The 3 A's of the
Section of Extension and Social Sciences…
Achievements, Aspirations & Action Plan

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भाकृअनुप-केन्द्रीय कन्द फसल अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
श्रीकार्यम, तिरूवनन्तपुरम 695 017, केरल,भारत

ICAR-Central Tuber Crops Research Institute
(Indian Council of Agricultural Research)
SREEKARIYAM, THIRUVANANTHAPURAM 695 017, KERALA, INDIA

From the Director

Dr. G. Byju

Agriculture is the cornerstone of the Indian economy, with over 70% of rural households relying on it for their livelihoods. This sector contributes around 17% to the nation's GDP and employs approximately 58% of the population. At ICAR-Central Tuber Crops Research Institute, the Section of Extension and Social Sciences plays a pivotal role in promoting sustainable agricultural practices and enhancing the lives of tuber crops farmers. Through our frontline extension programmes, we disseminate cutting-edge research and innovative technologies directly to farmers' fields. By conducting demonstrations, capacity building programmes and stakeholders interface programmes, we ensure that farmers can practically benefit from our technological interventions. Our research focuses on the socioeconomic aspects of farming, technology assessment and refinement, sustainable livelihood assessment, scaling up of biofortified varieties, Artificial Intelligence (AI) and Internet of Things (IoT) based smart farming, statistical and bioinformatics tools for tropical tuber crops. These programmes/interventions aim to enhance food security, combat malnutrition, and foster economic growth through entrepreneurship and value chain development. The integration of Information and Communication Technology (ICT) and smart farming technologies empower farmers with real-time information and modern agricultural practices, making farming more efficient and productive. Initiatives like '*Mera Gaon Mera Gaurav*' establish a direct link between the scientists and the farming community, ensuring that scientific advancements are translated into practical solutions. I am proud to present the contributions of the staff of Extension and Social Sciences towards advancing tuber crops research and development of sustainable agriculture in the form of coffee table book which highlights the significant achievements, aspirations and action plan. It will be a valuable resource material for all the stakeholders in strengthening the tuber crops sector in the country.

G. Byju
Director

01 October 2024

Our Mission

1. Technology assessment, demonstrations, capacity building programmes and documentation of farmers' innovations and Indigenous Technical Knowledge (ITKs) in tropical tuber crops to enhance farmers' yield and income.

2. Develop models for nutrition-sensitive agriculture to combat malnutrition in tropical tuber crops, promote sustainable entrepreneurship through technological and business interventions and empower women with targeted gender analysis initiatives.

3. Impact assessment, value chain analysis, AI based smart farming technologies and leverage big data, statistical and bioinformatics tools to improve productivity of tropical tuber crops.

Our Team

Scientists: 6

Sl.No.	Name	Cadre Discipline
1.	J. Sreekumar	Agricultural Statistics
2.	Sheela Immanuel	Agricultural Extension
3.	V.S. Santhosh Mithra	Computer Applications & IT
4.	P. Sethuraman Sivakumar	Agricultural Extension
5.	D. Jaganathan	Agricultural Extension
6.	P. Prakash	Agricultural Economics

Technical: 3 & Skilled Support Staff : 1

Sl.No.	Name	Designation
1.	V.S.Sreekumar	Assistant Chief Technical Officer
2.	T. Manikandan Nair	Technician
3.	Sneha S.S.	Technician
4.	Aswin Raj P	Skilled Support Staff

Sl.No.	Category	Number
1.	Young Professionals	2
2.	Contractual Staff	2
3.	Project Skilled Staff	1
4.	Apprentice	2

The 3 A's of the Section of Extension and Social Sciences…

What have we delivered?

1. On-farm testing and frontline demonstrations to evaluate the location-specific applicability and for showcasing the production potential of tuber crop technologies in farmers' fields.

2. Capacity building of farmers, extension personnel and other stakeholders for updating their knowledge and skills in advanced tuber crop technologies.

3. Farm advisories and effective use of media to promote tuber crop varieties and technologies among farmers and stakeholders.

4. Gender analysis to empower women in tuber crops farming. Impact assessment and value chain analysis of tuber crops for strengthening tuber crops sector.

5. AI based smart farming technologies to optimize resources for enhancing productivity.

6. Enhancing tuber crops research and development through big data analytics, statistical and bioinformatics tools.

1. Technology assessment, refinement and transfer

Frontline extension programmes

- During 1970-1974, 27 National Demonstrations (NDs) were conducted on high yielding varieties of cassava in Kerala, Tamil Nadu, Andhra Pradesh and Karnataka, which yielded 40 t ha^{-1}.

- Operational Research Project (ORP) was implemented during 1976-1980 in Thiruvananthapuram, Kerala and demonstrated proven technologies such as cassava varieties H-2304, H-1687, CMD eradication, and intercropping.

- Lab-to-Land Programme (LLP) was implemented in eight phases from 1978 to 1996, adopting 16 villages in Kerala, Tamil Nadu, and Odisha benefitting more than 1700 farm families.

Participatory technology transfer

- Evaluating and Popularizing of Tuber Crops Varieties (EPTC) during 1998-2004 to assess farmers' needs and evaluate available cassava varieties in Kerala and Tamil Nadu.

- Participatory Technology Development (PTD) was conducted from 1994-2002 for cassava, sweet potato, and yams in major states.

Technology assessment and refinement

- Technology Assessment and Refinement through the Institution Village Linkage Programme (IVLP) was conducted from 1996-2005 with 87 technological interventions, including 12 tuber crops

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interventions, five on tuber crops varieties, and seven on intercropping.

- Socioeconomic feasibility and economic viability of the technologies viz., improved varieties and site-specific nutrient management in tuber crops were assessed in major states involving 460 farmers and yield gap analysis was done.

