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ICAR

ICAR INSTITUTES PROFILE





Indian Council of Agricultural Research
New Delhi

ICAR
Institutes Profile

Indian Council of Agricultural Research
New Delhi

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Introduction

Indian Council of Agricultural Research

The Indian Council of Agricultural Research (ICAR) was established on 16 July 1929 as an autonomous organization under the Department of Agricultural Research and Education, Ministry of Agriculture & Farmers Welfare, Government of India. The Council is an apex body for coordinating, guiding and managing research, education and extension in agriculture including horticultural science, fisheries science, animal sciences and natural resource management in the country. With a network of 103 ICAR institutes, 11 ATARIs, 63 State Agricultural Universities, 3 Central Agricultural Universities and 731 Krishi Vigyan Kendras (KVKs) spread across the country, the council provides a unique agricultural system. The ICAR has played a pioneering role in ushering Green Revolution and modernization of agriculture in India through its research, education and extension activities.

ICAR Mandate

- Plan, Undertake, Coordinate and Promote Research and Technology Development for Sustainable Agriculture.
- Aid, Impart and Coordinate Agricultural Education to enable Quality Human Resource Development.
- Frontline Extension for technology application, adoption, knowledge management and capacity development for agri-based rural development.
- Policy, Cooperation and Consultancy in Agricultural Research, Education & Extension.

Significant Achievements

- The organization has made tremendous progress in the development of new varieties of field and horticultural crops. The noteworthy achievements during the past seven years is development of 71 biofortified varieties to alleviate malnutrition. Hon'ble Prime Minister dedicated 17 biofortified varieties to the nation on the occasion of World Food Day 2020. Higher replacement of old varieties with new ones and availability of high-quality seeds of such varieties contributed to pulses revolution during 2016-21.
- The country also witnessed sugar revolution which is attributed to sugarcane varieties mainly Co 0238 which gives 20 tons/ha more cane yield and about 12% higher sugar recovery. In horticultural crops, an all-round progress has been seen in varietal development of fruits, vegetables, plantation and medicinal plants. Digitized seed portal, sea route transportation protocols, etc. have been quite successful in expanding the reach of seeds and export markets of banana.

- The conservation and improvement of indigenous animal breeds is national priority. Our concerted efforts resulted in registration of 56 animal breeds including poultry. Improved breed of Frieswal cow was declared a new breed in 2019. Besides, new varieties of pig, sheep, poultry were also developed with better meat quality and productivity. Towards better animal health and hygiene, we focused on developing new vaccines and diagnosis kits for efficient management of animal diseases and increasing animal productivity.
- The induced breeding technologies, with a focus on ornamental fishes, standardized along with technology backstopping for promotion of open-sea cage farming. Several nutraceutical/health products from seaweeds were developed and commercialized.
- In order to hasten the process of soil health analysis, Minilab for soil testing at affordable price was developed and deployed. To reduce the chemical foot print in the soil and environment, new and remunerative integrated and organic farming system models were developed. These IFS models are being upscaled by different States.
- To ensure high-quality higher agricultural education, strengthened the process of accreditation of agricultural universities/colleges and measures were implemented to attract talent in agricultural education and research. Greater emphasis was on skill and entrepreneurship development under National Agriculture Higher Education Project (NAHEP).
- Our efforts to reach out to as many farmers as possible was intensified through the development and use of ICTs particularly through the energized KVK system. Intensive outreach programs were taken up for crop residue management, promoting of pulses and oilseeds, orientation towards nutria-sensitive agriculture and implemented programs for tribal and aspirational districts.

Crop Science

ICAR-Indian Agricultural Research Institute, New Delhi

1. Contact details

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ii. Name of the Director: Dr. Ashok Kumar Singh,

iii. Email address: director@iari.res.in Phone No.: +91-11-25842367; Fax: +91-11-2584642

2. Mandate and activities

- To conduct basic, strategic and anticipatory research in field and horticultural crops for enhanced productivity and quality.
- Research in frontier areas to develop resource use efficient integrated crop management technologies for sustainable agricultural production system.
- To serve as centre for academic excellence in the areas of post-graduate and human resources development in agricultural science.
- To provide national leadership in agricultural research, education, extension and technology assessment and transfer and to serve as a national referral point for quality and standards.

3. Salient achievements

- ICAR-IARI wheat varieties contribute nearly 60 million tons of wheat to nation's granary worth Rs. 80,000 crores, annually. Currently, the *Pusa Basmati rice varieties account for 90% of the total foreign exchange (Rs. 29524 crores)* earned through export of Basmati rice amounting to Rs. 32,804 crores. A number of bio-fortified varieties with high protein, vitamin, iron and zinc have been developed in wheat and maize. Using marker assisted selection (MAS) herbicide tolerant basmati rice varieties namely Pusa Basmati 1979 and Pusa Basmati 1985, have been developed, which are recommended for direct seeding.
- IARI developed and released world's first canola quality Indian mustard variety, *Pusa Double Zero Mustard 31,* with an average seed yield of 2.32 t/ ha maturing in 142 days. About *48% of mustard grown area in the Country is cultivated with ICAR-IARI varieties.*

- IARI's mango varieties Mallika and Amrapalli are grown on 232000 ha . Recently, institute has developed several varieties such as Pusa Surya, Pusa Arunima, Pusa Pratibha, Pusa Shressth, Pusa Lalima Pusa Peetamber with coloured peel and less sweetness targeting the export market.
- Developed ransgene free genome edited mutants of mega rice cultivar MUT1010 with enhanced yield and tolerance to drought and salt stress
- To enhance the consumption of millets and maize, two innovative products viz. HALLUR: 'Soft Bajra Atta' and MAKAI: 'Soft Makka Atta', having nutritional-richness of Pearl millet and Maize respectively with dough and chapatti making quality comparable to wheat were developed and commercialized.
- ICAR-IARI's Neem coated urea technology *technology saves 5kg urea for each bag sold in the Country every year.* DAC&FW has notified the MRP of 45 kg bag of urea instead of conventional 50kg bag of Urea.
- The satellite remote sensing station at IARI daily monitors paddy residue burning over Punjab, Haryana & UP and daily bulletins are sent to ICAR & concerned ministries of the Govt. of India.
- Pusa Decomposer, a microbial consortium developed for rapid decomposition of paddy straw has been found very effective and rapidly degrades paddy straw in situ into manure in 20-25 days following conventional tilling (CT) practices.
- Hon'ble Prime Minister dedicated the Nanaji Deshmukh Plant Phenomics Centre on 11 October, 2017 to the Nation to foster understanding of climate change impacts on crops. The Centre has generated 57 million image data, identified novel donors for WUE, Nitrogen Use Efficiency and drought tolerance in rice and wheat.
- Pusa STFR is a low cost, user-friendly, digital embedded system and programmable instrument, which analyses as many as fourteen important soil parameters and helps in balanced fertilization, improving use efficiency of applied nutrients and reducing the cost of cultivation
- Pusa Farm Sun Fridge is an innovative, off-grid, battery-less, cold storage facility for perishables that uses a combination of evaporative cooling and solar refrigeration to store harvested farm products on farmers' fields or in farm communities.
- IARI commercialized 318 technologies to 605 industry partners
- Since 1923, IARI has been playing a pioneering role in creating excellent human resource through post graduate teaching. IARI awards post-graduate degrees in 26 disciplines in Agricultural Sciences and related basic disciplines. At present total on roll students in campus is 1666 (1177 Ph.D., 454 M.Sc. and 35 M.Tech) including 612 female and 1054 Male Students and 21 international students. IARI was ranked 23rd in overall ranking of all Universities and Institutes in India by NIRF India Ranking 2017
- 15 Incubation programs were conducted by incubating 266 startups with a total fund of 7.97 Cr INR facilitated to 94 startups.

4. Knowledge/skill/technologies/products other services available for different stake holders

- A number of high yielding varieties in a range of crop species like wheat, rice, maize, chickpea, brassica, lentil, mungbean, pearlmillet, etc. including MAS (marker assisted selection) derived varieties have been developed from the crop improvement division.
- Developed various crop production practices, conservation agriculture based cropping system, a novel missing-row sowing technique, etc for raping the higher yield in various crops. Also, Pusa STFR has been useful for the quick and accurate estimation of various soil parameters.
- The institute takes consultancy projects, Contract Research Projects and Contract Service projects through MoUs. Consultancy services are provided in areas of seed production and commercialization; establishment of nursery, orchard, protected cultivation systems, hydroponics, kitchen gardening, urban farming, composting, farm mechanization, precision farming, integrated farming system models, natural resource management, processing and value addition, secondary agriculture, farmers' group formation.
- Services for vocational training as well as professional capacity building programmes; sale of improved seeds and planting materials; testing of soil, seeds and chemical; diagnostics of plant insect pest and disease; and agro-advisories are provided.

Basmati Paddy varieties

Carrot variety Pusa Rudhira

Pusa Farm SunFridge

ICAR-Central Institute for Cotton Research

1. Contact details

i. Postal Address: ICAR-CICR, Post Bag No. 02, Shankar Nagar P.O. Nagpur- 440010, (Maharashtra), India

ii. Name of the Director: Dr. YG Prasad

iii. Email address: director.cicr@icar.gov.in Phone No. 07103-275536

2. Mandate and activities

- Basic, strategic and adaptive research on production, protection, fibre quality and by-products of cotton
- Creation of new genetic variability for location-specific adoption in cotton-based cropping systems
- Coordination and monitoring of applied research on national and regional issues to develop improved varieties and technologies
- Dissemination of technologies and capacity building

Activities

1. Accelerating genetic gains for productivity enhancement, fibre quality, stress tolerance and climate resilience using transgenics, genome editing and pre breeding technologies
2. Development of ecologically compatible integrated pest management strategies for existing and emerging pests under conventional and niche area cotton production systems
3. Development of efficient resource management technologies for precision farming, smart cotton production, mechanical harvesting and high-density planting
4. Genetic improvement and development of production and protection technologies for desi, organic, ELS and naturally coloured cotton
5. Socio-economic dimension of cotton production system, technology dissemination, outreach, Impact assessment and industrial linkages

3. Salient achievements

- CICR has developed and released 63 cotton varieties/hybrids including 15 Bt and 4 Naturally coloured cotton varieties.
- CICR developed and patented the Bt detection kits
- Developed and disseminated High Density Planting System (HDPS) for enhancing cotton productivity on marginal soils under rainfed conditions

- Strategy for management of white fly successfully implemented in north India with reduction in whitefly infestation by more than 80%
- Male-sterility technique for hybrid seed production, management of mealy-bugs, enhancing cotton yields on calcareous soils, low cost machineries for small farmers, inter cropping with legumes, cover crops for weed management and conservation agriculture were standardized for widespread dissemination

4. Knowledge/skill/technologies/products other services available for different stake holders

a. Insecticide Resistance Management (IRM)/ Integrated Pest Management (IPM) strategies for pink bollworm; in 08 states covering 21 districts involving multiple stakeholders.

b. *E-Kapas* programme: Voice messages on cotton cultivation technologies are being sent on the mobile numbers of over 4 lakh registered farmers in 10 major cotton growing states

c. Weekly advisories to cotton farmers provided by the AICRP on Cotton Centres/CICR, Nagpur.

Trainings of trainers, farmers and other stakeholders: on cotton production and protection

Extra Long Staple Cotton Variety : CCB-51- An alternative to Suvin

CICR-H Bt Cotton 60
(Yugank Bt)

ICAR-Central Research Institute for Jute and Allied Fibres

1. Contact details

i. Postal Address : ICAR-CRIJAF, Barrackpore, Kolkata-700121 (W.B)

ii. Name of the Director : Dr. Gouranga Kar

iii. Email address & Phone No.: director.crijaf@icar.gov.in/ 91-33-25356124

2. Mandate and activities

- Basic and strategic research on improvement of jute and allied fibre crops for biotic and abiotic stresses, yield and quality.
- Development of economically viable and sustainable production technology, cropping systems and post-harvest technology.
- Coordination and monitoring of applied research on national and regional issues to develop improved varieties and technologies.
- Dissemination of technologies and capacity building.

Activities

- Breaking Yield Barrier for genetic gains (breeding, pre-breeding, biotechnology)
- Bridging Yield Gap and Area expansion of jute and allied fibres (biotic-abiotic stress management, farm mechanization, ICT-based extension and agro-advisory)
- Fibre Quality Improvement (breeding, pre-breeding, retting /degumming/ /nanotech)
- Ecosystem services, value addition, diversification and 'Wealth from Waste' from JAF crops
- Profiling of immunity-boosting bioactive compounds for food & medicinal use of Jute & allied fibre crops.

3. Salient achievements

- Ten jute and allied fibre crop varieties: 2 of tossa jute (JROMU 1 and JROB-2), 1 of white jute (JRCJ-11); 3 of kenaf-3 (JBMP-3, JBMP-4 and JRHC-3); 3 of roselle (JRR-17 and JRHS-1); 1 of sun hemp (SUN-03) have been developed, released and notified for general cultivation in jute growing states.
- Developed and commercialized "CRIJAF SONA" retting accelerator for faster jute retting. Whole-genome sequence of *C. olitorius* variety, JRO-524 resolving an estimated genome size of 415 Mbp and of bacterial strains of the 'CRIJAF SONA' retting accelerator have been decoded. With application of retting accelerator CRIJAF SONA, retting duration reduction

was 6 to 7 days; Productivity improvement was 8-10% ; Net income increased: Rs.12,000 to 15,000/ha. In 2020 and 2021, it was reached to 2.58324 lakh farmers covering 1.10893 lakh of jute area in 6 states. Royalty of Rs. 63.39 lakhs earned during last 4 years (2017-18 to 20-21) after commercialization of CRIJAF SONA.

- Designed and developed *in-situ* jute retting tank-based self-reliant farming with slow-moving rainwater and solar-powered free-flowing retting system for increasing income and improving fibre quality. Additional income of Rs.30,000-40,000 per hectare was obtained through in-situ pond-based farming and through improvement of fibre quality.
- Developed and commercialized small farm implements (CRIJAF nail weeder /Single wheel weeder, CRIJAF Multi-row Seed Drill) for farm mechanization in the jute-based cropping system. CRIJAF Nail Weeder / Single Wheel Weeder resulted in weed control by 80 - 85%; manpower savings of 50-55 mandays/ha, yield increase by 2-3 q/ha (10-12%) and monetary benefit of Rs.18000–19000/ha. Royalty of Rs. 55.49.1 lakhs earned during last 4 years after commercialization of these three small farm implements.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Breeder seed of new high-yielding varieties of jute, mesta, sunnhemp and fibre flax for seed producers.
- Low-cost small farm implements like CRIJAF-Seed Drill, CRIJAF- Nail Weeder and CRIJAF Single wheel jute Weeder for small and marginal farmers.
- CRIJAF SONA powder for faster jute retting for jute farmers.

Impact of CRIJAF SONA on Jute Retting

ICAR-National Institute for Research on Commercial Agriculture

1. Contact details

i. Postal Address: ICAR-NIRCA, Bhaskar Nagar, Rajahmundry, Andhra Pradesh -533 105

ii. Name of the Director: Dr. D. Damodar Reddy

iii. Email Address & phone: directorctri@gmail.com; director.ctri@icar.gov.in Phone No: 0883 – 2448995

2. Mandate and activities

- To conduct research on diverse aspects of commercial agriculture for enhancing farm income, employment, nutrition and export earnings, while ensuring sustainability of environment and agro-ecological assets
- To develop cost-cutting strategies, secondary agriculture technologies and diversified value chain models for increased profitability, competitiveness and sustainability
- To deliver front-line extension services for technology and market intelligence dissemination and organize trainings for stakeholders' capacity and competency building
- To collaborate, coordinate and liaison with producing, processing, value addition, marketing and exporting agencies for achieving its vision.

Activities

- Tobacco breeding for improved productivity and quality
- Crop production management in commercial agriculture
- Post-harvest produce management and value addition in high value commercial crops
- Frontline extension and market intelligence for enhancing farmers profitability and export promotion
- Implementation of Schedule Caste Sub-Plan and Tribal Sub-Plan for the benefit of targeted beneficiaries.

3. Salient Achievements

- Developed and released 94 varieties/ hybrids of different tobacco types for cultivation in different zones.
- Developed and popularized soil, crop and input management technologies. More than 90% of the tobacco area in the country is covered by these technologies.
- Climate resilient technologies *viz.,* farm pond technology, high density planting and foliar nutrition with KNO_3 were developed and recommended.

- Developed energy conservation and fuel saving (40-50%) techniques for tobacco curing to reduce dependency on forest fuel wood
- A process for purification of solanesol (95+%) from tobacco was developed and patented (No.21120).

4. Knowledge/skill/technologies/products other services available for different stake holders

- Production and supply of high-quality tobacco seed to meet more than 90% of seed requirement in the country.
- Scientific backstopping of Tobacco Board, Ministry of Commerce, GoI in its policy framing, and extension and developmental activities relating to FCV tobacco production in the country.
- Consultancy/advisory services on sustainable burley tobacco production to Godfrey Phillips India Ltd. Guntur, AP.
- Soil, water and leaf quality evaluation for Tobacco Board. Industry and farmers Capacity building trainings to farmers and other stakeholders for efficient management of tobacco production and processing (from seed to seed).

Varieties/ hybrids of different tobacco types

Tobacco seed supply

FCV: Siri

FCV: Kanchan

Burley: Banket A1

ICAR-Directorate of Groundnut Research

1. Contact details

i. Postal Address – ICAR-DGR, Ivnagar Road, Post Box No. 5, Junagadh-362001, Gujarat

ii. Name of the Director – Dr CS Praharaj (A)

iii. Email address & phone: director.dgr@icar.gov.in/ Phone No. – 0285-2673382 (O)

2. Mandates and activities

- Basic, strategic and adaptive research on groundnut to improve productivity and quality
- Provide access to information, knowledge and genetic material to develop suitable varieties and technologies
- Coordination of applied research to develop location specific varieties and technologies (AICRP on Groundnut)
- Dissemination of technology and capacity building

Activities

- Pre-Breeding for developing groundnut genotypes having resistance/tolerance to biotic and abiotic stresses and quality aspects (high Fe, Zn, Oleic ≥80%, oil >54%, etc.).
- Breeding groundnut varieties for high yield (>3000 kg/ha for rainfed and >4000 kg/ha for irrigated) having multiple disease and insect pest resistance and quality traits
- Management of abiotic stresses (drought, salinity and temperature) through agronomic, microbial, nutrient and water management practices
- Plant nutrition, soil health and biofortification of Fe and Zn in groundnut through fertilizer, agronomic and microbial package in high yielding groundnut cultivars
- Understanding important insect pests and diseases (biotic stresses) and their management for maximizing yield.

3. Salient achievements

- Developed/released more than 150 varieties of Groundnut with different habit groups along with dissemination of more than 100 crop management technologies (by DGR and AICRP on Groundnut)
- Developed exclusively five high yielding groundnut varieties (Girnar 1, Girnar 2, Girnar 3, Girnar 4 and Girnar 5) out of which two (Girnar 4 and Girnar 5) are biofortified with high oleic (>78%) acid. Besides, Raj Mungfali 3, HNG10, AK159, GG7, and Pratap Mungfali 5 were released from segregating materials supplied by DGR only.

- Developed two highly competitive strains of groundnut rhizobia (IGR6 and IGR40) having yield advantage of upto 18% and marketed through IFFCO, NAFED, etc.
- Developed criss-cross method of planting of groundnut having yield advantage of upto 15%
- Commercialized two process knowhows for production of enzyme cellulase from groundnut shell and proteases from de-oiled groundnut cakes through microbial processing
- Developed transgenic groundnut for imparting tolerance to drought (Dreb, mtlD) and biotic stresses (PBND and PSND: coat protein mediated; *Spodoptera*: cry1AC mediated) and maintained
- Pre- and post- harvest aflatoxin management practices developed and extended to stakeholders.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Five bioformulations *viz.*, *NutBoost*, *NutMagic*, *NutGrow*, *DroughtGuard* (water saving upto 30%) and *SalGuard* developed for groundnut cultivation, are ready for commercialization on non-exclusive licensing
- Sophisticated instrument for analysis of samples of stakeholders
- Contract service and research for private companies and Agri-Business Incubator for startups and entrepreneurs.

High yielding and bio-fortified variety released (Girnar-4 and Girnar-5).

ICAR-National Bureau of Agricultural Insect Resources

1. Contact details

i. Postal Address: ICAR-National Bureau of Agricultural Insect Resources, P.O. Box 2491, H.A. Farm Post, Hebbal Bengaluru 560 024, Karnataka, India

ii. Name of the Director: Dr. M. Nagesh

iii. Email ID & phone: director.nbair@icar.gov.in, Ph. No. 080-23411961

2. Mandate and activities

- To act as a nodal agency for collection, characterization, documentation, conservation, exchange, research and utilization of agriculturally important insect resources (including mites, spiders and related arthropods) and insect derived resources for sustainable agriculture.
- Capacity building, development of technologies for nonchemical pest management, dissemination of technologies and forging linkages with stakeholders.

3. Salient achievements

- Established National repository for preservation of insects, spiders and mites.
- Established a state of art National Insect Museum facility in 2019 with 2,16,093 preserved specimens of insects, mites and spider including 349 primary and secondary type specimens, for posterity and Research & Development.
- Established an *Ex Situ* live insect germplasm facility with 136 species, the biggest live insect repository for biological control in India.
- ICAR-NBAIR identified many invasive pests for introduction of biocontrol agents time to time their management including Sugarcane wooly aphid, Eucaplyptus gallwasp fly, Papaya mealybug, Fall armyworm, Rugose spiralling whitefly, Cassava mealybug and *Thrips parvispinus*.
- Developed: 161 technologies (including development of mass production and application protocols for insect biocontrol agents) out of which 32 commercialized with 101 licensees given to more than 20 companies and startups
- Succeeded in biological Control of Sugarcane Woolly Aphid
- Developed parasitoid based biological suppression of Papaya Mealybug
- Developed novel insecticidal WP formulations of *Heterorhabditis indica* for the biological control of white grubs & other soil insect pests and EPN technology for the biological

control of white grubs and other insect pests was granted Indian Patent and transferred non-exclusively to 16 companies.

- Waste to wealth: Black soldier fly: An alternative for waste management and feed

4. Knowledge/skill/technologies/products/other services available for different stakeholders

Biological control and EPN technologies for management of insect & pests in different crops.

BSF Egg

BSF Larvae

BSF Pupae

BSF Adult

ICAR-National Research Centre for Integrated Pest Management

1. Contact details

i. Postal Address: ICAR-National Research Centre for Integrated Pest Management, LBS Building IARI, Pusa Campus, New Delhi-110012

ii. Name of the Director : Dr. Subhash Chander

iii. Email address : Email: director.ncipm@icar.gov.in, Phone: 011-25843936, 25843935

2. Mandate and activities

- Information and Communications Technology (ICT) based surveillance, monitoring of pest population, research and promotion of pest smart IPM technologies for major crops.
- On farm validation of IPM technologies, forging linkages with commodity-based crop research Institutes, AICRP/ AINP and capacity building.

Activities

- ICAR-NCIPM is actively involved in development, validation and dissemination of AESA based IPM technologies through collaborative programs with different agencies, e-pest surveillance in agricultural crops and capacity building in IPM.

3. Salient achievements

- IPM technology validated and disseminated in different agricultural crops *viz*. rice (25104 ha), cotton (1106 ha), vegetables (1356 ha), fruits (207 ha), oilseed (285) and pulses (600 ha), totaling 28685 ha across India during the last decade.
- ICT based pest surveillance and advisory system implemented in 185 lakh ha in 25 field and horticultural crops across 11 states (Maharashtra, Haryana, Tripura, Madhya Pradesh, Punjab, Odisha, Telangana, Andhra Pradesh, Rajasthan) resulting in judicious use of pesticides and increase in production.
- National Patents: 08, International Patents: 03; 4 technologies commercialized, resulting in resource generation of Rs. 07 crores.
- Three *Trichoderma* isolates with biotic and abiotic stress tolerance submitted to ICAR-NBAIM, Mau (Accession No. NAIMCC-SF-0059, 60 & 61).

4. Knowledge/skill/technologies/products other services available for different stake holders

- Location specific IPM modules developed for different crops *viz.,* rice, cotton, maize, mustard, chickpea, green-gram, black-gram, pigeon-pea, groundnut, okra, tomato, brinjal,

chilly, cabbage, cauliflower, capsicum, radish, cucurbitaceous crops, kinnow, mango and guava.

- A total of 27 Mobile Apps on integrated pest management (IPM) technologies hosted on Google play store (approx. 17000+ download).

08-Patented technologies submitted for commercialization to Agrinnovate India, New Delhi, India.

ICAR-Sugarcane Breeding Institute

1. Contact details

i. Postal Address: ICAR-SBI Karumalai Chettypalayam, Veerakeralam, Coimbatore–641007, Tamil Nadu

ii. Name of the Director: Dr.G.Hemaprabha

iii. Email address & phone: director.sbi@icar.gov.in Phone no.: 0422-2472621

2. Mandate and activities

- Breeding of superior sugarcane varieties/ genotypes having high sugar productivity as well as sustainability and to assist State Sugarcane breeding programs
- To conduct basic and strategic researches on crop improvement, production & protection aspects of sugarcane
- Collection, maintenance, evaluation, documentation and conservation of sugarcane / *Saccharum* species genetic resources
- Effecting technology transfer, consultancy and human resource development in the areas of sugarcane agricultural research

3. Salient achievements

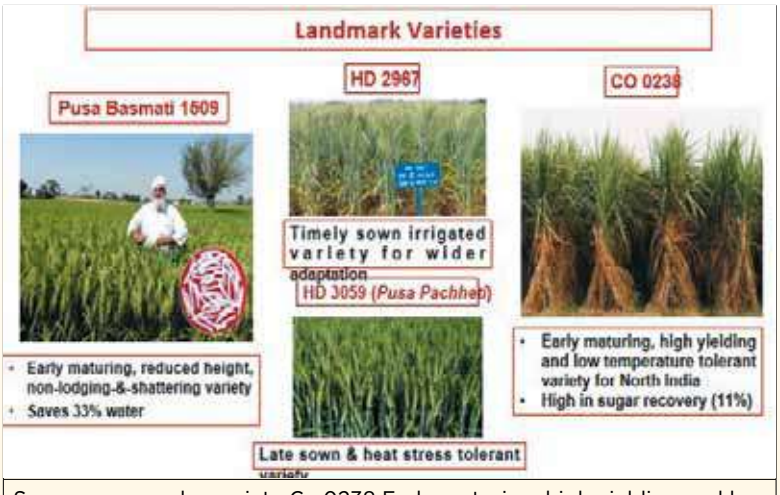
- In 1912 the Institute was established and now the institute is 109 years old
- In 1918 the first variety Co 205 was released which made a sugar revolution in India
- Since then over 3380 Co varieties were identified, of which 180 have become commercially successful. Major varieties are Co 285, Co 312, Co 419, Co 740, Co 7717, Co 6304, Co 86032, Co 0238, Co 15023 and Co 11015
- The Institute supports National sugarcane improvement by facilitating hybridization for 24 agricultural universities and research stations of India through fluff supply programme since 1972.
- Co canes cover over 80% area in the country, and two major varieties Co 86032 and Co 0238 cover over 70 % area and figure in the top 8 sugarcane varieties in the world.
- Co 0238 the wonder variety occupied 27.8 lakh hectare in 2021-22, and transformed India to a sugar surplus country, paving way to export of sugar as well as opening up bioethanol production. Presently the country could achieve 10 % blending mainly due to the contribution of Co 0238. Farmers got an additional benefit of Rs. 53,937 / ha and significantly played a major role towards Atmanirbhar Bharat. The cane productivity in India increased from 60.t/ha 214-15 to 81.8 t/ha in 2020-21, and crossed the world average productivity of 77 t/ha.

- Co 86032 released in 2000 AD has been covering 8.5 lakh ha to 12.5 lakh ha since 2008 and improved productivity in Southern states. It has a demonstrated productivity up to 420 t/ha, a figure not achieved with any other variety so far.
- The Institute has made pioneering contributions in management of red rot, smut and other diseases and came out with viable and cost-effective technologies. The recently licensed technologies are given.

4. Knowledge/skill/technologies/products/other services available for different stakeholders

Technologies commercialized:

i. Soil Moisture Indicator
ii. Sugarcane Sett treatment device
iii. Two row tractor drawn mechanical planter for sugarcane bud chip settlings raised in portrays
iv. ICAR-SBI EPN biopesticide formulation
v. Cane jam production from cane juice
vi. Cane Dietary Fibre Food Products
vii. Spray Dried Sugarcane Juice
viii. ICAR-SBI Standardised Liquid Jaggery
ix. freeze dried sugarcane juice
x. QUATRO Sugarcane Single Bud Cutter Machine
xi. ICAR-CIAE-SBI sugarcane rind removing equipment
xii. ICAR-CIAE-SBI Motorised double headed sugarcane single bud cutting machine
xiii. Sugarcane Detrashing tool
xiv. Powder Jaggery processing from sugarcane juice.



Sugarcane wonder variety Co 0238 Early maturing, high yielding and low temperature tolerant variety for North India with 11% sugar recovery


Soil Moisture Indicator

ICAR-Indian Institute of Millets Research

1. Contact details

I. Postal Address: ICAR-Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500 030

II. Name of the Director (A): Dr. CV Ratnavathi

III. Email & Phone : director.millets@icar.gov.in ; 040-24599300

2. Mandate and activities

- Basic and strategic research to increase productivity of millets and their diversified utilization for enhancement of profitability.
- Coordination and development of improved crop production and protection technologies of millets.
- Training and consultancy on millet production and utilization.
- Dissemination of technologies and capacity building.

Activities

- Research activities mainly aimed to transform subsistence farming of millets into a globally competitive climate resilient nutri-cereal enterprise through value addition to meet food, feed, fodder, nutrition, and bio-fuel requirements of the country for equitable prosperity.
- Development of hybrids, varieties, parental lines and novel genetic stocks
- Development and popularization of integrated crop production technologies and plant protection practices to major insect and diseases
- Promotion of organic farming and development of profitable inter-cropping systems to enable millet based cropping systems are more competitive.
- Participation in publicly-funded activities such as germplasm collection and evaluation, Breeder Seed production, and Front-line demonstrations.

3. Salient achievements

- New Cultivars Development: A total of 48 Sorghum hybrids, 54 sorghum varieties have been released and notified for national level including grain, forage, high biomass and sweet sorghums (Biofuel).
- Popularization of Nutri-cereals: IIMR created demand for Millets through Value chain development. Due to ICAR - IIMR initiative Central Government has announced that the year 2018-19, as "National Year of Millets" and Year 2023 is announced as International Year of Millets by United Nations. In addition, the Government also announced that henceforth "Millets" will be called as "Nutricereals" and relevant Gazette notification was also released.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Developed 48 Sorghum hybrids and 54 sorghum varieties.
- Sixty-seven technologies created for various stakeholders
- Through Centre of Excellence for Millets and NUTRIHUB business incubators at IIMR – Various technologies including preparation of various millet health foods including Ready to Eat and Ready to Cook types, Primary and Secondary Processing procedures for Millets etc available for start-ups, traders, farmers, staff, industrialists, exporters, home makers and for all the millets stakeholders.

Recently released Sorghum Variety – CSV 36

Eatrite – Millet Products

ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan

1. Contact details

i. Postal Address – ICAR-VPKAS, Mall Road, Almora – 263 601, Uttarakhand

ii. Name of the Director – Dr. Lakshmi Kant

iii. E-mail address – director.vpkas@icar.gov.in / Phone No. - 05962-230208

2. Mandate and Activities

- Basic, strategic and adaptive research for improving productivity and quality of important hill crops with emphasis on conservation and efficient utilization of natural resources.
- Development of post-harvest technologies and value addition.
- Dissemination of technology and capacity building on hill agriculture.

Activities

- Enhancing genetic gain in important crops of N-W Himalayan region for productivity, quality traits and multi-stress resilience through pre-breeding, conventional and accelerated breeding tools.
- Ensuring food and nutritional security in North West Himalayas through climate resilient enhanced production of millet and potential crops by post-harvest management, value addition and commercialization
- Strategies for improving productivity of important hill cropping systems through efficient resource utilization, diversification, mechanization and efficient water management
- Development of crop production and protection technologies to reduce the impact of global climate change on hill agriculture
- Strengthening outreach programme to disseminate the technologies to farmers, industry linkages and impact assessment

3. Salient Achievements

- Till date total 181 high yielding disease resistant varieties of 25 crops have been developed and notified by the institute.
- Development of first hybrid of maize (VL *Makka* 54), onion (VL *Piaz* 67) and extra early grain and baby corn (VL *Makka* 42).
- Development of dual-purpose wheat varieties (VL *Gehun* 616 and VL *Gehun* 829) for grain and green fodder.

- Development of *Vivek* thresher-cum-pearler for finger and barnyard millet, which has helped in reducing drudgery of the hill farm women.
- Devising a two-pronged strategy for managing the adult beetles and subterranean larvae of the menacing pest 'white grub'.
- A trade mark of the institute "VL Seed" for breeder and TL seed of ICAR-VPKAS, Almora has been registered under Trade Mark Act 1999 (Trade Mark No. 5060460 dated 26/07/2021, J.No. 2013, Class 31).

4. Knowledge/skill/technologies/products other services available for different stake holders

- Quality seeds of released varieties by institute and technologies for various stakeholders
- Commercialization of various technologies and machineries developed by the institute

Maize Hybrid 59

VL Mandua 382 – First white seeded finger millet variety suitable for organic cultivation in Uttarakhand hills

ICAR-Indian Institute of Agricultural Biotechnology

1. Contact details

i. Postal Address: ICAR-IIAB, Garhkhatanga, Ranchi – 834 003, Jharkhand

ii. Name of the Director: Dr. A. Pattanayak

iii. Email address: director.iiab@icar.gov.in

iv. Phone No: 9264448797 Ext- 201

2. Mandate and activities

i. Basic and strategic research in agricultural biotechnology

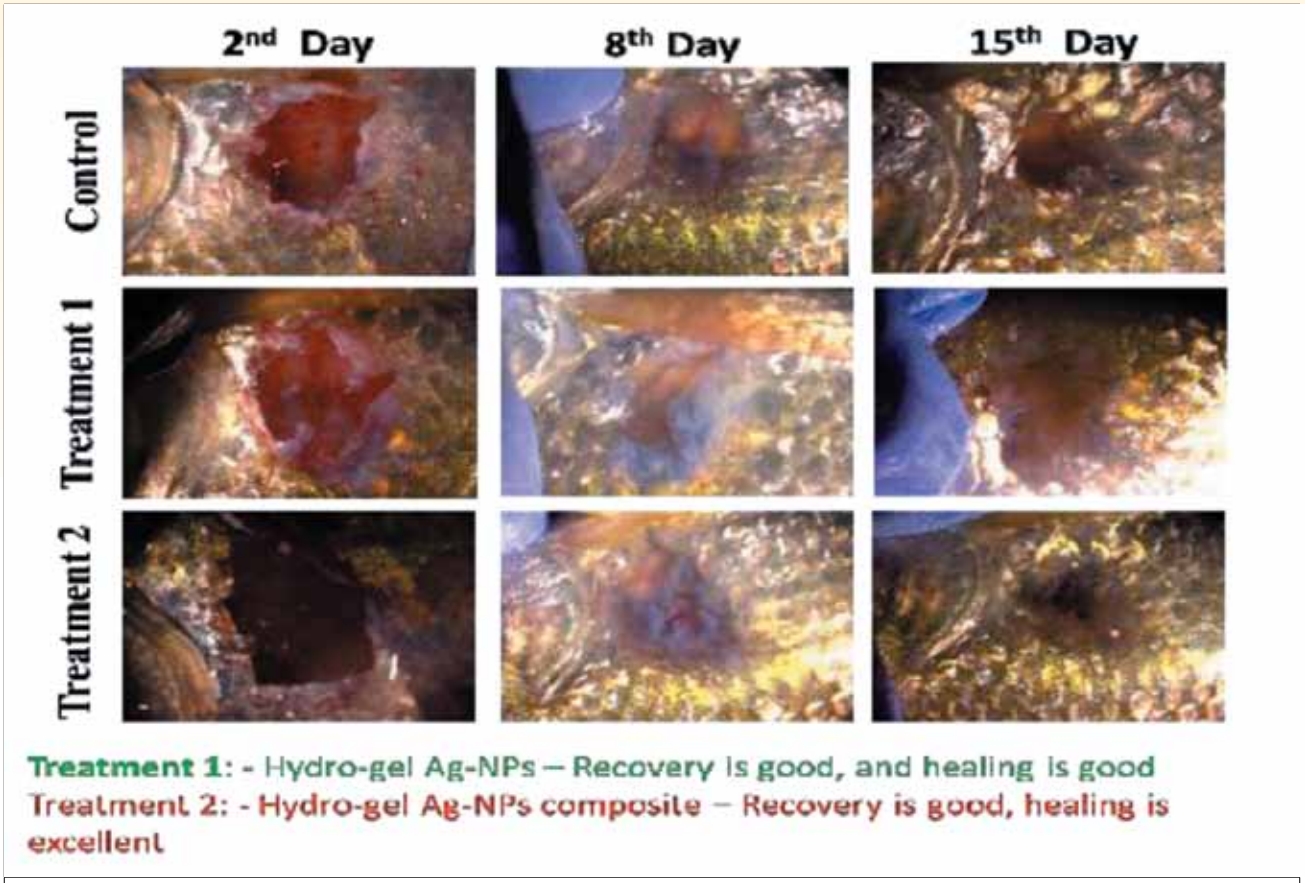
ii. Development of quality human resources for academic excellence in agricultural biotechnology and policy support

3. Salient achievements

- Two hundred and twenty-four germplasm accessions of *Artocarpus heterophyllus* collected from Eastern India were analyzed for population structure. Three distinct clusters without any geographical isolation were seen.
- Method of preparation of alcoholic nano-silver having anti-viral and anti-biofilm efficacy standardized.
- Differential proteins between X- and Y-spermatozoa of Indicus cattle have been identified which have use in immuno-sorting of sperms.
- A nano-composite hydrogel has been developed for wound healing of fish (patent filed).
- More than 15,000 SC/ST community farmers benefitted under different outreach programs.
- Three high-yielding varieties of rice and one of Indian Mustard, developed in collaboration with ICAR-RCER, Patna, and BAU, Ranchi, were released by SVRC

4. Knowledge/skill/technologies/products other services available for different stake holders

- A nano-composite hydrogel has been developed for wound healing of fish. The composite healed wounds completely within 15 days (patent filed).
- FSHβ has been identified as a genetic marker for litter traits in indigenous pig breeds of India. This marker will help in the selection of parents for improved litter size.



