Policy Brief # **67**

Smog: A transboundary issue and its implications in India and Pakistan

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Table of Contents

Setting the scene

Before 1986 farmers of North western Indian Punjab and eastern Pakistan use to harvest and plough fields manually. After crop harvesting, usual practice was to leave crop residues for 4-6 weeks to enhance nutrients for the next crop. With the rise of population, farmers have to leave manual practices and adopted mechanized harvesting from 1986 to meet food demands. Although this practice benefited a lot but compromised air quality in the region (Gadde et.al 2009).

Open residue burning is a common practice in many areas of the world including China, India, Pakistan, Nepal, Indonesia etc. (Lohan et.al 2017). Every year in October to November farmers burns crop residues after harvesting which results in poor air quality in the region of Punjab. Since this burned smoke stays for almost 3 weeks therefore it deteriorates air quality of Punjab. Seasonal meteorological conditions cause this smoke (resulting from crop burning) to cover whole Indo-Gangetic plain (IGP) from west to east (Badarinath et al., 2009; Mishra and Shibata, 2012).

Ai J. Haagen-Smit's (1970) defined smog as photochemical oxidation of organic materials originating with the petroleum industry and automobiles. According to Ritesh Gautam (2014) main sources of smog that affects Indo-Gangetic Plain are carbon (organic, black), dust, nitrates, sulfates, forest fires automobiles, power plants (coal based) and industries in the region.

A snapshot of smog in India and Pakistan

Figure 1 taken by Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite, released recently shows large amount of smog in areas of Indian New Delhi and some parts of Lahore Pakistan. As per Smit's definition smoke in the highlighted areas mixed with fog, dust, and industrial pollutants forming a thick haze.

Figure 1: NASA (November 7, 2017)

Figure 2 shows aerosol optical depth based on same sensor. This shows how aerosol affects absorption and reflection of light by atmosphere. The dark color depicts higher levels of airborne particulate matter. This pollution is covering areas of India (New Delhi, Lucknow and Kanpur) and Pakistan (Lahore). This was observed on November 7 and it persisted for another day i.e. November 8, 2017. In both regions the level of particulate matter was above the safe limits.

