

## Environmental Governance and Short-lived Climate Pollutants (SLCPs): The Case of Open Burning in Thailand

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### Abstract

Research on short-lived climate pollutants (SLCPs) has been based more on air pollution and energy models than how existing policies affect the model's recommended actions. This article analyses how Thailand's policies influenced attempts to control a critical source of SLCPs: open burning. In 2012, Thailand's Pollution Control Department (PCD) led a cross-agency initiative to combat open burning called the Eight-Point Plan. The Eight-Point Plan offered a wider range of compliance incentives than previously adopted control efforts to control open burning. However, the plan's effectiveness rests on improving the quality/coverage of monitoring data; expanding community engagement; and earmarking multi-year funding for sustained implementation. Introducing these enabling reforms will require strengthening environmental governance. Scholars working on co-benefits and SLCPs would also benefit from making governance more central to their research.

**Key Words:** Open agricultural burning; Short-lived climate pollutants (SLCPs), Eight-point plan; Co-benefits

The views expressed in this working paper are those of the authors and do not necessarily represent those of IGES. Working papers describe research in progress by the authors and are published to elicit comments and to further debate.

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## Introduction

Short-lived climate pollutants (SLCPs)—such as black carbon, tropospheric ozone, and methane—not only threaten local air quality, public health, and crop yields but can destabilise regional and global climate systems. Mitigating SLCPs can hence deliver significant co-benefits. Research on SLCPs has nonetheless focused more on air pollution and energy models than how existing policies affect the model's recommended actions (UNEP/WMO, 2011; UNEP, 2011).<sup>5</sup> This article analyzes how Thailand's policies influenced attempts to control a critical source of SLCPs: open burning.

In 2012, Thailand's Pollution Control Department (PCD) of the Ministry of Natural Resources and Environment (MNRE) led a cross-agency initiative to combat open burning called the Eight-Point Plan. The Eight-Point Plan offered a wider range of compliance incentives than previous efforts to control open burning. However, the plan's effectiveness still rests on improving the quality/coverage of monitoring data; expanding community engagement; and earmarking multi-year funding for sustained implementation. Introducing these enabling reforms will require strengthening environmental governance. Scholars working on co-benefits and SLCPs would also benefit from making environmental governance more central to their research.

The article is divided into five sections. The second section summarizes the potential and limitations of recent research on SLCPs. The third section fills a gap in this literature with a

