

OPEN WASTE BURNING IN ASIAN CITIES: CHALLENGES AND OPPORTUNITIES

SUMMARY OF OPEN WASTE BURNING WEBINAR SERIES NO. 1, 22 APRIL 2022

Background

Open burning of Municipal Solid Waste (MSW) is a common practice, especially in developing countries with inadequate solid waste management systems (Singh et al., 2014; Karunaratana et al., 2019). The main reasons are that it is the cheapest and easiest method of volume reduction and managing MSW, especially for residents in cities with no access to organised waste collection services. Currently, two billion people globally have no official waste collection services, and the waste of over three billion more is either dumped or subject to uncontrolled burning (Circular, 2019).

Open burning of MSW typically occurs under relatively low temperatures, which emits significant amounts of pollutants, especially particulate matter (PM) (PM10, PM2.5), black carbon (BC), organic carbon (OC), and gaseous pollutants such as nitrogen oxides (NOx), carbon monoxide (CO), methane (CH4) and non-methane volatile organic compounds (NMVOC) (UNEP, 2013). In addition, open burning of waste results in emissions of wide-ranging potentially hazardous substances such as polyaromatic hydrocarbons, mercury, arsenic, fine dust, sulphur oxides and hydrochloric acid, most of which are toxic and harmful to the environment and human health (UNITAR and UNIDO, 2019).

As such, the open burning of MSW represents one of the most significant pollution and climate change problems in developing countries. While various studies on the generation of persistent organic pollutants (POPs) and other hazardous substances exist (UNITAR and UNIDO, 2019), there is a lack of scientific evidence on how BC emissions from open waste burning impact climate change. This requires scientific study, including the quantitative assessment of such emissions. In this regard, IGES-CCET has been working with its partners to study BC emissions and related climate impacts from open waste burning in selected Asian cities. This first webinar, held on 22 April 2022 and co-organized by three parties – the Institute for Global Environmental Strategies-IGES Centre Collaborating with UNEP on Environmental Technologies (IGES-CCET), the Climate and Clean Air Coalition (CCAC), and the United Nations Industrial Development Organization (UNIDO) – aimed to share the results of the research study on open waste burning in Asian Cities, including experiences of case study cities, as well as enable panel discussions involving experts from IETC, CCAC, UNIDO, IGES-CCET and government officials from Padang City, Indonesia, and Stueng Saen City, Cambodia.

KEY TAKEAWAYS

Open burning is one of the common MSW management practices in many cities in the developing countries due to lack of official waste collection system.

Open burning is the cheapest and easiest way of managing MSW in terms of time and cost, though it is the worst and most expensive method in view of its impacts on the environment and human health.

The case study analysis identified that total climate impact from open burning even higher than the emissions from open dumping.

Open waste burning is occurring throughout the waste management system. While 95% of estimated climate impact caused due to burning of MSW at household level in Padang City (Indonesia), about 44% of the estimated climate impact is caused due to burning of MSW at the final disposal site in Saen Municipality (Cambodia)

There is no single solution for mitigating open waste burning, cities can apply integrated approach including secure waste collection service for all residents, including low income areas, awareness-raising, allocation of funds and resources to improve the waste treatment and final disposal sites, enforcement of laws, and introduction of decentralised monitoring mechanisms.

1ST SESSION: SHARING THE RESEARCH FINDINGS AND EXPERIENCES

1. Introduction to the workshop and research on open waste burning in Asian Cities: Rajeev Kumar Singh, Policy Researcher, CCET-IGES



Based on his recent study, *Dr. Rajeev Kumar Singh* highlighted

the practices of open burning in ASEAN cities and the impacts on climate and human health. He stated that one of the key reasons for the case study cities to practice open waste burning is the lack of MSW management systems. This has resulted in using the cheapest, easiest, and most practical sanitary means of volume reduction and disposal of combustible materials in the cities. Referring to the latest report of Engineering X, 2020, *Global Review on Safe End of Engineered Life*, he further underscored the gravity of the global picture on open waste

burning, stating that around two billion people globally have no waste collection services and that the waste of over three billion people is either dumped or subjected to uncontrolled burning. He also highlighted that around 41% of global waste has to date been burned openly, estimated at 620 million tons per year. He further explained the significant emissions of pollutants and hazardous substances from open waste burning, including PM (PM 10, PM 2.5), BC, NO_x, CO, CH₄, NMVOC, polyaromatic hydrocarbons, mercury, arsenic, sulphur oxide, and hydrochloric acid.

