

An Extension-Led Social Transformation Framework for Crop Residue Management and Environmental Stewardship

FROM INNOVATION TO IMPACT



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1. Model Vision & Strategic Background

Crop residue burning is not merely a problem of technology availability; it is a complex social, behavioural, economic and operational challenge. Conventional extension approaches often focus on machinery distribution, demonstrations and technical training, but sustained adoption requires farmers to overcome perceived risks, operational difficulties, uncertainty about yields and the influence of established community practices.

The Punjab Crop Residue Management (CRM) Model, developed and validated by ICAR-ATARI, Ludhiana and Directorate of Extension Education, PAU, Ludhiana, represents a strategic shift from conventional technology transfer to an extension-led social transformation model.

The model reframes residue management as a process of:

Technology Adoption → Confidence Building → Peer Learning → Collective Action → Behavioural Change → Environmental Stewardship

Instead of treating farmers as passive recipients of CRM technologies, the model positions them as active participants, local demonstrators and change agents. The creation of decentralized Innovation Hub Villages provides farmers with locally visible platforms where residue-management technologies can be demonstrated, evaluated and adapted under actual field conditions.

2. The Innovation Architecture

The defining feature of the Punjab CRM Model is the integration of three mutually reinforcing pillars— technical, behavioural and community dimensions rather than relying on machinery access alone.

Pillar	Strategic Focus
Technology-Smart	Happy Seeder, Super Seeder, Smart Seeder and other in-situ residue-management technologies
Behaviour-Smart	Risk reduction, confidence building, field evidence, farmer-to-farmer learning and behavioural reinforcement
Community-Smart	Innovation Hub Villages, CRM Ambassadors, youth engagement, social institutions, exposure visits and collective action

The model's strength lies in integrating core technical interventions with structured psychological and social mechanisms. This architecture converts residue management from a mechanical operation into a social adoption process.

A. Risk Management Strategy ('Mitigating Disenchantment')

Unsuccessful first experiences with intensive crop residue machinery can permanently discourage adoption. This strategy identifies vulnerable, early-stage farmers and matches them with specialized training, technical support, and dedicated CRM Ambassadors to minimize risk and protect community confidence.

B. Empirical Proof Channels ('Seeing is Believing')

Deeply rooted practices cannot be shifted by classroom instruction alone. Direct visible proof via localized Harvest Field Days and structured exposure visits presents undeniable evidence of yield sustainability and residue breakdown, transforming individual uncertainty into community adoption.

C. Asymmetric Influencer Networks (Multi-Generational Expansion)

Farmer-to-Farmer Extension (F2FE): Experienced early adopters act as direct local sources of knowledge, passing trusted practical advice directly to neighbouring farmers to bypass institutional scepticism.

Social & Spiritual Alliances: Collaborating with local cultural and faith leaders' frames burn-free agriculture as a moral responsibility and a

community value, increasing the social unacceptability of open burning.

Student-Centric Farm Family Approach: School and college students are trained as para-extension agents. By organizing street plays, contests, and village awareness tracks, youth introduce conservation values directly into their homes, creating a reliable path for inter-generational behavioural change.

