Introduction

Open burning is a waste and residue management technique that involves burning vegetation, straw, stubble, and other types of residue to prepare fields for planting. It is practiced in many tillage-based production systems and is especially acute in the Indo-Gangetic Plain, where rice and wheat are grown. Indeed, in addition to Punjab, this practice is widespread in neighboring states such as Haryana, Rajasthan and Uttar Pradesh. Here we discuss the implications for policymakers of open burning in Punjab, where a UNEP-funded project implemented by the Punjab Agricultural Management and Extension Training Institute (PAMETI) has been working to curb this practice because of its negative effects on public health, soil, and climate.

Dominant crop cycle systems in Punjab, India

Although the state of Punjab represents only 1.5% of India's land surface, it is known as its “grain bowl,” producing 29% of the country’s rice and 46% of wheat, thanks largely to fertile soils and arable lands. The state sows approximately 4.13 million hectares per year. Open burning is usually the result of traditional tillage systems in the region. The average farm size in Punjab is approximately 4 hectares, and rice is grown in the Kharif spring and summer months (April/May through October/November), while wheat is grown in the Rabi fall and winter months (October/November through April/May). Although many farmers and farmhands harvest, plan, and manage residue manually, some use combine harvesters. These combine harvesters and seeders are often not able to collect all of the residue from rice and wheat. Combines do not spread straw and chaff uniformly behind the machine, making it difficult to plant the next crop without burning the straw left over from the previous crop. Since the time window is short, there is little opportunity for tillage or other residue management practices. It is also difficult to employ seasonal farm workers to prepare the land from harvest of one crop to planting of the next crop.

Who burns what and why?

The area under paddy in Punjab, Haryana, Rajasthan, and Uttar Pradesh is around 3.0, 1.3, 5.8 and 0.18 million ha, respectively. These four states on an average produce around 37-39 million tons of rice residue. However, the states of Punjab and Haryana alone account for around 28-29 million tons of rice residue. In the case of wheat straw, about 85% wheat straw is managed with a straw baling machine and used for livestock bedding and feed, yet the leftover stubble (around 15% of the residue) is burned. The leftover residue, meanwhile, is spread over in the 80% of the sown field, and fires can spread even further if not properly put out. Although wheat straw is highly valued for feed and bedding for livestock, approximately 7-10 centimetres of stubble remain and loose straw is also sometimes spread across sown fields, making it difficult and/or burdensome to plant rice. In the case of rice straw, there is little or no market for it for livestock, and although new markets are developing for rice residue, such as briquettes to replace cow dung patties for energy production, the problem remains. Data reveal a substantial increase in burning activities over the last 10 to 15 years, likely due to the introduction of combine harvesters, although some data indicate that spot improvements is visible in certain districts where alternative practices are being introduced and promoted.

What are the impacts of open burning in India?

Open burning produces particulate matter (black carbon, or soot) that severely affects air quality. In the fall of 2017, it was estimated by the Indian government that 90% of haze in Punjab and New Delhi came from open burning. It was also estimated by the World Health Organization (WHO) that breathing during this time could be compared to smoking up to 100 cigarettes per day. It is also harmful to the composition of soil - unable to sequester nutrients such as nitrogen, phosphorus, potash, Sulphur, and organic carbon, - drying soil and rendering it less water-resilient. Smoke and haze from open burning can also cause traffic and even plane accidents. Fires in close proximity to forested areas can cause much larger and more dangerous forest fires. The soot from smoke known as black carbon is also very harmful to snow and ice covered regions, which is particularly harmful near the Himalayas, aggravating climate change and destabilizing weather patterns in the region.
Isn’t open burning banned?

While open burning is formally banned in India, it can be difficult and sometimes harmful to enforce these laws without proper extension and access to appropriate equipment, resulting in protests that have turned violent and/or willful ignorance of the law in favor of burning. During political campaign seasons, lawmakers sometimes temporarily lift the ban to appease farmers with no alternatives, which can aggravate the problem by intensifying the practice. As can be seen from satellite data recorded in October 2017, open burning is commonplace in India and in Punjab in particular:

What are some alternatives to open burning?

Better equipment and conservation agriculture (CA) methods can be a solution for both wheat and straw residue, yet this requires effective extension, education, and access to appropriately tailored equipment for farmers. CA calls for no burning of crop residues or vegetation biomass. Instead, biomass produced by crops is managed to enhance and maintain soil health and productivity, resulting in significant benefits which include: greater farm output and productivity (efficiency), greater stability in yields, enhanced resilience to biotic and abiotic stresses and extreme events, a range of ecosystem services such as clean water, control of soil erosion and land degradation, improved carbon, water and nutrient cycling, and greater water infiltration and soil water retention. CA is considered to save on purchased inputs including fuel because of the greater factor productivity, and hence is more profitable. CA is considered to be climate-smart because of its adaptability to climate change and ability to contribute to climate change mitigation through carbon sequestration and reduction in CH4 and N2O emissions. CA also has the ability to rehabilitate or regenerate degraded soil.

If CA is not a possible alternative, other uses for rice and wheat residue can be of use for domestic energy, replacing dung patties emitting methane. Government-backed biogas plants are being developed in Punjab, requiring fuel inputs from waste, also known as Waste-to-Energy or second-generation biofuel. Rice and wheat residue would thereby be given a second life and would provide for a cleaner and more controlled form of burning.