



# ANNUAL REPORT (DARE) 2022-23







# **ANNUAL REPORT**

## **(DARE)**

### **2022-23**



Department of Agricultural Research and Education  
Ministry of Agriculture and Farmers Welfare  
Government of India





## FOREWORD

GOVERNMENT is putting greater emphasis on Research and Development (R&D) for not only sustainable but also enhanced agricultural production in the country. Department of Agricultural Research and Education (DARE)/Indian Council of Agricultural Research (ICAR) through their research, education and extension programmes, are committed for transforming Indian agriculture from food self-sufficiency to enhancing profitability.

ICAR with 113 institutions spread across the country, is the largest National Agricultural Research Systems in the world. Nation celebrated 2022 as 75<sup>th</sup> year of its independence through Azadi Ka Amrit Mahotsav. In this context, DARE/ICAR undertook various activities including awareness campaigns and lectures by eminent persons on the thematic areas for reaching out to maximum stakeholders particularly farmers on various new developments in different sectors of agriculture.

Central Agricultural University (CAU), Imphal was established in 1993 under the Central Agricultural University Act, 1992. It is a residential university having 13 constituent colleges covering 7 north-east hill states under its jurisdiction except Assam. The University was ranked at 13<sup>th</sup> position in the ranking status of Agricultural Universities for the year 2020 by ICAR. On the recommendations of the ICAR Peer Review Team, the National Agricultural Education Accreditation Board, ICAR, New Delhi granted accreditation for various academic programmes (UG/PG/PhD) to this University and its constituent colleges from 28 March, 2021 to 27 March, 2026. Under Institutional Development Plan (IDP)-National Agricultural Higher Education Project (NAHEP), 10 faculties and 46 students of the University completed 3 months overseas training at various international institutes.

Dr Rajendra Prasad Central Agricultural University (DRPCAUI), Pusa, established on 7 October 2016, owes legacy of Rajendra Agricultural University, Pusa (1970) and Agricultural Research Institute and College, Pusa (1905). The University awarded degrees to 738 students including gold medals to 40 students in its 2<sup>nd</sup> convocation held on 7 November, 2021 in gracious presence of Hon'ble Vice-President of India Shri M. Venkaiah Naidu. Ministry of Communication, Government of India, released First Day Cover and stamp on Sukhet Model developed by the University on 24 February 2022. India Today MDRA survey placed the University under top 10 of the Government Universities for 3<sup>rd</sup> consecutive year. The University hosts 1821 students with multicultural backgrounds from 27 states of India and also accepts students with varied experiences, such as from the industry and foreign countries.

DRPCAUI has made outstanding achievement in term of implementation of New Education Policy, as the University has opened its door for school drop outs to PhD students in some of its academic programmes and also introduced measures for internationalization of education and improving students performance in various competitive examinations.



On research front, the University has released two crop varieties, viz. Rajendra Arhar 2 and Rajendra Ganna 2 through Central Variety Release Committee (CVRC)/State Variety Release Committee (SVRS), received grant of two patents and strengthened its technologies for monetization of agro-waste. The University has organized ISAE 55<sup>th</sup> Annual Convention and International Symposium from 23–25 November, 2021 at Gyan Bhawan, Patna and Kisan Mela 2022 “Regional Agriculture Fair for Eastern Region” on the theme “Entrepreneurship Development through Monetization of Agricultural Waste” during 12-14 March, 2022.

The Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi was sanctioned six research cum development projects to promote beekeeping, low-cost mushroom production and protected cultivation of high-value cut-flowers in addition to establishment of plant-health clinic and hi-tech nurseries for quality planting material under Rashtriya Krishi Vikas Yojana (RKVY) - Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (Raftaar) component by UP State Level Sanctioning Committee (SLSC) with an outlay of ₹ 854.90 lakhs.