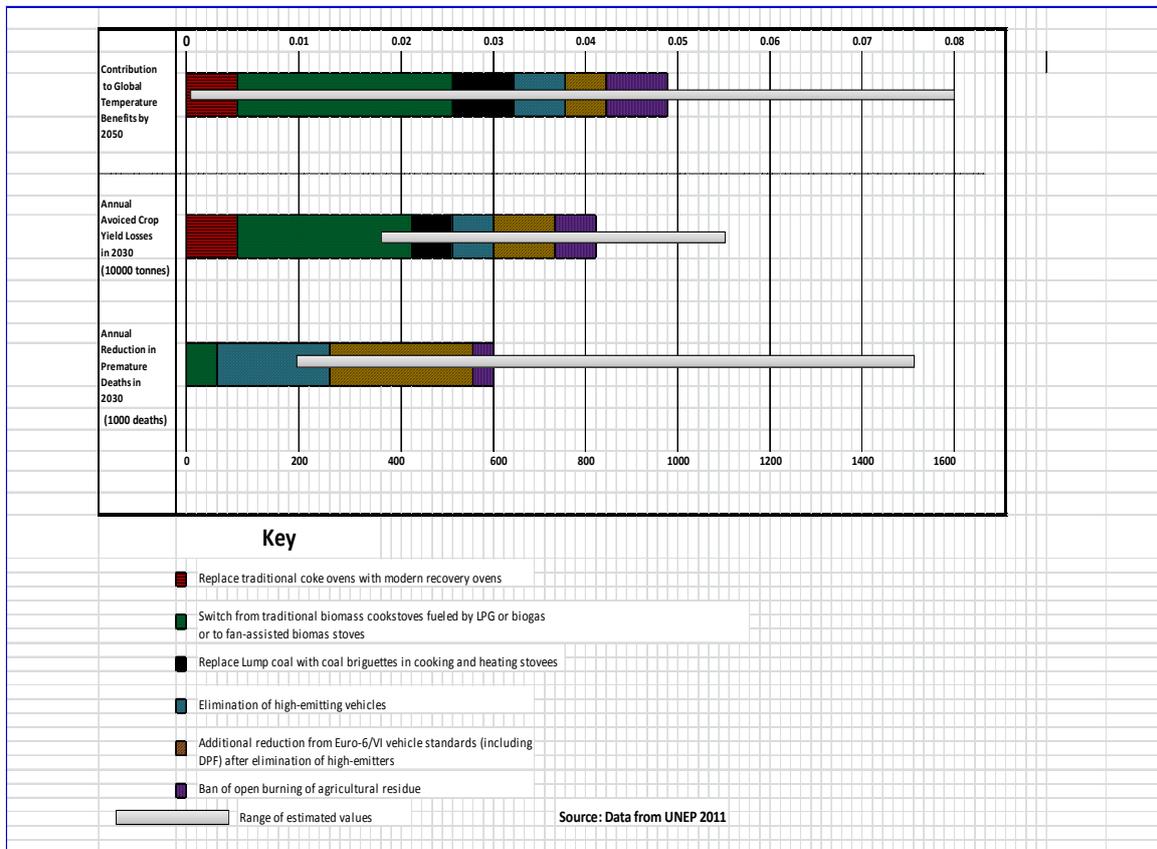
case study of open burning in Thailand. The fourth section provides recommendations for improving the implementation of the Eight-Point Plan. The final section concludes with suggestions for strengthening the link between research on governance and SLCPs. The article draws upon a review of primary documents, stakeholder interviews, and information gathered at meetings organized by Thailand's PCD in Bangkok and Northern Thailand during November 2012-January 2013.

## Literature Review: Bringing in Governance

Developing countries in Asia confront a wide range of local water, waste, and air pollution problems. Many developing countries in Asia have also begun to address these problems with solutions that simultaneously mitigate climate change. The development and climate benefits resulting from these solutions are known as co-benefits (Takemoto, Wada, & Hirofumi, 2012). In recent years, research on co-benefits from SLCPs has drawn steadily more attention (Jacobson, 2002; Ramanathan and Carmichael, 2008). Black carbon, the hard fraction of particulate matter 2.5 (PM<sub>2.5</sub>), has arguably elicited the most interest (Bice et al. 2009). The United Nations Environment Programme (UNEP) has identified 16 priority measures for black carbon, tropospheric ozone, and methane that could cut global warming by an estimated 0.5°C by 2050. Mitigating SLCPs can hence deliver significant co-benefits. This potential is projected to be especially sizable in Asia (UNEP/WMO, 2011; UNEP, 2011) (see Figure 1).

<sup>5</sup> The models are the Institute for Applied Systems Analysis (IIASA) Greenhouse Gas-Air Pollution Interactions and Synergies model, National Aeronautic Space Administration (NASA) Goddard Institute for Space Studies (GISS) model, the Max Planck Institute's ECHAM model, and the FASST Scenario Screening Tool (TM5-FASST).

**Figure 1: Climate, Health and Crop Benefits from Black Carbon Measures in North East Asia, South East Asia and Pacific**



Many of the SLCP technical measures listed in Figure 1 involve implementation of existing air pollution policies (including banning of open burning of agricultural residues). Research has nevertheless focused more on energy and air pollution simulation models than the performance of these policies. There is hence significant opportunity to integrate work on SLCPs with research that draws upon actual case studies on policy enforcement. Many of the issues related to policy enforcement feature prominently in work on environmental governance. Several points from environmental governance literature merit underlining.

To begin, clean air—like many environmental amenities—is a public good. For nearly five decades, scholars have maintained that providing environmental public goods like

clean air means formulating “coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated (Hardin, 1968) Command-control and market-driven instruments are the two most distinctive approaches to the provision of environmental public goods.

