SPECIAL ISSUE ARTICLE

Environmental Policy and Governance · UNEP ENVIRONMENT · **WILEY**

A transboundary political ecology of air pollution: Slow violence on Thailand's margins

Danny Marks[1] ⓘ | Michelle Ann Miller[2] ⓘ

[1]School of Law and Government, Dublin City University, Dublin, Ireland

[2]Asia Research Institute, National University of Singapore, Kent Ridge Campus, Singapore

Abstract

This study develops a transboundary political ecology of air pollution to show how its spatially and socially unequal distribution constitutes a form of slow violence among already marginal sections of society. Recent research on transboundary air pollution in Southeast Asia and globally has mainly focused on the supranational or regional scale of environmental governance without taking into proper account the socially differentiated impacts of these cross-border flows of environmental harm at lower organisational scales. Air pollution in Thailand, which ranks amongst the worst in the world, generates spill-over effects across sub-national borders that disproportionately impact the urban and rural poor. We examine the drivers of the three major sources of air pollution in Thailand: vehicular emissions, agricultural emissions and industrial emissions to direct attention toward the barriers and opportunities for collaborative governance in urban, peri-urban and rural settings. The article argues that administrative fragmentation and the protection of vested economic interests by Thai business and political elites have compromised transboundary governance of the air while adding to socio-spatial inequalities and environmental injustices. We recommend legislative reforms centred on cross-sectoral and cross-jurisdictional cooperation to provide redress for the slow violence perpetrated against marginal citizens in the governance of air pollution.

KEYWORDS
air pollution, environmental governance, political ecology, slow violence, Thailand, transboundary

1 | INTRODUCTION

Air pollution is the largest killer of humans, globally accounting for around 8.8 million premature deaths annually and reducing human life expectancy by an average of 2.9 years (Lelieveld et al., 2020). According to the World Health Organisation, 91 percent of the world's population breathes polluted air (Davis, 2020), defined as the contamination of the atmosphere by physical, biological or chemical agents that produce measurable adverse effects on humans, animals, vegetation or materials (Zawar-Reza & Spronken-Smith, 2005). In Southeast Asia alone, 2.6 million fatalities annually are linked to outdoor air pollution (Saengmanee, 2021). Accurate data is difficult to obtain; however, due to the delayed release of public information, the limited availability of longitudinal studies, and the dense concentration of monitoring stations in cities, which are the main focus of region-wide comparative air pollution studies (Paoin et al., 2021; Thomas, 2019). Research on the governance of air pollution in Southeast Asia also tends to either prioritise regional-level cooperation among ASEAN (Association of Southeast Asian Nations) member states or studies of individual cities, resulting in a deficit of knowledge about how cross-border flows of environmental harm

(re)shape social and spatial inequalities at other scales of governance within and between countries.

This study addresses gaps in knowledge about (sub-)national scales of transboundary governance of air pollution in the context of Thailand. Accounting for approximately 32,200 premature deaths in 2019 (Nikam et al., 2021), Thailand's severe air pollution problem reduces average life expectancy by 2 years (Roengjit, 2019). The seasonal and uneven spatial dispersal of air pollutants within Thailand; however, creates hidden social and economic impacts that disproportionately affect already vulnerable sections of Thai society. Known legally and colloquially in Southeast Asia as 'haze,' chronic air pollution blankets Thailand's national capital of Bangkok from November to February each year (Fotiou & Perkins, 2021), largely to the detriment of low-income households and outdoor workers in the construction, transport and hospitality sectors who cannot insulate themselves in purified indoor settings. By contrast, northern Thailand experiences the worst effects of unregulated biomass burning between February and April, disrupting agricultural and tourism livelihoods, adversely affecting community health, and, in the longer term, contributing to flows of out-migration (Mostafanezhad & Evrard, 2021; Sakdapolrak & Sterly, 2020). The transboundary nature of Thailand's air pollution problem extends well beyond its national borders to affect neighbouring Cambodia, Laos, Myanmar and Malaysia, and vice versa.

Using a transboundary political ecology approach, we argue that existing shortcomings in the governance of air pollution in Thailand constitute a form of slow violence against already marginal sections of Thai society. The study posits that this slow violence is transboundary in nature because: (a) cross-border flows of environmental harm tend to harden boundaries of social exclusion in the unequal exposure to air pollutants; and (b) the materialities of air pollution that shape its governance preclude its containment within individual jurisdictions or single-sector responses. We develop our argument by bringing recent work on transboundary political ecology (Miller, 2021a; Salisbury et al., 2011; Salisbury et al., 2012) into conversation with scholarship on the slow violence of air pollution to demonstrate how 'unequal power relations … are "inscribed" in the air' (Bryant, 1998, p. 89). Political ecologies of air pollution have tended to focus on cities that are concentrated sites of wealth and inequality, where the slow violence of governance prescriptions for gentrified indoor 'solutions' acutely manifests in the negative health impacts experienced by socioeconomically underprivileged neighbourhoods (Buzzelli, 2008; Graham, 2015; Namin et al., 2020; Véron, 2006). In Southeast Asia, where around 65 percent of the region's urban workforce was employed in the informal economy before the onset of the COVID-19 pandemic (UNESCAP, 2019), this convergence of inequalities and risk factors in dense urban spaces created complex challenges towards understanding the spatial and social consequences of air pollutants that resist territorial enclosure. The prevailing focus on macro-level drivers and air pollution in cities has resulted in a deficit of knowledge about the slow violence of exclusionary governance choices on peri-urban industrial settings and rural populations that rely on seasonal biomass burning to clear agricultural lands. In taking a transboundary political ecology approach, we address this problem of scaling human responsibility for the governance of air pollution and the environmental justice implications of existing policy choices for already marginal sections of society within and across these urban, peri-urban and rural contexts in Thailand.

In the next section, we apply our transboundary political ecology approach to examine the varying spatial dimensions of air pollution's slow violence. We then describe our methods, before discussing the main sources and drivers of Thailand's air pollution in urban, peri-urban and rural contexts and their transboundary governance implications. The study then analyses existing barriers to transboundary environmental cooperation and identifies possible ways to overcome them. The final concluding section makes policy recommendations for plausible co-governance actions to enhance transboundary cooperation in mitigating the slow violence of transboundary air pollution in Thailand's development context in which growth imperatives tend to mask or conceal a multitude of spatial and lived inequalities in Thai society.

2 | A TRANSBOUNDARY POLITICAL ECOLOGY OF THE SLOW, UNEQUAL VIOLENCE OF AIR POLLUTION

We argue that air pollution needs to be treated as a challenge for *transboundary* environmental governance (within as well as in between countries) rather than solely for *transnational* governance (across countries) or *urban* governance (within and between cities and extended urban populations). Transboundary political ecology, as a contribution to the political ecology of scale, is useful for scaling up analysis of air pollution to the supranational level as well as down to the (sub-)national scale of governance (Miller, 2021a; Salisbury et al., 2012). It can be applied to analyse the governance of fluid gases and particulate matter that traverse multiple borders. Air sheds, in contrast to watersheds, defy clear spatial resolution due to the difficulties involved in separating and retrieving clean air from polluted air (Véron, 2006). Atmospheric conditions such as wind, humidity and other weather conditions significantly affect these cross-border flows and further re-pattern the unequal socio-spatial distribution of transboundary air pollution. Moreover, air, usually understood to be a passive entity, unsettles and disrupts everyday bordering practises when it shifts shape to become a fugitive entity that requires multi-sited forms of ecological stewardship to mitigate its dispersal (Miller, 2020).

Transboundary political ecology has utility in highlighting how these dynamic materialities of air pollution generate geographically unequal socioeconomic outcomes, calibrated by wealth, income, gender and other demographics. It further shows connections between national policy decisions that are often spatially and temporally distant from socioeconomically underprivileged populations who tend to bear the cumulative burden of episodic air pollution. Recent work on the governance of air pollution remains predominantly focused on the macro-drivers of emissions (Bollen & Brink, 2014; Mejia, 2020) and the international legal challenges of air pollution for human, food and state security (Omri & Hadj, 2020; Yamineva & Romppanen, 2017). In Southeast Asia, airspace is only loosely and incompletely regulated by non-binding regional frameworks (for instance, the 2002 ASEAN Agreement

on Transboundary Air Pollution) and by the legislation of individual governments and their representative bodies (Varkkey, 2016). To date, Singapore is the only ASEAN member country to initiate a transboundary approach to this problem through its 2014 Transboundary Haze Pollution Act that targets the business sector by imposing fines on companies with operations in neighbouring countries found to contribute to haze pollution within Singapore's borders (Miller et al., 2020). Within resource-rich countries like Thailand, the absence of legislation on air pollution undermines efforts by government institutions to enforce industry standards of best practise and to hold transgressors to account from different (vehicular, industrial and agricultural) sectors and across (sub-)national jurisdictions.

Our transboundary political ecology contributes to an understanding of the institutionalisation of slow violence of air pollution across urban, peri-urban and rural contexts. Transboundary political ecology is attentive to the importance of asymmetrical power relations in (re)shaping boundaries of authority in environmental stewardship and in mediating the risks posed by development pressures (Miller, 2021a). Here, we draw from Nixon's (2011) notion of slow violence to illustrate how transboundary power relations are reconstituted by flows of air pollution and its cascading health and social impacts that accumulate incrementally and are difficult to quantify. These hidden dimensions of air pollution occur 'gradually and out of sight' in ways that are 'dispersed across time and space' so unremarkably as to be 'typically not viewed as violence at all' (ibid, 2). Slow violence thus creates specific spaces of suffering and environmental injustice among already marginalised groups who tend to experience the creeping longitudinal impacts of toxic exposure and 'toxic uncertainty' that produce health conditions and shape life opportunities spanning entire lifetimes or even generations (Auyero & Swistun, 2008).