Farm development work at Jhansi and Datia campus research farms ensured 100 per cent rainwater harvesting by constructing check dams and ponds at lowermost points of the farm. One dozen farm ponds and check dams covering 8 ha area were developed at the University Research Farm at Jhansi and two ponds at its Datia Campus in an area of 1 ha. These water bodies have been brought under fisheries production and recreational purposes, besides ensuring round the year water availability for irrigation.

Agricultural Scientists Recruitment Board (ASRB) plays a key role in recruitment of best quality scientists and other management personnel for ICAR and its research institutes across the country. In addition, the Board aids and advises the Council in evolving and implementing policies related to induction of human resource and its development including the Career Advancement Schemes for ARS Scientists. ASRB has consistently been endeavouring to reform and refine talent-search strategies to meet existing as well as emerging needs of the National Agricultural Research and Education System (NARES).

In its endeavour to recruit best talented human resources as per need of time, ASRB has taken several reforms in recruitment process. Selection criteria (scorecard) for selection of RMP and non-RMP positions have been revised from time to time to make it more objective and transparent. Latest IT tools have been employed to facilitate the applicants for online submission of applications and fees. NET certificates have been distributed and uploaded on digi locker to access the certificates online and many more. During the year, recruitment process for 11 RMP positions was completed. The Board conducted a combined examination of NET/ARS (Prelim)/Senior Technical Officer (STO) - 2021 in online mode for recruiting 222 Scientists and 65 Senior Technical Officers. Tier-I level of examination was conducted for filling up 44 vacancies of Administrative Officer (AO) and 21 vacancies of Finance and Accounts Officer (F & O) under ICAR.

Above activities show that agricultural research and development activities are slowly but steadily back to its pre Covid-19 pandemic period after a gap of two years. This Annual Report shows government's dedicated efforts for augmenting the production and productivity in agriculture for the benefit of citizens including farmers of the country. I hope this report will be useful for all concerned with agricultural research and education.

**(Narendra Singh Tomar)**

Minister of Agriculture and Farmers Welfare  
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01

# OVERVIEW

## Department of Agricultural Research and Education (DARE)

The Department of Agricultural Research and Education (DARE) was established in the Ministry of Agriculture in December 1973. DARE coordinates and promotes agricultural research and education in the country. It has the following four autonomous bodies under its administrative control:

- Indian Council of Agricultural Research (ICAR)
- Central Agricultural University (CAU), Imphal
- Dr Rajendra Prasad Central Agricultural University, Pusa, Bihar
- Rani Laxmi Bai Central Agricultural University, Jhansi, Uttar Pradesh

DARE provides the necessary government linkages for the Indian Council of Agricultural Research (ICAR), the premier research organization, for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country.

Besides this, it has Agricultural Scientists Recruitment Board (ASRB) as attached office and Agrinnovate India Limited (AgIn), a Government of India enterprise under its control.

India has one of the largest National Agricultural Research System in the world, comprising 102 ICAR institutes, 11 Agricultural Technology Application Research Institutes, 82 All India Coordinated Projects/Networks, 4 Deemed to be Universities, 3 Central Agricultural Universities and 63 State Agricultural/Veterinary/Horticultural/Fishery Universities in different states.

**Activities covered in this Annual Report are for the period from 1 October 2021 to 30 September 2022.**

### Indian Council of Agricultural Research

The Indian Council of Agricultural Research is an autonomous organization under the Department of Agricultural Research and Education, Ministry of Agriculture and Farmers Welfare, Government of India. Formerly known as the Imperial Council of Agricultural Research, it was established on 16 July 1929 as a registered society under the Societies Registration Act, 1860 on the recommendations of the Royal Commission of Agriculture. It was reorganized in 1965 and again in 1973, with its

