

Indian Council of Agricultural Research (ICAR) Technology Portfolio *for* _____ **Corporate Social Responsibility Conclave 2026**

*ICAR with CSR: Pathway to
a Sustainable Future*



Indian Council of Agricultural Research
New Delhi



Agrinnovate India Ltd.
New Delhi

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for

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Genesis of ICAR Technology Portfolio for CSR Conclave

THE Indian Council of Agricultural Research (ICAR) is serving the nation for over nine decades as the scientific backbone of Indian agriculture, playing a transformative role in converting India from a food-deficit nation into a global agricultural powerhouse. Today, ICAR stands at the forefront of advancing resilient agri-food systems through scientific research, technological innovation, strategic partnerships, and capacity building of stakeholders. Guided by the principles of Partnerships for Progress, Innovation for Impact, and Excellence for a *Viksit Bharat*, ICAR promotes participatory innovation, climate-resilient agriculture, sustainable natural resource management, and inclusive rural development.

With one of the world's largest publicly funded agricultural research and innovation systems, ICAR possesses an extensive institutional network spanning research institutes, agricultural universities, *Krishi Vigyan Kendras* (KVKs), and All India Coordinated Research Projects (AICRPs). This unparalleled reach and scientific expertise makes ICAR an ideal partner for Corporate Social Responsibility (CSR) investments aimed at generating measurable social, economic, and environmental impacts.

Under Section 135 of the Companies Act, 2013, corporate entities in India are mandated to spend at least 2% of their average net profits on socially impactful projects. Schedule VII, Item (ix)(b) explicitly permits CSR contributions to public-funded bodies (like ICAR), ensuring that corporate capital can be legally and strategically channelled into public scientific research to drive sustainable development.



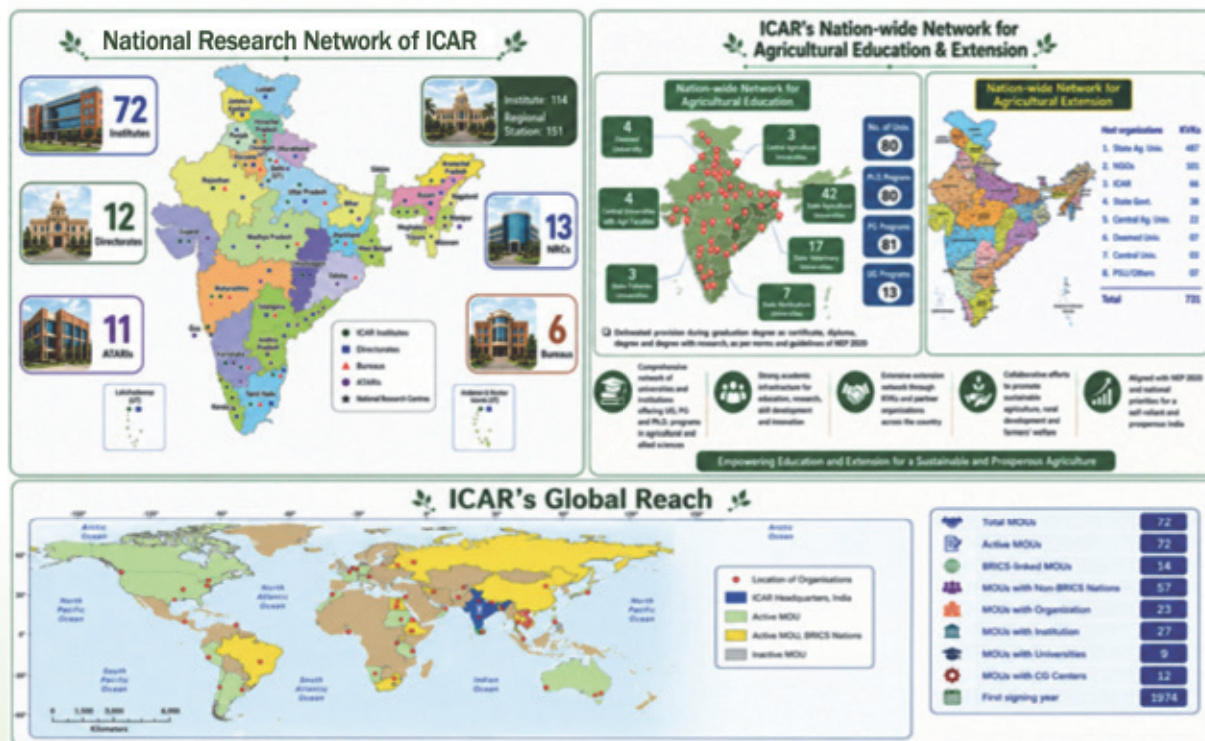
The ICAR-CSR Conclave 2026 seeks to leverage this extensive national infrastructure and scientific expertise to build strategic partnerships with corporate stakeholders. Through collaborative investments, corporate partners can transform CSR resources into scalable solutions that contribute directly to the United Nations Sustainable Development Goals (SDGs) and the national vision of a developed, self-reliant India by 2047 (*Viksit Bharat*).

Agrinnovate India Ltd. (AgIn), the technology commercialization and agribusiness interface company working for ICAR, will serve as the strategic facilitator for translating CSR partnerships into scalable impact. Through its expertise in technology commercialization, intellectual property management, industry engagement, startup promotion, and public-private partnerships, Agrinnovate will connect corporate CSR resources with validated ICAR technologies, research institutions, agri-startups, and field implementation agencies, thereby ensuring efficient deployment, monitoring, and scaling of CSR-supported initiatives.

Nation-Wide Research, Education and Extension Infrastructure

ICAR's strength lies in its unparalleled nationwide research, education, and extension network that connects laboratories with farms and innovations with communities.

- **Core Research Network:** The organization operates through a vast network comprising 114 Institutes, including 151 Regional Stations, 12 Project Directorates, 13 National Research Centres (NRCs), 11 Agricultural Technology Application Research Institutes (ATARIs), and 6 National Bureaux, covering every agro-climatic region of the country.
- **Agricultural Education Ecosystem:** ICAR coordinates India's largest agricultural education ecosystem, consisting of 80 agricultural universities (including Central, State, Veterinary, Fisheries, and Horticultural Universities). This system supports undergraduate, postgraduate, and doctoral education while promoting entrepreneurship in alignment with the National Education Policy (NEP) 2020.
- **Grassroots Delivery Architecture:** At the grassroots level, ICAR's extension architecture reaches millions of farmers through a network of 731 *Krishi Vigyan Kendras* (KVKs) operating across all districts, serving as the last-mile delivery mechanism for technologies, climate advisories, and skill development.



The ICAR has also developed a strong global footprint through an extensive network of international partnerships and collaborations. Since signing its first international Memorandum of Understanding (MoU) in 1974, ICAR has established 72 active MoUs with leading organizations, institutions, universities, and CGIAR centres across the world. These collaborations span North America, South America, Europe, Africa, Asia, and Oceania, facilitating scientific exchange, capacity building, technology transfer, and joint research initiatives. Notably, ICAR maintains 14 collaborations with BRICS-linked partners and 57 collaborations with non-BRICS nations, reinforcing India's role as a global leader in agricultural research and innovation for sustainable and resilient agri-food systems.