The transboundary governance dimensions of air pollution's indirect impacts are often as opaque and understated as slow violence itself. In Thailand, the close relationship between national government actors, state institutions and profitable but polluting industries blurs the boundaries of responsibility for air pollution and prevents meaningful advances from being made in the development and enforcement of pollution-control regulations (Roengjit, 2019). Inter-jurisdictional and inter-agency competition over limited financial resources creates a culture of suspicion among departmental heads who fear ceding control over business opportunities and key budgets if they cooperate in joint activities to mitigate air pollution (Marks, 2019). Precarious mobilisations of labour, out-migration and social dispossession typically follow such fragmented and divided policy-making cultures. The displacement of place-based coping strategies, environmental degradation and the neglect of human suffering are other common outcomes of political cultures that prioritise economic growth over environmental sustainability and social justice (Pangsapa & Smith, 2008). In these ways, slow violence renders air pollution as 'not simply as a technical problem, but as a historical agent of colonial dispossession' (Sandlos & Keeling, 2016, p. 7) in which self-interested political and business elites disenfranchise socioeconomically marginal Thais from their own properties and territorial homelands.

There is representational dimension to the slow violence of deteriorating air quality (Nixon, 2011). How air pollution is narrated, and by whom, is linked to the social production of scale, the primary means by which ecology is rendered political (Rangan & Kull, 2009). Techno-scientific narratives dominate public discussion of air pollution in Thailand while the slow violence of social, health and economic impacts remain largely hidden from sight. Here, the science of air pollution is not in question, but its public representation becomes problematic when it is used to serve the interests of powerful state actors and major polluting industries while reinforcing the marginal position of already vulnerable sections of society within broader sets of power relations and economic processes (Collins, 2010; Marks, 2015). This unequal representation is especially important in Thailand, which has the world's largest wealth gap with the richest one percent controlling almost 67 percent of the country's wealth (Lindsay, 2019). Moreover, these wealth inequalities have bred 'other kinds of inequality... built into the structure of society and the attitudes of its members,' including via privileged access to legal and political power structures (Phongpaichit & Baker, 2015, p. 17). As Mostafanezhad and Evrard (2021) point out in their study of northern Thailand, this power imbalance leads to selective recollections of air pollution in official accounts that create or reinforce existing vulnerabilities by narrowly determining what constitutes a disaster and selectively narrating who is impacted by it.

The divergent forms that slow violence can take have led to calls for a multi-sectoral and interjurisdictional approach to address it (Scheidel et al., 2020). To the limited extent that the slow violence of poor air quality has so far been considered in Thailand, economic impact assessments have begun to quantify the long-term healthcare costs of air pollution on the country's burgeoning ageing population and declining labour productivity due to pollution-related sick days (Economist Intelligence Unit, 2019). Yet the unequal social and spatial geographies of risk and exposure remain understudied, while initiatives to formulate coordinated responses across bordered spheres of human interest are almost non-existent. Mostafanezhad (2021) analyses these blurred boundaries of risk and responsibility in her work on air pollution in northern Thailand within a networked matrix of human-nature interactions across fluid urban–rural boundaries. She argues that unresolved and ambiguously defined urban–rural boundaries and mixed land use regimes create uncertainty about who is to blame for environmentally unsound practises that pollute the air across jurisdictions, complicating cross-border monitoring and law enforcement measures.

Transboundary political ecology does not seek to downplay or minimise these difficulties of crossing borders for governance purposes. Rather, it takes the continual 'ebb and flow' of borders as a starting point for understanding how humans and nature relationally transform each other (Salisbury et al., 2011, p. 149). This in turn directs attention towards the scalar politics of responsibility for air quality, allowing us to identify areas where environmental governance needs to be reformed (Miller, 2021a; Swyngedouw, 1997). Here, transboundary political ecology resonates with recent critical scholarship in urban political ecology that theorises the boundaries of air pollution as a more-than-urban problem by treating 'urban processes as complex multi-scaled metabolisms' (Graham, 2015, p. 194). Much of this work has reconceptualised air pollution away from its historical understanding as an 'urban problem' by emphasising the extended ecological footprint of capitalist urbanisation

processes, or the urbanisation of nature on a global scale (Angelo & Wachsmuth, 2015). These capital-driven processes add to slow violence against marginal societal actors by reinforcing deep power asymmetries through neoliberal strategies of 'accumulation by dispossession' or displacement (Harvey, 2005, p. 119).

The remainder of this study addresses these boundary issues in relation to the three main types of air pollution that originate from within Thailand and which have governance consequences extending beyond its national borders. These three sources of air pollution—vehicular emissions, industrial emissions and agricultural emissions—tend to be associated with urban, peri-urban and rural contexts respectively. In highlighting the transboundary dimensions of each type of pollution, we show how the governance challenges associated with specific emissions cannot be addressed by single jurisdictions, sectors or individual groups of polluters. Beyond illustrating how air pollution disrupts the everyday practises of boundary enforcement, a transboundary political ecology approach signals where collaborative opportunities exist, or could be created, to bring flows of people, knowledge, technologies and funding together across borders in the service of collective and socially inclusive environmental stewardship.

3 | METHODS

This study draws from a combination of documentary content analysis and qualitative interviews. We selected sites and subjects based on: (a) the three main types of pollutants found in Thailand, and (b) the urban (vehicular emissions), peri-urban (industrial emissions) and rural (agricultural emissions) settings within which each is primarily produced. Our first author conducted 19 semi-structured interviews between August 2020 and January 2021 (see Appendix A). All subjects were interviewed online due to health risks related to the COVID-19 pandemic and travel restrictions to Thailand from Dublin, where our first author is based. A combination of purposive (selective) sampling and snowball sampling (recruiting people recommended by interviewees) techniques were used to interview respondents from four sectors: government, private business, scientists and NGOs.

Our qualitative methods are suited to evaluating different perceptions of the causes and consequences of the slow violence of transboundary air pollution in Thailand's politicised national context that tends to downplay inequalities in development narratives. Questions that guided the semi-structured interviews were underpinned by two unifying themes: (1) perceptions of the underlying causalities and consequences of air pollution emanating from within Thailand; and (2) perceptions of the transboundary nature of the governance of air pollution. Due to the travel limitations imposed by COVID-19, we triangulated our interview findings where possible through qualitative documentary analysis (journal articles, books, legislation and media content). This documentary content analysis was conducive to comparing perceptions of air pollution in cases where varying characteristics (urban, peri-urban and rural settings and types of air pollutants) do not lend towards statistical analysis but can be applied in ways that have relevance for policy development in other areas.

4 | VEHICULAR EMISSIONS WITHIN AND BEYOND CITY BOUNDARIES

Our transboundary political ecology begins in Thailand's capital city of Bangkok, where vehicular pollution physically moves across the borders of Bangkok Metropolitan Administration (BMA) in the everyday passage of commuters, commodities and finance that service and maintain the city. Here, traffic congestion is the main source of air pollution and occurs all year round. Unlike many rural parts of Thailand, particular matter (PM) is monitored relatively effectively in Bangkok by 10 national monitoring stations and 50 municipal stations, although these do not release real-time data to the public and vary considerably by location (Thomas, 2019). Consequently, recent estimates of roadside PM2.5 contributions to Bangkok's total pollution levels diverge considerably according to where the reading is taken, ranging from 44 percent (ChooChuay et al., 2020) through to 73 percent (Wipatayotin, 2020).

Bangkok, the densely populated capital of a rapidly developing country, represents the epicentre of a national problem of vehicular emissions that degrades atmospheric quality within, above and beyond extended urban regions (Figure 1). A 2019 survey found that over 60 percent of Thai respondents claimed to own a car (Statistica, 2019). In Bangkok alone, car ownership surged from 4.2 million in 1999 to 10.7 million in 2019, (see Figure 2) (Thailand Clean Air Network, 2020), representing a 250 percent increase in emission-generating vehicles over two decades as the number of vehicles in
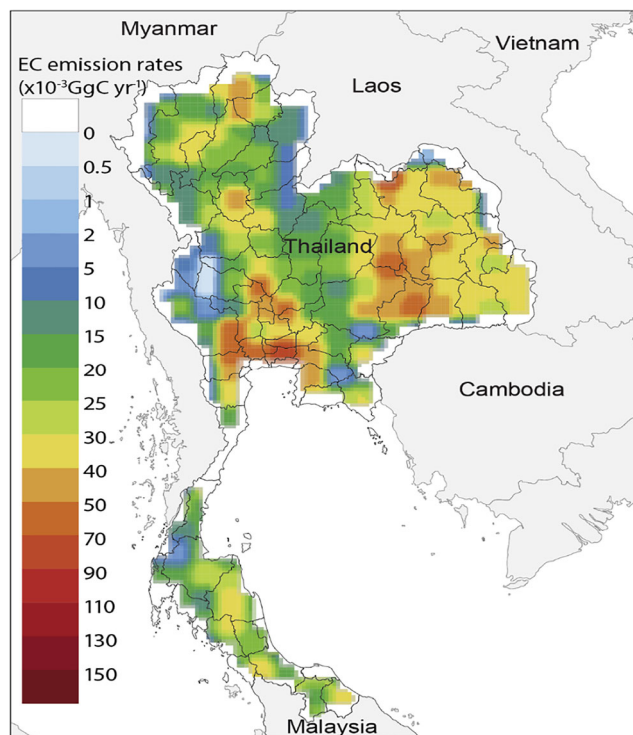

FIGURE 1 Annual distribution and concentration of vehicular emissions in Thailand (adapted from Xing et al., 2020) [Color figure can be viewed at wileyonlinelibrary.com]
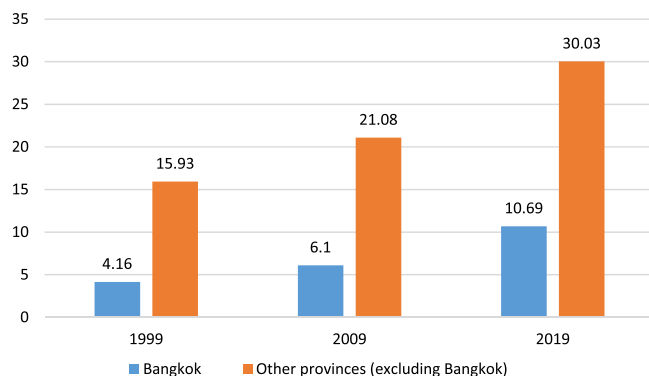
FIGURE 2 Number of cars in Thailand (in millions) (*Source*: Thailand Clean Air Network, 2020) [Color figure can be viewed at wileyonlinelibrary.com]

Bangkok exceeded its registered population of 10.5 million people. In part, this surge in vehicle ownership can be attributed to Bangkok's minimal parking costs and ample parking space. A recent study of parking space in commercial and retail spaces in major Asian cities found that Bangkok was one of the two highest providers of parking spaces in the region (Siu, 2017). Unlike many other countries, where buildings have a maximum number of allocated spaces, in Thailand, an antiquated Building Control Act requires commercial buildings to have a minimum number of parking spaces determined by their size.