Headquarters located in Krishi Bhawan, New Delhi, with support facilities in Krishi Anusandhan Bhawan 1 and 2 and NASC Complex, Pusa, New Delhi. The Union Minister of Agriculture and Farmers Welfare is the President of ICAR. The Principal Executive Officer of the ICAR is the Director General, who also functions as Secretary, Department of Agriculture Research and Education, Government of India. The General Body of the ICAR Society, headed by the Union Minister of Agriculture and Farmers Welfare is the supreme authority of the ICAR. Its members include; Ministers for Agriculture, Animal Husbandry and Fisheries, and the senior officers of the various state governments, Members of Parliaments and the representatives from industry, research institutes, scientific organizations and farming community. The Governing Body headed by the community Director General, who is also the Secretary, DARE is the chief executive and decision making authority of the ICAR. The Governing Body consists of eminent agricultural scientists, educationists, public representatives and representatives of the farmers. It is assisted by the Accreditation Board, Regional Committees, Policy and Planning Committee, several Scientific Panels and Publications Committee. In scientific matters, the Director General is assisted by 8 Deputy Directors General, one each in (i) Crop Science, (ii) Horticulture Science, (iii) Natural Resource Management, (iv) Animal Science, (v) Agricultural Engineering, (vi) Fisheries Science, (vii) Agricultural Education, and (viii) Agricultural Extension, who are also assisted by Assistant Directors General, and are the Heads of their Subject Matter Division (SMDs) for the entire country. SMDs are responsible for extending all technical and financial guidance and support to the Research Institutes, National Research Centres and the Project Directorates within their respective Divisions. In addition, Assistant Directors General of National Agricultural Science Fund (NASF), Coordination, Plan Implementation and Monitoring, Intellectual Relations and Human Resource Management also assist the Director General in their respective job roles.

The research set up of the ICAR includes 113 institutions, viz. 72 research Institutes, 6 National Bureaux, 23 Project Directorates and Agricultural Technology Application Research Institutes, and 12 National Research Centres. It also has 82 All-India

Coordinated Research Projects + Network Research Projects. The ICAR-Directorate of Knowledge Management in Agriculture (DKMA) functions as communication arm of the ICAR responsible for delivery of information/knowledge generated by the network of the ICAR and its institutions; and addresses mandate of ICAR through Publications, Information, ICT, and Public Relations Unit. The ICAR promotes research, education and frontline extension activities in 74 Agricultural Universities, which include 63 State Agricultural Universities, 4 Deemed Universities, 3 Central Agricultural Universities, and 4 Central Universities with agricultural faculty by giving financial assistance in different forms.

### **Central Agricultural University, Imphal**

Central Agricultural University, Imphal established in 1993 offers 9 Undergraduate, 45 Masters and 25 PhD Degree Programmes in different subjects/disciplines through its 13 constituent colleges. CAU, Imphal was ranked at 13<sup>th</sup> position in the ranking status of Agricultural Universities for the year 2020 by ICAR. The students of the University performed well at national level competitive examinations. The University has an exemplary record of placement in a number of private and public sector organizations, government undertakings, etc. A total of 103 students of the University were placed in various capacities in different organizations during 2021-22. Ten faculty members and 46 students of the University completed 3 months overseas training at various international institutes under Institutional Development Plan (IDP)-National Agricultural Higher Education Project (NAHEP).

During the year, University carried out 56 Intramural Research Projects (IRPs) and 146 Externally Funded Research Projects. A database of 303 north east fish species was also prepared. The University also organized 3 on-campus and 13 off-campus awareness programme which benefitted 459 participants and 529 participants, respectively. A total of 465 trainings, workshops, conferences, seminars, summer schools, etc were organized at different constituent colleges of the University. Among faculty members, 45 were deputed for participation in international conference and

seminar, 89 national conferences and seminars, 60 workshops and 27 long term training courses and 98 for short term training programmes. A total of 27 faculties of the University were also recognized for their excellence in research and developmental works. A Total of 10 MoUs were signed with reputed institutes during the period for cooperative relationship through mutual assistance in the areas of education, research and extension activities.

