

From Climate Risk to Resilient Communities: An Innovative Climate-Smart Agriculture Framework

Transforming Local Vulnerabilities through Science, Participation & Collective Action



**ICAR-Agricultural Technology Application Research Institute
Zone-I, PAU Campus, Ludhiana-141 004, Punjab, India**

From Climate Risk to Resilient Communities: An Innovative Climate-Smart Agriculture Framework

Transforming Local Vulnerabilities through Science, Participation & Collective Action



**ICAR-Agricultural Technology Application Research Institute
Zone-I, PAU Campus, Ludhiana-141 004, Punjab, India**

Year of Publication: 2026

Compiled by:

Parvender Sheoran

Ashish S Murai

Arvind Kumar

Keshava

Pragya Bhadauria

Rajesh Kumar Rana

Preeti Mamgai

Ranjay K Singh

Rajbir Singh

© All rights reserved

ICAR-ATARI, Ludhiana

ISBN No.:

978-81-983602-4-3

PME Ref. No.:

ATARI-1/Technical Bulletin/2026/31

Published by:

Director

ICAR-Agricultural Technology Application

Research Institute (ATARI), Zone-I,

Ludhiana-141 004, Punjab, India.

Tel: 0161-2401018; Fax: 0161-2412719

Email: zcu1ldh@gmail.com

Website: <https://atariz1.org.in>

Graphics Design & Page setting:

Harinderjeet Singh Jassi

1. BACKGROUND

The Climate-Smart Village (CSV) Methodological Framework, developed by ICAR-ATARI, Ludhiana, represents a strategic shift in agricultural extension—from linear technology transfer to a participatory, location-specific and institution-driven model of climate resilience.

Instead of promoting technologies in isolation, the framework begins with local climate-risk assessment and farmer-led prioritization, followed by tailored technological interventions, institutional convergence and continuous monitoring. Farmers are transformed from technology recipients into active partners in climate-risk management and local decision-making.

The core transformation is from managing individual climate risks to building resilient farming communities through locally tailored technologies, collective action and empowered village institutions.

2. THE INNOVATION ARCHITECTURE

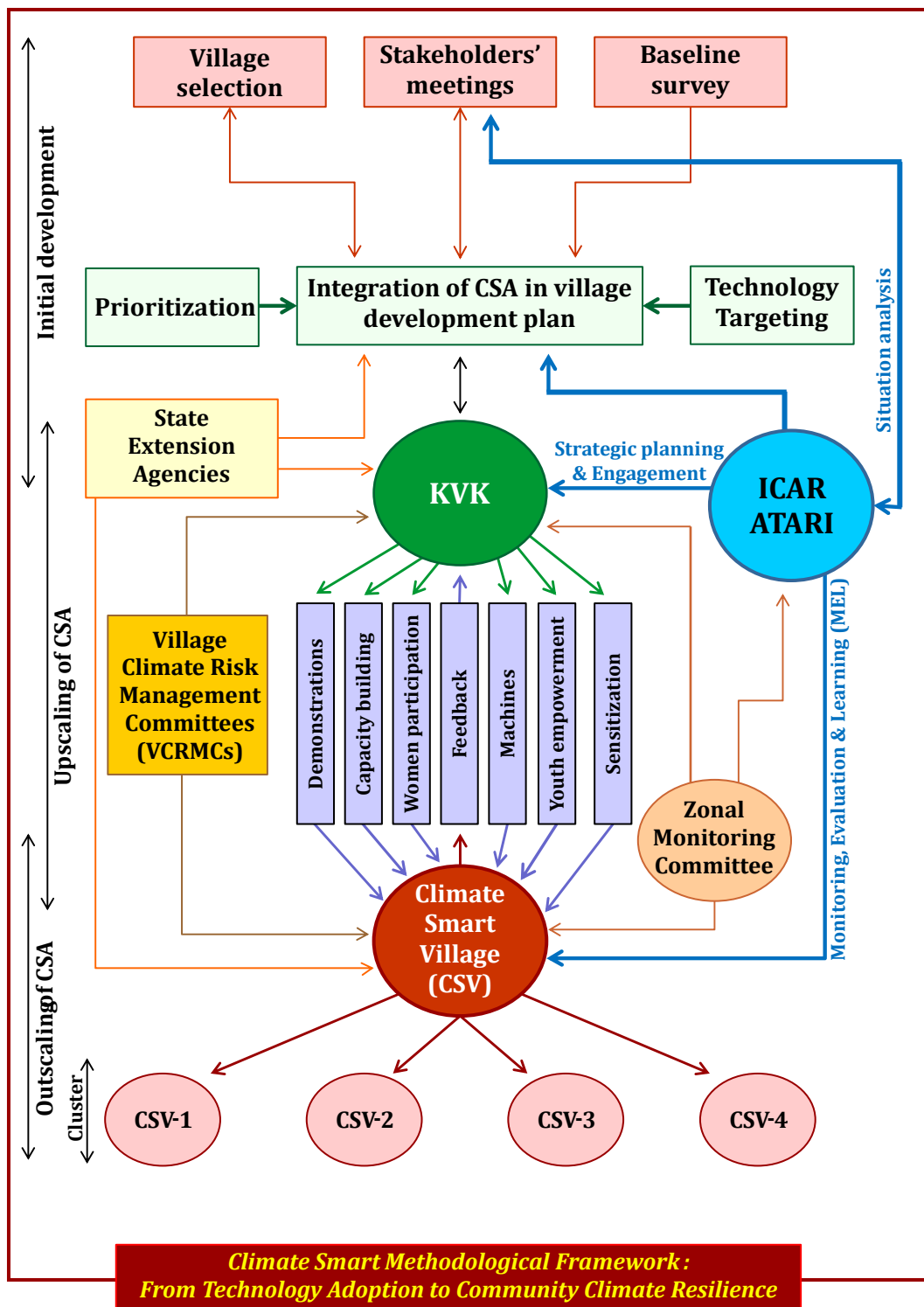
The framework integrates three mutually reinforcing pillars:

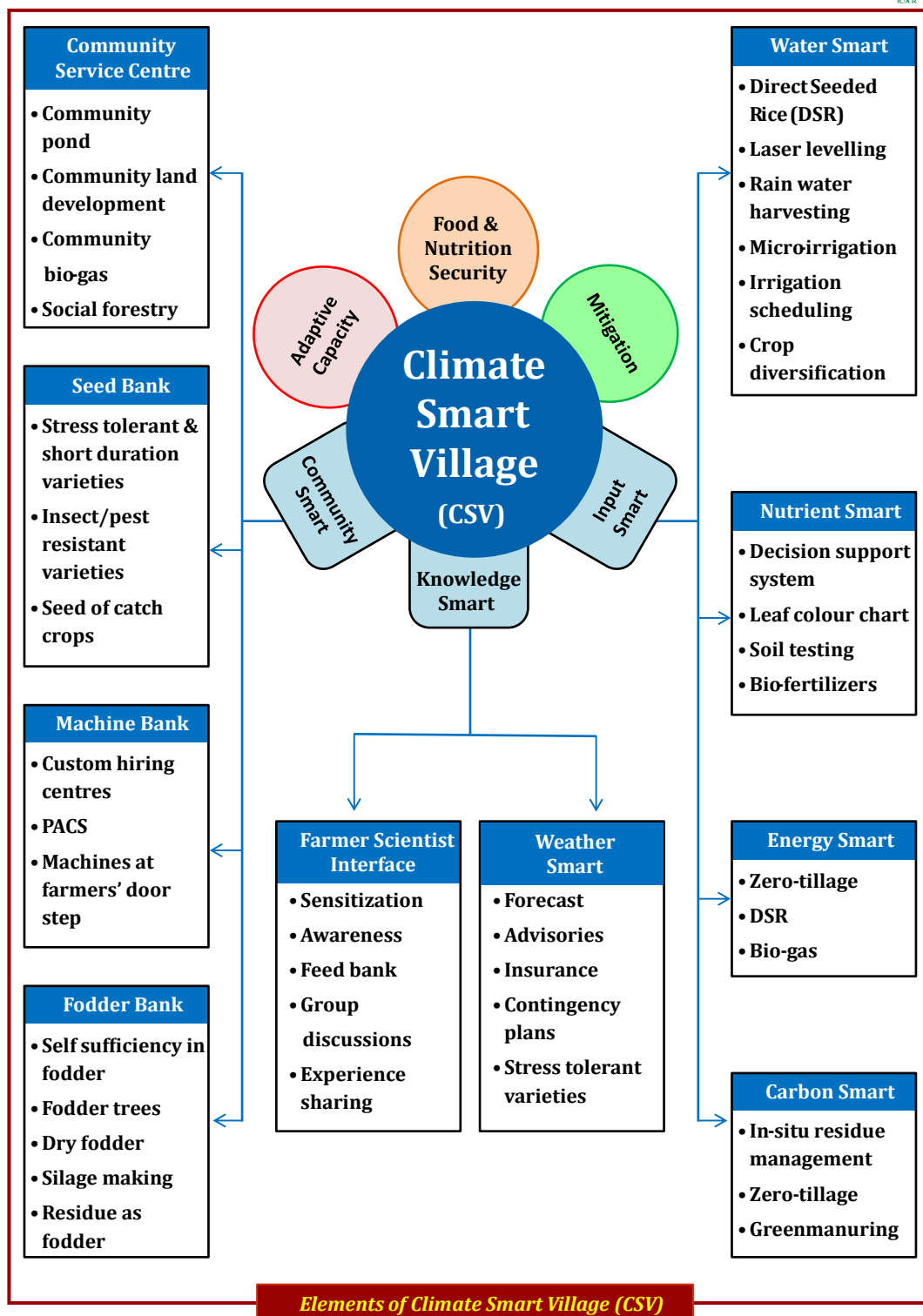
Pillar	Strategic Focus
Knowledge-Smart	Weather and agro-advisories, contingency planning, climate-resilient and stress-tolerant varieties
Input-Smart	DSR, laser land levelling, water harvesting, micro-irrigation, nutrient management, residue management, zero tillage and mechanization
Community-Smart	VCRMCs, Custom Hiring Centres, SHGs, FIGs, seed banks, fodder banks and community machinery services