2. Capacity building programmes

- Capacity building programmes on improved varieties and technologies for farmers, officials, entrepreneurs, students and other stakeholders.

- Enhancing technology utilization through capacity building programmes involving KVKs, Department of Agriculture/Horticulture and other line departments.

- Institute exposure visits are also arranged for the farmers, officials and students from different parts of the country.

- A total of 360 trainings for farmers, officials and students were imparted during the last decade.

- One day exposure visit cum training on 'Improved technologies of tuber crops' was organized in the last 10 years for the benefit of 7597 farmers, 1430 officials and 12544 students across the nation.

Capacity building programmes for different stakeholders

3. Farm advisories and use of social media

- Scientists along with other Divisions/Sections conducted more than 1000 farm advisory visits during the last 10 years for the benefit of tuber crops growers in Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Odisha, Gujarat, Maharashtra and Northeastern states.

- More than 500 agro advisories on tuber crops production, marketing and other aspects of tuber crops were disseminated through Facebook, TV channel, YouTube, radio, phone, newspaper and other social media.

4. Sustainable livelihood assessment

- The Rural Sustainable Livelihood Index (RSLI) analysis of tuber crops farmers and non-tuber crops

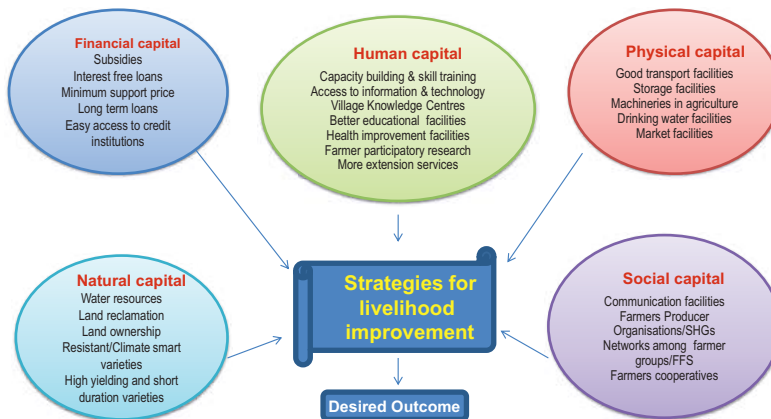**The 3 A's of the Section of Extension and Social Sciences…**

farmers were conducted in Kerala, Tamil Nadu, Andhra Pradesh, Karnataka and Odisha involving 520 farmers.

- Analysis at household level to identify the present status of various capitals namely natural, financial, social, physical and human capital were done using sustainable livelihood framework.

Data collection for assessing the Rural Sustainable Livelihood Index

The overall strategy for sustainable livelihood improvement of tuber crops growers was formulated.

Financial capital
Subsidies
Interest free loans
Minimum support price
Long term loans
Easy access to credit institutions

Human capital
Capacity building & skill training
Access to information & technology
Village Knowledge Centres
Better educational facilities
Health improvement facilities
Farmer participatory research
More extension services

Physical capital
Good transport facilities
Storage facilities
Machineries in agriculture
Drinking water facilities
Market facilities

Natural capital
Water resources
Land reclamation
Land ownership
Resistant/Climate smart varieties
High yielding and short duration varieties

Strategies for livelihood improvement

Social capital
Communication facilities
Farmers Producer Organisations/SHGs
Networks among farmer groups/FFS
Farmers cooperatives

Desired Outcome

Strategy for sustainable livelihood improvement of tuber crops growers

5. Women empowerment

- Women empowerment studies on tuber crops were conducted in Kerala, Tamil Nadu, Karnataka and Odisha for engendering research and development involving 460 farmers. Data on socio-economic profile, extent of participation of women empowerment level, needs, preferences, opportunities and constraints in tuber crops were analysed.
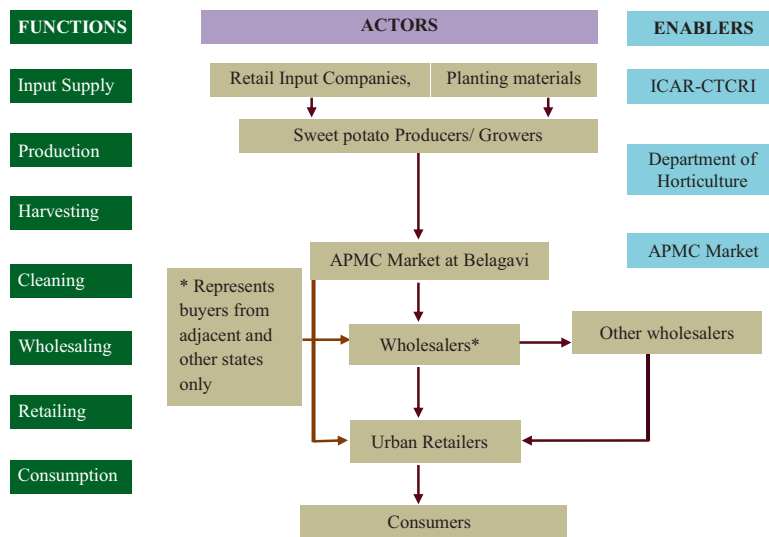
Surveys conducted for assessing the women empowerment in tuber crops production

6. Nutri-sensitive agricultural interventions for combating malnutrition

- The nutri-sensitive agricultural intervention model 'Rainbow Diet Campaign' for developing micro-value chains was field-tested in Attapadi tribal region, Kerala. Few key achievements of this intervention model are as follows.

- Biofortification Priority Index (BPI) for identifying priority areas was developed and using this approach, Meghalaya, Mizoram and Odisha were identified as priority states for promoting orange-fleshed sweet potato varieties.