### **Dr Rajendra Prasad Central Agricultural University (DRPCA), Pusa, Bihar**

DRPCA, is marching ahead with its vision of advancing professional competency for pursuing excellence in education, research and entrepreneurship in relation to agriculture and allied sectors with ethical values to meet the regional, national and global needs and offering specialized services to the farmers for decent livelihood. A total of 687 students from 27 states of India took admission registering significant increase over the last year admissions signifying pan India presence of the University.

To sharpen the communication and soft skills of students, three foreign language courses have been introduced and soft skills trainings have been organized. The University has also introduced Certificate and PG Diploma Courses to generate a pool of skilled human resource as per industry and societal needs. Development of varieties for different agro-climatic conditions and its release through Central Variety Release Committee (CVRC)/State Variety Release Committee (SVRC) development and validation of technology for different socio-economic groups and challenged ecology, value addition of the agricultural produce and advancement of scientific knowledge through 32 AICRPs, 3 International Projects, 4 Government of India funded projects, 4 Government of Bihar funded projects and more than 100 University funded projects, establishment of 7 Centre for advanced research/excellence; 1 Startup facilitation centre and up-gradation of Banana Research Centre at Goraul (Vaishali) are ongoing activities to gain excellence in research. To augment the farmers, income and showcase the farmer friendly technologies, products and services developed by

the University and transfer them to farmers, the university has organized a number of farmer fairs, frontline demonstrations (FLDs), on-farm trails (OFTs), training programmes, etc. whereby more than 10,500 farmers got benefitted with enriched knowledge of modern farming technology.

### **Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi**

RLBCAU, Jhansi was established as an institution of national importance by an Act of Parliament on 5 March, 2014. In RLBCAU, the on-going three undergraduate programmes for the degree of B.Sc. (Hons) Agriculture, BSc (Hons) Horticulture and BSc (Hons) Forestry have been continued, besides PG programme in eight subjects (Genetics and Plant Breeding, Agronomy and Plant Pathology, Soil Science, Entomology, Vegetable Science, Fruit Science and Silviculture and Agroforestry). ICAR-revised PG course curricula have been implemented.

Six research-cum-development projects under Rashtriya Krishi Vikas Yojana (RKVY)-Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (Raftaar) component by UP State Level Sanctioning Committee (SLSC) with an outlay of ₹854.90 lakhs has been sanctioned. These projects are mandated to promote beekeeping, low-cost mushroom production and protected cultivation of high-value cut-flowers in addition to establishment of plant-health clinics and hi-tech nurseries for quality planting material.

Agro-techniques were standardized for efficient use of irrigation and rain-water and crop diversification for climate resilient agriculture in Bundelkhand. Seeds of 100 varieties and germplasm accessions of cowpea obtained from different sources were screened for post-emergence herbicide tolerance of Imazethapyr in *kharif* 2020. Research work under various ICAR-AICRPs, viz. on Chickpea, and Rapeseed-Mustard, besides voluntary trials in the purview of AICRP-Maize, Barley, Pearl millet, MULLaRP and Sesame and Niger were also undertaken towards enhancing productivity and production of these crops through development of high-yielding, multiple disease-resistant varieties for central India.

Front Line Demonstrations (721) were organized at farmers' field on mustard (100), pea and lentil

(10), chickpea (15), wheat (3), groundnut (30), maize (100), urd (120), mung bean (5), aerobic rice (15), sesame (45), millets (100), medicinal plant (48), marigold (10), fruits (20), agro-forestry (100) at Jhansi, Lalitpur districts of Uttar Pradesh and Datia, Tikamgarh and Niwari districts of Madhya Pradesh.

### **Agricultural Scientists Recruitment Board (ASRB)**

ASRB advertised 90 posts of Research Management Positions (RMP) vide Advt. No.1/2021 dated 5 November, 2021. The Board completed the recruitment process of 11 posts of senior RMPs positions comprising Deputy Director Generals - 3, Directors of National Institutes - 2, Directors of other than National Institutes - 4, Assistant Director Generals - 2 till August 2022. During the year, scorecard for selection of RMP and Non-RMP positions was revamped to make it more objective and transparent. A web-based software (OASIS) (URL-<https://asrbapplication.in>) for online submission and scrutiny of application for RMP and non-RMP posts has been developed to facilitate the applicants. This software has been made applicable from Advt. No.1/2021.