Command-control instruments place the onus on government agencies to set and ensure compliance with environmental standards. This is often accomplished in a top-down manner through mandated changes in abatement technologies or production processes. Penalties and sanctions, ranging from fines to criminal charges, persuade emissions sources to comply with standards. Market-driven instruments

originated in response to the overly restrictive nature of the command-control approach. Rather than authorizing government agencies to decide how to meet standards, market-driven instruments employ financial incentives (from tradable permits to tax rebates) to encourage sources to identify their own abatement techniques (Karp & Gaulding, 1995). The market-driven approach is decidedly more bottom-up in orientation; it gives sources greater discretion to select their own means of compliance. While there are several differences between command-control and market-driven instruments, arguably the most fundamental divide is whether they force compliance from above or provide incentives from below.

The success of market-driven instruments also hinge on government agencies enabling their implementation. In particular, government agencies will need to:

- 1) Provide up-to-date monitoring of pollution levels and air quality to understand the severity of the problem;
- 2) Inform the general public of the current status and recommend preventive measures as well as share successful examples of more sustainable alternatives among sources; and
- 3) Provide a stable financial base for monitoring, information sharing and support shifts to more sustainable practices.

As will be demonstrated by the case of open burning, introducing these enabling reforms requires not only coordinating between multiple stakeholders but doing so at multiple levels. To the extent that literature has analyzed the role of governance in the case of open burning, it has focused chiefly on the political reasons for Indonesia's longstanding resistance (at the national level) to ratifying the ASEAN

Agreement on Transboundary Haze Pollution (at the regional level) (Jones, D.S. 2006; Nguitragool, 2011).<sup>6</sup> While the interplay between the regional and national level is indeed critical, there are also important multi-level dynamics within countries that warrant deeper understanding. The case of open burning in Thailand provides a useful window into those dynamics.

### **Case Study: Open Burning in Thailand**

The main sources of open burning in Thailand are agriculture land clearing and forest fires. Agricultural burning is commonly practiced for post-harvest land clearing on rice, sugarcane, maize, and other crops as well as removing unwanted insects and pests. Burning is believed to be the cheapest and fastest way to clear land before planting the next crop. Agricultural burning is not always controlled properly and can easily spread to forests. When it spreads, communities in Thailand tend to let the fires run their natural course: approximately 5% of forest fires occur naturally without the spread of flames from agricultural land clearing according to interviews for this project.

This results in what is increasingly known as Thailand's haze problem. The problem reached crisis proportions for the first time in 2007.<sup>7</sup> Since 2007, dust particles from the haze have exceeded standards for longer durations (at

<sup>6</sup> The ASEAN Agreement on Transboundary Haze's origins trace back to the 1980s when smoke from forest fires in Indonesia's Kalimantan provinces began to cause problems for public health in surrounding areas. The Agreement calls on members to develop their own plans to reduce forest and agricultural fires; establishes a Haze Pollution Fund to support fire fighting efforts; and clarifies parties could request or offer assistance to other parties through the ASEAN Coordinating Center on Transboundary Haze for joint emergency responses. Despite steps forward, Indonesia's unwillingness to ratify the treaty has led some to render the agreement a "paper tiger" (Nguitragool 2002).

<sup>7</sup> The PCD therefore warned people in affected areas to stay indoors to reduce exposure to the haze.

least seven consecutive days) earlier in the year (starting in February and peaking in March) across wider areas (above standard recording are routinely observed in multiple stations in Northern Thailand). The costs of the haze have also become increasingly evident. In 2012, the number of people suffering from haze-related ailments increased markedly as wildfires ravaged large tracts of forest land. To make matters worse, recent forecasts anticipate that dry weather will exacerbate the problem; open burning could become more common in a warmer climate (Keywood et al., 2013).

### *The Policy Landscape*

Pollution control is supervised by the PCD, established in 1992 within the Ministry of Natural Resources and Environment (MNRE). The PCD plays a pivotal role in developing and

implementing air pollution policies (Figure 1). It also works closely with other agencies such as Office of Environmental Policy and Planning (ONEP), the lead voice on all environmental policies and financing in the MNRE. In the case of open burning, the Ministry of Agriculture and Forestry at the national level as well as provincial governments and sub-district administrative organisations (SAO) contribute to the formulation and implementation of activities. The scope and details of air pollution abatement activities are spelled out in the Enhancement and Conservation of National Environmental Quality Act (NEQ) B.E. 2535, 1992 (passed in 1976 and revised in 1992). Air quality is controlled under national ambient air quality standards (NAAQs) under this Act.