ICAR's Journey for the Nation's Prosperity: From Scarcity to Surplus and a Climate-Resilient Future

OVERCOMING Acute Food Scarcity: At the dawn of independence, the newly formed nation inherited an agrarian economy that was fragile, fractured, and deeply vulnerable to environmental variability. The legacy of the 18th, 19th, and early 20th centuries was marked by complete monsoon dependency, leading to catastrophic regional famines that claimed over 30 million lives. The initial decade (post-1947) relied heavily on food aid, exposing national food security to geopolitical vulnerabilities. Recognizing that structural sovereignty depends on food self-sufficiency, India's early leadership prioritized the sector.

The institutional framework to achieve this began with the expansion of the National Agricultural Research and Education System (NARES), led directly by ICAR. The network initiated systemic changes through the land-grant institutional pattern, beginning with the establishment of the first State Agricultural University (SAU) at Pantnagar in 1960. This structural shift merged higher education, scientific laboratory experimentation, and decentralized field extension into a single, cohesive engine for rural growth.

The Multi-Sectoral 'Rainbow Revolution': The collaborative efforts between national policymakers, ICAR scientists, and Indian farmers triggered an agricultural expansion widely termed the Rainbow Revolution. This framework signifies synchronized, science-led growth across distinct sub-sectors:

The macro-historical shift achieved by this scientific network is highlighted by the multi-fold production increases achieved between 1950-51 and the latest data. Notably, this production expansion occurred while the net sown area remained relatively static, moving only from approximately 130 million hectares to 140 million hectares.



GREEN REVOLUTION

Focused on
field crop
production.



WHITE REVOLUTION

Transformed the
dairy sector via the
foundational
“Operation Flood”
program initiated
in 1970.



BLUE REVOLUTION

Advanced
aquaculture and
marine fisheries.



YELLOW REVOLUTION

Focused on
oilseeds.



GOLDEN REVOLUTION

Focused on
horticulture
and honey.



SILVER REVOLUTION

Focused on
poultry.



BROWN REVOLUTION

Building Resilience
of Drylands.

Today, agriculture and allied sectors contribute approximately 18% to India's Gross Value Added (GVA). In parallel, agricultural export earnings have climbed to USD 51.1 billion, showing a marked structural shift toward higher-value processed foods, which now comprise 20.4% of the export basket.

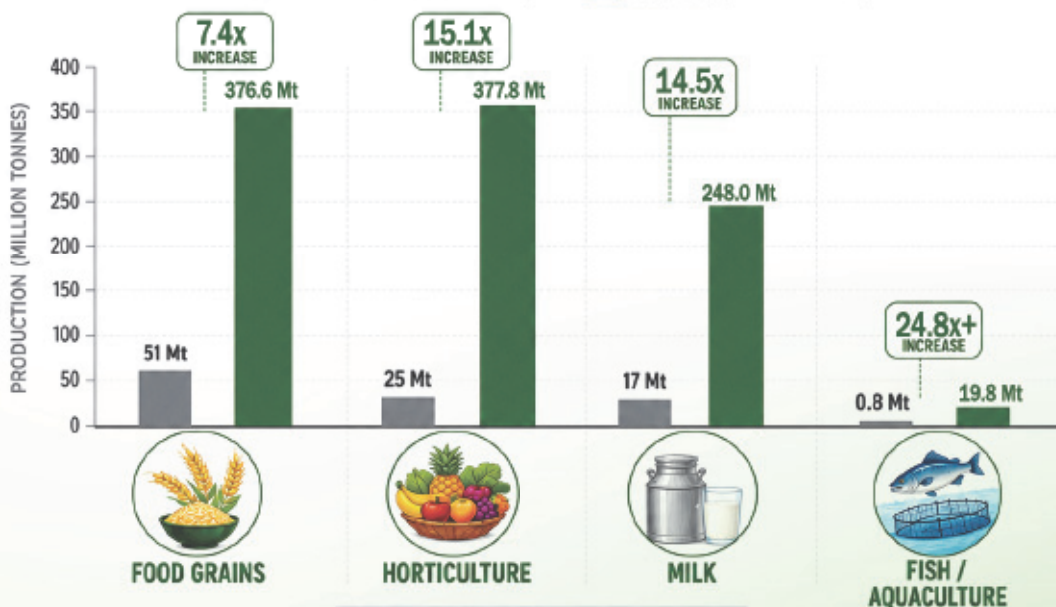


PRODUCTION TRAJECTORY: INDEPENDENCE vs. MODERN BASELINES

Growth in India's agricultural production since Independence
and current global standing

■ 1950–51 (Independence Era)

■ 2025–26 (Modern Baseline)



PRESENT GLOBAL STATUS



World's largest
rice producer;
second in wheat



Second globally
in fruits and
vegetables



Rank 1 globally
in dairy volumes



Second-largest
aquaculture producer
globally



ICAR Innovations Driving Sustainable, Resilient and Inclusive Agriculture for a Prosperous *Viksit Bharat*

THE vision of *Viksit Bharat* 2047 envisages a developed, self-reliant, inclusive and sustainable India. Agricultural transformation through science, innovation and partnerships forms a cornerstone of this national aspiration. The ICAR, through its research, education and extension initiatives, has been making significant contributions towards achieving both the goals of *Viksit Bharat* and the Sustainable Development Goals (SDGs). ICAR's interventions contribute substantially to strengthening socio-economic resilience, particularly in relation to SDGs 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-being), and 5 (Gender Equality).

Through the widespread adoption of ICAR-developed technologies on more than 50 million hectares, approximately 120 million farm families have benefited

OVERARCHING AIM OF ICAR

Advancing agri-food systems, science, participatory innovations, partnerships, and enhanced stakeholder capacity for building resilient food, land and water systems to ensure nutritious and healthy food for all, while protecting, conserving and restoring ecosystems, even in times of climate crisis.





through enhanced productivity, improved profitability and livelihood security. To address hidden hunger and improve nutritional outcomes, ICAR has released 203 biofortified crop varieties enriched with essential micronutrients such as iron, zinc and provitamin A. These varieties are helping to improve dietary quality and nutritional security among vulnerable populations. In promoting gender-inclusive development, ICAR's network of *Krishi Vigyan Kendras* (KVKs) has trained over 1.2 million rural women, while women constitute nearly 43 per cent of the scientific workforce within ICAR, reflecting its commitment to gender equity and women's empowerment.

ICAR also plays a vital role in advancing environmental stewardship, contributing directly to SDGs 6 (Clean Water and Sanitation), 12 (Responsible Consumption and Production), 13 (Climate Action), and 15 (Life on Land). Through the promotion of micro-irrigation, precision water management, watershed development and resource-conserving technologies, water-use efficiency levels exceeding 85 per cent have been demonstrated in several interventions. Sustainable production practices and clean-energy initiatives implemented across ICAR research systems have resulted in greenhouse gas emission reductions of approximately 46 per cent during the period 2014–2023. Furthermore, ICAR-developed technologies have facilitated the reclamation of nearly 2.22 million hectares of salt-affected soils, restoring degraded lands to productive use and enhancing the resilience of farming systems in coastal and arid regions.