A combined examination of NET/ARS (Prelim)/Senior Technical Officer (STO)-2021 was conducted in online mode during the year. As per result, 11,058 candidates qualified in National Eligibility Test (NET) in 60 disciplines. Based on defined criteria 304 candidates were called for interview for 65 posts and 63 candidates were recommended for appointment as Senior Technical Officer under Indian Council of Agricultural Research (ICAR). Tier-I level of examination was conducted in online mode for filling up 44 vacancies of Administrative Officer (AO) and 21 vacancies of Finance and Accounts Officer (F&AO) under ICAR.

### **Agrinnovate India Ltd**

Agrinnovate India Ltd. (AgIn), a Government of India enterprise, was incorporated under the Companies Act, 1956 (No. 1 of 1956) on 19 October, 2011 and owned by Department of Agricultural Research and Education (DARE), Ministry of Agriculture, Government of India. The Company has successfully been able to turn a new leaf in the recent past by initiating effective partnerships with ICAR institutes and private companies.



During the year 2021-22, AgIn handled several ICAR institutions and helped transfer a total of around 114 technologies earning a gross revenue of ₹5.33 crores. These technologies emerged from crop science (35%), dairy and veterinary sciences (14%), horticulture (45%) and fisheries (6%).

A total of 51 ICAR research institutions and 4 state agricultural universities commercialized their technologies through Agrinnovate during 2021-22. Significant technology transfers include, the grant of a non-exclusive Global License to ICAR-CSSRI, Karnal and ICAR-CISH, Lucknow developed ICAR-FUSICONT technology for control of Panama wilt of Banana Race T4 to Ms. Innotherra Pvt Ltd by Agrinnovate in September, 2021.

## Other Activities

India is a donor member country to Consultative Group on International Agricultural Research (CGIAR) since decades and also a voting member in CGIAR System Council, representing South Asia Constituency of the Consortium along with two alternate partner countries, viz. Bangladesh and Sri Lanka. India has assumed important role in CGIAR System as a permanent voting member.

Now, the CGIAR is going through a transition/change process and research will now be grouped in different Initiatives under the One-CGIAR (effective from January 2022, after the termination of the CGIAR Research Programmes by 31 December, 2021). The new initiatives will focus on identified areas, bringing together relevant CG Centers and the global demand, innovation and scaling partners.

The IC-CG (now merged with IC-IV) Section processes all work relating to CG Centres including processing of MoU, Work Plan and foreign visits of scientists/officials of ICAR/DARE, payment of annual contribution to CGIAR and collaborative projects between ICAR and CGIAR Centres. Major activities carried out during the reporting period are as follows:

## Work Plan

- Work Plan was signed on 2 December, 2021 for the period 2021-25 between Indian Council of Agricultural Research (ICAR) and Bioversity and CIAT Alliance under the existing Memorandum of Agreement. Scientific and Technical Cooperation in Research and Training to deliver research-based solutions that

harness agricultural biodiversity sustainably and transform food systems to improve people's lives in climate crisis.

- Work Plan signed on 2 September, 2022 for the period 2022-27 between Indian Council of Agricultural Research (ICAR) and International Wheat and Maize Improvement Centre (CIMMYT) developed in accordance with the MoU signed between ICAR and CIMMYT.