According to previous studies on open waste burning, the different types of emissions involved, such as SO_x, NO_x, CO₂, methane and their impacts on human health and the environment have already been

identified. However, he emphasized that there is a lack of scientific evidence and scarcity of studies focused on quantitatively assessing BC emissions from open waste burning and the consequences for climate change. BC, one of the key Short-Lived Climate Pollutants (SLCPs) or Short-Lived Climate Forces (SLCF) is currently a pollutant of primary concern due to its high negative impact on human health and climate. Its highly detrimental warming effects have attracted the attention of climate scientists and policymakers. According to the European Investment Bank (2016), BC has a warming impact on climate 1,055-2,020 times stronger than CO₂ over a 100-year time horizon. Scientists suggest that BC is likely to be the second most important contributor, after carbon dioxide (CO₂), to global

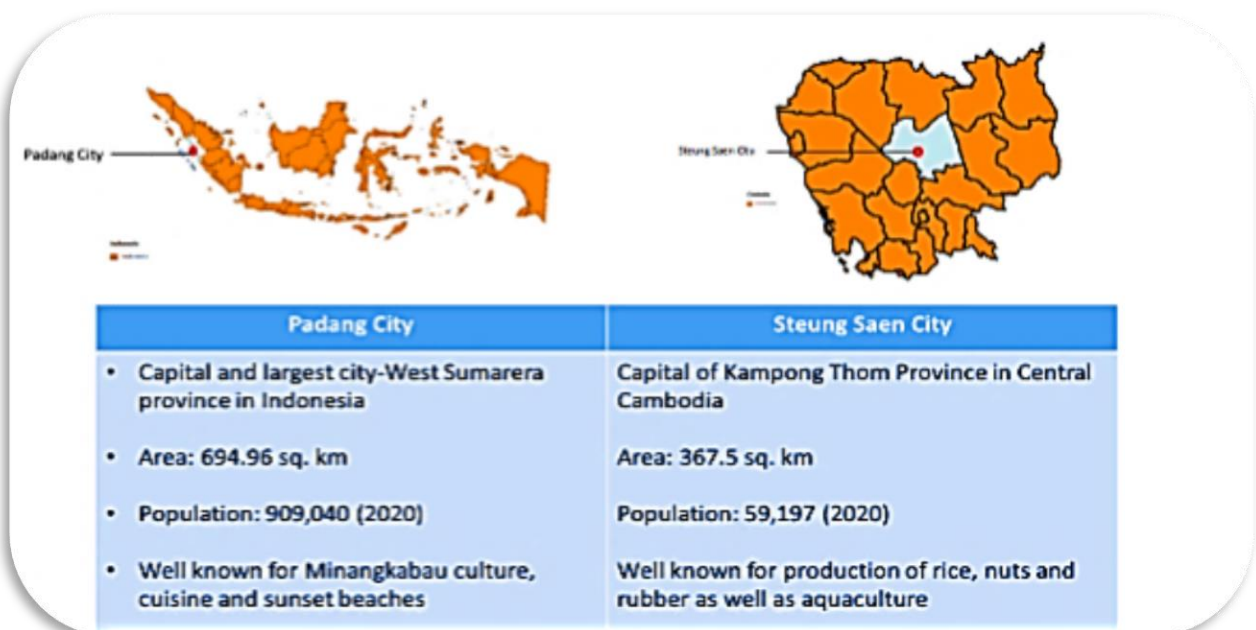


FIGURE 1: MAP OF PADANG CITY AND STEUNG SAEN CITY

warming. CCAC also strongly asserts that mitigation of GHGs such as carbon dioxide (CO₂) must be conducted together with near-term measures targeting SLCPs such as BC in order to keep the average global temperature rise to below 1.5 to 2°C. He ended by providing further detailed explanations of the research and its methodologies used for CCET's open waste

burning study in two case study cities selected from Indonesia and Cambodia, comprising:

1. Introduction to the study
2. Selection of the pilot cities and study areas
3. Training of local teams in each city to conduct the field survey
4. Development of a methodology for the field survey
5. Data collection and analysis

Dr. Rajeev also provided detailed explanations on calculating the

total amount of waste burned in the study areas with use of the Emission Quantification Tool (EQT) that was jointly developed by IGES-CCET and CCAC. The total amount of BC emissions from open burning and estimation of total climate impact caused by BC emissions due to open burning in the cities were also presented.

2. Experience sharing: Results of open waste burning in Asian cities: case studies from (i) Padang, Indonesia: Rizki Aziz, Head of Department of Engineering, Faculty of Engineering, Andalas University, and (ii) Steung Saen, Cambodia: Uch Rithy, Director, COMPOSTED



Dr. Rizki Aziz delivered a presentation on the assessment of the climate impact of Black Carbon

(BC) emissions from the open burning of MSW in Padang City. He explained the existing waste flow diagram and mass balance of waste management in the city, including the potential areas (uncollected waste and waste at final disposal site) of open waste burning before starting the assessment survey. He also gave details of the waste composition of Padang City, where food waste represents the highest proportion (45.24%), followed by plastics (28.10%), paper (7.47%), garden waste (6.74%), etc. He then gave a summary of open burning covering various sources, where the highest waste

burning takes place at households, amounting to 71,763.15 kg/day (94.7% of total waste burned in the city) and the lowest takes place at institutions, amounting to 465.93 kg/day (0.6% of total waste burned in the city). He also shared the total per capita waste burning of Padang City, which amounts to 0.077 kg/capita/day (where per capita waste generation is 0.67 kg/day).