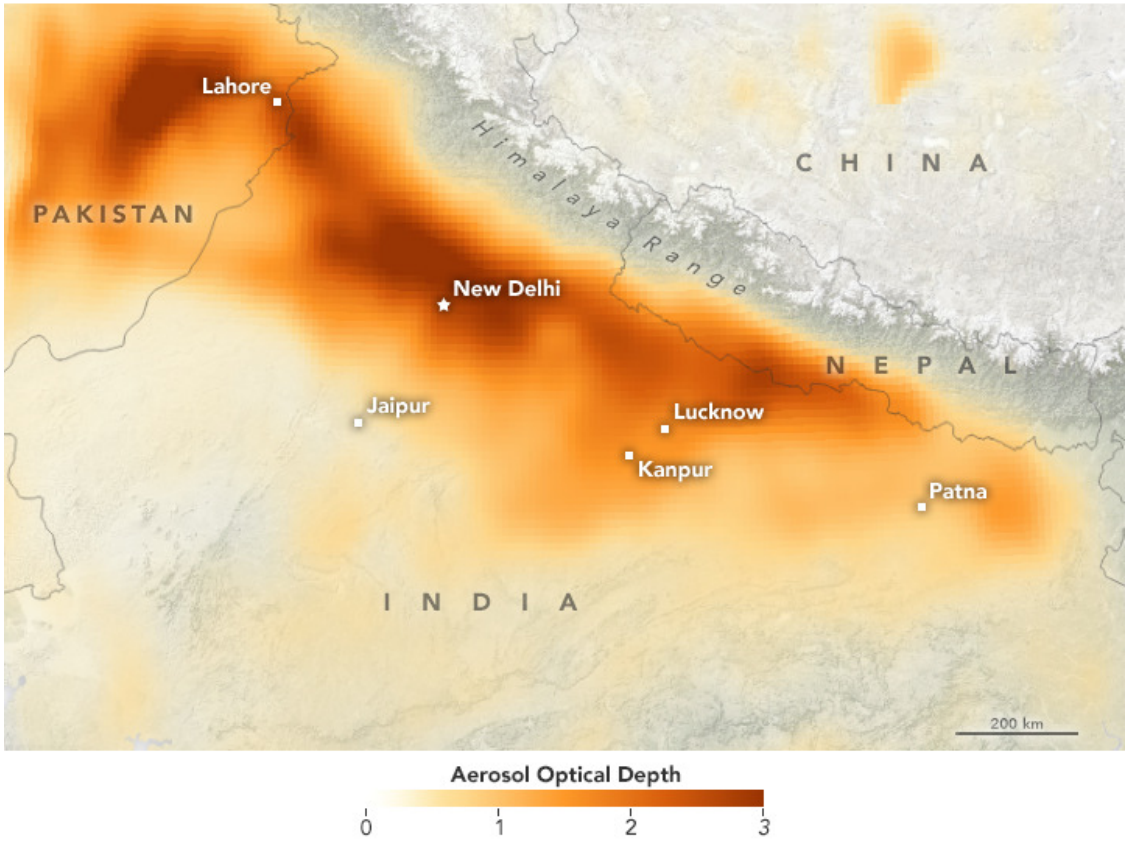


Figure 2: NASA (November 7, 2017)

If we look at table 1 of the air quality situation in India even a day after the data captured by NASA, particulate matter is exceeding the permissible limits. The safer limits of the permissible range of PM 2.5 and PM 10 is 0-60 µg/m3 and 0-100 µg/m3 respectively.

Table 1: Particulate matter (µg/m3) in India on November 8, 2017

Area	PM2.5	PM10
Pusa	521	537
Lodhi road	581	601
Mathura Road	626	555
Ayanagar	531	589
Delhi University	609	669
Noida	575	600
Airport	541	585
Pitampura	570	624
Gurugram	536	583

Source: System of Air Quality and Weather Forecasting and Research (SAFAR), India

Levels of particulate matter (PM2.5) in Lahore touched levels of 1,077 micrograms per cubic meter whereas permissible limit in Pakistan is 35 µg/m^3 in November 2017. Even on October 20th, 2018 particulate matter were recorded high in India and Pakistan (Atmosphere Monitoring Service, CAMS).