## Projects

- Extension of time to the approved project entitled "Biofortification of rice" for next 3 years funding under Harvest Plus Programme of CGIAR coordinated by Centre for Tropical Agriculture (CIAT) and International Food Policy Research Institute (IFPRI).
- Collaborative Research project entitled "International Mungbean Improvement Network Phase-2 (IMIN-2)" for the period of five year, funded by ACIAR, Australia in collaboration with ICAR-IIPR, Kanpur, and AVRDC, Taiwan and to authorize Director, ICAR-IIPR, Kanpur to sign the Research Collaborative Agreement (RCA) on behalf of ICAR.
- Establishment of nitrogen-efficient Wheat Production Systems in Indo-Gangetic Plains by the deployment of BNIN-technology in collaboration with the Indian Council of Agricultural Research (ICAR), Borlaug Institute for South Asia (BISA) and Japan International Cooperation Agency (JICA) for a period of five years.
- Collaborative research project entitled, "Tree Outside Forests in India (TOFI)" in collaboration with ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi; ICAR-Central Agroforestry Research Institute (CAFRI), Jhansi and International Centre for Research in Agroforestry (ICRAF) funded by United States Agency for International Development (USAID), USA for the period of five years.
- Collaborative research project entitled "Consumption of Resilient Orphan Crops and Products for Healthier Diets (CROPSPHD) and authorization to ICAR-NBPGR to sign sub-agreement for the period of three years.

## MoUs / MoAs

- Project Agreement between the GIZ and the World Agroforestry (ICRAF) for initiating pilot project entitled, “Sustainable Biochar Production and Use through Agroforestry Systems in Madhya Pradesh, Maharashtra and Odisha: A Climate-Resilient Soil Management Approach”, Short title: “Sustainable Biochar Production through Agroforestry System”.
- Tripartite MoU between the World Agro-forestry (ICRAF), Kenya, Department of Agriculture, Marketing and Cooperation, Government of Andhra Pradesh and Indian Council of Agricultural Research (ICAR) to develop and implement a joint research programme.
- Cooperative agreement between Progressive Environmental and Agricultural Technologies (PEAT), Hannover, Germany and ICRISAT and Professor Jayashankar Telangana State

Agricultural University, Rajendranagar, Hyderabad.

The above details show that India has made a commendable progress in genetic enhancement of different crops and the productivity levels have increased to more than three times (2373 kg/ha during 2020-21 from 710 kg/ha during 1960-61). Among other efforts, this has been made possible through release of more than 6,100 varieties of field and horticultural crops by DARE/ ICAR, since 1969.

**(Himanshu Pathak)**

Secretary, Department of Agricultural Research  
& Education and Director General,  
Indian Council of Agricultural Research



02

BODIES UNDER  
DARE AND THEIR  
ACTIVITIES

## CENTRAL AGRICULTURAL UNIVERSITY, IMPHAL

Central Agricultural University (CAU), Imphal was established in 1993 under the Central Agricultural University Act, 1992 of the Parliament (Act No. 40 of 1992). It is a fully residential university having 13 constituent colleges covering 7 north-east hill states under its jurisdiction except Assam.

### Academic Activities

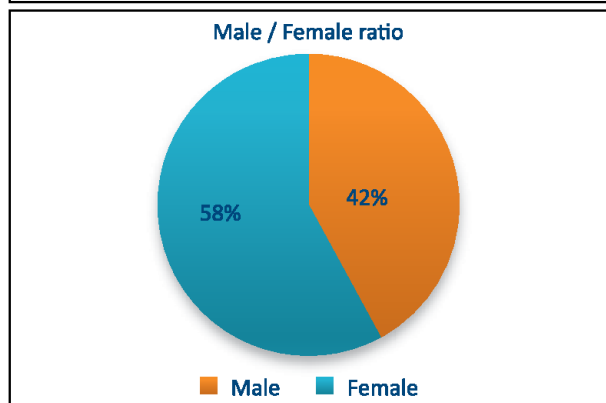
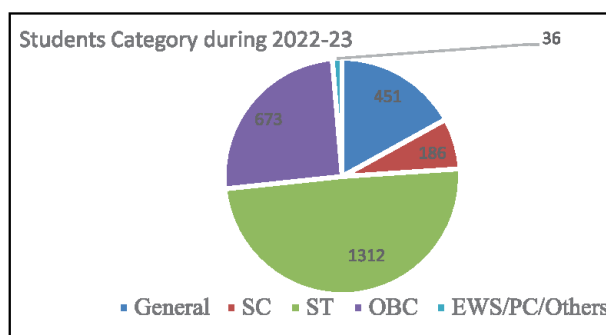
The Central Agricultural University offers 9 Undergraduate, 47 Masters and 25 PhD Degree Programmes in different subjects/disciplines through its 13 constituent colleges. The University was ranked at 13<sup>th</sup> position in the ranking status of Agricultural Universities for the year 2020 by ICAR. On the recommendations of the ICAR Peer Review Team, the National Agricultural Education Accreditation Board, ICAR, New Delhi granted accreditation for various academic programmes (UG/PG/PhD's) to the Central Agricultural University, Imphal (Manipur) and its constituent colleges from 28 March, 2021 to 27 March, 2026.