ICAR's broader contributions to agricultural transformation are equally noteworthy. The organization has released more than 6,978 improved crop varieties and hybrids, developed and disseminated over 1,152 technologies, and generated over 190 diagnostic kits and related technologies to support plant and animal health management. More than 20 indigenous animal vaccines have been developed to strengthen livestock health and reduce dependence on imported technologies. Through its nationwide network of 731 KVKs, ICAR has trained over 24.7 million farmers, promoting the adoption of improved technologies and best practices. The institution has also nurtured more than 1,000 agri-startups and agri-enterprises, fostering entrepreneurship, employment generation and innovation-led rural development.

These achievements demonstrate that ICAR's science-based interventions are not only contributing to food and nutritional security, enhanced farm incomes and sustainable natural resource



management, but are also accelerating India's progress towards the SDGs. By bridging cutting-edge research with grassroots implementation, ICAR continues to drive the transition towards a prosperous, inclusive and climate-resilient agricultural sector, thereby contributing significantly to the realization of the vision of *Viksit Bharat 2047*.

Current Agricultural Challenges and ICAR's Initiatives: Despite achieving food surplus, modern Indian agriculture faces serious resource limitations that threaten long-term sustainability. These challenges require a shift from volume-driven production to value-driven, resource-efficient methods.

Current Challenges in Indian Agriculture

- **Land Degradation:** Approximately 121 million hectares (36% of the total geographical land base) is degraded by erosion, salinity, alkalinity, or waterlogging. Average organic carbon in Indian soils has fallen below 0.5%.
- **Nutrient Imbalances:** Soil testing shows that 93% of soils are low in nitrogen, 91% low in phosphorus, and 51% low in potassium. Applied synthetic nitrogen often has low efficiency, with around half leaking into surrounding ecosystems.
- **Climate Vulnerability:** Rising temperatures and shifting monsoon patterns present ongoing risks to crop yields.

ICAR has adopted advanced genomic and digital solutions to address the above-mentioned challenges. Scientists use marker-assisted selection and CRISPR tools to add climate-resilient traits such as drought and submergence tolerance into popular crop varieties. Accordingly, ICAR unveiled the world's first genome edited rice varieties DRR Dhan 100 (Kamala) and Pusa DST Rice 1. These varieties yield upto 19-30 % higher under stress, mature upto 20 days earlier, and save billions of cubic meters of water while cutting field methane emission by 20%. The system has released over



1,300 climate-resilient field crop varieties alongside 203 biofortified varieties enriched with iron (Fe), zinc (Zn), and essential proteins. Furthermore, tools like Info Crop (a specialized simulation model for tropical crop systems) are paired with the Vulnerability Atlas of Indian Agriculture to maintain actionable District Agricultural Contingency Plans across more than 600 districts.

As ICAR navigates the complexities of 2026 and beyond, its core scientific paradigms have expanded to encompass broader socio-economic, ecological, and structural goals:

The "One Health" Triad: Soil, Animal, and Human Wellness: ICAR recognizes that human nutrition cannot exist without healthy soils and robust animal populations.

- **Soil Health:** Transitioning beyond simple macronutrient checking, ICAR focuses heavily on restoring biological vitality. Microbial-based technologies are being widely deployed for in-situ carbon sequestration, nitrogen fixation, and nutrient recycling to boost the declining organic carbon footprint.
- **Animal Health:** Moving from the historic eradication of Rinderpest, ICAR currently develops advanced thermo-tolerant vaccines and molecular diagnostics for emerging livestock and poultry threats. This ensures structural biosecurity, high reproductive performance, and reduced zoonotic transmission risk.
- **Human Health:** Food security has evolved into targeted nutritional security. By engineering and scaling 203 biofortified crop varieties (such as high-zinc wheat and iron-rich pearl millet), ICAR is actively tackling clinical malnutrition and hidden hunger across vulnerable populations.

Input Use Efficiency (IUE) Optimization: To curb resource mining and reduce chemical leakage, ICAR has pioneered breakthrough protocols to improve input efficiencies. The integration of neem-coated urea and nano-fertilizers has significantly lowered synthetic nitrogen losses while protecting groundwater ecosystems. Simultaneously, micro-irrigation systems integrated with drip fertigation have elevated on-farm water use efficiency by delivering precise nutrient-water complexes directly to root zones, maximizing crop output per drop.

Empowering Women in Agriculture: Women constitute the structural backbone of rural production systems, yet they frequently face resource disparities. ICAR has institutionalized gender-



responsive research frameworks across the country. This includes creating and distributing women-friendly ergonomic farm implements that dramatically reduce physical drudgery, running targeted vocational skill tracks through KVK networks, and supporting the creation of women-led Farmer Producer Organizations (FPOs) to foster financial autonomy and equitable leadership in modern value chains.

Targeted Skilling and Youth Retention in Farming: To transform farming into an attractive, high-income career path for younger generations, ICAR runs dedicated human resource development initiatives. Programs like ARYA (Attracting and Retaining Youth in Agriculture) provide rural youth with operational training in high-value enterprises like protected horticulture, apiaries, mushroom cultivation, and seed production. This is reinforced by the Student READY (Rural Entrepreneurship Awareness Development Yojana) module, which makes year-long experiential business modeling and industrial attachments a mandatory prerequisite for all agricultural undergraduates.

IPR Facilitation and the Agri-Startup Ecosystem: The integration of new-age technologies requires a vibrant, risk-mitigated corporate ecosystem. ICAR acts as a critical accelerator by managing 50 Agri-Business Incubators (ABIs) nationwide. Through these incubators, thousands of early-stage entrepreneurs are granted access to state-of-the-art public laboratories, pilot processing machinery, and structured mentoring.

To protect this collective intellectual capital, ICAR has established a robust Intellectual Property Rights (IPR) management framework. This system facilitates the smooth transfer of proprietary varieties and patentable manufacturing processes to the commercial market. As a result, tech-driven start-ups are now rapidly deploying artificial intelligence (AI), internet-of-things (IoT) sensors, drone-based seeding, and blockchain logistics data directly into the field.

Agrinnovate India Ltd. operationalizes this innovation ecosystem by facilitating technology licensing, industry partnerships, and commercialization of ICAR technologies. It acts as the principal interface between ICAR's research institutions and corporate partners, enabling CSR-funded technologies to progress from laboratory validation to large-scale field deployment.



CSR in Scientific Research: Role and Importance

ACHIEVING India's agricultural targets requires extensive cooperation between public research networks and private industry partners. The national agricultural strategy is aligned with key global environmental treaties (UNFCCC, UNCCD, UNCBD) and targets ambitious domestic goals:

- Enhancing net farm incomes by 200% through value addition.
- Reducing synthetic chemical fertilizer usage by 25% and water consumption by 20%.
- Increasing on-farm renewable energy application by 50%.
- Rehabilitating 26 million hectares of degraded land ecosystems.