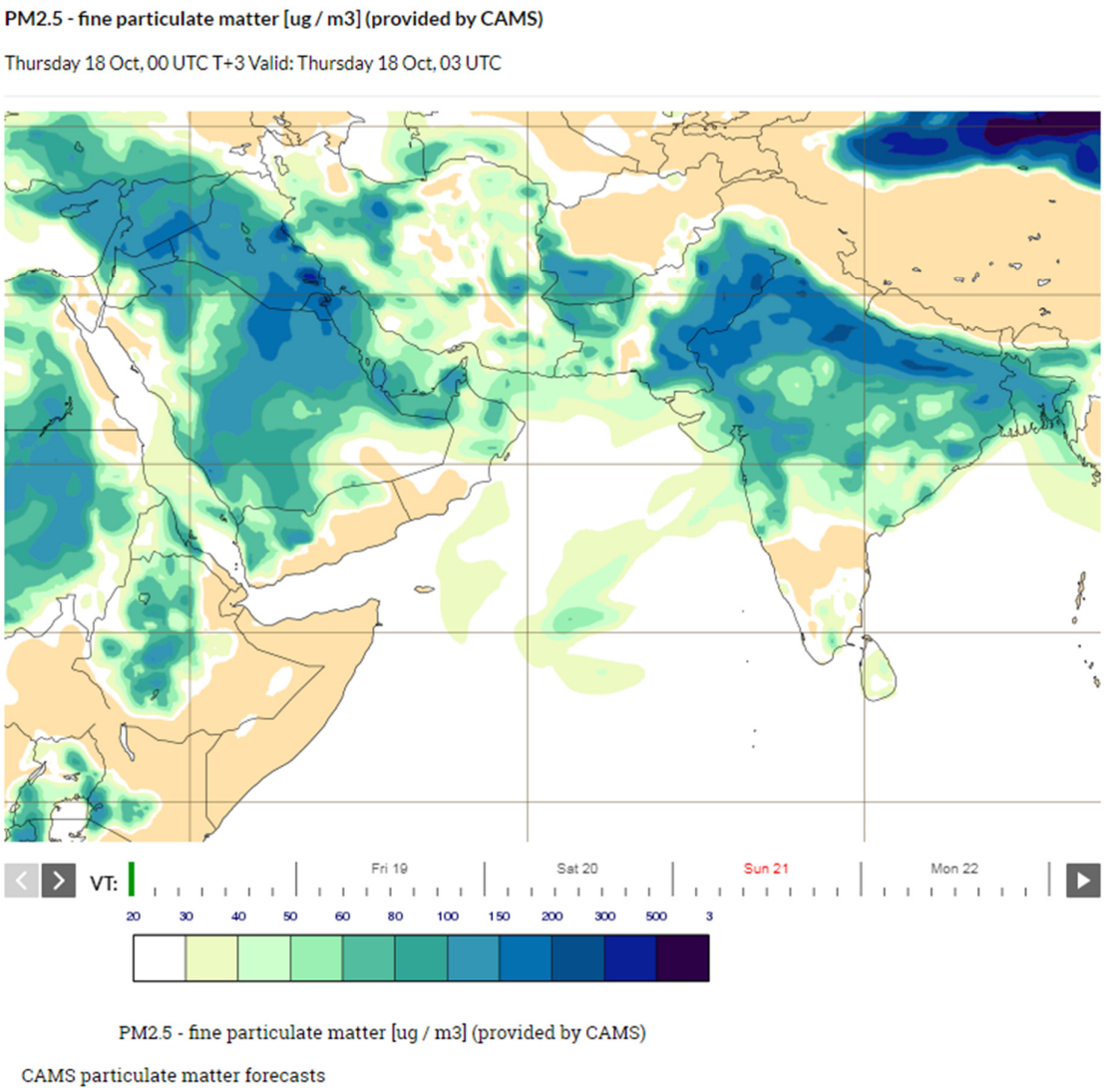


Figure 3: Particulate Matter in India and Pakistan (CAMS, 2018)

In India and Pakistan residual is burnt after harvesting in October to November which affects air quality of the region. In Pakistan most of the rice cultivation takes place in Punjab and same goes for Indian Punjab because of the suitable climatic conditions for the crop. In both countries stubble burning is the leading cause of forming smog. According to India's Ministry of News and Renewable Energy Sources Indian Punjab contributes 44-51 million tonnes of residue annually. According to a study, farmers burn 30-90% of residue which contributes to the smog formation in the region. According to estimates, paddy areas burnt every year in Indian Punjab and Haryana are 12.68 million hectares and 2.08 million hectares respectively (Lohan et.al 2017). Table 1 shows estimated paddy residue burnt area in north

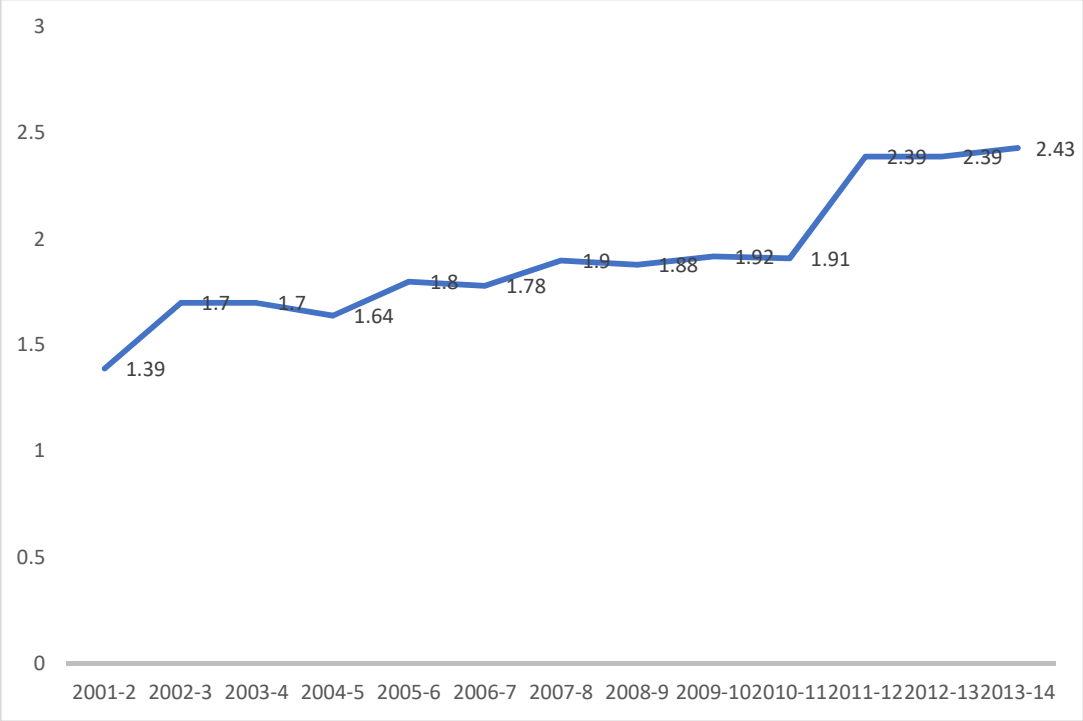
west states of India for the year 2014-2015. Table shows that only Haryana burns 1.29 million tonnes of paddy residues whereas rest of the Punjab burns 8.75 million tonnes of the residues.

