ESCAP | CSAM
Centre for Sustainable Agricultural Mechanization

Current status of Agriculture mechanization in India and machinery solutions for climate resilience, crop residue management, and conservation agriculture

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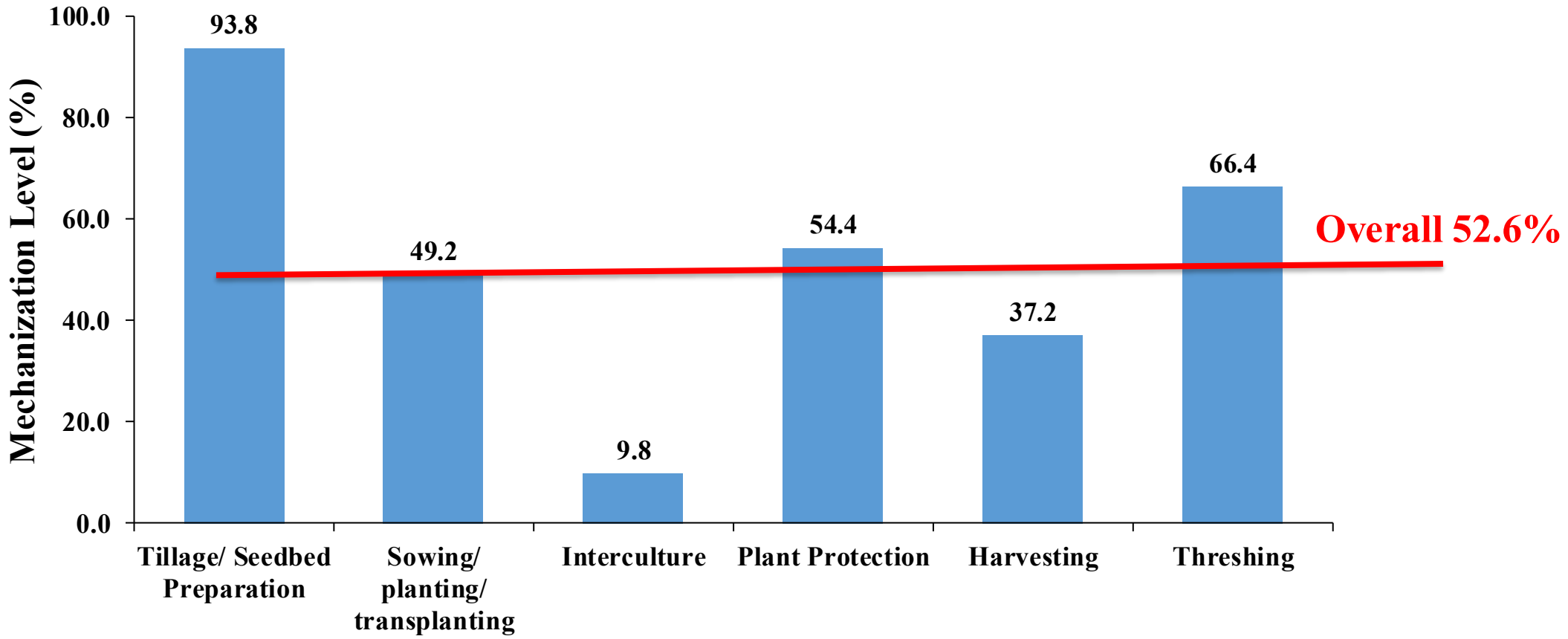
Eleventh Regional Forum on Sustainable Agricultural Mechanization
Climate-smart Agricultural Mechanization for Sustainable Crop Residue Management and Resilient Agrifood Systems
26-28 October 2026 – Tianjin, China

The National Imperative for Indian Agriculture

- Climate-smart agriculture for resilient food systems
- Climate extremes threaten crop productivity, water security and farm incomes.
- Three priorities: adapt to climate change, eliminate residue burning, conserve soil and water.
- Position India’s approach around productivity, sustainability and farmer prosperity.