A nano-composite hydrogel for wound healing of fish

- Microbial levan-based feed formulation has been developed for rohu (*Labeo rohita*) fingerlings to induce cytokine-mediated immune modulation against pathogen challenges.

ICAR-Indian Institute of Maize Research

1. Contact details

i. Postal Address: ICAR-Indian Institute of Maize Research, PAU Campus, Ludhiana, Punjab-141004

ii. Name of the Director: Dr. Sujay Rakshit

iii. Email address & phone: director.maize@icar.gov.in; pdmaize@gmail.com/ Phone: 9492430207, +91-161-2440048

2. Mandate and activities

- Basic and strategic research aimed at enhancement of productivity and production of maize, including specialty corn.
- Coordination of multi-disciplinary and multi-location research to identify appropriate technologies for varied agro-climatic conditions.
- Dissemination of improved technologies, capacity building and developing linkages.
- Coordination of the All India Coordinated Research Project (AICRP) on Maize and to carry out extension and outreach programmes.

3. Salient achievements

- 12 hybrids have been developed and released for commercial cultivation

Normal field corn hybrids (3):	DMRH 1301, DMRH 1308 and DMRH 1305
QPM hybrids (3):	LQMH1, IQMH 202 and IQMH 203
Baby corn hybrids (3):	IMHB 1539, IMHB 1532 and LBCH3
Popcorn hybrids (3):	LPCH3, LPCH2 and DMRHP 1402

- Patents: 4 and Copyright 1
- A rapid protocol was designed for differentiation of Quality Protein Maize (QPM) from normal maize, to link QPM produce with the market, for which patent filing is under progress (Patent application No. 202211015547 dt. March 21, 2022).
- Germplasm registered at NBPGR:36
- Precision nutrient management in maize system: The layering of CA-based management practices with precision nutrient prescriptions using SSNM based decision support tools offers a new management paradigm for scaling up of the MWMb system in north-west India.
- Technology for the management of fall armyworm in maize

- Commercialization of technologies: 8 technologies including seven maize hybrids and one Dynamic Volatile Collection System were commercialized and a total of Rs 53.867 lakh revenue generated.

4. Knowledge/skill/technologies/products other services available for different stake holders

- 12 hybrids developed and released for commercial cultivation are available for commercialization for different stakeholders.
- Four technologies *viz*., (i) Insect Handling Device, (ii) Insect Rearing Cage and (iii) Dynamic volatile collection system and (iv) A rapid protocol for differentiation of Quality Protein Maize from normal maize are available for commercialization.

Three bio fortified maize varieties LQMH 1, IQMH 202 and IQMH 203 dedicated to Nation by Hon'ble PM

The Insect Rearing Cage (Patent No. 311890)

ICAR-Indian Institute of Pulses Research

1. Contact details

i. Postal Address: ICAR-Indian Institute of Pulses Research, Kalyanpur, Kanpur-208024 (U.P.), India

ii. Name of the Director: Dr.Bansa Singh

iii. E-mail Address/phone: director.iipr@icar.gov.in, diriipr.icar@gmail.com

2. Mandate and activities

- Basic and strategic research on pulses to improve productivity and quality.
- Provide equitable access to information, knowledge and genetic material to develop improved technology and enhanced pulse production.
- Planning, coordination and monitoring of applied research on national and regional issues through All India Coordinated Research Project.
- Dissemination of technology and capacity building.

Activities

- Genetic enhancement for yield, adaptation, and quality; and seed delivery system research of different pulse crops
- Accelerating genetic gain and trait discovery through pre-breeding, new breeding tools and biotechnology
- Development of climate smart agro-technologies for diversified agro-ecological regions
- Crop health management for resilience to global climate change
- Physio-chemical intervention for nutrient amelioration, post-harvest management, bio-fortification and value addition
- Innovative extension research, socio-economic impact, market, gender, youth and IT-enabled data management for policy research

3. Salient Achievements

✓ Development of new high yielding and multiple stress resistant varieties: 63 varieties of pulse crops have been released and notified in different pulse crops.

✓ Matching agro technologies for higher yield in pulses (new agro-chemicals, post emergence herbicides, micro-irrigation and resource conservation technologies)

✓ Promotion of mungbean as a Spring & Summer crop

✓ Introduction of pulses (early pigeonpea) in soybean-wheat & cotton-wheat cropping system

- ✓ Pulses as intercrop in cropping systems under rainfed/ dryland systems
- ✓ Promotion of pulses (Lentil, chickpea and fieldpea) under rice fallow
- ✓ Production of 466950.0 q Quality seed of pulse crop (last 4 years) under seed hub programme.

4. Knowledge/skill/technologies/products other services available for different stake holders

- ✓ Production of quality seeds of varieties developed by institute
- ✓ Development of mobile apps and other web based expert systems for various stakeholders.

Chickpea (IPCK 2002-29)

Pigeonpea (IPA 203)

Climate resilient short duration varieties of pulse crops for newer niches

ICAR-Indian Institute of Rice Research

1. Contact details

i. Postal Address : ICAR- IIRR, Rajendranagar, Hyderabad 500030, TS.

ii. Name of the Director : Dr R M Sundaram

iii. Email address : director.iirr@icar.gov.in Phone No.: 040-24591216/218

2. Mandate and activities

- Basic and strategic research for enhancing rice productivity under irrigated ecosystem.
- Coordination of multi-location testing to develop location specific varieties and technologies for various ecosystems.
- Dissemination of technologies, capacity building and establishing linkages.

3. Salient achievements

- A total of 1436 rice varieties including 127 hybrids have been released to date for various ecologies across the country through All India Coordinated Rice improvement programme.
- First BLB resistant "Improved Samba Mashuri" was developed through MAS.
- IIRR has developed a rapid and reliable assay for assessment of purity of seed-lots of rice hybrids and CMS lines and a rapid diagnostic kit for Rice Tungro virus and artificial screening technique for false smut under glass house and field conditions
- Developed genome edited lines of Samba Mahsuri (Gn1a) with increased grain number (350-500).
- An efficient 8 row drum seeder, ridding type drum seeder, pot pudler have been designed and developed for saving labour, time and water.
- Novel concept of trap crop for yellow stem borer management developed and Ecological engineering for control of insect pests.
- Value added products like Rice Riche Pain Relieving Gel, Rice Riche Moisturizing Lotion, Rice Riche Cream for Dry and Cracked heel and Rice based face scrub which keeps skin smooth, soft and moist developed.
- Developed Rice Knowledge Management Portal (www.rkmp.co.in) which is the largest repository of knowledge on any single crop (rice).
- Water saving technologies, Integrated pest management, Integrated Nutrient management packages were developed for rice ecologies.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Improved and biofortified rice varieties.
- Alternate wetting and drying method of Irrigation for rice.
- Trap Crop Technology: Aromatic rice as a trap crop for stem borer management in rice.
- Ecological engineering with bund crops for enhancing biological control and monetary returns.
- Rice Based Health Care Products: Rice Riche Pain Relieving Gel, Rice Riche Face Scrub, Rice bran oil based low fat spread, Rice riche moisturizing lotion, Rice riche cream for cracked heel and dry skin
- IIRR 8 Row Seeder: A row seeder (also known as drum seeder)
- Training on Good Agricultural Practices to various stakeholders.

Improved Samba Mashuri

DRRH3- First MS grain hybrid

ICAR-Indian Institute of Seed Science

1. Contact details

i. Postal address: ICAR- Indian Institute of Seed Science, Kushmaur Village, Kaithauli Post, Maunath Bhanjan, Uttar Pradesh – 275 103

ii. Name of the Director: Dr. Sanjay Kumar

iii. Email address/phone: director.seed@icar.gov.in / Ph. No.: 0547-2970721

2. Mandate and activities

- To perform basic, strategic and anticipatory research in seed science and technology.
- To coordinate the seed production and seed technology research.
- To impart capacity building in the field of seed production, testing, quality assurance, certification and policy issues.

Activities

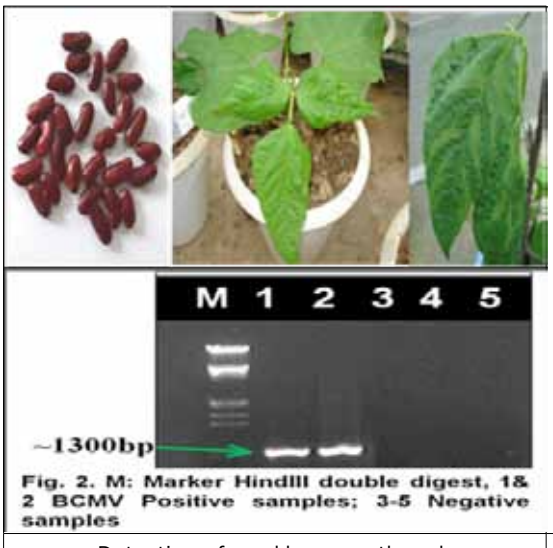
- Research in the areas of seed production & certification

3. Salient achievements

- 570145 q of breeder seed was produced against the indent of 425689 q during 2017-21. Likewise, 2101624 q of quality seed (FS, CS, TFL) was also produced.
- Survey revealed the contribution of formal and informal seed sector in total seed supply in the country in the ratio of 64:36 (cereals- 67:33, pulses- 57:43 and oilseeds- 52:48).
- Recommendations on isolation distances (field standards) in crops viz. pearl millet (C/S) - 200 m; sorghum (C/S) - 100 m; rape seed and mustard (F/S & C/S) - 200 m & 50 m; pigeon pea (F/S) - 250 m have been incorporated in IMSCS, 2013.
- Optimized seed production technology for green manure crops (dhaincha, pillipesera & sunhemp) and integrated approaches for maximizing seed yield and quality in eleven field crops.
- Seeds of paddy, onion, soybean and sunflower stored in airtight polythene bags (700 gauge) along with desiccant beads (zeolite beads/silica gel) @ 5g/kg seed-maintained seed quality even after 6 months of storage.
- Developed integrated practices for management of seed borne diseases viz. Alternaria blight in tomato; Alternaria leaf spot in sunflower; pod blight in soybean caused by *Colletotrichum dematium*; fruit rot of chilli caused by *Colletotrichum capsici* and *Alternaria alternata*.

4. Knowledge/skill/technologies/products other services available for different stake holders

- The device viz. 'Three-way matrix sampler' for seed genetic purity assessment and a method thereof has been patented and available for commercialization.
- Alternative sites for hybrid seed production identified in field crops viz. paddy, sunflower, sorghum, maize, pearl millet, pigeon pea and castor.
- Exposure of pigeon pea seeds to 40 oC for 24 h effectively attenuate the ill-effects of early heat stress in pigeon pea resulting in seed yield enhancement up to 18.8 per cent over control.
- DNA based protocols (conventional PCR and RT-PCR) developed for detection of seed borne pathogens (*BCMV in common bean and PMMV, C. truncatum, C. coccodesin* capsicum).
- Technology for effectively removes Karnal bunted seeds in wheat.
- Excellent seed testing and seed processing facility accessible for local seed growers.
- Dedicated seed sale counter for farmers and capacity building and input distribution.



Detection of seed borne pathogeb BCMV infection using RT-PCR

Three-way matrix sampler for seed genetic purity assessment

ICAR-Indian Institute of Wheat and Barley Research

1. Contact details

i. Postal Address: ICAR-Indian Institute of Wheat and Barley Research, Agrasain Marg, Karnal, Haryana 132001

ii. Name of the Director: Dr. Gyanendra Pratap Singh

iii. Email address: director.iiwbr@icar.gov.in, Phone: +91-184-2267490; Fax: +91-184-2267390

2. Mandate and activities

- Basic and strategic research to improve productivity and quality
- Coordination and development of improved production and protection technologies for sustainable production
- Providing the genetic diversity through pre-breeding and accelerate the breeding cycle through offseason nurseries
- Surveillance and forewarning for management of diseases
- Dissemination of improved technologies, capacity building and development of linkages

3. Salient achievements

- Development of new high yielding varieties with better disease resistance and improved quality under All Indian Co-ordinated Project (AICRP) on Wheat and barley.
- A total of 500 Wheat varieties and 104 barley varieties were developed and more than 300 Genetic stocks got registered for various traits. Among these varieties 4 varieties (WB2, DBW187, DBW 303, DDW 48) were bio-fortified. Industrial use varieties viz., DDW 47: Pasta; DBW 168: Biscuit; DWRB 160-Malt barley were also developed.
- Five wheat varieties DBW 173, DBW 187, DBW 222, DBW 252, DBW303 and two barley varieties DWRB 160, DWRB182 got licenced and generated total revenue of Rs. 4,49,20,240 during 2018-2021. A total of 711 licences (MoAs) were signed with private seed growers.
- Varietal Replacement Rate of 82.73 % was achieved and first time, ICAR-IIWBR varieties came under top 10 DAC top indented lists (DBW 187-Ist rank, DBW303-2nd rank & DBW222-7th rank). The IIWBR wheat variety DBW 187 has a spread of 5.00 million hectare.
- *Lr*80, a new widely effective leaf rust resistance gene was identified from local wheat Hango-2, that confers resistance to *Puccinia triticina* in India.

- Deveoplment of an improved version of rotary disc drill with ability to sow wheat in the surface residue for rice-wheat and sugarcane-wheat cropping systems.

4. Knowledge/skill/technologies/products/other services available for different stakeholders.

- Development of seed portal for distribution of seeds to farmers belonging to various states of India.
- Dissemination of improved technologies among farmers.
- Two Mobile apps viz., Gheoon Doctor and Jau Jankari for various stakeholders.

DBW 187 (Karan Vandana)

DBW 303 (Karan (Karan Vaishnavi)

ICAR-Indian Institute of Sugarcane Research

1. Contact details

i. Postal Address: ICAR-IISR, Raebareli Road, P.O.-Dilkusha, Lucknow 226002\

ii. Name of the Director: Dr. A.D. Pathak

iii. Email address/phone: director.sugarcane @icar.gov.in Phone No. 0522-2480726

2. Mandate and activities

- Basic, strategic and adaptive research on production and protection in sugarcane and breeding for sub-tropical regions of the country
- Coordination and monitoring of applied research on national and regional issues to develop improved varieties and technology and
- Dissemination of technologies and capacity building.

3. Salient achievements

- Total of 12 Sugarcane varieties and 2 sugar beet varieties developed
- Total number of 18 agricultural machinery developed
- Spaced transplanting technique and Bud chip technology
- Biological methods for improving ratoon cane productivity
- Skip-furrow method of irrigation and improving water use efficiency in sugarcane
- Integrated farming system for doubling farmers' income
- Biological control of top borer by *Isotima javensis and Pyrilla perusilla* Walker by *Epiricania melanoleuca* Fletcher
- Light trap for the management of white grub and IISR Combo trap
- Management of post-harvest sucrose losses in sugarcane
- Developed three pans improved jaggery unit with moulding frame for production of jiggery at commercial value.

4. Knowledge/skill/technologies/products other services available for different stake holders

The Institute provides analytical facilities in Referral Lab for soil, water and plant analysis, seeds of improved varieties of sugarcane and sugar beet, biofertilizer, improved farm machinery

for mechanization of sugarcane agriculture and value-added jaggery. The Institute also provide services viz., online examination centre, conference facility, guest house and library facilities.

Sugarcame variety CoLk 94184

Multi tasker sugarcane planter

ICAR-National Bureau of Plant Genetic Resources

1. Contact details

i. Postal Address: ICAR-NBPGR, Pusa Campus, New Delhi- 110012, INDIA

ii. Name of the Director: Dr ASHOK KUMAR

iii. Email address: director.nbpgr@icar.gov.in; Phone No.: 91-11-25802780; 91-11-25843697

2. Mandate and activities

- Management and promotion of sustainable use of plant genetic and genomic resources of agri-horticultural crops and to carry out related research.
- Coordination and capacity building in PGR management and policy issues governing access and benefit sharing of their use.
- Molecular profile of varieties of agri-horticultural crop and GM detection technology research.

3. Salient achievements

- The institute acts as National Genebank (NGB) repository which is the second largest in the world, in terms of germplasm holdings (~4.6 lakh accessions), has conserved *ex situ* in the form of seeds/embryo/embryonic axes/ meristems/ DNA as well as whole plants. It currently holds 4,62,466 accessions belonging to 1991 species of agri-horticultural crops and their wild & weedy relatives. In addition, 1,943 accessions are conserved *in vitro* and 14,468 accessions have been cryopreserved. In the last five years over 64,742 germplasm accessions were provided in the national agricultural system.
- A total of 2,835 explorations executed and 2,81,610 accessions of different crops have been collected so far. In addition, >23,665 herbarium specimens of 4,271 species belonging to 1,521 genera and 267 families are conserved in National Herbarium of Cultivated Plants (NHCP).
- Stringent quarantine examination of 49,97,795 imported samples resulted in interception of 78 exotic pests of quarantine significance including insects/ mites (26), fungi (6), viruses (19), nematodes (9) and weeds (18) preventing possible yield losses in the event of their introduction into the country.
- Institute is ISO 9001:2008 certified for Quality Management System in the mandated PGR activities (w.e.f. 7.3.2015).
- Its GM Detection Facility is designated as a 'National Referral Laboratory' to detect the presence/absence of LMOs and GMOs under the Seeds Act, 1966 (w.e.f. 15.11.2017) and accredited as per international standard ISO/IEC 17025:2005 (w.e.f. 29.06.2018).

4. Knowledge/skill/technologies/products other services available for different stake holders

Various services provided by Bureau include:

- DNA fingerprinting of released varieties in the country.
- National supply of germplasm to various stakeholders in the country.
- Import and export of PGR under exchange.
- Quarantine of imported PGR including transgenics and issue of Phytosanitary Certificate for PGR exported.
- Registration of germplasm for unique traits.
- GM Lab is gazette notified National Referral Laboratory to detect presence or absence of LMOs and GMOs.
- NHCP serves as a reference collection for identification, taxonomic studies and teaching of cultivated plants.
- NBPGR has been organizing trainings on PGR management, Biosecurity, GM detection, etc. It is the **Centre of Excellence for training on** *in vitro* **conservation and cryopreservation for Asia-Pacific Region (since 2006)**.

ICAR-National Institute for Biotic Stress Management

1. Contact details

i. Postal Address: ICAR-NIBSM, Baronda, Raipur 493225, Chhattisgarh

ii. Name of the Director: Dr. Probir Kumar Ghosh

iii. Email address/phone; director.nibsm@icar.gov.in / Phone No. (0) 771-2277333

2. Mandate and activities

- Basic, strategic and adaptive research on biotic stresses in agriculture.
- Development of quality human resources for academic excellence, linkage with various stakeholders for technology management and policy support research.

Activities

- Utilizing modern frontier science-based plant resistance sourcing and its exploitation.
- Understanding the biology of crops as influenced by biotic stresses.
- Holistic crop health management.
- Undertake relevant policy support research for biotic stress management.

3. Salient achievements

- Efforts of native bio-control agents identified three signature kairomones to enhance the parasitic activity of *Trichogramma*spp., *Bacillus thuringiensis* strains (three strains), endophytes (one strain), and bacteriophages (two strains) with enhanced antagonistic effects to microbial pathogens.
- Silicon application studies revealed its wide-spread involvement in imparting tolerance to borers in rice (yellow stem borer) and wheat (pink stem borer) and to improve crop-production traits.
- Pan India mapping of the genetic groups of white-fly (*Bemisiatabaci*) revealed prevalence of eleven distinct genetic groups. Three amongst these, viz., Asia II-3, Asia II-6 and Asia III are reported for the first time from India.
- Identified and characterized bacterial endophytes effective for biotic (*Sclerotium rolfsii)* and abiotic (drought) stresses withplant growth promotion activities in chickpea.
- Developed improved agro-inoculation method for Mungbean yellow mosaic India virus suitable for screening against yellow mosaic resistance in mungbean, giving 100 percent infection.

4. Knowledge/skill/technologies/products other services available for different stake holders

Following products are under large scale evaluation for finalization

1. Three native *Bacillus thuringiensis* (Bt) isolates are found to effective in causing mortality on *Spodopteralitura* both under lab and in planta conditions. One isolate is under large scale field evaluation.
2. Application of kairomone (Octadecane 500 ppm)gel formulation enhanced the parasitic activity of *Trichogramma japonicum* by reducing the damage caused by rice yellow stem borer.

Developed Improved agroinoculation method for screening against yellow mosaic disease for resistance in mungbean giving 100 % infection

ICAR-National Institute for Plant Biotechnology

1. Contact details

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Phone No.: 011-25848783/ 011-25841787/ 2584278

2. Mandate and activities

- To undertake basic plant molecular biology research for understanding molecular mechanisms underlying basic biological processes.
- To develop capabilities of devising tools and techniques of biotechnology and genetic engineering for crop improvement.
- To use the knowledge gained and technologies developed for advancing agriculture development.
- To serve as a national lead centre for plant molecular biology and biotechnology research and to create trained manpower in the areas of plant biotechnology and genetic engineering.

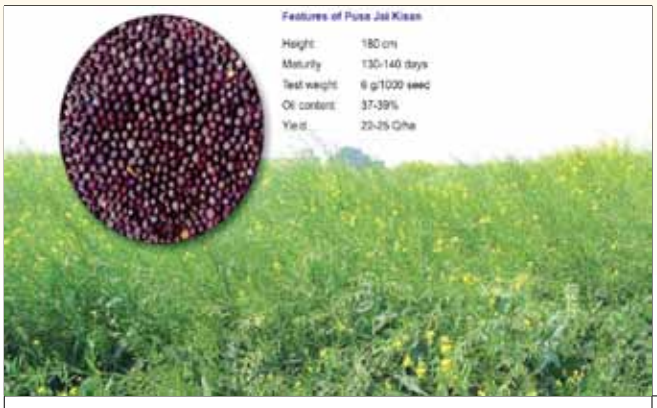
3. Salient achievements

- Development of mustard variety, PusaJaikisan
- Complete genome sequences of 11 crop species
- Development of blight resistant rice variety, Improved Pusa Bsamati-1, through MAS
- Identification of gene *(Pi*-54) for blast resistance in rice and development of tolerant varieties by transfer of this gene.
- Nagina 22 mutant repository from which herbicide tolerance was identified and transferred to rice variety

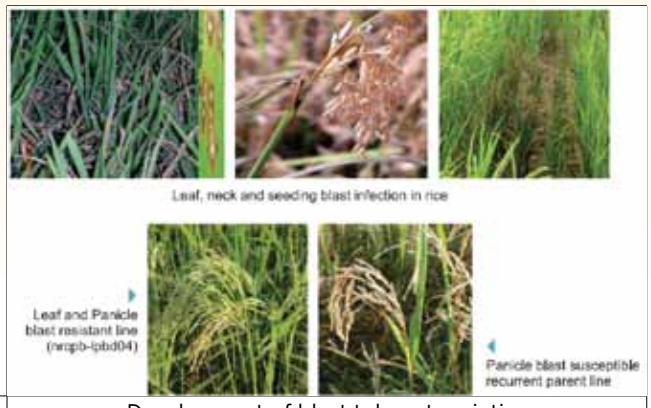
4. Knowledge/skill/technologies/products other services available for different stake holders

- Development of SNP chips in rice (commercialized), Pigeonpea and mango for genotyping and mapping purposes

- Development of improved varieties in rice, Pigeonpea, chickpea and mustard in collaboration with other ICAR Institutes
- Male sterile lines with restorer in Brassica species for hybrid seed production



A high yielding mustard variety called 'Pusa Jai Kisan'



Development of blast tolerant varieties by transfer of *Pi-54* gene

ICAR-National Rice Research Institute

1. Contact details

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Phone: +91-671-2367757/67; EPBX: +91-671-2367768-783 Fax: +91-671-2367663

2. Mandate and activities

- Conduct basic, applied and adaptive research on crop improvement and resource management for increasing and stabilizing rice productivity in all ecologies with special emphasis on rainfed ecosystems and related abiotic stresses.
- Generation of appropriate technology through applied research for sustainable increase in productivity and income from rice and rice-based cropping/farming systems in all the ecosystems in view of decline in per capita availability of land.
- Maintain database on rice ecology, ecosystems, farming situations and comprehensive rice statistics for the country as a whole in relation to their potential productivity and profitability.
- Impart training to rice research workers, trainers and subject matter/extension specialists on improved rice production and rice-based cropping and farming systems.

Activities

i. Genetic improvement of rice for enhancing yield, quality, and climate resilience

ii. Enhancing the productivity, sustainability and resilience of the rice-based system

iii. Biotic Stress Management in Rice

iv. Photosynthetic Enhancement, Abiotic Stress Tolerance and Grain Nutritional Quality in Rice

v. Research to enhance socio-economic wellbeing of rice stakeholders

vi. Development of climate resilient rice technologies for rainfed upland, rainfed lowland and coastal ecology.

3. Salient achievements

i. Rice Varieties Developed: One hundred and fifty-nine (159)

ii. Patents Granted: Two

iii. Developed Solar based “Alternate Energy Light Trap (AELT)”.

iv. Mobile Apps developed: riceXpert; csaXpert; riceNxpert; paddyseedXpert

v. Developed visual diagnostic tool for identification and management of nutrient disorders and diseases in rice

vi. Developed Water footprint of rice in India.

vii. Extension Model developed: two (4S4R and INSPIRE1 &1)

4. Knowledge/skill/technologies/products other services available for different stake holders

- Quality seed production of High yielding varieties and High Protein Rice.
- Capacity building programmes in Good Agricultural Practices of rice.

Promising rice varieties: Bio-fortified {CR Dhan 310 (high protein 10.4%) and CR Dhan 315 (high zinc 25.0ppm)}, Climate resilient CR Dhan 801 (both for drought and submergence tolerance) and Hybrid rice (Rajalaxmi).

ICAR-National Bureau of Agriculturally Important Microorganisms

1. Contact details

i. Postal address: ICAR-National Bureau of Agriculturally Important Microorganisms (ICAR-NBAIM), Kushmaur, Maunath Bhanjan, 275103, U.P.

ii. Name of the Director (A): Dr. Harsh Vardhan Singh

iii. Email/phone: director.nbaim@icar.gov.in Phone: 0547-2970726, 2970727

2. Mandate and activities

- To act as the nodal Institute at national level for acquisition and management of indigenous and exotic microbial genetic resources for food and agriculture, and
- To carry out related research and human resource development, for sustainable growth of agriculture.

Activities

- Exploration and collection, Identification, characterization, documentation, Conservation, maintenance and utilization of AIM, Microbial biodiversity and systematics, and Human Resources Development (HRD).
- The Bureau has Research and Service functions. In addition extension activities are being taken up for the benefit of the farmers to propagate microbe based low cost technologies.

3. Salient achievements

- The Bureau has acquired the status of International Depository Authority (IDA) by World Intellectual Property Organization (WIPO), Geneva in 2020.
- NAIMCC was also adopted as member of The Asian Consortium for the Conservation and Sustainable Use of Microbial Resources (ACM) in 2020.
- The Bureau acts a depository for agriculturally important microorganisms with than 7650 microbial cultures at NAIMCC and maintains a core collection of
- Discovered two novel bacterial species
- Genomic facility: The Bureau has done countries' first complete draft genome sequencing of *Mesorhizobium ciceri* strain Ca181 in 2011, whole genome sequencing of various agriculturally important microbes *Exiguobacterium profundum* PHM 11, *Bacillus subtilis* RC 25, *Pseudomonas azotoformans* SC 14, *Chromohalobacter salexigens* ANJ 207, *Fusarium udum* F-02845, *Pseudomonas koreensis* P2 and *Staphylococcus xylosus* LSR_02N
- The Bureau has developed diagnostic markers for fungal pathogens

- Microbe based technologies developed for nutrient and biotic-abiotic stress management

4. Knowledge/skill/technologies/products other services available for different stake holders

- Bureau has developed several microbe based technologies for various stakeholders and are available for commercialization viz., Bio Bacter, Bio Phos, Bio Phos+, Bio Potash, Bio NPK, Bio Grow, Bio Zn, RhizoNBAIM-C, RhizoNBAIM-A, Bio Sulphur, Bio Shakti 1, Bio Shakti 2, ZincFort, IronFort, Bio Sanjeevni, EndoBio-I, Endo-Pro, Eco-Pesticide, Bio-Pulse, Green Fungicide, Eco-Green Fungicide, Vardan-1, Bio-Care, Crop Care, Palm Raksha, Palm Amrut, Bio Compost

Control	BioNPK treated

Bio NPK Liquid Biofertilizer comprising nitrogen (N_2) fixing (*Azotobacter chroococum*), P-solubilizing (*Paenibacillus tylopili*) and K-solubilizing (*Bacillus decolorationis*) bacteria for augment ing 25-30 kg N, 20-25 kg P_2O_5, and 10-15 kg K ha^{-1}

ICAR-Indian Institute of Oilseeds Research

1. Contact details

i. Postal address: Director, ICAR-Indian Institute of Oilseeds Research (IIOR), Rajendranagar Hyderabad – 500 030

ii. Name of the Director : Dr. M. Sujatha

iii. E-mail address: director.iior@icar.gov.in; Phone: 040-24598444, 24016141

2. Mandate and activities

- Basic and strategic research to augment the productivity, oil content and quality of castor, sunflower, safflower, sesame, niger and linseed
- Information management on oilseeds to develop policy framework for research and development strategy
- Coordination of applied research on national and regional issues to develop location specific varieties and technologies
- Dissemination of technology and capacity building

Activities

- Activities for development of improved varieties/hybrids of castor, sunflower, sesame, linseed and safflower and production and protection technologies to enhance the productivity of oil crops and their dissemination.

3. Salient achievements

- Facilitated the development and release of 30 varieties and 23 hybrids in castor; 21 varieties and 33 hybrids in sunflower; 43 varieties and five hybrids in safflower; 93 varieties in sesame and 54 varieties in linseed.
- Developed a new cytoplasmic male sterile line in sunflower using the wild species Helianthus argophyllus [assigned the International FAO Code 'ARG-6'] and tagged the fertility restorer gene using sunflower specific simple sequence repeat marker.
- Developed and recommended region and crop-specific remunerative cropping systems, cultural practices and nutrient management packages for maximizing the productivity on a sustainable basis.
- Registered three bio-pesticides *viz.*, DOR Bt-1 WP formulation to manage pod borer (*Helicoverpa armigera*) in pigeonpea, DOR *Trichoderma harzianum* Th4d SC formulation to control major diseases in castor, sunflower and safflower and *Beauveria bassiana* SC formulation to manage capitulum borer/pod borer (*H. armigera*) in sunflower and pigeonpea with the CIB&RC and licensed these technologies to 46, 4 and 4 private entrepreneurs,

respectively. Rs. 1.32 crore generated through licensing of three biopesticide technologies such as, Bt-1, *B. bassiana* and Th4d formulations.

- Developed seed priming technology based on biopolymer chitosan + *Trichoderma harzianum* Th4d for management of *Fusarium* wilt in castor and *Macrophomina* root rot in safflower.
- Promising hybrids of sunflower and varieties of sesame were evaluated in North Eastern Hill states in order to promote area expansion and crop diversification in non-traditional areas. Short duration sunflower hybrids KBSH-78 and CO-2 and sesame varieties GT-10 and CUMS-17 were found suitable in rice fallow areas of NEH regions.

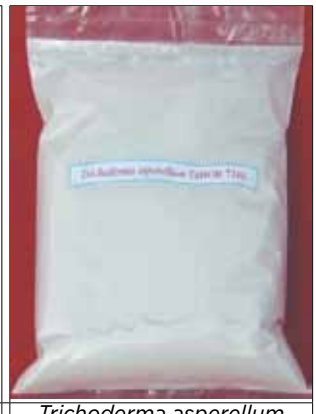
4. Knowledge/skill/technologies/products other services available for different stake holders

- *Bacillus thuringiensis* var. *kurstaki* WP formulation
- *Beauveria bassiana* SC formulation
- *Trichoderma harzianum* (Th4d) liquid formulation
- *Trichoderma asperellum* Ta 7316 5% WP (Th4d) liquid formulation
- Castor hybrids (DCH-519, DCH-177, ICH-66, ICH-5); Sunflower hybrids (DRSH-1, TilhanTec SUNH-1), safflower variety (ISF-1, ISF-764).

Bacillus thuringiensis var. *kurstaki* WP formulation

Beauveria bassiana SC formulation

Trichoderma harzianum (Th4d) Powder formulation



Trichoderma asperellum Ta 7316 5% WP (Th4d) Powder formulation

ICAR-Indian Grassland and Fodder Research Institute

1. Contact details

i. Postal Address: ICAR-IGFRI, Near Pahuj Dam Gwalior Road, Jhansi 284003 UP

ii. Name of the Director: Dr. Amaresh Chandra

iii. Email Address/phone: director.igfri@icar.gov.in/ Phone No.: +91 510 2730688, Mob.-9450041285

2. Mandate and activities

- Basic, strategic and adaptive research on improvement, production and utilization of fodder crops and grasslands.
- Coordination of research on forages and grasslands for enhancing productivity and quality for enhancing livestock productivity.
- Technology dissemination and human resource development.

3. Salient achievements

- Technology for round the year fodder production system for irrigated situation & perennial grassland
- High density nursery for Bajra-Napier hybrid multiplication for easy multiplication of rooted slips
- Fodder production through cultivation of perennial fodder crops in inter-row spaces of mango orchards
- Developed 16 varieties of Leguminous Fodder Crops and 29 varieties of Grasses & Cereal Fodder Crops
- Developed 6 machinery/prototypes (Grass seed harvester, Defluffing machine, Berseem Chicory seed separator, Berseem Seed Drill, evaporative cool hydroponic fodder production system and Urea treatment gadget)
- National Fodder Resource Development Plan: As part of NIAFTA, State level workshops conducted for 26 states and 20 states specific Fodder resource development plan published

4. Knowledge/skill/technologies/products other services available for different stake holders

- Regular trainings on fodder production &utilization to state govt. officials/NGOs/Gaushalas
- Distribution of Seed & planting material to farmers

- Weather advisory given to farmers though M-Kisan Portal
- Services of Agri-Business Incubation Centre for entrepreneurship
- Short videos on You tubes on fodder production & associated technologies.
- Consultancy for grassland & pasture rejuvenation/development
- Soil & Plant analysis
- Complete Feed Block- A balance ration for livestock; Total mixed ration for goat; Feed Pellets, Area Specific Mineral mixture, Phosphate solubilizing biofertilizers suitable for fodder crops of problem soils.