CSR in India has evolved from voluntary, philanthropic check-signing into a statutory framework for sustainable nation-building. Under Section 135 of the Companies Act, 2013, corporate entities meeting specific financial thresholds are mandated to spend at least 2% of their average net profits on socially impactful projects.

While traditional CSR concentrated on immediate social relief (such as distribution or basic infrastructure build-outs), its role in Scientific Research and Development (R&D) addresses root-cause vulnerabilities. Investing CSR capital into institutional R&D acts as a social multiplier because scientific breakthroughs like climate-resilient crop varieties or water-saving field protocols permanently upgrade the livelihood capacity of millions of smallholders, moving them from vulnerability to economic resilience.



India is a pioneer globally in explicitly linking corporate capital to public scientific ecosystems through legislative policy:

- **Schedule VII, Item (ix) Amendment:** The Ministry of Corporate Affairs expanded the statutory scope to explicitly recognize research expenditures. Item (ix)(b) specifically permits contributions to public-funded universities, national laboratories, and autonomous bodies established under major scientific departments, including the ICAR.
- **SDG Alignment Rule:** The statutory amendment mandates that R&D projects funded via corporate CSR contributions under these national bodies must be directly aimed at promoting the Sustainable Development Goals (SDGs).
- **No Commercial IP Reciprocity Rule:** Legally, CSR grants given to public institutions like ICAR cannot be accompanied by any direct commercial benefit or exclusive Intellectual Property (IP) rights accruing back to the corporate donor, ensuring that innovations remain public goods for community welfare.

While India's overall CSR capital pool is substantial, its thematic distribution shows a historical concentration that is currently undergoing a strategic shift:

- **National CSR Footprint:** Annual national CSR spending has stabilized at over ₹34,900 crore (with over ₹1.84 lakh crore spent cumulatively over the past decade).
- **Structural Asymmetry:** Historically, Education (~44%) and Healthcare (~18% to 25%) have captured the lion's share of corporate funding. By contrast, Environment & Sustainability (~10% to 13%) and direct institutional Agricultural Research receive a fractional allocation of the remaining capital pool.
- **Emerging Pivot:** Driven by global Environmental, Social, and Governance (ESG) compliance mandates, progressive corporations (led by the BFSI, IT, and Energy sectors) are shifting focus toward agricultural supply chain resilience, carbon offset projects, and rural asset creation.

Globally, corporate support for R&D and sustainability operates under a matrix of tax incentives, mandatory ESG disclosures, and green bonds:

- **ESG Mandate Scale:** Global ESG-driven assets are projected to exceed \$50 trillion, altering how multinational companies channel their sustainability expenditures.

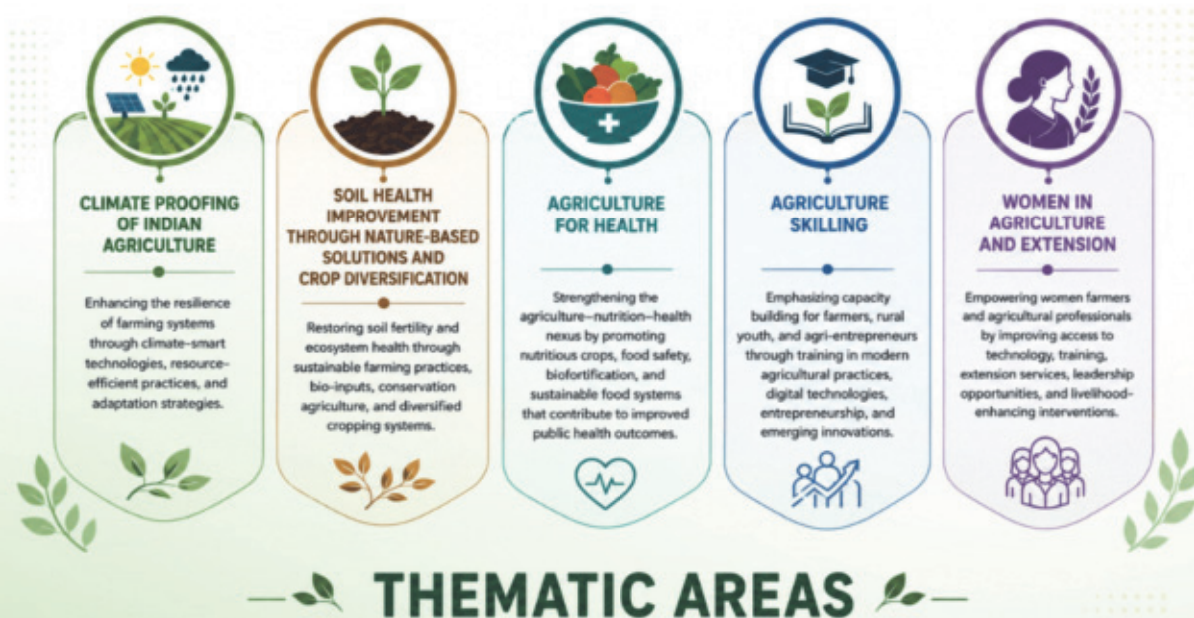


- **Blended Finance and Public-Private Partnerships (PPPs):** In developed economies, corporations channel an average of 15% to 20% of their sustainability budgets directly into university-linked or state-sponsored research centres via blended finance models. This accelerates innovations in precision agriculture, synthetic biology, and carbon capture.
- **Decarbonization Focus:** Over 70% of Fortune 500 companies have committed to net-zero carbon targets. This makes them active international investors in regenerative agriculture projects across developing nations to build verifiable carbon offsets.



5

ICAR Technical Portfolio and CSR Conclave 2026: Thematic Areas



MOVING beyond traditional philanthropy, the CSR Conclave 2026 introduces five interconnected thematic pillars designed to translate corporate capital into measurable socio-economic and environmental returns, strategically mapped to the SDGs and aligned with the



national mandate of *Viksit Bharat 2047*. By converging ICAR's advanced scientific capabilities with corporate strategic investments, these pillars provide transparent, legally compliant frameworks to de-risk smallholder livelihoods, restore vital natural resources, and scale next-generation innovations across India's diverse agro-climatic zones.

The following sections outline the core challenges, operational mechanisms, and collaborative investment portfolios defined for each thematic focus area:

Theme 1: Climate-Proofing Indian Agriculture

Climate change stands as the definitive challenge of the twenty-first century, presenting an array of systemic risks including volatile thermal brackets, irregular precipitation patterns, and acute extreme weather aberrations. For emerging economies like India, these environmental disruptions directly threaten the primary sector.

India supports nearly 18% of the global human population despite holding a mere 2.4% of the world's landmass and only 4% of its freshwater resources. Because agriculture sustains approximately half of the national workforce, climate-induced stressors such as localized drought, structural flooding, sea-level salinity intrusion, and emerging vector/pest mutations pose a direct threat to long-term macroeconomic stability and food security.