Further, he shared the results of studies, including estimated emissions of BC and related climate impacts from open waste burning by each sector covered in this study, including households, commercial, institutions, public places, and final disposal sites. The key findings are:

- 95.1% of estimated climate impact is caused due to burning of waste at the household level.

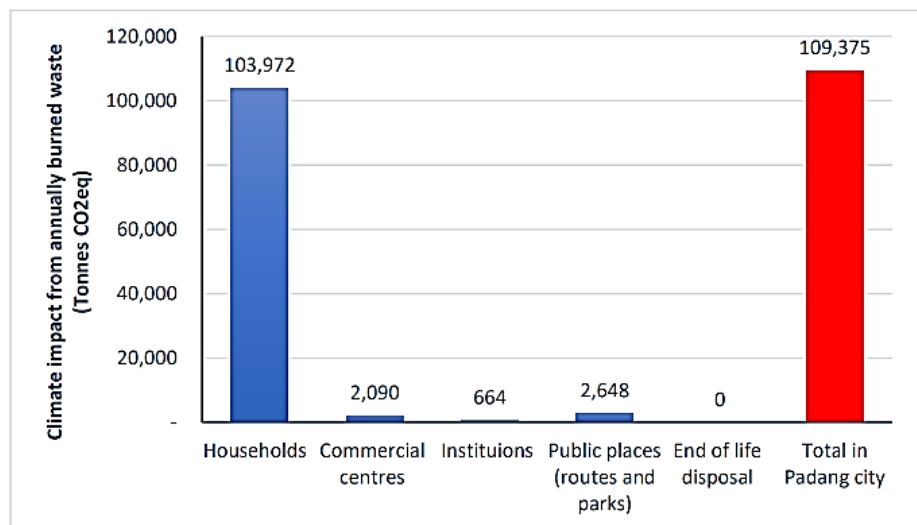


FIGURE 2: CLIMATE IMPACT FROM BC IN PADANG CITY

- The remaining 4.9% of climate impact resulted from BC emissions from the burning of waste at commercial centers (1.9%), institutions (0.6%), and public places (2.42%).
- The climate impact from BC emissions per tonne of waste burned in Padang city is 299.6 tonnes CO₂eq; however, an annual emissions figure of 109,375 tonnes of CO₂-eq involving no climate impact from BC emissions was observed at the final disposal site, due to the absence of open waste burning activities there, as reported by city officials.

then explained the waste composition of Steung Saen City, where food waste represents the highest proportion (34%), similarly with Padang city, followed by plastics (23%), garden waste (16%), and paper (8%), etc.

However, in contrast to Padang City, he explained that the highest waste burning takes place at the final disposal sites, amounting to 3,640 kg/day (48.4% of total waste burning in the city), and least at institutions, amounting to 50.82 kg/day (0.7% of total waste burned in the city). He also shared the total per capita waste burning of Steung Saen City due to open burning at the different sources, amounting to 0.127 kg/capita/day (where the per capita waste

generation is 0.59 kg/day).

Further, he shared the emissions of BC and related climate impact from each sector, including households, commercial, institutions, public places, and final disposal sites as below:

- 43.7% of the estimated climate impact is caused due to BC emissions from the burning of waste at the final disposal site, followed by BC emissions from the burning of waste at households (21.7%), public places (33.7%) and institutions (0.9%).
- Total climate impacts from annual waste burning in the city amounted to 6,603 tonnes of CO₂-eq.



Mr. Uch Rithy delivered a presentation on an assessment of the

climate impact of Black Carbon (BC) emissions from the open burning of MSW management in Steung Saen City, Cambodia. He explained the existing waste flow diagram and mass balance of waste management in the city. He