Seasonal fodder crops inter-planted with perennial grass has much higher fodder production round the year

Defluffing machine

ICAR-Indian Institute of Soybean Research, Indore

1. Contact details

i. Postal Address: ICAR-IISRI, Khandwa Road, Indore (Madhya Pradesh)-452001, INDIA

ii. Name of the Director: Dr. Nita Khandekar

iii. Email address: director.soybean@icar.gov.in; dsrdirector@gmail.com Phone: 9448737473, +91-731-24761888

2. Mandate and activities

- Basic, strategic and adaptive research on soybean for improving productivity and quality
- Provide access to information, knowledge and genetic material to develop improved technology and enhanced soybean production.
- Coordination of applied research to develop location specific varieties and technologies;
- Dissemination of technology and capacity building

Activities

- Augmentation, conservation and management of soybean genetic resources in the country
- Breeding for yield enhancement and associated characters, resistance/tolerance to biotic and abiotic stresses and for quality enhancement of soybean
- Coordination of multi-location research and breeder seed production in the country through AICRP on Soybean
- Development of technologies for integrated pest and disease management.
- Development of farm machinery for soybean
- Identification and use of soil rhizospheric microbes for sustainable soybean production,
- Transfer of technology, impact assessment and development of user-friendly software for efficient data management and technology dissemination

3. Salient achievements

- Released 15 varieties including drought tolerant, null KTi, first lipoxygenase 2 free, first double null variety for KTi and Lox 2, as well as, early maturing, high yielding varieties with biotic and abiotic stresses
- Developed improved production technologies

- Technology for seeds treatment for effective biocontrol method against lepidopteran insects of soybean.
- Development of web-based applications, interactive Mobile App- Soybean Gyan etc.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Set-up agri-business incubation centre with incubates/ startups have been inducted for development and promotion of soya-based food products, microbial biofertilizer and quality seed production
- Fifteen technologies related to farm implements, specialty soybean varieties and microbial technologies were commercialized to Agri-input companies.

IS 130

ICAR-Directorate of Rapeseed-Mustard Research

1. Contact details

i. Postal Address: ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321303 (Rajasthan)

ii. Name of the Director : Dr. Pramod Kumar Rai

iii. Email address: director.drmr@gmai.com, Phone No. : 05644-260379, 260495

2. Mandate and activities

- Basic, strategic and adaptive research on rapeseed-mustard to improve the productivity and quality.
- Provide equitable access to information, knowledge and genetic material to develop improved varieties and technologies.
- Coordination of applied research to develop location specific varieties and technologies.
- Technology dissemination and capacity building.

Activities

- Utilizing frontier research for better exploitation of genetic resources.
- Development and identification of appropriate production and protection technologies.
- Capacity building and knowledge management through technology assessment, refinement and dissemination.

3. Salient achievements

- 274 rapeseed-mustard varieties were developed till year, 2021. There are 64 varieties of rapeseed-mustard are in seed chain for breeder seed production and 57 varieties are since 2010.
- Bio-fortified Indian mustard varieties viz., Pusa Double Zero Mustard-31 (PDZM 31) and PDZM 33, RLC 3 and six varieties of Gobhi sarson were developed.
- Indian mustard hybrid NRCHB 506 and varieties NRCDR 2, NRCHB 101 and DRMR IJ-31, developed at DRMR and licensed.
- More than 50 crop production and protection technologies were developed through ICAR-DRMR and AICRP-RM coordinating centres.
- A web based expert system of crop variety selection and a mobile app on Mustard farming (Hindi & English) was developed and popularized among farmers.
- Popularizing rapeseed-mustard cultivation in rice–fallow areas of eastern states, NEH and non-traditional areas.

- Under mustard seed-hub project a total of 4178.65q certified seed of rapeseed-mustard was produced during rabi 2019-2020.
- Mustard value chain established at 10 different locations including NEH states.

4. Knowledge/skill/technologies/products other services available for different stake holders

- High yielding rapeseed-mustard varieties for different agro-climatic zones of India.
- Crop production and protection technologies for high productivity of rapeseed-mustard.
- Web based expert systems and mobile apps
- Non-exclusive licensing for seed production and other technologies.
- Capacity building of farmers and extension personnel and skill development training and consulting services.

Indian mustard variety DRMR IJ 31 (Giriraj)


Farm women in FLD on Indian mustard NRCHB 101 in Assam

Indian mustard variety DRMR 150-35

ICAR-Indian Agricultural Research Institute (Assam)

1. Contact details

i. Postal Address: ICAR- Indian Agricultural Research Institute, Dirpai Chapori, Gogamukh – 787035 (Assam)

ii. Name of the Nodal Officer : Dr. Khem Bahadur Pun

iii. e-mail: iariassam2017@gmail.com; Phone No. +91-7011540122

2. Mandate and activities

IARI-Assam is unique in its structure, functioning, mandate and objectives that are specific to the North Eastern states:

Post Graduate Education

- Promote excellence, foster high standard research for holistic agrarian development and orient the educational programme towards future needs and opportunities in South East Asia.
- Strengthen formal/non-formal training to promote entrepreneurial skills for commercialization of agriculture in the region through different diploma courses in the line of poly techniques.

Research

- Conservation and utilization of biotic resources of North East India for higher farm productivity and industrial uses.
- Acid soil management vis-à-vis development of crop varieties and technologies suitable for acidic soil of North East India.
- Productive utilization of water resources through multi-disciplinary research
- Develop appropriate cropping systems to attain multiple cropping for increasing productivity with long term sustainability in the North Eastern states.
- Develop integrated farming system models & to promote organic agriculture.
- Develop horticulture and animal husbandry-based diversified farming system modules to promote rural entrepreneurship.
- Effective postharvest management and value addition using appropriate food engineering protocols to enhance farm income and promote agribusiness.

Outreach

- Generate innovative extension models, dovetail them to developmental models, and disseminate them through KVKs, state agricultural universities and state agricultural

extension and other development departments of different states of the North-East India.

- Promote client oriented on-farm/farm innovation research and technology assessment, refinement and transfer through participatory approaches on convergence mode.
- Foster development in communication research and linkages with rural development programmes and strengthen micro-planning through inter-departmental and participatory approaches.

3. Salient Achievements

Establishment activities:

- Of the allotted land area (587 acres), 44 acres are currently being developed in to academic-cum-residential campus. Shaikshanik Bhawan (a Prefabricated building) & 1853 m boundary wall around 44 acres were completed.
- The campus of ICAR-IARI, Gogamukh (Assam) was inaugurated by Hon'ble Minister of Agriculture & Farmers Welfare, GOI, Shri Narendra Singh Tomar ji on the 25th September, 2020.
- Construction of Academic-cum-Administrative Building was completed inJune 2022.

Academic activities:

- From the academic session of 2015-16, students of IARI-Assam are being admitted at IARI-New Delhi for M.Sc. Programme each year in four teaching disciplines.39 students have completed M. Sc. Programme and 25 students are currently undergoing M. Sc. Programme.
- Field research work on various problems pertaining to the North Eastern region is being carried out by the students in the region itself.

Inputs Supplied:

For the extension of the technologies generated by ICAR, Seeds amounting to 2.39 Crores were distributed under NEH scheme for demonstrations at farmers' fields in Assam through Krishi Vigyan Kendras under the Director, ATARI, Zone-VI, Guwahati (Assam) during 2019-2022.

4 Knowledge/skill/technologies/products other services available for different stake holders

Scientists belonging to the disciplines of Agricultural Statistics, Fruit Science, Aquaculture, Fish Health, Agricultural Processes &Structural Engineering, Spices and Medicinal plants are acting as the resource persons for different stakeholders.

Main Gate

Academic-cum-Administrative Building

ICAR-Indian Agricultural Research Institute (Jharkhand)

1. Contact details

i. Postal Address : ICAR-Indian Agricultural Research Institute-Jharkhand Gauria Karma, Barhi, Hazaribagh, Jharkhand -825405

ii. Name of the Director : Dr. Ashok Kumar Singh

iii. Email Address/ Phone No.: iarijharkhand@gmail.com

2. Mandate and activities

- Conducting basic, strategic and anticipatory research in the field of agriculture and allied sector for enhanced productivity quality and livelihood security.

Activities:

a) Education:

(i) To promote excellence and foster high standard of education for holistic agrarian development in region

(ii) To orient the education program towards future needs and opportunities present in the area.

(iii) Strengthen non-formal training to promote entrepreneurial skills for commercialization of agriculture.

(iv) To develop quality human resources in agriculture and allied sector to cater the future needs.

b) Research:

(i) To increase the utilization of water resources through multi-disciplinary research on water harvesting, micro irrigation, enhancing WUE to achieve higher factor productivity.

(ii) To develop alternate cropping systems to attain multiple cropping and increase the productivity in the eastern states.

(iii) Develop integrated farming systems models for the eastern states keeping in view of the specific requirements of the region.

(iv) Develop horticulture and animal husbandry-based diversification systems to promote rural entrepreneurship.

(v) Develop effective postharvest management and value-addition protocols for agri-produce to enhance the farm income and longer period of availability.

c) Outreach

(i) Develop innovative extension models, dovetail them to developmental models, and disseminate them through KVKs, State Agricultural Universities and State extension and development departments in different states of the eastern India.

(ii) Promote client oriented on-farm research and technology assessment, refinement and transfer through participatory approaches.

(iii) Foster development in communication research and linkages with development programmes

3. Salient achievements

- Initiated research on assessment of various rhizobacteria based bioinoculations for wheat ; the impact of rice straw derived biochar on productivity of rice-wheat system in acidic soil ; evaluation of fodder varieties of bajra-napier hybrids like IGFRI-10, Co-1, Co-5 and Kamdhenu in agro-climatic conditions of Jharkhand and recorded yield potential of 140-200 tones/ha with 8-10 cuts in years and hence could sustain milk production in livestock by feeding these fodder round the year.
- Three plant types of Papaya (JHP-4 yielded 40.59 kg fruit weight (First crop & 8 months duration) followed by JHP-5 (32.758) and JHP-6 (19.38). JHP-4 recorded an average fruit weight of 2.255 kg with saffron color pulp and 16.00 TSS) have been identified for higher yield and other horticulture traits in the Jharkhand.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Integrated Farming System Models of ICAR institutes which are suitable for Eastern Region of India.
- Technical backstopping and related farm advisory & consultancy services for promoting agri-start-ups in different enterprises of agriculture and allied sectors
- Participatory Production, procurement and distribution of quality planting materials like seeds of improved varieties of different crops.

Administrative Building

Papaya varieties identified for higher yield and other horticulture traits in the Jharkhand

Horticultural Science

ICAR-Central Citrus Research Institute

1. Contact details

i. Postal Address: ICAR-CCRI, PB No.464 Shankar Nagar P.O., Nagpur- 440010

ii. Name of the Director: Dr Dilip Ghosh

iii. Email Address/Phone Number: director.ccri@icar.gov.in 0712-2500813

2. Mandate and activities

- To undertake basic and applied research for developing technologies for improvement and increased productivity in citrus.
- To act as a repository for genetic resources and scientific information relating to citrus.
- To undertake research to develop technologies for better shelf life and utilization of citrus fruits considering domestic and export needs.
- To act as a Centre for training in advanced research methodologies and technology upgradation in citrus.
- To collaborate with relevant national and international organizations/ Govt. agencies for citrus research and technology dissemination.
- To provide consultancy services and undertake contract research to solve the problems of citrus industry

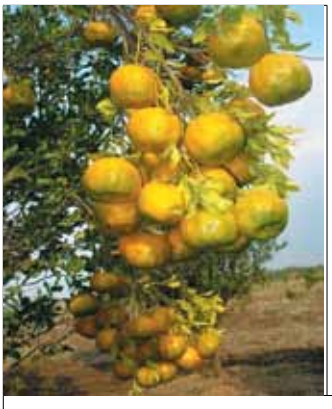
3. Salient achievements

- The protocol for containerized disease-free planting material of citrus standardized and till date more than 50 lakhs disease-free plants of different cultivars of citrus has been produced and distributed.
- Institute has released nine varieties *viz.*, Cutter Valencia, Flame Grapefruit, NRCC Pummelo-5, NRCC mandarin seedless-4, NRCC Acid lime-7, NRCC Acid lime-8, Pummelo US-145, NRCC Grapefruit-6 and Alemow rootstock. Three varieties *viz.*, Cutter Valencia, Flame Grapefruit and NRCC Pummelo-5 released by SVRC, Maharashtra for cultivation in Maharashtra.

- STG and micro-budding technique standardized for scientific citrus nursery development.
- Diagnostic tools for insect-pest and diseases has been developed for sensitive detection and also eco-friendly management.
- Developed and commercialized value added products *viz.*, RTS and carbonated beverages from acid lime, Nagpur mandarin and nutri-jelly from acid lime.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Protocol for containerized disease-free planting material of citrus standardized.
- Micro-budding technique standardized for scientific citrus nursery development.
- Protocol for value added products.
- Diagnostic tools for insect-pest and diseases has been developed.
- Training module for producing disease free planting material.



Nagpur mandarin

NRCC Acid lime

ICAR-Central Institute for Arid Horticulture

1. Contact details

i. Postal Address: ICAR-CIAH, Sri Ganganagar Rd, Bichhwal, Beechhwal Rural, Rajasthan 334006

ii. Name of the Director: Dr DK Samadiya (Act.)

iii. Email Address: director.ciah@icar.gov.in; Phone No: 0151-2250147

2. Mandate and activities

- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of horticultural crops of arid and semi-arid regions.
- Repository of genetic resources and scientific information on horticultural crops of arid and semi-arid region.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies on fruit crops of arid and semi-arid regions.

3. Salient achievements

- Maintained 64 germplasm of date palm under national field repository.
- Two elite male palm (CIAH/DP/M-01 IC-0632315 and CIAH/DP/M-03 IC-0624490) were identified for more pollen production.
- Rain tolerant or late maturing genotype (IC-0624544) in date palm identified.
- Identified suitable cultivars (fresh fruit-Barhee, Halawy, Khuneize for pind-Dhamas, Nagal for dry date-Medjool) for commercial cultivation of date palm in arid region.
- Standardized somatic embryogenesis protocol of tissue culture and cell suspension culture system.
- Standardized protocol for primary and secondary hardening of tissue culture plants in date palm cultivar Halawy and Khalas.
- Standardized propagation through offshoot production technology in date palm.
- Standardized protocol for dry date and browning reduction in date palm during storage.
- Major insect (white scale, red palm weevil, lesser date moth, rhinoceros beetle) and disease (*Alternaria* leaf spot) were identified and management major recommended.

4. Knowledge /skill/technologies/products/other services available for different stakeholders

- Protocol for production of disease free quality planting material of arid fruits..
- Tissue culture technique standardized for date palm.
- Protocol for value added products.
- Training module for producing disease free planting material.

CIAH Bael var. Thar Srishti

ICAR-Central Institute for Subtropical Horticulture

1. Contact details

i. Postal Address: ICAR-CISH, Rehmankhera, P.O, Kakori, Uttar Pradesh 226101

ii. Name of the Director: Dr Neelima Garg (Act.)

iii. Email Address/Phone Number: director.cish@icar.gov.in: 0522-2841022

2. Mandate and activities

- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of subtropical horticultural crops.
- Repository of subtropical horticultural crop genetic resources and scientific information.
- Transfer of technology, capacity building and impact assessment of technologies.

Activities

- Management of genetic resources of mandated fruit crops and their conventional and molecular characterization.
- Crop improvement through breeding and genetic engineering.
- Enhancing productivity through improving quality and quantity of planting material using modern propagation techniques and root stocks, precision farming practices including mechanization and management of biotic and abiotic stresses.
- Reduction in post harvest losses through improved post harvest management practices, value addition and diversification of products.
- Human resource development, transfer of technology and evaluation of its socio-economic impact.
- Data storage and retrieval on all aspects of mandated crops.

3. Salient achievements

- Institute has developed two **mango** varieties viz. CISH Ambika, a regular bearing hybrid for export market and CISH Arunika to overcome the problem of biennial bearing; four **guava** varieties viz. CISH Lalit, CISH Shweta, CISH Dhawal and CISH Lalima from open pollinated seedling selections; CISH Jamwant, an improved variety of **jamun** and identified three **bael** varieties (CISH B-1, CISH B-2 and CISH B-3); one promising accession of **jamun** (CISH J-42) and two nutraceutically rich **aonla** selections (CISH A-31 and CISH A-33).

- Institute has identified two mango rootstocks (ML-1 and ML-2) for salinity tolerance (>9pH), mango hybrids (H-1748, H-4104, H-4065, H-4133) and seven guava hybrids for high lycopene and soft seeds.
- Institute has GI tagged the mango variety Rataul.
- Developed rapid multiplication technique (Wedge grafting) for multiplying guava and other subtropical fruits throughout the year in greenhouse as well as in open conditions, which is well adopted by 119 accredited nurseries for the multiplication of mango, guava, bael and aonla.
- Standardized rejuvenation technologies for improving productivity of old and unproductive orchards of mango, guava and aonla. Around 11,600 ha area has been brought under mango rejuvenation in U.P. and Bihar to the tune of 10-12 ton/ha.
- High density planting in mango cv. Dashehari with 400 plants ha-1(5.0 x 5.0 m) and guava cv. Allahabad Safeda and Lalit with 555 plants ha-1 (3.0x6.0 m) was optimized.
- Developed Espalier architecture for high yield and quality guava production in HDP [Yield: 31 t/ha (18t/ha in traditional cultivation)].
- Designed low cost hydroponics models for urban horticulture.
- CISH Bio-enhancer developed and commercialized. Yield enhancement: 8-10 % in vegetables.
- Banana wilt disease caused by FOC TR-4 mitigated through ICAR-FUSICONT technology jointly developed with ICAR-CSSRI, Lucknow.
- Developed a novel tissue culture technology for production of FOC TR-4 tolerant banana plants using bio-immuno compound at *in vitro* stage.
- Protocol has been standardized for export of Dashehari mango by sea route in collaboration with NHBHIMA Technology development and validation led to export of Dashehari mango to the tune of 1758.2 tons.
- Eleven technologies of amla prash, aonla cider, aonla fibre biscuit, aonla tea, aonla-fennel squash and RTS, aonla-coriander squash and RTS, aonla-dill squash and RTS and vinegar have been commercialized.
- Insect trap technologies [Rain-proof and long lasting fruit fly traps technology for fruit (CISH-OMAT) and vegetables (CISH-VMAT) crops, CISH Glue Trap (Multi-layered, white oil glue based long-lasting insect sticky trap for agriculture use), CISH Trap-1 (Automated colour changing solar light insect trap with CFL having restrictor with regulated crop area illumination), CISH Trap-2 (Solar operated dual UV light automated Agricultural insect trap with restrictor having regulated crop area illumination), CISH Trap-3 (Automatic electrical UV light source trap with restrictor having regulated crop area illumination), CISH Trap Container (Rain proof fruit fly container)] developed and commercialized.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Institute produces and sales healthy and genuine planting materials of different varieties of mango, guava, aonla and bael.
- Institute incubates entrepreneurs through Agri-Business Incubation Centre (ABI), recently established at the Institute.
- Advisories are being issued through Institute website, publishing opinion on print media, interviews in electronic media and through ICT tools and reply to farmer's calls.
- Institute provides consultancy service and technical guidance to farmers and different agencies.
- Institute provides testing facilities, viz. soil and leaf analysis, evaluation of chemicals/ fungicides/ insecticides.

H-4104 (promising mango hybrid)

H-4133 (promising mango hybrid)

ICAR-Central Institute of Temperate Horticulture

1. Contact details

i. Postal Address: ICAR-CITH Old Airport Rd, Rangreth, Srinagar, Jammu and Kashmir 190007

ii. Name of the Director: Dr Om Chand Sharma (Act.)

iii. Email Address/Phone Number: director.cith@icar.gov.in: 0194-2305044

2. Mandate and activities

- To act as national repository of germplasm & scientific information on temperate horticultural crops.
- To undertake basic, strategic and applied research on temperate horticultural crops in collaboration with national and international agencies to enhance productivity and quality.
- To serve as centre of training for human resource development & transfer of technology.

Activities

- Establishment of field gene bank and management of genetic resources and scientific data base of temperate horticultural crops.
- Genetic improvement of temperate horticultural crops for yield, maturity, quality, resistance to biotic and abiotic stresses through conventional breeding methods and use of biotechnological tools.
- Standardization of nursery management and high tech propagation techniques of temperate horticultural crops.
- To device efficient and cost effective production technologies and cropping systems for increasing productivity and improving quality of temperate horticultural crops.
- To develop eco-friendly integrated disease/pest management modules and diagnostics.
- Post-harvest value addition, product diversification and waste utilization for increasing availability and returns.
- To work out economics of production and impact assessment of technologies.
- Commercialization and transfer of technologies and skilled manpower development.

3. Salient achievements

- Institute has maintained about2800 germplasm accessions of temperate horticultural crops.

- Institute has released 17 varieties in different crops having higher productivity and quality (Walnut-10, Apricot-3, Cherry-2, Apple-1 and Garlic-1). Four walnut varieties (CITH-W-1, CITH-W-2, CITH-W-3 and CITH-W-4) and have been protected under PPV&FRA.
- In apple, three varieties (Ammol, Golden Snow and Amrit) have been developed with better fruit quality and three varieties (Priame, Pritor and Pride) have been developed as scab resistant varieties.
- In garlic, CITH-G 3is recommended for release by AINRP on O&G.
- In exotic vegetables, one variety each of Broccoli (CITH –Broccoli-1), Chinese cabbage (CITH C C-1), two varieties of Swiss Chard (CITH SC-Green & CITH SC-Red) have been developed.
- One hybrid of cabbage with bicoloured leaves has also been developed and ready for release.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Developed High density plantation in apple.
- Developed Medium and High density plantation in other temperate fruit crops like pear, plum, cherry, apricot, peach, almond and walnut.
- Developed Intensive saffron cultivation technology.
- Promoted indigenous high quality walnut varieties.
- Products like E-Nose, apricot fruit bar, cape goose berry jam, quince candy, dehydrated rose hips etc. developed.
- Services provided: NDDMA (Mobile App; Nutrient deficiency diagnose and manager in apple), PPA (Software application: Predictor and planner for almond) and Land use contingency planner for apple and walnut (Online Application: LUCP).

Apple var. Ammol

Apple var. Priame

Apple var. Golden Snow

ICAR-Central Island Agricultural Research Institute

1. Contact details

i. Postal Address: ICAR-CIARI, JP44+C84, Garacharama, Port Blair, Andaman and Nicobar Islands 744101

ii. Name of the Director: Dr Eaknath Bhanudasrao Chakurkar

iii. Email Address: director.ciari@icar.gov.in: Phone Number: 03192-250436

2. Mandate and activities

- To provide a research base to improve the productivity of agri-horticulture, livestock and fisheries of Andaman & Nicobar and Lakshadweep group of Islands through basic, applied and adaptive research.
- Conservation, characterization and sustainable utilization of natural resources and harnessing through post harvest and value addition.
- To standardize technologies for health coverage and bio security of plant, animal and fishery resources.
- To standardize techniques for capture and culture fisheries including coastal aquaculture
- Vulnerability studies of Island ecosystem and adaptive strategies to develop climate resilient agriculture.
- Transfer of technology, capacity building, policy support and market intelligence to stake holders.

Activities

- Conservation and utilization of Island biodiversity
- Enhancing the productivity of agriculture, livestock, and fisheries sector.
- Management of biotic and abiotic stress.
- Frontier research for knowledge and increased productivity.

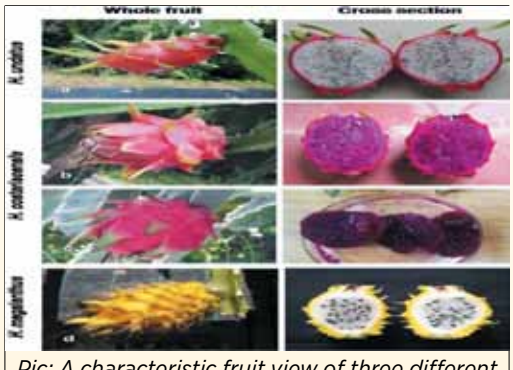
3. Salient achievements

- Developed varieties viz.*Piper pendulispicum*(woody pepper-rich in oleoresin content), *Haematocarpusvalidus*(Blood fruit – rich anthocyanin content, natural colourant), *Garciniaandamanica*(substitute for dry mango powder , dehydrated rinds as acidulant).
- Developed package and practices of Dragon fruit (15-20 kg fruits/pole).
- Developed Eco-friendly containers for horticulture nursery.

- Developed vegetative propagation protocol for Andaman Padauk (*Pterocarpusdalbergioides*).
- Developed Air layering in woody perennials for round the year production of planting material.
- Developed Soilless cultivation of Coriander (ArkaIsha) under Vertical Farming System.
- Developed Novel semi-intensive techniques for cultivation of Burmese Coriander (DweepHanGreens).
- Developed Integrated farming systems (IFS) for doubling farmers income.
- Developed Trimodel therapy (*DweepGauMaRakshak*) for treatment of hump sore in cattle: More than 200 farmers covered with 100 % success.
- Developed Herbal immune enhancer for poultry.
- Developed Mini incubator technology for rural poultry production.
- Developed Larval rearing technology for freshwater ornamental fancy guppy fish.
- Developed Herbal eye drop for treatment of conjunctivitis in livestock and poultry.
- Developed technology on Mitigation of Iron Deficient Anaemia (IDA) in piglets through 2-7-10-15 module of iron therapy.
- Developed FAFA MALAN CHART (FAMACHA) to detect anaemic status in goat and to correlate with parasitic.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Developed package and practices of Dragon fruit.
- Developed Eco-friendly containers for horticulture nursery.
- Developed vegetative propagation protocol for Andaman Padauk (*Pterocarpus dalbergioides*).
- Developed Integrated farming systems (IFS) for doubling farmers income.
- Developed Herbal immune enhancer for poultry.
- Developed Mini incubator technology for rural poultry production.
- Developed FAFA MALAN CHART (FAMACHA) to detect anaemic status in goat and to correlate with parasitic.



Pic: A characteristic fruit view of three different Hylocereus species of Kamalam fruit

ICAR-Central Plantation Crops Research Institute

1. Contact details

i. Postal Address: ICAR-CPCRI, Chowki, Kerala 671124

ii. Name of the Director: Dr Anitha Karun (Act.)

iii. Email Address/Phone Number: director.cpcri@icar.gov.in 04994-232333

2. Mandate and activities

- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of coconut, arecanut and cocoa.
- Repository of plantation crops genetic resources and scientific information.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies on plantation crops through AICRP on Palms.

3. Salient achievements

- World's largest repository of coconut germplasm with 455 accessions (323 indigenous and 132 exotic genotypes) is maintained in the Institute. The exotic collections are from 28 countries of South Asia, South-East Asia, Africa, Caribbean Islands, Indian Ocean Islands and Pacific Ocean Islands.
- ICAR-CPCRI is the National Active Germplasm Site for Plantation crops and host National Gene Banks for coconut, arecanut and cocoa.
- International Coconut Gene Bank for South Asia & Middle East (ICG -SA & ME) under tripartite agreement among ICAR-FAO-ITPGRFA is stationed at ICAR-CPCRI, RC, Kidu.
- Released fifteen improved varieties of coconut (Chandra Kalpa, Kera Chandra, Chowghat Orange Dwarf, Kalpa Pratibha, Kalpa Dhenu, Kalpa Mitra, Kalparaksha, Kalpasree, Kalpatharu, Kalpa Jyothi, Kalpa Surya, Kalpa Haritha, Kera Keralam, Kalpa Shatabdi and Kalpa Ratna).
- Released six high yielding hybrids of coconut (Chandra Sankara, Kera Sankara, Chandra Laksha, Kalpa Samrudhi, Kalpa Sankara and Kalpa Sreshta)
- Dwarf varieties namely Chowghat Orange Dwarf, Kalpa Jyothi and Kalpa Surya were released exclusively for tender coconut.

- Kalpa Pratibha, Kalpa Haritha, Kalpa Samrudhi, Chandra Sankara, Kalparaksha, Kera Chandra, Chandra Laksha, Kalpasree, Kalpa Shatabdi, Kalpa Sankara and Kalpa Sreshta are dual purpose varieties suitable for copra and tender nuts.
- In arecanut, 178 germplasm collections consisting of 23 exotic and 155 indigenous are conserved at ICAR-CPCRI, RS, Vittal.
- Eleven improved varieties of arecanut, including nine selections (Mangala, Sumangala, Sreemangala, Mohitnagar, Swarnamangala, Kahikuchi, Madhuramangala, Nalbari and Shatamangala) and two dwarf hybrids (VTLAH1 and VTLAH2) have been developed and released for cultivation.
- In cocoa, 515 germplasm collections including 475 exotic and 40 indigenous clones are conserved in field gene banks at ICAR-CPCRI, RS, Vittal, Karnataka.

4. Knowledge/skill/technologies/products other services available for different stake holders

- National Active Germplasm Site for Plantation crops and host National Gene Banks for coconut, arecanut and cocoa.
- International Coconut Gene Bank for South Asia & Middle East (ICG -SA & ME).
- Variety development protocol of coconut varieties.
- Varieties suitable for copra and tender nuts.
- Training module on plantation of coconut, arecanut, cocoa and on value added products.

Coconut var. Kalpa Ratna

Arecanut var. Shatamangala

Cocoa var. VTLCH6

ICAR-Central Tuber Crops Research Institute

1. Contact details

i. Postal Address: ICAR-CTCRI, PO, Amadi Nagar, Sreekariyam, Thiruvananthapuram, Kerala 695017

ii. Name of the Director: Dr MN Sheela (Act.)

iii. Email Address: director.ctcri@icar.gov.in, Phone Number: 0471-2598431

2. Mandate and activities

- To undertake basic, strategic and applied research for generating technologies to enhance productivity and utilization potential of tuber crops (other than potato).
- To act as a national repository of scientific information on tuber crops.
- To coordinate network research with State Agricultural Universities and ICAR Institutes for generating location specific technologies.
- To act as a centre for human resource development for various clientele systems involved in research and development of tuber crops.
- To undertake transfer of tuber crops technology through consultancy, outreach programmes and linkage with developmental agencies.

3. Salient achievements

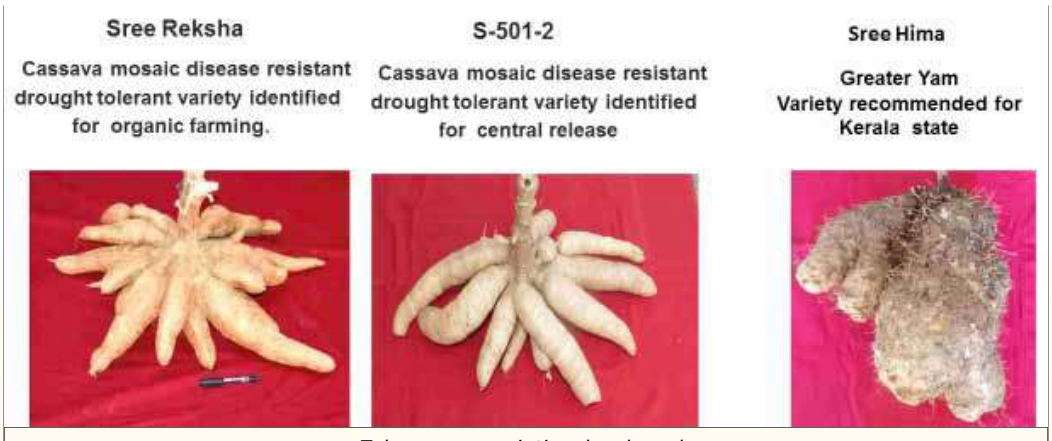
- ICAR-CTCRI has released 68 improved varieties in tropical tuber crops viz., cassava (19), sweet potato (21), greater yam (10), white yam (5), lesser yam (2), taro (8), elephant foot yam (2) and Chinese potato (1) with high yield and other important quality traits.
- Developed Minisett techniques for rapid multiplication of quality planting materials of tropical tuber crops.
- Organic production technologies, conservation agriculture practices, efficient cropping systems, site specific nutrient management (SSNM), development of zone-specific customized fertilizers and micronutrient formulations were developed for increasing the productivity and profitability.
- Developed Bioformulations viz., *Nanma, Menma* and *Shreya* for the management of pests of different crops including tuber crops.
- Developed Integrated disease management (IDM) packages for the management of yam anthracnose, collar rot in elephant foot yam and taro leaf blight.
- Developed Diagnostic tools like lateral flow device based diagnostic kit for detection of viruses, RT-LAMP method for detection of *Dasheen mosaic virus* infecting elephant foot

yam, rolling circle amplification (RCA) based detection of *sweet potato leaf curl virus* and *Sri Lankan cassava mosaic virus*.

- Developed technologies for value added products including functional and speciality foods, protein enriched pasta, functional pasta, vacuum fried chips, extruded products, functional sago, rice analogue, anthocyanin rich sweet potato capsules etc.
- Developed Cassava harvester, motorized cassava chipping machine and Chinese potato grader to reduce the drudgery among farmers and farm women.
- IT tools viz., e-Crop to simulate crop growth in real-time in the field for smart farming; Tuber Crops Online Marketing System (TOMS); self-learning sweet potato growth model; CASSNUM version 1.1, a decision support system for site specific nutrient management (SSNM) of cassava and *Sree Poshini*, a mobile app for SSNM of tuber crops have been developed.

4. Knowledge/skill/technologies/products/other services available for different stakeholders

- Improved varieties of tropical tuber crops.
- Protocols for quality planting material production of tropical tuber crops.
- Customized fertilizers and micronol for cassava, sweet potato, elephant foot yam and yam.
- Cropping system models/Organic farming technologies.
- Thippi compost from cassava processing factory waste.
- Cassava biofumigant pilot plant and cassava based bioformulations.
- Integrated pest and disease management packages.



Tuber crops varieties developedv

ICAR-Central Potato Research Institute

1. Contact details

i. Postal Address: ICAR-CPRI, CPRI Road, Near HP High Court, Milsington Estate, Shimla, Himachal Pradesh 171001

ii. Name of the Director: Dr Narendra Kumar Pandey (Act.)

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2. Mandate and activities

- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of potato.
- Repository of genetic resources and scientific information on potato.
- Transfer of technology, capacity building and impact assessment of technologies.
- Disease-free nucleus and breeder seed potato production.
- Coordinate research and validation of technologies through AICRP on potato.

Activities

- Collection, conservation and characterization of germplasm.
- Development of high yielding varieties with climate resilience and stress tolerance.
- Increase in potential production and productivity of Potato.
- Standardization of technologies (on production/protection/post-harvest handling/ processing/value-addition) for enhanced productivity & profitability.
- Training and capacity building of stakeholders.
- Field demonstrations of technologies for their adoption.

3. Salient achievements

- Conservation of more than 4000 germplasm.
- Partnered with 26 international institutes belonging to 14 countries in deciphering the complex potato genome.
- Developed and released 66 potato varieties with different traits *viz.* late blight resistance, heat tolerance, processing quality (6 varieties), multiple resistances to diseases and increased yield.
- Developed & registered 23 improved breeding lines as elite genetic stocks having earliness, resistance to pest & disease and frost tolerance.
- Developed pan India late blight forecasting model Indoblightcast.

- Developed and standardised virus detection and diagnostic techniques including dipstick assay for all important viruses.
- Technology for boric acid (3%) treatment in seed to check soil and tuber borne diseases.
- Developed IPM for management of all important diseases and pests.
- A methodology for estimation of potato acreage and production in the northern Indo-Gangetic plains using crop modelling, remote sensing and GIS has been developed in collaboration with Space Applications Centre (ISRO), Ahmedabad.
- Development of Seed Plot Technique which enabled seed potato production in sub-tropical plains.
- Annual production of about 30000 q breeder seed of about 25 commercial varieties to facilitate supply of quality potato planting material in the country.
- Developed aeroponic technique for production of healthy seed potato.
- Carried out impact assessment of potato technologies to estimate socio-economic returns to research investments.
- Dissemination of potato technologies through various extension programmes was undertaken at CPRI in order to bridge yield gap across the country.
- Standardized the methods for nutritional profiling in potatoes.
- Developed elevated temperature and on-farm storage technologies for storing table and processing potatoes.
- Developed and commercialized several value added products from potatoes viz. Cookies, Daliya, Semolina etc.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Aeroponics for quality seed production.
- Mechanization solutions for potato crop management.
- Potato Breeder's seed.
- Potato production, protection and post-harvest management practices.
- Value added products.
- Vegfast technology for home scale vegetable production.

Potato var. Kufri Kiran

Aeroponic for potato seed production Apple var. Golden Snow

ICAR-Directorate of Cashew Research

1. Contact details

i. Postal Address: ICAR-DCR, Mottethadka, Darbe (P.O, Puttur, Karnataka 574202

ii. Name of the Director: Dr TN Raviprasad (Act.)

iii. Email Address: director.dcr@icar.gov.in, Phone No: 08251-231530

2. Mandate and activities

- To undertake strategic, basic and applied research for enhancing productivity, quality, processing efficiency and value addition of cashew.
- To serve as National Repository of genetic resources and scientific information on cashew.
- To coordinate All India Coordinated Research Project on Cashew for addressing location and region specific problems.
- To promote capacity building through transfer of technology and consultancy services to stakeholders.