Strategic Alignment: Deploying targeted climate-resilient technologies on the farm generates immediate socioeconomic dividends, mapping cleanly onto the SDGs:

- **SDG 1 (No Poverty) and SDG 2 (Zero Hunger):** Scaled integration of resilient crop strains and backyard poultry insulates marginal incomes and protects caloric and nutritional outputs from seasonal volatility.
- **SDG 3 (Good Health) and SDG 6 (Clean Water):** Precision micro-irrigation and watershed asset creation fortify regional water tables while reducing vector risks to secure human and livestock health.
- **SDG 7 (Affordable Energy) and SDG 12 (Responsible Production):** Transitioning to solar-powered pumping grids and low-carbon, fuel-efficient machinery cuts inputs and establishes a sustainable circular bioeconomy.



- **SDG 8 (Decent Work), SDG 13 (Climate Action) and SDG 14 (Life Below Water):** Establishing decentralized community assets like custom hiring centers and seed banks insulates rural labor against climate shocks, while advanced aquaculture paradigms protect inland and marine aquatic life.

The ICAR has built a multi-layered framework designed to move innovations from laboratories directly into field operations:

National Innovations in Climate Resilient Agriculture (NICRA): Operating as the primary network blueprint across 151 highly vulnerable districts, NICRA has validated climate-smart toolkits directly with local farmers. To date, the program has directly benefited 6,93,629 farmers through field demonstrations and trained 6,47,735 individuals across 23,613 capacity-building modules. Additionally, ICAR has instituted District Agriculture Contingency Plans (DACPs) for 650 districts to standardize local administrative responses to sudden weather anomalies.

Precision and Integrated System Initiatives:

- **ICAR-NePPA (Precision Agriculture):** Active across 16 core locations, this network deploys Internet of Things (IoT) sensors, robotics, and predictive data analytics to optimize real-time fertilizer and water delivery while tracking pest outbreaks in staple crops like cotton and rice.
- **AICRP-IFS and AINP-OF (Integrated Farming and Organic Systems):** Operating across 25 States/UTs, this framework has finalized 76 diversified Integrated Farming System (IFS) models and 80 tailored organic cropping packages, building natural biological buffers against market and weather volatility.
- **CRP-CA (Conservation Agriculture):** This platform scales resource-efficient methodologies that significantly lower production costs, eliminate residue burning, and improve soil organic carbon levels.

Bridging the Gaps: Despite strong technical proof-of-concept models, scaling these solutions across India's broader agricultural landscape faces several key challenges:

- **Fragmented Holdings:** Small and marginal farmers often lack the capital and adaptive capacity to absorb the upfront costs of modern technologies.



- **The Adoption Bottleneck:** Social, technical, and localized financial barriers can slow down the adoption of conservation tools at the grassroots level.
- **Information Asymmetry:** Last-mile extension networks require continuous updates to effectively deliver real-time early warning advisories and decision-support tools.
- **Finance Gaps:** Rural communities often face limited access to dedicated adaptation finance and structured risk-mitigation capital.

The Horizon: Emerging Tech and Future CSR Strategies: To bridge these gaps, the ICAR-CSR Conclave 2026 provides a clear roadmap for corporate social investments, turning environmental challenges into verifiable social outcomes:

- **Accelerating Speed Breeding Initiatives:** Sponsoring advanced genomic research pipelines to quickly scale and distribute stress-tolerant seed varieties.
- **Decentralized Asset Distribution:** Funding the establishment of village-level Custom Hiring Centers to give marginal farmers shared access to climate-smart implements and conservation machinery.
- **Deploying Digital Information Grids:** Investing CSR capital into AI-driven agromet advisories, smart-sensor irrigation setups, and automated pest monitoring tools.
- **Unlocking Voluntary Carbon Markets (VCM):** Developing regional compliance frameworks that aggregate smallholder conservation practices, allowing corporate sponsors to trade or claim high-integrity carbon offsets.

Theme 2: Soil Health Improvement through Nature-Based Solutions and Crop Diversification

Soil functions as the primary biological infrastructure driving agricultural productivity, national food security, environmental equilibrium, and rural livelihoods. As a dynamic, living ecosystem, soil regulates hydrological flows, drives carbon sequestration, and anchors terrestrial biodiversity. However, India's production landscapes face intense structural strains. Intensive cropping cycles, widespread land degradation, severe macro- and micro-nutrient imbalances, and declining soil organic matter, combined with climate-induced anomalies, have placed severe stress on soil health.



With nearly half of the domestic workforce relying on agriculture, restoring and maintaining soil health is a national imperative. Systemic interventions across physical, chemical, and biological dimensions are critical to improving nutrient-use efficiency, increasing smallholder farm incomes, and reinforcing the climate resilience of Indian agriculture.

The Soil-SDG Interlinkage Matrix: Implementing scientific soil interventions creates clear socio-environmental benefits that map directly onto the SDGs:

- **SDG 1 (No Poverty) and SDG 2 (Zero Hunger):** Improving soil fertility directly enhances crop productivity, food output, and farm profitability, insulating smallholder livelihoods against market shocks.
- **SDG 6 (Clean Water and Sanitation):** Remediating soil architecture improves field water-retention capacity while minimizing chemical runoff into regional groundwater tables.
- **SDG 13 (Climate Action):** Expanding soil organic matter turns vast agricultural landscapes into active carbon sinks, building resilience against extreme weather.
- **SDG 15 (Life on Land):** Reversing land degradation patterns preserves essential microbial biodiversity and prevents desertification.

ICAR's Scientific Benchmarks and Impact Architecture: The ICAR provides the core scientific backend and technology blueprints powering India's major land-regeneration programs:

Digital Soil Resource Mapping and Diagnostic Infrastructure

- **The Soil Health Card (SHC) Engine:** ICAR's standardized soil-testing methodologies provided the baseline for generating over 25 crore Soil Health Cards. The roll-out of the *Mrida Parikshak* analytical mini-lab kits enabled the decentralized distribution of 28 million site-specific fertilizer advisories.
- **National Soil Spectral Library:** This framework houses more than 40,000 spectral signatures, accelerating high-throughput soil diagnostics nationwide.
- **Land Resource Inventory (LRI):** ICAR has mapped over 100 lakh hectares under micro-level LRI models, providing data that can boost crop yields by 10–25% while lowering land degradation by 20–40% through targeted management.



Long-Term Evaluation and Precision Nutrient Delivery

- **AICRP-LTFE (Long-Term Fertilizer Experiments):** Operating across 18 major agro-ecological nodes, this project tracks long-term soil health shifts. It has systematically demonstrated that integrating organic amendments with minimal synthetic inputs is essential to sustaining soil organic carbon (SOC) levels.
- **STCR (Soil Test Crop Response):** Using targeted yield-prescription math, STCR models deliver precise fertilizer recommendations for specific crop-soil combinations, reducing fertilizer waste while protecting baseline profitability.

