ICAR Research Complex for Eastern Region, Patna

Major Achievements of last 02 years

(2024-26)

- **Technology for Greening Rice-fallow areas in Eastern region:** Technological options for greening rice fallow areas (~11.65 m ha) through crop intensification involving short duration drought tolerant Rice (110-115 days, e.g. Swarna Shreya/Lalit) under DSR followed by chickpea, lentil, Rapeseed-mustard and safflower under Zero tillage and residue retention systems, enhanced system productivity & net returns by ~50% & 15%, respectively, demonstrated across ~1000 acres in Bihar, Jharkhand and Chhattisgarh. Package of practices developed & shared with State govt./stakeholders.
- **Multitier Cropping System for Rainfed Uplands:** A multitier cropping system developed for rainfed uplands of Eastern India integrates trees and crops of different heights, durations, and purposes to enhance land productivity, resource-use efficiency, and income stability under moisture stress. The system includes mahogany (upper layer), mango (Amrapali) (mid layer) and filler fruit crops such as guava, custard apple, and subtropical peach, along with intercrops like rice, ragi, and winter oilseeds (niger/linseed). It increased net returns by 30–40% and improved soil organic carbon compared to monocropping. The technology has been commercialized through MoUs, adopted by over 500 farmers, and demonstrated to around 4,000 farmers, showing strong potential for sustainable upland agriculture.
- **Millet-based Climate Resilient Cropping System for Eastern India**: Evaluation of ten millet-based diverse cropping systems identified maize cob–pigeon pea (ZT) (22.3 t/ha) followed by sorghum fodder-mustard (ZT)-urd bean (ZT) (18.5 t/ha) systems for their adoption in Eastern India. These systems reduced input cost by 43-69% and enhanced income by two times & popularized under CRAP with Govt. of Bihar.
- **Weed Management in Conservation Agriculture (CA) System:** A conservation agriculture-based zero-till system (ZTDSR–ZTW–ZTG) integrated with efficient herbicide schedules achieved 78–93% weed control efficiency. It recorded 5.9% higher rice grain equivalent yield and 15.2% higher net returns over conventional tillage. The system also improved soil organic carbon by 35.9% (0–7.5 cm), increased water productivity by 23%, and reduced global warming potential by 33.5%, demonstrating strong potential for sustainable intensification in the Eastern Indo-Gangetic Plains (EIGP).
- **Crop Diversification Frameworks for irrigated plains EIGP:** Crop diversification programme was conducted in 500 acres in the farmers' fields in East and West Champaran Districts of Bihar where rice crop was diversified with maize, soybean, ragi, bajra and pigeon pea due to which

system productivity enhanced by 45–67 % and water productivity by 43–72 % over the base crop rice. With the learning of diversification programme, in Kharif 2025, about 350 ha more rice fields have been diversified with Maize, Ragi and Bajra by own.

- **Sustainable Intensification Technology for Rice–Wheat System:** Developed RCT-based rice–ZT wheat–ZT greengram system achieving 11% higher net returns, ~25% higher energy productivity, 46% higher soil organic carbon, and 8–10% lower global warming potential.
- **Valuation of Ecosystem Services:** Assessment of Ecosystem services (ES) provided by different rice establishment methods indicated that ZTDSR provides the highest ES value at approximately US$ 9583 ha^{-1} yr^{-1}, about 9.3% higher than conventional RPTR. Regulation and maintenance services (e.g., temperature regulation, carbon flow, and nutrient cycling) contribute ~79.4% of the total ES value, while provisioning and cultural services contribute 20.3% and 0.3%, respectively.
- **Water-smart farming system:** A water-smart integrated farming system based on raised–sunken beds combined with diversified cropping, aquaculture, horticulture, and poultry significantly improved land and water productivity along with overall system resilience. It achieved 195–233 q/ha land productivity and 11.0–14.4 kg/m^3 water productivity, far exceeding rice monocropping and rice–wheat systems. Integrated fish farming produced 0.84 kg/m^2 yield, while poultry integration further enhanced outputs through better duck growth and egg production. Overall, the system efficiently utilized resources and promoted climate-resilient, sustainable agriculture.
- **Solar irrigation pump sizing tool:** The Tool supports optimal pump size selection to reduce groundwater over-extraction and improve energy–water use efficiency. The tool has been adopted by **MNRE** under **PM-KUSUM** across **20** states in India. Similar tool has also been developed for Nepal which is currently being used in all **7 provinces** of the Nepal.
- **Developed solar-based agricultural technologies**, including a solar paddy thresher (threshing + winnowing, 5–6 q/day), a hybrid solar light–pheromone trap (auto on/off with adjustable height), and an Agri-PV model (5.2 kW, 50% shading) enabling dual land use.
- **Indigenous Sensor-based Lysimeter developed**: A low-cost non-weighing lysimeter (~Rs 10,000/unit) was developed for studying nutrient leaching and soil water balance in PAN India.
- **UAV-based crop water stress mapping for precision irrigation:** A UAV-based precision irrigation technology using multispectral and thermal sensors was developed to estimate crop water stress index (CWSI) in wheat. Machine learning (RF, SVM, XGB, ANN) with vegetation indices enabled high-accuracy stress prediction, with RF performing best (R^2 up to 0.93). The