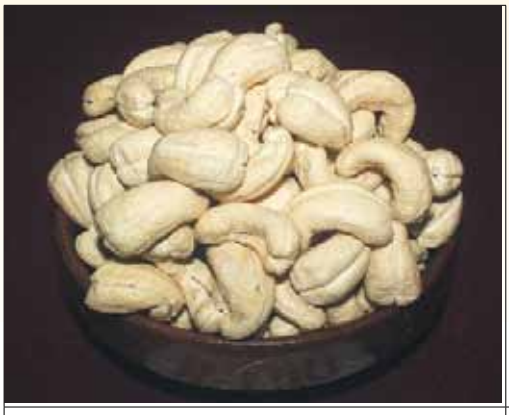
3. Salient achievements

- Softwood grafting and nursery management techniques were standardised for commercial multiplication of cashew.
- Collected and conserved 552 germplasm accession in the National Cashew Field Gene bank
- Released six varieties of cashew, namely, NRCC Selection-1, NRCC Selection-2, Bhaskara, Nethra Ganga, Nethra Vaman and Nethra Jumbo-1.
- Developed and popularised high density and ultra density planting techniques.
- Standardised nutrient management, soil and water conservation and irrigation management.
- Developed packages for intercropping in cashew in earlier stages of plantation.
- Standardised management strategies for major pests of cashew such as tea mosquito bug and cashew stem and root borers.
- Developed six post harvest machineries and standardised value added products from cashew kernels and cashew apples.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Impart training and consultancy on various aspects of cashew cultivation, cashew processing and post-harvest handling.
- Commercialised various varieties, technologies, machineries, products and protocols.

- Organises field days, exhibitions, farmer's fair, guided tours, front line demonstrations etc for the benefit of different stakeholders in cashew.
- Leverage the power of social media and ICTs for effective transfer of technologies in cashew.



Cashew var. H-130

Cashew apple

ICAR-Directorate of Floricultural Research

1. Contact details

i. Postal Address: ICAR-DFR, College of Agriculture Campus, Narveer Tanaji Wadi, Shivajinagar, Pune, Maharashtra

ii. Name of the Director: Dr KV Prasad (Act.)

iii. Email Address/Phone Number: director.dfr@icar.gov.in

020-25537025

2. Mandate and activities

- To conduct basic, strategic and applied research to enhance sustainable productivity, quality and utilization of ornamental crops.
- To develop a repository of genetic resources and scientific information on ornamental crops.
- To transfer technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies through AICRP on Floriculture.

Activities

- To achieve the set mandate/objectives, research is planned and being conducted under four important themes *viz.* Crop Improvement, Crop Production, Crop Protection and Post-harvest Management & Value Addition.

3. Salient achievements

- Repository of flower crop germplasm maintained in mandate flower crops like chrysanthemum (140 nos.), rose (25 nos.), gladiolus (79 nos.), tuberose (24 nos.), marigold (30 nos.), Heliconia (45 nos.). Speciality flowers (ginger lilies, etc.), begonias and ferns were collected, evaluated and recommendations were made for different purposes.
- Improved varieties in different commercial flower crops (Tuberose - 'Sahyadri Vaman'; Chrysanthemum DFR-C1, C2 and C3; gladiolus DFR GH-31, DFR GH-46 and DFR Gladiolus Hybrid-87) are in different stages of their release.
- Unique DNA finger prints (SRAP markers, M4E3 for tuberose & M1E5 for gladiolus) were developed for tuberose (13 nos.) and gladiolus (10 nos.).
- Phytochemical analysis including analysis of VOCs of flower crops chrysanthemum, tuberose, rose is in progress.
- Environmental Horticulture – Screening of the plant species in the vertical landscape based on Air Pollution Tolerance Index (APTI) is in progress.

- Wealth from Waste: Use of industrial and agricultural by-products in potting media of potted flowering plants is optimized for important potted plants.
- Molecular characterization including sequencing of 16S rDNA of Phytoplasma infecting aster, chrysanthemum, gerbera, annual chrysanthemum & marigold is standardized.
- Disease diagnostics - Farmer Friendly on farm quick diagnostic tools based on serological lateral flow assay technique for detection of *Plantago Asiatica Mosaic virus* (PlAMV), a major pathogen of Liliums developed in association with USDA.
- Floricare mobile app developed and launched in August 2019.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Technical guidance for commercial cultivation of flower crops (loose and cut flowers).
- Capacity building in commercial floriculture, ornamental horticulture, crop protection, post-harvest handling, etc for all stakeholders.
- Quality planting material of commercial flower crops (gladiolus, tuberose, chrysanthemum, marigold, aster, etc).
- Contract research/service; field diagnostic visits; etc.
- Tuberose dwarf variety – Sahyadri Vaman and improved varieties of gladiolus and chrysanthemum are ready for licensing.

Sahydri Vaman- Tuberrose variety

Polypropylene foldable crates

ICAR-Directorate of Medicinal and Aromatic Plants Research

1. Contact details

i. Postal Address: ICAR-DMAPR, Near Railway Station, Boriavi, Gujarat 387310

ii. Name of the Director: Dr Satyanshu Kumar (Act.)

iii. Email Address: director.dmapr@icar.gov.in: Phone No: 02690-271602

2. Mandate and activities

- Basic, strategic and applied research on genetic resource management, crop improvement and enhancing productivity of Medicinal and Aromatic Plants through Good Agricultural Practices and organic farming technologies.
- Identification, purification and synthesis of active biomolecules of Medicinal and Aromatic Plants.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies through AICRP on Medicinal and Aromatic Plants.

3. Salient achievements

- A number of varieties have been developed in important medicinal plants like Isabgol, Ashwagandha, Senna, Kalmegh, Asalio, Tulsi and twenty germplasm were registered during the last five years.
- Good agricultural practices (GAP) have been developed in all the mandate crops under ICAR- DMAPR and ICAR- AICRP on medicinal and aromatic plants.
- Technology for preparation of enriched compost from Isabgol straw and low-graded rock phosphate has been developed.
- A modified Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) GC-MS based method was standardized for the detection of eleven multi-class pesticides in Ashwagandha, Isabgol, Senna and Kalmegh.
- Process for preparation of withanolide enriched extracts from roots of Ashwagandha was standardized.
- Innovative technology for removing coloured impurities from water by utilizing aromatic plant waste.
- Process developed for microencapsulation of extracts of *Andrographis paniculata (*King of bitters*)* and *Cassia angustifolia.*

- Process developed for anthocyanin rich microencapsulated product from *Garcinia indica* fruit juice.
- Developed improved protocol to obtain callus in endangered plant guggal(*Commiphorawightii).*
- A low-cost organic growing media was prepared from waste biomass and low-grade mineral powder for kalmegh seedling production.
- Process for isolation of highvalue molecules namely α-mangostin and xanthochymol was developed.
- Two phytoformulations F5 and F10 developed for control of acaricide resistant ticks were found effective in experimentally challenged and naturally highly infested animals.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Training module on Good Agricultural Practices (GAP) of 35 medicinal plants.
- Quality planting material production.
- Mobile apps on cultivation practices of medicinal plants.
- GC-MS protocol for extraction.

Aswagandha

Guggal

Giloe

ICAR-Directorate of Mushroom Research

1. Contact details

i. Postal Address: ICAR-DMR, NH 22, Chambaghat, Solan, Himachal Pradesh 173213

ii. Name of the Director: Dr VP Sharma (Act.)

iii. Email Address: director.mushroom@icar.gov.in, Phone No: 01792-230451

2. Mandate and activities

- Strategic and applied research on collection, conservation, utilization and production of edible and medicinal mushroom.
- Transfer of Technology and capacity building of stakeholders for spawn production.
- Coordination of network research for validation and evaluation of specific technologies through AICRP on Mushroom to enhance productivity.

3. Salient achievements

- Five strains of *Morchella* Mushroom (DMRO-163, DMRO-165, DMRO-168, DMRO-169 and a new *Morchella* culture) were identified for their high sclerotial production potential. Commercial spawn production technique standardized for *Morchella* Mushroom. Attempts on artificial cultivation of *Morchella* Mushroom were made and fruit bodies of 1 cm size were produced.
- Substrate colonization has been completed in all the five strains tried for the seasonal cultivation of *Morchella* mushroom in the field conditions. The exogenous nutrition was provided to all the strains as readymade food for the initiation of fruit body in *Morchella* mushroom.
- Cultivation technique for *Isaria cicadea* developed.
- One high yielding strain of button mushroom U3-54 was released.
- 2 New hybrids of oyster and Shiitake namely PSCM-35 & DMRO-352 were released for cultivation.
- High yielding SSIs were identified by fruiting trial from NBS-5 and NBS-1 strains of button mushroom.
- Two new value added products from Mushroom i.e. Shiitake Mushroom vegetable soup mix and Oyster Mushroom spread have been developed.
- AICRP trial on Oyster mushroom was laid out and variety PL-3906 out yielded check in two flushes.

2. Knowledge/skill/technologies/products other services available for different stake holders

- Varieties developed and its production protocol.
- Commercial spawn production technique standardized
- Trial on Oyster mushroom- Technique.
- Cultivation protocol.

Mushroom cultivation

Oyster Mushroom

ICAR-Directorate of Onion and Garlic Research

1. Contact details

i. Postal Address: ICAR-DOGR, (NH-50), Taluka Khed, Dist Pune, Rajgurunagar, Maharashtra 410505

ii. Name of the Director: Dr Vijay Mahajan (Act.)

iii. Email Address: director.dogr@icar.gov.in, Phone Number: 02135-222026

2. Mandate and activities

- Basic, strategic and applied research on genetic resource management, crop improvement and production technologies for enhancing and sustaining production of onion and garlic.
- Transfer of Technology and capacity building of stakeholders for enhancing productivity of onion and garlic.
- Coordinate research and validation of technologies through AINRP on onion and garlic.

3. Salient achievements

- Developed 10 Onion varieties namely Bhima Super, Bhima Raj, Bhima Red, Bhima Dark Red, Bhima Shubhra, Bhima Shweta, Bhima Safed and 2 Garlic varieties namely Bhima Omkar and Bhima Purple suitable for all over India in different seasons. Out of which 5 varieties of onion have been commercialized to more than 100 companies/FPOs.
- The onion storage structures have been designed and tested. More than 31,000 storage structures are available with farmers of Maharashtra.
- ICAR-DOGR has developed two mechanical Onion graders (Manual and power operated graders) which are also commercialized.
- Agri-Business Incubation Centre (ABI) for new entrepreneurs has been started at ICAR-DOGR.

3. Knowledge/skill/technologies/products other services available for different stake holders

- Controlled storage structure for onion has been developed. The technology has been commercialized, through Agrinnovate.
- ICAR-DOGR has developed *Kharif* onion production technology to overcome this issue. This technology ensures 20-25 tons of yields per hectare without compromise in quality of bulbs.

- Micro-irrigation technology for Onion and Garlic has been developed by ICAR-DOGR, which significantly improves the marketable bulb yield. This saves water and labour expenses, further useful for getting high nutrient use efficiency through fertigation.

Onion var. Bhima Red

Onion var. Bhima Dark Red

Garlic var. Bima Omkar

ICAR-Indian Institute of Horticultural Research

1. Contact details

i. Postal Address: ICAR-IIHR, Hassaraghatta Lake Post, Bengaluru- 560 089 Karnataka

ii. Name of the Director: DR (Mrs.) Devi Sharma

iii. Email Address: director.iihr@icar.gov.in: Phone Number: 080-28466353

2. Mandate and activities

- To conduct on-Farm Testing to identify the location specificity of agricultural technologies under various farming systems.
- To organise Front Line Demonstrations to establish its production potentials on the farmers' fields.
- To organise Training of farmers to update their knowledge and skills in modern agricultural technologies and training of extension personnel to orient them in the frontier areas of technology development.
- To work as resource and knowledge centre of agricultural technology for supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district.
- In order to create awareness about improved technology, a large number of extension activities will be taken up.
- The seeds and planting materials produced by the KVKs will also be made available to the farmers.

3. Salient achievements

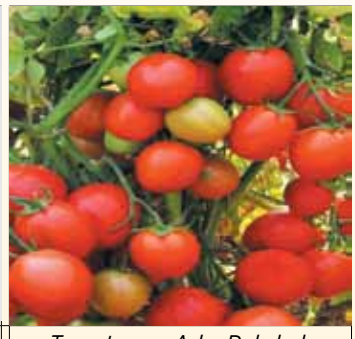
- National Active Germplasm Site (NAGS) for major fruit & vegetable crops. More than 12,500 germplasm of Horticultural importance are maintained (Fruits-2169, Vegetables - 9217, Flower & Medicinal plants – 1087, Mushrooms – 93).
- More than 300 varieties/hybrids of horticultural crops have been developed. Many high yielding and multiple disease resistant varieties of vegetable and flower crops have been identified.
- Crop production technology for major tropical and sub-tropical fruit crops including high density planting; vegetable crops in open field and protected cultivation, flower crops and medicinal crops have been standardized.
- Abiotic stress tolerant lines of vegetable crops for high moisture, high temperature and low moisture stress have been identified; Interspecific grafting as a strategy for mitigation of flooding stress in tomato has been standardized.

- Mushroom production and spawn production for oyster, milky, shitake and other mushrooms have been standardized; many Women Self Help Groups have been trained to promote entrepreneurship and livelihood; various value added products also have been developed.
- Developed Farm Machinery for end-to-end production in onion (sowing to harvesting to grading), solar powered vending van, hot-water treating unit.
- Probiotic fruit beverages, osmatic dehydrated products and bars from different fruits fruits, shelf-life extension technologies including minimal processing, dry flower technology, etc have been developed.
- Nutrient management technologies viz. consortia of beneficial microbes, micronutrient formulations, microbial decomposers have been developed and commercialized.
- Non-chemical methods for pest, disease and nematode management including neem based products, pheromone traps, microbial biopesticides have been developed and commercialized; management of many emerging pests and diseases have been demonstrated.
- Outreach to farmers and other stakeholders National Horticultural Fairs, Crop Diversity fairs, field demonstrations in farmers' fields.
- Impact analysis has estimated that approximately ₹ 30,050 crore has been accrued as benefit annually with 15 technologies developed at IIHR.

4. Knowledge/skill/technologies/products other services available for different stake holders

- 79 lines ofvarieties or hybrids of horticultural crops for seed and planting material & 225 technologies are available for licensing.
- Supply of seed and planting material of released varieties. Seed Portal of the institute facilitates online purchase of seeds by farmers.
- Diagnostic service for import and export of seeds and planting material of horticultural crops is facilitated.
- State of the art facility for testing the food safety and pesticide residue analysis.
- Incubation facility for post-harvest technology and fermentation based microbial products has been facilitating start-ups and entrepreneurs.
- Training for the trainers (i.e.) extension agencies, government and private agencies; farmers' training.

Guava var. Arka Kiran



Tomato var. Arka Rakshak (Multiple disease resistance)

ICAR-Indian Institute of Oil Palm Research

1. Contact details

i. Postal Address: ICAR-IIOPR, Pedavegi, Andhra Pradesh 534475

ii. Name of the Director: Dr Ravi Kumar Mathur (Act.)

iii. Email Address: director.iiopr@icar.gov.in, Phone Number: 08812-259409

2. Mandate and activities

- Basic, strategic and applied research on genetic resource management, crop improvement and production technologies for enhancing productivity of oil palm.
- Transfer of technologies and capacity building of stakeholders for increasing production of oil palm.

Activities

- Collection, conservation, cataloguing and evaluation of oil palm germplasm.
- Genetic enhancement & Biotechnological studies in oil palm.
- Efficient resource management strategies & Oil palm based cropping systems.
- Physiological and biochemical basis for growth and yield in oil palm.
- Development of labour saving tools and machineries for oil palm cultivation.
- Development of Integrated pest and disease management practices.
- Dissemination of technology & ICT applications in oil palm sector.

3. Salient achievements

- ICAR-IIOPR has developed various agro-techniques for oil palm.
- Three oil palm varieties viz. Godavari Swarna, Godavari Ratna, Godavari Goldwere identified for release.
- Standardized the technology for oil palm hybrid seed production.
- Established five new oil palm seed gardens with advanced parent materials.
- Maintains germplasm assemblage of 128 accessions. Twenty oil palm germplasm accessions with high yield and better oil quality were imported from Malaysia.
- Studied different dormancy breaking techniques in oil palm seeds.
- Standardized a novel method for insect assisted controlled pollination through pollinating weevil during hybridization (Patent granted IPO No. 387063).
- Developed CAPS marker for identification of fruit forms and Microsatellite marker for identification of dwarf oil palm at nursery.

- Irrigation at crop factor 0.7 coupled with 1200:600:1200 g NPK/palm/year through soil application at quarterly intervals is recommended for higher yield.
- Standardized sustainable production technology for oil palm through *in situ* mulching and improved management.
- DRIS norms and optimum leaf nutrient concentrations ranges developed for routine diagnostic and nutrient advisory purposes in different States.
- Developed various physiological concepts for better understanding of oil palm under non-traditional environments.
- Oil palm has been identified a large Carbon sink and the annual carbon sequestered ranged between 17.78 and 37.87 tonnes C per ha.
- Developed management practices for control of pests (like rhinoceros beetle, leaf eating caterpillar, bag worm, rogues white fly) and diseases (like basal stem rot, bud rot, stem wet rot).
- Training programmes on oil palm cultivation were organized to 3500 officers and 36000 farmers.
- Mobile apps (20) and short video films (6) on different aspects of oil palm cultivation have been brought out.
- Oil Palm Kisan Mobile Message Services in the form of text messages as well as voice messages for the benefit of oil palm stakeholders.
- Feasibility studies were undertaken for identification of potential areas for oil palm cultivation in the country.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Supply of third generation hybrids with high oil yield and dwarfness to oil palm farmers.
- Standardized oil palm nursery management techniques.
- Standardized oil Palm based cropping system in juvenile plantations with Annuals (maize, tobacco, chillies, ridge gourd, okra, and colocasia) and Biennials/Perennials (banana, guinea grass and moringa).
- Standardized oil palm based cropping systems for mature oil palm plantations - oil palm-cocoa, red ginger, heliconia, bush pepper, banana, ornamental crops & spices.
- Developed oil palm based mixed farming system with fodder crops, dairy and back yard poultry.
- Standardized fertilizer schedule for fertigation using venturi system and reported a saving of 50 % of recommended fertilizer dose.
- Standardized the vermi-composting technique for decomposition and nutrient recycling of oil palm biomass, which could reduce 50 % of inorganic fertilizers.

- Developed improved harvesting sickles (DOPR-1 and DOPR-5) with light weight high strength poles and Height adjustable hydraulic lift platform for harvesting oil palm FFB from tall palms.
- Developed Oil palm Ablation tool for removal of inflorescence during juvenile phase (Patent granted IPO No. 393982).
- Fabricated trunk chipping bucket for felling aged palms.
- Analysis of Soil and leaf nutrient for precise fertilizer management.
- Oil and Bunch analysis.
- Establishment and management of oil palm seed gardens.

Oil Palm based cropping system

Novel method for insect assisted controlled pollination in oil palm

ICAR-Indian Institute of Spices Research

1. Contact details

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ii. Name of the Director: Dr (Mrs.) CK Thankamani (Act.)

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2. Mandate and activities

- Basic, applied and strategic research on genetic resource management, crop improvement, crop production and protection technologies for enhanced production of safe spices.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies under AICRP on Spices

3. Salient achievements

- Largest germplasm repository of spices: - Black pepper-3850, cardamom-439, Ginger-665, Turmeric- 925,Clove- 225, Cinnamon-408,Garcinia- 116, Vanilla-63.
- Developed 30 improved varieties of spices for yield and quality sustainability and biotic resistance: Black pepper -10, Turmeric -8, Ginger -4, Cardamom-4, Tree spices -4.
- Established molecular signatures and QR codes for released spice varieties of black pepper and seed spices varieties for genetic purity.
- Standardized barcoding to detect plant-based adulterants in black pepper, chilli powder, turmeric powder, cinnamon bark, and mace
- Developed and demonstrated integrated farming system (IFS) model for spice crops including spices, vegetables, fruits, coconut and dairy components with sustainable income for a farm family. Developed eco friendly weed management and production technologies for major spice crops.
- Standardized Soil test based fertilizer recommendation for targeted yield for major spice crops viz., black pepper, ginger, turmeric and cardamom. Also developed and patented crop specific micronutrient formulations for major spices.
- Standardized several plant propagation techniques for spices including single bud portray and microrhizhome technologies for ginger and turmeric and potting mediums and on an average supplied 1.5 lakh rooted cuttings of black pepper and 15 tonnes of seed rhizomes of ginger and turmeric to farmers every year.
- Developed climate models for establishing its relationship with yield over the changing climate and delineated Climate analogue sites for future expansion of black pepper, small cardamom and seed spices.
- Developed Organic production packages and good agricultural practices for major spices. Also developed organic production package for spices specifically for NE states. Standardized

and popularised technologies for mitigating abiotic stress in black pepper by scheduling irrigation in large scale area.

- Developed and popularized Eco friendly bio intensive management of major pathogens of black pepper, cardamom, ginger and turmeric with Trichoderma sp., Bacillus sp and PGPR consortia
- Developed integrated technology for the management of bacterial wilt in ginger involving soil solarization, bio agents application and drenching with $CaCl_2$ in hot spot areas of the disease.
- Developed IPM and green technologies for the management of cardamom thrips, pollu beetle in black pepper and shot borer in cardamom, ginger and turmeric.
- Developed Diagnostics: Multiplex PCR assay for simultaneous detection of *Phytophthora*, *Pythium* and *Fusarium,* molecular techniques for detection of black pepper, ginger and cardamom viruses and developed PCR, RPA and LAMP protocols for detection and differentiation of *Phytophthora* species
- Web Portals and information portals were developed and hosted:-Indian Plant Virus Database, Radobase, Ginger Transcriptome Database, SpiceCom, Phytophthora TranscriptomeDB, PASSCom, PiperPep, PLASBID, Phytoweb, Spicegenes, SPICEST, AgroTech for spices, Spice Bibliography, GST Lead Base.
- Commercialized varieties, crop specific micronutrients, bio agents and bio capsule technologies to several entrepreneurs across India and abroad by issuing 60 non exclusive licenses. Institute is awarded with 7 patents and also filed 4 patents on several technologies.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Training module on integrated farming system (IFS) model.
- PCR assay for simultaneous detection of *Phytophthora*, *Pythium* and *Fusarium,* molecular techniques for detection of black pepper, ginger and cardamom viruses and developed PCR, RPA and LAMP protocols for detection and differentiation of *Phytophthora* species.
- Eco friendly bio intensive management of major pathogens of black pepper, cardamom, ginger and turmeric.
- Soil test based fertilizer recommendation.
- Training module for entrepreneurs/farmers/stakeholders/Govt. agencies on different aspects of production, protection technologies and post harvest management.
- Barcoding to detect plant-based adulterants.

Turmeric var. Pragathi

Ginger var. Rejatha

Nutmeg var. Viswasree

ICAR-Indian Institute of Vegetable Research

1. Contact details

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ii. Name of the Director: Dr TK Behra

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2. Mandate and activities

- Basic, strategic and applied research to enhance and sustain productivity, monitor quality and utilization of vegetable crops.
- Repository of vegetable crops, genetic resources and scientific information.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies under AICRP on vegetable Crops.

Activities

- ICAR-IIVR has research programs on 42 vegetables with major focus on tomato, brinjal and chilli in Solanaceous vegetables; peas, French bean and cowpea in Leguminous vegetables; cauliflower and cabbage in cruciferous vegetables; bitter gourd, ash gourd, pumpkin, pointed gourd, muskmeleon, bottle gourd, sponge gourd, ridge gourd and cucumber in cucurbitaceous vegetables; okra in malvaceous vegetables and radish and carrot in root vegetables.
- ICAR-IIVR functions through AICRP (Vegetables Crops) and 03 Divisions namely Division of Vegetable Improvement, Division of Vegetable Production and Division of Vegetable Protection.

3. Salient achievements

- Institute has developed 141 high yielding and disease resistant varieties/hybrids including tomato (monopartite and bipartite viruses resistant KashiAman, KashiAdarsh and ToLCV virus resistant KashiAbhiman), Okra (YVMV & OELCV resistant KashiKranti and KashiVardan) and Indian bean(YMV resistant KashiHaritima) and cowpea (GMV resistant KashiNidhi), identified through the AICRP (VC), which have led to 20-25% higher productivity of these crops.
- Nutritionally superior varieties have been developed in radish (KashiLohit), carrot (Kashi Krishna) and okra (KashiLalima).
- For ameliorating micronutrient deficiency in vegetables, crop-specific multi micronutrient formulation 'KashiSookshma-Shakti' has been prepared, which increases yield by 12-38% in different vegetable crops.

- Production technologies for sustainable cultivation of vegetables such as conservation tillage, organic farming, integrated nutrient management, protected cultivation, drip &fertigation*etc.* have been standardized in a gamut of vegetable crops.
- Development of grafting technology in vegetables for catering the needs of urban farming, improving yield and mitigating biotic and abiotic stressesunder changing climatic conditions.
- Integrated pest management technologies have been developed for the management of major diseases and pests of vegetables crops.
- A wide range of value-added products of vegetables have been developed with the aim to reduce produce losses and provide alternative food products to consumers.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Five patented technologies pertaining to value added products are available for commercialization viz., Process for shelf stable low-fat tomato-whey soup, Process and composition for preparing instant bottle gourd kheer mix, Moringa soup mix and process thereof, Moringa drink mix powder and implementation thereof and Process for preparation of dried green chilli powder.
- Transfer of technologies to the farmers and other stakeholders through capacity building, demonstration, field day, showcasing.
- Development of grafting technology in vegetables.

Tomato var. Kashi Adarsh

Brinjal var. Kashi Manohar

ICAR-National Research Centre for Banana

1. Contact details

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ii. Name of the Director: Dr (Mrs.) S Uma (Act.)

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2. Mandate and activities

- Basic, strategic and applied research on genetic resource management, crop improvement and production technologies for sustainable and enhanced production and utilization of banana.
- National banana gene bank management, coordination and validation of research for enhancing and sustaining the productivity of banana.
- Transfer of technology and capacity building of stakeholders for enhanced and sustained production of banana.
- Referral Laboratory for monitoring the quality of micro-propagated banana plants.

Activities

- Improving banana through conventional and molecular breeding approaches and exploiting the genetic resources to tackle biotic and abiotic stresses and developing nutritionally rich bananas to meet the demand of food and nutritional security.
- Use of novel technologies like bioreactors to produce quality TC bananas on a large scale to meet increasing demand.
- Developing Hitech banana production technologies for increasing the income of the farmersand for domestic and export markets.
- Developing climate resilient technologies to tackle abiotic stresses.
- Improved post-harvest technologies, waste utilisation and value addition in banana.
- Integrated pest and disease management for major pests and diseases.
- Dissemination of technologies on improved production, postharvest processing and value addition to all the stakeholders through targeted training programmes.

3. Salient achievements

- Recipient of the prestigious Sardar Patel Outstanding ICAR Institution Award 2020 in the category of small Institutes.
- Identified promising ITC accessions resistant to Fusarium wilt, race 1 and elite clones like NRCB selection 15 (for dwarfness) and 16 (high beta carotenoid content).

- Development of ICT tools for banana hybridization program, development of Fusarium wilt resistant Grand Nain mutant and identification of markers associated with Fusarium wilt, anthocyanin pigments, *etc.*
- Nutrient dynamics and agro-techniques were developed for the newly released cultivars. Cultivars with high yield potential for leaf industry were identified. Banana starch and its physical and chemical properties were quantified. Biofilms were prepared and evaluated. Drought resistant / tolerant cultivars and drought mitigating chemicals were identified. Anthocyanin profiling and quantification was done for a few north-eastern banana cultivars. Transgenic banana with iron rich events were identified and multiplied.
- New and emerging pests of banana and their natural enemies documented and banana hybrids resistant to root-lesion nematodes were identified.
- Sources of resistance for TR4 identified based on screening in TR4 hotspots in Bihar.
- Novel markers were developed for early detection and monitoring of virulent strains of *Foc*STR4.
- Bioagent consortia for TR 4 management were identified based on field evaluation and a cheap mass production technique standardized for *Trichoderma*.
- Diagnostic kits were developed and validated against BBTV, BBrMV and CMV.
- Sea shipment protocol developed for the export of Nendran bananas to the United Kingdom.
- Agri-incubation unit established for promoting entrepreneurship in banana-based products.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Bioreactors for micropropagation of banana on large scale.
- New cultivars with desirable traits (Kaveri Kalki, Kaveri Sugantham, Kaveri Haritha, Kaveri Saba, Kaveri Kanya).
- Farm level macropropogation technology for ruling cultivars.
- Technology for production of value-added banana products such as sauce, sweet chutney, jam, baby food, health drink, flour soup mix, squash, blended juice, central stem candy, peel and flower pickles, flour-based noodles, pasta,etc.
- Diagnostic kits including lateral flow devices for detection of banana viruses.
- Multiplex PCR for simultaneous detection of 4 banana viruses.
- Banana Shakti – a micronutrient mixture.
- Potential strain of *Trichoderma viride* NRCB-1.
- Shipment protocols for major cultivars.

Banana plant

Ripened banana bunch

Bananas in bunch

ICAR-National Research Centre for Grapes

1. Contact details

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ii. Name of the Director: Dr RG Somkuwar (Act.)

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2. Mandate and activities

- Strategic and applied research on safe grape production and productivity.
- Transfer of technology and capacity building of stakeholders for enhanced and sustained production of grapes.
- National Referral Laboratory for Food Safety and Pesticide residue in fruits.

3. Salient achievements

Released four grape varieties

i. **Manjari Naveen:** A clonal selection from the Centennial Seedless.

i. **Manjari Medika:** It is a hybrid of PusaNavrang × Flame Seedless.It is a teinturier variety (coloured pulp apart from coloured skin) suitable for juice making.

ii. **Manjari Kishmish:** White clonal selection from KishmishRozavis. Raisin recovery is higher (26-27%) as compared to Thompson Seedless (24-25%). Due to higher raisin recovery the profit margin is expected to increase atleast by 15%.

iii. **Manjari Shyama:** It is a cross between Black Champa x Thompson Seedless.Variety has black, crunchy and bold berries (18 - 20 mm) suitable for table purpose with yield of 30 to 32 MT/ha. It is found to be tolerant to berry cracking due to rains.

- **Improving water use efficiency in vineyards**: Standardised irrigation schedule based upon pan evaporation and crop growth stage that resulted in an average 52% savings in irrigation water over farmer's practice.
- **Integrated Decision Support System (DSS) for Grapes**. It provides recommendations based on crop data, farm data, and prevailing weather conditions. Application programming interface (API) has been developed.
- **Bio-intensive strategy for the production of "zero residue grapes":**Successfully demonstrated at four locations. The strategy included (i) Management of primary inoculum of pathogens, (ii) Identification and application of naturally occurring

efficient antagonists and entomopathogens, (iii) Induction of systemic resistance in grapevines using microorganisms, (iv) Identification and application of *Bacillus subtilis*strain DR-39 for enhanced degradation of pesticide residues (v) Restricted use of single site action fungicides during the high risk period; and sulphur thereafter and (vi) conservation of natural enemies.

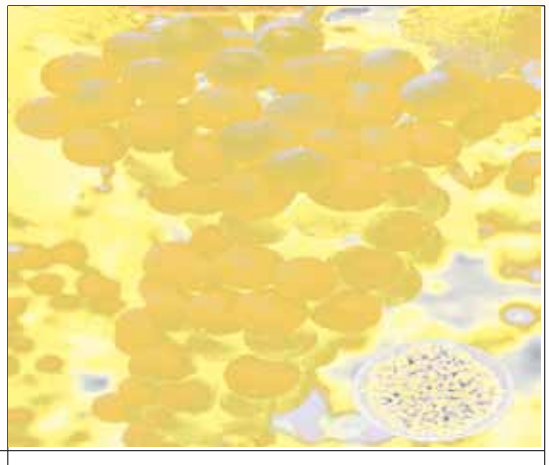
- **Bio-remediation of pesticides using *Bacillus subtilis* strain DR-39 bio formulation**: The wet powder formulation of *Bacillus subtilis*, DR-39 contains efficient *Bacillus subtilis*DR-39 strain with a bacterial population of 1×10^9cfu/g which enhances the degradation of pesticide when applied at a dose of 2.5 g/l. The technology has been validated for grapes at multiple locations on farmers' field and vineyards of ICAR-NRCG, Pune. The grape growers had an average profit of 1.2 lakh from the demo plots in the year 2019-20. Degradation of pesticides residues at later stage becomes easy thereby making them MRL compliant for export.
- Implemented good agricultural practices and stringent residue monitoring plan in grapes.

4. Knowledge/skill/technologies/products other services available for different stake holders

- **Knowledge / skill in the field of cultivation of grapes**
  - DUS testing andregistration of new grape varieties under PPVFRA,
  - Scientific grape nursery
  - Canopy management
  - Water and nutrient management
  - Optimum use of bio-regulators in grapes
  - Disease management, bio-intensive disease management,
  - Insect pest management,
  - Mass spectrometry technology and emerging applications
  - Setting up of pesticide residue &aflatoxins testing laboratory
  - Analytical methods of agrochemical residues.
- **Training and capacity building on different aspects of grape cultivation**
- **Technologies / products**
  - Disease free planting material of rootstocks and commercial varieties of grapes.
  - *Bacillus subtilis* bio formulation contains efficient *Bacillus subtilis* DR 39 strain and having bacterial population 1×10^9 CFU/g which enhance the degradation of pesticide.
  - Liquid and solid bio-formulations of *Trichodermaasperelloides* strain 5R with 5×10^{11} spores per ml and 1.6×10^{11} spores per gm respectively; enhances the disease resistance of grapevines to various foliar diseases, especially powdery mildew.

- *Trichodermaafrohurzianum* (NAIMCC-F-01938) liquid formulation is a simple formulation which contains 5×10^8 spores / ml. It helps in reducing the disease incidence on grapevines. Inoculation can be done by foliar application.
- Delta T Calculator- Android mobile applicationcalculates the Delta T value for the given temperature and relative humidity for farmers on their fingertips on Android mobile phone to easily calculate it without needing dry and wet bulb thermometers.
- *Metarhiziumbrunneum*, effective biocontrol agent against *Dervishiyacadambae* infesting grapes.

Grapes var. Manjari Shyam



Grapes var. Manjari Kishmish

ICAR-National Research Centre on Litchi

1. Contact details

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ii. Name of the Director: Dr Sheshdhar Pandey (Act.)

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2. Mandate and activities

- Applied and strategic research on genetic resources and production technologies for enhanced, sustained and safe production of litchi.
- Transfer of technology and capacity building of stakeholders for enhancing and sustaining productivity of litchi.

Activities

- The research and extension activities of the institute continually supporting the farmers to increase the yield and quality of the litchi for sustainable production, Post-harvest management and value addition (commercialization of litchi beverages/products) of the litchi for enhancing shelf life of the produce and long distant transportation.
- Annual growth in acreage of 3.8% and production by 6.4% has been registered after establishment of the NRCL.

3. Salient achievements

- Technology on Rejuvenation of unproductive senile orchards developed.
- Released three new litchi varieties: GandakiSampada, GandakiLalima, and GandakiYogita, and a new variety of longan, i.e. NRCL Longan-1.
- Increase in non-traditional area of litchi.
- Breaking off season barrier by litchi production in December month in South India.
- NRCL Trichoderma T-01 control wilting of trees.
- Developed value added products like Litchi squash, Litchi RTS, Dehydrated litchi pulp, Litchi wine, Litchi nut.
- Assured flowering and fruiting through girdling of primary branches.
- Improving fruit quality in litchi through bunch bagging.
- Off season propagation in litchi.
- Potting media for raising healthy litchi plants.
- Post-cut dip solution to enhance nursery survival.

- Litchi-based cropping system models.
- Integrated management of litchi fruit and shoot borer.
- Integrated management of litchi mite.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Rejuvenation of unproductive trees
- Assured flowering and fruiting through girdling of primary branches
- Improving fruit quality in litchi through bunch bagging
- Potting media for raising healthy litchi plants
- Litchi-based cropping system models
- High density planting system
- Integrated management of litchi fruit and shoot borer
- Integrated Management of Litchi Mite
- NRCL Trichoderma- A biological fungicide
- Production of wine from litchi fruits.

Shahi Litchi

Litchi plant

ICAR-National Research Centre for Orchids

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2. Mandate and activities

- Applied and strategic research on conservation, improvement and culture of orchids for enhancing productivity and utilisation.
- Transfer of technology and capacity building of stakeholders for enhancing and sustaining productivity of orchid.