This trend towards increasing vehicle ownership; however, conceals expanding boundaries of socioeconomic inequalities. Official poverty levels in Thailand have been rising since 2015 after three decades of increasing household incomes and consumption growth (World Bank, 2020), adding to social vulnerability to the impacts of air pollution while aggravating the drivers of vehicular emissions. Set against this pattern of car ownership among Thailand's middle classes, public transport within and to Bangkok has been unable to keep pace with the burgeoning numbers of poor and near-poor residents and commuters from other jurisdictions who cannot afford to drive to work. Public transport infrastructures and facilities that connect Bangkok internally and with other places have not kept pace with the volume of commuters. Public buses are of poor quality and are outdated, as are bus routes, resulting in lengthy wait times. Other alternatives modes of public transportation—mass rail and public boats—are still too limited to significantly reduce car usage. Negative public perceptions about public transport have intensified Bangkok's traffic problem, while creating a burgeoning category of commuters for whom cars have become extensions of their homes (Marks, 2020).

Rather than invest in public transport to bridge this socioeconomic gap and reduce vehicular emissions, the Thai government has instead promoted a national culture of aspirational car ownership that mirrors its own development priorities focused on economic growth at the expense of sustainability considerations. This is evident in media advertisements where cars are portrayed as status symbols (Marks, 2020). Yet car commuting culture has also been facilitated by the low cost of vehicle ownership relative to public transport for those who can afford to pay down-payments on vehicles. Pujinda and Yupho (2017) found

that an average train commuter pays approximately US$120 per month whereas private vehicles only cost US$100 to operate. In contrast to many other countries, Thailand's national government has encouraged vehicle ownership by lowering excise taxes. For instance, Singapore's licence fee and high-excise duty tax have raised car prices to above US $80,000, more than double Bangkok's average car price of US$29,947. Further, Thailand has low annual registration fees, ranging from US$32 to US$224 per year, approximately 100 times less than Singapore's annual taxes for car owners (Budget Direct Insurance, 2021).

Car commuting culture within and between jurisdictions has been further driven by the 'first car buyer scheme,' introduced in 2012 by the Prime Minister Yingluck Shinawatra government (2011–2014) to stimulate economic recovery from the 2011 Central Thailand floods. Yingluck's cabinet issued a 100,000 Baht (US$2900) tax rebate for first-time auto buyers to purchase vehicles with a maximum engine size of 1.5 litres). Resoundingly popular among those who could afford the down payment, this scheme led to a marked increase in the number of registered vehicles in Bangkok by 420,000 cars, or 10 percent. While this helped the automobile industry, car dealers and gasoline companies to rebound from the floods, it dramatically worsened vehicular emissions (Marks & Elinoff, 2020). As a local activist observed: 'We need to reduce our car usage. The sales of cars are increasing every year. We need to increase car prices' (2).

Adding to this environmental problem, many older cars with diesel engines, low-fuel efficiency and high pollutant outputs remain in circulation in Thailand because they incur low taxes. For this reason, registered cars aged ten years or older almost doubled from 7.7 million cars in 2007 to 14.1 million cars in 2019 (Thailand Clean Air Network, 2020). Thailand's tax regime also encourages ownership of high-polluting diesel vehicles (6), especially pickup trucks, which constituted half of all vehicle sales in 2017 and around one-quarter of Bangkok's registered vehicles, making tax changes for this vehicle especially problematic given its popularity (Janssen, 2018). In the context of Thailand's deeply divided leadership and fragmented governance system, no state agency wants to deal with an unpopular public issue that could risk ceding power (Marks, 2019). For example, when a Thai NGO representative complained to the BMA about diesel pollution, BMA officials claimed it was not their responsibility. Her subsequent telephone calls to the Pollution Control Department (PCD), the Bangkok police and the Department of Land Transport (DLT) yielded similar comments. 'Everybody operates in a silo. They are throwing the hot potato around,' she lamented (7).

The slow violence of air pollution's uneven spatial and social dispersal is perpetuated by political and business leaders and senior bureaucrats who make decisions about air pollution and set industry standards, while insulating themselves from its negative effects in air-conditioned environments with air purifiers. Thailand's political and business elites are also more likely to make lengthy car commutes from leafy suburbs to city centres, avoiding public transport. Their vested interests keep vehicle taxes to a minimum while indefinitely deferring the introduction of pollution taxes. As a parliamentary advisor stated: 'A pollution tax on vehicles and industry has been postponed. I don't know when it will be reconsidered. Politicians don't want to propose anything that could be unpopular' (5).
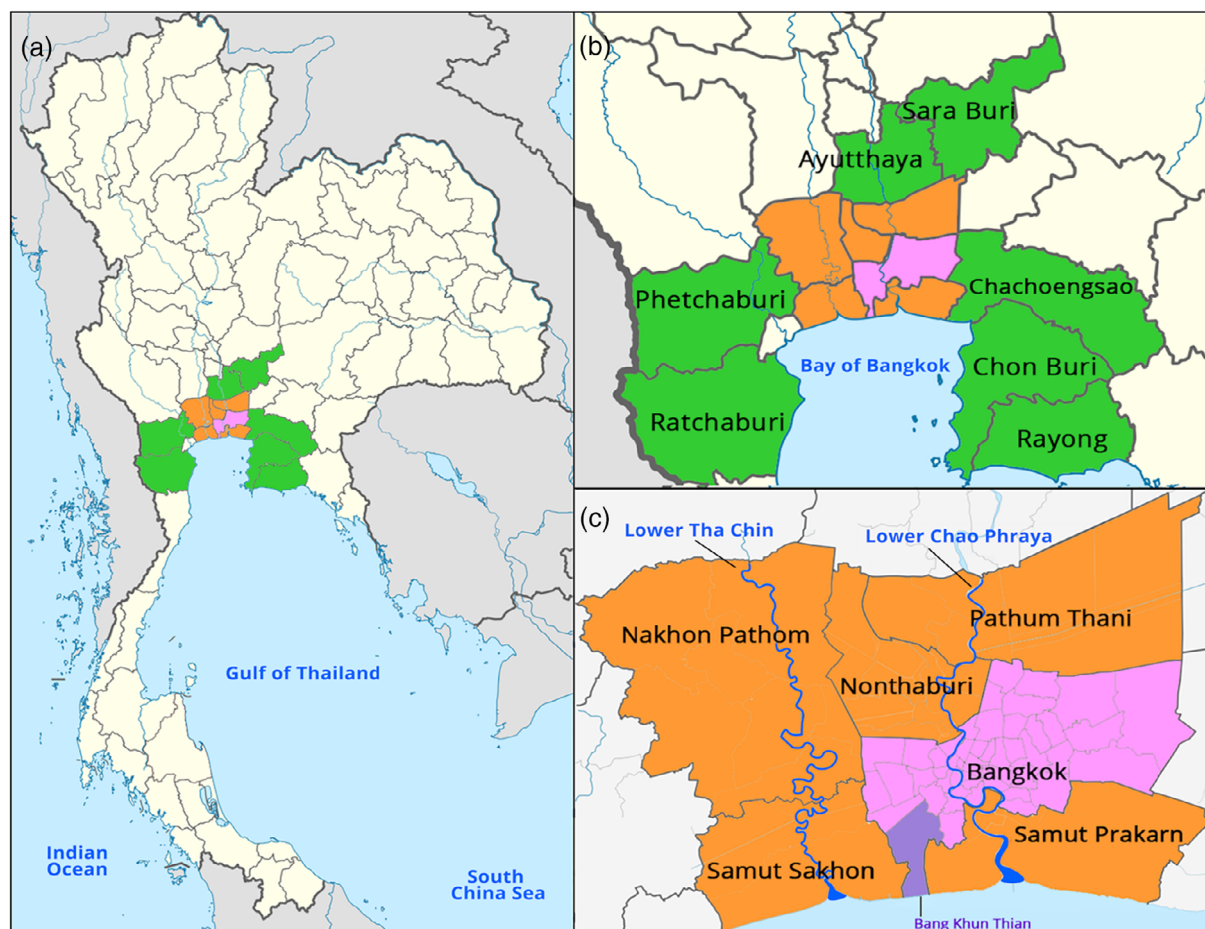
FIGURE 3   Map of (a) Thailand; (b) the extended Bangkok metropolitan region; and (c) the Bangkok metropolitan region (*Source*: Fischer, 2021) [Color figure can be viewed at wileyonlinelibrary.com]

Meanwhile, socio-economically marginalised Thai citizens who tend to lack private health insurance remain at heightened risk of exposure to roadside pollution. Informal street vendors, motorbike taxi drivers, street sweepers and open-air bus riders with reduced purchasing power generate relatively small pollution footprints. Yet they are far more likely to suffer the slow violence of air pollution, as are their children (when schools periodically close on account of bad air quality) and elderly family members residing in non-air-conditioned homes. Yet even among these vulnerable groups, the boundaries of toxic exposure can vary widely even within the same suburb. For instance, a Bangkok-based study on the negative health effects of traffic air pollution on street vendors found that roadside street vendors were twice as likely as residential street vendors to develop respiratory conditions and other illnesses linked to air pollution (Kongtip et al., 2008). This is because PM from vehicular exhaust is highest along roadsides, underneath flyovers and in street canyons between buildings (Smedley, 2019).

