

STUBBLE BURNING

Context

Despite penalties, subsidised machinery and efforts to commercialise paddy straw, **stubble burning persists in north-west India** due to the **short harvest-sowing window and high costs of handling bulky residue**. With parali now fetching **₹1.5–2/kg in parts of Punjab**, the challenge is to make **non-burning economically viable for farmers**.

Why Does Stubble Burning Persist Despite Environmental Regulation?

- **Short Sowing Window:** Farmers have little time to clear paddy fields before wheat is sown, making burning the quickest option.
 - **Eg:** ICAR estimates that the effective window for residue-management operations in Punjab can be as short as **10 days**, leaving limited time for slower alternatives.
- **Machinery Gap:** Alternative machines may not be available in sufficient numbers to cover the entire area in time.
 - **Eg:** ICAR modelling found that within 25 days, Happy Seeders could potentially cover only **34.03%** and Super Seeders **42.94%** of Punjab's cultivable area.
- **High Transport Cost:** Paddy straw is bulky, so moving it over long distances can reduce the value earned from it.
- **Limited Effect of Penalties:** Fines raise the cost of burning, but may not be sufficient when farmers face strong time and disposal pressures.
 - **Eg:** Under Punjab's 2024 enforcement framework, farmers faced environmental compensation of **₹2,500 for holdings below 2 acres, ₹5,000 for 2–5 acres and ₹15,000 for holdings above 5 acres**, yet the state still recorded **10,780 farm-fire incidents between September 15 and November 26, 2024**.

- **Implementation Coordination Gap:** Regulation places responsibility on individual farmers, but non-burning requires coordinated access to machinery, operators and timely field operations.

What Does Stubble Burning Reveal About the Contradictions of India's Green Revolution Model?

- **Food Security vs Sustainability:** The Green Revolution improved food production, but the later rice-wheat system created serious ecological costs.
 - **Eg:** Punjab's procurement system supported national foodgrain supply, while procurement-induced rice cultivation was linked to **50–65% of groundwater decline** in the state.
- **Income Security vs Resource Conservation:** Policies that reduce farmers' market risk can also encourage cultivation of resource-intensive crops.
 - **Eg:** A doubling of rice procurement increased rice area by **at least 25%**, showing that stronger procurement can reinforce paddy cultivation.
- **Intensive Cropping vs Residue Pressure:** Growing two crops in quick succession leaves little time to manage crop residue.
 - **Eg:** The **10-day effective residue-management window** estimated by ICAR shows how the tight rice-wheat cycle creates a residue problem.
- **National Benefit vs Local Cost:** Foodgrain benefits are spread across the country, while resource damage is concentrated in producing states.
 - **Eg:** Punjab supplies rice to the national procurement system, while its intensive rice cultivation contributes to severe local groundwater depletion.
- **Waste Disposal vs Circular Agriculture:** Treating straw only as waste ignores its possible value as an input or raw material.

- **Eg: Biochar made from paddy straw** can be returned to soil and can improve water retention and nutrient-use efficiency, creating a possible link between residue management and soil improvement.

Why Is Stubble Burning Also a Problem of Groundwater Sustainability?

- **Water-Intensive Paddy:** Stubble burning is linked to paddy cultivation, which increases irrigation demand and groundwater extraction.
 - **Eg:** Procurement-induced rice cultivation accounted for **50–65% of Punjab's groundwater decline between 1981 and 2015**, according to a Nature Communications study.
- **Procurement Lock-In:** Assured paddy procurement sustains rice cultivation, thereby sustaining the groundwater demand associated with it.
 - **Eg:** A doubling of rice procurement increased rice area by **at least 25%** in the following year, linking procurement incentives to continued rice cultivation.
- **Groundwater-Crop Mismatch:** Stubble burning is concentrated in regions where continued paddy cultivation can worsen already stressed groundwater resources.
 - **Eg:** Haryana's **Mera Pani Meri Virasat** promotes crop diversification in water-stressed areas, showing the need to shift cultivation away from paddy where groundwater is scarce.
- **Cumulative Depletion:** Continued paddy cultivation can cause gradual groundwater decline, making stubble burning a symptom of an increasingly unsustainable cropping system.
 - **Eg:** The Punjab study found that the groundwater impact of higher rice procurement **accumulated over 6–7 years**, showing that the resource cost emerges over time.

How Can Crop Diversification Address the Problem of Stubble Burning?

- **Reduce Residue at Source:** Growing less paddy means producing less paddy straw.
 - **Eg: Mera Pani Meri Virasat** encourages farmers to replace a substantial part of paddy area with crops such as maize, pulses and other alternatives.
- **Reduce Groundwater Use:** Replacing paddy with less water-intensive crops can reduce pressure on groundwater.
 - **Eg:** ICAR has promoted **maize as a rice substitute in Haryana and Punjab** to reduce pressure on water resources.
- **Replace Procurement Security:** Farmers need reliable returns from alternative crops before they will move away from paddy.
 - **Eg:** Farmers consulted in ICAR's maize work identified **assured marketing and remunerative prices** as major conditions for wider maize adoption.
- **Build Alternative Markets:** Crop diversification will not last if farmers cannot sell the new crops easily.
 - **Eg:** ICAR points to **ethanol, feed and starch industries** as important markets that can create demand for maize.
- **Target Water-Stressed Areas:** Diversification gives the greatest benefit where paddy puts the most pressure on groundwater.
 - **Eg:** Haryana's diversification policy targets areas with serious groundwater stress instead of applying the same approach everywhere.

Way Forward

- **Combine Regulation with Alternatives:** Enforcement should go together with timely access to residue-management machines.
- **Localise Processing:** Support village-level **biochar, biomass and other processing units** through FPOs, SHGs and cooperatives.

- **Create Assured Straw Markets:** Connect farmers with reliable buyers so that straw has value before it is burned.
- **Rebalance Crop Incentives:** Strengthen market support for **maize, pulses, oilseeds and other suitable crops.**
- **Link Crop Policy with Groundwater:** Discourage paddy expansion in areas where groundwater is already severely stressed.
- **Share Value with Farmers:** Farmers should receive a fair share of the value created from **straw and residue-based products.**