Activities

- To collect, characterize, evaluate and utilize Orchid Germplasm.
- To develop marketable varieties for cut flowers and pot plant production.
- To develop/refine mass-propagation protocol for threatened medicinally and commercially important orchids.
- To develop package of practices for cultivation of orchids.
- To sustain the productivity and quality through management of biotic and abiotic stresses.
- To develop appropriate pre and post-harvest technologies for extending shelf-life and value addition in orchids.
- To develop strategic alliances for research and technology transfer.

3. Salient achievements

- Collected and conserved 3208 accession belonging to 360 orchid species.
- Developed 9 varieties and identified elite breeding lines suitable for cut flowers and potted plants.
- Standardized *in-vitro* propagation techniques of commercial and native orchid species.
- Developed methodology for estimation of metabolic activity of cut flowers to enhance vase life of Cymbidium hybrid cut-flowers.
- Developed methodology for Image based validation and modelling of leaf area in orchids and moisture deficit stress phenotyping in orchids using Artificial Intelligence based model.
- Developed/refined production and protection technologies for improvement of productivity, marketing and utilization of orchids.

- Chemical profiling of Orchids for medicinal and aromatic compounds was done and identified 16 compounds which possesses anti-fungal, anti-bacterial, antioxidant properties, vasodilatory effect, anti-viral activity against influenza, anti-cancer, analgesic, anti-pyretic action and hyper glycaemia properties.
- Developed 4 Mobile apps (Orchid Farming, OrchidoPedia, OrchidMAN, Orchid Pest Management) related to orchid cultivation, Orchid database developed for Sikkim Himalayas.
- Obtained 2 Copyrights and Registered 2 Geographical Indications.
- Developed DUS testing guidelines for 8 commercial orchid genera. And also acts as DUS testing centre for Orchids.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Production, Protection and Post-Harvest technologies of Orchids for Commercial production.
- Organic nutrient solution for orchids from locally sourced materials.
- *In-vivo* propagation technologies for *Cymbidium, Dendrobium, Phalaenopsis, Phaleonopsis, Zygopetalum, Paphiopedilum, Vanda, Lilium.*
- *In-vitro* mass-propagation technologies for *Cymbidium, Dendrobium, Paphiopedilum, Zygopetalum, Phaleonopsis and Vanda.*
- Production of true to type plants by induction of Apomixis.
- The technology for drying of Orchid flowers.
- Single floret packaging of *Cymbidium* orchids.
- Value addition of dried leaves of Cymbidium by making baskets and other handicrafts.
- Orchid based farming systems in combination with leafy vegetable and other ornamental crops.
- Training programmes for Scientists, Horticulture Officers and Farmers to improve knowledge in cultivation of orchids.
- Developed mobile apps (Orchid Farming, OrchidoPedia, OrchidMAN, Orchid Pest Management) for dissemination of information regarding orchids.

Vanda

Indian Dendrobium

Indian Prime Minister Shri Narendra Modi smells the orchid 'Dendrobium Narendra Modi' named after him

ICAR-National Research Centre on Pomegranate

1. Contact details

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iii. Email Address/Phone Number: director.nrcpom@icar.gov.in: 0217-2350262

2. Mandate and activities

- Basic, strategic and applied research on genetic resource management, crop improvement, production and protection technology for enhanced and sustained productivity of pomegranate.
- Transfer of technology and capacity building of stakeholders for enhancing and sustaining productivity of pomegranate.

Activities

- Collection & conservation of germplasm in FGBHIMA
- Improvement of pomegranate.
- Development& Refinement of technology for production and protection of pomegranate
- Post-harvest management & Value addition.
- Transfer of technology.

3. Salient achievements

- Developed *in-vitro* protocol for propagation of pomegranate var. Bhagwa including biohardening.
- *Penicillium pinophilum* based bioformulation for potassic fertilizer supplementation developed.
- Developed Pomegranate variety Solapur Lal : A biofortified HYV, high TSS (17.6°B) and Solapur Anardana: HYV, 5.76%TA, rich in anthocyanin, for anardana purpose
- Technology / process for Value Added Products: Pomegranate Juice, Pomegranate RTS beverage, pomegranate based blended RTS, Pomegranate Seed Oil, Hi-fibre cookies from deoiled seed cake, Peel powder, mouth-freshner, etc.
- Integrated Disease and Insect Pest Management developed.
- Stem Solarization to control bacterial blight disease of pomegranate.

- Solapur Anar: Mobile-app for android and IOS platforms in 6 languages viz.,English,Hindi, Marathi, Gujarati, Kannada, and Telugu.
- Dalimb-Mitra: A digital platform for pomegranate growers with advisories.

4. Knowledge/skill/technologies/products other services available for different stake holders

- In vitro propagation of pomegranate cultivar Bhagwa including biohardening.
- Two step hardwood cutting protocol for propagation of pomegranate.
- Technology for pomegranate Juice / RTS beverage.
- Technology for Minimal processing of pomegranate arils.
- Technology for extraction of pomegranate seed oil.
- *Penicillium pinophilum* based bioformulation for potassic fertilizer supplementation.
- Stem solarization to control bacterial blight disease of pomegranate: An eco-friendly, economical and effective technology.
- Solapur Lal: A bio-fortified pomegranate variety.

Pomegranate: Sholapur Lal

ICAR-National Research Centre on Seed Spices

1. Contact details

i. Postal Address: ICAR-NRCSS, Tabiji Farm, Beawar Road, ajmer-305206 Rajasthan

ii. Name of the Director: Dr SN Saxena (Act.)

iii. Email Address/Phone Number: director.nrcss@icar.gov.in: 0145-2684400

2. Mandate and activities

- Basic, strategic and applied research on genetic resource management, crop improvement, production and protection technologies for enhancing and sustaining productivity of safe seed spice.
- Transfer of technology and capacity building of stakeholders for enhancing and sustaining productivity of seed spice.

Activities

- Collection, evaluation, characterization and conservation of germplasm.
- Breeding variety with high yield potential, quality and resistance to biotic-abiotic stresses.
- Developing efficient agro-techniques for achieving the high production and productivity.
- Evolvingbetter and efficient managements ystem for control of pests and diseases.
- Studyof nutritional and water management aspects.
- Development of package on organic farming of theseed spices for export, based on environment friendly production of potential technology.
- Research on seed technology for production of quality seeds of improved varieties.
- Study of economics of production and marketing.
- Development of pre and post-harvest technology for better processing, storage and utilization.
- Development of export oriented technology for export of raw and value-added product towards national economy.
- Transfer of technology for farmers and extension agencies.

3. Salient achievements

- Developed and released varieties in Coriander(04),Fenugreek(03), Fennel(03), Ajwain(02), Dill(01), Nigella(02)and Celery (01).
- **Unique Germplasms identified in following:**
  - ✓ Anise elite lines AA-17-S4 and AGP-2: earliness and higher yield.
  - ✓ Dill elite lines AD-S-44 and AD-S-2015-2: high yield and quality.
  - ✓ Fennel mutant line RF/250/73/1: dwarf and early maturity.

- ✓ Fennel mutant line RF/200/65/5: dwarf, synchronization in flowering and early maturity.
- ✓ Fennel mutant line RF/200/46/2(1): early flowering, synchronous flowering, multiple branching and early maturities.
- ✓ Fennel mutant line RF/225/88/1: multiple branching, dwarf and early maturity.
- ✓ Fennel mutant line RF/225/37/10: synchronous flowering and early maturing mutant of fennel.
- ✓ Fenugreek mutant/ selection lines for broad pods and bunch type leaves for vegetable purpose.

- Developed seed spice based intercropping system.
- DevelopedOrganic production technology for seed spices.
- Developed protected cultivation technology for seed spices.
- Developedoff-season production of leafy coriander and fenugreek.
- Integrated nutrient management in coriander and fennel developed.
- Micronutrient management in coriander, fennel, fenugreek and nigelladeveloped.
- Developedpesticide free cumin production through application of bio-agents and botanicals.
- DevelopedIPM module for the management of aphids and thripsin cumin and coriander.
- DevelopedEco-friendly management of cumin wilt.
- Management of cumin blight using spray scheduling developed.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Rhizobacterial isolates *Bacillus aerophilus* (King's B-15/ Cor-20) enhancing the coriander yield
- Phosphate solubilizing bacteria (PSB) for fennel cultivation under semi- arid climate of Rajasthan, India.
- Microbial formulation of *Pseudomonas fluorescens* and *Bacillus megaterium* for boosting the growth and yield of cumin crop.
- Two Microbial formulations of *Rhizobium* + *Bacillus megaterium* and *Rhizobium* + *Bacillus subtilis*+ *BHIMA megaterium* for boosting the growth and yield of fenugreek crop.
- Cryogenic Grinding technology for spices: A novel approach for retention of flavour and medicinal properties of seed spices.


Cumin var. GC-4


Fenugreek var. AFg-3


Fennel var. AF-1

Natural Resource Management

ICAR-National Bureau of Soil Survey and Land Use Planning

1. Contact details

i. Postal Address: ICAR-National Bureau of Soil Survey and Land Use Planning Amravati Road, University PO, Nagpur- 440 033

ii. Name of the Director: Dr. B. S. Dwivedi

iii. Email address: director.nbsslup@icar.gov.in, Phone No.: Phone No. 0712-2500386

2. Mandate and activities

- To conduct soil survey and mapping of the soils of the country to promote scientific and optimal land use programmes in collaboration with relevant institutions and agencies.
- To conduct and promote research in the National Agricultural Research System in the areas of Pedology, Soil survey, Remote sensing applications, Land degradation, Land evaluation and Land use planning.
- To impart training and education to create awareness on soil and land resources and their state of health.

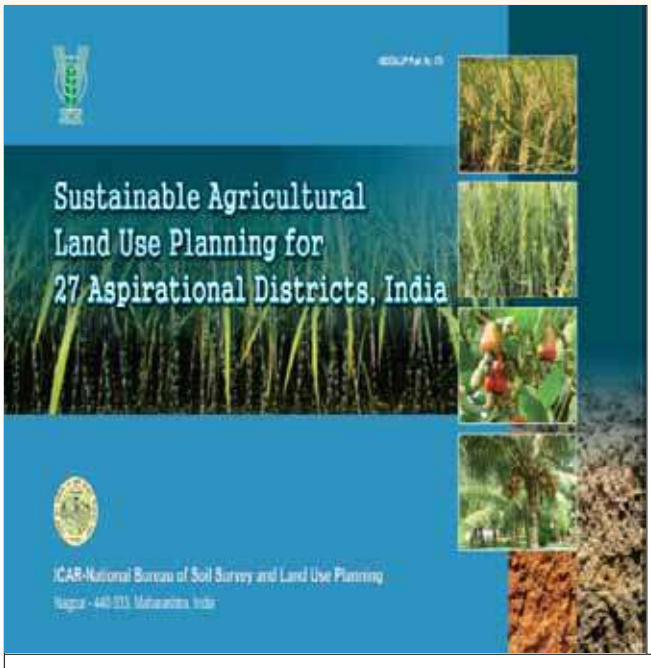
Activities

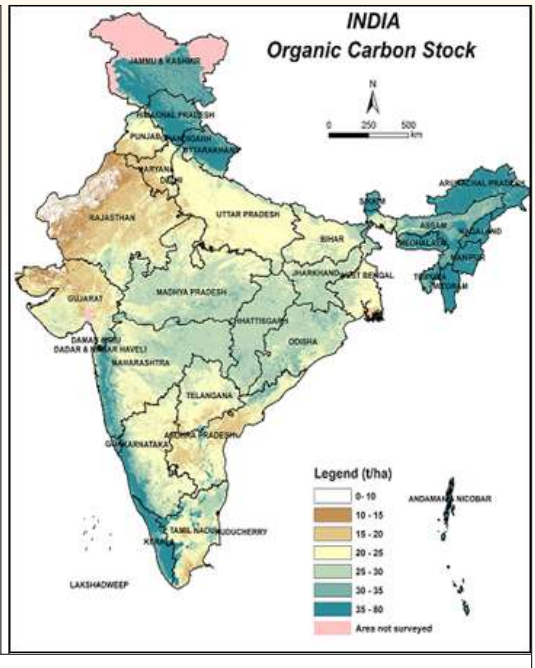
- Inventorization of natural resources
- Basic Pedological Research
- Soil Survey Data Interpretation and Applications
- Land Evaluation and Land Use Planning

3. Salient achievements

- Prepared soil maps of the states (1:250,000 scale) and several districts (1:50,000 scale) of the country and land resource inventory of 296 blocks covering 10 states at 1:10000 scale.
- Prepared soil degradation map of the country (1:4.4 million scale) and different states of the country (1: 2,50,000 scale)

- Developed agricultural land use plans for 27 aspirational districts in 8 states
- BHOOMI Geo-portal, a Gateway to Soil Geospatial database has been developed and dedicated to soil resources of the nation for use of different stakeholders.
- *Developed Soil organic carbon map of India.*





Pomegranate: Sholapur Lal

ICAR-Central Soil Salinity Research Institute

1. Contact details

i. Postal Address: ICAR-Central Soil Salinity Research Institute Zarifa Farm, Kachhwa Road, Karnal-132001 (Haryana)

ii. Name of the Director: Dr. P.C. Sharma

iii. Email address: director.cssri@icar.gov.in, Phone No.: 0184-2290501 (O)

2. Mandate and activities

- Developing technologies for reclamation and management of salt affected soils and use of poor quality irrigation waters in different agro-ecological regions of India.
- Evaluate and recommend strategies that promote adoption of preventive/ameliorative technology.
- Coordinate/support the network of research for generating and testing location specific technologies.
- Centre for training in salinity researches in the country.

Activities

- Studies on characteristics andgenesis of salt affected soils.
- Amelioration / management of salinity prone as well as salt affected soils.
- To collect, assess and develop plant genetic resources tolerant to stresses arising due to excess of salts, sodicity and water stagnation.

3. Salient achievements

- **In-Vitro Bio-Immunization Technology :**Inducing fusarium wilt tolerance in Banana plants through incorporation of lipo-polypeptides as biomolecules.
- **Salt tolerant rice variety CSR 76 released** by Uttar Pradesh SVRC during the year 2021 for sodic soils.It can tolerate the sodicityupto pH~9.6 having grain yield of of4.0-4.5 t/ha.
- **CSR GROW-SURE :**A bio-enhancer CSR-GROSURE is effective in the management of crop growth in sodic soils up to pH 9.0. It comprise of highly efficient salt tolerant bacteria strains CSR-M-16 (*Bacillus licheniformis*), CSR-A-11 (*Lysnibacillusfusiformis*), and CSR-A-16 (*Lysnibacillussphaericus*).

Salt tolerant rice variety

CSR-GROSURE- a bio-enhancer, in vegetable crops under inland sodic conditions

ICAR-Indian Institute of Soil and Water Conservation

1. Contact details

i) Postal Address: ICAR-Indian Institute of Soil and Water Conservation (IISWC), 218, Kaulagarh Road, Dehradun – 248 195, Uttarakhand, India

ii) Director: Dr M.Madhu,

iii) E-mail: directorsoilcons@gmail.com Ph: +91 135 2758564 & 2752452,
Website: www.cswcrtiweb.org

2. Mandate and activities

- Research for management of land degradation in a primary production systems and rehabilitation of degraded lands in different agro-ecological regions of the country.
- Co-ordinate research network for developing location-specific technologies in the area of soil and water conservation.
- Centre for training in research methodologies and updated technology in soil and water conservation and watershed management.

3. Salient achievements

- Development of models watersheds across the agroecologies.
- Developed technologies for land degradation neutrality.
- Developed Bio-engineering technology for treatment of torrents in Shivaliks.
- Technologies for rehabilitation of mine spoil areas in hilly regions
- *JholaKundi*: a low cost water harvesting technique for augmenting production of *jhola* lands in Eastern Ghats High Land Region of Odisha
- Recharge filter – a cost effective technology for augmenting groundwater

Vertical Drain In Tea Plantation, R.C., Udhagamandalam

Minespoil Rehabilitation Project, Sahastradhara, Dehradun

ICAR-Directorate of Weed Research, Jabalpur

1. Contact details

i. Postal Address: ICAR-Directorate of Weed Research, Maharajpur, Adhartal, Jabalpur-482004 (M.P.)

ii. Name of the Director: Dr. J.S. Mishra

iii. Email: director.weed@icar.gov.in/ Tel: 0761-2353138

2. Mandate and activities

- Conduct research for developing viable weed management technologies in crop and non-crop situations.
- Coordinate network research in weed management in different agro-ecological regions.
- Repository of information in weed science and act as a center for training in weed management.

Activities

- To develop economical, environment friendly and sustainable weed management technologies for crops, cropping system and non-crop situations.
- To develop site specific and ergonomically designed precision weeding tools.
- To study aquatic and problematic weeds and their management through conventional and biological methods.
- To conduct risk analysis of major alien invasive weeds.
- To assess the possible risk of herbicide residue hazards on environment and develop their mitigation techniques.

3. Salient achievements

- Bio-control of aquatic weed -Water hyacinth
- Management of *Parthenium*through Mexican beetle (*Zygogrammabicolorata*)
- Biocontrol of aquatic weed*Salviniamolesta*
- Management of isoproturon resistant *Phalaris minor* in wheat
- Development of Weed Atlas
- Management of *Orobanche* in mustard
- Phytoremediation of polluted water through weeds
- Weed management in Conservation Agriculture

Releasing of bio-agent in Salvinia infested pond

Complete control of Salvinia after 18 months

ICAR-Central Agroforestry Research Institute

1. Contact details

i. Postal Address: ICAR-Central Agroforestry Research Institute Gwalior Road, Jhansi 284003 (Uttar Pradesh), India

ii. Name of the Director: Dr. A. Arunachalam

iii. Email address: director.cafri@icar.gov.in/ Phone No.: +91-510- 2730214
Mobile: 9212441230

2. Mandate and activities

- Develop sustainable agroforestry (AF) practices for farms, marginal land and wastelands in different agroclimatic zones of India.
- Coordinate network research for identifying AF technologies for inter-region.
- Training in AF research for ecosystem analysis.
- Transfer of AF technology in various agro climatic zones.

Activities

- Conducting basic, strategic, applied research on tree-crop interactions, soil fertility improvement and ecological productivity.
- Analysis of ecosystem services and socioeconomics of AF systems
- Development of location-specific AF interventions for livelihood security, value addition, watershed management, technology refinement and carbon sequestration
- Framework for AF outreach and policy analysis

3. Salient achievements

- Total area under AF in 15 agro-climatic zones has been estimated to be 28.427 million ha of the total geographical area.
- Carbon sequestration potential of AF system existing on farmer's field has been found as 0.35 t C ha-1 yr-1 and total carbon sequestration potential of 17 states has been found 8.13 million tonnes.
- The total soil organic carbon (SOC) in AF system existing on farmer's field varied from 46.59 to 104.84 t C ha-1 in 0-90 cm soil depth under different states.
- Developed more than 80 AF technologies for different agro-climatic zones of the country for income augmentation and livelihood security of farmers.

Agroforestry Area in different states

Melia and guava based Agroforestry system at farmer's fileds at Sinagr, Jhansi

ICAR-Central Research Institute for Dryland Agriculture

1. Contact details

i. Postal Address: ICAR - Central Research Institute for Dryland Agriculture Santoshnagar, Hyderabad - 500 059 (Telangana)

ii. Name of the Director: Dr. V.K. Singh

iii. Email address/ Phone No.: director.crida@icar.gov.in, 040-24530177

2. Mandate and activities

- To undertake basic and applied research for sustainable and climate resilient agriculture in rainfed areas
- To Co-ordinate network research for generating location-specific technologies in rainfed areas
- To serve as a centre for capacity enhancement in natural resource management in drylands

Activities

1. Development of system based farm production technologies
2. Designing, developing and demonstration of Climate resilient technologies
3. Rainwater harvesting and management
4. Extending agro-advisory services based on real time weather conditions.

3. Salient achievements

- Developed 650 district agricultural contingency plans.
- Risk and vulnerability assessment of Indian agriculture to climate change at district level as per IPCC AR-5.
- Real-time contingency measures (soil, crop and water) to cope with early/midseason/terminal drought and flood.
- Drought proofing action plans for 24 vulnerable districts of Karnataka, Andhra Pradesh and Rajasthan.
- Prepared Risk Assessment and Vulnerability map of India in which 310 districts fall in 'Very High' and 'High' climate vulnerability

Vulnerability of Indian Agriculture to Climate Change

State of art infrastructure for Climate Change Research

ICAR-Central Coastal Agricultural Research Institute

1. Contact details

i. Postal Address: ICAR- Central Coastal Agricultural Research Institute Ela, Old Goa – Goa- 403402

ii. Name of the Director: Dr.Parveen Kumar

iii. Email Address: director.ccari@icar.gov.in / Phone no.: 0832-2995095

2. Mandate and activities

- Researches on the field and horticultural crops, livestock, and fisheries relevant to the natural resource base of coastal India for sustainable productivity
- Develop climate-resilient land use and farming systems for improved and sustainable livelihood through coastal agriculture
- Act as a centre of agro-eco-tourism

Activities

- Conservation and management of natural resources of coastal region
- Conservation and utilization of genetic resources in the coastal region
- Development and validation of production technologies of major crops of coastal region
- Development and validation of production technologies of livestock and fisheries
- Improving livelihood security through post-harvest technologies and other agri-enterprises

3. Salient achievements

- Resource mapping and characterization in coastal areas.
- Development of suitable crop varieties
- Development of location specific integrated farming system models for livelihood improvement
- Development of agro-ecotourism models.

ICAR-Indian Institute of Soil Science

1. Contact details

i. Postal Address- ICAR-Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal – 462038 Madhya Pradesh, India.

ii. Name of the Director- Dr. Ashok K. Patra

iii. Email address: director.iiss@icar.gov.in; patraak@gmail.com/ Phone No: 0755-2730946

2. Mandate and activities

- Basic and strategic research on physical, chemical and biological processes in soils related to management of nutrients, water and energy
- Advanced technologies for sustainable soil health and quality
- Coordinate the network research with State Agricultural Universities, National, International and other Research Organizations

Activities

- Soil health management
- Conservation agriculture and carbonsequestration*vis-à-vis*climatechange
- Soil microbial biodiversity
- Soil pollution, remediation and environmental security

3. Salient achievements

- Developed Mridaparikshak Mini-lab, analysed 3.34 million soil samples and prepared 28 million soil health cards.
- SQI CAL software developed for rapid assessment of soil health/quality
- Developed, validated & recommended MIR spectroscopy technology for rapid assessment of SOC, sand, silt, clay content, pH and water retention for major soils of India.
- Developed e-Atlas for 640 districts on micronutrient deficiencies covering 28 states.
- Developed DSS/App for precise fertilizer recommendations for different agro-ecological sub-regions
- Developed 5 Biofertlizers technologies
- Developed low-cost INM technology
- Developed critical limits of heavy metals for soil under sensitive agroecosystem

Mridaparikshak

Liquid biofertilizer of Rhizobium, Azotobacter, Azospirillum

ICAR-Indian Institute of Water Management

1. Contact details

i. Postal Address: ICAR-Indian Institute of Water Management Chandrasekharpur, Bhubaneswar-751 023, Odisha

ii. Name of the Director: Dr. R.K. Panda

iii. E-mail address: director.iiwm@icar.gov.in; Phone No.: +91-674-2300060

2. Mandate and activities

- Strategies for efficient management of on-farm water resources for sustainable agricultural productivity.
- Coordinate research for generating location-specific technologies for efficient use of water resources.
- Center for training in agricultural water management.

Activities

- Management of rainwater, canal water and groundwater
- On-farm technology dissemination including wastewater management, water policy & governance
- Frontier areas of research have been initiated under in Agri-CRP on Water project.
- Providing consultancy, collaboration, or contract research services.

3. Salient achievements

- Conjunctive use of groundwater and canal water for increasing cropping intensity
- Design and development of indigenous rubber dams for watersheds
- Micro-level water resource development through tank-cum-well system
- Augmenting water resources of minor irrigation projects through secondary storage reservoirs
- Raised and sunken bed technology for crop diversification in canal command of high rainfall area
- Developed groundwater recharge model for hard rock areas
- *In situ* phytoremediation of hexavalent Chromium from water for safe irrigation.

Rubber Dam

Water Management under Automated Drip Irrigation and Fertigation for Okra Crop (Udaipur)

ICAR Research Complex for Eastern Region

1. Contact details

i. Postal Address: ICAR-Research Complex for Eastern Region, ICAR Parisar, P.O.: Bihar Veterinary College, Patna- 800 014

ii. Name of the Director:Dr.AshutoshUpadhyaya, Director (Acting)

iii. Email address: director.icar-rcer@icar.gov.in; directoricarrcer@gmail.com, Phone No.:+91-612-2223962

2. Mandate and Activities

- Strategic and adaptive research for efficient integrated management of natural resources to enhance productivity of agricultural production systems in eastern region.
- Transform low productivity-high potential eastern region into high productivity region for food, nutritional and livelihood security.
- Utilization of seasonally waterlogged and perennial water bodies for multiple uses of water.
- Promote network and consortia research in the eastern region.

Activities

- Development of various agricultural technologies for improving productivity in EIGP and Eastern Hill & Plateau region.
- Development of suitable technological interventions for restoration of water congested ecologies.
- Development of location specific production technologies including crop diversification.
- Development of IFS models suitable for smallholders.

3. Salient Achievements

- Developed suitable crops varieties for improving the productivity.
- Developed half acre, one acre and 2 acre IFS models for smallholders in EIGP and tribal farming system in Eastern Hill & Plateau.
- Diversified aquatic production systems with integration of water chestnut,Alocasiaand sweet flag with makhana.
- Makhana cultivation in cropping system mode.

Rice Variety –Swarna Shreya

ICAR-Indian Institute of Farming Systems Research

1. Contact details

i. Postal Address: ICAR-Indian Institute of Farming Systems Research Institute Modipuram, Meerut-250 110, Uttar Pradesh

ii. Name of Director: Dr A.S. Panwar

iii. E mail address: director.iifsr@icar.gov.in Phone No.: 91-9412078001

2. Mandate and activities

- Research in integrated farming systems (IFS) on production technologies for improving productivity and resource use efficiencies.
- Develop efficient, economically viable and environmentally sustainable integrated farming system models for different farming situations.
- On-farm testing, verification and refinement of system-based farm production technologies.
- Coordinate and monitor integrated farming systems research in the country

Activities

- Farming systems characterization, typology and modelling
- Development of prototype IFS models including organic farming systems
- Development of organic farming packages for cropping systems
- National level coordination of research on IFS, cropping systems, organic and natural farming systems

3. Salient achievements

- Developed 64 Multi - enterprise prototype IFS models including 8 IOFS models suitable for 26 States/UTs.
- Developed organic farming packages for 68 cropping systems covering 52 major crops suitable to 16 States.
- Agroclimatic zone specific crop plan maps developed for 14 crops.

Prototype IFS model developed for West Godavari district of Andhra Pradesh

Banana based prototype IFS model developed for Kerala

ICAR-Central Arid Zone Research Institute

1. Contact details

i. Postal Address: Director, ICAR-Central Arid Zone Research Institute (CAZRI), CAZRI Road, Jodhpur 342008

ii. Name of Director: Dr. O.P. Yadav

iii. E mail address: director.cazri@icar.gov.in Phone No.: 0291-2786584/2788706

2. Mandate and activities

- Basic and applied research on sustainable farming systems in arid ecosystem
- Repository of information on the state of natural resources and desertification processes
- Livestock-based farming systems and range management practices for the chronically drought-affected areas
- Generating and transferring location-specific technologies

3. Salient achievements

- Developed technology for stabilization of sand dunes.
- Developed agri-horti crop varieties for improving productivity in arid and semi-arid environments.
- Solar energy application in agriculture including development of agri-voltaic system for crop production and electricity generation.

Agri-voltaic system: Crop production and electricity generation from a single land use system

Pomegranate variety, CAZRI Vishal

ICAR National Institute of Abiotic Stress Management

1. Contact details

i) Postal Address: ICAR-National Institute of Abiotic Stress Management Malegaon, Baramati, Pune, Maharashtra, India

ii) Name of the Director: Dr Himanshu Pathak

iii) Email address: hpathak.iari@gmail.com; director.niasm@icar.gov.in
Phone no: +91-9899247590

2. Mandate and activities

- Basic and strategic research to manage abiotic stresses in crops, livestock and fisheries.
- Repository of information on abiotic and biotic stresses, adaptation and mitigation strategies and policies.
- Building sustainable agriculture in multi-stressed agro-ecosystems.
- Serve as Center of Academic Excellence in managing multiple stresses in agriculture.

Activities

- Assessment of the vulnerability of crops, horticulture, livestock and fisheries to abiotic stresses.
- Development of technologies and policies for adaptation and mitigation of atmospheric, water and soil stresses with frontier science.
- Development of repository of information on abiotic stress management for climate-smart
- Agriculture
- Establishmet of Center of Academic Excellence for human resource development to manage multiple stresses in agriculture.

3. Salient achievements

- Developed technology for rehabilitation of degraded basaltic and rocky land through suitable horticultural interventions.
- Developed SORF machine for improving ratoon cane yields (10-38%),and saving in water (6-21%) and fertilizer (20-25%) use.
- Developed phenomics protocols and prototypes of tools to accelerate phenotyping of crop plants

- Developed technology for wastewater treatment synergizing with integrated approach of constructed wetland and aquaponics.

Optimisation of dragon fruit technology for marginal lands

SORF machine to save water, fertilizer with trash retention in ratoon sugarcane

ICAR Research Complex for NEH Region

1. Contact details

i. Postal Address: ICAR Research Complex for NEH Region, Umroi Road, Umiiam, Meghalaya 793103

ii. Name of the Director: Dr Vinay Kumar Mishra

iii. Email address / Phone No.: director.icar-neh@icar.gov.in

2. Mandate and activities

- To develop and improve sustainable farming systems for different agro-climatic and socio-economic conditions of NEH region, including organic agriculture.
- To improve crops, horticulture, livestock and fishery and to impart training for development of local competence for efficient management of resources.
- To collaborate with state Departments for testing and promotion of improved farming technologies.

Activities

- Development of IFS models for achieving food and nutritional security
- *Jhum* fallow improvement through suitable technological interventions
- Soil acidity amelioration for improving productivity
- Developing cost effective livestock production technologies.
- Development of agri-horti crop vatieties for improving productivity.

3. Salient achievements

- Developed IFS models for improving livelihood security of tribal folk
- Improved productivity of fruits and vegetables through suitable technological interventions.
- Rainwater harvesting and its judicious use
- Developed diagnostic kits and vaccines for animal and plant diseases
- Enhanced production and productivity by the development of new breeds
- Development of processed products from locally available resources.

Gomati Dhan/ TRC 2005-1/ IET 21517 / IC 615569

IOFS model at farmer's field of Mynsain village, Meghalaya

ICAR-Mahatma Gandhi Integrated Farming research Institute, Motihari

ICAR-Mahatma Gandhi Integrated Farming Research Institute

1. Contact details

i. Postal Address: ICAR-Mahatma Gandhi Integrated Farming Research Institute Piprakothi, Motihari (East Champaran), Bihar 845429

ii. Name of the Director: Dr. K. G. Mandal

iii. Email address: director.MGIFRI@icar.gov.in, Phone No.: 09438184806

2. Mandate and activities

- Adaptive research for location-specific integrated farming system models (fish-based) for flooded, flood-prone and wetland ecology.
- Centre for vocational and advanced training to promote fish-based integrated farming systems.

Activities:

- Delineation, situation analysis and mapping of flood-prone, flood-affected and waterlogged areas
- Characterization and monitoring of soils and nutrient status of water congested ecologies
- Design and development of IFS technology/ packages/ model for water congested ecosystems
- Post-flood crop management, design and development of efficient water management technology
- Capacity building of farmers and other stakeholders on different components of IFS

3. Salient achievements

- Crop diversification and intensification in water surplus ecologies.
- Developed post flood management plans.

Animal Sciences

ICAR-National Dairy Research Institute

1. Contact details

i) Postal Address: ICAR-National Dairy Research Institute (Deemed University), Karnal-132001 (Haryana)

ii) Name of the Director: Dr. M. S. Chauhan

iii) Email address/phone: dir@ndri.res.in Phone No. : 0184-2252800

2. Mandate and activities

- Research in the areas of dairy production, processing and marketing
- Human resource development in dairy sector
- Dissemination of innovative dairy technologies.

3. Salient Achievements

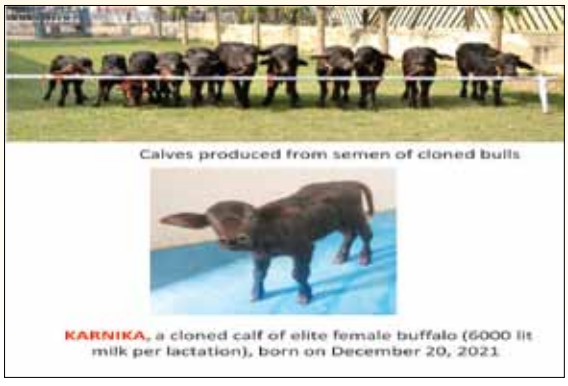
- Developed two high yielding Crossbred milch cows, Karan Fries and Karan Swiss, and improved Deoni – a dual purpose breed.
- Produced the world's first *in vitro* fertilized buffalo calf, through Embryo Transfer Technology.
- World's first cloned buffalo calf was produced using economical Hand-guided cloning technique.
- India's first Ovum-Pick up – IVF cattle calf named 'Holi' was produced.
- Salivary fern like patterns-based estrus identification method was developed for dairy farmers.
- Livestock Methane inventory and Feed formulation softwares were developed.
- Area specific mineral mixture was developed for dairy animals.
- Hansa Test was developed in 1962 for detection of buffalo milk in cow milk.
- Optimized technological Processes for Commercial Production of Traditional Dairy products including paneer, dahi, lassi, barfi, kalakand and chhana based sweets were developed.

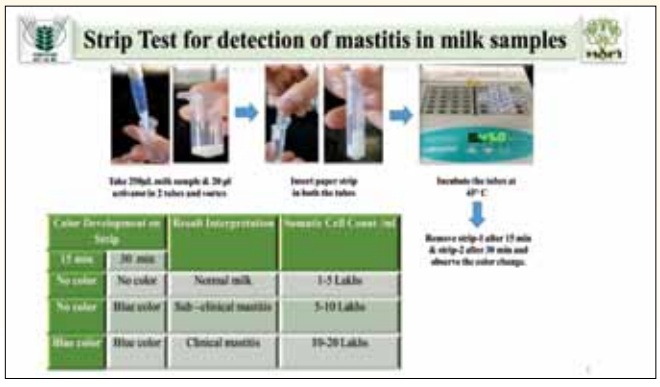
- Long-life and convenient ready-to-make mixes for *gulab-jamun*, rasogolla mix powder, instant kulfi-mix powder, *rasmalai, basundi*, *kheer, payasam*, *paladapayasam* have been developed
- Technological packages for Milk-Millet Composite foods such as Bajra (Pearl millet) *lassi*, sorghum (*Jowar) lassi,* Barley based fermented milk beverage, and Iron fortified biscuits were developed.
- Developed a rapid method for the detection of adulteration in milk of vegetable oils and fats and method was adapted by BIS.
- Economic surplus generated by crossbreeding program in Haryana was estimated at ₹389 million.
- The net present value of the benefits from semen sexing technology was estimated at ₹24.10 lakhs per 100 heifers under best management practices.
- The estimated economic surplus generated by the adoption of Compound Cattle Feed (CCF) was over Rs 44,000 million in Eastern India and the adoption of Anionic Mineral Mixture (AMM) was found to have a potential of generating economic welfare worth Rs. 4,862 crores in Haryana and Rs. 20 thousand crores in the country.
- Awarded 1644 B.Sc/B.Tech, 3357 M.Sc./M.V.Sc./M.Tech. and 1653 Ph.D. degrees, and trained over 12 lakhs farmers.
- The Institute has disseminated 27.66 lakh frozen semen doses and 14.78 lakh ml of liquid semen of elite bulls of cattle and buffalo from 1980 to 2021.
- NDRI ranked first among all Agricultural Universities and four Deemed Universities of ICAR consecutively five times in the years 2016-17, 2017-2018, 2018-19, 2019-20 and 2020-21.
- Bagged the Sardar Patel Outstanding ICAR Institution Award in 2014.

4. Knowledge/skill/technologies/products/other services available for different stake holders.

- A total number of 169 technologies have been developed since 2013, commercialized on 113 occasions generating revenue worth Rs. 297.65 lakhs. During the last 17 years, 81 patents applications were filed, out of which 36 have been granted and the others are under consideration. NDRI has nurtured more than 112 entrepreneurs from different parts of the country in establishing their commercial ventures and 8 of them are renowned start-ups.
- Cost-effective tests including strips for detection of adulterants, antibiotics residues, pesticide residues.
- Tests for differentiating milk of different species and A1/A2 milk.
- Technologies for the manufacture of several types of fermented dairy products, ready-to-reconstitute dairy products, and functional dairy foods.
- Native strains of probiotic and product-specific dairy cultures characterized and validated are finding potential applications for making probiotic and other fermented dairy foods.