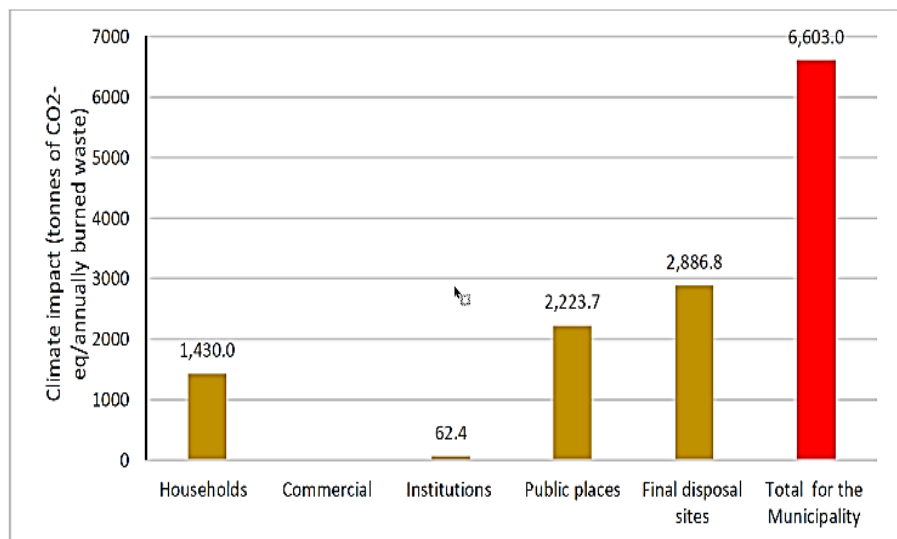


FIGURE 3: CLIMATE IMPACT FROM BC IN STEUNG SAEN CITY

2nd SESSION: PANEL DISCUSSION

Moderator: Dr. Shunichi Honda, Programme Office, UNEP. *Panelists:* 1. Sandra Mazo-Nix, MSW Initiative Coordinator, CCAC; 2. Carmela Centeno, Industrial Development Officer, UNIDO; 3. Nirmala Menikpura, IGES Fellow, IGES; 4. Nguon Dalen, Deputy Director of Administration, Steung Saen City, Cambodia; 5. Ir. H. Mairizon, Head of Environmental Agency, Padang City, Indonesia



Introducing CCAC activities, Ms. Sandra Mazo-Nix highlighted that CCAC was

established in 2012 to support countries in reducing SLCPs and since then has grown its network to more than 400+ members, including 73 countries, financial institutions, and civil society organizations that perform activities around the world on mitigation of SLCPs from different sectors, including waste.

She also highlighted that CCAC is a cooperative group led by state partners aiming for high-level political engagement, which is critical for driving change around the world. Further, she emphasized CCAC's goal to reduce SLCPs, particularly BC, CH₄, O₃, and HFCs. She further stressed that SLCPs are much more powerful global warming (GW) agents than CO₂ and are harmful to people, ecosystems, and agricultural production. She then explained that CCAC focuses on acting quickly to achieve timely results and multiple benefits. CCAC promotes science-based solutions and works together

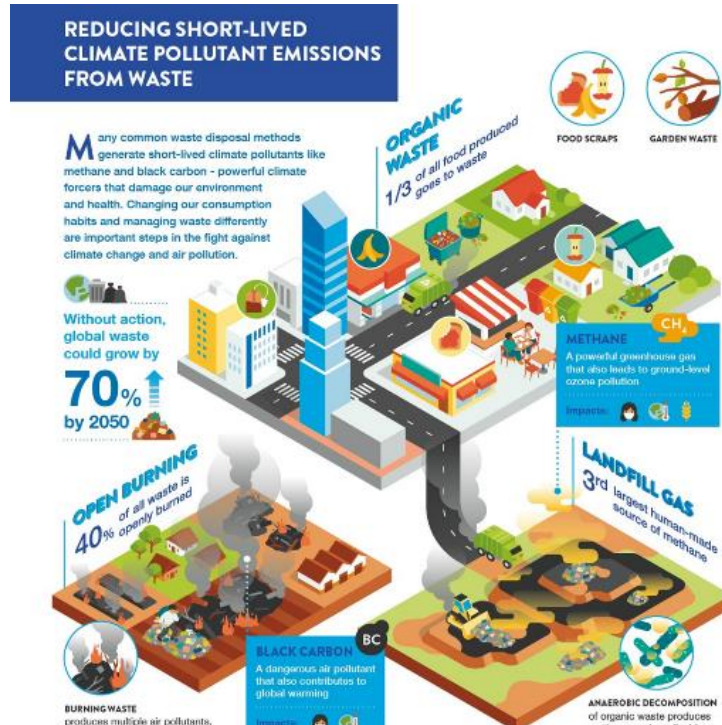


FIGURE 4: REDUCING SHORT-LIVED CLIMATE POLLUTANT EMISSIONS FROM WASTE SECTOR

with its partners to promote leadership and awareness. She commented that in the waste sector, CCAC focuses on three major areas: i. Open burning, ii. Organic waste, and iii. Landfill gas recovery for mitigation of SLCPs. Regarding the open burning of waste, CCAC carries out activities around the world to increase the knowledge, research, initiatives, and capacities to mobilize support for action at all levels of government, the private sector, and civil society. Further, she emphasized that CCAC supports partner countries in

increasing their accessibility to financial resources to implement activities on larger scales. She also added that CCAC assists in enhancing scientific knowledge for decision-makers, scaling up actions, and promoting the multiple benefits of actions.



Ms. Carmela Centeno, in her presentation explained that UNIDO is a specialized agency of the UN that promotes industrial development through economic

