ICFA

भारतीय कृषि एवं खाद्य परिषद्

INDIAN COUNCIL OF FOOD AND AGRICULTURE

Report

on

Crop Residue Burning

Challenges & Solutions

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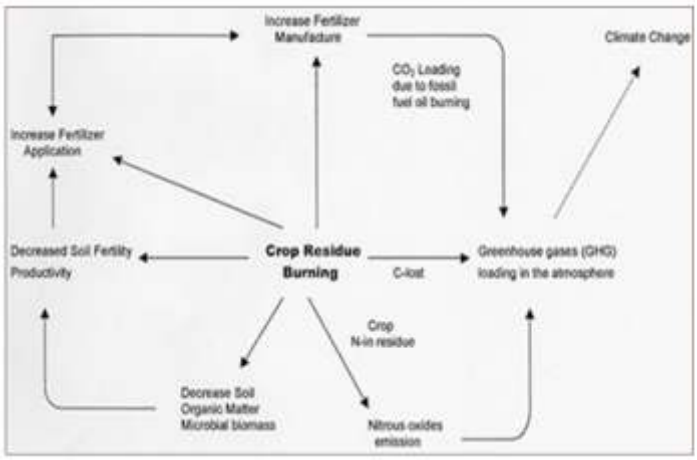
1. Background

1.1 Global Context

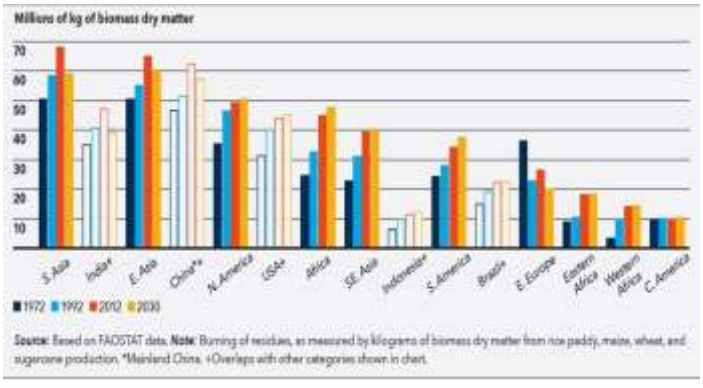
Total global open burning of biomass accounts for nearly 37 percent of global black carbon. This includes burning of forest, savannah, and agriculture residue burning. According to studies (like Bond et al, 2013), emissions from biomass burning are estimated at 2,760 Gg per year. Agriculture is considered to be the sector as the largest emitter of black carbon even if only approximately 60 percent of these emissions were related to agricultural activities. The effects of open burning on the climate are not straightforward, however. Open burning emits significant amounts of co-pollutants, including warming agents such as carbon monoxide and cooling agents such as organic carbon. Cooling effect of organic carbon is due to reason that it is lighter in color than black carbon, and can be therefore be reflective. As a result, it is possible that in some cases, biomass burning has a net cooling effect in the short run, much before the longer term effects of Green house gasses (GHGs) are factored in.

Fig 1: Crop Residue Burning: How the Menace Builds Up



Crop residue burning is a global phenomena and many of the countries are a part of this so called menace. In aggregate terms, China, India, and the United States are the top burners of crop residues. Brazil, Indonesia, and the Russian Federation are the other big contributors of crop residue burining. However, in relative terms, Africa is home to some of the most intensive rates of residue burning per hectare of harvested land. It is also the region where burning is growing the fastest. In aggregate terms, Mexico and Tanzania are the most intensive burners, followed by Brazil, the United States, and Nigeria. And over the past decades, burning has progressed significantly in countries including Brazil, Indonesia, Thailand, India, and China.