- Innovative dairy equipment viz. butter melting system, conical press vat (CPV), surface heat exchanger, and cooling system for viscous dairy products are also available for transfer to the prospective clients.





ICAR-Central Institute for Research on Buffaloes

1. Contact details

i. Postal address: ICAR-Central Institute for Research on Buffaloes, Hisar – 125001 (Haryana)

ii. Director: Dr. T.K. Datta

iii. E-mail : director.cirb@icar.gov.in Phone No. : +91-01662 281602

2. Mandate and activities

- Basic and strategic research for enhancing technology development on all aspects of buffalo productivity.
- Information repository and dissemination of buffalo production technologies.

3. Salient achievements

- The Institute has contributed enormously in production, supply and use of high genetic merit bulls for breeding purpose. 455 high genetic merit bulls have been supplied in a decade to different agencies.
- Produced 10 clone buffaloes of elite buffalo bulls of which 7 are donating semen. Twenty thousand semen doses have been produced from cloned bulls. Produced more than 60 progenies using cloned bulls' semen.
- At CIRB in the last 25 years the annual increase in standard lactation milk yield was 2.5%. It increased to 2867 kg in 2021-22 from 2291 kg in 2013-14.
- A Protocol to lower the sperm number from conventional 20 million to 12 million per dose of frozen semen for artificial insemination has been developed. This will be helpful in increasing semen doses without affecting conception rate.
- Development of pregnancy diagnostic kit 'Preg-D' a urine based technique for pregnancy diagnosis in buffaloes and cattle.
- Composite feed developed which reduced methane production by 30% with increase of milk and growth.
- ICAR-CIRB Semen Freezing Lab got accredited by DADF, Govt. of India.
- One pregnancy established using OPU-IVF technology in buffaloes
- Establishment of cryo-bank of primary somatic cells of elite buffaloes.
- 4647 stakeholders were trained regarding scientific management of buffaloes in last 5 years.
- A handy and portable 'Field Microscope' for the evaluation of sperm motility in field condition

- Modified artificial vagina with temperature sensor
- Area specific mineral mixture
- Egg yolk free semen extender
- Noninvasive technology of infra-red thermal imaging as a potential tool for assessing udder health and mastitis diagnosis and management
- Pregnancy diagnosis kit 'Preg-D' which is a urine based novel technique for pregnancy diagnosis in buffaloes and cattle.

ICAR-Directorate of Poultry Research

1. Contact details

i. Postal Address: ICAR-Directgorate of Poultry Research, Rajendranagar, Hyderabad, Telangana-500030

ii. Name of the Director: Dr. R.N. Chatterjee

iii. Email address: Director.dpr@icar.gov.in Phone No. 040-24015651

2. Mandate and activities

- Basic and applied research to enhance productivity of poultry
- Development of new germ plasm for rural poultry husbandry
- Capacity building.

Activities

- The Institute is actively involved in improving pure bred chicken and duck breeds/lines and developing high yielding chicken varieties employing both conventional and advanced scientific breeding tools for both backyard and intensive poultry farming in the country. The Institute is engaged in basic research in poultry and also developing package of practices and management tools utilizing locally available resources and value addition to the poultry produces for maximizing profits for the farmers as well as poultry Industry.

3. Salient achievements

- Developed high yielding dual purpose low input colour chicken varieties namely, Vanaraja, Gramapriya, Srinidhi, Swetasree, Vanashree, Janapriya, Pratapdhan, Kamrupa, Jharsim, Narmadanidhi and Himsamridhi suitable for backyard poultry farming producing 130 to 180 eggs annually and attaining 1.5 kg body weight at 12 to 14 weeks of age
- Developed high yielding meat purpose commercial colour chicken variety namely, Krishibro attaining 1.5 kg body weight at 5 weeks of age
- Developed high yielding egg purpose commercial chicken varieties namely, Krishilayer and Athulya yielding more than 300 eggs annually
- Developed a feed supplement, Oxycure (blend of trace minerals and osmolytes) for alleviating heat stress in chickens.
- Three phytogenic feed additives were developed as alternatives to antibiotic growth promoters, which showed promising results *in vivo* in Krishibro chickens.
- ALV detection protocol established and the incidence of ALV reduced to less than 1% at the farm

- Integrated farming model with backyard chicken, moringa and earthworms developed
- Developed low cholesterol egg producing knock down chicken through RNAi approach where cholesterol content in eggs was reduced by 14.3%.
- Single candidate gene-based marker assisted selection was employed in a broiler line on pilot scale, where around 30% improvement was achieved for body weight at 6 weeks of age.
- Whole genome sequence of 10 native chicken breeds were explored and native chicken specific medium density 74K SNP chip is being developed for its use in genomic selection.
- Cryopreservation of PGCs of native chicken breeds for ex situ conservation of chicken breeds
- In the last seven years (2014-15 to 2020-21), ICAR-DPR supplied about 297.23 lakh chicks of improved chicken varieties to about 14.93 lakh rural families across the country.
- ICAR-DPR has immensely contributed to growth of the poultry industry in the areas of poultry nutrition, health and capacity building, contributing a total of about Rs. 600 crores/ year.

4. Knowledge/skill/technologies/products/other services available for different stake-holders:

- High yielding chicken varieties for both backyard (Vanaraja, Gramapriya, Srinidhi, Swetasree, Vanashree, Janapriya, Pratapdhan, Kamrupa, Jharsim, Narmadanidhi and Himsamridhi varieties of chicken) and intensive (Krishibro, Krishilayer and Athulya varieties of chicken) poultry farming.

ICAR-Indian Veterinary Research Institute

1. Contact details

a. Postal Address: ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly (UP) -243122

b. Name of the Director: Dr. Triveni Dutt

c. Email address: director.ivri@icar.gov.in, directorivri@gmail.com
Ph.: +91 0581-2300096(Off.); Fax No.: +91 0581-2303284.

2. Mandate and activities

a. Basic and strategic research for improvement of animal health for enhanced productivity

b. Human resource development, imparting under-graduate and post-graduate education

c. Dissemination of livestock production and health technologies.

3. Salient achievements

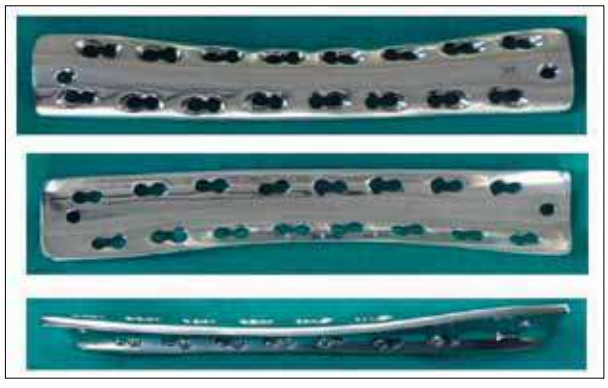
- The institute has contributed immensely to animal disease control programmes by developing required diagnostics and vaccines. Most notable ones include development of vaccines against Rinderprest, PPR, FMD, Ranikhet disease helped in eradication of Rinderpest, Equine Infectious Anaemia, Dourine and CBPP diseases from Indian livestock.
- The institute has developed vaccines for important animal and poultry diseases. These include vaccines against Sheeppox, Goatpox, Infectious Bursal Disease, Brucellosis, Classical Swine Fever and Duck .
- The institute has been instrumental in developing different diagnostic kits against various diseases for effective and early assessment of disease incidence in animals and poultry populations. Important aids developed for early disease detection include diagnostic kits for Rotavirus infection (an antigen-capture ELISA), Foot and mouth disease (blocking ELISA), PPR (MAb-based competitive ELISA), Bluetongue (Sandwich ELISA), antibody ELISA kits for Japanese encephalitis in pigs, Newcastle disease, Infectious Bursal disease and other.
- An eco-friendly herbal acaricide for control of ticks, including acaricide resistant species that infest livestock and pet animals.
- A mesenchymal stem cell conditioned media-based formulation for treatment of skin wounds that promotes faster wound healing with minimal scar tissue.
- A synthetic crossbred population named *Vrindavani* with high production potential of more than 3200 Kg milk per lactation has been developed and disseminated in the field.
- A crossbred pig variety, named *Landlly*, well-adapted to Indian conditions has been developed and released for dissemination in the field.

- Two purebred livestock breeds i.e., *Rohilkhandi* goat and *Ghurrah* pig have been genetically characterized and registered with national nodal agency.
- Molasses-based multi-nutrients liquid supplement (MMLS) for ruminants and Urea Molasses Liquid Diet (UMLD) for livestock; solid multi-nutrients block (SMB) for cattle have been developed.
- Secured 27 patents for different products/technologies related to veterinary and animal husbandry sector.
- The institute has registered 15 designs for different veterinary devices and 38 different copyrights.
- 38 technologies have been transferred to 141 commercial houses/ entrepreneurs/ companies/ stakeholders.
- Veterinary Devices:Various veterinary devices have been designed for efficient treatment of livestock ailments. These include Locking Plate for repair of fracture in radius, Fracture Fixation Device for animals, Fracture Fixation Nail for animals and others.
- Mobile Applications: ICAR-IVRI, in collaboration with ICAR-IASRI, New Delhi and various other institutes, has developed 18 mobile applications on different aspects of farm management and animal healthcare to provide knowledge and enhance skills of field veterinary officers, paravets, livestock entrepreneurs and other stakeholders.

4. Knowledge/skill/technologies/products/ other services available for different stake holders

- **Human resource development by ICAR-IVRI, Deemed University:** The institute was conferred 'Deemed to be University' status in 1983 and is involved in the teaching and training activities to budding veterinarians. The institute offers Master's and Doctorate programme in 22 and 19 different disciplines of veterinary and animal sciences, respectively. The institute also offers Bachelors degree in Veterinary Sciences and Animal Husbandry (BVSc & AH) for students from different regions of the nation.
- **Library Services and literature support:** IVRI Library named 'National Library of Veterinary Sciences' is one of the oldest libraries in this specialized area in South Asia region. Many reputed journals have been subscribed with subscription linked to the IP address of the Institute's intranet facility. Books, magazines minikits, folders, and other extension material are readily available to the stakeholders from the institute.
- **Support to farmers through ATIC as a single window system:** Farmers are supported via Tele-consultancies, exposure visits, exhibitions, screening of documentaries and mobile ATIC van facility.
- **Biological products:** 11 different kinds of biological products are available on demand for different stakeholders including State Animal Husbandry Departments.
- **Diagnostic and testing services:** Diagnostic testing services are provided for different bacterial, viral and parasitic diseases. Besides, facilities pertaining to hormonal, nutritional, biochemical, and milk and meat product analyses are available to stakeholders.

- **Referral Veterinary Polyclinic & Teaching Veterinary Clinical Complex:** Daily (24*7) basic and advanced healthcare services are provided to sick animals throughout the year. These facilities pertain to diagnosis, therapeutics and prophylaxis of various patho-physiological conditions. Besides, students (the future veterinarians) are trained and exposed to real field situations through RVP and other field camps.
- **Services offered for wildlife species:** Consultation, disease investigation, treatment to ailing animals, healthcare management training and species identification based on tissue specimens are provided to Zoos and other wildlife centres located throughout the nation.
- **Laboratory animal facility:** This facility supplies laboratory animals to institutions registered with CPCSEA for research and biological production.



ICAR-National Research Centre on Mithun

1. Contact details

i. Postal Address: ICAR-National Research Centre on Mithun, Medziphema-Nagaland – 797106, India

ii. Name of the Director: Dr. M. H. Khan

iii. Email address: Director.NRCMithun@icar.gov.in, Haider.Meraj@icar.gov.in

2. Mandate and activities

- Identification, evaluation and characterization of mithun germplasm available in the country
- Conservation and improvement of mithun for meat and milk
- To act as repository of information on mithun.

3. Salient Achievements

✓ Whole genome sequencing of mithun

✓ Morphometric-cum-physical characterization of mithun populations of Nagaland, Arunachal Pradesh, Mizoram and Manipur.

✓ Development of simple methodology for determination of age of mithun under field conditions

✓ Implemented 100% AI in mithun farm and Embryo Transfer technology in mithun

✓ Qualitative characterization of mithun milk and meat.

4. Knowledge/skill/technologies/products/other services available for different stakeholders

Technologies:

✓ Formulation of area-specific mineral mixture for mithun.

✓ Low cost complete feed block using locally available trees/shrubs and industrial by-products which improved the dry matter and gross energy intake.

✓ Developed and standardized a protocol for collection, freezing of semen and artificial insemination (AI) in mithun leading to the birth of AI calves in the farm as well as in farmers' field.

✓ Developed value added products of milk, meat and hides of mithun.

✓ Development of semi-intensive mithun rearing model

✓ Developed Mineral Block and block dispenser for mithun

Skill:

✓ Conducted 24 nos. of skill development training programme for the stakeholders of mithun rearing states of NE India benefitting 1014mithun farmers.

Products:

Developed the following value added products of mithun meat and milk products:

✓ **Meat products**: Meat pickle, Smoked meat and Meat patties

✓ **Milk products:** Curd, Rasgulla

✓ **Hides products:** leathers such as Jacket, Carry bags, Sandal

ICAR-National Research Centre on Pig

1. Contact details

i. Postal address : Rani, Guwahati, Assam, PIN-781131

ii. Name of the Director : Dr. Vivek Kumar Gupta

iii. Email address : Director.nrcp@icar.gov.in; nrconpig@rediffmail.com

iv. Phone: 0361 2847195

2. Mandate and activities

- To undertake basic and applied research for enhancing pig production
- To act as a repository of information on pig production
- Capacity building.

Activities

- Conservation and genetic improvement of indigenous pigs
- Optimization of physiological and reproductive efficiency including identifying markers for early detection of fertility
- Characterization of production system, feeding practices and their optimization for enhancing pig production, especially under field conditions.
- Artificial Insemination in Pigs
- Continuous monitoring, recording of pig diseases and development of disease management protocol
- Technology development for improved post-harvest handling, processing and value addition of pig products
- Institute-stakeholder linkages and skill development.

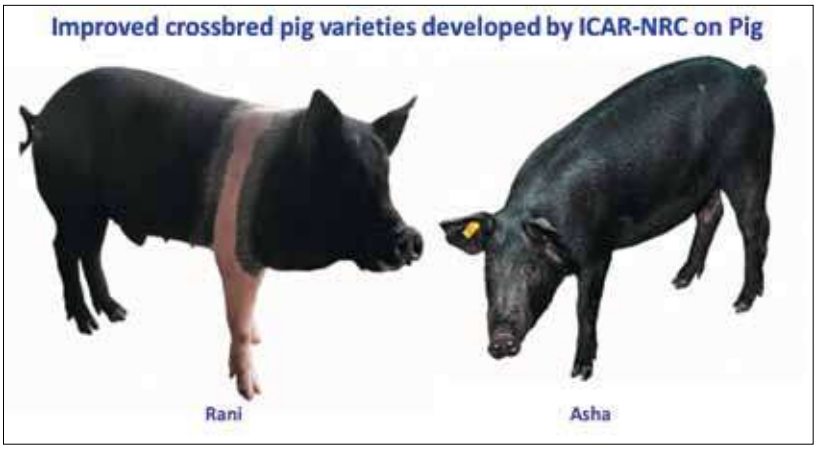
3. Salient achievements

- Developed critical scientific interventions for augmenting pig production, pork processing and its transfer for livelihood support and nutritional security in the country.
- Registered 10 indigenous pig germplasm and developed 9 crossbred pig verities
- Conducted more than 10000 artificial inseminations in the field and produced over 40000 piglets through AI.
- Tested more than 9000 biological samples to extend continuous support in monitoring and surveillance of pig diseases and developed 5 diagnostic kits.

- Developed 11 technologies, signed 15 technology transfer agreements, incubated 19 entrepreneurs and established 6 startups.
- Conducted over 500 training programmes and trained over 15000 beneficiaries.
- Granted 3 patents, 1 trademark and 14 copyrights.

4. Knowledge/skill/technologies/products/services available for stakeholders

- Improved germplasm for foundation stock.
- Liquid semen for Artificial Insemination.
- In-house capacity building programmes.
- Consultancy and contract research services
- Technologies for processing value added pork products and state of the art pork processing plant.
- Standardized feed formulations and feed production unit
- Well-equipped quality control laboratory.
- Agri-Business Incubation Centre.



ICAR-Central Avian Research Institute

1. Contact details

i. Postal Address: ICAR-Central Avian Research Institute, Pilibhit Road, Izatnagar-243122

ii. Name of the Director: Dr A.K. Tiwari

iii. Email address / Phone No.: director.cari@icar.gov.in / +91-581-2303223

2. Mandate and activities

- Basic and applied research on productivity enhancement for sustainable production in diverse avian species including domestic fowl.

a) Enhancing productivity and climate resilience of diversified poultry species

b) Developing self-sustainable climate smart production systems along with effective management of farm waste and by-products for enhanced productivity and profitability of poultry

c) Improved food safety and product quality to ensure effective production and marketing risk management in poultry value chain

- Human resource development and capacity building.

3. Salient achievements

- Minimizing the dependency of Indian poultry sector on imported poultry stock, institute has made significant strides by developing and propagating improved germplasm of diversified poultry, *viz.*,Japanese quails, turkey, Guinea fowl, ducks and desi fowls including broiler and layer chickens.
- Introduced Japanese quails as well as Guinea fowlsin India.
- Identified and evaluated over 36 non-conventional feed stuffs for utilization as poultry feed to scuttle competition with human food apart from various feed additives, mineral premixes, toxin binders, and innovative herbal antimicrobials, pre and probiotics etc.
- Developed feeding standards (BIS& ICAR) for different categories of poultry birds in India for precise nutrient supply.
- Developed and commercialized 48 novel poultry processed products such as egg rasmalai, egg kulfi, CARI Protein rich biscuits, chicken meat bites/ wafers/ finger chips/pickleetc.
- Patented and commercialized "CARI Poultry Semen Diluent" technology.
- Developed molecular signature for differentiating Indian wild quail's vis-à-vis Japanese quails.

- Green energy production via novel DAC technology for efficient utilization of poultry excreta/waste.

4. Knowledge/skill/technologies/products/other services available for different stakeholders.

- Feed sample analysis facility on nominal payment basis
- Elite germplasm of diversified poultry species
- Facilitating entrepreneurship development in poultry and allied sectors through Agribusiness Incubation Centre; Licencing of technologies& detailed project report facility.
- Undertaking contract research projects for evaluation of various commercial/novel products etc.
- Skill /human resource development in poultry production management and allied fields, such as feed manufacturing, hatchery management, poultry waste management etc.
- Various published literature including books, technical/extension bulletins, folders, leaflets etc.
- Mobile applications namely, JQauilXpert, ICAR-CARI, Backyard Poultry Farming App & disseminating knowledge via social media channels: Facebook; YouTube, Instagram etc.

CARI-Nirbheek 2

CARI-Pearl

ICAR-Central Institute for Research on Goats

1. Contact details

i. Postal address: ICAR-Central Institute for Research on Goats, Makhdoom P.O Farah (Mathura) , U.P. Pin-281122

ii. Name of Director: Dr. Dinesh Kumar Sharma (Acting)

iii. E mail: director.cirg@icar.gov.in

2. Mandate and activities

- To undertake Research, Training and Extension Education Programmes for improving milk, meat and fiber production of goats and to develop processing technologies of goat products.

3. Salient achievements

- In last seven years, 2706 animals were distributed to the farmers belongs to 16 States. 42 multiplier flocks of goats were established through providing improved goat to the farmers of UP, Haryana, Uttarakhand..
- Produced 27042 cryopreserved semen doses and distributed 6800 doses to farmers/ stakeholders of 13 States (Uttar Pradesh, Haryana, Himachal Pradesh, Uttarakhand, Rajasthan, Madhya Pradesh, Bihar, Kerala, Punjab, Delhi, West Bengal, Tamilnadu, Jharkhand). Farmers are getting around 40% conception rate.
- Through breeding and genetic improvement program the body weight at 12 months increases to: Jamunapari-48%, Barbari -35%, Jakhrana -45%.
- The kidding rate increases to: Jamunapari-1.5%, Barbari-1.7%.
- Five patented granted -Patent No 327196, 340760, 341364, 364566, 383967.
- Five Mobile app developed and available on play store-Bakri Mitra , Goat farming , Goat products , A.I in Goats, Goat Breeds.

4. Knowledge/skill/ technologies/products/other services available for different stake holders

- **Technologies: Drug & Diagnostic** -BRUCHEK: A Dot-ELISA Kit for detection of brucellosis in goats and sheep, Diagnosis of para tuberculosis ELISA KIT (Serum and Milk), Stressol-G : An Herbal Antistress Formulation, PARACHEK CARD – An eye mucosa colour targeted selective treatment chart for goats, Aja – Sanjeevani – Herbal Immunomodulatory Formulation for Amelioration of Weaning Stress in Goat kids, EASY KIDDER – a herbal formula to minimize parturition problems, Intra vaginal sponge for Induction and Synchronization of estrus,BRUCLEAR-herbal drug to prevent abortion and shedding of Brucella,Diagnostic kits-Enterotoxaemia detection in small ruminants, Indirect

ELISA for detection of Johne's disease in ruminants, Peptide based DIVA ELISA kit for Johne's disease, Visual LAMP (vLAMP) assay for detection of Brucella spp. in domestic animals, TaqMan® probe based RT-PCR for diagnosis of Brucella melitensis in goats, TM16 peptide based iELISA for quick detection of coenurosis in goats, Multiplex mRNA qRT-PCR for detection of active MAP shedding in Johne's disease.

- **Production Technology**-Goat Feeder for Better Feed Utilization, Pelleted Complete Feed Technologies for Sustainable Goat Production. Herbalanticocidial complete pellet feed formulation for goats
- **Meat/Milk Technology** -Retort processed non-curry based goat products, Retort processed goat meat curry products, Low salt shelf stable chevon pickle, Gluten free goat meat product, Chevon nuggets with healthier and balanced fat and fatty acids, Goat meat Pickle, Goat meat Nuggets, Herbal Goat meat Nuggets, Goat meat Sausage, Goat meat Patties, Meat Shami Kebab, Meat Murukku, Meat Nimkee, Meat /Milk Biscuits.

Production/ Meat/Milk Technology

Drug & Diagnostic

ICAR-Central Sheep and Wool Research Institute

1. Contact details:

i. Postal Address: ICAR-Central Sheep and Wool Research Institute (ICAR-CSWRI) Avikanagar–304 501 (District Tonk), Rajasthan

ii. Name of the Director: Dr Arun Kumar

iii. Email address: director.cswri@icar.gov.in Ph No.: +91 1437 220162 / 240490

2. Mandate and activities

- Basic and applied research for improving sheep production, products processing and rabbit husbandry
- Dissemination of technologies for sheep productivity enhancement and management.

Activities

- Basic and applied research on all aspects of sheep and rabbit production
- Development, updation and standardization of meat and fibre technologies
- Trainings on sheep and rabbit production and utilization to stakeholders
- Transfer of improved technologies on sheep and rabbit production to farmers, rural artisans and development workers
- Providing referral and consultancy services on production and products technology of sheep.

3. Salient achievements

- Developed prolific sheep – **Avishaan** possessing inheritance of Garole (12.5%), Malpura (37.5%) and Patanwadi (50.0%)., produced 46% more body weight .
- Developed cost-effective feeding protocols for sheep to maximizing mutton production and strategies for functional food values.AharVattika for reduced methane emission.
- Developed **Avikesil-S** (foroestrus synchronization in sheep) with a success rate of 83-85% and facilitate. Accelerated lambing system with 3 extra lambs in life time.
- Devised annual health calendar for sheep flocks. Strategies like modified worm management programme, targeted selective treatment, breeding for disease resistance and community dilution resulted in reduced dependency and use of anthelmintics
- Development of value added products from wool (Shawl, carpet, blankets, pelt, composites, quilt, handicraft items, mutton (Nuggets, Sausages, patties, pickle, soup, loaf, kofta and **Avicookies** (4 times more protein than other biscuits) milk (Flavoured milk, Panner, Cheese, peda, Kulfi, Gulab Jamun etc).

- Developed molecular assays for identification of cashmere (Pashmina) fibre from processed textile products and for identification of adulteration of meat of sheep and goats.

4. Knowledge / skill / technologies / products / other services available for different stake holders

- Training programmes on recent advances in sheep production and health (for field veterinarian), capacity building in woollen and handicraft products (women empowerment and artisan), sheep and goat rearing practices (farmers).
- The major technologies / services available for different stakeholders are supply breeding seed stocks on book value to farmers and development agencies, *Fec B* genotyping of sheep, semen analysis and pregnancy diagnosis, AI in sheep with chilled semen, Avikasil-S for oestrus synchronization, flock health management and consultancy, testing, processing and product manufacturing from wool, analysis of feed and fodder, Memnaprash (milk replacer/ supplements) for lambs,Avikaminmix (area specific mineral mixture) for sheep and goats, feed block / supplementary feeding to farmer's flock.

Avishaan ewe with triplets

Lambs produced by oestrous synchronization and AI at farmer's door

Memnaprash supplementation to lambs

Value added products from meat and milk from sheep

ICAR-National Institute of High Security Animal Diseases

1. Contact details

i. Postal Address: ICAR-National Institute of High Security Animal Diseases, Hathai Kheda Dam road, Anand Nagar, Bhopal-462022, Madhya Pradesh

ii. Name of the Director: Dr. V. P. Singh

iii. Email address / Phone No: director.nihsad@icar.gov.in

2. Mandate and activities

- Basic and strategic research on exotic, emerging and re-emerging animal diseases.
- Biorisk management and capacity building in the areas of biosafety, biosecurity and bio-containment for handling high risk pathogens.

Activities

- Development of novel diagnostics and vaccines for control of exotic and emerging diseases.
- Diagnostic preparedness and services for Exotic & emerging infectious diseases of livestock and poultry.
- Host-pathogen studies for Exotic & emerging infectious diseases of livestock and poultry.
- Capacity building in the areas of biosafety, biosecurity and biocontainment for handling high risk pathogens.

3. Salient achievements

- Avian Influenza Laboratory of ICAR-NIHSAD, Bhopal is a designated OIE Reference Laboratory and accreditated with ISO 17025:2017 for Avian Influenza diagnosis.
- NIHSAD has diagnostic preparedness for 22 exotic and emerging animal diseases including Avian Influenza, Bovine viral diarrhea (BVD), Crimean–Congo hemorrhagic fever (CCHF), Lumpy skin disease, Porcine reproductive and respiratory syndrome (PRRS), African Swine Fever (ASF), Swine Influenza, Henipavirus (Nipah and Hendra virus infection) and tested around 11 lakhs samples from more than 100 outbreaks including Avian Influenza, PRRS, LSD & ASF and the surveillance of Indian and imported/exported poultry, livestock and related products samples.
- Many novel animal/avian viruses belonging to different genotypes have been isolated and characterized for Avian Influenza (2.2, 2.2.1, 2.3.2.1a, 2.3.2.1c, 2.3.4.4.B clades & G1 lineage for H5N1 and H9N2 subtype respectively), BVD (BVDV-1,2 &HoBiPeV), BDV 3, LSD (field strain), PRRS (HPV genotype II), ASF (p72-genotype II), SARS-CoV-2

(B.1.617.2), Swine influenza (A/H1N1pdm09), MCF (OvHV-2) and Enzootic bovine leucosis (Genotype 6).

- Investigated Antarctic Animal and Environmental Metaviromes and studied the interface of migratory and native aquatic birds during migratory season in north-eastern India using metaviromics technique.
- Host pathogenic interaction studies on Avian Influenza, PRRS, BVD revealed the involvement of newer molecules in the pathogenesis.
- Development of vaccines -reverse genetics based Avian Influenza vaccine, inactivated vaccine for low pathogenic Avian Influenza & PRRS.
- Development of diagnostics for exotic and emerging animal diseases including Avian Influenza, PRRS, BVD and CCHF.
- Capacity building on Biosafety, biosecurity and bio-containment for handling high risk pathogens, advanced diagnostics for Avian Influenza, BVD, PRRS for national and international participants.

4. Knowledge/skill/technologies/products/other services available for different stake holders.

- Indirect ELISA kit for detection of avian influenza virus (AIV) antibodies in chickens.
- Indirect ELISA kit for detection of porcine reproductive and respiratory syndrome virus (PRRSV) antibodies in domestic pigs.
- Multiplex Real Time RT-PCR Kit for Avian Influenza A virus typing, and diagnosis of H5, N1 and H9 Subtyping.
- Lateral flow test for rapid detection of H5 avian influenza virus antigen in poultry.

Lateral Flow rapid test kit for Avian Influenza H5 virus antigen

Indirect ELISA kit for detection antibodies against PRRS virus

ICAR-National Bureau of Animal Genetic Resources

1. Contact details

a) Postal address: ICAR-National Bureau of Animal Genetic Resources, GT Road By pass, Near Basant Vihar, Karnal-132001(Haryana) India

b) Name of the Director: Dr B P Mishra

c) E-mail: director.nbagr@icar.gov.in; Phone: 0184-2961000(O), Fax 0184-2960460; Website: https.//nbagr.icar.gov.in

2. Mandate and activities

- Identification, evaluation, characterization, conservation and sustainable utilization of livestock and poultry genetic resources of the country
- Coordination and capacity building in animal genetic resources management and policy issues.

Activities

a) Identification, Characterization and documentation of native AnGR

b) Conservation of native breeds of livestock and poultry species

c) Genomics for population structure and diversity of native AnGR

d) Trait identification and characterization of native AnGR for value addition

e) Policy support and Capacity building for AnGR management.

3. Salient achievements

- About 230 breed/populations of indigenous livestock and poultry were characterized and documented by the Bureau which included 120 newly identified breeds/populations of indigenous AnGR across the country.
- A total of 202 breeds of indigenous livestock and poultry including 3 indigenous dog breeds have been registered in the country by ICAR-NBAGR and further Gazette Notified by the DARE, MoA&FW, Govt. of India.
- Cryopreservation of germplasm of indigenous breeds in form of Semen (49 breeds/ populations), Somatic cell (24 breeds/populations) and DNA (169 breeds/populations)at National Gene Bank of the Bureau. *In situ* conservation of 17 indigenous breeds carried out in their breeding tract.
- Omics based trait characterization for climatic adaptation, heat/ cold tolerance in native cattle, buffalo and sheep breeds, also unique animal products viz. milk (Sahiwal), colostrum

(cattle/yak), meat (Kadaknath chicken) and meat (Mandya sheep)

- AGR-IS database is available with all kind of information on native breeds in the country
- 8 SNP Chips developed for native breeds/ species, 1 patent granted.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Expertise for trainings on AnGR management specifically on identification, characterization, conservation & utilization of native animal breeds
- Karyotyping and DNA Testing of genetic abnormalities/diseases for breeding bulls, A1A2 allele testing in cattle
- National framework for germplasm registration for registering animal breeds/lines by any citizen of India
- Scientific literature (breed monographs, calendars etc.)on native breeds for sale.

Felicitation of a breed applicant by Hon'ble A&FW Minister


भारत का राजपत्र
The Gazette of India

Gazette notification of Registered breeds

ICAR-National Institute of Animal Nutrition and Physiology

1. Contact details

i. Postal Address: Hosur Main Road, Adugodi, Bengaluru – 560030, Karnataka

ii. Name of the Director: Dr. Raghavendra Bhatta

iii. Email address / Phone No.: directornianp@gmail.com ; 080-25711303/304

2. Mandate and activities

- To conduct basic and fundamental research with respect to animal feed resource management using physiological-nutritional approaches to improve animal productivity and profitability of livestock farmers.

3. Salient achievements

- **Area Specific Mineral Mixture**-A more practical and cost-effective mineral supplement for improving general health, productive and reproductive performance of dairy animals.
- **Sheepmin &Goatmin** -Supplementation of sheep and goat mineral mixture improves growth and health with better weight gain, low mortality and higher immune status in sheep and goat.
- **HaritDhara & Tamarin Plus** -An anti-methanogenic feed supplement which is very effective in reducing enteric methane emission by 20% and both can be fed to cattle, buffalo and sheep.
- **ReproFat Plus** – It contains critical macronutrients, essential macro and micro minerals and natural anti-oxidant which improves rumen function, liver and ovarian health, fertility, milk quality and milk yield in dairy animals.
- **Milk Replacer for Lambs** -Milk replacer is a special feed containing quality ingredients that are highly digestible and designed for supporting the nutritional needs of young nursing lambs in achieving optimum growth and health.
- **Reprovardhak** -It is a more potent product in estrous synchronization programmes in small and large animals which does not have any side effects even on repetitive use for augmentation of reproduction.
- **BUFFASOL**: This novel buffalo-specific semen extender contains the essential metabolites that are generally found deficient in buffalo seminal plasma as compared to that of the cattle. Approximately, 80% of the buffalo bulls responded to this new semen extender and exhibit improved post-thaw sperm qualities of the cryopreserved semen.

- **Grain Sprouts Production** – It is easy and cost-effective method to produce mould-free sprouts with minimum requirement of water and provides better scope for efficient utilization of crop residues and vertical green fodder production.
- **AB Free**: Phytogenic blend as replacement of antibiotic growth promoter in poultry
- Pineapple fruit residues silage as fodder source for livestock. The technology has been commercialized.
- Areca-sheath as an alternate dry fodder for livestock.
- Strategic supplementation of limiting nutrients through locally available feedstuffs for improved milk production.
- Azolla cultivation in portable HDPE containers.
- **Value added animal products:** Low cholesterol egg and omeg-3-enriched poultry meat developed by dietary manipulation.

4. Knowledge/skill/technologies/products/other services available for different stake holders.

- **Technologies/Products**: Area Specific Mineral Mixture, Sheepmin & Goatmin, HaritDhara & Tamarin Plus, ReproFat Plus, Milk Replacer for Lambs, Reprovardhak, BUFFASOL, Grain Sprouts Production etc.
- **Services**: Proximate analysis of feed and fodders, fiber fractions and analysis of fatty acids; Estimation of minerals, metabolizable energy, aflatoxins, hormones etc.

ICAR-National Institute of Veterinary Epidemiology and Disease Informatics

1. Contact details

i) Postal Address: ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR-NIVEDI), Ramagondanahalli, Post Box No. 6450,Yelahanka, Bengaluru-560064, Karnataka, India

ii) Name of the Director: Dr. B. R. Shome (A)

iii) Email ID : director.nivedi@icar.gov.in; Phone no.: 080 23093100/110/111

2. Mandate and activities

A. Epidemiology, informatics and economics of animal diseases including zoonoses.

- Outbreak investigation, identification of risk factors
- Development of national level risk map of economically important diseases

B. Surveillance, forecasting and forewarning for management of animal diseases including zoonoses.

- Estimates of disease burden (seroprevalence)
- Disease forecasting /forewarning

C. Repository and capacity development.

- Maintenance of National Livestock Serum Bank
- Organization of capacity-building programs at national and international level.

3. Salient achievements

- **Rinderpest eradication**-The institute was the nodal center for sero-monitoring/surveillance of Rinderpest during the eradication programme and played a pivotal role in implementing the project from 1990-1998.In the VIII plan, the institute was strengthened by providing 32 state level diagnostic/disease investigation laboratories for sero-monitoring activity under National Project on Rinderpest Eradication (NPRE) with support of ICAR and European Union.
- Development of robust Forecasting system –National Animal Disease Referral Expert System) NADRES V2 and animal disease surveillance
- Development of diagnostic/population survey kits for important animal and zoonotic diseases
- Capacity building training for various stakeholders related to animal sector-International and national training

4. Knowledge/Skill/Technologies/products/other services available for different stake-holders.

Technologies:

- Indirect ELISA for surveillance of brucellosis in small ruminants (sheep and Goats)
- Indirect ELISA kit for sero-diagnosis of brucellosis in livestock and humans
- IBR Avidin Biotin ELISA (AB ELISA): For detection of antibodies against IBR in bovines
- Pen-side diagnostic kit for human brucellosis
- Recombinant VSG and monoclonal antibody based competitive inhibition enzyme linked immunosorbent assay for the detection of antibodies against *Trypanosoma evansi*
- Monoclonal antibody based double antibody sandwich ELISA for the detection of *T. evansi*antigen in animals
- Competitive ELISA for the differential diagnosis of brucellosis infected from vaccinated animals
- Surravey-Kit for population survey of Trypanosomiasis in bovines
- ELISA kit for assessment of Antibody against Classical Swine Fever in pigs
- Recombinant Non-Structural Proteins (fused) based ELISA for detection of BT antibodies in sheep and goats
- Recombinant Leptospiral surface antigen-based immune-diagnostic test-LAT for Bovine Leptospirosis (Applied patent)
- Recombinant polyclonal antibodies-based diagnostics for PPR virus antibodies (ABrC-ELISA) and antigens (ABrAC-ELISA) detection in sheep and goats
- NADRES V2-animal disease forewarning web application
- ADMaC Mobile app-animal disease forewarning mobile application
- NER-LDF mobile app-animal disease forewarning mobile application for Northeastern states
- AINPonGIP mobile app-disease data of Haemonchosis from different places of Rajasthan and forewarning
- Blue tongue Mobile app-forewarning of blue tongue two months in advance for all taluks of Karnataka
- EPI Cal App-intended for use by epidemiologists and researchers
- CaDDES web app-field query-based animal disease diagnosis portal

Products:

- Indirect ELISA kit for Sheep and Goat Brucellosis
- Protein–G based indirect ELISA kit for Bovine Brucellosis
- Avidin-Biotin ELISA kit for IBR (Bovines)

- Lateral Flow Assay for diagnosis of brucellosis in livestock
- Surravey-Kit for population survey of Trypanosomiasis in bovines
- PPR Avidin-Biotin Recombinant Antigen Capture ELISA Kit.
- PPR Avidin-Biotin Recombinant Competitive ELISA kit
- IBR AB ELISA Kit
- Leptospira staining kit with reference slide

Services:

- Sampling Plan and Sampling Frame, Statistical data analysis, Disease modelling, GIS mapping and modelling, Prediction risk maps.
- Screening of biological samples for brucellosis, leptospirosis, IBR and other livestock diseases.
- Public Private Partnership (PPP) mode contractual research project on various diseases i.e IBR, BVD, Leptospirosis, Brucellosis etc.