system supports real-time spatial water stress mapping for efficient irrigation management.

- **Developed three climate-resilient rice varieties**: (a) Swarna Purvi Dhan 4 (CVRC-Semi-dwarf, high yielding 4.5-5 t/ha, early 115-120 days, drought, disease and insect tolerant, desirable cooking quality): for direct seed condition aerobic condition in water limiting irrigated as well as drought prone rain fed areas of Eastern India (BH, JK, ChG). (b): Swarna Purvi Dhan-5 (CVRC-Semidwarf, high yielding 4-4.5 t/ha, early 110-115 days, drought, disease and insect tolerant, Zn-25.5 ppm, Fe 13.1 ppm): for direct seed condition in drought prone rain fed mid-upland ecosystems of Eastern India. (c) Swarna Mohan Dhan, has been developed and released through the State Varietal Release Committee (SVRC), Jharkhand. The variety is specifically suited for direct-seeded rice cultivation under drought-prone and early direct-sown conditions, offering improved adaptability and resilience in rainfed production systems.
- **Chickpea variety Swarna Lakshami:** A CVRC-notified desi chickpea variety [S.O. 1560 (E), dated 26 March 2024] for NEPZ (including Bihar) with semi-spreading habit, 59.5 cm height, and 129-day maturity. It shows heat stress tolerance, double pods/peduncle, protein >20%, zinc >46 ppm, dal recovery >78%, 100-seed weight 21.27 g, and average yield of 1750 kg/ha. It is resistant to Fusarium wilt and tolerant to collar rot and dry root rot, recommended for UP, Bihar, Jharkhand, West Bengal, and Assam.
- **Development of High-Yielding Fruit and Vegetable Varieties**: A total of 14 improved horticultural varieties, comprising 3 fruit and 11 vegetable varieties, were developed and released, significantly enriching the varietal portfolio for eastern India's diverse agro-climatic conditions. These include Bael ‘Swarna Vasudha’ Mulberry ‘Swarna Rasrani’ and Litchi ‘Swarna Madhu’ among fruit crops; and Tomato ‘Swarna Prakash’, Cherry Tomato ‘Swarna Ratan’, Chilli ‘Swarna Arohi’, ‘Swarna Apurva’ and ‘Swarna Praphulya’, Lablab Bean ‘Swarna Vishist’, Capsicum ‘Swarna Atulya’, Bitter Gourd ‘Swarna Yamini’, Dolichos Bean ‘Swarna Nidhi’, Vegetable Soybean ‘Swarna Sugandha’, and Amaranth ‘Swarna Suparna’ among vegetable crops.
- **Characterized & Registered 4 indigenous livestock and poultry breeds** with NBAGR-Jharkhandi Cattle, Palamu Goat, Kodo Duck, and Mala Chicken (2025-26).
- **Peripatetic fish vending cart**: An innovative solar-powered mobile fish vending unit designed to enhance mobility, hygiene, storage, and marketing efficiency. It features a 250-L live fish tank with solar aeration, a 100-L insulated storage box for frozen fish, a hygienic cutting platform, tool storage, and waste disposal units. The cart improves market access, expands customer reach, and increases income opportunities for fish vendors. Suitable for coastal and inland fish-producing regions, it offers strong commercialization potential for fish vendors, farmer groups, NGOs, and development agencies.