As the COVID-19 pandemic progresses at the time of writing, the slow crisis of daily vehicular emissions is likely to persist amidst the pandemic-induced recession that has cost millions of Thai citizens their jobs while raising household debt (World Bank, 2020). While vehicle ownership is predicted to stagnate in this economically strained context, air pollution may not improve due to a series of

missed opportunities by the Thai government. National plans to reduce emissions have become subordinated to a short-term focus on development-driven pandemic recovery at the expense of building ecological resilience in the longer term. We see this in Thailand's postponed plans to continue its transition to a global low emissions fuel standard. In 2012, the national government commenced this transition, although unlike other countries in Southeast Asia, it has delayed upgrading to the new global emissions standard (Euro 5) until at least 2023 amidst pandemic recovery pressures (Thailand Clean Air Network, 2020). As a former senior PCD official explained:

> The automotive industry said to the government because of COVID-19, we are not able to do this. We don't have enough economic help, so cars will be more expensive. People say they cannot afford it. Most of the time, the government will pay more attention to economic problems. So the government decided to postpone Euro 5 for three years (3).

At the same time, COVID-19 has further delayed government plans to sustainably develop public transport services by replacing the engines of 3000 old buses with electric engines (4). Other low-

emission initiatives, such as a fledgling electric vehicle (EV) market, has not yet expanded, unlike in the European Union, due to inadequate charging infrastructures and limited incentives to buy EVs (4). As successive Thai governments have never encouraged Thai citizens to drive less by presenting them with viable public transport alternatives (6), political support for transitioning to a low-emission economy using EVs and public transport is also lacking. As a parliamentary advisor admitted: 'We are thinking about setting up a low-emission zone in Bangkok but it is controversial. It may not be selected' (5).

With growth agendas driving air pollution and constraining discussion of sustainable development alternatives in Thailand, citizens who lack formal access to decision-making bodies are likely to remain without a voice and unaccounted for in official statistics regarding the costs of vehicular emissions. They are similarly excluded from gentrified clean and green plans for Thailand (Board, 2020) that indefinitely defer improvements to public transport infrastructures and facilities. These barriers to social inclusion are not limited to vehicular emissions. As the next section highlights, politically connected polluting industries similarly add to socioecological injustices against factory workers and their families on an expanding scale in peri-urban environments.

5 | THE UNDOCUMENTED SLOW VIOLENCE OF INDUSTRIAL EMISSIONS

Just as flows of commuting vehicles emit pollutants within and across the administrative boundaries of Bangkok, industrial emissions from factories in surrounding provinces similarly defy territorial containment and pose ongoing challenges to cross-jurisdictional cooperation. The Bangkok Metropolitan Region (BMR), which comprises Bangkok and the neighbouring five provinces (Nonthaburi, Pathum Thani, Samut Songkran, Samut Prakarn and Nakhon Pathom), shares an unresolved industrial pollution problem with surrounding provinces including Aytthaya, Saraburi, Chachaengsao, Chonburi, Rayong, Ratchaburi and Phetchaburi (Figure 3). As with vehicular emissions, the air pollution linked to chemical and industrial activities occurs all year round, but is exacerbated by wind and weather conditions, with pollutants general being suppressed during the monsoon season (June to October) and intensified during the dry (February to May) and cool seasons (November to January) when wind currents are weak and air pressure is high (Nikam et al., 2021). These variables, coupled with discrepancies over the varying locations of monitoring stations and irregular data availability, have generated divergent estimates of the contributions of industrial emissions to Bangkok's overall emissions, which range from 4.5 percent (ChooChuay et al., 2020) through to 17 percent (Thailand Clean Air Network, 2020).

Very little is known about the slow violence of industrial emissions on factory workers, their communities and out-migration from heavily polluted peri-urban areas because Thailand has no Emissions Inventory (EI) database to record industrial emissions, despite having around 140,000 polluting factories. As the head of a local environmental NGO explained:

At the end of October (2020), we had satellite data that there was pretty bad air pollution. The data was definitive that it was not caused by vehicular emissions—it was a period when there were no cars on the road. The sourcing instead pointed to nearby factories—there around 40,000 factories surrounding Bangkok—but industrial emissions are hardly talked about (7).

This lack of official data has profound implications for the governance of industrial emissions because this problem does not exist in official records. As such, it cannot be meaningfully discussed, integrated into formal policy choices and regulatory mechanisms, or addressed through multi-sector, multi-scalar and cross-jurisdictional environmental actions. In this way, the Thai case contrasts with other countries where factories are legally required to disclose their emissions, such as in the United States' Toxics Release Inventory, and, in other developed countries, Pollutant Release and Transfer Registers (Thailand Clean Air Network, 2020). Factories, especially in Rayong, Saraburi and Samut Sakhon, emit continual plumes of black smoke (Figure 4), but the absence of EIs makes it impossible to identify the perpetrators. As a Thai NGO representative complained: 'Since there
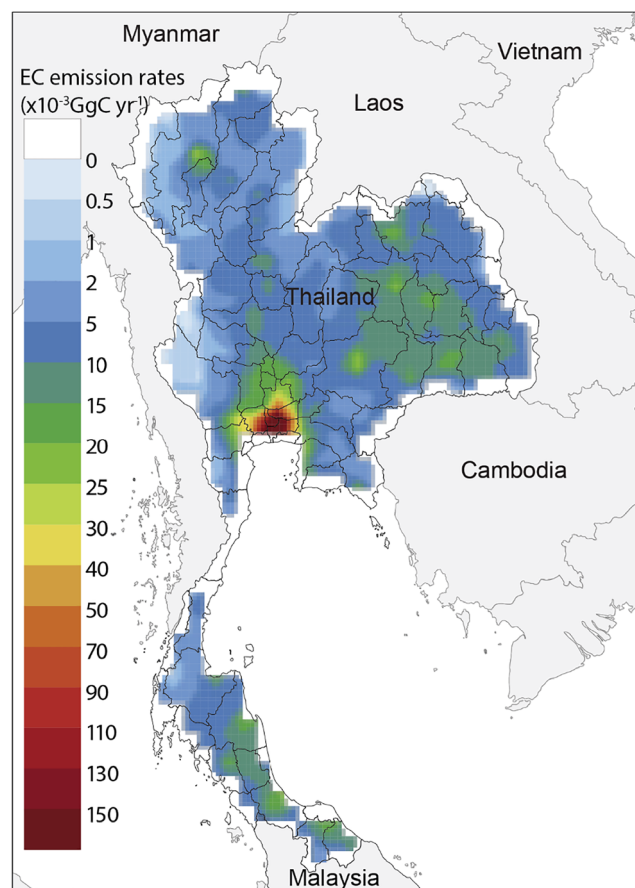

FIGURE 4 Annual industrial emissions by distribution and density in Thailand (adapted from Xing et al., 2020) [Color figure can be viewed at wileyonlinelibrary.com]

are no emissions inventories from factories, we're working blind' (7). Moreover, a parliamentary advisor noted that 'No PM2.5 standards exist for factories.' While the Thai government periodically asks factories to replace dirty fuels with natural gas during chronic transboundary haze episodes, only some owners comply, and even then, only do so within a finite period because 'we cannot force them to do so, only can ask them' (5).

Legislative loopholes have further benefited politically connected factory bosses responsible for industrial emissions. In April 2019, for instance, the National Legislative Assembly revised Thailand's 1992 Factory Act, which, according to one NGO representative, conferred political leverage to business groups to weaken, undermine or ignore existing environmental regulations (8). Under this revised legislation, only industrial companies with more than 50 employees and machinery exceeding 50 horsepower are subject to monitoring for waste discharge and anti-pollution measures, including air pollution (Marks & Breen, 2021). An NGO worker explained that this deregulated environment makes it 'easy to open a factory. But it's very difficult to close. You have to go to court to close them' (10). She added that sometimes these court orders close the factories for 45 days so that they stop polluting, but then 'it is back to business-as-usual' (ibid).

Transboundary environmental governance challenges are likely to multiply in this unregulated policy context. With factories no longer required to apply to renew their licences, irrespective of non-compliance with safe industry standards, the slow violence of forced out-migration, associated transitions into precarious forms of employment, and chronic health conditions in communities around factories will invariably accumulate (Roberts-Davis & Saetang, 2019; Rujivanarom, 2019). The law is expected to further open up Thailand's borders to waste from China, which stopped importing plastic waste from January 2018. As Thailand has struggled to expand its domestic capacity to keep pace with surging global waste imports that China once absorbed (Marks et al., 2020), many of its recycling firms and processing plants have become emitters for 'all sorts of air pollution' (7).

Institutional fragmentation in Thailand's governance system poses serious barriers to the coordination and regulation of industrial air pollution. The PCD is only authorised to inspect pollution complaints, but this under-resourced agency cannot fine or close down major industrial polluters. Under the Factory Act, the authority to fine major polluters rests with the Department of Industrial Works (DIW) under the Ministry of Industry (Thailand Clean Air Network, 2020). This creates a conflict of interest as the DIW's mandate is to expand industrial growth rather than curb it through environmental regulations (Thailand Clean Air Network, 2020). What often happens, therefore, is that the PCD complains to the DIW about factories' pollution levels, which DIW often ignores. Alternatively, as a PCD official admitted: 'the factories always prefer to pay less so when the DIW officials want to visit, DIW already informs them [in advance] so they are already prepared (9)' and will not have to pay a fine. After DIW visits, factories typically resume emitting high levels of pollutants (8, 9). For this reason, environmental NGOs complain that it is 'very difficult to get information' about air pollution from DIW (10). Even when

environmentally progressive factory owners ask for government support to revert to cleaner technologies, they are usually unable to obtain official assistance. As an NGO representative explained, in the absence of a Clean Air Act or equivalent legislation to safeguard industry emissions standards, the government is not compelled to 'provide this technology or links to entrepreneurs or other officials. They only think within their line of duty and don't cross this line. They don't think about helping the private sector (to be cleaner)' (10).