**Figure 2: PCD Organizational Chart**



### **Source: PCD**

Thailand's open burning problem first came to the attention of policymakers through the ASEAN Agreement on Transboundary Haze Pollution. Signed by all ten ASEAN Member

Countries in 2002, the Agreement unites signatories in a shared commitment to tackling transboundary pollution from land and forest fires. While Indonesia's reluctance to ratify has limited its effectiveness, the Agreement has

helped raise awareness of the severity and impacts of open burning in Thailand (Tipayarom, Thi, & Oanh, 2007).

### *Early Control Efforts*

The Thai government made several attempts to control open burning as a result of this growing awareness over the past decade. In 2007, the then Prime Minister, General Surayuth Chulanon, established the “Forest Fire and Haze Committee for Northern Provinces (8 provinces).” However, the committee was terminated in January 2008 after General Surayuth stepped down from office. Less than a year later, Thailand’s then newly elected Prime Minister, Mr. Abhisith Vejachiva, took a similar approach by issuing order no. 126/2009 to establish a “National Haze and Forest Fire Committee” and assigned the MNRE to serve as Chairperson. But even with the high-profile appointments a lack of interagency cooperation and budgeting insufficiency also achieved limited success.

In 2010, the National Haze and Forest Fire Committee issued order no. 1/2010 to set up a subcommittee for eight Northern Provinces. The subcommittee was tasked with 1) identifying countermeasures and developing action plans to address the haze problem; 2) improving public relations with local stakeholders; and 3) supervising operations in the provinces. In addition, the subcommittee established provincial coordination centres to develop working plans and monitoring methodologies as well as coordinating

information collection and dissemination with central, regional, and provincial sources. The plan nevertheless suffered a fate similar to the other control efforts. In consequence, the haze problem was left largely unaddressed while the number of forest fires grew to at least 1,000 and as much as 2,500 between 2007 and 2012.

### *The Eight-Point Plan*

By 2012 the open burning issue had drawn growing attention from the media, which led the current Prime Minister, Yingluck Shinawatra, to task the MNRE (and the PCD) with drafting plans to ban outdoor fires during peak periods (Bangkok Post, 2012). Following that request, the PCD began holding meetings to brainstorm countermeasures for the coming dry season. The PCD gradually expanded the scope of that dialogue to include not only several divisions in the MNRE but local officials from affected communities. This consultative process produced what was initially a Nine-Point Plan.

In early December 2012, the PCD submitted the Nine-Point Plan to the cabinet and received approval in early January 2013. Revisions during the review process merged the first and second point, culminating with an Eight-Point Plan. The Eight-Point Plan became effective on 8 January 2013; some of the listed actions such as the public relations campaign were rolled out in Northern Thailand shortly thereafter. Table 1 summarizes the key countermeasures in the Eight-Point Plan and assortment of responsible agencies.