- **Eco-Friendly Plantable Seedling Pot:** A biodegradable and sustainable alternative to plastic nursery pots, developed from rice straw, natural binders, and water. The pot decomposes within 3–5 months after planting, enriches the soil, reduces transplant shock, and promotes healthy root growth through improved aeration and drainage. It offers an eco-friendly solution to plastic pollution and crop residue burning, with strong commercialization potential for nurseries, agri-entrepreneurs, and agro-based industries across India.
- **Agroforestry models for rehabilitation of coal mine affected areas:** An agri-horti-silvi-pastoral model (Teak/Mahogany/Bakain/Mango, soil and water conservation measures like Tephrosia in boundaries/contours, micro-rain water harvesting structure Doba, mulching/residue retention, cover crops, millets, rice, mustard etc) were developed for coal mine–affected land in Jharkhand through site survey, soil analysis, vegetation enumeration, and PRA-based species screening. This system improved soil quality and micro-environment, leading to better vegetation establishment and increased floral and faunal biodiversity. Annual carbon sequestration after 8 years: 0.266 ± 0.040 Mg C ha^{-1} (above- and below-ground biomass)
- **Evaluation of natural Farming:** Four-year results indicated that rice and wheat productivity under natural farming (NF) was 25–30% and 30–35% lower, respectively, than conventional farming. However, summer mungbean recorded higher productivity under NF. Rice and wheat under conventional systems were affected by lodging during heavy wind and off-season rainfall, whereas NF rice remained stable. Rice yield under NF improved over time, increasing from 3.8 t/ha in the first year to 4.3 t/ha in the third year (~12% increase). Soil organic carbon (SOC) was slightly higher under NF (0.60%) compared to conventional farming (0.58%), indicating gradual soil health improvement. Evaluation of 60 rice and 27 wheat genotypes under NF (2023-25) showed yield ranges of 1.76–4.31 t/ha and 1.35–3.19 t/ha, respectively.
- **Crop diversification**: Diversification of rice crop with maize, soybean, ragi, bajra and pigeon pea in East and West Champaran enhanced system productivity by ~ 45-67% and water productivity by ~43-72%**,** demonstrated in ~1000 acres.
- **Integrated farming system models:** IFS (one & two acre) models developed for irrigated, rainfed, hill & plateau region with net monetary gains of ₹1.86–2.68 lakh, demonstrated in collaboration with KVK, state govt.
- **Climate Resilient Agriculture Program (CRAP) with Govt of Bihar:** Implemented by ICAR-RCER with Govt. of Bihar in Gaya and Buxar (Rabi 2019-2026), the programme addresses drought, heat stress, floods, low water-use efficiency, and low farm income. Covering five villages per district, it promoted climate-resilient technologies such as DSR, stress-tolerant rice varieties, laser land levelling, zero tillage in wheat/lentil/chickpea, raised-bed maize and potato, millet diversification, mungbean inclusion in rice–wheat system, maize–potato intercropping, and INM. About 2,936 acres and ~3,000 farmers were covered annually. Zero tillage wheat showed ~100% farmer

acceptance. Around 8,100 farmers were trained through various capacity-building program.

- **Participatory Research Application for Year-Round Income and Agricultural Sustainability (PRAYAS): A process model for empowering weaker sections:** The PRAYAS model is a participatory, science-based development framework implemented across 16 villages in seven eastern states-Assam, Bihar, Jharkhand, Odisha, West Bengal, Chhattisgarh, and eastern Uttar Pradesh-to empower SC and ST farmers. Focused on income enhancement, sustainability, and human resource development through climate-resilient technologies, water conservation, skill development and market linkages the model has reached over 12,000 tribal and SC farmers (2023-25) and 8,000 farmers (2025-26), increasing farm income by about 20% and strengthening climate resilience and sustainable livelihoods, with strong potential for replication through consultancy-based development projects.
- **Special Campaign "Ek Ped Maa Ke Naam":** Under this programme, 6000 tree saplings were planted by the main institute, FSRCHPR Ranchi, and two KVKs in Buxar (Bihar) and Ramgarh (Jharkhand) to raise awareness among farmers about the severe impacts of climate change.
- **Implementation of NEH Component: ICAR RCER, Patna**

