

Stubble Burning Practice Impacts on Agricultural Productivity & Climate Change

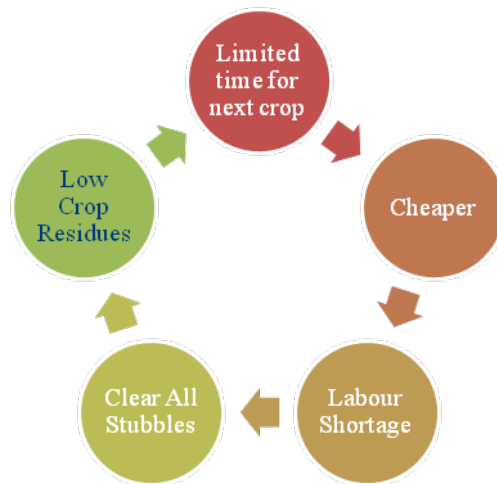
Chandar, K, Hemantha Kumar, J, Reddy I.V.S, Murthy, K.G.K, Naganjali, K, Neelima, P, Pavani, T and Deepak Reddy B
 Agricultural College, Aswaraopet-507301
 Professor Jayashankar Telangana State Agricultural University, Telangana, India
 Corresponding author: Korrachandar04@gmail.com

Manuscript No: KN-V2-03/004

What Is Stubble Burning Practice....?

- Stubble burning also called Parali burning, stubble burning is a method of removing paddy crop residues from the field to sow wheat.
- It is usually done in the last week of September to November.
- It is usually required in areas that use the combined harvesting method which leaves crop residue behind.
- It is practiced by the farmers to prepare the land for the next cultivation.
- It is practiced mainly in the Indo-Gangetic plains of Punjab, Haryana, and UP to clear the fields for Rabi crop sowing.

Why farmers are following stubble burning



Impact of Stubble Burning on Environment

1. Air Pollution:

Stubble burning emits toxic pollutants in the atmosphere containing harmful gases like Carbon Monoxide (CO), methane (CH₄), carcinogenic polycyclic aromatic hydrocarbons, and volatile organic compounds (VOC). These pollutants disperse in the surroundings and eventually affect air quality and people's health by forming a thick blanket of smog.

2. Degradation of Soil fertility:

Soil becomes less fertile and its nutrients are destroyed when the Stubbles/Straw is burned on the field
 Consequences...

A. Loss of Organic Matter: Stubble burning leads to the rapid combustion of crop residues, resulting in the depletion of organic matter content in the soil.

B. Reduced Soil Fertility: Organic matter plays a crucial role in soil fertility by improving soil structure, moisture retention, and nutrient availability. Stubble burning diminishes these fertility-enhancing properties.

C. Soil Compaction: The intense heat generated during stubble burning can lead to soil compaction, reducing porosity and impairing water infiltration and root growth.

D. Altered Soil Microbial Communities: Stubble burning alters the composition and activity of soil microbial communities, disrupting essential soil processes such as nutrient cycling and organic matter decomposition.

E. Soil Erosion: With reduced organic matter and weakened soil structure, stubble-burned soils are more susceptible to erosion by wind and water, leading to loss of topsoil and soil fertility.

F. Nutrient Loss: The burning of crop residues accelerates the release of nutrients stored within the stubble, increasing the risk of nutrient loss through volatilization and atmospheric deposition, further degrading soil fertility.

G. Increased Soil Acidity: Stubble burning releases acidic compounds into the soil, contributing to soil acidification over time, which can negatively impact plant growth and nutrient availability.

H. Loss of Soil Biodiversity: Soil organisms, including earthworms, insects, and beneficial microbes, are adversely affected by stubble burning, leading to a decline in soil biodiversity and ecosystem resilience.

I. Impaired Water Quality: Erosion of stubble-burned soils can lead to sedimentation in water bodies, impairing water quality and aquatic habitats due to increased nutrient runoff and sedimentation.

J. Long-term Degradation: Continuous stubble burning exacerbates soil degradation over time, leading to desertification, land degradation, and loss of agricultural productivity, posing significant challenges for sustainable land management and food security.

Effects on agricultural productivity

Stubble burning contributes to climate change primarily through the release of greenhouse gases (GHGs) into the atmosphere, particularly carbon dioxide (CO₂) and methane (CH₄). While obtaining precise statistical data on the exact contribution of stubble burning to climate change can be challenging due to various factors influencing emissions and their measurement, several studies provide valuable insights into the extent of its impact:

1. Carbon Dioxide Emissions: Stubble burning releases significant amounts of carbon dioxide, a major greenhouse gas responsible for global warming. According to a study published in the journal "Atmospheric Environment," stubble burning in India contributes to the emission of millions of tons of CO₂ annually. For example, one estimate suggests that the burning of rice residues alone in Punjab and Haryana releases around 20-25 million tons of CO₂ each year.

2. Methane Emissions: In addition to CO₂, stubble burning also releases methane, another potent greenhouse gas with a much higher global warming potential than CO₂ over shorter timeframes. According to research published in the "Journal of Environmental Quality," stubble burning can result in significant methane emissions from agricultural fields. These emissions contribute to the enhanced greenhouse effect and amplify the rate of global warming.