**Table 1: Implementing Responsibilities**

Countermeasure	Responsible Agencies
1. Prohibit burning of agriculture residue, waste, and unwanted flora during an “80 day period” (21 January – 10 April) except in areas receiving a waiver. Each province received a quota and defined area for burning during this period. Special permission from local administrators is required for burning during the period.	<ul style="list-style-type: none"> <li>- Ministry of Interior (MOI) with other key agencies, i.e. Department of Provincial Administration (DOPA), Department of Local Administration (DOLA), Governors of Chiang Mai, Chiang Rai, Phrae, Nan, Lamphoon, Lampang, Phayao, Mae Hong Son, and Tak Provinces</li> <li>- Ministry of Transport (MOT) with key agencies, i.e. Department of Highways (DOH), and Department of Rural Road (DORR), for control of open-burning along the highways</li> </ul>
2. Intensify forest fires prevention	<ul style="list-style-type: none"> <li>- Department of National Park Wildlife and Plant Conservation (DNP) and Royal Forest Department (RFD) in close collaboration with the aforementioned agencies for countermeasure 1</li> </ul>
3. Promote “villages free from burning”	<ul style="list-style-type: none"> <li>- Pollution Control Department (PCD) and the Department of Environmental Quality and Promotion (DEQP) within the Ministry of Natural Resources and Environment (MNRE)</li> </ul>
4. Engage private companies to participate in haze and forest fire countermeasures through corporate social responsibility programs	<ul style="list-style-type: none"> <li>- Electricity Generation Authority of Thailand (EGAT)</li> <li>- Ministry of Energy (MOEN)</li> <li>- Ministry of Agriculture and Cooperatives (MOAC) with key agencies, i.e. Land Development Department (LDD), and Department Agricultural Extension (DOAE)</li> </ul>
5. Raise awareness by stepping up public relations	<ul style="list-style-type: none"> <li>- Public Relations Department (PRD)</li> <li>- Ministry of Tourism and Sports (MTS)</li> <li>- Ministry of Social Development and Human Security (MOS)</li> <li>- Ministry of Education (MOE)</li> <li>- Ministry of Public Health (MOPH)</li> </ul>
6. Establish an early warning haze incident notification system	<ul style="list-style-type: none"> <li>- Thai Meteorological Department (TMD)</li> <li>- Department of Disaster, Prevention and Mitigation (DPM) in cooperation with the Royal Thai Army, Royal Thai Navy, Royal Air Force, and Border Patrol Police in case of need to putting out the large-scale open fires</li> </ul>
7. Expand cooperation with neighbouring countries to mitigate trans-boundary haze	<ul style="list-style-type: none"> <li>- Ministry of Foreign Affairs (MFA)</li> <li>- Ministry of Defense (MOD) in collaboration with MNRE</li> </ul>
8. Establish “haze pollution prevention and solution centres” for nine provinces in Northern Thailand	<ul style="list-style-type: none"> <li>- Ministry of Interior (MOI) with key agencies assigned for countermeasure 1 and Department of Disaster Prevention and Mitigation (DPM) in collaboration with PCD of MNRE</li> </ul>

In addition to the involvement of the listed agencies, “The Haze Prevention and Mitigation Administrative Centre for the Nine Northern Provinces” was established as part of the Eight-Point Plan and nine other provincial coordination centres were set up (to be chaired

by the heads of respective agencies at the provincial level). The provincial centres are currently acting as focal points for implementing many of the listed countermeasures, including monitoring and controlling open burning during the “80 day

peak period” that runs from January to April and reporting the status to the PCD. The provincial governors were to introduce provincial level regulations to restrict open burning during the peak period as well as enforce related regulations and fines.

According to interviews with PCD officials, the total budget for implementing the Eight-Point Plan for the fiscal year 2013 is 2,040 million Baht (approximately 64 million US dollars). This figure is made up of 220 million Baht from the normal annual budget, 329 million Baht from the extra emergency budget and 1,471 million Baht from the long-term budget. The newly created national level Haze Prevention and Mitigation Administrative Centre was to be funded through the normal administrative budget of the MNRE’s PCD and the Ministry of Interior’s Department of Disaster Prevention and Mitigation (DPM).

### *Compliance Mechanisms*

In contrast to previous efforts to manage open burning, the Eight-Point Plan placed a greater emphasis on public consultation to strengthen compliance. In the past, public participation was typically requested only during implementation—that is, after the design of the program had already been determined. But many stakeholders felt that the purposes of the measures had not been clearly explained and proposed measures were frequently poorly suited to local conditions. Those involved in crafting the Eight-Point Plan expected that greater engagement would help anticipate problems and identify barriers in implementation before they emerged. As a result, a focus was placed on working with communities to identify and disseminate best practices through the plan’s consultation process.

To demonstrate this commitment, the PCD organized a series of public meetings in nine provinces in Northern Thailand in November 2012. The meeting attracted 300-500 people per province. Attendees consisted representative from local government, community groups, educational institutions, the private sector, and the military. The meeting helped not only to solicit local feedback but also better understand challenges in each high risk area.