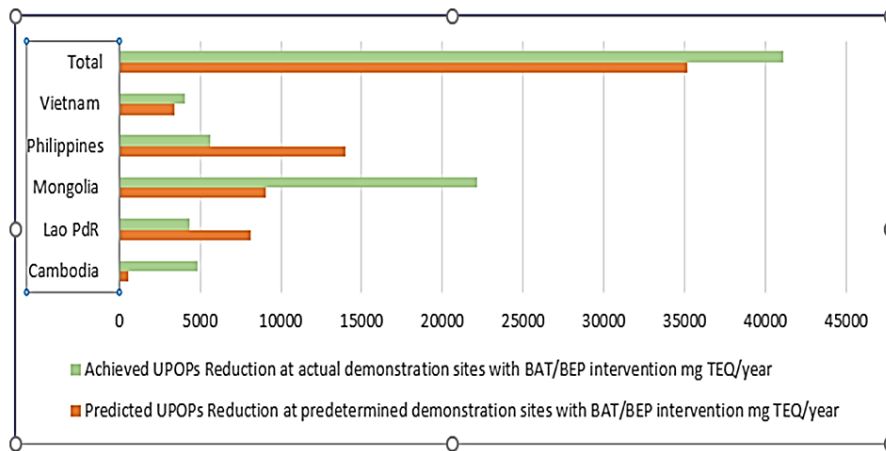


FIGURE 5: DIOXIN REDUCTION FROM UNIDO'S PROJECT IN ASIA

competitiveness, shared prosperity, and environmental sustainability. Further, she underlined that UNIDO fosters SDG 9 (Industry, Innovation, and Infrastructure) by promoting and accelerating inclusive and sustainable industrial development (ISID) in its Member States. She also underscored that UNIDO also assists member states to meet Environment Convention-related obligations by focusing on industry-related provisions. Under this provision, UNIDO learned from its member states that open burning is one of the priority areas for Asia and Africa as a part of the Stockholm Convention on Persistent Organic Pollutants (POPs).

Therefore, UNIDO has been working on the mitigation of unintentionally emitted POPs in consideration of their impact on the environment and human health. She also highlighted UNIDO's project on open burning, entitled "Demonstration of Best Available Technologies (BAT)

and Best Environmental Practices (BEP) in the open burning sector in response to the Stockholm Convention on POPs". The project's objective is to create resource-efficient waste management systems to reduce U-POP emissions through the introduction of BAT/BEP at sites of open burning. She explained that UNIDO is working with five countries (Cambodia, Lao PDR, Mongolia, Philippines, and Vietnam) under a project in which UNIDO has received 7.56 mil. USD from the Global environment facility (GEF). The project spans five years to June 2022. She also highlighted the global environmental commitment of UNIDO for the GEF project, aimed at reductions of 35,167 mg TEQ/year, while in fact UNIDO intervention in the pilot countries through this project achieved a reduction of 41,126 mg TEQ/year.



This was followed by Dr. Shunichi Honda, who facilitated

the panel discussion. Based on the study and previous presentations, he highlighted that open burning is taking place in many places in cities, and that city governments associate with the need for people to rely on open waste burning.

How does Steung Saen City act to reduce open waste burning and what are the measures the city has introduced to reduce open waste burning?

Nguon Dalen, Deputy Director of Administration, Steung Saen City. Open waste burning is a sensitive issue. There is no separation of MSW at source and all mixed waste is disposed of at the final disposal site. There are no incentives and insufficient support from the government for proper waste management in the city. As Cambodia lies in a tropical region, city temperatures can reach 42 degrees C, which also creates a favorable environment for uncontrolled open waste burning at the final disposal site. According to the current study, about 80% of generated waste is collected by the city and the remaining 20% is uncollected and either burned or disposed of in the

environment. A pressing issue for the city is how to raise awareness and urge residents to take action. People are not serious about the issue due to a lack of knowledge about the adverse impacts of open waste burning on the environment and human health. Some insist that waste management is not their responsibility, and that as they pay taxes this should be handled by the municipality or national government. Moreover, some people are not willing to pay waste collection fees, hence, they feel the easiest and cheapest way to manage their waste is to burn it on their premises or in front of the house.

To tackle the open waste burning issue, Steung Saen city has already taken the following steps:

First: Planning to construct a new sanitary landfill with support from ADB.

Second: Planning to introduce a new waste collection fee system to make the fees affordable for all residents, including poor neighborhoods.

Third: Partnered with a local NGO, COMPOSTED, for the separation of organic waste, which generates a compost fertilizer product.

In addition, the city aims to create awareness among children, and in this regard is planning to include new awareness-raising materials in student curricula starting from the secondary education level.

(Moderator): Based on the study and previous presentation, we learned that there is no open waste burning at the final disposal site in Padang City; however, it does occur on roadsides and at the household level.

What actions does Padang city take to control open waste burning in the city?

H. Mairizon, Head of Environmental Agency, Padang City, Indonesia: In Padang City, MSW is managed in two ways: i) waste reduction, and ii) handling of the waste in an environmentally friendly manner. Currently, the government has a budget for handling waste; however, it is insufficient, and the city also lacks the infrastructure for proper waste management. In addition, the waste banks, a community-based waste recycling system, are not functioning as intended due to the lack of budget. People are not aware of how to separate the waste at source. Similarly to Steung City, people expect the local government to collect their waste without having to pay waste collection fees, hence open burning is considered the easiest and cheapest means of managing waste.

To reduce open burning, the city is attempting to educate people to separate their waste and ensure the waste banks function normally. The city also provides rickshaws, motorcycles, and other vehicles to collect waste from households to temporary collection points; however, the lack of budget means these facilities do not extend to all community groups. The city also tries to minimize illegal dumping and open burning by assigning city staff for monitoring illegal dumpsites. Further, the city is trying to secure external funds to establish a Refuse-derived fuel (RDF) plant, for which a feasibility study has been conducted and shows establishment would be beneficial in Padang City. In this regard, the city is trying to secure funding from the Central government of Indonesia.