Fig 2: Geography and Evolution of Crop Residue Burning



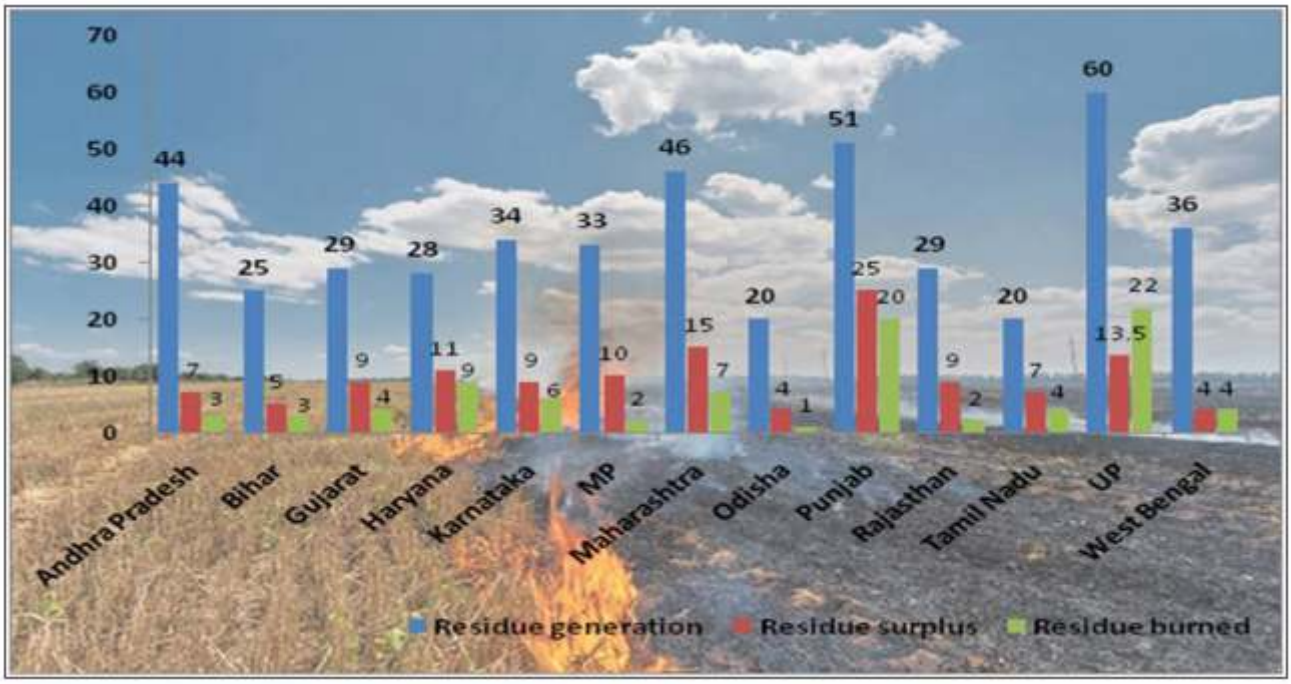
Source: Based on FAOSTAT data. Note: Burning of residues, as measured by kilograms of biomass dry matter from rice paddy, maize, wheat, and sugarcane production. *Mainland China. +Overlaps with other categories shown in chart.

1.2 Indian Context

As per available estimates, India produced about 99 million tons of wheat, 11.5 million tons of rice, 45 million tons of coarse grains, 24 million tons of maize, 355 million tons of sugarcane, 45 million tons of fibre crops (jute, mesta, cotton), 24.5 million tons of pulses and 31 Mt of oilseed crops. Out of various crops grown, rice, wheat and sugarcane are prone to crop maximum residue burning. These crops are preferred by farmers since they provide higher economic return, as compared to other crops.

Harvesting of various crops generates large volume of residues both on and off farm. In a study conducted by the Ministry of New and Renewable Energy, it is estimated that about 500 million tons of crop residues are generated annually. The generation of crop residues is highest in Uttar Pradesh (60 million tons), followed by Punjab (51 million tons) and Maharashtra (46 million tons). Among different crops, cereals generate maximum residues (352 million tons), followed by fibres (66 million tons), oilseeds (29 million tons), pulses (13 million tons) and sugarcane (12 million tons). Another important aspect that cannot be ignored is the fact that many of these regions of crop residue burning are closer to some of the large metros including the National Capital Region, where there is already a pressure on the environment due to emissions from thousands of vehicles, air conditioners etc. Crop residue burning in Punjab and Haryana is often blamed for worsening air quality in the Delhi National Capital Region. Another study by scientists working in the US and India has found that impact of crop residue burning in the Northwest region can spread as far as to central and southern states like Maharashtra, Madhya Pradesh, Telangana, Chattisgarh and even parts of Odisha.