The PCD also explored how the private sector could contribute through both regular business practices and corporate social responsibility (CSR) programs. For instance, companies involved in harvesting corn were encouraged to consider a contract farming arrangement. The proposed arrangement would provide free seeds, planting consultations, and guarantees for unlimited crop purchases in exchange of non-open burning agreements. Interviews revealed that the private sector was generally receptive to PCD’s proposal; however, some company representatives wanted more details on how they could be involved in a long-term solution beyond the contracting.<sup>8</sup>

Above and beyond these efforts, awareness raising was made a feature of the Eight-Point Plan. The most significant efforts at boosting awareness began on 19 January 2013 with the kick-off of an Eight-Point Plan campaign in nine provinces. Starting in Chiang Mai, the campaign underlined that achieving open burning targets required cooperation from multiple stakeholders. During the 80-day peak period, the haze centres and responsible parties were to monitor haze closely, while simultaneously promoting countermeasures.

<sup>8</sup> Interviewees wanted more information about the current status, affected areas, recommended countermeasures, and benefits before establishing an appropriate program.

Each province slightly modified its approach to reflect the variations in burning quotas and as well as languages used.

Another distinctive element of the Eight-Point Plan was to identify and disseminate community-based best practices. The “Demonstration Villages for Open Burning Free Prototype” encouraged villagers to employ their own methods to mitigate haze. Community-based activities included self-monitoring and self-regulating fires; introducing effective forest fire controls; initiating public relation campaigns; introducing alternative income from non-burning practices; and developing community or tribal-based rules for controlling open burning and forest fires.

There are also efforts underway to encourage villages to create sustainable self-learning groups for open-burning free activities. These groups were expected to motivate other villages to follow. Villagers in Lamphoon Province, for instance, established teams to create firebreaks prior to the dry season to prevent forest fires from spreading into cultivation areas adjacent to the forest. Although the measure is not uprooting the cause of forest fires, it can reduce the damages.

### **Informational, Institutional and Financial Barriers**

As laid out in the Eight-Point Plan (and the broader range of proposed compliance mechanisms), the haze problem is clearly on Thailand’s policy agenda. However, the Eight-Point Plan may focus too much on ameliorating the impacts of haze during the peak period rather than providing a long-term sustainable solution to the problem. The barriers are categorized in three below.

#### ***Informational Barriers***

There have already been significant improvements in developing and compiling data on air pollution from open burning. Greater efforts can nonetheless be made to improve data quantity/quality, especially in the high risk areas (centres of forest fire/open burning). Increasing the number of the air quality monitor stations is particularly needed as some provinces with risk areas have no stations or are far from operating stations. The shortage in data is partly due to lack of financial support for local regulatory authorities to monitor and report as well as for local universities to provide relevant analyses.

Information sharing could be also improved. Despite recent efforts to raise public awareness, for many communities the impacts and magnitude of the haze problem still remain poorly understood. The public’s participation during the PCD meetings in Northern Thailand underscored that many of the uncooperative villagers lack an overall awareness of open burning. During a field visit and public consultations in November 2012, interviews further revealed the difficulties involved in tailoring information to community needs. To illustrate, in Om-Goi District in Chiangmai province, corn growers are often perceived as uncooperative and a significant source of open burning. However, local administrative officers confided that public relations and education programs failed because 90% of these farmers use indigenous languages and could not understand materials provided in Thai.

Another common challenge involves changing a mind-set of farmers who believe in traditional land use management and cultivation practices. There are many cases where a lack of public

cooperation is due to strong belief in traditional technologies and practices. For instance, many villagers are convinced that burning can increase productions in high value crops such as baby bamboo. This is further related to the lack of access to technologies or alternatives that could persuade villagers otherwise.<sup>9</sup> As a result, restrictions on burning are understandably seen as creating unnecessary hardships by farmers.