(Moderator): CCET-IGES has conducted a study on open waste burning in ASEAN cities, in which CCET-IGES has generated scientific data on the subject in the case study cities. From the study, we learned that cities are facing many challenges on how to mitigate the practice of open burning.

Could you explain how these cities or other cities could use

the scientific data to act and reduce open burning?



Dr. Nirmala Menikpura,
IGES Fellow.
Open waste

burning creates atmospheric pollution, which is closely linked with damaging human health effects. Based on our study, we found that open burning is much worse than open dumping, diverging from the general belief that open waste dumping is the worst treatment option in terms of climate change. In the case of Padang City and Steung Saen City, our study found that 77% and 55% more GHG and SLCP emissions result, respectively, if waste is openly burned compared to waste openly dumped. Moreover, during our study we identified several data gaps

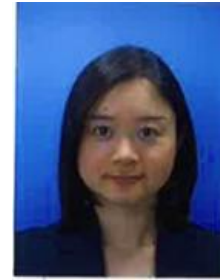
and challenges, as follows:

- Lack of understanding on open burning and its impacts
- Lack of availability of tangible information
- Too many unfounded assumptions
- Limited or lack of data on burning
- Lack of capacity, financial and human resources at the city level
- Unwillingness of the general public regarding data sharing

The recommendations to overcome the above limitations are as follows:

- Awareness raising
- Allocation of funds and resources; especially financial, technical, and public support are very important for gathering information and data
- Enforcement of laws
- Introduction of alternatives for avoidance at burning sites.

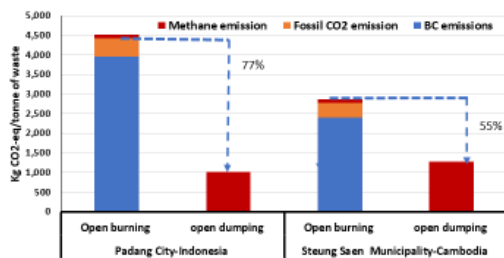
If the cities mentioned practice all the above steps, they will be able to mitigate open waste burning practices and related emissions significantly at the city level.



Concluding the webinar, **Ms. Tatsuno,**
Programme Coordinator,
IGES-CCET

thanked all the participants, presenters, and the moderator for their contributions to the webinar. Further, she requested all participants to fill out the online questionnaire on the webinar, and reminded everyone about the second session on open waste burning, to be held in the next few months.

Climate impact from open burning even worse than open dumping



Data gaps and challenges



Recommendation to improve challenges

Awareness-raising and capacity development at city level	Allocate fund and resources for data gathering/surveys at city level	Cities/municipalities must accept the responsibility for enforcement of laws	Introduce alternatives for waste avoidance at burning places

FIGURE 6: IMPACT OF OPEN BURNING, DATA GAPS AND CHALLENGES

Feedback from participants

A total of 217 people registered for the webinar; however, only 102 attended the event. Participants were from different regions of the world and a good gender balance was observed (see Figure 7). The majority of participants were from Japan, followed by Indonesia, the United States, and other countries. The webinar helped the audience understand about the status of open waste burning in Asian Cities, and also created awareness of the impact of open burning on the environment and human health, as can be seen from Figures 10 and 11. Figure 9 shows that about 25% of respondents were not aware of open waste burning in Asia prior to the webinar, which changed to 96% afterwards.

In addition, Figure 10 shows that 22% of respondents were not aware of the impact of open waste burning before, which changed to 100% of respondents being aware of the impacts of open waste burning on the environment and human health after the webinar. It was also understood from the survey questionnaire that open burning is a critical issue for cities and countries (see Figure 11). Moreover, we also try to evaluate the satisfaction level of participants from the webinar through a questionnaire survey, and based on the responses, we understood that the majority of participants found the webinar useful, as more than 80% rated it at 8 and above out of 10 for overall

satisfaction (on a scale of 0 to 10; see Figure 8). According to the participant responses to the questionnaire for potential topics under open waste burning, we learned that the majority of participants would like to learn about good practices and global initiatives, followed by methodology and quantification, challenges and issues, funds and incentives, and other matters (see Figure 12). CCET will consider the responses from the participants and incorporate them into the next webinar on Open waste burning.