The institute implemented a four-pillar framework covering institutional engagement, two-way knowledge exchange, skill development, and field demonstrations benefitting 2000 farmers during 2024-26. Capacity-building programmes included IFS, horticulture skill development, FPO strengthening, and livestock–fish integration training. Customized IFS models implemented in Ri-Bhoi (Meghalaya), Dhalai (Tripura), Longleng (Nagaland), Imphal (Manipur), and Kolasib (Mizoram) generated net profits of ₹1.80–2.87 lakh/ha.

- **Viksit Krishi Sankalp Abhiyan (VKSA-2025):** ICAR-RCER acted as the nodal agency for Bihar and Jharkhand, mobilizing 103 teams in Bihar and 57 in Jharkhand in collaboration with ICAR-ATARI, KVKs, SAUs, and State Departments. The campaign reached around 9 lakh farmers, with ICAR-RCER deploying 32 teams (about 100 scientists/technical staff) who directly interacted with about 2 lakh farmers to address field issues, disseminate technologies, promote schemes, and identify researchable problems. Under the Viksit Bharat Programme, 380 villages were covered through KVKs in Buxar (Bihar) and Ramgarh (Jharkhand).
- **Seed & Planting production:** The institute is annually producing over 40-50 tonnes of quality seed of Rice, Wheat, and Pulses; 3.4 tonnes of Vegetables and Mushroom Spawn of about 5.0 tonnes. Supplied 50+ tonnes of quality seeds (rice, wheat, pulses) to NSC, SSC, SAUs, KVKs, NGOs, and farmers. Also, more than 1 lakh planting materials of horticultural crops were also produced.
- **MoU & MoAs:** For promotion of research, technology commercialization and collabariation, RCER developed 42 MoUs & 7 MoAs during last two years.

- **Capacity building:** During last 2 years under various programmes like SCSP/TSP, NEH component, RKVY Programme, VKSA, CRA, Sponsored programme by state govt. (ATMA, Line dept. etc) and various institute programmes etc, ~ 230,610 farmers were covered in more than 2250 events, training programmes, farmers fairs, field days etc.
- **Education**: The institute is also involved in the education mandate in carrying out academic activities of B.Sc., M. Tech, and Ph.D. students as a part of the IARI Mega University under the concept of the Sun-Satellite-Planet model since 2023. Currently, the institute has enrolled students, including 38 B. Sc (Hons.) Agriculture students and 2 M.Tech (SWC&E) and 3 Ph.D. (SWC&E), and 3 Ph.D. (Agronomy).

Certified Technologies in the year 2024-25

1. Improved agro-techniques for enhancing the productivity of millets in eastern India
2. Innovative millet-based climate-resilient cropping systems for eastern India
3. Technology for sustainable intensification of rice-fallow in Eastern India
4. Climate resilient agriculture practice in rice fallow ecosystems of the East India Plateau
5. Low-cost non-weighing Lysimeter for assessing nutrient leaching loss
6. Modified drip fertigated mulched planting system for commercial cultivation of vegetables in the East India Plateau
7. Agroforestry models for rehabilitation of coal mine affected areas in the Eastern plateau & hill region
8. Tephrosia biomass mulching technology for improving soil health and productivity of a fruit orchard
9. Climate Resilient Model Village Developed at Gaya and Buxar districts of Bihar
10. Strengthening the export potential of farmer producer organizations (FPO) through One District One Product (ODOP): A Conceptual Model
11. Nutrigarden Model Addressing Anemia and Hypovitaminosis Challenges of Eastern India
12. Flood-prone areas identified as fruit hubs in Bihar: A policy framework
13. Model for structural and functional analysis of the Makhana value chain model.