Table2: Estimated paddy residue burnt area in north west states of India

	Punjab	Haryana	Total
Total paddy area in 000 hectares	2845	1206	4051
Total wheat area in 000 hectares	3512	2499	6011
Paddy wheat rotation area in 000 hectares	2680.9	1113.9	3794.8
Area under basmati rice variety in 000 hectares	30	825	845
Paddy area excluding basmati rice variety million tonnes	2815	391	3206
Area harvested by combine harvester in 000 hectares	2533.5	351.9	2885.4
Area under zero tillage, in 000 hectares	633.38	0.50	633.8
Paddy residue burning area in 000 hectares	1900.13	351.4	2251.5
Production of paddy million tonnes	11.10	4	15.37
Amount of paddy residue burnt million tonnes	8.75	1.29	14.42
Percent burnt area	66.79	29.14	55.58

Source: Lohan et.al 2017

Figure 4 shows rice crop production in last 15 years in Pakistan and it has increased from 1.39 million tonnes per hectares to 2.43 million per hectares. In most of the areas of Punjab old practice of burning after rice harvesting is practiced which deteriorates air quality. According to a study rice straw burning in Punjab constitutes for 72% whereas bagasse contributes to 14% of the total pollution in Pakistani Punjab (Irfan et.al 2015).



Source: Pakistan Bureau of Statistics

Other than crop burning increased traffic, coal power plants, fire crakers and brick kilns contributes to smog pollution (Srivastava, 2017).

Figure 4: Rice production in Punjab Pakistan

Socio economic impacts of smog in India and Pakistan

Smog causes cardiac issues, allergies, high blood pressure and eye irritation (Sughis et al. 2012). Poor air quality affects health badly. Kids and women are particularly more vulnerable to this kind of pollution as they absorb more air per pound of their weight. Doctors declared emergency and authorities shut down schools and issued warning to wear masks and not go out in public places. Airports were closed and flights were delayed. Almost 30 flight operation at Allama Iqbal Lahore airport were suspended (Jamal, 2017). In Pakistan motorway (M-1 and M-2) remained closed for few days. Particulate matter in both countries were alarming in November. Pakistan also shut down 180 factories. In Delhi few coal power plants were closed temporarily to make air quality better. 6000 schools in New Delhi remained closed due to choking smog (Phys Org, 2017).

Particulate matter can enter into lungs because of its small size and then penetrates into blood stream causing irreparable damage. According to World Health Organization 60,000 Pakistanis died in the year 2015 due to fine particulate matter. According to health ministry almost 1,000 new patients were treated for respiratory issues in nine public hospitals everyday due to smog in Lahore (Fioriti, 2017). Smog

also causes asthma and tightening of throat (Safi, 2017). A Delhi based surgeon linked, with smog, cancer in females and non-smokers in their 30's and early 40's years of age (Safi, 2017).

On November 5th 2017 total 10 people were killed and 25 injured due to visibility issue caused by smog in Lahore (Munir, 2017). On November 9th eight students were killed in Punjab when a truck ploughed into them when they were waiting for their bus on the roadside (Phys Org, 2017). According to Lancet Commission air pollution causes 300,000 pre-mature deaths annually in Pakistan and 2.5 million deaths in India (Khan, 2017; Hincks, 2017).

Alternate uses of rice residues

Farmers need to be given awareness for the alternate use of rice residue. According to research conducted by Kumar et al, following can be alternate uses of rice residue instead of in-situ burning;

- As fodder for animals
- Bedding material for animals in winters
- Mushroom cultivation
- Paper production
- Generation of energy from thermal power plants
- Bio gas generation

What needs to be done?

- Ban diesel generators and fireworks
- Promote alternate of stubble burning and for that farmers need to be given awareness
- Bilateral talks with India
- More research is needed to find out exact causes of smog in Punjab Pakistan
- Policy at regional level should be developed to tackle this issue together

References:

Gadde B., Bonnet S., Menke C., and Garivait S. 2009. Air pollutant emissions from rice straw open field burning in India, Thailand and the Philippines. Journal of Environmental Pollution. Volume 157, Issue 5. Access date October 20th, 2018 https://www.sciencedirect.com/science/article/pii/S0269749109000189#!

