost-benefit ratios reduces CSPO’s attractiveness. Marketing RSPO whilst implementing CSPO demands can be an incentive for farmers to reject their advertising campaign.

RSPO focuses on biodiversity and mitigating forest cover. S&B and transboundary haze are not their top priority, despite its obvious effects on their aims. Issue with global governance without full integration on Indonesian’s socio-politico-legal context[19], reducing impacts on eradicating S&B.

3. Transboundary Governance

International environmental agreements on a global scale are voluntary, and difficult to establish consistent or rigorous implementation as complete ban is unfeasible.

Voluntary legislations decreases incentive for immediate action. Indonesia took 12 years to sign the ASEAN agreement.[13] The agreement on transboundary haze pollution aims to “co-ordinate national action for preventing and monitoring transboundary haze pollution through exchange of information, consultation, research and monitoring”.[20 p2] Studies argue that the agreement was “shallow” as it lacks in depth localised policies.[21] These interventions based from globalisation benefits Indonesia through external help from neighbouring and affected countries, like providing satellite data to aid haze research. [7] This is based on relationship between countries, and corruption from either country would nullify external interventions.

Governance anomalies such as the Singapore Act are open to prosecute individuals and companies.[13] The Singapore Act is a non-treaty based governance, taking economic power away from companies that engage with S&B cultivation.[13] This is effective to the extent of reducing the demand for unsustainable products. However, no action on companies or farmers decreases effectiveness through the chance of continuation with other suppliers.

Governance recommendations

1. Tragedy of the Commons

Transboundary haze pollution is a Tragedy of a Common. Elinor Ostrom’s Common-Pool Resource Management should be considered.[22] Despite similar interventions proposed,[7] many failed to consider the economic power from large corporate companies. Corrupt governance is unreliable with tendencies towards financial bias. Therefore, company-to-community relationships needs to be strongly established, with the help of education for both parties.[17]

Building on the Environmental laws, communities affected should have the final verdict on whether companies can use their native land for crop production. Companies propose short and long term plans for community authorities before establishing plantations. Authorities made up of local community leaders can monitor and rebuke companies’ plans if they affect the environment in a significant way. This establishes

company-to-community relationships, prevents further practice of Slash-and-Burn and encourages sustainable and ethical farming practices.[22]

Institutional change is recommended to strengthen communication between company and community. Though voluntary compliance, a society compiled with individuals from both parties are recommended to oversee behavioural change and solidify norms and expectations.[23] Education on sustainable farming and the environment should be a part of the community's school curriculum, delivered either by community authorities or the Indonesian's school board. Mandatory courses on sustainable farming is also recommended for licensed farmers, delivered by community authorities.

2. Tax and fines

Establishing a S&B tax prevent companies and farmers from excessively burning.

1. Companies/farmers declares land amount for S&B
   - Land declared needs to be owned and licensed by the company/farmer, prevents 3rd party to S&B
2. Tax correlates with burning area and farm area
   - General base price ratio:

$$\frac{\textit{Burning Area}}{\textit{Farmland Area}}$$

3. Community authorities regularly monitoring prevents corruption
4. Limit: one S&B per year

FIG.1 - REGULATIONS FOR VOLUNTARY S&B

Failure to declare or compile with declaration will result in fines. Tax will be calculated exponentially to burning affected area. This aims to mitigate large scale burning while respecting traditional S&B practices. Small scale farmers may use S&B as a last resort, accommodating their security. Fines will double original tax fees.

This reduces the incentive for large companies to clear land on a large scale with S&B methods. This also encourages small scale farmers to use other methods whilst allowing an extent of freedom in cultivation. Monitoring from local or governmental authorities are needed for this to be effectively implemented. Police or civil forces help monitor forest actions. Licensing to farm or tamper forests recommended for easy tracing. Tax and fine revenue goes towards improving healthcare or health governances. Fines may help reduce corruption, decreasing incentive for authorities to succumb to bribery. With effective implementation, community institutions changes, utilising shame culture as an institution for the benefit of the environment.

3. Reactive policies

Most governance recommends are proactive policies, which takes longer to establish. Reactive policies can be useful as a short-term solution until the proactive policy takes effect.[24]

Inspired by how countries have combatted the recent COVID-19, mask wearing regulations and work from home notices can significantly reduce health impacts from PM2.5 particles. Schools and other activities should be moved online if available. Regular AQI monitoring is needed. Recommended regulation at 100 AQI, critical implementation at 200 AQI.[25]

Immediate awareness and education for the ASEAN community may also prevent minor allergic reactions. School curriculums around SEA should include topics about the haze and its effects. Students with respiratory conditions must be allowed to learn remotely. Regular updates about haze should be highlighted in media and news, regularly informing citizens methods to keep themselves healthy and safe. Wealthier neighbouring countries may also provide additional support in healthcare systems either though labour or equipment.