As with the transport sector, the slow violence of industrial emissions remains largely unknown and undocumented in Thailand and globally. Critical political ecologies have pointed out that physically proximate actors tend to bear the highest costs of toxic exposure, while spatially and/or temporally distant actors and decision-makers reap the biggest material benefits (Davies, 2018; Sandlos & Keeling, 2016). This is equally true of Thailand's polluting industries, where factory owners generally live far away from production sites while factory workers and their communities who are economically reliant on industrial growth for livelihood continuity suffer protracted and often acute health problems linked to toxic exposure.

That this slow violence has only ever been documented in a piecemeal way is partly due to the difficulties in monitoring pollution impacts that are only revealed over extended timeframes, sometimes across generations. For example, in 1997, around 1000 school children and teachers were hospitalised due to breathing difficulties, nausea, headaches and nasal irritation from air pollution generated by the state-owned Map Ta Phut, Thailand's largest industrial estate and the world's eighth biggest petrochemical hub in Rayong Province (Viwatpanich, 2012). Although an independent US-based study found air pollutants in the vicinity of the estate to be 119 times above industry safety standards, subsequent testing conducted by scientists, including those sponsored by the Industrial Estate Authority of Thailand that owns and operates Map Ta Phut, reported mixed results (ibid). This created media controversy and public uncertainty about the estate's culpability in generating toxic outputs. In this way, estate owners used their representational power to decouple the slow violence inflicted on Map Ta Phut workers and their communities from its underlying causalities. It was only in 2009 that Thai courts banned the estate's expansion, by which time, at least 2000 people had died from cancer linked to long-term toxic exposure (Pangsapa, 2014). Too late, these fatalities alleviated the representational challenge of 'drawing public attention to catastrophic acts that are low in instant spectacle but high in long-term effects' (Nixon, 2011, p. 10).

6 | AGRICULTURAL BURNING AND ITS TRANSBOUNDARY CONSEQUENCES

The third major contributor to Thailand's deteriorating air quality is emissions from the agricultural sector, including from the illegal encroachment of plantations into state forests and protected areas that contribute to aggregate biomass burning emissions (see Figure 5). Haze pollution caused by the use of fire to clear land for planting and remove excess biomass is not unique to Thailand, as neighbouring
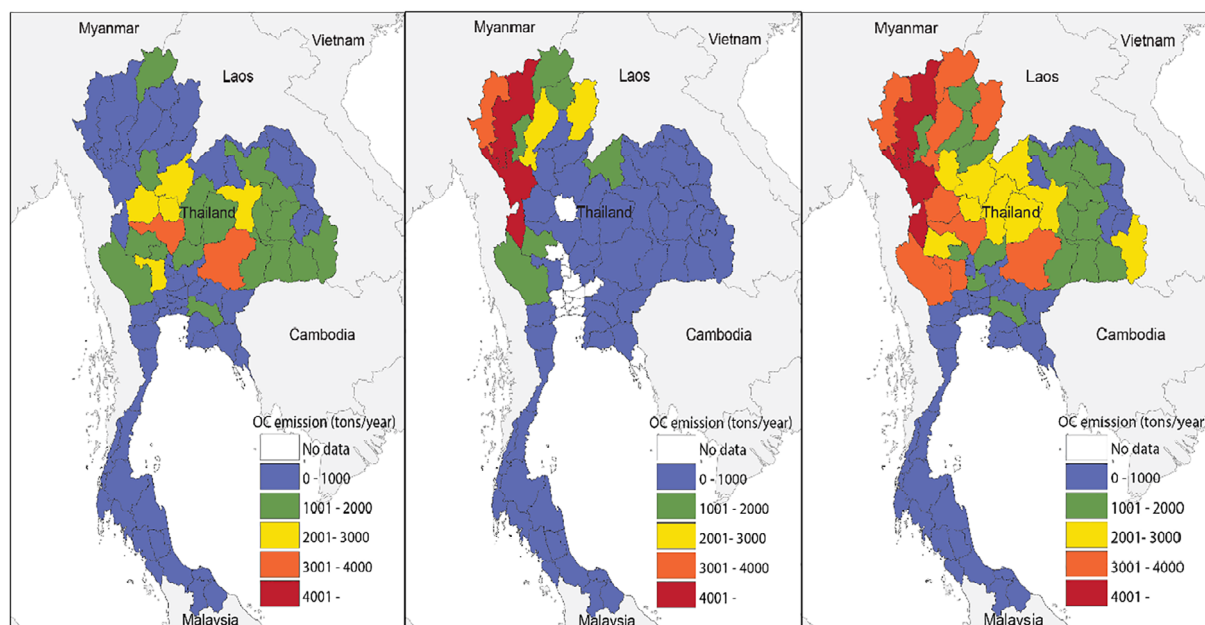
FIGURE 5 (a) Agricultural emissions, b) forest fire emissions; and (c) total biomass burning emissions by annual density and distribution in Thailand (adapted from Phairuang et al., 2019) [Color figure can be viewed at wileyonlinelibrary.com]

countries including Myanmar, Laos, Cambodia and Vietnam, have similar traditions of swidden agriculture (Nikam et al., 2021). In Chiang Mai and surrounding areas, an estimated 90 percent of emissions derive from agricultural burning, and yet neither smallholder farmers nor plantation owners receive any government support or incentives to transition to more sustainable modes of production (11).

The transboundary and slow violence consequences of biomass emissions linked to agriculture are profound but under-reported. Slow violence manifests in the growing numbers of out-migrating Thai farmers whose lives have been made untenable by deteriorating environmental conditions in their natal homes or who are forced to travel to urban centres to pay for the medical expenses of family members suffering the long-term effects of air pollution (Sakdapolrak & Sterly, 2020). This in turn reveals a hidden transboundary governance dimension of agricultural emissions; flows of rural workers have traditionally moved back and forth across jurisdictional borders as a coping strategy in times of crisis and environmental stress by pursuing flexible livelihood opportunities away from home.

As a problem for transboundary governance, agricultural emissions cannot be properly understood as simply a rural or agrarian problem. Just as urban commodity demands drive unsafe burning practises in rural areas, the consequences of agricultural burning spill across urban–rural boundaries and jurisdictional borders to penetrate the heart of urban settlements. Thailand's crop-burning season between January and April tends to be associated with northern rural areas (11). This generates impacts that are experienced locally as livelihood losses, increased mortality rates and hospital admissions (Mostafanezhad, 2021). According to one estimate, these combined factors reduce life expectancy by up to 4 years in the northern city of Chiang Mai (Roengjit, 2019). Transboundary flows of airborne pollutants from sugarcane and rice burning also contribute 24–38 percent

of aggregate air pollution in Bangkok (ChooChuay et al., 2020; Thailand Clean Air Network, 2020), though a small portion likely originates from Cambodia (12, Bangkok Post, 2019).

Sugarcane production offers one example of the transboundary governance dimensions of agricultural emissions and the slow violence that underpins this lucrative industry. Thailand's sugarcane industry, which relies on biomass burning to accelerate harvesting, generates over 1.5 million jobs nationwide and revenues of around $US6 billion annually. Thailand exports around 70–75 percent of its sugar to low-tariff ASEAN countries and ranks second globally, behind Brazil. Industry competition is institutionalised by the 1984 Cane and Sugar Act, which legislates a quota system and distribution mechanisms between growers and millers (Manivong & Bourgois, 2017). With wealthy owners of sugar companies holding the balance of power in this industry, the Thai government has taken 'a kid gloves' approach to environmental governance since 'setting back billionaire families is not exactly this government's priority' (19).

Set against the economic benefits of sugarcane production, its environmental consequences for air quality are severe. Sugarcane burning accounts for between 60 and 67 percent of production (Manivong & Bourgois, 2017; Thailand Clean Air Network, 2020), and incomplete combustion leaks toxic black carbon emissions (Nikam et al., 2021). Because crop burning takes place during the cooler, high-pressure months of November to April, there is little wind to disperse the smoke, resulting in chronic haze pollution over Thailand's northeast and central provinces where sugarcane is grown (ibid).

Here, it is important to recognise that agricultural burning is just as much a symptom of slow violence as it is a cause of it. Because the Thai 'government doesn't give any money or machines' (2) or stipulate a minimum wage for cane cutters, smallholders with fluctuating incomes and ongoing production costs are forced to pollute their own

homelands (Pajai, 2020). Rather than offer sustainable livelihood alternatives, such as subsidising the use of machinery to clear excess biomass, the government tends to comply with the requests of agribusiness companies and farmer groups to relax the percentage of burnt sugarcane that they can then legally sell (2). Farmers say burning is cheaper, faster and requires less labour than mechanised harvesting machines, which are used less than 10 percent of the time (Manivong & Bourgois, 2017). As an Agricultural Promotion Department officer explained, 'The (harvesting) machine is very expensive. Most farmers are poor. They won't use it' (14). Many hired cutters refuse to work if they are unable to harvest using burning methods because they are paid by output rather than hourly wages (14, 18). Farmers locked into contract farming schemes feel pressured to deliver sugarcane on time to the millers (15). For these reasons, even after the Ministry of Agriculture imposed a burning ban in 2019, numerous sugarcane farmers circumvented it by burning their fields at night (Mostafanezhad & Evrard, 2021; Phumruang, 2020). As one Chiang Mai-based scholar reasoned, 'How can we expect farmers to stop burning their land if they do not receive sufficient extension services and equitable contracts with agricultural corporations to promote sustainable, environmentally-sensitive practises?' (Bangkok Tribune, 2019).

The same power imbalances that underpin sugarcane production contribute to transboundary haze pollution in other agricultural sectors. Thailand, a global rice producer employing around 3.7 million farmer households to cultivate 10 million hectares (Hazlegreaves, 2020), burns over 4 million tonnes of rice straw annually, with the emissions dispersed across multiple provincial boundaries in the central, lower northern and north-eastern provinces (Junpen et al., 2018). A Ministry of Environment and Natural Resource consultant observed that 'Farmers in Central Thailand grow rice three times per year. Every time they burn waste, it causes air pollution in Bangkok' (15). Lacking time and machinery to clear their lands between growing cycles, farmers resort to burning as the fastest method to remove excess biomass and kill pests and weeds (Nikam et al., 2021).