Diagnostic kits available at ICAR-NIVEDI

NADRES v2 : Disease forecasting and forewarning web application

ICAR-National Research Centre on Meat

1. Contact details

i. Postal Address: ICAR-National Research Centre on Meat, Hyderabad Chengicherla, PB. No. 19, Boduppal Post, Hyderabad 500092 Telangana

ii. Name of the Director: Dr S. B. Barbuddhe

iii. Email address / Phone No.: E mail: director.nrcmeat@icar.gov.in; Phone: 040-29801672

2. Mandate and activities

- Basic and applied research in meat science and technology for meat production, processing, value addition and utilization
- Capacity development for different levels of personnel in meat sector
- National repository of information in meat and allied sectors.

3. Salient achievements

- Established NABL accredited meat species identification laboratory by covering 12 species including wild animals
- Established package of practices for production of organic meat from sheep
- Designed Portable and Meat Production and Retailing Facility (P-MART) for sheep and goats
- Implemented mobile meat stall scheme with Govt of Karnataka under which 180 mobile meat stalls were provided by subsidy programs benefiting 180 stakeholders.
- Established model small ruminant slaughterhouse at Tirupati
- Established block chain based traceability system for Indian buffalo meat sector
- Till date provided 47 consultancies to entrepreneurs, licensed technologies to 26 entrepreneurs, completed 12 contract research projects with the industry, organized 109 training programs and signed MoUs with 16 Universities from across India
- ICAR NRC on Meat has been recognized as host institute by MSME, as FoSTaC Training Centre by FSSAI, accredited by ASCI for supply chain management and animal health worker training programme and recognize as National Referral laboratory for Meat and Meat Products by FSSAI.

4. Knowledge/skill/technologies/products/other services available for different stake holders

- Technologies for hygienic meat production and value addition to meat
- Models for implementation of the livestock and meat traceability

- Portable meat production and retailing facilities for hygienic meat production from small ruminants under small scale system
- Field level LFA based kits for species identification of pork and chicken
- Service facility for species identification of the meat and meat products
- Training programs on hygienic meat production, value addition to meat and quality evaluation of meat and meat products
- Consultancy services for establishment of the slaughterhouses and meat product processing plants.

Portable meat production and retailing facility for hygienic meat production under small scale production system

Certified organic sheep maintained by NRC on Meat

Kit for species identification of chicken Meat, Hyderabad

ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh

1. Contact details

i) Postal Address: ICAR-National Research Centre on Yak Dirang, West Kameng District, Arunachal Pradesh, Pin-790101

ii) Name of the Director: Dr. Mihir Sarkar

iii) Email address: director.nrcy@icar.gov.in/yakdirector@gmail.com

iv) Phone No.: +91-3780-242259

2. Mandate and activities

- Identification, conservation, characterization and evaluation of yak germplasm
- Improvement of yak for draught and milk.

Activities

- Establishment of nucleus herd (s) of yak.
- To develop and frame conservation strategy of yak and to take up research on *ex-situ* and *in-situ* conservation of yak genetic resources in a collaborative mode
- To conduct research on different aspects of yak improvement in terms of production, productivity, health and quality improvement of products
- To conduct research on scientific utility of yak crossbreds being traditionally carried out by people of mid-altitude areas to frame a strategy on crossbreeding with cattle.

3. Salient Achievements

✓ **Established nucleus yak herd** with experimental sheds at Nyukmadung (2750 meter above mean sea level and 31 km away from Dirang).

✓ **Sustainable improvement of yak farming system in highland areas:**

- Development of economic and efficient feeding strategies of yak like Total mixed ration, Area specific mineral mixture etc for feeding yaks for enhanced production.
- Conservation of forages as silage & Complete Feed Blocks with development of multi-cut, cold adapted highland pastures to mitigate winter feed crisis of yak.
- Development of diagnostics and control measures against many yak diseases like FMD, Brucelliosis, IBR,GI bacterial pathogens, chlamydiosis, babesiosis etc
- Standardization of Frozen semen technology and Artificial insemination in yak

- Conservation and multiplication of yak germplasm through application of biotechnological tools
- Value addition of yak products for making the yak husbandry profitable so as to improve the livelihood status of yak farmers
- Yak breed characterization and registration of first Indian yak breed as *Arunachali*yak(INDIA_YAK_2300_ARUNACHALI_16001).

✓ **Formulation of Yak Insurance Policy**

✓ **Development of Bankable Yak Farming**

✓ **Technology Transfer and Improvement of livelihood security of tribal farmers**

Registration of first Indian yak breed as *Arunachaliyak*

Farm Sedentarization of Yaking

ICAR-National Research Centre on Camel

1. Contact details

i. Postal Address : ICAR-National Research Centre on Camel, Post Box -07, Jorbeer Bikaner: 334 001 (Rajasthan)

ii. Name of the Director : Dr Artabandhu Sahoo

iii. Email address : nrccamel@nic.in, director.nrccamel@icar.gov.in Phone : +91 151 2230183 Fax : +91 151 2970153

2. Mandate and activities

- Basic and applied research for improvement camel health and production.
- Information repository on camel research and development.
- Development of camel eco-tourism.

Activities

- To carry out and applied research on camel production
- To carry out survey of camel genetic resources in India.
- To carry out research on draught ability, milk production potential, reproductive performance and management of camel diseases
- To carry out research for enhancing productivity by nutritional intervention.
- To carryout research exploring camel immune system and its applicability in diagnosing and treating human diseases.
- Technology validation and its impact on the socio-economic status of camel keepers.
- To act as a repository of information on camel research and development.
- To collaborate with national and international resources.
- Development of human resource in the area of camel health and husbandry

3. Salient achievements

- Among the camel breeds Kachchhi breed has been identified as best dairy camel breed.
- Phenotypic characterisation of Jalori, Mewari, Marwari and Sindhi camel breeds
- Unique properties of camel milk identified like camel milk lower fat and total solids compared to cattle and buffalo milk while higher total salts, free calcium, protective proteins, vitamin C and micro minerals viz. iron, copper and zinc. Small chain fatty acids are present in lesser amount than large chain fatty acids in camel milk. Camel milk has higher concentration of

whey proteins compared to cow milk. Camel milk whey proteins are more heat resistant than the cow milk.

- Study on keeping quality concluded that Shelf life of raw camel milk is 8 hours at 37°C and more than 3 week at 4-6°. Extension of shelf life of raw camel milk up to 20 hours can be done by using LP system activation. The development of acidity is comparatively slow in camel milk than cattle milk.
- Various camel milk products viz., kulfi, flavoured milk, lassi, paneer, cheese, mawa, gulabjamun, barfi, camel milk powder, tea and coffee has been developed and evaluated.
- A kit for the detection of thyroid cancer in human patients, utilizing the single domain antibodies of the camel has been developed in collaboration with BARC, Mumbai
- Therapeutic value of camel milk in management of diabetes established in collaboration of SPMC, Bikaner
- Successful immunization of dromedaries against the Venom of Indian saw scaled viper Echiscarinatussochureki achieved
- Package of practices for camel calf rearing are developed. A total of 156 management practices have identified with their respective scientific relevance value in hot arid region.
- Camel can easily pull ploughs in sandy soils for about 6 hrs daily with an intermittent rest of 3 hr and can plough at a rate of 750-1050 square meter/hr. The depth of ploughed land measured 9-15 cm.
- Camel can generate draft force of 17-22% of body weight and produces 1.16 H.P.
- An Indian camel can haul 1.5 to 2 tonnes of load for around 8 hrs covering a distance of 30-35 kms/day on two/four wheel cart with in-between rest of about 3-3.5 hrs.
- Bikaneri camels are better than Jaisalmeri and Kachchhi for endurance and draught purpose whereas Jaisalmeri breed performs better for riding/race.
- Area specific mineral mixture (ASMM) was prepared and tested under field conditions.
- Comparative study of camel carting vs. bullock carting under hot arid region indicated that camel carting is more profitable for the small and marginal farmers due to higher cost benefit ratio and short pay back period.

4. Knowledge/skill/technologies/products/other services available for different stake holders.

1. Camel Milk Cheese (Cheddar type)
2. Camel Milk Nuggets
3. Fruit Flavoured Whey Drink
4. Sugar Free Camel Lassie
5. Camel Milk Paneer
6. Camel Milk Kheer

7. Camel milk chocolate
8. Camel Milk Gulab Jamun
9. Camel Milk Barfi
10. Camel Milk Peda
11. Camel Milk Sandesh
12. Spray dried camel milk powder
13. Lyophilized skim milk powder
14. Camel Milk Skin Cream
15. Fermented Camel Milk (CamYo)
16. Millet-based Camel Milk Products such as Rabri, Drink & Shakes.
17. Complete Feed Block
18. Complete Feed Pellets
19. Area Specific Mineral Mixture
20. Skin application for treatment of Thikria (skin candidiasis)
21. Formulations for the treatment of Dermal Mycoses in Camel
22. Yoga Mat
23. Shawl
24. Sapling Bags

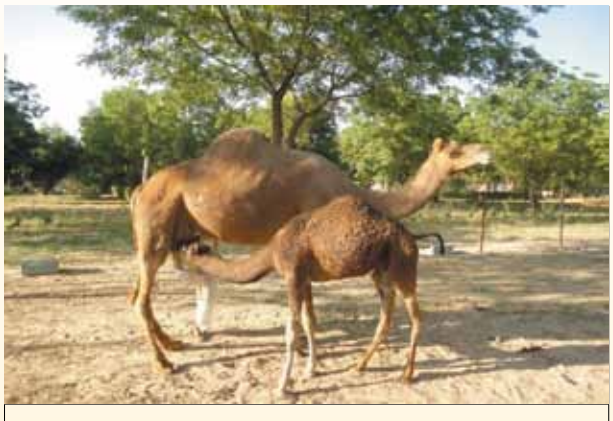
Ustra Aarogyam APP-ICAR-NRCC

- The main objective of this app is to provide detailed information about camel health management to camel farmers, veterinarians and veterinary science students

Training

- The Centre imparts training to the scientists/veterinarians in the following fields Camel management and health, Molecular markers for characterization of camel breeds, Database management, Preparation camel milk products, Diagnosis and control of camel diseases.

Kulfi from camel milk



Elite female

ICAR-National Research Centre on Equines (NRCE)

1. Contact details :

i. Sirsa Road, Hisar-125 001, Haryana, India

ii. Name of the Director: Dr Yash Pal

iii. Email: nrcequine@nic.in, Phone: 01662-282502, 275787, Fax: 01662-276217

2. Mandate and activities

- Basic and strategic research on equine health and production
- To provide advisory and consultancy services and capacity development
- National repository of veterinary, dairy, and rumen microorganisms and their identification, characterization and documentation
- Distribution of microbes for teaching, research and development of new technologies

3. Salient achievements:

- National Referral Lab for testing of 10 major equine diseases and human glanders.
- The S&M activities have helped in declaring country-freedom from African horse sickness (AHS) in 2006 by the Office International des Epizooties (OIE).
- Continuous surveillance and monitoring of equine diseases by NRCE has led to diagnosis and control, and eradication of equine infectious anaemia Glanders outbreaks in 2006-2007, 2010; 2012 onwards were diagnosed and controlled.
- Diagnostic tests developed at NRCE are being used for (i) disease surveillance and monitoring to pre-empt the disease occurrences (ii) disease investigation and (iii) disease diagnosis to understand the source of infection and to suggest treatment, control and prevention strategies.
- Six breeds of horses (Marwari, Kathiawari, Spiti, Zanskari, Manipuri, Bhutia) have phenotypically and genetically been characterized. It will help in registration of horses. This information will also be helpful in developing "Breed Signatures".
- The artificial insemination service is being provided to the farmers at the centre and at farmers' door.
- Three international OIE twinning programmes completed.
- Equine piroplasmosis Lab got NABL accreditation for ISO-17025 Certification.
- Patent filed: 16; Granted: 5
- Number of Technologies developed/released: 23

- The NCVTC repository has a collection of more than 4500 microbial cultures of animal origin, including recombinant clones, and phages of veterinary and animal importance.
- National Biodiversity Authority (NBA) has recommended to designate the NCVTC as National Repository to Ministry of Environment and Forests, Government of India under section 39 of the BD Act for safe custody of veterinary related and Biosafety Level–III microorganisms.
- Basic and fundamental contributions in virus-host interactions and antiviral drug development.
- Identified the repurposing potential of emetine against SARS-CoV-2 for the treatment of COVID-19 patients.
- Provided insights in understanding mechanisms of viral persistence/ exclusion during coinfections which has enabled developing methodologies to purify positive sense RNA virus from mixed culture.
- Highlighted bacteriophage research in International phage research community through International webinars & awareness programs.

Vaccines

- Equine herpes Virus-1 vaccine (Equiherpabort)
- Updated Equine Influenza vaacine
- A modified vaccine construct for EHV1
- Ancovax-Coronavirus (SARS-CoV-2/COVID-19) vaccine for Animals
- A Modified Attenuated Lumpy Skin Disease Virus (LSDV) Vaccine

Diagnostic kits

- Equiherpes B-ELISA kit for diagnosis of EHV– 1 infection
- Recombinant protein-based ELISA kit for diagnosis of Glanders
- Recombinant protein-based ELISA kit for diagnosis of EIA
- Recombinant gG-based type-specific ELISA for differentiation of EHV1 and 4 infection
- Monoclonal antibody-based ELISA kit for diagnosis of rotavirus infection
- Japanese Encephalitis Virus Antibody Test Kit, iELISA for equids and pigs.
- Canine SARS-CoV-2 Antibody detection ELISA Kit
- Recombinant antigen-based ELISA kit for diagnosis of Trypanosoma evansi.
- Recombinant antigen-based ELISA kit for diagnosis of Theileriaequi
- LFA for diagnosis of equine piroplasmosis

Reproduction technologies

- Pregmare kit for pregnancy diagnosis in mares
- Cryopreservation of equine semen.
- LFA for pregnancy diagnosis
- Parentage testing technology

ICAR-Central Institute for Research on Cattle

1. Contact details

i. Postal Address: ICAR-Central Institute for Research on Cattle Grass Farm Road, Meerut Cantt, Meerut, Uttar Pradesh 250 001

ii. Name of the Director: Dr Abhijit Mitra

iii. Email address / Phone No. director.circ@icar.gov.in; 0121 26534136, Fax 0121 2657134

2. Mandate and activities

1. Basic and strategic research on productivity and production enhancement of cattle including indigenous cattle.
2. Dissemination of scientific information and technology for cattle production management.

Activities:

- Increasing cattle productivity using the latest breeding tools.
- Enhancement of cattle productivity through reproductive techniques.
- Use of nutritional and management interventions for optimization of cattle productivity.
- HRD and technology dissemination.

AICRP on Cattle

- Conservation and genetic improvement of important indigenous cattle breeds.
- Production of progeny tested crossbred bulls and genetic improvement of cattle under field conditions.

3. Salient achievements

1. Improvement of 24-36% in the milk production potential of indigenous cattle breeds viz., Gir (from 1875 to 2564 Kg), Kankrej (1670 to 2004 Kg) and Sahiwal (1575 to 1958 Kg) Sahiwal under the Indigenous Breeds Project (IBP).
2. Evolved a national milch cattle "Frieswal™" having a stable inheritance of 62.5% HF and 37.5% Sahiwal involving >68000 lactation records of # animals maintained at 37 Military Farms (MoD) at different agro-climatic regions of the country and potential to yield > 7000 Kg of milk in lactation with a maximum peak yield of 41 Kg in a day.
3. Developed a standardized methodology for large-scale Field Progeny Testing (FPT) involving the farmers' herds.
4. Up to 60% improvement in the first lactation milk yield of crossbred animals maintained at the farmers' herd at project operating areas in GADVASU (42.86%), Ludhiana, Punjab; KVASU (60.35%), Thrissur, Kerala; BAIF (10.9%); Pune, Maharashtra and GBPUAT

(41.64%), Pantnagar, Uttarakhand under the Field Progeny Testing (FPT) programme.

5. Developed real-time data entry software for AICRP on Cattle named "Systematic Information Resources for Dairy Animal Management-SIReDAM" (Web link: *http://webtom.cabgrid.res.in/SIReDAM/I)*
6. Produced more than 47 lakhs doses of frozen semen and distributed more than 27 lakhs doses. Currently, semen doses of around 20 lakhs of Frieswal and 224085 of Gir, 123991 of Kankrej and 144801 of Sahiwal are available for meeting the breeding demand of the country.
7. Provided regular training to the farmers on various advanced aspects of dairy cattle management and also conducted training programmes for scientists, academicians, technical officers and students under HRD activities.
8. Developed and obtained two design patents namely Pronil-CVP™ and Prolacure-UtP™for resolving the reproductive problems in bovines.
9. Developed the following six technologies and applied for grant of Indian patent

i. Colour-based test for differentiation of Cow vs. Goat milk/meat samples,

ii. LAMP assay for rapid detection of cow components adulterated in buffalo milk/meat

iii. Easy and economical Protocol for BLAD testing in bulls and all the technologies have been filed for patenting.

iv. Single tube tetra ARMS PCR-based assay for genotyping FMD virus receptor in cattle

v. Tetra primer displacement PCR assay for detection of Complex Vertebral Malformation (CVM) in cattle

vi. COWCAM kit for detecting cow milk adulteration in camel milk or vice versa at the level of 1%.

Fisheries Science

ICAR-Central Marine Fisheries Research Institute

1. Contact details

i. Postal Address: ICAR-CMFRI, Post Box No. 1603, Ernakulam North P.O., Kochi-682018, Kerala

ii. Name of the Director: Dr. A. Gopalakrishnan

iii. Email address: director.cmfri@icar.gov.in / Phone No.: 0484-2394867, 2391407

2. Mandate and activities

ICAR-CMFRI undertakes research programmes on marine fisheries resource assessment and management, coastal mariculture and open-sea farming. The Institute has 11 research centres along the coasts to carry out region-specific research and technology dissemination.

- Monitor and assess the marine fisheries resources of the Exclusive Economic Zone (EEZ) including the impact of climate and anthropogenic activity and develop sustainable fishery management plans.
- Basic and strategic research in mariculture to enhance production.
- Act as a repository of geo-spatial information on marine fishery resources and habitats.
- Consultancy services; and human resource development through training, education and extension.

3. Salient achievements

- Developed a national database on marine fish landings of about 1200 species covering 1511 fish landing centres on GIS platform from the EEZ of India for the last 5 decades.
- Stock assessment of 52 marine fish stocks and genetic stock identification of 8 species.
- Developed Fishery Management Plans (FMPs) for sustainable exploitation of the marine fisheries of maritime states. Further, developed restoration protocols through artificial reef development.

- Developed and popularized open-sea cage culture technology leading to the operation of > 3500 cages along the coasts. Further, developed Integrated Multi-Trophic Aquaculture (IMTA) technology with the integration of cage culture and seaweed farming.
- Identified a potential area of 23970 ha for seaweed farming and 46823 ha for cage culture along Indian coasts.
- Developed breeding and hatchery technologies for 37 marine fish/shellfish species including marine ornamental fishes. Further, developed broodbanks for cobia and Silver pompano.
- Developed 12 nutraceuticals from seaweed/mussel for treating lifestyle diseases.
- Discovered 226 fish/shellfish/other marine organisms new to science.
- Identified and mapped new and non-conventional deep-sea marine resources.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Site selection/ designing/ fabrication/ installation/operation of fish seed production, artificial reefs, open-sea cages, seaweed farming and mariculture.
- Consultancy on design of finfish/shellfish hatchery; environment management plan (EMP) and social & economic impacts of natural disasters/new technology
- Human resource development through training and demonstration.

ICAR-Central Inland Fisheries Research Institute

1. Contact details

i. Postal Address: ICAR-CIFRI, S.N. Banerjee Road, Monirampur, Barrackpore, Kolkata-700120, West Bengal

ii. Name of the Director: Dr. Basanta Kumar Das

iii. Email address: director.cifri@gmail.com / Phone No: 033-25920177

2. Mandate and activities

ICAR-CIFRI is involved in addressing issues related to sustainable fisheries management in inland open waters for environmental integrity and livelihood.

- Basic, strategic research for sustainable management of inland open water resources.
- Develop protocols for productivity enhancement in reservoirs and wetlands and aquatic ecosystems health management.
- Act as a repository of information on inland open water fisheries resources.
- Human resource development through training, education and extension.

3. Salient achievements

- Developed protocols for size-specific reservoirs and wetlands for enhancing productivity, implementation of which have led to a 3-4 fold increase in fish productivity.
- Characterized fish and fisheries resources, aquatic ecology, ecosystem health and invasion of exotics in important riverine systems, estuaries, reservoirs and wetlands. Further, developed a database on inland open water resources (≥0.5 ha) covering 19 major states.
- Designed, developed and popularised 'CIFRI GI CAGE®' for cage culture in inland waters. Further, developed CIFRI CAGEGROW® feed for cage culture of pangas.
- Developed and demonstrated 'CIFRI PEN HDPE®' pen culture technology for carp seed production in reservoirs and wetlands.
- Developed database on nutrient profiles of food fishes (NUTRIFISHIN) providing information on species-specific benefits for human health.
- Developed 'CIFRI ARGCURE®' - a medicine for controlling Argulosis and 'CIFRI Fish Tanavhari'- anesthetic herbal formulation for fish handling & live fish transportation. Further, developed 'CIFLIN' for detecting formaldehyde adulteration in fish.
- Developed national guidelines for cage culture in open waters, road-maps for sustainable management and development of inland open water fisheries of 12 major states.

- Extended consultancy services to over 20 government and non-governmental organisations for the impact of dams on fisheries, navigational disturbances, hydro-electric power projects, fish pass efficacies, etc.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Operation of cage and pen culture in reservoirs and wetlands.
- Consultancy services on environment impact assessment (EIA) and environmental management plan (EMP) of large open-water bodies.
- Training and demonstration in inland open-water fisheries management.

ICAR-Central Institute of Freshwater Aquaculture

1. Contact details

i. Postal Address: ICAR-CIFA, Kausalyaganga, Bhubaneswar-751002 (Odisha)

ii. Name of the Director: Dr Saroj Kumar Swain

iii. E-mail address : director.cifa@icar.gov.in / Phone No.: 0674-2465421

2. Mandate and Activities

The major thrust areas of ICAR-CIFA include species & systems diversification, genetic improvement, water use efficiency, nutrition & feed development, fish health management, etc. for enhancing productivity and economic returns in freshwater aquaculture.

- Basic and strategic research for the development of sustainable culture systems for freshwater finfish and shellfish.
- Species and systems diversification in freshwater aquaculture.
- Human resource development through training, education and extension.

3. Salient Achievements

- Developed breeding and seed production technologies of >20 freshwater foodfish species including major & minor carps, catfishes, murrels, etc. and >10 ornamental fishes.
- Development of different grow-out culture systems with different productivity levels.
- Developed FRP portable hatchery for the small-scale decentralized breeding facility.
- Developed genetically-improved strains of important carps/freshwater prawn through selective breeding demonstrating >60% higher growth in rohu; >30% in catla and >50% in giant freshwater prawn at farmers' fields. Further, developed disease resistance *Jayanti* rohu against *Aeromonas hydrophila*.
- Developed shining barb from rosy barb through selective breeding.
- Developed several functional feeds for different life stages of important freshwater carps, catfishes and freshwater prawns.
- Developed CIFAX-a therapeutic formulation for control of Epizootic Ulcerative Syndrome (EUS). Further, developed Immunoboost-C as an immunostimulant to improve brood fish health and seed production in carps, and CIFACURE for controlling common bacterial and fungal infections in freshwater ornamental fishes.
- Developed diagnostic kits for Edwardsiellosis, Aeromoniasis and Bacterial gill disease of carps, and molecular diagnostics for viral pathogens in freshwater fish/prawn.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Breeding, seed production and grow-out technologies of freshwater fishes and prawns for diversification of aquaculture.
- Aquaculture products including quality seed, feed, health management formulations/kits, etc.
- Analytical services for water/sediment, feed/ingredients, etc.
- Human resource development through training & demonstration and consultancy.

ICAR-Central Institute of Brackishwater Aquaculture

1. Contact details

i. Postal Address: ICAR-CIBA No. 75, Santhome High Road, MRC Nagar, Raja Annamalai Puram, Chennai-600 028, Tamil Nadu

ii. Name of the Director: Dr. K. P. Jithendran

iii. Email address: director.ciba@icar.gov.in / Phone No: +91-44-24618817, 24616948

2. Mandate and activities

ICAR-CIBA undertakes R&D programmes for developing viable, eco-friendly and sustainable farming technologies for brackishwater finfish/shellfish species. The two centers at Kakdweep and Navsari located on the east and west coasts also undertake region-specific research and technology dissemination.

- Basic, strategic and applied research for techno-economically viable and sustainable culture systems for finfish and shellfish in brackishwater.
- Species and systems diversification in brackishwater aquaculture.
- Act as a repository of information on brackishwater fishery resources with a systematic database.
- Human Resource Development, capacity building and skill development through training, education and extension.

3. Salient achievements

- Developed breeding and seed production technologies for commercially-important brackishwater finfish/shellfish including seabass, milkfish, pearlspot, grey mullet, mangrove snapper, silver moony, spotted scat, mystus catfish, mud crab and major shrimp species.
- Developed grow-out technology for commercially-important brackishwater finfish/shellfish species. Further, standardized biofloc-based seed rearing and grow-out technologies for commercially-important shrimps.
- Developed cost-effective, functional and grow-out feeds for different life stages of the economically-important brackishwater species.
- Developed cost-effective kits for disease diagnosis and water quality assessment, and microbial products for aquatic health management.
- Decoded whole genome of Indian white shrimp, grey mullet and important microbes.
- Prepared GIS-based maps for potential sites for brackishwater aquaculture.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Breeding, seed production and grow-out technologies for commercially-important brackishwater finfish/shellfish.
- Disease diagnosis, biofloc technology and cost-effective functional feeds.
- Human resource development through training & demonstrations and providing consultancies.

ICAR-Directorate of Coldwater Fisheries Research

1. Contact details

i. Postal Address: ICAR-DCFR, Anusandhan Bhawan, Industrial Area, Bhimtal-263136, Nainital, Uttarakhand.

ii. Name of the Director: Dr. Pramod Kumar Pandey

iii. Email address / Phone No: dcfrin@gmail.com / 05942-247280, 247279

2. Mandate and activities

ICAR-DCFR undertakes research for sustainable fisheries management and developing location and system-specific aquaculture technologies for coldwater regions for enhanced productivity.

- Basic, strategic and applied research in coldwater fisheries and aquaculture.
- Act as a repository of information on the hill fisheries resources.
- Human Resource Development through training, education and extension.

3. Salient achievements

- Developed GIS-based aquatic resource maps for planning, sustainable utilization and development of fisheries and aquaculture in Indian Himalayan regions.
- Developed packages of practices for commercially-important coldwater fish species viz., rainbow trout for enhancing productivity and production.
- Developed cost-effective feed for different life stages of rainbow trout.
- Developed breeding and seed production technologies of diversified coldwater species including mahseers and snow-trouts for stock enhancement and conservation.
- Established and demonstrated Re-circulatory Aquaculture System (RAS) for intensive rainbow trout culture.
- Developed a multi-tier model for integrated fish farming using polytanks in the mid-hill region.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Design and layout for establishing golden mahseer and rainbow trout hatchery and farm for seed production and grow-out culture, and Re-circulatory Aquaculture System (RAS) for intensive rainbow trout culture.

- Starter and grow-out feed for rainbow trout seed rearing and grow-out farming; and diagnostic kits for identification of bacterial and fungal pathogens of coldwater aquaculture species.
- Human resource development through training & demonstration and consultancy.

ICAR-Central Institute of Fisheries Technology

1. Contact details

i. Postal Address: ICAR-CIFT, CIFT Junction, Willingdon Island, Matsyapuri P.O., Cochin-682029, Kerala.

ii. Name of the Director: Dr. Leela Edwin

iii. Email address: ciftdirector@gmail.com / Phone No: 0484-2412300

2. Mandate and activities

ICAR-CIFT is dedicated to catering to the research needs in designing resource-specific gears and fuel-efficient fishing boats/vessels, product development, processing & value addition and quality control. The four research centers have been undertaking region-specific research, technology dissemination and technical support to the industry.

- Basic and strategic research in fishing and processing.
- Design and development of energy-efficient fishing systems for responsible fishing and sustainable management.
- Development of implements and machinery for fishing and fish processing.
- Human Resource Development through training, education and extension.

3. Salient achievements

- Developed over 90 resource-specific gears and fuel-efficient fishing boats/vessels for harvesting fishery resources from different ecosystems.
- Developed several devices such as by-catch reduction devices (BRD), turtle/juvenile excluder devices, Fish eye BRD, etc. for resource conservation.
- Developed and popularised fishing devices such as V form /V form slotted otter boards for wide opening of the trawl nets.
- Standardization of fishing gear materials and accessories.
- Developed value-added products such as retort pouch, canned/mince based/ high pressure/ breaded & battered/ready eat/ready to cook products.
- Developed high-value compounds from aquatic organisms including seaweed as human health supplements.
- Developed smart packaging techniques such as intelligent packaging, active packaging, antibacterial packaging films from LDPE/ Chitosan films, etc.
- Developed products from fish waste such as encapsulated PUFA/ calcium, hydroxyapatite, chitin & chitosan, collagen, oyster peptide extracts, etc.

- Processing machinery viz., solar/infrared/biomass hybrid driers, descaling machines, etc.
- Formulation of National standards for fish & Fishery products for FSSAI/ BIS.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Resource-specific gears and crafts designs.
- Fish products/value-added products and high-value compounds.
- Skill development programmes, analytical services and consultancies.
- Technology transfer, Business incubation and Entrepreneurship development.

ICAR-Central Institute of Fisheries Education

1. Contact details

i. Postal Address: ICAR-CIFE, Panch Marg, Off. Yari Road, Versova, Andheri (West), Mumbai-400 061 (Maharashtra)

ii. Name of the Director: Dr. C.N. Ravishankar

iii. Email address: director@cife.edu.in, director.cife@icar.gov.in / Phone No: 022-26363404

2. Mandate and activities

ICAR-CIFE offers post-graduate and doctoral programmes in eleven disciplines in fisheries and aquaculture and has been a dream destination for students pursuing their higher studies. The five research centers located in different parts of the country also undertake region-specific research, technology dissemination and human resource development.

- Conduct post-graduate programmes in fisheries sciences.
- Basic and strategic research in frontier areas of fisheries science.
- Human Resource Development, capacity building and skill development through training, education and extension.

3. Salient achievements

- Awarded >1450 post-graduate (M.F.Sc.) degrees, >425 doctorate degrees and >2800 diploma degrees in different disciplines. The Institute is ranked 7th among the 67 Agricultural Universities in India (2021).
- Developed and demonstrated shrimp farming technology for the inland saline region with production levels of 5-6 tonnes/ha in 4 months culture period. The technology has been spread over a 2500 ha area in Haryana, Punjab, Rajasthan and Uttar Pradesh.
- Developed genetically improved Indian catfish (magur) through selective breeding and demonstrated over 16% higher cumulative growth performance after 3rd generations.
- Developed several aquaculture products including diagnostics, feeds, etc. and post-harvest value-added products.
- 57 entrepreneurs have been incubated at the Agri-Business Incubator of the Institute since 2016.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Diploma course on entrepreneurship development at Kolkata Centre

- Certificate courses at Kakinada and Rohtak Centres.
- Shrimp farming technology for Inland saline water.
- Fish processing technologies and Ready-to-eat fish products.
- Training & demonstration and consultancy on different aspects of fisheries and aquaculture.

ICAR-National Bureau of Fish Genetic Resources

1. Contact details

i. Postal Address: ICAR-National Bureau of Fish Genetic Resources, Canal Ring Road, P.O. Dilkusha, Lucknow-226 002 (UP)

ii. Name of the Director: Dr. Kuldeep Kumar Lal

iii. Email address: director.nbfgr@icar.gov.in / Phone No.: 0522-2441735, 2440145

2. Mandate and activities

The major activities of ICAR-NBFGR involve the collection, characterization, catalouging, and documentation of fish genetic resources of different aquatic ecosystems of the country and their conservation strategies. Further, the institute undertakes research and provides necessary policy guidelines for the introduction of exotics, quarantine for prevention of transboundary diseases, etc.

Mandate

- Exploration, characterization and catalouging of fish genetic resources.
- Maintenance and preservation of fish genetic resources for conservation and utilization of prioritized species.
- Evaluation of indigenous and exotic germplasm including risk assessment and fish health.

3. Salient achievements

- Developed a database on fish diversity of India named Aquatic Genetic Information System of India (AqGRISI), which contains information on 3157 native finfish species. Further, developed six online databases - Fish Barcode Information System, Fish Karyome, Fish and Shellfish Microsatellite Database, Fish Mitogenome Resource, Hypoxia Responsive Gene in Fishes, and Abiotic responsive gene of fishes.
- Characterized genetic stock structure in their natural distribution range for over 30 finfish and shellfish species.
- Sperm cyro-banking for over 30 fish species for sustaining genetic diversity. The technology was up-scaled through field validation in 32 hatcheries in 10 states.
- Discovered forty-six new fish species during explorations of ecologically diverse habitats in India during the last decade.
- Decoded four fish genomes viz., magur, hilsa, rohu and catla.

- Implementing National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) in 21 states through the involvement of 31 health laboratories across the country.
- Development of different policy documents for the country including the introduction of exotics, fish quarantine, hatchery accreditation, etc.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Supply of fish cell lines through the National Fish Cell line Repository, and supply of quality fish seed.
- Detection of OIE-listed fish pathogens reported from India.
- Training, capacity development and consultancy on aquaculture and fish conservation.

Agricultural Engineering

ICAR-Central Institute of Agricultural Engineering

1. Contact details

i. Postal Address : ICAR-CIAE, Nabiabgh, Berasia Road, Bhopal-462038 (MP)

ii. Name of the Director: Dr CR Mehta,

iii. Email address: director.ciae@gmail.com, director.ciae@icar.gov.in, Phone: 0755-2737191

2. Mandate and activities

- Research on agricultural mechanisation, post-harvest food processing, Irrigation and drainage engineering and energy management in agriculture.
- Human resource development and capacity building through outreach and training programs, commercialization and utilization of agricultural engineering technologies.

Activities

- To conduct basic and applied research related to agricultural mechanization, post-harvest processing and value addition of crops, energy management in agriculture and irrigation and drainage engineering.
- To conduct feasibility testing of prototypes of proven designs of farm implements and machinery on farmers field, selected from different regions for adoption under local conditions with a view to bridge the identified mechanization gaps.
- Human resource development and capacity building through outreach and training programs, commercialization and utilization of agricultural engineering technologies.

3. Significant Achievements

- The Institute developed about 220 technologies/farm equipments/machines/process protocols during last 8 years. Out of that 130 technologies were commercialized. The important technologies developed such as High speed planter for soybean, Deep placement fertilizer applicator,Small tractor mounted hydraulic platform, Ultra-Low Volume (ULV) Spraying System, High pressure variable range sprayer, Sprayer equipped with electro-pneumatic

system to control whitefly in cotton crop, Tractor operated planter for tissue culture banana, Liquid urea spraying system retrofitted on straw baler, Animal cart mounted solar sprayer, Tractor operated intra row cum inter row weeder for orchards and Dust separation system for wheat straw combine etc.