3. Satellite Observations: Satellite-based studies provide valuable insights into the spatial extent and temporal variability of stubble burning and its associated emissions. For instance, data from satellite sensors like NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) have been used to monitor and quantify the extent of stubble-burning events in regions like Punjab and Haryana during the post-harvest season. These observations help researchers estimate the amount of CO₂ and CH₄ released into the atmosphere due to stubble-burning activities.

4. Climate Models: Climate models are employed to assess the cumulative impact of various sources of greenhouse gas emissions, including stubble burning, on global climate patterns. While the direct contribution of stubble burning to climate change may seem small compared to other sources like fossil fuel combustion, its localized effects can exacerbate regional climate variability and amplify the overall warming trend.

3. Impact on Agricultural Productivity

Stubble burning has a significant negative impact on agricultural productivity due to its adverse effects on soil health, crop yields, and long-term sustainability. Here are some of the key ways in which stubble burning affects agricultural productivity:

A. Soil Degradation: Stubble burning contributes to soil degradation by depleting essential nutrients and organic matter in the soil. When crop residues are burned, valuable nutrients such as nitrogen, phosphorus, and potassium are lost, reducing soil fertility over time. This can result in decreased nutrient availability for crops, leading to stunted growth, lower yields, and diminished agricultural productivity.

B. Loss of Soil Structure: Burning crop residues can also degrade soil structure, reducing its ability to hold water and nutrients. This can result in increased soil erosion, compaction, and decreased water infiltration rates, negatively impacting crop growth and yield potential. Poor soil structure can also impede root development and nutrient uptake by plants, further limiting agricultural productivity.

C. Reduced Soil Moisture Retention: Stubble burning can lead to increased evaporation of soil moisture due to the removal of crop residues, which act as a protective layer and help retain moisture in the soil. Loss of soil moisture can result in water stress for crops, particularly during dry periods, leading to reduced growth, flowering, and fruit set, ultimately affecting yields and agricultural productivity.

D. Increased Pest and Disease Pressure: Stubble burning can exacerbate pest and disease pressure in agricultural fields by disrupting natural pest control mechanisms and creating favourable conditions for pest infestations and disease outbreaks. Burning crop residues can eliminate beneficial insects, disrupt soil microbial communities, and expose crops to pathogens and pests, leading to yield losses and reduced productivity.

E. Long-Term Sustainability: The practice of stubble burning is not sustainable in the long term and can lead to soil degradation, loss of biodiversity, and environmental degradation. Continual burning of crop residues depletes soil organic matter, disrupts nutrient cycling processes, and contributes to air and water pollution, posing risks to agricultural sustainability and future food security.

4. Effects on the Economic Development

Apart from its effects on health and the environment, air pollution also affects the growth of a country's economy. The effectiveness of air pollution management in a country is dependent on the economic and technological development of the country, which implies that increased pollution affects the country's economy in many ways. In recent years, tourist inflow has decreased in Delhi by about 25-30% due to the increase in

the level of air pollution. The productivity of workers in different disciplines is also affected by air pollution through sickness and poor visibility,

Stubble burning has several negative effects on economic development, particularly in agricultural regions like Punjab and Haryana in India. Here are some of the key economic impacts:

A. Reduced Agricultural Productivity: Stubble burning contributes to soil degradation and loss of soil fertility. The burning of crop residues depletes essential nutrients in the soil, reduces soil moisture retention capacity, and increases soil erosion. Over time, this can lead to reduced agricultural productivity, lower crop yields, and decreased farm incomes. Farmers may incur additional costs for fertilizers and other inputs to maintain soil fertility, further impacting their profitability.

B. Healthcare Costs: Stubble burning contributes to air pollution, which has significant public health implications. Exposure to high levels of particulate matter and other pollutants can lead to respiratory problems, cardiovascular diseases, aggravated asthma, bronchitis, and other health issues. The healthcare costs associated with treating pollution-related illnesses impose a significant economic burden on individuals, families, and the healthcare system as a whole.

C. Loss of Tourism Revenue: Stubble burning contributes to air pollution and the formation of smog, which can deter tourists from visiting affected regions. Reduced tourism activity can lead to a decline in revenue for businesses reliant on tourism, such as hotels, restaurants, transportation services, and recreational activities. The negative impact on the tourism sector can ripple through the local economy, affecting livelihoods and economic growth.

D. Costs of Environmental Cleanup and Mitigation: Addressing the environmental consequences of stubble burning, such as soil degradation, air pollution, and water contamination, requires significant financial resources. Governments and other stakeholders may need to invest in measures such as soil conservation, reforestation, air quality monitoring, pollution control technologies, and public awareness campaigns. These costs can strain public budgets and divert resources away from other development priorities.

E. Impact on Livelihoods: Stubble burning and its associated environmental degradation can undermine the livelihoods of farmers and rural communities dependent on agriculture. Reduced agricultural productivity and incomes can lead to poverty, food insecurity, and migration to urban areas in search of alternative employment opportunities. The loss of skilled agricultural laborers and the depopulation of rural areas can further hinder economic development and exacerbate social challenges.

Conclusion

Stubble burning in India exacerbates air pollution, impacting public health, the environment, and economic development. It contributes to respiratory illnesses, soil degradation, reduced agricultural productivity, and climate change. Urgent action is needed to address this issue through sustainable agricultural practices, technological innovations, and policy interventions. By promoting alternatives to stubble burning, such as residue management techniques and renewable energy solutions, India can mitigate its adverse impacts, protect human health, preserve natural resources, and foster sustainable development for future generations.