- Nutriseed Villages for large-scale production of biofortified sweet potato were created in Tripura (3 nos.), Meghalaya (1), Assam (2) and Kerala (1). School connect programme wherein 55 students from a tribal school in Attapadi, Kerala enrolled in 3 Musketeers Sweet Potato (3-M-SP) programme and produced about 120 kg of biofortified sweet potatoes in school gardens.

- Development of micro-value chains for biofortified sweet potato included the development of seed system, market linkage and promoting consumption. Two-tier planting material production system involving central seed facility and grassroot level nutriseed villages were developed in Tripura, Tamil Nadu and Kerala.

7. Value chain assessment

- Value chain analysis of sweet potato was conducted in Karnataka and Odisha states with a sample of 509 covering 422 farmers and consumers, 35 commission agents of APMC market and aggregators, 17 wholesalers and 35 retailers.

- The value chain of sweet potato representing various actors at the upstream, midstream and downstream levels, along with their functions and interrelationships were analysed.

FUNCTIONS	ACTORS	ENABLERS
Input Supply	Retail Input Companies, / Planting materials	ICAR-CTCRI
Production	Sweet potato Producers/ Growers	Department of Horticulture
Harvesting		
Cleaning	APMC Market at Belagavi	APMC Market
Wholesaling	* Represents buyers from adjacent and other states only / Wholesalers* → Other wholesalers	
Retailing	Urban Retailers	
Consumption	Consumers	

Value chain map for sweet potato

Value chain survey at APMC market in Belagavi

Forecasting of sweet potato prices

- Price forecasting of sweet potato was carried out for six selected states in India using time series monthly market price, collected from AGMARKNET price portal from January 2010 to December 2021.

- Three forecasting time series models were used to know the best model for forecasting sweet potato prices in the selected states of India. Based on the indicators viz., MAPE, MAE and RMSE values, the TDNN model is found to be the best and accurate forecast method.
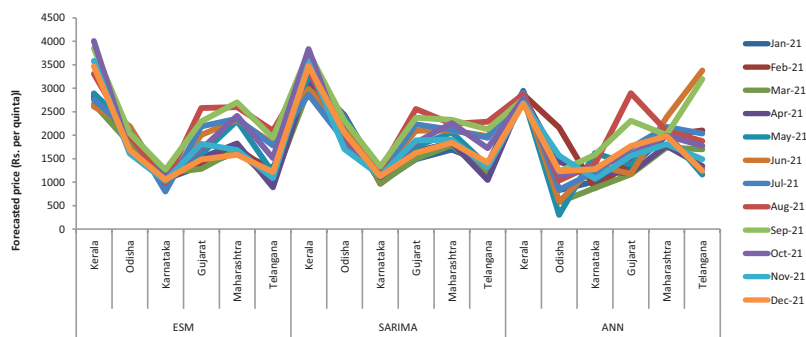
Price forecasting of sweet potato using ESM, SARIMA and ANN model

8. Impact assessment

- Diffusion of improved varieties of cassava and Chinese potato in Tamil Nadu was assessed covering 520 farmers which revealed that improved varieties of cassava viz., H-165, H-226, Sree Jaya, Sree Athulya, Sree Reksha and Sree Kaveri were adopted by 39% of the farmers resulting in additional yield (13%) and income (17%). Chinese potato variety 'Sree Dhara' was adopted by 38% of the farmers which resulted in additional yield and income of 25 %.

- Diffusion of improved varieties of cassava in Kerala was assessed covering 142 farmers which revealed that 14% adopted improved varieties of cassava viz., Sree Pavithra, Sree Reksha, Sree Jaya, Sree Vijaya, and Sree Visakham, with an additional yield and income of 6%.

- About 78% of the sweet potato area in the country is cultivated with high-yielding varieties, while 22% of the area is still dominated by local races. Among the three states studied, it was estimated that high-yielding sweet potato varieties were grown in 44% of the area in Odisha followed by Uttar Pradesh (31%) and West Bengal (3%).

- Diffusion of sweet potato varieties in Karnataka was assessed covering 120 farmers which indicated that 79% of the farmers adopted *Kanjanghad*, 20% adopted *Malakappuri* and 1% adopted other varieties.

- The gross benefit generated by 13 cassava production technologies developed during 1971 to 2010 for the states of Kerala, Tamil Nadu and Andhra Pradesh was estimated as ₹6955 crores. The gross benefit generated by 13 sweet potato production technologies developed during 1968 to 2010 for the states Odisha, Uttar Pradesh and West Bengal was estimated as ₹5180 crores.

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The impact of 15 tuber crops technologies released from 2010 onwards estimated using the partial budgeting analysis generated a gross benefits of ₹ 186 crores.

9. ICT and smart farming technologies

- IoT device: Electronic Crop (e-Crop) is an AI enabled IoT device that simulates crop growth in response to weather and soil parameters and generates agro-advisory that is sent to the farmer's mobile by SMS.

- A System and a Method for Automated Fertigation of Crops (SMAFC): It is a device for fertigation of crops for precise and automated application of nutrients and water to crops to reduce yield gaps and optimize crop yield potential as per the advisory of e-Crop.

- Crop growth simulation models: EFYSIM- an elephant foot yam growth model, SPOTCOMS- a sweet potato growth model; SIMCAS-a cassava growth model; MADHURAM-the world's first sweet potato growth model.

- Decision Support System: Sree Visakham cassava expert system for early warning for mealy bug infestation; Tuber crops online marketing system, OUSHADHAM for disease and pest diagnostic system for tuber crops, Cassava protector, Tuber Information Cafe, CASSNUM 1.1 for nutrient management of cassava.

- Mobile Apps: Krishi Krithya for e-Crop based smart farming; Variety Finding Tool (VFT) cassava and VFT taro; TuberGuru App for information of tropical tuber crops; Sree Poshini for site specific nutrient management based fertilizer recommendations.