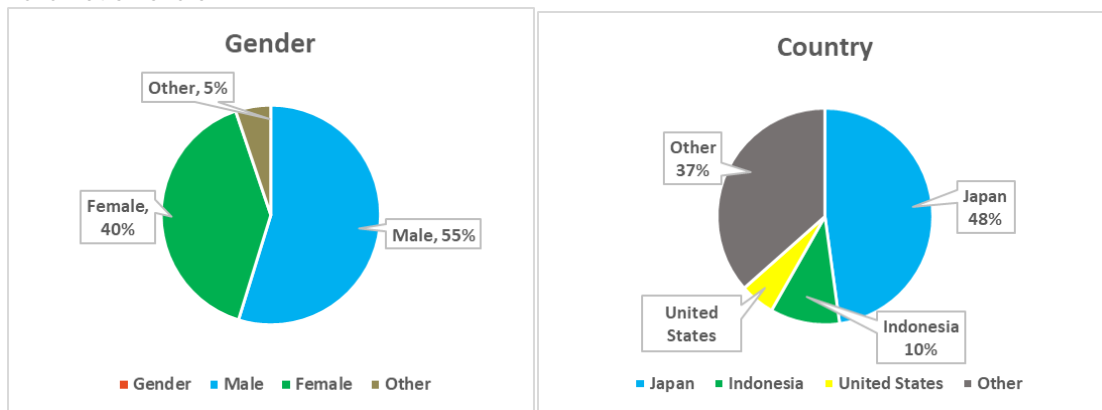


FIGURE 7: GENDER AND COUNTRY OF PARTICIPANTS

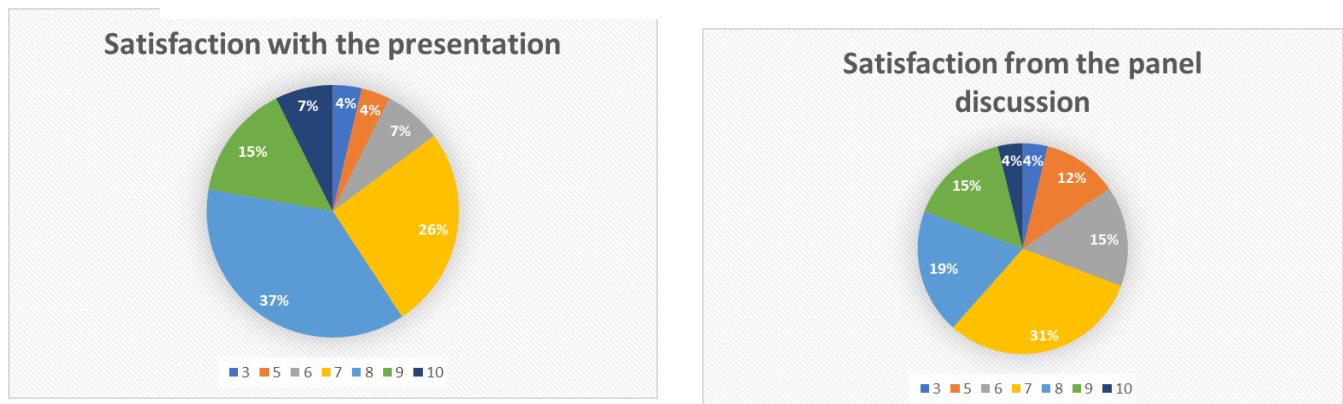


FIGURE 8: PARTICIPANT RESPONSES FOR SATISFACTION WITH PRESENTATION AND PANEL DISCUSSION



FIGURE 9: PARTICIPANT RESPONSES ON OPEN BURNING AS A CRITICAL ISSUE

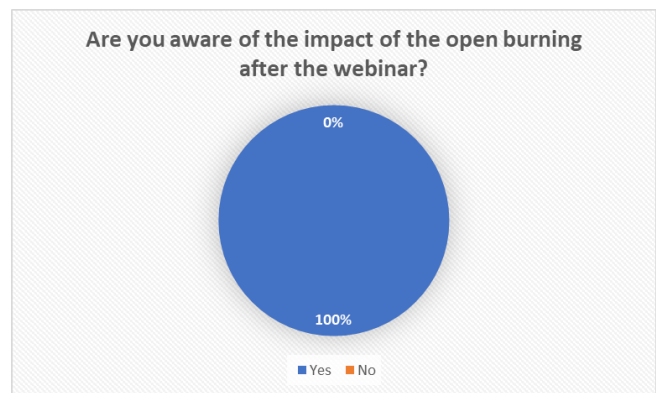
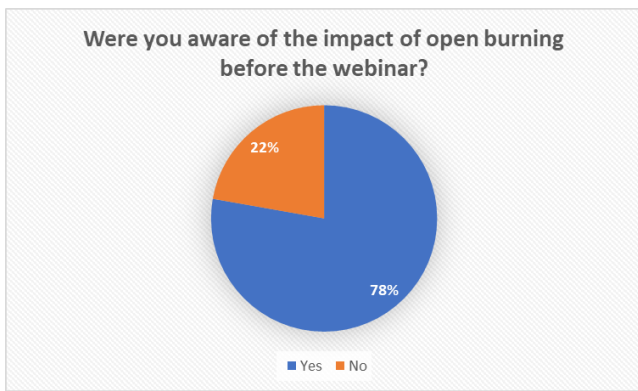