This integrated architecture ensures that climate resilience is not dependent on a single technology, but is built through a portfolio of complementary solutions matched to local vulnerabilities and resource conditions.

3. THE PARTICIPATORY TRANSFORMATION MODEL

- Assess Identify climatic stresses, agricultural vulnerabilities, natural-resource constraints and livelihood risks.
- Prioritize Use farmer typology, baseline assessment and VCRMCs to identify locally relevant priorities.
- Target Select technologies based on their contribution to food and nutrition security, climate-risk management, adaptation, mitigation and income





enhancement.

- Implement Deploy village-specific technological modules and contingency plans with farmers, farm women and community institutions.
- Converge Leverage line departments, MGNREGS, financial institutions, cooperatives, NGOs and private organizations.
- Monitor & Refine Continuously assess adoption, productivity, resource efficiency, income and resilience, and refine interventions based on field evidence.

4. SCALE OF VALIDATION

The framework was validated across 66 villages in four states—Punjab (PB), Himachal Pradesh (HP), Jammu & Kashmir (J&K) and Uttarakhand (UK)—benefiting 39,553 farmers. The validation established a village-level institutional architecture comprising VCRMCs, CHCs, SHGs, FIGs, seed and fodder banks.

66 Villages | 4 States | 39,553 Farmers

5. QUANTIFIABLE AGRICULTURAL IMPACT

5.1 Higher Productivity with Greater Climate Resilience

- 15–18% higher wheat productivity through improved and yellow-rust-resistant (PBW 725, PBW 677) and heat-tolerant (HD 725, HD 2967, HD 3086, WH 1105) varieties in PB, HP, J&K and UK.
- 8–12% higher rice yields through short-duration varieties (PB 126, PB 1509, PB 1121) in Punjab.
- >15% production gains in rice and wheat from short-duration, heat- and drought-tolerant varieties under stress conditions.
- 1–1.5 q/ha additional wheat yield with Happy Seeder-based cultivation in normal years in Punjab.

5.2 Resource Efficiency

Intervention	Measured Impact
Laser land levelling	25-30% irrigation-water saving; 5-8% yield increase in paddy (PB)
DSR	18-25% lower irrigation requirement (PB)
Scientific N management	10-15% lower fertilizer use, ₹1,500-2,000/ha savings PB, HP, J&K and UK
Lower operational cost	₹6,000-8,000/ha (PB, HP, J&K and UK)

6. FARM PROFITABILITY & LIVELIHOOD TRANSFORMATION

The framework moved the development focus beyond crop productivity towards profitability, diversification and livelihood security.