- Database/Information system: TUBERTECH on the ICAR-CTCRI technologies; TUBERHELP on information system of tuber crops.

- Five hundred drone demonstrations were conducted in Kerala and Tamil Nadu.

System for Automated Fertigation of Crops and Drone demonstrations

10. Statistical and bioinformatics applications in tuber crops

- A web application was developed for carrying out basic statistical data analysis and data visualization specifically tailored for Agricultural Research, Agrianalytics@R can be accessed at *https://sreejyothi.shinyapps.io/agrianalyticsr/*

Web application Agrianalytics@R

- Developed an Interactive database of genomic variations in cassava, CasGVD. Genomic variations (SNPs and INDELs) compiled from whole genome analysis of two genotypes, Sree Kaveri and 9S-127. The integrative genome viewer (IGV) was integrated with the genomic variant database, which helps in chromosomal location wise retrieval of genomic variants in cassava.
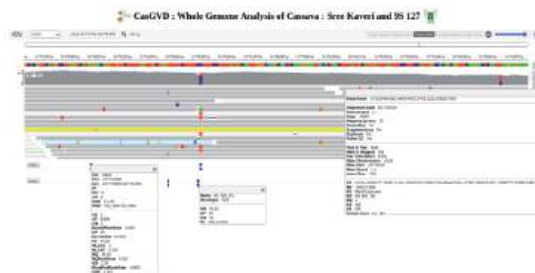
Genomic database CasGVD

- Methodology developed for comparative and functional genomics analysis and reconstructed the starch biosynthesis and carotenoid biosynthesis pathways in cassava.

- Developed an R-package for computing Soil Quality Index (SQI) by integrating ANOVA, Principal Component Analysis and computation of SQI.

- Machine learning models were developed for the prediction of plant pathogen protein-protein interaction for colocasia-*Phytophthora* interaction using the protein sequence information on plant and pathogen. An interactive web application for prediction of interacting proteins using RShiny was developed which can select the protein features and the methods for prediction of plant host pathogen interaction.

- Meta-QTL associated with cassava mosaic disease resistance and cassava brown streak disease resistance were identified using meta-analysis of Quantitative Trait Loci (QTL) in cassava for biotic stress resistance.

- R tool was developed for identifying optimal number of clusters, clustering using K means, hierarchical clustering, computing intra and inter cluster distances at optimal number of clusters. SAS macro has been developed in SAS which can be used along with PROC glm for attaching superscripted alphabets to interaction means in factorial experiments.

- An interactive web-based gene network development tool, RIntGeneNet was developed using R, which facilitates the construction of gene regulatory networks from microarray gene expression data.

- Developed database of SNPs and miRNAs in cassava and elephant foot yam.

- A web based interactive database of tuber crops statistics was developed using 'R environment for statistical computing' and Shiny package.

- Developed a new method based on correlated mutation analysis, RMRCM, for predicting protein-protein interaction using regularized multinomial regression. R-code for implementation of the new method RMRCM is available via *www.ab.wur.nl/rmrcm*.

11. Concepts/Methodologies developed

Innovative extension methodologies/tools

- Seed villages on tropical tuber crops: To scale up improved varieties of tuber crops in major tuber crops growing states of India (2023).

- A method for assessment of sensory acceptability of biofortified sweet potato among school children using a customised Bradley-Terry paired preference model (2023).

- Targeted field intervention for scaling up of biofortified varieties (Rainbow Diet Campaign): Creating new institutional structure and processes for planting material production, anganwadi linkage to address malnutrition (2022).

- Sweet potato price forecasting models: Models for forecasting sweet potato prices in selected states of India using time series monthly market price (2022).

- Impact assessment tools: Method for assessing the impact of field interventions in Chinese potato (2022).

- Sweet potato Biofortification Priority Index: An index for selecting priority states in India for scaling up of biofortified varieties of sweet potato (2021).

- Rural sustainable livelihood index of tuber crops: Methodology to study the livelihood of tuber crops farmers (2020).

12. Developmental programme

SCSP Programme (2019-2022)

- The SCSP programme was implemented in Malappuram, Ernakulam, Thiruvananthapuram, Kollam, Alappuzha, Kottayam and Pathanamthitta districts in Kerala; Tenkasi, Tirunelveli, Salem, Namakkal, Pudukottai, Karur and Kallakurichi districts in Tamil Nadu and East Godavari and West Godavari districts in Andhra Pradesh.

- A total of 289 demonstrations on improved varieties and technologies of tropical tuber crops viz., cassava, sweet potato, elephant foot yam, greater yam and Chinese potato were conducted in Kerala, Tamil Nadu and Andhra Pradesh covering an area of 57.8 ha.

- Planting materials of tropical tuber crops viz., cassava: 46000 stems, sweet potato: 1.1 lakh vine cuttings, Chinese potato: 5.5 lakh stem cuttings, elephant foot yam: 21.75 t, greater yam: 3.0 t were distributed.

- Critical inputs viz., chemical fertilizers: 33.27 t, micronol for tuber crops: 2600 litres, Knapsack sprayers: 55, spade: 230, pick axe: 230, vermicompost: 2 t, micronutrient mixture: 2 t, biofertilizers (PGPR I): 2 t, biocontrol agents (PGPR II): 2 t, AMF: 1.6 t, power sprayers: 185, crow bar: 185 and radio: 185 were distributed.

- Machineries viz., Chinese potato grader (2 nos.), cassava chipping machines (8 nos.), cassava slicers/cutters (208 nos.) were distributed to farmers' groups for post-harvest processing and value addition in Chinese potato and cassava, respectively.

- Capacity building programmes (24 Nos.) on various aspects of tuber crops-based enterprises were conducted in Kerala, Tamil Nadu and Andhra Pradesh for the benefit of 1896 SC farmers and farm women.