FIGURE 10: PARTICIPANT RESPONSES FOR AWARENESS ON OPEN WASTE BURNING IN ASIA BEFORE AND AFTER THE WEBINAR

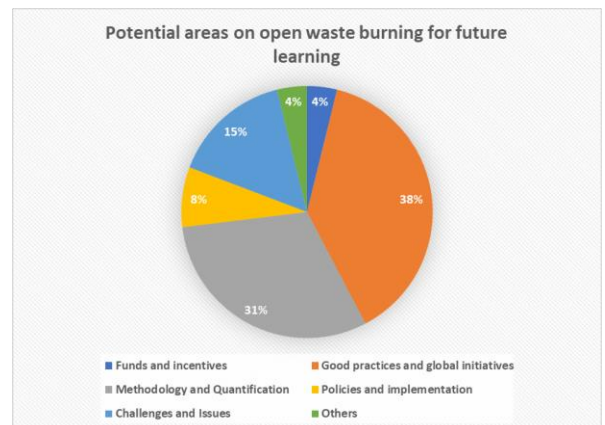
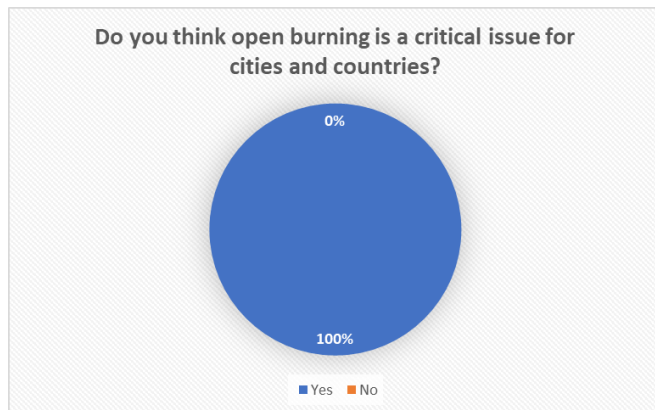


FIGURE 11: PARTICIPANT RESPONSES FOR AWARENESS ON IMPACT OF OPEN WASTE BURNING BEFORE AND AFTER THE WEBINAR

FIGURE 12: PARTICIPANT SUGGESTIONS FOR FUTURE TOPICS

Webinar Series on Open Waste Burning in Asia (2022/2023)

Webinar No. 1: Practices of Open Waste Burning in Asian Cities - Challenges and Opportunities

Registration
<https://us02web.zoom.us/j/9182283743?pwd=VW5lLjZkZGZlVGVkZWVvVWpG>
 22 April 2022, 17:00-18:00 JST (Earth Day 2022)

Moderator
 Shunichi Honda
 Programme Officer, UNEP

Introduction
 Miwa Tatsuno
 Programme Coordinator, CCET

Experience sharing

Rajeev Kumar Singh
 Policy Researcher, CCET

Rizki Aziz
 Head of Department of Engineering, Faculty of Engineering, Andalas University, Representing Padang City, Indonesia

Uch Rithy
 Director, COMPOSTED, Representing Siem Reap City, Cambodia

Panel Discussion

Sandra Mazo-Nix
 MSW Initiative Coordinator, CCAC

Carmela Centeno
 Industrial Development Officer, UNIDO

Nirmala Menikpura
 IGES Fellow, IGES

Ir. H. Mairizon
 Head of Environmental Agency, Padang City, Indonesia

Nguon Dalen
 Deputy Director of Administration, Siem Reap City, Cambodia

Logos: UNEP, UNIDO, IGES, CCET

References:

- Circular, 2019. Black carbon from burning waste has significant climate impact". Available in <https://www.circularonline.co.uk/news/black-carbon-from-burning-waste-has-significant-climate-impact/>
- Engineering X. 2020. Global Review on Safer End of Engineered Life. Engineering X (founded by the Royal Academy of Engineering and the Lloyd's Register Foundation). DOI: 10.5518/100/58
- European Investment Bank, 2016. Financial Report 2016, Imprimerie Centrale, Luxembourg. Available in https://www.eib.org/attachments/thematic/short_lived_climate_pollutants_report_2016_en.pdf
- Karunarathana, A., Singh, R.k., Rajapaksha, T., Premakumara, D.G.J., Onogawa, K., 2019. State of Municipal Solid Waste Management in Negombo City, Sri Lanka.
- Singh, R.K., Yabar, H., Mizunoya, T., Higano, Y., Rakwal, R., 2014. Potential benefits of introducing integrated solid waste management approach in developing countries: a case study in Kathmandu City. J. Sustain. Develop. 7 (6).
- UNEP, 2013. Shrestha, R.M., Kim Oanh, N.T., Shrestha, R. P., Rupakheti, M., Rajbhandari, S., Permadi, D.A., Kanabkaew, T., and Iyngararasan, M, Atmospheric Brown Clouds (ABC) Emission Inventory Manual, United Nations Environment Programme, Nairobi, Kenya.
- UNITAR and UNIDO, 2019. Stop Open Waste Burning. Available in <https://stopopenburning.unitar.org/guidance-and-examples>



Prepared by

Rajeev Kumar Singh and Premakumara Jagath Dickella Gamaralalage with the support of Miwa Tatsuno and Miki Inoue

For More Information

IGES Centre Collaborating with UN Environment on Environmental Technologies (CCET), 2108-11 Kamiyamaguchi, Hayama, Kanagawa 240-0015 Japan, Phone: +81-46-855-3840; Fax: +81-46-855-3809