Lohan S.K., Jat H.S., Yadav A.K., Jat M.I., Sindhu H.S., Choudhary M., Peter J.K., and Sharma P.C. 2017. Burning issues of paddy residue management in north-west states of India. Renewable and Sustainable Energy Reviews. Access date October 20th, 2018 file:///C:/Users/MIS/Documents/Smog/India-RSERresisidueburning.pdf

Badarinath K.V.S,. & Kharol S., and Sharma A.R.2009. Long-range transport of aerosols from agriculture crop residue burning in Indo-Gangetic Plains – A study using LIDAR, ground measurements and satellite data. Journal of Atmospheric and Solar-Terrestrial Physics. 71(1):112-120

Mishra A.K., and Shibata T. 2012. Synergistic analyses of optical and microphysical properties of agricultural crop residue burning aerosols over the Indo-Gangetic Basin (IGB). Journal of Atmospheric Environment. 57, 205-218.

Smith A.J.H. 1970. A Lesson from the Smog Capital of the World. Proceedings of the National Academy of Sciences Vol. 67, No. 2, pp. 887-897. < https://www.arb.ca.gov/research/hsawards/a_lesson_from_the_smog_capital_of_world.pdf>

Gautam R. 2014. Challenges in Early Warning of the Persistent and Widespread Winter Fog over the Indo-Gangetic Plains: A Satellite Perspective. Reducing Disaster: Early Warning Systems For Climate Change. pp 51-61 < https://link.springer.com/chapter/10.1007%2F978-94-017-8598-3_3#page-1>

Irfan M., Riaz M., Arif M.S., Shahzad S.M., Hussain S., Akhtar M.J., Berg L.V.D., and Abbas F. 2015. Spatial distribution of pollutant emissions from crop residue burning in the Punjab and Sindh provinces of Pakistan: uncertainties and challenges. Environmental Science and Pollution Research.

Volume 22, Issue 21. Access date October 20th, 2018 < https://link.springer.com/article/10.1007/s11356-015-5421-7>

Fioriti J. 2017. Pakistan indifferent as smog kills more people than militancy. Phys Org. Access date October 20th, 2018 < https://phys.org/news/2017-11-pakistan-indifferent-smog-people-militancy.html>

Munir A. 2017. Smog is so bad in India, Pakistan, motorists can't see to drive. USA Today. Access date October 20th, 2018 < https://www.usatoday.com/story/news/world/2017/11/05/smog-india-pakistan-air-pollution-causes-car-accidents-illness/833620001/>

Phys Org. 2017. Delhi schools shut as toxic smog hits India and Pakistan. Access date October 20th, 2018 < https://phys.org/news/2017-11-schools-toxic-smog-delhi.html#nRlv>

Phys Org. 2017. Thousands of schools close as smog envelopes India, Pakistan. Access date October 20th, 2018 < https://phys.org/news/2017-11-thousands-schools-smog-envelopes-india.html#nRlv>

Srivastava A. 2017. Parents angry as Delhi schools reopen despite smog. Access date October 20th, 2018 < https://phys.org/news/2017-11-parents-angry-delhi-schools-reopen.html#nRlv>

Khan M.S. 2017. Lahore’s smog returns. Daily Times. Access date October 20th, 2018 < https://dailytimes.com.pk/132433/lahores-smog-returns/>

Safi M. 2017. 'Half my lung cancer patients are non-smokers': toxic air crisis chokes Delhi. The Guardians. Access date October 20th, 2018 < https://www.theguardian.com/world/2017/nov/10/lung-cancer-delhi-toxic-air-crisis-pollution-health-india>

Sughis M., Nawrot T.S., Haque S.I., Amjad A., and Nemery B. 2012. Blood pressure and particulate air pollution in schoolchildren of Lahore, Pakistan. BMC Public health. Access date 20th October 2018 < https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3403904/>

Jamal S. 2017. Smog in Pakistan causing accidents, illness and flight disruption. Gulf News Pakistan. Access date 21st October 2018 < https://gulfnews.com/news/asia/pakistan/smog-in-pakistan-causing-accidents-illness-and-flight-disruption-1.2120678>

Hincks J. 2017. Toxic Smog Is Shrouding the Indian Capital Again. Here's Why. Time. Access date 22nd October, 2018 http://time.com/5014681/india-delhi-smog-pollution/

Kumar P., Kumar S., and Joshi L. 2014. Alternate uses of crop stubble. Socioeconomic and environmental implications of agricultural residue burning. Springer. Pp 69-89. Access date 24th October, 2018 < https://link.springer.com/content/pdf/10.1007%2F978-81-322-2014-5_4.pdf>