- Dairy, poultry and piggery diversification increased household income by approximately ₹3,000–5,000/month (PB, HP, J&K and UK).
- Vegetable diversification in HP generated approximately ₹2.50 lakh/ha annual net returns, compared with ₹44,000/ha from wheat.
- Pomegranate cultivation in HP generated approximately ₹4.76 lakh/ha annual net returns, compared with ₹2.80 lakh/ha from traditional apple.

7. SOCIAL & INSTITUTIONAL TRANSFORMATION

The defining strength of the CSV framework is its ability to combine technological transformation with social and institutional transformation. Farmers and farm women participate in climate-risk assessment and intervention planning, while VCRMCs, CHCs, SHGs, FIGs, seed banks and fodder banks create mechanisms for collective resource access, local decision-making and sustained adoption.

Visible Behavioural Transformation

- All four Punjab Climate-Smart Villages became crop-residue-burning-free.
- Recommended varieties achieved 85% adoption in kharif and 98% in rabi season in adopted villages of PB, HP, J&K and UK.
- DSR adoption reached approximately 75% in Punjab.
- Laser land levelling achieved 98–100% adoption in PB and plain areas of HP, J&K and UK.

The most significant social outcome is the transition from individual technology adoption to collective village ownership of climate-smart agriculture.

8. POLICY & INSTITUTIONAL IMPACT

The innovation has demonstrated relevance beyond individual farmers and villages by influencing institutional mechanisms and public programmes. The Custom Hiring Centre framework was adopted by the Government of Punjab for mechanized crop-residue management. The experience also supported the promotion of water harvesting and high-value crop diversification through line departments in Himachal Pradesh.



The CSV framework provides a practical model for policymakers to:

- Shift from technology-centric schemes to outcome-centric climate-resilience programmes;
- Institutionalize participatory village-level climate-risk planning;
- Promote shared-resource institutions such as CHCs, seed and fodder banks;
- Strengthen convergence among departments, schemes and financial institutions;
- Scale technologies according to local vulnerability and farm typology; and
- Embed monitoring, farmer feedback and measurable outcomes into extension programmes.

9. INNOVATION-TO-IMPACT SCORECARD

The CSV framework translated climate-smart interventions into measurable agricultural, economic, social, institutional and policy outcomes.

Impact Dimension	Outcome
Scale	66 villages across 4 states
Reach	39,553 farmers
Productivity	15-18% higher wheat productivity
Water security	18-30% water saving through key interventions
Input efficiency	10-15% lower N use
Farm economics	₹6,000-8,000/ha operational savings
Income diversification	₹4,000-5,000/month additional household income
Behavioural change	Punjab CSVs became residue-burning-free
Technology adoption	Up to 98-100% for laser land levelling
Institutional strengthening	VCRMCs, CHCs, SHGs, FIGs, seed & fodder banks
Policy influence	CHC framework adopted by Government of Punjab

10. OVERALL IMPACT

The CSV Framework demonstrates that climate resilience is achieved not through a single intervention, but through the systematic integration of technology, farmer participation, institutional convergence, behavioural change and continuous learning. Validated across 66 villages in four states and benefiting 39,553 farmers, the framework generated measurable gains in productivity, resource-use efficiency, farm profitability, livelihood diversification and adaptive capacity, while creating community institutions capable of sustaining climate-smart practices.

“The Climate-Smart Village framework provides a scalable extension model for converting local climate risks into locally owned solutions—integrating science, community institutions and institutional convergence to deliver measurable gains in productivity, profitability, resource efficiency and long-term resilience.”

The Impact Pathway

**“Climate Risk → Local Diagnosis → Tailored Technology →
Collective Adoption → Resource Efficiency → Higher Productivity →
Income Diversification → Community Resilience”**

References:

- Murai, Ashish Santosh; Kataria, Palvi and Sheoran, Parvender (2025) Annual Report 2024-25. Technology Demonstration Component: National Innovations in Climate Resilience Agriculture (NICRA). ICAR-Agricultural Technology Application Research Institute, Zone-I, Ludhiana, Punjab. 332p.
- Murai, Ashish Santosh; Kataria, Palvi and Sheoran, Parvender (2024). Agricultural Adaptation and Resilience in Response to Climate Variability. Technology Demonstration Component: National Innovations in Climate Resilient Agriculture (NICRA). ICAR-Agricultural Technology Application Research Institute, Zone-I, Ludhiana, Punjab. 246p.
- Sodhi, G.P.S.; Singh, R.K., Dhillon; G.S., Ahuja; S., Kaur, A.; Sunidhi, Kaur, T.; Murai, A.S.; Singh, R. and Kaur, S. (2023). Adoption Behaviour of Climate-resilient Agricultural Practices in Punjab under NICRA Project. Indian Journal of Extension Education, 59(2), 46–50. <https://doi.org/10.48165/IJEE.2023.59210>.
- Prasad, J.V.N.S.; Girija Veni, V.; Srinivasarao, Ch.; Kundu, S.; Ramakrishna, B.; Sammi Reddy, K.; Singh, R.; Singh, S.K.; Murai, A.S.; Rohilla, P.P.; Makkar, G.S.; Rampal, V.K.; Grover, J.; Brar, J.S.; Goyal, N.K.; Jakhar, D.S.; Kiran, B.V.S.; Singh, V.K. and Bhaskar, S. (2023). Can adoption of climate resilient management practices achieve carbon neutrality in traditional green revolution states of Punjab and Haryana? Journal of Environmental Management, 338, 117761. <https://doi.org/10.1016/j.jenvman.2023.117761>.
- Singh, Rajbir; Murai, Ashish Santosh; Chahal, V.P.; Singh, Randhir and Singh, A.K. (2021). Journey of Climate-Smart Villages: Pilots to Clusters. ICAR-Agricultural Technology Application Research Institute, Ludhiana. 44p.

Official Letterhead of ICAR-CRIDA, Hyderabad

Ref:

Date:

Certificate for Establishment of Climate-Resilient Villages under the NICAR-TDC Component

To Whom It May Concern

This is to certify that, under the strategic leadership and guidance of Dr. Parvender, Director, ICAR-ATARI, Ludhiana, and the overall guidance of the Deputy Director General (Agricultural Extension), ICAR, New Delhi, ICAR-ATARI, Ludhiana has been facilitating the development and scaling of Climate-Resilient Villages (CRVs) across Zone-I, with intensified efforts since February 2023. The initiative translates the climate vulnerabilities identified by ICAR-CRIDA, Hyderabad, into location-specific, field-level resilience measures across the districts of Himachal Pradesh (4), Jammu & Kashmir (5), Punjab (4) and Uttarakhand (4). Through coordinated action of the KVKs and continuous guidance and supervision of Dr. Parvender, 66 villages have been transformed as Climate-Resilient Villages, demonstrating a systematic approach to reducing climate risks, strengthening farm resilience and diversifying rural livelihoods.

The interventions encompass climate-resilient crop varieties and production technologies; soil, water and natural-resource management; livestock and allied-sector interventions; establishment of seed and fodder banks and Custom Hiring Centres (CHCs); value addition and development of high-value products for livelihood diversification; and formation of Village Climate Risk Management Committees (VCRMcs) for participatory climate-risk assessment, planning and implementation. The initiative has thus provided an integrated institutional framework for translating climate-risk assessment into community-led adaptation, technology adoption, resource conservation and livelihood resilience, with the KVKs serving as the frontline platform for technology scaling, capacity building and community mobilization. The details regarding 66 CRVs are as follows:

List of Climate Smart Villages in Zone-I

S. No.	State	Name of the District /KVK	Name of the CRVs	No. of CRVs/ KVK	Vulnerability Attributes	Identified Technological Interventions
1.	Himachal Pradesh	Bilaspur	Bari-Majherwan	1	Floods, earthquakes	Water harvesting; protected cultivation; drought/short-duration varieties; fodder production
2.		Chamba	Banjul, Chacho, Khalla, Khalnera, Kiri, Lagga, Ghasiti, Hathla, Pracha, Padhrui, Osal, Matiara, Sarol, Chhoel Gaduari	14	Drought, erratic rainfall, hailstorms	Water harvesting; mulching/anti-hail nets; drip irrigation; low-chill apple; crop diversification
3.		Kullu	Chhoel Gaduari, Mohal-1, Reri, Seriber, Teguber, Seardh	6	Drought, erratic rainfall, and temperature fluctuations	Water harvesting; mulching; drought/short-duration varieties; low-chill apple; vegetable diversification; fodder
4.		Mandi	Seardh	1	Erratic rainfall occasional frost, fog and hailstorm	Mulching; short-duration/ drought-tolerant varieties; heat-stress management; crop diversification; silage; livestock management