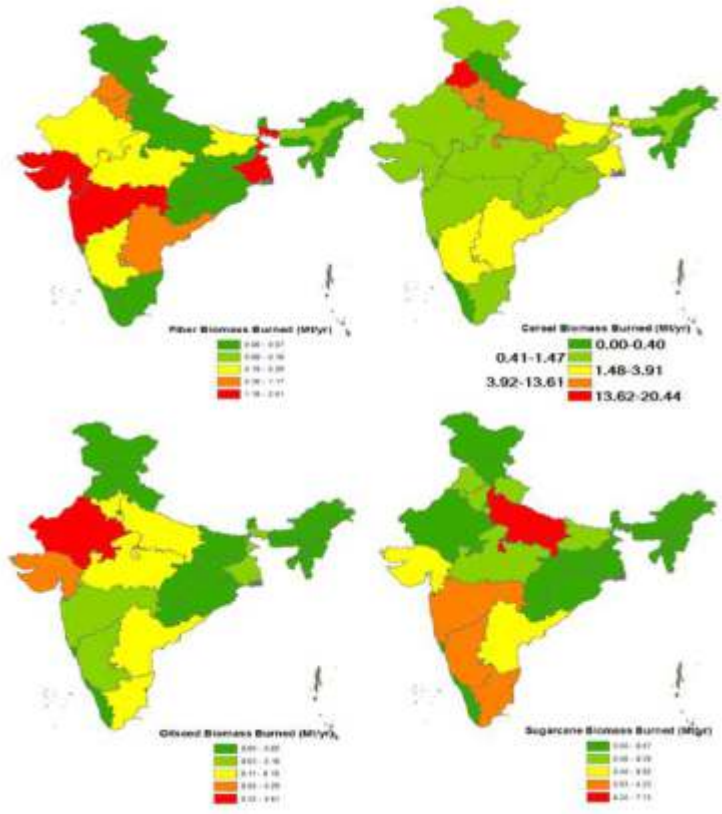
Fig 3: Status of Crop Residue Generation, Surplus and Burning in Different States (in million tons)



Source: Ministry of New & Renewable Energy, Govt. of India

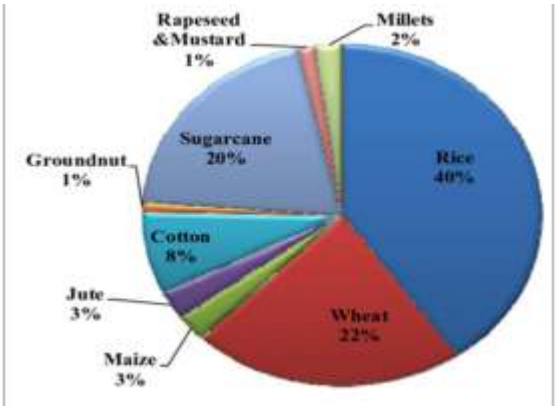
Different regions in India show differential amount of biomass burning in terms of some of the major crops grown like cereals, fibre crops, oilseeds, sugarcane etc. The northern, central and the western regions contribute to crop burning in a considerable manner as cultivation of these principle crops in these regions are maximum. States like Uttar Pradesh, Punjab, Gujarat, Maharashtra, Rajasthan are the epicentres of maximum crop residue burning.