- Yield enhancement due to technological interventions in tropical tuber crops viz., cassava: 8-13%, sweet potato: 9.66%, elephant foot yam: 10-24% and Chinese potato: 10-16%.

- Established strong linkage with KVKs, State Agriculture and Horticulture departments, FPOs and progressive farmers for overall development of SC population in project locations.

Demonstrations on improved varieties and technologies of tuber crops

Training programmes on improved technologies of tuber crops

Distribution of critical inputs to tuber crops farmers

NEH Programme

- NEH programme was implemented in Nagaland, Manipur, Meghalaya, Tripura and Arunachal Pradesh during 2012-2019 (Phase 1) and 2020-2024 (Phase 2) to enhance the food, nutritional security and livelihood improvement of the tribal people. To achieve these objectives, collaborations were established through (i) establishing Satellite Incubation Centre Multi-Technology Testing and Vocational Training Centre, College of Fisheries, Central Agricultural University (Imphal), Tripura. (ii) Involving partner agencies in the ICAR-CTCRI Institutional project – College of PG Studies in Agricultural Sciences, Central Agricultural University (Imphal), at Umiam, Meghalaya; North-Eastern Hill University (Tura), ICAR – Research Complex for Norh Eastern Hill Region (Umiam), KVKs and other line departments.

- Under the Rainbow Diet Campaign programme implemented during 2020-2024, the biofortified varieties were popularised for maximising the area and enhancing household consumption.

- Under the Nutriseed village programme, vines of biofortified sweet potato varieties Bhu Sona and Bhu Krishna were distributed. A total of 82100 vines and 14.21 tonnes tubers of biofortified varieties were distributed to 1127 tribal farmers of Tripura (Tribes - Debbarma, Tripuri, Chakma, and Regmi); Meghalaya (Khasi and Garo tribes); Arunachal Pradesh (Mishmi tribe) for quality planting material production through nutriseed villages, cultivation in home gardens as well as for direct consumption.

- A total of four nutriseed villages were developed in Tripura (Gandacherra, Karnamaipara and Bolkhali in Dhalai district as well as Takarjala in Sepahijala district) involving 12 farmers. Through the Nutriseed villages intervention, seven ha of area was brought under biofortified varieties in Tripura during 2022-2023. The biofortified sweet potato average annual per capita consumption in the project villages increased from pre-intervention level of zero in 2021 to 18.3 kg in 2023 in Tripura.

- To popularise improved varieties of tuber crops, 199 Frontline demonstrations on improved varieties of cassava (H-165, Sree Vijaya, Sree Jaya, Sree Pavithra and Sree Reksha), greater yam (Orissa Elite), sweet potato (Sree Kanaka, Bhu Sona, Bhu Krishna), taro (Muktakeshi) and elephant foot yam (Gajendra) were conducted in Meghalaya, Manipur, Nagaland, Tripura and Arunachal Pradesh. The tuber crops varieties found suitable for cultivation for high yield and good culinary quality for specific locations are (i) Cassava - Sree Vijaya (Garo Hills, Meghalaya; Mukokchung and Peren, Nagaland); (ii) Taro – Muktakeshi (Garo Hills, Meghalaya and Anjaw district, Arunachal Pradesh; Ukhrul district, Manipur); (iii) Sweet potato – Bhu Sona and Bhu Krishna (Dhalai and Sepahijala districts, Tripura)

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and (iv) Elephant foot yam - Gajendra (West Tripura). Under the varietal replacement programme, implemented at Anjaw district of Arunachal Pradesh revealed that taro variety Muktakeshi has significantly increased the farmers income. The total increase in the income was 217.44% against the baseline of 2019-20, of which var Muktakeshi alone has contributed to 167.85% increase in the farmers income.

● Under the farmer-focused participatory quality planting materials production implemented in Meghalaya, the farmers produced cassava (52000 stems), greater yam (20 tonnes), taro (75 tonnes) and elephant foot yam (30 tonnes) during 2012-2015. From these locally produced materials, 2.67 tons of yams, 3.49 tons of elephant foot yam, 2.85 tons of taro and 3100 stems of cassava were procured and distributed to other farmers in Meghalaya.

● To create sustainable grassroots entrepreneurship in remote areas of Ukhrul district, Manipur, a Village Incubation Centre was created at Riha village, in 2015. The Centre has facilities for commercial manufacturing of cassava-based snacks foods for home consumption and sale through markets in Imphal. During 2016-2017, the farmers generated Rs. 26000/- through sale of starch and snacks produced using the facilities at the incubation centre.

● Capacity building programmes (57) were conducted to 2616 farmers and other stakeholders.

Area expansion of biofortified sweet potato varieties

Mera Gaon Mera Gaurav

● The innovative initiative *'Mera Gaon Mera Gaurav'* – 'My Village My Pride' by Ministry of Agriculture and Farmers' Welfare, Govt. of India was implemented by ICAR-CTCRI, Thiruvananthapuram and its Regional Station ICAR-CTCRI, Bhubaneswar in 49 villages from October 2015. Trainings, demonstrations on improved practices, farm advisory visits, mobile

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advisory services are organized in the selected villages for the benefit of farming community. Cutting across all disciplines, farm problems are diagnosed and effective solutions are delivered. National priorities such as secondary agriculture, climate change, good agricultural practices and soil and health management of crops are also envisaged in this programme.

Farm advisory visits to MGMG villages

13. Commercialization

- The Institute has signed technology license agreement (TLA) with M/s Tech Visit IT Pvt. Ltd., Mumbai and transferred the technology of e-Crop for Rs. 17.70 lakhs. Electronic crop (e-Crop), the first IoT device of ICAR is an electronic crop simulator that simulates crop growth in real time and helps to do smart farming to increase yield at reduced application of fertilizers and water.