In maize production, too, contract farmers frequently circumvent government bans on agricultural burning to meet production targets set by private agribusinesses. This constitutes a form of slow violence as it jeopardises the health of contract farmers while reinforcing unequal power relations to their long-term detriment as a short-term strategy to avoid indebtedness (Greenpeace Southeast Asia, 2020). Subsistence farmers with limited access to agricultural lands have also become increasingly indebted to large agribusinesses since 2012 due to falling global commodity prices, combined with fluctuating yields and reduced government subsidies (Mostafanezhad & Evrard, 2021). Consequently, they are under continual pressure to produce high-yielding crops to repay debts instead of investing in sustainable technologies and mechanised methods of clearing land that do not rely on the use of fire.

At the transnational scale, Thailand's Northern provinces in particular suffer from the impacts of transboundary haze from agricultural burning in neighbouring countries. NASA satellite data between December 2018 and May 2019 revealed 6879 hotspots of heightened fire risk in maize plantations in upper northern Thailand compared with 14,828 hotspots in maize plantations in neighbouring Myanmar's Shan State (Bangkok Tribune, 2019). A Bangkok-based environmental science professor estimated that 'The majority of hot spots are located outside Thailand, about 70%. They are all in our neighbouring countries' (13). While this figure has not been independently verified, all maize-producing countries in mainland Southeast Asia, including Thailand, have sought to accelerate national production in recent years to meet growing regional demand, especially from China, which uses maize to feed livestock used for meat consumption (Blake et al., 2019). Thai agribusiness conglomerates that profit from this boom in maize exports have been protected from liability by successive Thai governments. For example, Woods (2015) found that maize became the main cash crop in Myanmar due to industrial maize contract farming schemes promoted by Charoen Pokphand (CP), Thailand's largest private company, to supply China's chicken-feed market. In the sugar industry, Thailand's major producers, Mitr Phol Sugar, and Khon Kaen Sugar Industry, have both expanded into Cambodia and Laos with plantation-style operations spanning tens of thousands of hectares (Hirsch, 2020a). To date, there have been virtually no public campaigns to boycott maize, sugar or sugarcane or discussions to penalise transgressions of sustainable industry standards by these supranational actors. Instead, indebted smallholder farmers who themselves must bear the heavy costs of agricultural and other forms of air pollution continue to be cast as the primary perpetrators (Dejsupa, 2021).

7 | BARRIERS AND OPPORTUNITIES TO TRANSBOUNDARY COOPERATION

Our examination of three types of air pollution found in Thailand directs attention towards urban, peri-urban and rural settings in which slow violence is inflicted upon marginal sections of Thai society. While vehicular, industrial and agricultural emissions are more concentrated in particular parts of Thailand, they are incubated and perpetuated at higher scales of governance through the policy choices of political and business elites, institutional competition among government departments, and inadequate legislation to regulate safe industry standards (Marks & Breen, 2021). The transboundary governance consequences of these choices are experienced at the grassroots level in the form of out-migration to other jurisdictions by impacted people from heavily polluted areas and in the differentiated public health outcomes between more and less affluent populations that shape life opportunities in ways that remain unacknowledged in official discourses and which occur out of sight, especially when health conditions are only revealed over extended timeframes.

In each of the three types of air pollution described in this study, institutional barriers pose ongoing obstacles to the formulation of more effective and inclusive forms of environmental action. In Thailand's capital city of Bangkok, the government's lack of investment in outdated public transport infrastructure and a national culture that reifies car ownership adds to the slow violence of vehicular emissions against poor and near-poor residents, informal workers and

commuters who are unable to afford vehicle ownership, air purifiers or private health insurance. Here, the boundaries of exclusion from protection against air pollution manifest within and between neighbourhoods and extend well beyond the borders of Bangkok's city limits to impact commuter workers and compromise the air quality of surrounding jurisdictions. In Thailand's peri-urban areas where factories are most concentrated, industrial emissions similarly impact socioeconomically marginal workers and their communities while reinforcing power asymmetries that privilege factory owners who drive pollution and typically reside in distant localities. Both industrial and agricultural emissions are aggravated by a lack of political will to regulate and legally enforce cleaner modes of production. In rural areas where a combination of land scarcity and unabated commodity demands push agricultural production ever deeper into forests and conservation areas, biomass burning is occurring on an unprecedented scale. Like traditional societies elsewhere in Southeast Asia, swidden agriculture in Thailand has long been used to remove excess organic matter, kill pests and prepare lands for planting in smallholdings using safe burning practises that establish fire breaks within a controlled perimeter during favourable wind and weather conditions (Miller, 2021b). Yet the unregulated burning on large plantations by sugarcane, rice and maize conglomerates devalues and displaces this intergenerational knowledge and the communities whose livelihoods have long depended on it, forcing outmigration and transitions into uncertain and often precarious livelihoods.

In Southeast Asia, where the governance of transboundary air pollution is 'left to the legal and policing mechanisms of the state in question' (Hirsch, 2020b), Thailand has experienced setbacks in effectively governing air quality at both the international and national levels due to the blurring of boundaries between state and private business interests. For this reason, Thailand has historically demonstrated a reluctance to work cooperatively with neighbouring countries in addressing air pollution by carefully avoiding this topic during ASEAN ministerial meetings (7, 16). As an NGO representative explained:

> The Ministry of Foreign Affairs said that this is not our role to bring up transboundary haze (at ASEAN) but that it should come from PCD. There was no political will. If they (the Thai government) tabled this discussion, it may backfire. Other countries might ask so who is burning and how do you manage your own air pollution? (7)

A symptom of the close relationship between successive Thai governments and profitable but polluting companies has been the emergence over time of legislative gaps that afford impunity to the major perpetrators of the slow violence of air pollution. As a Greenpeace official explained: 'There is a gap in the law—these companies who invest overseas in maize setup a shell company in other countries where they have no responsibility for human rights violations and the Thai law cannot do anything' (16). Thailand's lead agency responsible for this issue, the PCD, lacks sufficient political will and has limited legal authority. Its mandate is restricted to monitoring

and reporting PM and other airborne pollutants, not to enforce legal compliance by fining or incarcerating polluters (3, 6, 16). For example, the PCD can report factories that emit hazardous pollutants to the National Environment Board, but only the DIW has the power to fine them, which creates a conflict of interest due to the latter's own mandate to promote industrial growth (3, 4, 7).

Within Thailand's partially decentralised and fragmented state system, these institutional barriers to cooperation exist both between jurisdictions and within and among government agencies (Marks & Lebel, 2016). State agencies operate in a silo structure that encourages inter-agency competition over power and resources while simultaneously facilitating the deferral of responsibility for air pollution to others. This situation creates policy incoherence and allows conflicting agendas to operate, even within the same agency (cf. Sandström et al., 2020). For instance, the BMA has endeavoured to reduce air pollution in Bangkok by spraying water and installing air monitoring towers (16). At the same time, in contrast to Japanese local governments (Fujikura, 2011), it has done nothing to reduce the underlying problem of vehicular emissions, which could be achieved by strengthening public transport services and infrastructures. As a UNEP official explained, 'For many years BMA never put any effort to manage pollution even though they have so much funding' (17).

Similar conflicts of interest allow financial benefits to accrue to local officials, eroding state authority from within by diverting state resources that could otherwise be invested into the alleviation of air pollution and its cascading effects. We see this in the reluctance among certain provincial governors to fulfil their responsibility to report illegal agricultural burning practises. That these governors are not held accountable for their non-compliance with environmental legislation is indicative both of the opportunities that exist for personal enrichment and the gaps in legal authority in the absence of any over-arching monitoring and law enforcement regime (14, 16).

As a starting point to bridging these legal and political gaps, consensus is urgently needed to better align public-private-state interests around a commitment to protect clean air as a public good. This would entail debunking the popular myth in government and business circles that air pollution is an unavoidable by-product of economic growth (3). A Greenpeace official believes it is for this reason that 'in the government's action plan on air pollution, they don't mention anything about factories' (16). For their part, industries such as automobile companies, agribusiness corporations and factory owners have long tried to justify their emissions by claiming that their contributions to economic growth constitute a national good. To combat this hegemonic narrative, environmental NGOs have convened public awareness campaigns about the dangers of breathing air pollution (2, 4, 7, 10), but a Thai NGO leader lamented that 'most people don't know about air pollution and how it affects their health.' More optimistically, however, a Thai scholar activist pointed out that 'PM2.5 is a new word in the Thai vocabulary. Nobody knew about PM2.5 until the last three years' (2). If public awareness continues to grow, he reasoned, then this could provide a spur for government action because public pressure 'forces the government to do something and pushes ministries to work together' (2).

As the genesis of such a movement against air pollution, in September 2020, civil society organisations including the Thai Clean Air Network and Greenpeace submitted a Thai Clean Air Act petition containing over 24,300 signatures to the national parliament. Should their efforts eventually succeed, a Clean Air Act in Thailand could provide the basis for connecting with similar legislation already in place in the USA, the UK and Singapore. Notwithstanding the shortcomings of clean air legislation elsewhere, it represents a vital first step toward acknowledging the severity of the problem and committing to improve air quality standards in compliance with global industry standards of best practise. Additionally, Thai activists hope that a Thai Clean Air Act could provide a 'citizen air platform' to stem the slow violence of pollution's unequal distribution by including rights of participation for all Thai citizens to monitor and enforce air quality within and between neighbourhoods (7). Granting a political voice to the most vulnerable could encourage the Thai government to recognise the slow violence of air pollution's many hidden effects. Without such recognition, it will be impossible to overcome existing barriers to cooperation and to hold the perpetrators accountable for their far-reaching transgressions.

8 | CONCLUSIONS

This transboundary political ecology analysis has directed attention toward the slow violence of air pollution through its uneven distribution within and between urban, peri-urban and rural areas. We have argued that this slow violence should be conceived and acted upon as a transboundary phenomenon because the dynamic properties of airborne pollutants defy border controls to (re)produce social and spatial inequalities. These hidden and concealed dimensions of air pollution disproportionately affect the long-term health, livelihoods and life opportunities of socially vulnerable and economically marginal Thai citizens. This slow violence is driven and tacitly endorsed by higher scales of business and political interests that profit from pollution-inducing forms of growth, namely, the owners of agribusinesses, factory owners and automobile corporations, who can afford to spatially and temporally remove themselves from air pollution's worst effects.