S. No.	State	Name of the District /KVK	Name of the CRVs	No. of CRVs/ KVK	Vulnerability Attributes	Identified Technological Interventions
5.	Jammu & Kashmir	Anantnag	Shangrin	1	Drought, heat wave, cold wave, occasional frost, fodder shortage	Vermicomposting; protected cultivation; SRI; drought/cold-tolerant varieties; fodder; water-saving irrigation
6.		Bandipora (Part of Erstwhile Baramulla)	Sumlar, Chountimulla, Kootasatri, Palpora, Kudara, Surrinder	6	Heavy snowfall, harsh winters, prolonged dry spell	Mulching; water harvesting; drought/short-duration varieties; cold-tolerant vegetables; high-density apple; fodder
7.		Kathua	Garah, Kannah, Kootah, Maya, Said Sohal, Badholi, Loukhali	8	Erratic rainfall, droughts and crop failures	Water harvesting; soil-health management; climate-resilient varieties; crop diversification; livestock resilience
8.		Leh (Ladakh)	Chuchot Shamma	1	Water scarcity and temperature fluctuations	Drip irrigation; mulching; frost-tolerant vegetables; silage; mineral supplementation
9.	Punjab	Poonch	Mangnar	1	Prolonged dry spells, untimely rainfall, low temperature	Rainwater harvesting; drought-tolerant wheat; heat-stress management; crop diversification; polyhouse nursery; fodder
10.		Bathinda	Bhisiana, Burj Mehma, Deon, Killi Nihal Singh, Kothe Chet Singh, Mehma Sarja	6	High or low temperature, high rainfall in short span, frost, hailstorm	Short-duration rice; heat-tolerant wheat; DSR/AWD; residue management; heat-stress management; summer moong
11.		Faridkot	BhagSingh Wala, Ghuduwala, Jalaleana, Kingra, Pindi Blochan, Veerewala Kalan	6	Erratic rainfall, droughts and crop failures	DSR/AWD; short-duration rice; heat-tolerant wheat; residue management; green manuring; silage; fodder
12.		Gurdaspur	Bharth, Khokhar	2	Dry spells	Short-duration rice; heat-tolerant wheat; DSR/AWD; residue management; heat-stress management; summer mash
13.		Moga	Meenia	1	Water-logging	DSR/AWD; short-duration rice; heat-tolerant wheat; residue management; green manuring; silage; backyard poultry
14.	Uttarakhand	Bageshwar	Karala paladi	1	Rainfed drought rabi season /frost during winter /hailstorm	Moisture conservation; water harvesting; protected cultivation; drought/short-duration crops; low-chill apple; fodder
15.		Champawat	Tyarsoo	1	Drought and cold stress	Mulching; natural farming; drought-tolerant millet; crop diversification; fodder; rainwater harvesting; intercropping
16.		Tehri Garhwal	Chopariyalgaon, Dabri, Indargaon, Kaleth, Selur, Semwalgaon	6	Climatic constraints: prolonged dry spells; cold wave; hails; unpredictable rainfall resource constraints: low soil fertility; poor access to quality seeds; fodder scarcity in dry months	Moisture conservation; protected cultivation; water harvesting; drought/short-duration varieties; nutrition gardens; livestock management
17.		Uttarkashi	Anole, Bhadkot, Dunda, Neri	4	drought	Vermicompost; natural farming; water harvesting; mulching; drought /short-duration varieties; resilient livestock breeds

This certificate is issued on the basis of the duly verified records of the Institute.

(Dr. V.K. Singh)
Director, ICAR-CRIDA, Hyderabad

Recognition for Field-Level Impact



The **Model for Methodological framework for developing Climate Smart Villages** has been certified by the Indian Council of Agricultural Research (ICAR), New Delhi, vide **Certificate No. ICAR-AEXT-ATARILDH-Methodology-2024-090**, in recognition of its field-validated approach, measurable environmental outcomes and demonstrated potential for large-scale replication.



twitter.com/atari1icar



www.facebook.com/icaratari.ludhiana.5



www.youtube.com/@icar-atariludhianazone-i8059



atariz1.org.in