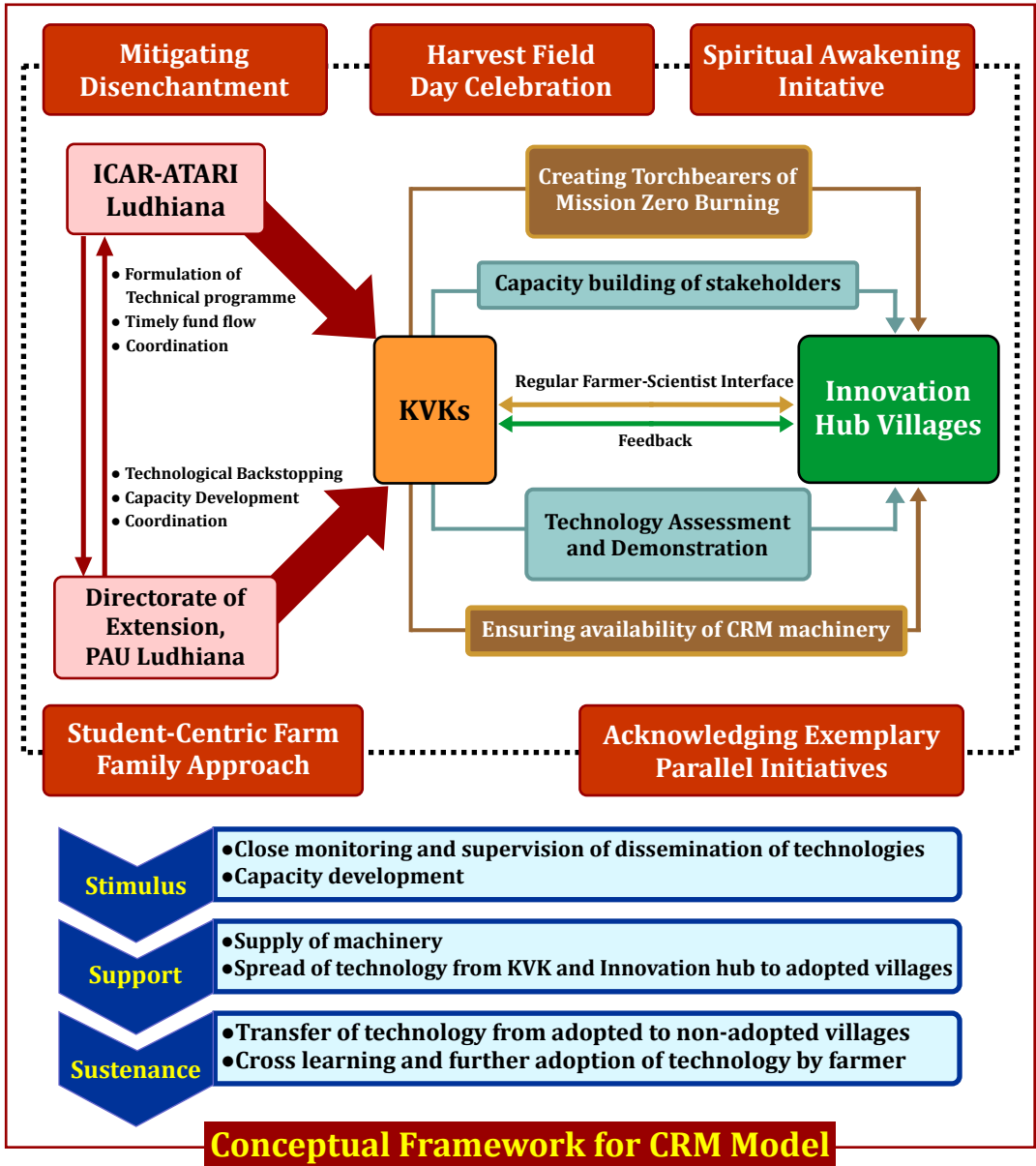


3. Strategic Scaling: The 3-S Transformation Matrix

To scale the initiative cleanly from small regional pilots into broad national permanence, the model organizes field actions across three distinct lifecycle phases:

Stage	Strategic Purpose	Major Actions	Expected Transformation
Stimulus	Create visible evidence	Innovation Hub Villages, demonstrations, Harvest Field Days, exposure visits	Awareness → Trust
Support	Reduce adoption risk	CRM Ambassadors, technical handholding, F2FE, troubleshooting, first-adopter support	Trust → Confidence → Adoption
Sustenance	Institutionalize collective action	District-level mobilization, youth engagement, community networks, convergence and replication	Individual Adoption → Community Movement





4. Scale of Validation

The model was implemented across 406 villages in 22 districts of Punjab, creating a large-scale field platform for testing and refining extension-led CRM strategies.