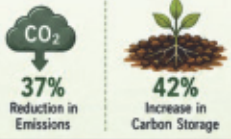
Applied Eco-Engineering and Biological Inputs

- **Biofertilizer Production Ecosystems:** ICAR manufactured and distributed 924 tonnes of high-efficiency biofertilizers (including 547 tonnes of nitrogen-fixing strains, 222 tonnes of PSB, and 124 tonnes of KRB), with targeted technology transfers directly reaching marginalized SC/ST farming clusters.
- **Conservation Agriculture and Resource Conservation Technologies (RCTs):** ICAR developed 141 validated soil and water conservation technologies. These systems cut surface runoff and erosion by 30–50%, improve groundwater recharge by 20–45%, increase crop yields by 20–60%, and lift farm incomes by up to 100%.

Quantified Field Impacts: Success Stories and Outcomes

The table below highlights the field performance of ICAR-developed soil management models across various agricultural zones:



APPLIED INTERVENTION	SOURCE METRIC / STUDY FRAMEWORK	QUANTIFIED SOCIO-ECONOMIC AND AGRONOMIC YIELDS
 SOIL HEALTH CARD ADOPTERS	 National Productivity Council (NPC) Audit	• 8 to 10% reduction in production costs; • 5 to 6% increase in crop yields. 
 BALANCED NITROGEN MANAGEMENT	 MANAGE Impact Evaluation	• Adopters reduced Urea input by 20 kg/ha and DAP/SSP by 19 kg/ha; • increased micronutrient use by 9.15 kg/ha. 
 PROBLEM SOIL RECLAMATION	 ICAR Saline and Sodic Land Protocols	• Reclaimed 2.22 million hectares of degraded land; added 17 million tonnes of grain to the national pool; generated ₹20,000 crore in rural wages. 
 LAND DEGRADATION MITIGATION	 Long-term Spatial Matrix (2000–2021)	• Restored 4.8 lakh hectares of degraded lands. • Improved arid zone carrying capacity from 28 to 130 humans/sq. km. 
 CONSERVATION AGRICULTURE (PUNJAB RICE-WHEAT SYSTEM)	 Rice-Wheat System Matrices	• Shift to Direct Seeded Rice (DSR) and Crop Residue Management (CRM) cut emissions by 37% and boosted carbon storage by 42%. 
 LANDSCAPE-LEVEL RESILIENCE	 Integrated Farming Systems (IFS) Program	• Scaled to 1.04 lakh households across 79 districts; • stabilized annual smallholder incomes at 1.5 to 3.6 Lakh/Ha. 



Critical Challenges in the Soil Ecosystem

- **Declining Soil Organic Carbon (SOC):** Critical production zones are experiencing a steady drop in base soil organic carbon levels.
- **Nutrient Imbalances:** The historical over-application of synthetic Nitrogen continues to skew natural N:P: K balancing ratios.
- **Widespread Micronutrient Deficiencies:** Essential trace elements like Zinc, Boron, Iron, and Sulphur are increasingly depleted across major agricultural belts.
- **Smallholder Access Barriers:** Marginal farmers face technical and economic barriers when trying to adopt scientific soil-management tools.

Emerging Opportunities and Future Corporate CSR Strategies: The ICAR-CSR Conclave 2026 outlines structured, highly strategic investment avenues for corporate partners to deploy capital into verifiable, soil-centric environmental projects:

Funding Next-Gen Digital Soil Diagnostics: Investing CSR capital in handheld IoT soil sensors, AI-driven soil diagnostics, and automated local testing centers.

Scaling Nature-Based and Biological Production Hubs: Sponsoring village-level composting units, vermicomposting infrastructure, and beneficial microbial production hubs to reduce chemical dependence.

Investing in Carbon Farming Infrastructure: Providing funding for specialized conservation machinery, zero-till seed drills, and laser land-leveler to support landscape-level carbon sequestration projects.

Sponsoring Degraded Land Reclamation: Partnering with ICAR to fund localized drainage networks and soil-amendment distributions to reclaim saline, sodic, or acidic soils in vulnerable rural communities.

Theme 3: Agriculture for Health: The Paradigm Shift to Preventive Healthcare

The intersection of agriculture and public health represents the frontier of sustainable development, shifting the national focus from mere food security (caloric volume) to nutritional security (nutrient



density). Globally, agricultural design acts as a primary tool for public health support, with organizations like the FAO and WHO advocating for "Nutrition-Sensitive Agriculture" to counter the \$3.5 trillion annual economic toll of malnutrition and hidden hunger.



In a landmark step toward this integration, the Union Government launched the SEHAT Mission (Science Excellence for Health through Agricultural Transformation) on May 11, 2026. Jointly anchored by the Indian Council of Agricultural Research (ICAR) and the Indian Council of Medical Research (ICMR), the SEHAT Mission represents India's first formal, national-scale convergence of



the agricultural and health sectors. It transitions healthcare from a reactive, treatment-based model to a proactive, prevention-oriented framework with a clear baseline: "Healthy Food, Healthy Farms, Healthy India."

The mission directly targets the dual national burden of micronutrient deficiencies and rising non-communicable lifestyle diseases (NCDs) like diabetes and hypertension by treating food as preventive medicine. Backed by ICAR's scientific expertise, the SEHAT Mission deploys a multi-pronged matrix across five distinct priority pillars:

- **Precision Nutrition and Biofortification:** Scaling up the evaluation and adoption of ICAR's biofortified, nutrient-dense staples (zinc-rich wheat, iron-dense pearl millet) to eradicate hidden hunger directly via regular diets rather than expensive industrial supplements.
- **Promotion of Climate-Resilient Traditional Grains:** Re-commercializing nutrient-dense native millets (Kodo, Kutki, Ragi, Jowar, Bajra) as daily functional foods to manage NCDs and lifestyle disorders.
- **Integrated Farming Systems (IFS) and Nutri-Gardens:** Sponsoring diversified farm models combining crop cultivation, horticulture, animal husbandry, and beekeeping to establish a resilient, farm-to-plate nutritional supply loop for rural families.
- **Occupational Health and Safety for Farmers:** Implementing structural guidelines to reduce chemical imbalance and toxic pesticide exposure among agricultural laborers, safeguarding the health of the primary producers.
- **Strengthened "One Health" Preparedness:** Constructing collaborative surveillance networks at the critical human-animal-environmental interface to proactively monitor zoonotic disease risks and antimicrobial resistance (AMR).

CSR Partnership Leverage: The launch of the SEHAT Mission opens an immediate, highly prestigious avenue for corporate social investment. CSR partners can sponsor regional "SEHAT-compliant" model villages, establish localized community Nutri-Gardens, or fund the distribution networks of biofortified seeds to targeted districts with documented nutritional deficiencies. This approach maximizes direct health outcomes while ensuring alignment with both national mandates and corporate ESG criteria.



Theme 4: Next-Gen Agri-Skilling

India's agricultural sector is undergoing a rapid technological transformation driven by digitalization, automation, climate variability, and shifting global market demands. Simultaneously, the sector faces critical structural challenges, including labor shortages, an aging farming population, youth migration, and a historical mismatch between academic curricula and industry requirements. As India advances toward its *Viksit Bharat @2047* and *Atmanirbhar Bharat* objectives, human capital has emerged as the defining factor for future competitiveness.