Technology license agreement with M/s Tech Visit IT Pvt. Ltd., Mumbai

14. Institute Technology Management Unit (ITMU)

- The Institute Technology Management Unit & Professional Services Cell (ITMU & PSC) under the guidance of the Institute Technology Management Committee (ITMC) has carried out the following technology transfer, contract research and consultancy services of the Institute.

- Number of technologies commercialized: 17
- IPR protection and commercialization of technologies: 3
- Technology licensing: 24
- Contract manufacturing: 8
- Contract research: 9
- Consultancy services: 6
- Patent: 6

Licensing biopesticide technology with M/s Green edge, Tiruchirapalli

MoU for consultancy with M/s Spudnik farms, Bengaluru

15. Agribusiness Incubation (ABI) Centre

- Established in 2019 for creating agri-businesses through technology provision, skill upgradation and incubation for sustainable entrepreneurship using technological advancements in tropical tuber crops in the areas of production of quality planting materials, eco-friendly farming, smart farming and nutrition & health.

Incubation programmes implemented through SIC

ABI programmes

- Imparts training and capacity building to prospective entrepreneurs in agribusiness ecosystem. A total of 763 agripreneurs, entrepreneurs, students, startups, FPCs, SHGs, MSME and big companies were trained in business related areas.

- Incubatee enrolment - Startup Incubation: 10, Nutriseed farmers: 32, School connect: 55 students, Certified Agritech startup Professional scheme: 136 students.

M/s Mati farms – Startup
Incubatee, Odisha

Arrowroot ladoo – a product
developed through incubation programme, Odisha

Satellite Incubation Centre (SIC) - A collaborative value-chain entrepreneurship model

- ICAR-CTCRI ABI has developed three SICs in cassava regions of Tamil Nadu (KVK, Kallakurichi under TANUVAS), sweet potato regions (RS CTCRI, Bhunabeswar) and multiple tuber crops belt (College of Fisheries, Central Agricultural University (Imphal), Lembucherra in Tripura).

- The Satellite Incubation Centre was internationally recognised as an Institutional Innovation model by Food and Agricultural Organisation of United Nations which was published as a working paper in 2023.

Satellite Incubation Centre, KVK,
Kallakurichi, TANUVAS, Tamil Nadu

Satellite Incubation Centre, MTTC&VTC,
College of Fisheries, CAU(I), Tripura

16. Human Resource Development

- The HRD cell is functioning from 2014 as per the National training policy of Govt of India. HRD cell caters to training needs of all employees of ICAR-CTCRI for improving the job efficiency.

- The Institute design courses, prepare training manuals and evaluate the training for better performance and improved service delivery. Training programmes are well planned and customised to suit the needs of the stakeholders. The Institute is deriving partners from across the country as well as from abroad to serve as resource persons. Our core competency includes genomics, agronomic practices for sustainability, soil nutrient management, integrated pest and disease management, value addition, smart farming and soft skills.

- Training calendar is published every year for the benefit of stakeholders.

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17. Exhibition

● ICAR-CTCRI is regularly participating in exhibitions organised by National and State level Departments and organizations to showcase the technologies. Participated in 202 exhibitions for the benefit of stakeholders in different parts of the country during the last 10 years.

Exhibitions for showcasing technologies

18. Other Information

External funded projects as PI

● No. of external funded projects completed:19 (Rs. 3.52 crores)

● No. of external funded projects (ongoing): 04 (Rs. 1.84 crores)

Patent

● Electronic Crop- an IoT device for providing realistic agro advisory to the farmers (Indian Patent No: 523325, Date of grant: 11 March 2024).

Technologies Certified by ICAR

Lead Developers

1. e-Crop Based Smart Farming (eCBSF): One of the best 5 technologies in Horticulture Science Division of ICAR (2023)

2. Method for assessing factors influencing adoption

3. Method for assessing the impact of field interventions in Chinese potato

4. Price forecasting model for sweet potato

Co-Developers

1. Multi-micronutrient formulation for Chinese potato

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2. Package of practices for organic production of cassava

3. Power operated size based Chinese potato grader

4. Secondary-and micronutrients-inclusive customised fertilizers for taro

5. Agronomic strategy to mitigate high temperature stress in sweet potato

6. Integrated management package for postharvest rot in elephant foot yam

7. Organic management package for postharvest rot in elephant foot yam

8. Cassava and Sweet potato Resistant Starch - RS4 type (Chemically modified)

9. Seed villages for scaling up of improved varieties of cassava in Tamil Nadu
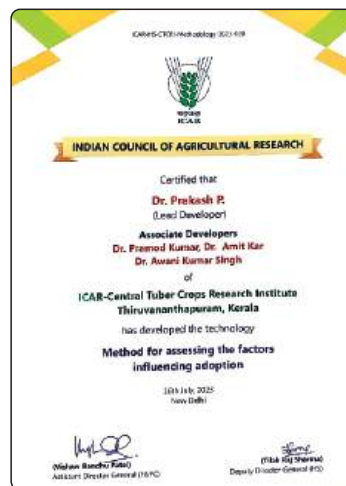
Receiving technology certificates from dignitaries

Facilities and Infrastructure

Museum   Agri Business Incubator

- **Museum:** Showcases the tuber crops technologies, products, and publications for the benefit of farmers and other stakeholders.

- **Institute Technology Management Unit (ITMU):** Facilitates technology transfer, contract research and consultancy services of the Institute.

- **Agri Business Incubator**: Provides technology, skill upgradation and incubation for entrepreneurship using technological advancements in tropical tuber crops in production of quality planting materials, eco-friendly farming, smart farming and nutrition & health.