Due to the pandemic, the new academic session started from 1 October, 2021 for UG and 10 November, 2021 for Master's courses. The PhD Programmes for all the colleges started from 23 December, 2021. A total of 570,239 and 52 students were admitted in various Undergraduate, Masters and PhD programmes, respectively during the year. A total of 408 UG and 133 PG students completed their degrees and 15 students were also awarded PhDs during this period. Out of the total students' strength of 2,658 in the University; 451 students belong to the general category; 186 scheduled castes; 1,312 scheduled tribes; 673 other backward class; and 36 EWS/Physically handicapped/others. Out of them, 1,118 students were male and 1,540

were female amounting to Male: Female ratio as 1:1.38.

The students of the University performed well at national level competitive examinations. During the period under report, 19 students were selected in Junior Research Fellowship (JRF) examination, 2 students in ICAR SRF examination and 4 in GATE examination. The University has an exemplary record of placement in a number of private and public sector organizations and government undertakings. A total of 103 students of this University were placed in various capacities in different organizations during 2021-22.

Under IDP NAHEP, students of the University completed 3 months overseas training at various international institutes.



Name of College	Degree Programme	No. of Students	Host Institute
College of Agriculture, Imphal	BSc (Hons) Agriculture	11	International Rice Research Institute (IRRI), Philippines
College of Horticulture and Forestry, Pasighat	BSc (Hons) Horticulture	7	The Botanical Garden Organization, Chiang Mai, Thailand
	BSc (Hons) Forestry	5	College of Forestry and Environmental Sciences, Central Mindanao University (CMU), Philippines
College of Agricultural Engineering and Post Harvest Technology, Ranipool, Sikkim	BTech (Agril. Engineering)	3	Asian Institute of Technology, Bangkok, Thailand
	BTech (Food Technology)	1	Food Technology Division, School of Industrial Technology, Universiti Sains, Malaysia

Name of College	Degree Programme	No. of Students	Host Institute
College of Community Science, Tura, Meghalaya	BSc (Hons) Community Science	4	Thailand Textile Institute, Bangkok, Thailand
College of Veterinary Sciences and Animal Husbandry, Selesih, Aizawl	BVSc	10	International Training Centre on Pig Husbandry, Phillipines
Colleges of Fisheries, Lembucherra, Tripura	BSc (Fisheries)	5	Asian Institute of Technology, Bangkok, Thailand