We have also argued that redress for the slow violence of air pollution requires transboundary forms of environmental stewardship that traverse jurisdictions, silos of governmental authority and sectors. It is especially important that such collective stewardship actively include the voices of marginal Thai citizens whose prolonged experience of toxic exposure produces spaces of exception, within which, their biological sub-citizenship remains unaccounted for in official narratives about pollution's costs. This oversight needs to be redressed to dispel the myth that pollution is an unavoidable consequence of national growth and to mitigate the staggered injustice of human casualties. The foundation for a more inclusive and equitable politics of environmental action thus needs to emphasise the subordination of short-term economic gains to a longer-term agenda that takes considerations of socioecological justice and environmental sustainability as its core (cf. Kronenberg, 2013).

The Thai Clean Air Act proposed by civil society actors holds promise as the basis for one such collaborative response to air pollution. While legislation is never a solution in and of itself, a formal commitment to protecting air quality would provide a legal foundation for developing networked and multi-stakeholder environmental partnerships and programs currently lacking in Thailand. Of equal importance, formal recognition of air quality as a common good is vital to ensuring wider protections and fairer forms of compensation for exposure to the slow, unequal violence of air pollution.

Further research is needed to develop pathways for diverse actors and institutions to work together in their shared interest of combatting air pollution across jurisdictions and property boundaries. Regional and urban political ecology studies of air pollution have provided valuable insights into the macro-level dynamics and extended urban processes that drive contamination of the air. Building on these contributions, the still nascent field of transboundary political ecology can further extend our understanding of opportunities that exist, or could be created, to facilitate cross-border flows of knowledge, funding, expertise and technologies in the service of providing redress for air pollution's unequal social outcomes at different scales of environmental governance.

ORCID

Danny Marks https://orcid.org/0000-0003-0833-880X
Michelle Ann Miller https://orcid.org/0000-0003-3375-8398

REFERENCES

Angelo, H., & Wachsmuth, D. (2015). Urbanizing urban political ecology: A critique of methodological Cityism. *International Journal of Urban and Regional Research*, 39(1), 16–27.

Auyero, J., & Swistun, D. (2008). The social production of toxic uncertainty. *American Sociological Review*, 73(3), 357–379.

Bangkok Tribune. (2019). Anti-pollution groups urge ASEAN leaders to curb transboundary haze as the 35th ASEAN summit opens. Bangkok Tribune. https://bkktribune.com/anti-pollution-groups-urge-asean-leaders-to-curb-transboundary-haze-as-the-35th-asean-summit-opens/

Blake, D. J. H., Thiengburanathum, P., Thiengburanathum, P., Friend, R. M., Doherty, B., & Thankappan, S. (2019). Chapter two– looking at complex agri-food systems from an actor perspective: The case of northern Thailand. In D. Barling & J. Fanzo (Eds.), *Advances in food security and sustainability* (Vol. 4, pp. 33–65). Elsevier.

Board, J. (2020). Greener and cleaner: Reimagining our cities in the wake of COVID-19. Channel News Asia https://www.channelnewsasia.com/news/asia/covid-19-greener-cleaner-cities-urban-planning-southeast-asia-12783362

Bollen, J., & Brink, C. (2014). Air pollution policy in Europe: Quantifying the interaction with greenhouse gases and climate change policies. *Energy Economics*, *46*, 202–215.

Bryant, R. L. (1998). Power, knowledge and political ecology in the third world: A review. *Progress in Physical Geography*, *22*, 79–94.

Budget Direct Insurance. (2021). Why are cars so expensive in Singapore? https://www.budgetdirect.com.sg/car-insurance/research/why-are-cars-so-expensive-in-singapore

Buzzelli, M. (2008). A political ecology of scale in urban air pollution monitoring. *Transactions of the Institute of British Geographers*, *33*(4), 502–517.

ChooChuay, C., Pongpiachan, S., Tipmanee, D., Suttinun, O., Deelaman, W., Wang, Q., Xing, L., Li, G., Han, Y., Palakun, J., & Cao, J. (2020). Impacts of PM2.5 sources on variations in particulate chemical compounds in ambient air of Bangkok, Thailand. *Atmospheric Pollution Research*, *11*(9), 1657–1667.

Collins, T. W. (2010). Marginalization, facilitation, and the production of unequal risk: The 2006 Paso del Norte floods. *Antipode*, *42*(2), 258–288.

Davies, T. (2018). Toxic space and time: Slow violence, necropolitics, and petrochemical pollution. *Annals of the American Association of Geographers*, *108*(6), 1537–1553.

Davis, N. (2020). Outdoor air pollution cuts three years from human lifespan—Study. The Guardian https://www.theguardian.com/environment/2020/mar/03/outdoor-air-pollution-cuts-three-years-from-human-lifespan-study

Dejsupa, T. (2021). Ceasing fire: Thai sugar farmers struggle to change polluting ways. NHK World https://www3.nhk.or.jp/nhkworld/en/news/backstories/1497/

Economist Intelligence Unit. (2019). All choked up: Thailand's air pollution. http://www.eiu.com/industry/article/1477870931/all-choked-up-thailands-air-pollution/2019-04-04

Fischer, C. (2021). The mother of corruption. *Water Science Policy*. https://doi.org/10.53014/ZBHV5554

Foreign haze "contributing" to pollution. (2019). Bangkok Post. https://www.bangkokpost.com/thailand/general/1617894/foreign-haze-contributing-to-pollution

Fotiou, S., & Perkins, M. (2021). Deciphering the black box of air pollution data in Thailand. *United Nations ESCAP* https://www.unescap.org/blog/deciphering-black-box-air-pollution-data-thailand

Fujikura, R. (2011). The influence of local governments on national policy-setting processes to regulate Japan's vehicle emissions. *Environmental Policy and Governance*, *21*(5), 309–324.

Graham, S. (2015). Life support: The political ecology of urban air. *City*, *19*(2–3), 192–215.

Greenpeace Southeast Asia. (2020). Maize, land use change, and transboundary haze pollution. *Greenpeace* https://www.greenpeace.org/southeastasia/publication/4117/maize-land-use-change-and-transboundary-haze-pollution

Harvey, D. (2005). *A brief history of neoliberalism*. Oxford University Press.

Hazlegreaves, S. (2020). Agricultural practices in Thailand maximise rice production and cultivation. *Open Access Government* https://www.openaccessgovernment.org/agricultural-practices-in-thailand-maximise-rice-production-and-cultivation/89275/

Hirsch, P. (2020a). Limits to neoliberal authoritarianism in the politics of land capitalisation in Thailand: Beyond the paradox. *Canadian Journal of Development Studies/Revue Canadienne d'études Du Développement*, *41*(3), 363–380.

Hirsch, P. (2020b). Scaling the environmental commons: Broadening our frame of reference for transboundary governance in Southeast Asia. Asia Pacific Viewpoint.

Janssen, P. (2018). Bangkok's bad air driven by car-making success. Asia Times https://www.asiatimes.com/2018/04/article/bangkoks-bad-air-driven-by-car-making-success/

Junpen, A., Pansuk, J., Kamnoet, O., Cheewaphongphan, P., & Garivait, S. (2018). Emission of air pollutants from rice residue open burning in Thailand, 2018. *Atmosphere*, *9*(11), 449.

Kongtip, P., Thongsuk, W., Yoosook, W., Chantanakul, S., & Singhaniyom, S. (2008). Health effects of air pollution on street vendors: A comparative study in Bangkok. *Thai Journal of Toxicology*, *23*(1), 5–5.

Kronenberg, J. (2013). Linking ecological economics and political ecology to study mining, glaciers and global warming. *Environmental Policy and Governance*, *23*(2), 75–90.

Lelieveld, J., Pozzer, A., Pöschl, U., Fnais, M., Haines, A., & Münzel, T. (2020). Loss of life expectancy from air pollution compared to other risk factors: A worldwide perspective. *Cardiovascular Research*, *116*(11), 1910–1917.

Lindsay, S. (2019). Thailand's wealth inequality is the highest in the world: What will this mean for the upcoming elections? ASEAN Today https://www.aseantoday.com/2019/01/thailands-wealth-inequality-is-the-highest-in-the-world-what-does-this-mean-for-upcoming-elections/

Manivong, P., & Bourgois, E. (2017). White paper: Thai sugarcane sector & sustainability. FairAgora https://www.bonsucro.com/white-paper-thai-sugarcane-industry-sustainability-released/

Marks, D. (2015). The urban political ecology of the 2011 floods in Bangkok: The creation of uneven vulnerabilities. *Pacific Affairs*, *88*(3), 623–651.

Marks, D. (2019). Assembling the 2011 Thailand floods: Protecting farmers and inundating high-value industrial estates in a fragmented hydro-social territory. *Political Geography*, *68*, 66–76.

Marks, D. (2020). An urban political ecology of Bangkok's awful traffic congestion. *Journal of Political Ecology*, *27*(1), 732–758.

Marks, D., & Breen, M. (2021). The political economy of corruption and unequal gains and losses in water and sanitation services: Experiences from Bangkok. *Water Alternatives*, *14*(3), 795–819.

Marks, D., & Elinoff, E. (2020). Splintering disaster: Relocating harm and remaking nature after the 2011 floods in Bangkok. *International Development Planning Review*, *42*(3), 273–294.

Marks, D., & Lebel, L. (2016). Disaster governance and the scalar politics of incomplete decentralization: Fragmented and contested responses to the 2011 floods in Central Thailand. *Habitat International*, *52*, 57–66.

Marks, D., Miller, M. A., & Vassanadumrongdee, S. (2020). The (geo)political economy of Thailand's marine plastic pollution crisis. *Asia Pacific Viewpoint*, *61*(2), 266–282.

Mejia, S. A. (2020). Global environmentalism and the world-system: A cross-national analysis of air pollution. *Sociological Perspectives*, *63*(2), 276–291.