### ***Institutional Barriers***

One of the key challenges is to ensure the proposed measures be followed through. The Eight-Point Plan was approved only for 2013 and thus question exists about 2014 and beyond. A related challenge involves the institutional arrangements overseeing the Plan's implementation. In theory, creating a committee to coordinate and jointly look into the problems make sense considering the fact that no agency can solve them single-handedly. In reality, committees often lacks the authority to command agencies—they can only *request* assistance from participating agencies. Most ministries have different priorities and yearly targets, and combating haze is not part of either these priorities or targets. Therefore, agencies in the committee tend to lend their support only when it aligns closely with pre-existing administrative mandates. This does not mean agencies do not want to cooperate but rather they are restricted by their own yearly targets and organizational structures.

The lack of accountability for participating agencies also presents a challenge. There are 28 agencies involved in mitigating open burning. The sheer number of agencies makes it easy to

shift accountability to other participating agencies. The fact that the PCD, a department within a line ministry, is leading these efforts makes it easier still for higher-ranked organizations to skirt responsibility.

Insufficient human resources at the local level also present a sizable hurdle. A shortage of staff is particularly evident during the open burning peak season. Previous efforts to control haze problem revealed that top-down approaches implementation struggled due to similar shortfalls. The recent effort to engage with a broader cross-section of stakeholders is a step in the right direction, but it has not helped fill human resources needs.

### ***Financial Barriers***

Arguably the greatest near-term barrier will be generating sufficient funds to support the implementation of the Eight-Point Plan. As suggested previously, funding for implementing this program came chiefly from the regular budget (with some additional support from the emergency budget). An expanded and separate budget line will be needed to address many of the above barriers. This includes improving the quality and coverage of the data, providing feasible alternatives for local communities, and increasing staffing. These problems are particularly acute at the local level where there are growing expectations for the provision of public goods but limited resources to meet those expectations.

### **Recommendations**

The recommendations focus on overcoming informational, institutional and financial barriers outline above.

One key recommendation is a continued effort to expand the quality and coverage of air

<sup>9</sup> This includes some cases where there are no readily available alternatives to burning such as maize crops planted on hillsides slopes that cannot be reached by tractors.

pollution data for a longer-term response. Increasing the number of the air quality monitor stations in risk areas with limited or few stations will be critical. There is a chance that the monitoring activity may be boosted by the strengthened implementation of the ASEAN Haze Agreement; however, recently concluded 23<sup>rd</sup> ASEAN Summit held in Brunei Darussalam in October 2013 did not indicate any specific timeline when Indonesia, the sole non-signatory state of the Agreement, is going to ratify it (ASEAN Secretariat, 2013).

There is also an under exploited opportunity to build capacity for data gathering in universities located in Northern Thailand. Collaboration between these educational institutions and key universities elsewhere in Thailand such as Bangkok's Asian Institute of Technology (AIT) could prove fruitful. Developing more accurate emission factors in Northern Thailand could also help monitor the haze problem at the regional level.

A second set of recommendations involves the development and dissemination of awareness raising and public relations materials. On this point, it will be important that the PCD does not stop with a single publicity tour. A continual process will be needed; such a process could entail educating targeted local officials and communities through local mass media, including radio and billboards. This also can be done by working with local networks and existing working groups, head of villages/ local leaders, women's groups, youth groups, and religious groups. Similarly, it will be critical to make sure that the messages reach the intended audience. Translating materials into the right languages is absolutely essential. A periodic stock taking of "which communities are understanding the haze problem and to what

extent" will help gauge the effectiveness of these efforts.

Another set of recommendations relates to identifying alternatives to open burning. As part of the awareness raising efforts, it will be crucial to demonstrate practical alternatives to open burning. Planting mushrooms has been offered as one possible high-income alternative. Others involve providing machines to help induce organic process that transform agricultural residue into fertilizer or baling machines that help to collect the residue for resale as hay (Oanh, 2011). Curbing open burning is also related to modernizing farming methods/agricultural technology. An increase in machine use in harvesting can help collection and treatment in bulk of agricultural residue. The collected biomass could then be converted into energy, organic fertilizers, or other value-added products. The responsibility for introducing these technologies will fall on government agencies.