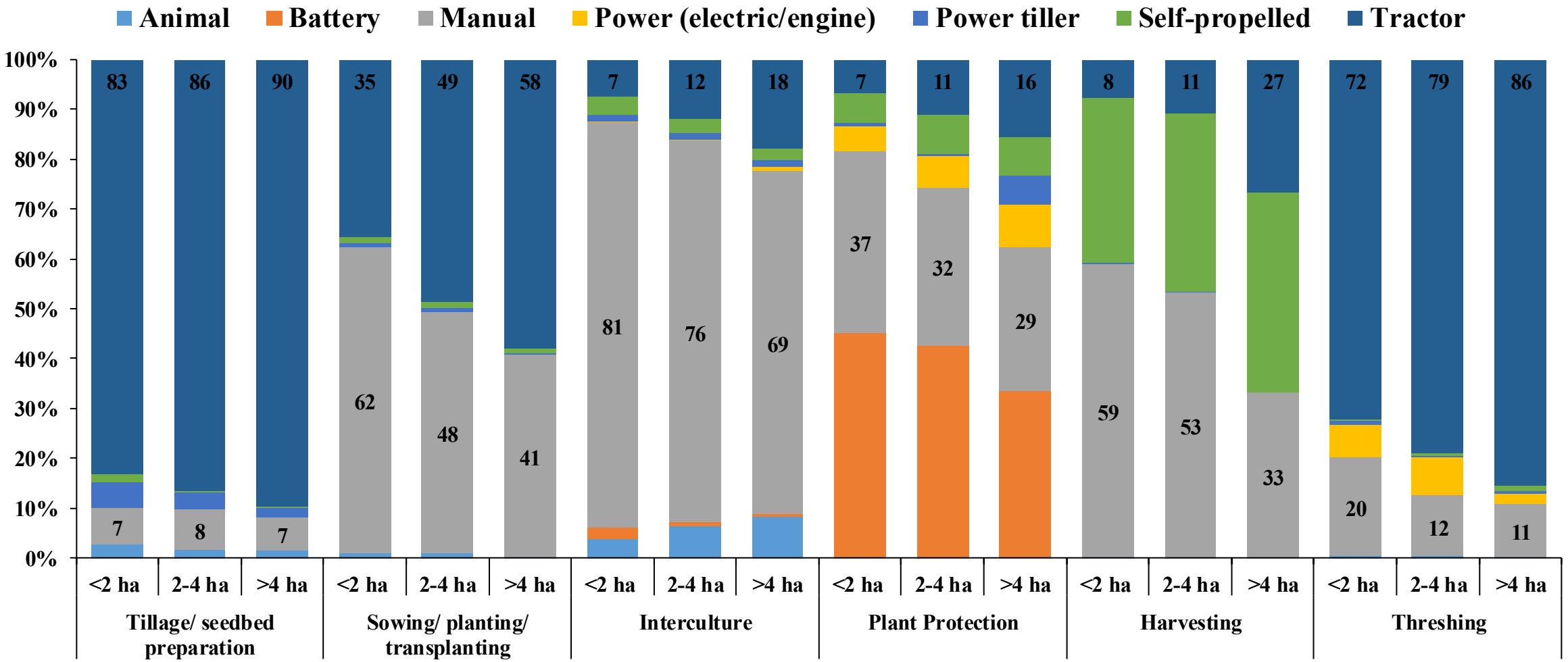


National mechanization overview and needs



Farm Power Source Utilization

(Based on Farmers Category & Farm operation)



National Climate-Resilience Initiatives

- ICAR's National Innovations in Climate Resilient Agriculture (NICRA) demonstrates technologies in 151 climatically vulnerable districts.
- 2,996 climate-resilient crop varieties were released during 2014–2025, according to the 2026 government backgrounder.
- Promote contingency planning, crop diversification, micro-irrigation, agroforestry and integrated farming.