Fig 4: Distribution of Emissions from Crop Burning across Regions



Looking at the contribution to total crop residue burning in terms of different crops, rice, wheat and sugarcane together contribute to a massive 82% of the total biomass burning from crops in India. Thus, while some of these crops are the biggest water guzzlers in terms of irrigation water, after harvesting, managing the crop residues poses environmental hazards in the form of residue burning on the fields. Any intervention targeted at arresting the residue burning in these crops will significantly reduce the menace. Cotton contributes to 8% of the crop residue burning while jute and maize contribute 3% each.

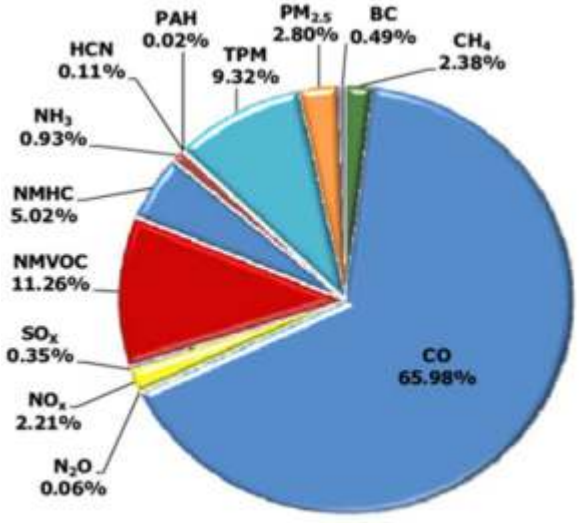
Fig: 5: Contribution of different crops in residue burning



Source: Ministry of New & Renewable Energy, Govt. of India

Out of the total gasses emitted from crop residue burning in India, almost 66% of it is carbon monoxide. Crop residue burning is a major source of black carbon in the environment. The most widespread increase in black carbon over the eastern and central-south regions is seen in the post-monsoon and winter periods. This is a confirmation of the greater role of transport of black carbon from north-westerly source regions in during this time. Crop residue burning is also a major source of Non-Methane Volatile Organic Compound (NMVOC). NMVOCs contribute to the formation of ground level Tropospheric ozone. In India, of the different types of gasses emanating from crop residue burning, more than 11% account for NMVOC emission. Non-methane hydrocarbons (NMHCs), accounting for 5% of the total gas emission from crop residue burning are known to have an important role on air quality due to their high reactivity.

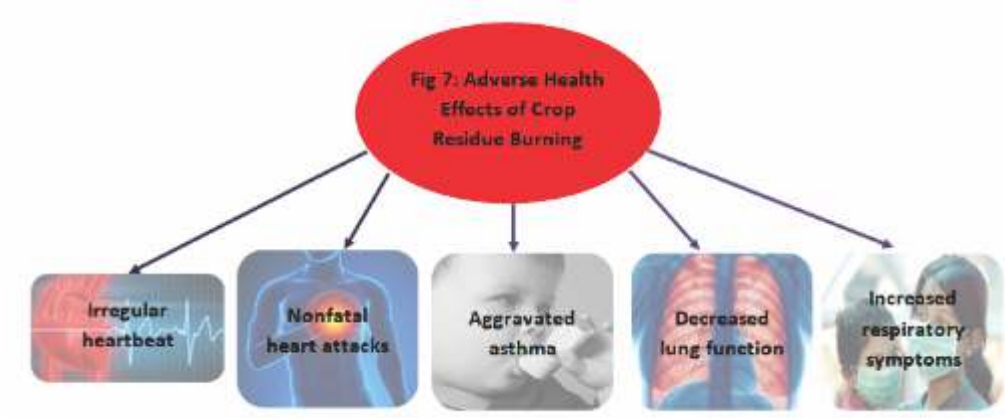
Fig 6: Contribution of Different Gasses from Crop Residue Burning in India



Source: Ministry of New & Renewable Energy, Govt. of India

2. Health Impacts of Crop Residue Burning

The net effect of all these emissions is catastrophic on the environment and health of human beings. Numerous scientific studies have linked this pollution exposure to a variety of problems, predominantly effecting both lungs and heart. Premature death in people with heart or lung disease is also linked to such pollutants.