Transforming agriculture from a traditional subsistence activity into a knowledge-intensive, technology-enabled enterprise requires a highly skilled, entrepreneurial workforce. Agricultural skilling is no longer merely an educational priority; it is a strategic national investment essential for accelerating innovation, enhancing export competitiveness, and driving rural prosperity.

Strategic Alignment with SDGs: Investing in advanced agricultural and allied skills creates multi-dimensional socio-economic benefits that map onto the United Nations SDGs:

AGRI-SKILLING FOR A SUSTAINABLE FUTURE: ALIGNING WITH THE SUSTAINABLE DEVELOPMENT GOALS



1 NO POVERTY



2 ZERO HUNGER

- Skill acquisition directly increases farm **productivity** and **profitability**, providing robust **livelihood security**.



4 QUALITY EDUCATION



5 GENDER EQUALITY

- Competency-based training supports **lifelong learning** while reducing **gender disparities** by equipping women farmers and self-help groups (SHGs) with **technical leadership**.



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

- Targeted training generates skilled **rural employment**, fosters **agri-startups**, and modernizes **value chains**.



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION

- Skills in post-harvest management and climate-smart agriculture reduce food loss and lower environmental footprints.



14 LIFE BELOW WATER



15 LIFE ON LAND

- Capacity building in **advanced mariculture** promotes sustainable use of aquatic resources and conserves terrestrial ecosystems.





Academic Restructuring and Higher Education (NEP-2020 Integration): ICAR has transformed the higher education landscape by implementing the 6th Deans Committee Report across Agricultural Universities. This framework introduces structural flexibility and multidisciplinary learning aligned with the National Education Policy (NEP) 2020:

- **Credit-Based Skill Insertion:** Dedicated skill courses (12 credits) are embedded within the first two years of undergraduate (UG) programs across 14 distinct streams (including Agriculture, Horticulture, Agri-Business Management, and Natural Farming).
- **Multiple Entry/Exit System:** Students have the option to exit after one or two years with a formal Certificate or Diploma, followed by a mandatory 10-week industry internship to ensure immediate job readiness.
- **Diploma-to-Degree (D2D) Pathways:** Clear operational guidelines enable 10th and 12th-class pass students to transition directly from technical diplomas into bachelor's degree programs, boosting the national Gross Enrolment Ratio (GER).
- **Experiential Learning Platforms:** Flagship programs like ARYA (Attracting and Retaining Youth in Agriculture) and Student READY incorporating the RAWA (Rural Agriculture Work Experience) module provide students with hands-on, field-level entrepreneurial training under real-world conditions.

High-Value Horticulture Value Chains: Horticulture contributes nearly 42% of the agricultural Gross Value Added (GVA) from just 14% of the cultivated land area. To sustain this momentum, ICAR's skilling programs have expanded beyond conventional production into specialized tech modules:

- **High-Tech Production:** Training covers Good Agricultural Practices (GAP), tissue culture, micropropagation, and automated nursery management.
- **Controlled Environments:** Building technical capacity in greenhouse management, vertical farming, hydroponics, and soilless cultivation.
- **Post-Harvest Engineering:** Upskilling workers in cold chain logistics, blast freezing, modified atmosphere packaging, and international food safety traceability standards to minimize post-harvest economic losses.



The Blue Economy (Aquaculture and Fisheries Sunrise Sector): To reach the national target of 40 million tonnes of fish production by 2047, ICAR's Fisheries Science Division has established structured training calendars focused on modernization:

- **Production Intensification:** Training covers advanced genetics (marker-assisted selection), Biofloc Technology (BFT), and Recirculatory Aquaculture Systems (RAS), where personnel manage complex bio-engineering and real-time water chemistry.
- **Open-Water Mariculture:** Building capacity in structural cage engineering, mooring dynamics, and automated feeding systems for offshore cage farming and seaweed cultivation.
- **Sustainable Harvest and Safety:** Training capture fishers in advanced navigation, localized sonar mapping, energy-efficient crafts, and sea safety protocols to reduce on-board occupational hazards.

Core Challenges in the Agri-Skilling Ecosystem

- **Infrastructure Deficits:** Many rural training facilities face gaps in modern laboratories, high-tech farms, and sensor-based equipment.
- **Faculty Competency Gaps:** There is an immediate need to train instructional faculty in advanced, competency-based technical delivery.
- **Rapid Tech Obsolescence:** The fast pace of technological change makes it difficult to keep vocational courses continuously updated.
- **Pathogen and Climate Uncertainties:** Rising transboundary aquatic pathogens and extreme weather anomalies require advanced, real-time diagnostic and biosecurity skills that are not yet widely available at the farm level.
- **Weak Industry Linkages:** Insufficient institutional alignment between academia, extension networks, and private corporate recruiters limits formal apprenticeship opportunities.

Emerging Technologies and Opportunities (Agriculture 4.0): The next generation of rural employment relies on cross-disciplinary, high-tech interventions. Corporate partnerships can target several key technical domains:

- **Establishing Regional Centres of Excellence:** Partnering with ICAR to fund state-of-the-art skill hubs equipped with advanced machinery, automated greenhouses, and virtual reality (VR) simulation labs for hands-on technical training.



- **Developing Digital and Hybrid Learning Frameworks:** Sponsoring AI-enabled, multilingual e-learning portals and interactive online tools to make high-tech agricultural training accessible across remote areas.
- **Sponsoring Rural Startup Incubation Hubs:** Allocating CSR capital to business incubators housed within ICAR institutes to mentor, fund, and scale youth-led agri-enterprises and Farmer Producer Organizations (FPOs).
- **Launching National Certification and Inclusion Programs:** Funding internationally accredited skill certification modules specifically for women farmers, tribal communities, and youth in aspirational districts to improve employment opportunities and export readiness.

Building a skilled, innovative, and entrepreneurial workforce is a vital national investment. By aligning resources with emerging technologies and establishing strong public-private partnerships, the ICAR-CSR Conclave 2026 can help bridge the gap between academic knowledge and industry expectations positioning India as a global leader in sustainable, knowledge-driven agriculture for *Viksit Bharat 2047*.

Theme 5: Women in Agriculture and Extension

The structural transformation of Indian agriculture is increasingly defined by the feminization of agriculture. Driven by rapid male out-migration to urban centres and changing economic pressures, women have shifted from being secondary contributors to the primary managers of rural farm economies.

According to the Government of India's Periodic Labour Force Survey (PLFS), nearly 76.95% of economically active rural women are engaged in agriculture and allied sectors, making up over 33% of the total agricultural workforce and nearly 50% of self-employed farmers. Furthermore, research from the S M Sehgal Foundation indicates that rural women perform up to 70% of labour-intensive food production tasks and oversee 60–80% of domestic food security. Despite this profound systemic footprint, deep structural barriers persist:

- **Asset Inequity:** The Agriculture Census highlights that women hold only 12.8% of operational land holdings (representing just 10.34% of the total area). This lack of land ownership limits their access to formal credit, cooperative memberships, and institutional farm subsidies.