- **Statistics and Bioinformatics Lab**: The lab is equipped with Linux and Windows workstation, 6 standalone terminals and 8 TB network assisted storage to assist High Performance Computing. The Lab is installed with commercial software packages like SAS, DNASTAR, BioBam (Blast2GO) and other open-source software for statistical and bioinformatics applications. The lab supports genomic research by providing access to analytical expertise and state-of-the-art computational infrastructure in genome and proteomic analysis, transcriptome analysis, molecular modelling and bigdata analytics.

- **Agricultural Knowledge Management Unit:** Agricultural Knowledge Management Unit (AKMU) caters to meet the ICT needs of the Institute by providing and maintaining the Internet, Email, Video Conferencing and other computer related facilities. The ICAR-CTCRI website https://www.ctcri.org. and social media platforms of the Institute are maintained and updated by AKMU. It is a nodal point of National Knowledge Network of India (NKN) for effective sharing of scientific resources.

Publications

Total publications: 916 (last 30 years)

Sl. No.	NAAS Score	Nos.	Per cent

Number of research papers: 281

Sl. No.	NAAS Score	Nos.	Per cent
1	>6	104	37
2	<6	177	63
Total		**281**	

Other publications: 635

Sl. No.	Name of publication	Nos.
1	Symposia Papers	272
2	Books	25
3	Book chapters	62
4	Technical bulletins	32
5	Technical folders	57
6	Technical leaflets	19
7	Popular articles	128
8	Radio/TV/Video film	40
	Total	**635**

Peer Recognition

Students Guidance

Ph.D.   : 02
M.Sc.   : 29
M.Phil : 03
Total   : 34

External Examiner

Ph.D. : 13
M.Sc. : 35
Total : 48

Peer Reviewer

NAAS >6 : 23
Others   : 30
Total   : 53

Awards & Fellows

Awards : 32
Fellow : 03
Total   : 35

Collaborations and linkages

- College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram, Kerala.
- Coconut Development Board, Kochi, Ministry of Agriculture & Farmers' Welfare, Govt. of India.
- M/s SAGOSERVE, Salem, Tamil Nadu.
- Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu.
- Kerala University of Digital Sciences, Innovation and Technology, Thiruvananthapuram, Kerala.
- Kerala Agricultural University, Thrissur, Kerala.
- Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.
- Central Agricultural University, Imphal, Manipur.
- Northeastern Hill University, Tura Campus, Meghalaya.
- National Institute of Agricultural Extension Management, Hyderabad, Telangana.
- Department of Agriculture/Horticulture, Government of Tamil Nadu, Odisha, Andhra Pradesh & Telangana.
- Kerala State Industrial Development Corporation (KSIDC), Government of Kerala.
- Kerala Development and Innovation Strategic Council (KDISC), Government of Kerala.
- Kerala Startup Mission, Government of Kerala.
- State Agricultural Management and Extension Training Institute, Government of Kerala
- Department of Horticulture & Meghalaya Basin Development Agency, West Garo Hills, Meghalaya.
- Madurai Agribusiness Incubation Forum of NABARD, Madurai, Tamil Nadu.
- Centre for Research on Innovation and Science Policy (CRISP), Hyderabad, Telangana.
- KIIT University, Bhubaneswar, Odisha

External Funding Agencies

- ICAR-National Agricultural Innovation Fund (NAIF), Government of India.
- Department of Science and Technology, Government of India.

- National Bank for Agriculture and Rural Development (NABARD), Government of India.

- Rashtriya Krishi Vikas Yojana (RKVY), Government of Odisha & Government of Kerala.

- Department of Agriculture and Farmer's Welfare, Government of Kerala.

- Kerala State Planning Board, Government of Kerala.

- Kerala State Council for Science, Technology and Environment (KSCSTE), Government of Kerala.

- Kerala State Horticulture Mission, Government of Kerala.

- Department of Electronics and Information Technology (DietY)

- Indian Council of Social Science Research (ICSSR), New Delhi

- ICAR Extramural Funding, New Delhi

- National Institute of Agricultural Extension Management (MANAGE), Hyderabad.

Aspirations

- Technology assessment and refinement for enhancing productivity and profitability of tuber crops in major tuber crops growing states of India.

- Developing grassroot entrepreneurship models for creating sustainable entrepreneurship across tuber crops value chains.

- Gender mainstreaming in tuber crops research and development.

- Value chain assessment of tuber crops for enhancing productivity and profitability of tuber crops farming.

- Impact assessment of varieties and technologies of tuber crops.

- Increasing the export prospects of tuber crops through export-focused startup ecosystem development.

- Developing nutrition-sensitive agricultural intervention models and policy framework for combating malnutrition among children.

- Developing farmer focused approaches for grassroot-level Intellectual Property identification, validation and commercialization.

- Data integration of multi omics (transcriptomics, proteomics, metabolomics and phenomics) and AI assisted 'omics' tools for tuber crops.

- Developing intuitive web-tools for statistical analysis, visualization and sharing of tuber crops 'omics' data.

- Extending e-Crop based Market driven Smart Farming System to more areas and more crops to ensure food and livelihood security to the growing population.

- Development and scaling up of Artificial Intelligence (AI) based solutions to users for sustainable development of tuber crops.