Crop Residue Management: From Burning to Utilization

- Central Sector Crop Residue Management Scheme
- Since 2018–19, the scheme has supported in-situ and ex-situ residue management.
- By June 2026: ₹4,266.47 crore in assistance, over 3.54 lakh machines distributed and more than 43,500 Custom Hiring Centers established.
- Promote Happy Seeder, Super Seeder, Smart Seeder, balers and straw-based bioenergy.



Technology and Circular Bio-economy

- Farm mechanization • Custom hiring • Waste-to-wealth
- Convert surplus straw into compressed biomass, biogas, bio-CNG, compost and industrial feedstock.
- Government estimates indicate agricultural residues could generate over 18,000 MW of power annually.
- Strengthen FPO-led aggregation, local biomass supply chains, machinery access and private-sector partnerships.



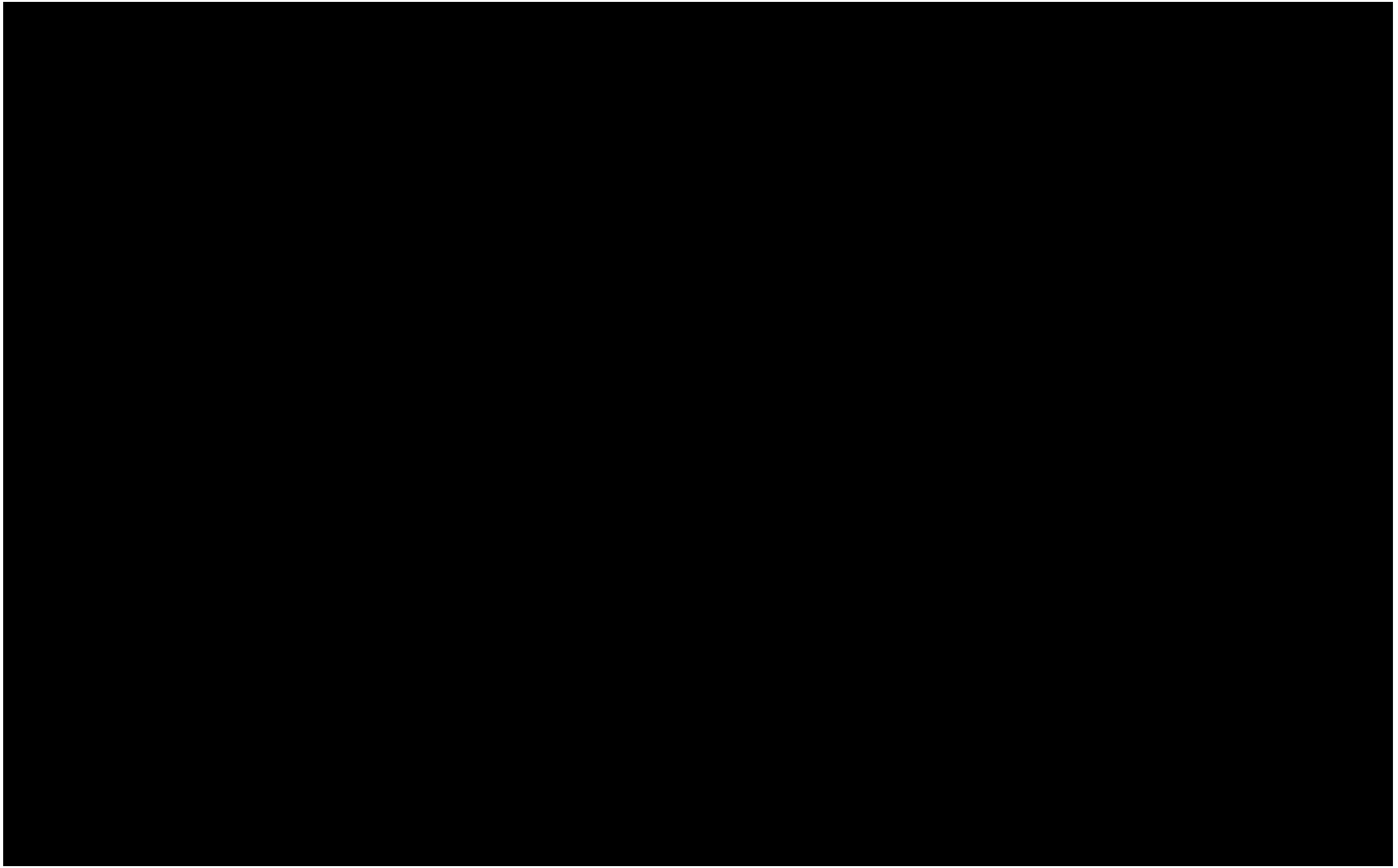
Roadmap and Measurable Outcomes

- Scale science into farmer-level impact
- Expand climate-resilient technologies through KVKs, ICAR institutes, state departments and FPOs.
- Link machinery subsidies to utilization, residue-burning reduction and local biomass markets.
- Track indicators: hectares under conservation agriculture, residue utilized, soil organic carbon, water productivity, farm costs and yield stability.
- Vision: resilient farms, cleaner air, healthier soils and higher farmer incomes.



Major CRM machinery and their applications

Machinery	Primary function	Management approach
Super Straw Management System (Super SMS)	Chops and evenly spreads straw behind a combine harvester	In-situ
Happy Seeder	Sows wheat directly into standing paddy stubble and loose straw	In-situ
Super Seeder	Cuts, incorporates and manages residue while sowing the next crop	In-situ
Smart Seeder	Enables seeding under crop residue with reduced conventional tillage	In-situ
Paddy Straw Chopper / Shredder / Mulcher	Chops and spreads straw for mulching or subsequent incorporation	In-situ
Straw Rake	Collects and windrows loose straw for baling	Ex-situ
Straw Baler	Compresses straw into compact bales for transport and utilization	Ex-situ
Crop Reaper / Reaper Binder	Harvests crops and cuts or binds stalks for easier collection	Harvesting and collection