- **Extension and Knowledge Gaps:** Women farmers receive less than 20% of mainstream agricultural extension services, severely restricting their adoption of advanced technologies and data-driven farming methods.

As the United Nations recognizes the crucial role of women at the grassroots level, empowering these farmers is central to achieving SDG 1 (No Poverty), SDG 5 (Gender Equality), and *Viksit Bharat @2047* targets.

Institutional Frameworks: To bridge these systemic gaps, India's national research framework operates through specialized gender-focused institutions:

- **ICAR-Central Institute for Women in Agriculture (ICAR-CIWA):** Located in Bhubaneswar, ICAR-CIWA generates gender-disaggregated farm data, creates ergonomically designed, women-friendly tools, and designs specialized capacity-building models.
- **National Gender Resource Centre in Agriculture (NGRCA):** Operating under the Ministry of Agriculture & Farmers Welfare, NGRCA acts as a national clearinghouse for policy advocacy, mainstreaming gender budgeting across public expenditures, and ensuring targeted fund flow to women-led agricultural initiatives.

Drudgery Reduction and Ergonomic Engineering: Conventional farm machinery is often too heavy and poorly suited for the physical demands of female agricultural workers, leading to high levels of physical fatigue. ICAR-CIWA and the Directorate of Extension have introduced a range of gender-friendly, ergonomically optimized tools:

- **Pre- and Post-Harvest Tools:** Lightweight, adjustable hand-weeders, protective manual seed-drills, high-efficiency vegetable peelers, and ergonomic sugarcane strippers.
- **Safety and Efficiency:** These tools improve field safety, reduce time demands, and boost labor productivity by 25–30% across manual harvesting and sowing tasks.

Nutrition-Sensitive Agriculture and Bio-fortification: To combat rural malnutrition, ICAR utilizes the JANANI Intensive Farming System (Nutri-garden Model). This approach integrates high-yield, biofortified crop varieties directly into small plots managed by women:

- **Crop Selection:** Cultivating micronutrient-dense options like zinc-rich wheat, iron-fortified pearl millet, and vitamin A-abundant sweet potatoes.



- **Systemic Impacts:** These micro-farms directly tackle maternal anemia, secure local food production, and generate surplus high-value produce for local markets.

Enterprise Development and High-Value Value Chains: Moving beyond subsistence farming requires equipping women with specialized skills for high-value agricultural markets:

- **Allied Agricultural Enterprises:** Targeted capacity building in scientific mushroom production, backyard poultry management, and high-yielding apiaries.
- **Circular Economy Initiatives:** Training women to convert water hyacinth and other aquatic weeds into organic compost, bio-fertilizers, and sustainable thread-based eco-packaging.

Reimagining Agricultural Extension: Traditional, male-centric extension models are shifting toward decentralized, peer-led, and digitally driven knowledge networks:

- **The Power of Self-Help Groups (SHGs):** Integrating agricultural training into existing SHG networks scales technical knowledge quickly. Empowering women as Krishi Sakhis (community agriculture counselors) provides dependable, peer-to-peer technical guidance directly at the village level.
- **Digital Extension Frameworks:** Leveraging initiatives like Bharat Vistaar the national Digital Public Infrastructure (DPI) for AI in agriculture delivers localized, audio-visual agronomic advice, weather alerts, and crop diagnostics directly to women's mobile devices, bypassing traditional mobility constraints.
- **Custom Hiring Centres (CHCs):** Establishing women-led equipment hubs funded by public and corporate partnerships allows smallholder female farmers to access advanced machinery on a rental basis, lowering capital costs.

Sustainable agricultural growth and true rural modernization rely on empowering women farmers. By shifting the focus of agricultural extension from generic training to gender-transformative, technology-driven capacity building, public and private partnerships can turn systemic vulnerabilities into economic opportunities ensuring women lead the way toward an equitable, food-secure, and self-reliant nation.



Way Forward: Strategic CSR Collaboration and Investment Opportunities

THE ICAR-CSR Conclave-2026 highlights a highly diversified portfolio of high-impact investment areas where corporate stakeholders can deploy resources to drive rural development and environmental resilience:

- **Scaling Climate-Resilient Landscapes:** Corporate funding can scale ICAR's tested models, such as the National Innovations in Climate Resilient Agriculture (NICRA) protocols, across vulnerable agropastoral zones.
- **Nutritional Security via Biofortification:** Companies can sponsor the distribution networks and community seed banks for ICAR's 203 biofortified crop varieties, directly fighting malnutrition at the village level.
- **Last-Mile Technological De-risking:** CSR funds can set up farm machinery custom hiring centres, sensor-based smart irrigation grids, and local processing hubs, lowering the entry barrier for marginal farmers.
- **Precision and Eco-Friendly Inputs:** Supporting the scaling and adoption of nano-fertilizers, bio-stimulants, and micro-irrigation networks paired with smart fertigation to optimize water and nutrient use efficiency.
- **Custom Hiring Centres (CHCs) for Conservation Tillage:** Partnering to establish village-level CHCs that grant smallholder farmers affordable access to modern conservation machinery (e.g., Happy Seeders, laser land levelers), preventing crop residue burning and improving soil carbon.
- **Decentralized Digital Infrastructure:** Funding IoT-driven weather stations, automated drone-seeding services, and blockchain-enabled tracking data to connect FPOs directly with premium industrial buyers.



- **Post-Harvest and Storage Technology:** Investing in farm-gate processing centers, solar-powered pack-houses, and cold chain logistics to reduce spoilage in high-value horticulture and dairy streams.
- **Women-Led Agrarian Enterprise Funds:** Allocating CSR capital to supply ergonomic, women-friendly implements on a large scale, and setting up dedicated operational grants for women-led FPOs.
- **Next-Gen Entrepreneurship and Incubation Equity:** Co-funding ICAR-managed Agri-Business Incubators (ABIs) to provide proof-of-concept grants, seed capital, and IPR facilitation for grassroots student innovations and tech startups.
- **One Health Bio-Security Net:** Funding rural veterinary diagnostic camps, cold-chain storage for livestock vaccines, and community-led awareness drives to counter zoonotic diseases and ensure farm animal health.
- **Nutritional Village Programs (Poshan Gaon):** Directing investments toward the saturation of vulnerable rural pockets with ICAR's 187 biofortified seed varieties, systematically fighting regional malnutrition and hidden hunger.
- **Commercial Scaling of Genome-Edited Crops:** Partnering for the rapid seed multiplication and regional trial distribution of the groundbreaking *DRR Dhan 100 (Kamala)* and *Pusa DST Rice 1* lines to meet the "Minus 5 and Plus 10" macro-strategy freeing up five million hectares of rice land for high-value pulses and oilseed diversification.

Through targeted CSR investments, corporate partners can combine commercial strategy with public research infrastructure. This collaboration helps drive modern scientific adoption, build climate resilience, and secure sustainable livelihood models across the nation.



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