A related set of recommendations involves the enforcement mechanism. To clarify some of the administrative roles, the PCD should consider mapping detailed responsibilities by each agency under existing laws and regulations. For example, the Local Administrative Office should limit or control the company license to curb emissions of harmful substances and monitor actions closely on the ground. The forest regulations may need to be revisited to protect encroachment of farming activities (maize and soy) into forests; community-based approach to encourage locals to suitable grow forestry crops in the management of forestry will also need to be reconsidered. Finding/developing good practices and scaling up with the assistance from local academic institutes/universities can accelerate these

efforts. This mapping exercise could accompany some of the data gathering and awareness raising activities.

Much of what is recommended will require increased funding. Guaranteed funding for the Eight-Point Plan over a longer time horizon than one year will be helpful in building confidence in the program. Earmarking more resources for local governments to manage open burning is also needed. Some of the financing effort will not necessarily involve providing more budget but using existing funds differently. For instance, providing financial incentives for localities that are identified as demonstrating best practice solutions could help with the recent attempts at strengthening bottom-up compliance. It would also make the government plan to approach open burning from the bottom-up more credible.

## Conclusions

Research on co-benefits from SLCPs has focused more on energy and air pollution models than whether the model's policy recommendations can be implemented effectively. Thailand already has relatively comprehensive air pollution and sectoral laws. Thailand's legal frameworks and supporting institutions thus could provide numerous entry points for SLCPs. Successfully implementing these actions will, of course, require not only integrating references into existing laws and institutions. It will require enforcing those laws effectively.

The article's case study demonstrated that the open burning and resulting haze pollution has become an increasingly serious problem in Northern Thailand. The government has attempted to rectify the problem with the

establishment of committees and action plans that lacked a coherent long-term vision to address the underlying causes of the problem. Not surprisingly, these initial efforts registered limited success. Since 2012, the PCD has been tasked with developing and implementing an Eight-Point Plan. The Plan is not only more comprehensive but placed a greater emphasis on raising public awareness and engaging with affected stakeholders.

This engagement led the PCD to conclude that enforcement of regulations to ban open burning was lacking, but more importantly it found that banning may not be the best solution. Rather, farmers need alternative ways of managing their agriculture waste other than burning and want economic opportunities to generate value-added products. Finding alternative ways that work and have them adopted by the local would naturally require time, but the activities initiated at the local levels or trials by the universities would more likely be practical, feasible, and sustainable than top-down measures. In this regard, the Eight-Point Plan's emphasis on increased engagement can be considered soft but one of the appropriate entry points belatedly enacted to correct the observed low awareness and understanding of the issues by the locals. This could be a good wakeup call for other countries that faces similar problems.

For a long-term endeavour, building compliance mechanisms into the development and the implementation of the plan is commendable and have the potential to be more effective than previous initiatives. Although the leading agency (in this case the PCD) would not be given instantaneously a commanding authority to other collaborating agencies on the matter, the accumulation of data and findings fed by the local governments and organizations

should bring about a capacity to handle the issues and a chance to prove the abatement impacts. Compliance mechanism to curb open burning could focus on collecting the relevant data and information and narrowing the loopholes to create a fairer ground for existing and potential burners.

It is obvious that an insufficient financial support can be a severe constraint, but prioritizing measures may be of the issue to maximize the impacts with limited resources. While provincial governments in questions would need support from the central government, there are clear shared roles by the central government, private sector, academia, and local farmers. The central government can focus on two things other than enforcement the regulations—the provision of support for data collection (monitoring stations and associated human resources) and R&D to develop alternative methods to opening burning in farming practice and create markets for alternative crops that induces engagement of local universities and private agricultural firms. Success stories would give the leading

authority a leverage to mobilize larger financial support.

Without continued efforts, Thailand runs the risk of having the Eight-Point Plan become another commendable but ineffective attempt to address open burning. Further development of the Eight-Point Plan and lessons dawn are expected to opportunities for cross learning by neighbouring countries.

More generally, the article suggests there is ample room to integrate research on SLCPs and research on environmental governance. One clear way forward would be to draw upon empirical case studies to inform how governance can be incorporated into the development of mitigation scenarios. A related line of inquiry could work toward more explicitly incorporating governance variables such as institutional capacity and coordination into air pollution and energy models. These steps would enrich both research on SLCPs and related policymaking processes—effectively generating their own co-benefits.

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