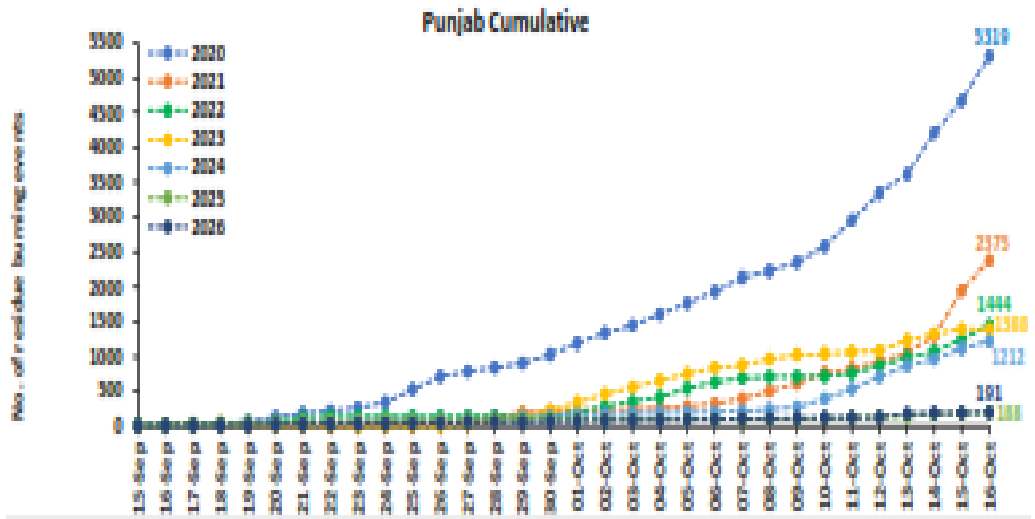


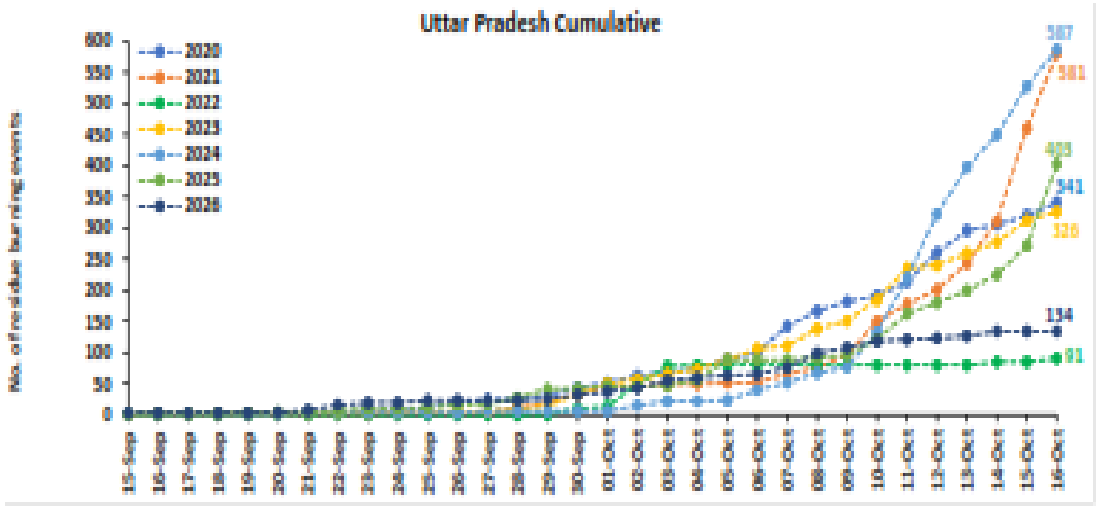
The year wise number of machines delivered to the Individual Farmers and Custom Hiring Centres in four states since 2018-19 to 2025-26 (as per DA&FW information)

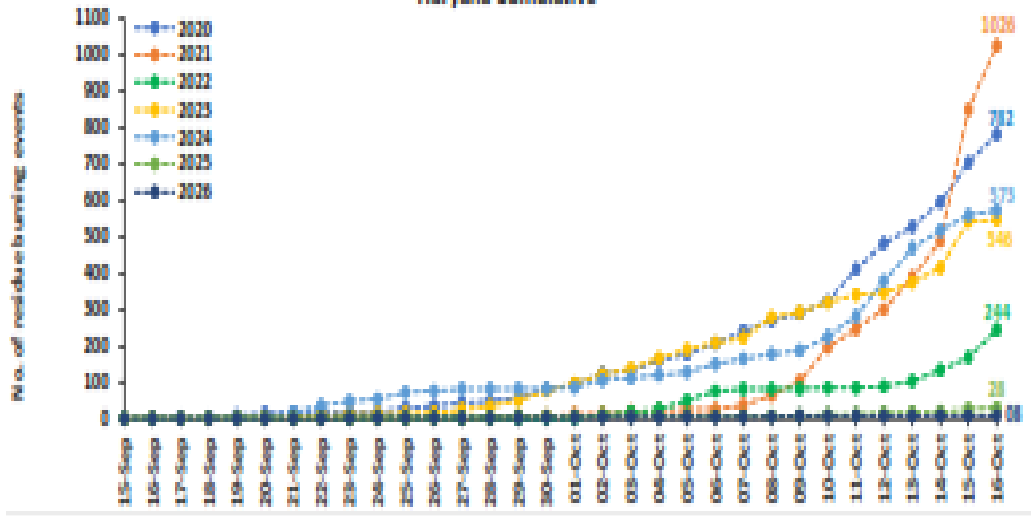
State/Agency	Number of machines delivered to the Individual Farmers and Custom Hiring Centres							
	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26
Punjab	27747	23068	25811	13796	27250	13179	18352	11093
Haryana	10627	14078	29020	19052	7641	10620	9844	9885
Uttar Pradesh	23306	7054	13651	14057	7681	6227	2572	1972
NCT of Delhi	0	111	51	85	0	0	0	0
Total	61680	44311	68533	46990	42572	30026	30768	22950