3. Impacts of Crop Residue Burning on Agriculture Sector

Although there may be some short-term benefits to burning crop residue, there is a slow and steady reduction in soil health that will eventually result in reduced productivity that cannot be overcome with increased additions of mineral fertilizers. Some of the adverse effects are:

3.1 Loss of Nutrients

It is estimated that burning of one tonne of rice straw accounts for loss of 5.5 kg Nitrogen, 2.3 kg phosphorus, 25 kg potassium and 1.2 kg sulphur besides, organic carbon. Generally crop residues of different crops contain 80% of Nitrogen (N), 25% of Phosphorus (P), 50% of Sulphur (S) and 20% of Potassium (K). If the crop residue is incorporated or retained in the soil itself, it gets enriched, particularly with organic Carbon and Nitrogen.

3.2 Impact on soil properties

Heat from burning residues elevates soil temperature causing death of beneficial soil organisms. Frequent residue burning leads to complete loss of microbial population and reduces level of N and C in the top 0-15 cm soil profile, which is important for crop root development. As a result, there is a slow and steady reduction in soil health that will eventually result in reduced productivity that cannot be overcome with increased additions of mineral fertilizers.

3. 3 Wastage of valuable fodder for animals

Many of the crop residues in the form of straw are good source of fodder for dairy animals. Once burnt, these go waste. This is more serious a loss when considered in the backdrop a severe shortage of fodder for animals.

4. Techniques of Crop Residue Management

4.1 Technological interventions

- Incorporation of crop residue into soils through adoption of conservation agriculture practices to prevent soil erosion from wind & water and to augment the soil moisture
- Promotion of use of crop residue for preparation of bio enriched compost or vermi-compost and its utilization as farm yard manure
- Use of crop residue for cultivation of mushroom particularly species like Agaricus bisporus (white button mushroom) and Volvriella Volvacea (straw mushroom)
- Use of agri machineries and implements like happy seeder, turbo seeder, shredder, baling machines, zero- seed-cum-fertilizer drill etc. to facilitate in-situ management of crop residue and retaining the straw as surface mulching

4.2 Practice of conservation agriculture

This is a very effective, sustainable and productive method of agriculture practice and avoiding crop residue burning. The spread and acceleration of conservation agriculture (CA) is essential to contain and curb a environmentally unjustifiable practice like crop residue burning and the spread of conservation agriculture should be a farmers' driven approach. Through CA, farmers can illustrate that alternatives to burning can become viable across a wide range of farming systems and geographies with appropriate forms of support. CA represents an exit from burning as three of its central tenets are to minimize soil disturbance (by not tilling), to maintain soil cover and to diversify crop species.

4.2 Diversified use of crop residues

- Diversified use of crop residue as fuel for power plants, production of cellulosic ethanol etc.
- Use of crop residue, rice straw in paper/board/panel and packing material industry
- Collection of crop residue for feed, brick making, etc. and extending subsidy for transport of crop residue to fodder deficient areas

4.3 Capacity building and awareness generation

- Organising training of farmers for creating awareness about effects of crop residue burning, adoption of conservation agriculture practices and resource conservation technology through all ongoing State/Centre Sector Schemes
- Creation of awareness about various measures to prevent crop residue burning through mass media, print media, etc. just before the harvesting seasons
- Demonstrations of crop residue management technology on a large scale by the State Department of Agriculture and other Government Institutions
- On-farm demonstrations to create awareness and dissemination of various technologies and organising field days under ongoing programmes/schemes

4.4 Enacting laws and legislations to curb the menace

- Bringing of suitable laws or rules or orders for prevention or banning the practice of crop residue burning as per policy and priority of the respective States where crop residue burning is rampant
- Incentivizing establishment of projects aiming at utilization of crop residues as raw materials
- Issuing of advisory from Ministry of Environment, Forests & Climate Change (MoEF&CC), State Pollution Control Boards, Green Tribunal etc. to various State Governments and Union Territories to curb this nuisance of crop residue burning
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Tit bits from Ancient History!