Reference List

1. Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F.S.I., Lambin, E et al. Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society*, 2009;14(2). Available from: https://www.ecologyandsociety.org/vol14/iss2/art32/.
2. Silva S, Heald C, Geddes J, Austin K, Kasibhatla P, Marlier M. Impacts of current and projected oil palm plantation expansion on air quality over Southeast Asia. *Atmospheric Chemistry and Physics*. 2016;16(16):10621-10635. Available from: doi.org/10.5194/acp-16-10621-2016
3. Latif M, Othman M, Idris N, Juneng L, Abdullah A, Hamzah W et al. Impact of regional haze towards air quality in Malaysia: A review. *Atmospheric Environment*. 2018;177:28-44. Available from: doi.org/10.1016/j.atmosenv.2018.01.002
4. Ketterings Q, van Noordwijk M, Bigham J. Soil phosphorus availability after slash-and-burn fires of different intensities in rubber agroforests in Sumatra, Indonesia. *Agriculture, Ecosystems & Environment*. 2002;92(1):37-48. Available from: doi.org/10.1016/S0167-8809(01)00287-0
5. Show D, Chang S. Atmospheric impacts of Indonesian fire emissions: Assessing Remote Sensing Data and Air Quality During 2013 Malaysian Haze. *Procedia Environmental Sciences*. 2016;36:176-179. Available from: doi.org/10.1016/j.proenv.2016.09.029
6. Betha R, Pradani M, Lestari P, Joshi U, Reid J, Balasubramanian R. Chemical speciation of trace metals emitted from Indonesian peat fires for health risk assessment. *Atmospheric Research*. 2013;122:571-578. Available from: doi.org/10.1016/j.atmosres.2012.05.024
7. Islam M, Hui Pei Y, Mangharam S. Trans-Boundary Haze Pollution in Southeast Asia: Sustainability through Plural Environmental Governance. *Sustainability*. 2016;8(5):499. Available from: doi.org/10.3390/su8050499
8. Quah E. Transboundary Pollution in Southeast Asia: The Indonesian Fires. World Development. 2002;30(3):429-441. Available from: doi.org/10.1016/S0305-750X(01)00122-X
9. Singleton, I., Wich , S.A., Nowak, M., Usher, G. & Utami-Atmoko, S.S. Pongo abelii (errata version published in 2018). *The IUCN Red List of Threatened Species 2017*: e.T121097935A123797627. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T121097935A115575085.en. Downloaded on 16 April 2021
10. Ancrenaz, M., Gumal, M., Marshall, A.J., Meijaard, E., Wich , S.A. & Husson, S. Pongo pygmaeus (errata version published in 2018). *The IUCN Red List of Threatened*

Species 2016: e.T17975A123809220. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T17975A17966347.en. Downloaded on 16 April 2021

11. Nowak, M.G., Rianti, P., Wich , S.A., Meijaard, E. & Fredriksson, G. Pongo tapanuliensis. *The IUCN Red List of Threatened Species 2017*: e.T120588639A120588662. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T120588639A120588662.en. Downloaded on 16 April 2021.
12. Willcox, D.H.A., Chutipong, W., Gray, T.N.E., Cheyne, S., Semiadi, G., Rahman, H., Coudrat, C.N.Z., Jennings, A., Ghimirey, Y., Ross, J., Fredriksson, G. & Tilker, A. Arctictis binturong. *The IUCN Red List of Threatened Species 2016*: e.T41690A45217088. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T41690A45217088.en. Downloaded on 16 April 2021.
13. 8. Ng K. Transboundary Haze Pollution in Southeast Asia: The Effectiveness of Three Forms of International Legal Solutions. *Journal of East Asia and International Law*. 2017;10(1):221-244. Available from: http://dx.doi.org/10.14330/jeail.2017.10.1.11
14. 9Tomich T. Agricultural development with rainforest conservation: methods for seeking best bet alternatives to slash-and-burn, with applications to Brazil and Indonesia. *Agricultural Economics*. 1998;19(1-2):159-174.
15. Environmental Management, Law Concerning (Law No. 23, 1997).
16. Law No. 32/2009 on Environmental Protection and Management.
17. Pasaribu S, Vanclay F, Zhao Y. Challenges to Implementing Socially-Sustainable Community Development in Oil Palm and Forestry Operations in Indonesia. *Land*. 2020;9(3):61. Available from: doi.org/10.3390/land9030061
18. Tan, K.T., Lee, K.T., Mohamed, A.R. and Bhatia, S. Palm oil: Addressing issues and towards sustainable development. *Renewable and Sustainable Energy Reviews.* 2009;13(2):420–427. Available from: doi.org/10.1016/j.rser.2007.10.001
19. Ruysschaert, D. and Salles, D. Towards global voluntary standards: Questioning the effectiveness in attaining conservation goals. *Ecological Economics*. 2014;107: 438–446.
20. Associate of South East Asian Nations. ASEAN Agreement on Transboundary Haze Pollution. ASEAN Legal Instruments. 2003
21. Forsyth, T. (2014). Public concerns about transboundary haze: A comparison of Indonesia, Singapore, and Malaysia. *Global Environmental Change*. 2014;25:76–86. Available from: doi.org/10.1016/j.gloenvcha.2014.01.013

22. Ostrom, E. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge: *Cambridge University Press (Canto Classics)*. 2015;.

23. North, D. Institutions, Institutional Change and Economic Performance. *Cambridge University Press*. 1990;.

24. Reactive and Proactive Policy | GEOG/EME 432: Energy Policy [Internet]. E-education.psu.edu. [cited 16 July 2021]. Available from: https://www.e-education.psu.edu/geog432/node/128

25. Air Quality Index Scale and Color Legend [Internet]. aqicn.org. [cited 16 July 2021]. Available from: https://aqicn.org/scale/

Image 1: Basu, M. (2016). *In bid to cut haze, Indonesia persuades farmers against slash-and-burn*. *GOV INDISDER*. [Accessed 23 Mar. 2021].

Image 2: Kapil, S. (2019). *Southeast Asia enveloped in haze*. *DownToEarth*. [Accessed 23 Mar. 2021].