Miller, M. A. (2020). Bordering the environmental commons. *Progress in Human Geography*, *44*(3), 473–491.

Miller, M. A. (2021a). A transboundary political ecology of volcanic sand mining. *Annals of the American Association of Geographers*, *112*(1), 78–96.

Miller, M. A. (2021b). Market-based commons: Social agroforestry, fire mitigation strategies and green supply chains in Indonesia's peatlands. *Transactions of the Institute of British Geographers*.

Miller, M. A., Middleton, C., Rigg, J., & Taylor, D. (2020). Hybrid governance of transboundary commons: Insights from Southeast Asia. *Annals of the American Association of Geographers*, *110*(1), 297–313.

Mostafanezhad, M. (2021). The materiality of air pollution: Urban political ecologies of tourism in Thailand. *Tourism Geographies*, *23*(4), 855–872.

Mostafanezhad, M., & Evrard, O. (2021). Chronopolitics of crisis: A historical political ecology of seasonal air pollution in northern Thailand. *Geoforum*, *124*, 400–408.

Namin, S., Xu, W., Zhou, Y., & Beyer, K. (2020). The legacy of the home owners' loan corporation and the political ecology of urban trees and air pollution in the United States. *Social Science & Medicine*, *246*, 112758.

Nikam, J., Archer, D., & Nopsert, C. (2021). *Air quality in Thailand*. Stockholm Environment Institute.

Nixon, R. (2011). *Slow violence and the environmentalism of the poor*. Harvard University Press.

Omri, A., & Hadj, T. B. (2020). Foreign investment and air pollution: Do good governance and technological innovation matter? *Environmental Research*, *185*, 109469.

Pajai, W. (2020). Burning dilemma: Sugarcane farmers struggle in Thailand's green vision. *Southeast Asia Globe* https://southeastasiaglobe.com/thailand-sugarcane-burning/

Pangsapa, P. (2014). Environmental justice and civil society: Case studies from Southeast Asia. In P. G. Harris & G. Lang (Eds.), *Routledge handbook of environment and society in Asia* (pp. 36–52). Routledge.

Pangsapa, P., & Smith, M. J. (2008). Political economy of southeast Asian borderlands: Migration, environment, and developing country firms. *Journal of Contemporary Asia*, *38*(4), 485–514.

Paoin, K., Ueda, K., Ingviya, T., Buya, S., Phosri, A., Seposo, X. T., ... Honda, A. (2021). Long-term air pollution exposure and self-reported morbidity: A longitudinal analysis from the Thai cohort study (TCS). *Environmental Research*, *192*, 110330.

Phairuang, W., Suwattiga, P., Chetiyanukornkul, T., Hongtieab, S., Limpaseni, W., Ikemori, F., Hata, M, & Furuuchi, M. (2019). The influence of the open burning of agricultural biomass and forest fires in Thailand on the carbonaceous components in size-fractioned particles. *Environmental Pollution*, *247*, 238–247.

Phongpaichit, P., & Baker, C. (2015). *Unequal Thailand: Aspects of income, wealth and power*. NUS Press.

Phumruang, C. (2020). Sugarcane growers defy burning ban. Bangkok Post https://www.bangkokpost.com/thailand/general/1834734/sugarcane-growers-defy-burning-ban

Pujinda, P., & Yupho, S. (2017). The paradoxical travel behavior of Bangkokians. *Environment-Behaviour Proceedings Journal*, *2*(5), 393–402.

Rangan, H., & Kull, C. A. (2009). What makes ecology political'?: Rethinking scale' in political ecology. *Progress in Human Geography*, *33*(1), 28–45.

Roberts-Davis, T. L., & Saetang, P. (2019). Trading away health and the environment: The toxic business of waste imports into Thailand. Bangkok: Ecological Alert and Recovery–Thailand (EARTH) https://english.arnika.org/publications/trading-away-health-and-the-environment-the-toxic-business-of-waste-imports-into-thailand

Roengjit, S. (2019). The pollution paralysis: Thailand's structural inability to clean up its air. Bangkok Post https://www.bangkokpost.com/thailand/special-reports/1796019/the-pollution-paralysis-thailands-structural-inability-to-clean-up-its-air

Rujivanarom, P. (2019). Activists up in arms over new factory law. The Nation Thailand. http://nationthailand/national/30364470

Saengmanee, P. (2021). Change is in the air. Bangkok Post. https://www.bangkokpost.com/life/social-and-lifestyle/2065723/change-is-in-the-air

Sakdapolrak, P., & Sterly, H. (2020). Building climate resilience through migration in Thailand. Migration Information Source https://www.migrationpolicy.org/article/building-climate-resilience-through-migration-thailand

Salisbury, D. S., de Melo, A. W. F., & Tipula, P. T. (2012). Transboundary political ecology in the Peru-Brazil borderlands: Mapping workshops, geographic information, and socio-environmental impacts. *Revista Geografica*, *152*, 105–115.

Salisbury, D. S., López, J. B., & Vela Alvarado, J. W. (2011). Transboundary political ecology in Amazonia: History, culture, and conflicts of the borderland Asháninka. *Journal of Cultural Geography*, *28*(1), 147–177.

Sandlos, J., & Keeling, A. (2016). Toxic legacies, slow violence, and environmental injustice at Giant mine, Northwest Territories. *Northern Review*, *42*, 7–21.

Sandström, A., Söderberg, C., Lundmark, C., Nilsson, J., & Fjellborg, D. (2020). Assessing and explaining policy coherence: A comparative study of water governance and large carnivore governance in Sweden. *Environmental Policy and Governance*, *30*(1), 3–13.

Scheidel, A., Del Bene, D., Liu, J., Navas, G., Mingorría, S., Demaria, F., ... Temper, L. (2020). Environmental conflicts and defenders: A global overview. *Global Environmental Change*, *63*, 102104.

Siu, J. (2017). The most expensive city in the world to park is no surprise. AutoGuide.Com. https://www.autoguide.com/auto-news/2017/05/the-most-expensive-city-for-parking-is-no-surprise.html

Smedley, T. (2019). *Clearing the air*. Bloomsbury Sigma.

Statistica. (2019). Car ownership in Thailand 2019 https://www.statista.com/statistics/1027960/thailand-car-ownership-among-consumers/

Swyngedouw, E. (1997). Neither global nor local:'glocalization'and the politics of scale. In K. R. Cox (Ed.), *Spaces of globalization: Reasserting the power of the local* (pp. 137–166). Guildford Press.

Thailand Clean Air Network. (2020). Clean air blue paper: Insights on the impact of air pollution and its root causes. Bangkok. https://thailandcan.org/Clean_Air_Blue_Paper_EN.pdf

Thomas, J. (2019). ASEAN lacks crucial data on air pollution. The ASEAN Post https://theaseanpost.com/article/asean-lacks-crucial-data-air-pollution

UNESCAP (2019). The future of Asia and Pacific cities. Transformative pathways toward sustainable development. Bangkok, Thailand: United Nations.

Varkkey, H. (2016). Recent ASEAN developments on peat fires and haze: National responses. *Malaysian Journal of International Relations*, *4*(1), 163–173.

Véron, R. (2006). Remaking urban environments: The political ecology of air pollution in Delhi. *Environment and Planning A*, *38*(11), 2093–2109.

Viwatpanich, K. (2012). Suffering from industrial estate development: A case study in Map Ta Phut, Thailand. International Seminar on Population and Development, Sherubtse College. 32–47.

Wipatayotin, A. (2020). Govt takes flak over haze. Bangkok Post. https://www.bangkokpost.com/thailand/general/1835749/govt-takes-flak-over-haze

Woods, K. (2015). CP maize contract farming in Shan State, Myanmar: A regional case of a place-based corporate agro-feed system (no. 14). BRICS initiative for critical agrarian studies (BICAS).

World Bank (2020). Taking the pulse of poverty and inequality in Thailand. 5th March. https://www.worldbank.org/en/country/thailand/publication/taking-the-pulse-of-poverty-and-inequality-in-thailand (accessed 16 November 2021).

Xing, L., Li, G., Pongpiachan, S., Wang, Q., Han, Y., Cao, J., Tipmanee, D., Palakun, J., Aukkaravittayapun, S., Surapipith, V., & Poshyachinda, S. (2020). Quantifying the contributions of local emissions and regional transport to elemental carbon in Thailand. *Environmental Pollution*, *262*, 114272.

Yamineva, Y., & Romppanen, S. (2017). Is law failing to address air pollution? Reflections on international and EU developments. *Review of European, Comparative & International Environmental Law*, *26*(3), 189–200.

Zawar-Reza, P., & Spronken-Smith, R. (2005). Air pollution climatology. In J. E. Oliver (Ed.), *Encyclopedia of world climatology* (pp. 21–32). Springer Netherlands.

APPENDIX A

Interviewee information

Interview number	Identity	Date interviewed
#1	Bangkok Metropolitan Administration (BMA) officer	29 September 2020
#2	Economics professor at Kasetsart University and member of the Thai Clean Air Network	13 November 2020
#3	Former senior PCD official	25 September 2020
#4	Former head of Electric Vehicle Association of Thailand (EVAT)	30 October 2020
#5	Parliamentary advisor	12 November 2020
#6	Kasetsart University environmental science professor	24 September 2020
#7	Head of a local NGO working on air pollution	6 November 2020
#8	Head of a local NGO working on industrial environmental problems	25 August 2020
#9	Mid-level PCD official #1	23 August 2020
#10	Mid-level local NGO official working on industrial environmental problems	8 November 2020
#11	Chiang Mai University professor researching air pollution	7 November 2020
#12	Mid-level PCD official #2	30 September 2020
#13	National Institute of Development Administration (NIDA) Environmental Science professor	9 November 2020
#14	Agricultural Promotion Department senior official	11 November 2020
#15	Ministry of Environment and Natural Resource (MONRE) consultant	15 October 2020
#16	Greenpeace mid-level official	12 November 2020
#17	United Nations Environment Programme (UNEP) official	19 September 2020
#18	Thai agricultural expert and development consultant	18 January 2021
#19	Thai financial sector consultant	19 January 2021