In the Andes prior to the arrival of the Spanish and the introduction of the plough, the practice of burning fields carried a penalty of death because it damaged the soil, the lifeblood of high agricultural yields!

5. Major Recent Initiative in India to Curb Crop Residue Burning

A series of measures have been adopted in the recent times by the Government to curb the practice of crop residue burning in several States. The Centre has provided RS. 757.18 crores to farmers of Punjab, Haryana and Uttar Pradesh to encourage the farmers to purchase various agri machineries like happy seeder, paddy straw chopper/cutter, mulcher, Reversible Mouldboard (RMB) ploughs, shrub cutter, zero till drill, super straw management system on combine harvesters, rotary slashers, rotavators etc. The current Government under the leadership of Prime Minister Narendra Modi has approved RS. 1,151 crores of Central funds for control of crop residue burning in four major Indian States. Of these funds, RS. 591 crores will be spent this fiscal while the remaining is planned to be spent next fiscal.

6. Recommendations and Suggestions

- **Encouragement of private companies and Public Private Partnerships (PPP) in biomass based energy and fuel plants:** Paddy straw is having attractive potential in terms of energy. Although the technology for rice husk utilization is well-proven in industrialized countries of Europe and North America, such technologies are yet to be taken up on a large and commercial scale in India, though various research based organizations are coming forward in this regard. Considering the immense benefit that such initiatives can provide both in terms of crop residue management and meeting the ever growing demand for fuel and energy, Government should come up with a focussed and mission mode approach towards encouraging such ventures.
- **Showcasing as an additional source of income for farmers:** Linking farmers to companies that utilize biomass like crop residues for producing bio fuel, paper/board/panel, packing materials, feed, brick making etc. to sell crop residues can be showcased as a profitable and valuable source of additional income.
- **Providing incentives to companies using crop residues as raw materials:** Various kind of incentives can be designed in a creative and innovative manner so that increasing number of private players who use crop residues as raw materials are encouraged to go to farmers' doorsteps to procure crop residues. Transportation subsidy, tax benefits, convergence of other special trade incentives to purchase of crop residues from farm gates can be considered
- **Linking CSR activities of large oil companies who are also into biofuel production:** Companies like Indian Oil, Hindustan Petroleum, ONGC, Reliance and various other national and Multinational oil companies can be encouraged to produce more bio fuel and use more quantity of crop residues from farmers' fields after each harvesting season in time. Their mandatory CSR activities can be converged to this aspect.
- **Location specific interventions by State Governments:** State Governments may identify various need based, location specific interventions suitable to particular agro-ecological zones for management of crop residues and implement the same under the Annual Work Plan (AWP) of various ongoing schemes or programmes or missions of DAC.
- **Availing financial assistance from Rashtriya Krishi Vikas Yojana (RKVY):** State Governments can also avail financial assistance from Rashtriya Krishi Vikas Yojana (RKVY), which provides flexibility to the states for taking up any components/interventions required for holistic and integrated development of agriculture including management of crop residue.
- **Extending subsidy to the farmers for hiring resource conservation machineries from Custom Hiring Center:** Although the recent initiative of the Central Government to allocate funds for encouraging subsidised machines that can reduce crop residue burning is a good one, however, still farmers need to spend quite some money from their own apart from the 80% subsidy. Instead of this, Government can actually support the CHCs and Agriculture Service Centers for promotion of establishment of such machines to the farmers at the time of crop harvesting.
- **Dedicated agencies for educating, awareness building and monitoring of crop residue burning:** State Governments of highly vulnerable States in terms of crop residue burning may engage dedicated agencies from the rural development and livelihood sector to undertake intensive training and awareness building programmes along with monitoring of crop residue burning.

भारतीय कृषि एवं खाद्य परिषद्

INDIAN COUNCIL OF FOOD AND AGRICULTURE

B-Wing, 2nd floor, Naurang House, KG Marg, New Delhi-110001
Ph: 011 - 41501465, 41501475 | Fax: 011 - 23353406
Website: www.icfa.org.in