- Developing GIS based tools for change detection, crop monitoring, agricultural mapping, crop health monitoring and crop yield prediction.
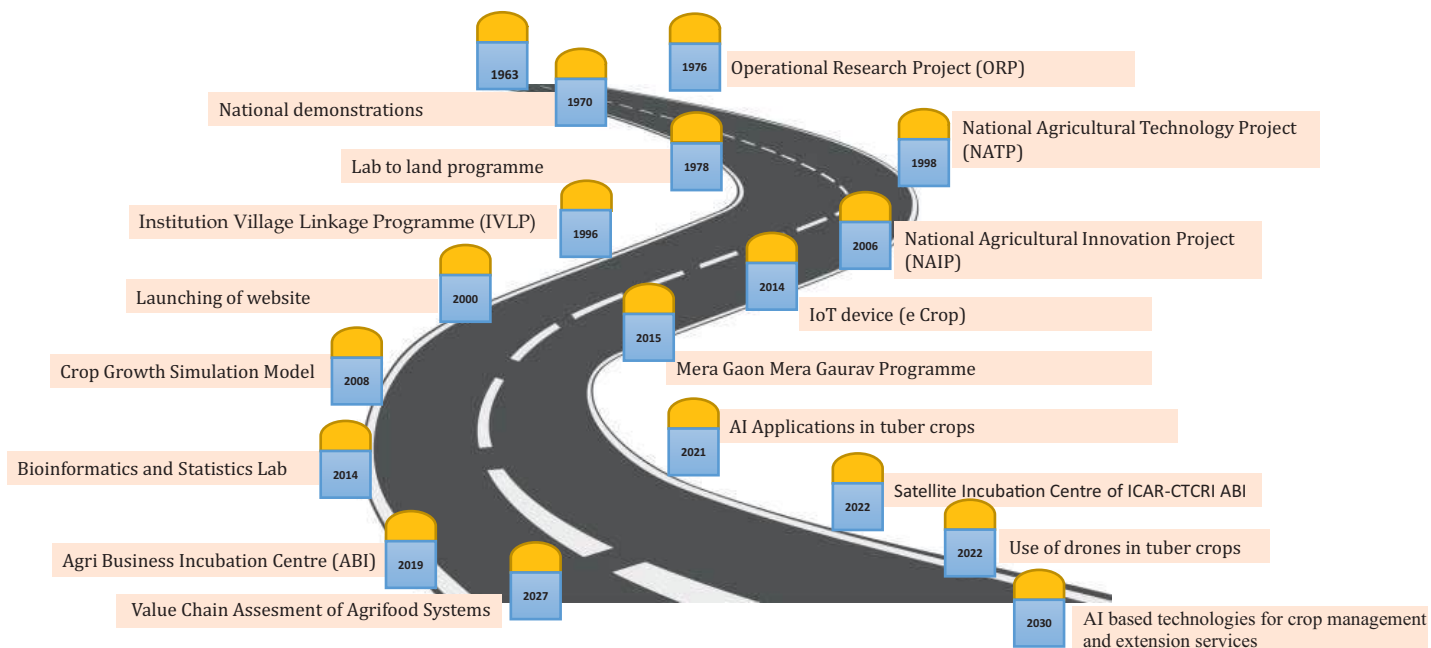
Action plan

- Technological interventions through frontline extension programmes (FLDs/OFTs) in collaboration with KVKs and line departments in major tuber crops growing states of India.

- Women empowerment and value chain assessment studies in major tuber crops growing states of India.

- Estimation of extent of adoption of tuber crops varieties and technologies, assessing the socio-economic impact and estimation of economic benefits in adoption of tuber crops varieties and technologies.

- Establishment and assessment of Satellite Incubation Centers in non-traditional and prospective tuber crops areas in Central, Western and North Indian regions for grassroot entrepreneurship development.

- Creating export information and facilitation unit under ICAR-CTCRI ABI and its Satellite Incubation Centres.

- Sensitization models and institutional systems i.e. creation of farmer IP cell in the incubator, for identifying, validating and commercializing grassroot Intellectual Property

- Development of tools and techniques for integrating Rainbow Diet approach in the field-level nutrition-sensitive agricultural interventions for combating malnutrition.

The 3 A's of the Section of Extension and Social Sciences…

- In-silico identification of candidate gene(s) linked to stress resistant and nutritional traits in tuber crops through analyses of heterogeneous datasets.

- Development of geometric deep learning models for improved protein-protein interaction prediction, evaluation, and application in host pathogen interaction of tuber crops.

- Development of an interactive database of genomic information in tuber crops.

- Extending e-Crop based smart farming technology with the help of the panchayat raj system existing in the country by utilizing the funds available with local self-governments and implemented through decentralized planning.

- AI technology like predictive models/image analysis models will be developed using the data available or using those collected through IoT devices/sensor/drones. Apps will be developed to transfer it to the clienteles.

- Development and application of deep learning models for assessing crop change detection, crop health monitoring, development of vegetative and thermal indices using GIS data.

Achievements and Milestones

National demonstrations — 1963
Operational Research Project (ORP) — 1976
Lab to land programme — 1970
National Agricultural Technology Project (NATP) — 1998
Institution Village Linkage Programme (IVLP) — 1978
National Agricultural Innovation Project (NAIP) — 2006
Launching of website — 1996
IoT device (e Crop) — 2014
Crop Growth Simulation Model — 2000
Mera Gaon Mera Gaurav Programme — 2015
Bioinformatics and Statistics Lab — 2008
AI Applications in tuber crops — 2021
Agri Business Incubation Centre (ABI) — 2014
Satellite Incubation Centre of ICAR-CTCRI ABI — 2022
Value Chain Assesment of Agrifood Systems — 2019
Use of drones in tuber crops — 2022
2027
AI based technologies for crop management and extension services — 2030

Technology assessment, refinement and commercialization; ICT based innovative extension approaches; Reusable workflows and pipelines for bioinformatics and statistics; Value chain assessment and impact assessment; AI based technologies for phenotyping, genotyping and crop management

ICAR-Central Tuber Crops Research Institute

Sreekariyam, Thiruvananthapuram 695 017, Kerala, India
Phone: (91) (471) 2598551 to 2598554
E-mail: director.ctcri@icar.gov.in
Website: https://www.ctcri.org
Social Media

Facebook   Twitter   Whatsapp   Instagram   You Tube