- Training programmes were conducted for rural youth in the area of establishment of custom hiring centers of agricultural machinery. Till March 2022, around 1457 prospective entrepreneurs were trained and in the last three years about 1313 custom hiring centers have been established in different parts of Madhya Pradesh
- Training programmes were conducted for promoting cultivation of horticultural and field crops under protected cultivation practices. It has benefitting more than 1700 farmers and helped in establishing 30 Polyhouses, 7 Shade Net/Walk in tunnels and 50 Drip Irrigation Mulching systems. About 300 trained farmers are earning profits of about Rs. 2 to 15 lakh per year from protected cultivation technologies depending on area and type of intervention.
- Training on "Entrepreneurship Development on Soybean Processing" has been provided to 2800 prospective entrepreneurs at the institute. More than 240 soy based enterprises have been established throughout the country generating gross monetary benefit of more than Rs. 75 crore per annum.
- Through its skill and knowledge development programmes, the institute organized 67 events for about 2100 different types of stakeholders, in which 36 programmes were exclusively for the NEH region and four training programmes conducted for 80 foreign participants during last two years. Knowledge dissemination among professional colleagues was done through 12 summer/winter schools and short courses.
- A study was conducted to assess economic impact of five technologies developed by institute namely manual cono-weeder, paddy drum seeder, inclined plate planter, animal drawn seed-cum-fertilizer drill and CIAE twin wheel hoe which have been well adopted by the users and popularized in number of states. It was estimated that there was a monetary benefit of Rs. 7032 crore/annum from these technologies in 2018. With ongoing efforts for popularization and commercialization of developed farm equipment and machinery in different parts of the country, the potential of annual benefit is expected to be of the order of Rs 20,000 crore.

ICAR-Central Institute of Post-Harvest Engineering & Technology

1. Contact details

i. Postal Address : ICAR-CIPHET, P.O. PAU Ludhiana (Punjab) –141004

ii. Name of the Director : Dr Nachiket Kotwaliwale

iii. Email address: ciphetludhiana1989@gmail.com, director.ciphet@icar.gov.in
Phone No.: 0161-2313101,

2. Mandate and activities

- Research on post-harvest processing, preservation, storage and value addition of agricultural commodities.
- Human resource and entrepreneurship development in post-harvest engineering and technology.

Activities

- Research on post-harvest processing, preservation, storage and value addition of agricultural commodities and entrepreneurship development in post-harvest engineering and technology.

3. Salient achievements

- Developed 245 machinery / technologies/ process protocols. These pertain to on-farm field dryers for paddy, solar dryer for perishable commodities, improved storage structure for fruits and vegetables, cleaners, graders, shellers, peelers, decorticators, makhana processing unit, protein isolate pilot plant, technology for minimal processing and packaging of vegetables, software for non-destructive quality evaluation, pilot scale technology for processing for production of tomato puree, paste and sauce, process for development of value-added meat products, technology for production of groundnut milk, curd and paneer and many others.
- The institute worked for policy support through national level projects like assessment of post-harvest losses of food commodities in agriculture and allied sectors; storage standards for warehouse and CAP storage of food grains; fumigation protocol and chamber for export of grapes; procurement and storage standards for pulses. The institute work has benefitted FCI, APEDA and other national agencies.
- Established agro-processing enterprises such as makhana processing plants (05 nos), kinnow grading and waxing plants (50 nos), millet processing plants (05 nos), honey processing units (02 nos), jaggery processing plants (01 no) in production catchment.

- Established more than 260 agro-processing centres (APC) in production catchment all over India for processing and value addition of variety of farm produce, thus improving farmer's income and helping in reduction of post-harvest losses.
- Fifty specialized farmers training were conducted and about 15000 farmers were trained in different post-harvest processing technologies.
- Tested 120 processing machinery/equipment manufactured all over the country and enabled easy availability of processing machinery to stakeholders.

ICAR-Indian Institute of Natural Resins and Gums

1. Contact details

i. Postal Address : ICAR-IINRG, Namkum, Ranchi- 834010 (Jharkhand)

ii. Name of the Director: Dr K K Sharma

iii. Email address: director.iinrg@gmail.com , kewalkks@gmail.com, Phone: 0651-2261156

2. Mandate and activities

- Research on lac production technologies and processing and value addition of natural resins (including lac), gums and gum-resins.
- Information dissemination, training and technology transfer to farmers, processors and entrepreneurs and tribal people on lac, gums and gum-resins for sustainable livelihood.

Activities

- Research and development on all aspects of lac and other natural gums & resins (excluding production) such as harvesting/ tapping, processing, product development, training, information repository, technology dissemination and national/international cooperation.

3. Salient achievements

- Descriptors of lac insect have been developed and published. Sixty five lines of lac insects are being conserved live under potted conditions.
- Albizia procera (Siris) has been identified as a promising host plant for raising kusmi lac crop during winter season.
- Lac production technologies have been standardized for various hosts such as *Flemingiasemialata*, *Ber*, *Calliandracalothyrsus*. *C. calothyrsus*was found to be a very good host for cultivation of both the strains of lac insect, *Kerria lacca*..
- Different intercropping models of *Flemingiasemialata*with vegetable crops were developed for both summer and winter season for production of lac along with other crops for effective utilisation of land.
- Sixteen lac-based bioactive compounds have been synthesized and evaluated.
- Gum acacia and gum karaya were purified and their structures modified by cross linking agents for preparation of hydrogels.
- Developed lac-based fruit coating formulation for kinnow, and apple.
- Physico-chemical properties of guar gum, karaya gum, gum ghatti, khair gum & tamarind gum documented.

- Developed Lac scraper cum crusher, Lac washing machine, Lac Grader and Lac winnower for Small Scale Lac Processing Units (Capacity-100 kg stick lac day).
- Developed integrated small scale lac processing unit (capacity-100 kg stick lac/ day) integrating different unit operations i.e. crushing, grading, pre-soaking and washing in single unit/system.
- Pilot plants for Technical & Pure Grade Lac Dye (capacity 4 kg & 1 kg per batch), aleuritic acid (capacity 2 kg/batch) and bleached lac (40 kg/batch) were established. Process of aleuritic acid extraction from lac resin refined and yield increased from 13-14% to 17-18%.


ICAR-National Institute of Natural Fibre Engineering and Technology

1. Contact details

i. Postal Address : ICAR-NINFET, 12, Regent Park, Kolkata-700040 (West Bengal)

ii. Name of the Director: Dr D B Shakyawar

iii. Email address: director.ninfet@icar.gov.in , nirjaftdirectorcell13@gmail.com
Phone: 033-24711807

2. Mandate and activities

- Basic and strategic research on processing of natural fibres and their agro-residues, development of value added products and quality assessment.
- Capacity Building and Entrepreneurship Development

Activities

- The Institute is carrying basic and applied researches on harvest processes of natural fibres in thematic area of automation and sensor technology, product development and quality assurance in value chain, bio-processing technology, bye-product utilization, capacity building and entrepreneurship development

3. Salient achievements

- Developed Power ribbinor for jute with 10-12% higher fibre recovery.
- Developed Pineapple leaf fibre extractor with capacity of 30 Kg green Leaves.
- Developed Banana fibre extractor with capacity of 120-150 Kg green stem.
- Developed Sisal fibre extractor and Flax fibre extractor.
- Jute Fibre Grading System (IS 271: 2020)
- Digitised Grading Instruments for Fineness Meter, Bundle Strength, Colour -Lustre, and Moisture content.
- Developed an accelerated retting of jute method “NINFET Sathi”.
- Developed Jute based ornamental fabrics for home textiles.
- Developed Wool and jute based Mulching Material (NJM) for high value horticultural crops.
- Developed value added products like Jute Stick Activated carbon (JAC), micro crystalline cellulose.
- Developed Jute leaf drink: a unique Health supplement

- Organized skill development program, entrepreneurship development program, FLD, inputs distribution, incubation through SCSP, NEH MGMG and ABI project.

ICAR-Central Institute for Research on Cotton Technology

1. Contact details

i. Postal Address: ICAR-CIRCOT, Adenwala Road, Matunga East, Mumbai-400019 (Maharastra)

ii. Name of the Director: Dr (Smt.) Sujata Saxena

iii. Email address: circotmumbai@gmail.com , director.circot@icar.gov.in Phone: 022-24127273

2. Mandate and activities

- Basic and strategic research on processing cotton and its agro-residues, development of value-added products and quality assessment
- Skill development and business incubation services and function as referral laboratory for cotton fibres

Activities

- Research, Skill Development, Technology transfer and commercial services like testing, consultancy and Incubation in the domain of post-harvest processing of cotton and value addition to its by-products and biomass.

3. Significant Achievements

- The Institute has played a pivotal role in the modernization of the Ginning sector in the country through Technology Mission on Cotton. The trash content of the Indian cotton has significantly reduced to less than 5% and the quality has significantly improved. About 32% of the ginning factories have adopted the pre-cleaning system developed by the institute. Net Benefit to the Ginning factories due to bale value improvement and incremental ginning out-turn (5%) as a result of the CIRCOT intervention amounts to over Rs. 438 crores annually on an average.
- As technological partner in the AICRP on cotton, institute ensures that new cotton varieties and hybrids developed by the public and private sector meet the technological requirements of textile industries for processing into yarns or fabric. Institute has developed indigenous Calibration Cotton for cotton fibre quality testing equipment and is the only supplier in the world after USDA. 350 Indian industries are using this calibration cotton leading to the savings of foreign exchange.
- Undertaken research on eco-friendly and sustainable processing of cotton, technical textiles, utilization of cottonseed meal for non-ruminant feed, value addition to linter and utilisation of cotton biomass as Industrial raw material and source of energy.

- Developed 40 Machinery/products,46 process protocols and commercialized six machineries during last eight years in the field of post-harvest processing of cotton.
- Conducting research in the field of Nano science and technology for textile and agriculture applications and it has established World's third and first Nano Cellulose Pilot Plant in the country during the year 2015.
- Undertaken skill development and capacity building programmes on Ginning and Cotton quality assessment, nanotechnology and various aspects of cotton and by-product processing technologies. During 2014-2022, 190 Trainings were conducted for 3736 participants including farmers, ginners and other stakeholders.
- The ABI and RKVY-R-ABI centres at Institute incubated 16 entrepreneurs during 2014-2022, and 6 graduated under ABI. Currently 73 start-ups are being incubated under R-ABI and the grant of Rs. 497 lakhs has been sanctioned to 41 start-ups under pre-seed and seed stage funding.
- ICAR-CIRCOT has generated a revenue of **Rs. 1376 Lakhs** during 2014-2022 by offering consultancies, contract research, trainings and commercial testing services to the stakeholders.

Agricultural Extension

ICAR-Directorate of Knowledge Management in Agriculture

1. Contact details

i. Postal Address: Krishi Anusandhan Bhawan-I, Pusa Campus, New Delhi-110012, INDIA

ii. Name of the Director: Dr. SK Malhotra

iii. Email address: director.dkma@icar.gov.in Phone No.: 011-25842787

2. Mandate and activities

- To collate, compile, publish and disseminate useful agricultural knowledge.
- To manage information repository and act as custodian of agricultural knowledge through print and emerging media of information and communication.
- To plan and coordinate the dissemination of agricultural information at national and international levels.
- To act as a knowledge centre and clearing-house for information relating to research for development in agriculture, animal husbandry, fisheries and allied sciences including home sciences using state-of-the art information and communication technologies.
- To provide literature for strengthening and promoting research, education and extension.

Activities

- Publication of Agricultural literature: Research Journals (2), Popular Journals (4), Annual Reports (2), Books & Handbooks (8), text books, and other miscellaneous publications.
- Maintaining Website & Social Media Platforms of ICAR & DARE.
- Media Publicity & Public Relations: Holding/ participation in melas/exhibitions, Publicity in print electronic media, Films production

3. Salient achievements

- Two research journals, namely Indian Journal of Animals Sciences and Indian Journals of Agricultural Sciences, are being published at monthly interval since 1931. So far 92 volumes of each have been published.
- **Four popular journals:** Indian Farming (Monthly), खेती (मासिक), Indian Horticulture (Bi-monthly) and फल–फूल (द्वैमासिक) are being regularly published and so far 72, 75, 67 and 43 volumes respectively of these journals have been published respectively.
- Annual Reports:Two annual reports of ICAR and DARE are being published on yearly basis.
- **Handbooks:** DKMA has published eight handbooks including Handbook of Agriculture (11 reprints), Handbook of Horticulture (5 reprints), Handbook of Fisheries and Aquaculture (5 reprints), Handbook of Animal Husbandry (8 reprints), Handbook of Agricultural Engineering, Handbook of Integrated Pest Management, Handbook of Agricultural Extension (in pipeline) & Handbook of Agricultural Education (in pipeline).
- During the last five years, DKMA has also also published 2 Reference Books, 10 Textbooks, 2 Monographs, 3 Manuals, 4 Technical Books, 2 Popular Books, 5 Technical Bulletins, 2 ICAR at a Glance, 4 Achievements of GOI and 10 speeches of AM, Mos, and DG (ICAR).
- **Media & publicity work:** Advertisements done on demand basis and organization/ participation in melas/exhibitions in India & abroad to increase visibility.
- **ICAR Tableaus:** Tableaus of ICAR on 26th January Republic Day celebrations was commissioned during the years 2018 (*Mishrit Kethi Khusio ki Kheti*) and 2019 (Kishan Gandhi). The Kishan Gandhi tableau of ICAR was awarded as the best tableau of 2019.
- **Website & social media platforms:** Apart from regular uploads on website, the total users have increased to 211K on ICAR Facebook, 121K on Twitter handle and 54.8K on YouTube channel. The major events organized on agriculture by PMO, Agriculture & related ministries and ICAR are webcasted live on there.
- **Open Access:** The open access portal has papers included in the journals published by the ICAR and 49 professional societies in agriculture and allied sectors. The research articles put in Open Access mode has been viewed by farmers, scientists from more than 180 countries.
- **No. of publications printed:** In all more than 10,000 publications, have been published by DKMA, out of which 4,000 are priced publications.
- **Awards/Recognitions:** DKMA has been awarded 10 times on various occasions.

4. Knowledge/skill/technologies/products other services available for different stake holders

ICAR-DKMA disseminates knowledge in the form of handbooks, e-Books, textbooks, table books, pocket books, reprints, agro-advisories, research journals, popular journals/magazines, theme based special issues, news & reports, organizing melas/exhibitions, trainings in editing to the Professional Societies (49) in agriculture.

ICAR-Agricultural Technology Application Research Institutes (ATARIs)

There are 11- Agricultural Technology Application Research Institutes (ATARIs) across the country in different agro-ecological regions.

1. Contact details

1.	**ICAR-Agricultural Technology Application Research Institute, Zone-I Ludhiana**	**Postal Address :** ICAR-ATARI, Zone-I, PAU Campus, Ludhiana-141004 Punjab **Name of the Director :** Dr. Ranbir Singh **Email Address :** zcu1ldh@gmail.com **Phone No.:** 01961-2401018, 8587956728
2.	**ICAR-Agricultural Technology Application Research Institute, Zone-II Jodhpur**	**Postal Address :** ICAR-ATARI, Zone-II, CAZRI Campus, Diselshed Road, Jodhpur – 342005 (Rajasthan **Name of the Director :** Dr. S. K. Singh **Email Address :** atari.jodhpur@icar.gov.in **Phone No.:** 0291-2740516, 9794769353
3.	**ICAR-Agricultural Technology Application Research Institute, Zone-III Kanpur**	**Postal Address :** ICAR-ATARI, Zone-III, Rawatpur, Near Vikas Bhavan, Kanpur 208002 **Name of the Director :** Dr. U.S. Gautam **Email Address :** zpdicarkanpur@gmail.com **Phone No.:** 0512-2533560, 8004938467
4.	**ICAR-Agricultural Technology Application Research Institute, Zone-IV Patna**	**Postal Address :** ICAR-ATARI, Zone-IV, Central Potato Research Station Campus, Sahay Nagar, Patna – 801506 (Bihar) **Name of the Director :** Dr. Anjani Kumar **Email Address :** ataripatna@gmail.com **Phone No.:** 0612-2226086/2226950, 9811696364
5.	**ICAR-Agricultural Technology Application Research Institute, Zone-V Kolkota**	**Postal Address :** ICAR-ATARI, Zone-V, Bhumi Vihar Complex, Block-GB, Sector-III, Salt Lake, Kolkata, West Bengal-700097 **Name of the Director : Dr. S.K. Roy** **Email Address :** atarikolkota@gmail.com **Phone No.:** 033-23353830, 8902443733
6.	**ICAR-Agricultural Technology Application Research Institute, Zone-VI Guwahati**	**Postal Address :** ICAR-ATARI, Zone-VI, Housefed complex, Dispur, Guwahati-06 **Name of the Director :** Dr. Rajesh Kumar **Email Address :** atari.guwahati@icar.gov.in **Phone No.:** 0361-2840008
7.	**ICAR-Agricultural Technology Application Research Institute, Zone-VII Barapani**	**Postal Address :** ICAR-ATARI, Zone-VII **Name of the Director :** ICAR Research Complex for NE Region, Barapani **Email Address :** icarzcu3@gmail.com **Phone No.:** 0364-2950033

8.	**ICAR-Agricultural Technology Application Research Institute, Zone-VIII Pune**	**Postal Address :** ICAR-ATARI, Zone-VIII, College of Agriculture campus, Shivajinagar, Pune 411005 **Name of the Director :** Dr. Lakhan Singh **Email Address :** atari.pune@gmail.com **Phone No.:** 020-25512665, 7088994447
9.	**ICAR-Agricultural Technology Application Research Institute, Zone-IX Jabalpur**	**Postal Address :** ICAR-ATARI, Zone-IX, JNKVV campus, Adhartal, Jabalpur-482004 **Name of the Director :** Dr. S.R.K. Singh **Email Address :** zcunit@rediffmail.com, atari.jabalpur@icar.gov.in **Phone No.:** 0761-2680807, 2680158, 9425151947
10.	**ICAR-Agricultural Technology Application Research Institute, Zone-X**	**Postal Address :** ICAR-ATARI, Zone-X, CRIDA campus, Santosh Nagar, Hyderabad, Andra Pradesh - 500059 **Name of the Director :** Dr. Y.V. Prasad **Email Address :** zcu5hyd@gmail.com, atari.hyderabad@icar.gov.in **Phone No.:** 040-24006500, 9490192749
11.	**ICAR-Agricultural Technology Application Research Institute, Zone-XI**	**Postal Address :** ICAR-ATARI, Zone-XI, M.R.S, HA. Farm (P.O.), Hebbal, Bengaluru, Karnataka – 560 024 **Name of the Director :** Dr. V. Venkatasubramaniun **Email Address :** atari.bengaluru@icar.gov.in **Phone No.:** 080-23510616

2. Mandate and activities

- Coordination and monitoring of technology applications and frontline extension education programmes
- Strengthening of agricultural extension research and knowledge management.

3. Salient achievements

There are 11 ATARIs across various agro-ecological regions of country. Their performances are indicated as below:

- On an average conductance of 36813 on farm trials with more than 6755 technologies across 16820 locations per year by all KVKs
- Conductance of more than 296983 FLDs/year covering an area of 165613 ha and 1473461 animals by all KVKs
- More than 52238 trainings programmes conducted in a year involving 15.99 lakhs farmer/ rural youth and extension personnel by all KVKs
- 7.65 lakh Extension activities were conducted by active participation of KVKs benefitting more than 236.35 lakh farmers/year.
- More than 1.51 lakh quintals of quality seed produced and distributed to more than 4.87 lakh farmers in a year by all KVKs.
- More than 490 lakh quality planting materials are being produced in a year benefitting more than 6.15 lakh farmers in a year.

- About 3.97 lakh soil, water, plant and manure samples are being analysed in a year from about 68904 villages and about 4.56 lakh soil health cards are being distributed with recommendation of doses of fertilizers.
- More than 48474 progeny animals are being produced and distributed to farmers.
- More than 3.52 lakh messages are being sent to more than 375 lakh farmers in a year by all KVKs.

4. Knowledge/skill/technologies/products other services available for different stake holders

The schemes being implemented/services available at KVKs are : Attracting & Retaining Rural Youth in Agricultures, Cluster Frontline Demonstrations in Oilseeds & Pulses under NFSM, Farmer FIRST, Mera Gaon Mera Gaurav, Tribal Sub-Plan, Demonstration of Climate Resilient Integrated Farming System, Sustainable Livelihood through Skill Development, Creation of Seed Hub for increasing indigenous Production of Pulses and Oilseeds in India, National Innovation in Climate Resilient Agriculture, Knowledge System Homestead Agriculture Management in Tribal Areas (KSHAMTA), Value Addition Technology Incubation Centre in Agriculture (VATICA), Nutri-Sensitive Agricultural Resources Innovation (NARI), Doubling of Farmers Income, Soil Health Card, Farmers Producers Organisations, Creation of Custom Hiring Centres, etc.

Method Demonstration

Plantation in Tribal Areas

Value addition

Agricultural Education

ICAR-National Academy of Agricultural Research Management

1. Contact details

i. Postal Address: ICAR-National Academy of Agricultural Research Management, Rajendranagar, Hyderabad 500030, Telangana, India.

ii. Name of the Director: Dr. Dr. Ch. Srinivasa Rao

iii. Email address: chsrao_director@naarm.org.in / Phone No.: +91-40-24581322, 24015070

2. Mandate and activities

- Capacity development, research and policy advocacy for NARES.Serve as a Think Tank for ICAR and facilitate strategic management of human capital

3. Salient achievements

- Organized **334** capacity buildingprograms to various levels of functionaries in agricultural research and education reaching over **25,453** stakeholders during 2016-2022.
- Foundation Course for Agricultural Research Service (FOCARS) is the flagship programme of the Academy, which is offered twice a year for ARS probationers. During last five years, **9** batches have completed FOCARS programmes successfully.
- The Academy conducts three Post Graduate academic programmes such as, Post-Graduate Diploma in Management-Agriculture (PGDMA), Post-Graduate Diploma in Technology Management in Agriculture (PGDTMA) and PG Diploma in Educational Technology Management (PGD-ETM)wherein about **467** students have graduated during 2016-22.
- More than **13,161** faculty/students benefitted through 7 Massive Open On-line Courses (MOOC) courses offered by the Academy.
- During the last five years the Academy implemented various research studies in the six areas, the results of which were published as research papers **(420),** technical bulletins and training manuals **(130)** and policy briefs **(25)** and others.

- a-IDEA, Technology Business Incubator of NAARMincubated **83** Agri startups and conducted 'Entrepreneurship Development programs for about **2108** Agri-Graduates under 'Student Ready Agri-preneurship'.
- **80** FPOs (Farmers Producers Organizations) were trained in business plan development and market linkages, thus contributing to the national program on FPOs.
- A total of **162** MoUs were executed by the Academy with several governments, private institutions and universities during last five years.

4. Knowledge/skill/technologies/products other services available for different stake holders

- Academy organizes various capacity building programs such as Foundation course for state agricultural universities faculty, administrative and finance officers, Management Development Programs for pre-RMPs, coordinators of KVKs, Executive Development Programs for ICAR directors, off-campus for scientists/faculty and other category staff of NARES, Foundation course for newly recruited scientists of Agricultural Research Service (FOCARS), Refresher Courses/Summer /Winter Schools-21days for students and other need based programs for researchers, academicians, extension personnel, policy makers, farmers and farmer-groups, agripreneurs, agribusiness houses and other stakeholders of the NARES.
- A new agri-innovation Centre, a-Idea at NAARM caters to the needs of potential young agri-preneurs in the ecosystem
- Performing the role of a think tank in providing policy prescriptions and strategic inputs to ICAR for facilitating the organizational renewal of institutions of NARS and ensure the long-term viability of Indian agriculture.
- Offers two year fully residential Post Graduate Diploma in Management-Agribusiness Management (PGDM-ABM) andone year distance education programs such as Diploma in Technology Management in Agriculture (DTMA) and Diploma in Education Technology Management (DETM) in online mode.
- To cater the needs of large scale of clientele in a short time, the Academy organizes Massive Open Online Course (MOOC) on Competency Enhancement for Effective Teaching to develop effective teaching styles for quality education.
- During last five years' academy has developed technologies viz., a) Knowledge Platform for Farmers (2016)
- Knowledge Management Portal for Agrobiodiversity (2016) and c) "m PRIORITIZE", the first mobile application from NAARM in collaboration with CDAC was developed for prioritizing the agricultural problems.

ICAR-Central Institute for Women in Agriculture

1. Contact details

i. Postal Address: ICAR - Central Institute for Women in Agriculture Plot No. 50-51, Mouza - Jokalandi, P.O. - Baramunda, Bhubaneswar - 751003, Odisha, India

ii. Name of the Director: Dr. Anil Kumar

iii. Email address: director.ciwa@icar.gov.in; Phone No : (0674)-2387940, 2387241

2. Mandate and activities

- Research on gender issues in agriculture and allied fields
- Gender-equitable agricultural policies/ programmes and gender-sensitive agricultural-sector responses
- Co-ordinate research on Home Science.

Activities

- Technology assessment and refinement in gender perspective
- Management of operational drudgery for farm women
- Livelihood and nutritional security of farm families
- Gender sensitive extension methodologies
- Repository of gender disaggregated data and policy advocacy and Coordination and monitoring AICRP on Women in Agriculture.
- Capacity building, Consultancy services, Human Resources Development (HRD), and Collaborative network projects.
- Conducts various national flagship programmes*viz;* Mera Gaon Mera Gaurav, Tribal Sub Plan programme, Aspirational Districts, Swachch Bharat Abhiyan.

3. Salient achievements

- Acid treated and fermented fish silage from dressing waste of fishes used as low cost poultry feed and organic manure.
- A woman SHG with brand name "Fishlikes" was formed for Marketing of fish products produced by women SHGs. This was also linked to retail fish supply chain (Falcon Chilika Fresh retail outlets).
- 541 Technologies assessed and 58 found suitable for farm women
- Gender Friendly Farm equipments and Custom Hiring Centres were established in 44 villages in 1050 Households of Koraput district, Odisha

- Low cost poultry feed utilizing fish silage and *Azolla*f or higher economic return by farmwomen.
- Two Women Producer Company viz., "Chitri Dora Farmers Producer Company" in Koraput, Odisha was registered in Rice Seed Production and Padmabana' Farmer Producer Company for production of vegetables, oilseeds, paddy seeds and market linkage of their agricultural produce in Nischintakoili block of Cuttack district, Odisha.
- To strengthen the Poshan Abhiyan, "Nutrition Smart Villages: An Innovative Model for Strengthening Poshan Abhiyan" is launched in 75 village across India through the network of AICRP on Women in Agriculture along with the Nodal Institute ICAR-CIWA, Bhubaneswar at 14 centres in 13 States of India.
- The Millet based High Fiber Food Mix was developed by ICAR-CIWA, AICRP on Home Science Centre, UAS, Bengaluru
- Eighteen (18) nos. of dietary products with Low Glycemic Index were developed by AICRP centres
- Value added handicraft products (110 nos.) from under-utilized fibres: jute, deccani wool, sisal, cots wool, sunhemp, buil, babana, bhindi, ambadi have been developed
- Developed 12 different types of protective clothing for various agricultural activities and agri based textile industry workers
- Developed 510 nutrition gardens and an iron rich product using locally available green leafy vegetable developed named as lehyam to combat anaemia.
- 704 capacity building programmes conducted during last five years covering 31626 farm women.
- Doubling Farmers' Income 69% increase in income (Rs. 89,300/- to Rs. 1,51,200/-).
- Family Poultry Model: Backyard poultry with *Vanaraja* chickens (20) gave net income of Rs.13650/- in 9 months; Established 20 Women SHGs for Rural Poultry based Farming Systems
- Gender Sensitive Entrepreneurship Model through Institute-Industry-Stakeholders Linkage in Convergence Mode in dairy, horticulture and farm implements sectors.
- Integrated homestead aquaculture with special focus on production of small indigenous fishes
- Agri-Nutri (GSAN) Farming System Model for enhancing nutrition with a multi-stake holder value chain.
- Improved goat farming system model and Dairy farming system model involving gender friendly complete package of practices
- Multi Agency Participatory Extension Model (MAPEM) for promotion of backyard poultry by rural women. Introduced in participatory action research mode in four villages of Khorda district of Odisha.
- Resource Efficient Horticulture Model for improved nutrition and income of Smallholders

4. Knowledge/skill/technologies/products other services available for different stake holders

- 'DRWA Hand Operated Maize Dehusker-sheller': Reduced drudgery by 48.9% and increasing efficiency of operation. (Commercialized)
- Women Friendly Power Operated Groundnut Stripper Cum Decorticator
- Ergonomically suitable low cost harvesting bag for easy loading and unloading while harvesting fruits and vegetables
- Low cost Solar Drying Rack for drying of food products for preservation
- A prototype of disc type ridger considering the female anthropometry has been designed and developed with women's perspective to ease the earthing up operation.
- High Fibre Food Mix for management of obesity developed by ICAR-CIWA AICRP on Home Science Centre, University of Agricultural Sciences, GKVK, Bengaluru (Commercialized)
- Nutri dense mix to address under- nutrition
- Nutridense ladoo
- Exclusive portal for gender in agriculture based on gender disaggregated data, technologies, methodologies *etc.* which may help the stakeholders at national and international level.
- Database on Low Glycemic index food - A total of 362 foods from different food groups having low Glycemic Index (GI) for addressing non-communicable diseases such as diabetes were documented and a database on low glycemic index foods for the management of diabetes was prepared.

ICAR-National Institute of Agricultural Economics and Policy Research

1. Contact details

i. Postal Address: ICAR-National Institute of Agricultural Economics and Policy Research, Dev Prakash Shastri Marg, Library Avenue, Pusa, New Delhi - 110012

ii. Name of the Director: Dr. Pratap Singh Birthal (Acting)

iii. Email address: Email: director.niap@icar.gov.in; Phone No.: +91-11-25843036

2. Mandate and activities

- Agricultural economics and policy research on markets, trade and institutions
- Growth and development models for sustainable agriculture
- Technology policy, evaluation and impact assessment

Activities:

1. Policy studies on agricultural development issues through in-house, collaborative and consultancy research
2. Strengthening agricultural economics and policy research

3. Salient achievements:

- Agricultural growth is likely to grow not more than 4% over the next 15 years, i.e. by 2037.
- Number of cultivators has been declining since 2011-12, but the decline is due to withdrawal of female cultivators.
- Credit besides enhancing agricultural productivity also improves its resilience to climate change, indicating need for adaptation finance.
- The poor uptake of crop insurance is due to its less adaptation gains compared to other adaptation measures such as irrigation.
- Farm mechanisation is positively associated with crop yield and net returns.
- Seasonality, plays an important role in their exports of vegetables. It is essential to identify seasonal trade windows and promote exports of commodities having a comparative advantage.

4. Knowledge/skill/technologies/products other services available for different stake holders

Product Development

- **MILKSAFEON:** Mobile App was developed under the ICAR-NIAP project on Policy Imperatives for Promoting Value Chain of Agricultural Commodities in India and released

by Secretary, DARE and DG (ICAR) on the occasion of the National Milk Day Celebration at NDRI, Karnal on November 26, 2021.

- **FFP Portal:** The Farmer FIRST (Farm, Innovations, Resources, Science and Technology) Program, an FFP portal (https://ffp.icar.gov.in/) has been developed. This program was initiated in October 2016 to provide a platform to farmers and scientists for creating linkages, capacity development, technology adaptation and application, on-site input management, feedback and institution building.

ICAR-NIAP team distributing seed kit under SC Sub Plan Basahra village, Panipat, Haryana

Training Program for the Officers of the Indian Economic Services

ICAR-Indian Agricultural Statistics Research Institute

1. Contact details

i. Postal Address: Library Ave, Pusa, New Delhi, Delhi 110012

ii. Name of the Director: Dr. Dr Rajender Parsad

iii. Email address: director.iasri.car.gov.in; Phone: 91-11-25841479

2. Mandate and activities

- Research, education and training in agricultural statistics, computer applications in agriculture and agricultural bioinformatics.
- Advisory/ consultancy services/ methodological support/ computational solutions to NARES/NASS (National Agricultural Research and Education System/ National Agricultural Statistics System)

Activities

- ICAR-DC (Data Centre) and ICAR-DR (Disaster-Recovery-Centre)
- ASHOKA (Advanced Super Computing Hub for Omics Knowledge in Agriculture)
- Advanced Statistical Software's and Tools
- Advanced Bioinformatics Software's and Tools
- In-house developed customized Statistical Software's
- CAFT (Centre for Advanced Faculty Training)
- Training and Teaching Labs, AR/VR Lab
- KRISHI-MEGH (cloud infrastructure for ICAR) and AGRI-DIKSHA Channel
- e-governance Online Systems

3. Salient achievements

- Developed the methodology for General Crop Estimation Surveys (GCES), cost of cultivation studies for principal food crops, cash crops and horticultural crops, Integrated Sample Surveys (ISS) for livestock products estimation, fruits and vegetable survey, for estimation of multiple crop area of different crops in North Eastern Hilly Regions using Remote Sensing data; for estimation of post-harvest losses, small area estimation technique and integration of technologies and CCEs for providing estimates at GP (Gram-Panchayat) level for PMFBY (Prime Minister FasalBimaYojna).
- Developed efficient and cost effective design of experiments, analysis of experimental data

and their innovative applications for both Single factor and multi-factor experiments with respect to crop improvement programmes, breeding trials, food processing, post-harvest storage and value addition, crop sequence experiments, agroforestry experiments, designs for multi-stage trials, experiments in which it is difficult to change level of factors, artificially created environments, farmers participatory research trials for resource conservation technologies, experiments with mixtures, etc.Involved in the planning, designing and analysis of several AICRPs including Integrated Farming Systems Research (both on station and on farm trials), Soil Test Crop Response, Long Term Fertilizer Experiments, Vegetable Crops, Sorghum, Small Millets, Maize, etc.

- Developed procedures for estimation of genetic parameters; construction of selection indices; studying G × E interactions; progeny testing and sire evaluations; detection of QTLs, classification of genotypes using molecular marker data, etc. The modification in the procedure of estimation of genetic parameters has been suggested for incorporating the effect of unbalanced-ness, presence of outliers, aberrant observations and non- normality of data sets. Procedures for studying genotype environment and QTL environments interactions.
- Developed crop yield forecast model using weather variables. Developed weather based forewarning system for crop pests and diseases and yield loss assessment.
- **Statistical packagesand software: SPAR**: Statistical Package for Agricultural Research data analysis, **SPAD**: Statistical Package for Augmented Designs, **SPFE**: Statistical Package for Factorial Experiments , **SPBD**: Statistical Package for Balanced Incomplete Block Designs, SPAB: Statistical Package for Animal Breeding, **SSDA**: Software for Survey Data Analysis
- **R-Packages**: More than 30+ R-packages has been developed.
- **ASHOKA** (Advancedsupercomputing Hub for OMICS Knowledge in Agriculture) for high performance computing in the field of agricultural bioinformatics and computational biology.Developed **National Agricultural Biocomputing Portal** fora single point of access to High Performance Computing (HPC) resources for allNARES users.
- **Web Resources for E-learning and e-advisory:** Design Recourses Server; Sample Survey Resources Server; Service oriented computing through Indian NARS Statistical Computing Portal), Information Systems for AICRPs.
- KRISHI portal (Agricultural Knowledge Resources and Information Systems Hub for Innovation) as a centralized research data repository for knowledge management (recognized in the form of Gold Icon Award from MEITY, Govt. of India)
- **Biological Databases/Servers/Systems/Prediction-Tools**: More than 60+ biological databases/servers/systems/prediction tools have been developed.
    - **Microsatellite Databases :** 15+; rice, Wheat, Chickpea, Pigeon Pea, Vigna sp., Banana, Sugar beet, Cattle, Buffalo, Goat, Fish, Microbes, etc.
    - **Genomic and protein data resources:** 10+; Onion, Mango, Legume, Cluster bean, Livestock, Fish, Halophile protein, etc.
    - **Transcriptome Databases:** 10+; Fish, Coconut, Wheat, Vigna, Pearl millet, Small cardamom, etc.

- **Software tools and web servers:** 15+; protein structure comparisons, prediction of putative miRNA, Breed, Anti-microbial peptides in fish and animals, splice site, donor splice site, nitrogen fixation genes, variety identification, trait associated genes etc., gene set analysis with QTL, Codon usage analysis, prediction and classification of HSP, coding, non-coding region
- **Algorithms and tools:** 10+; protein structure comparison, modeling, trait associated gene prediction, splice sites prediction, coding and non-coding RNAs etc.

- Established **ICAR Data Center** and **ICAR-DR** (Disaster-Recovery) that holds certified IT Service Management System (ISO/IEC 20000-1:2011) and Unified Communication & Web hosting services with "icar.gov.in" domain. It also hosts ICAR Cloud Infrastructure and Services.