406 villages | 22 districts

6.85 lakh+ participants mobilized | 347 residue-burning-free villages

5. Quantifiable Impact Analysis (Innovation to Impact Pathway)

The effectiveness of this social transformation model is proven by solid field results gathered during regional implementation by the numbers across Punjab from 2023 to 2026.

Impact Dimension	Quantified Field Metric	Long-term System Evaluation / Significance
Reach & Mobilization	● 406 Villages ● 22 Districts ● 1,123 Awareness Channels ● 3.70 Lakh Farmers via Kisan Melas, Exposure Visits etc.	Mobilized over 6.85 lakh total participants, successfully building deep community-wide engagement.
Behavioral Shift	● 2020 Baseline: 83,002 fires ● 2023: 36,663 2024: 10,909 ● 2025: 5,114 cases	Achieved a 94% net reduction in satellite-reported residue-burning incidents.
Economic Savings	● 11.4 Million Tonnes Straw Retained ● > ₹600 Crore Saved in Cultivation	Direct operational savings back to farmers by eliminating traditional land clearing costs.
Nutrient Recycling	● 62,700 t Nitrogen (N) ● 26,220 t Phosphorus (P) ● 2,85,000 t Potassium (K)	Returned vital nutrients to soil, valued at ₹1,681 Cr (subsidized) to ₹2,448 Cr (market).
Resource Conservation	● 571 Million m³ Water Conserved ● ₹400 Crore Power Grid Savings	Substantially reduced stress on groundwater levels and regional agricultural energy demands.
Youth/Social Hubs	● 37,568 Students Engaged ● 347 Burning-Free Villages	Successfully built permanent, independent community ownership of clean cultivation goals.

6. Policy Implications & Scalability

The Punjab experience demonstrates that crop-residue burning cannot be addressed through a single-dimensional approach based exclusively on

machinery, regulation or awareness. The model provides policymakers with a practical framework to:

- shift from technology-centric to behaviour- and outcome-centric CRM programmes;
- establish Innovation Hub Villages as decentralized learning platforms;
- institutionalize farmer-to-farmer extension;
- integrate youth & educational institutions into environmental campaigns;
- strengthen convergence among extension agencies, KVKs, line departments and local institutions;
- use field evidence and community demonstration to accelerate adoption;
- measure success through behavioural and environmental outcomes, rather than merely counting machines distributed.

7. Overall Impact

The Punjab CRM Model demonstrates that eliminating stubble burning requires more than technology—it requires technology, evidence, behavioural change, trusted networks and collective action. By transforming farmers from technology recipients into confident adopters and community change agents, the model turns extension into an engine of social transformation. Its greatest achievement is the shift from individual residue management to collective environmental stewardship, creating sustained behavioural change, stronger community ownership and cleaner rural environments.

A decade-long struggle Campaigns to CRM, FIRs to red entry: How Punjab reduced farm fires by 94%

Behind this achievement lies a decade-long struggle of how Punjab tackled a practice that contributes to severe air pollution, soil degradation, and widespread health problems, particularly in North India.

The Indian EXPRESS
JOURNALISM OF COURAGE

CHANDIGARH
Dec 1, 2025

<https://indianexpress.com/article/cities/chandigarh/a-decade-long-struggle-punjab-reduced-farm-fires-10395344/>



The model offers a scalable and replicable framework for other agrarian states, demonstrating how extension-led community action can drive sustainable agriculture, residue-free villages and responsible resource conservation.

Core Message

“The Punjab CRM Model demonstrates that stubble burning is not solved by machinery alone—it is solved when technology is combined with confidence, community and behavioural change.”

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Recognition for Field-Level Impact



The **Model for Scientific Crop Residue Management and Environmental Stewardship** has been certified by the Indian Council of Agricultural Research (ICAR), New Delhi, vide **Certificate No. ICAR-AEXT-ATARILDH-MODEL-2024-41**, in recognition of its field-validated approach, measurable environmental outcomes and demonstrated potential for large-scale replication.



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