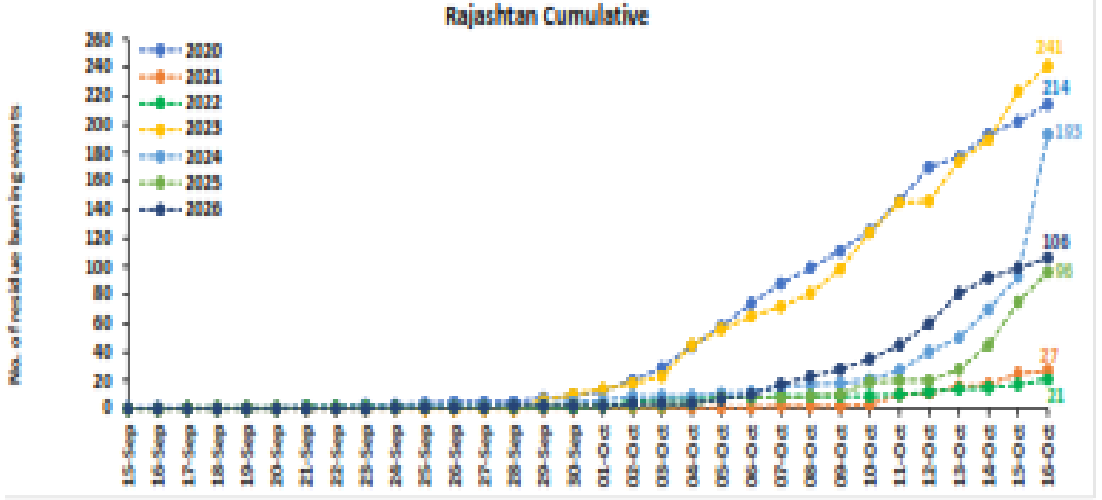
Number of crop residue burning events captured in Punjab, Haryana and UP from 2020 to 2025

States	2020	2021	2022	2023	2024	Year 2025	Percentage reduction in events in 2025 compared to 2020 (%)
Punjab	83,002	71,304	49,992	36,663	10,909	5114	(-) 93.8
Haryana	4,202	6,987	3,661	2,303	1,406	662	(-) 84.2
UP	1,756	1,350	1,268	1,775	2,772	7290	(+) 315
Total	88,960	79641	54,851	40,741	15,087	13,066	(-) 85.3%


Punjab Cumulative
No. of residue burning events
2020
2021
2022
2023
2024
2025
2026
5319
2375
1444
1212
191
188


Uttar Pradesh Cumulative
No. of residue burning events
2020
2021
2022
2023
2024
2025
2026
387
341
320
134
91


Haryana Cumulative
No. of residue burning events
2020
2021
2022
2023
2024
2025
2026
1038
782
373
244
28
18


Rajashtan Cumulative
No. of residue burning events
2020
2021
2022
2023
2024
2025
2026
241
214
108
37
21

Opportunities for regional cooperation

- **Joint R&D and Technology Transfer:** Share crop-specific machinery, conservation agriculture practices and precision farming technologies.
- **Climate Resilience & Crop Residue Management:** Collaborate on zero tillage, residue mulching, straw management, biomass utilization and climate-smart machinery.
- **Harmonized Testing & Standards:** Strengthen ANTAM for common machinery testing protocols, safety and quality assurance.
- **Capacity Building & Knowledge Exchange:** Conduct regional training, expert exchanges, field demonstrations and collaborative research.

THANK YOU

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