#### Faculty members of the University who completed 3 months overseas training

Name of faculties/ Directors/ Deans/ Associate Coordinators	Designation	Host Institute
Dr Sheikh Mohammad Feroze	Assistant Professor	School of Environment, Resources and Development, AIT, Thailand
Dr M. Norjit Singh	Assistant Professor	Chulalongkorn University, Pathum Wan District, Bangkok, Thailand
Dr Shravan M Haldhar	Associate Professor	Prince of Sonkla University, Hat Yai, Songkhla, Thailand
Dr Amit Kumar Singh	Assistant Professor	Agricultural Research Organization, The Volcanic Institute, Rishon, Lizion, Israel
Dr Nangsol Dolma Bhutia	Assistant Professor	Agricultural Research Organization, The Volcani Centre, Israel
Dr Himadri Saha	Assistant Professor	Kyushu University, Japan
Dr Soibam Khogen Singh	Assistant Professor	James Cook University, Singapore
Dr Dibyendu Kamilya	Assistant Professor	Asian Institute of Technology (AIT), Bangkok, Thailand
Dr Sagar Chandra Mandal	Associate Professor and Head	Asian Institute of Technology (AIT), Bangkok, Thailand
Dr BN Hazarika	Dean, College of Horticulture and Forestry, Pasighat	Galilee International Management Institute P.O. Box 208, Nahalal 106000, Israel

### Research Activities

The University research aims to develop need based research projects through sustainable and eco-friendly scientific and technical approaches for developing agricultural technologies/practices/ agricultural machines and equipments which can bring about a far reaching impact on productivity and profitability of crops, animals and fishes and develop new products for value-addition, enhance income generation and in turn the socio-economic upliftment of the people of north eastern hill region. During the year under report, the University carried out 76 Intramural Research Projects (IRPs) where 18 IRPs were newly sanctioned, 56 are ongoing and 2 were completed under University Funded Research Programmes. Out of the 145 Externally Funded Research Projects, 37 were newly sanctioned, 86 are ongoing and 22 were completed. A number of recommendations have been made that helped in the development of agro-based crop improvement, plant protection, and economically sustainable

technologies, specific for different agro-climatic conditions of the region. A database of 303 north east fish species was prepared. The drinking sweat and tears *Lisotrigona* bees of the first kind were reported by the Department of Entomology from Thenzawl area of Mizoram. Overall, 32, collections of citrus accessions were made during the trip from various parts of Sikkim, viz. Khamdong, Yangyang, Mamging, Ravangla, Radhukhandu, Dentam, Dzongu, Bermiok and Lum. IC numbers for 26 accessions out of 32 collections were received from NBPGR, New Delhi. Out of total number of 7 local collections of cassava from Manipur 1 germplasm got accession number from NBPGR, New Delhi. The University has successfully studied a preservation technique for local delicacy, i.e. bamboo shoot in brine and frozen form. In addition, five products are developed from local raw material such as ginger candy, tamarind candy, aonla candy, papaya tutti-frutti, Hatkora (*Citrus macroptera*). Squash which were branded as a 'Zo Foods' under FSSAI registration.



## Extension Education Activities

The Directorate of Extension Education provides extension services to the farmers of seven north-eastern states through various programmes and activities. The programmes implemented during the year include trainings, demonstration, field days, kisan melas, farmer congress, exhibitions, radio talks, TV telecast, film shows, workshop, etc. Transfer of technology activities were planned and coordinated in different districts of the seven states through its 13 constituent colleges, six Krishi Vigyan Kendras and six Multi Technology Testing and Vocational Training Centres.

The Directorate organized 3 on-campus awareness programme which benefitted 459 participants. Two training programmes for extension functionaries were also organized which benefitted 67 participants. Also, 13 off-campus awareness cum training programme were also held which benefitted 529 participants. During whole programme Covid-19 protocol and SOP were maintained as per GoI and GoM. In addition, the directorate organized a number of webinars and workshops for the farmers, unemployed youths and extension functionaries.

Financed by the MeitY, GoI, and implemented by DIC, New Delhi and CAU, Imphal, “Mobile Based Agro-Advisory” for farmers of College of Fisheries, Tripura; College of Veterinary Sciences and Animal Husbandry, Mizoram; College of Horticulture and Forestry, Arunachal Pradesh; College of Agriculture, Manipur; College of Post Graduate Studies in Agricultural Science, Meghalaya were developed for the welfare of the farmers. All the KVKs under the extension department along with constituent colleges of the University located in different states of the north-eastern region also conducted a number of awareness camps, trainings, FLDs and method/result demonstrations for the farmers, unemployed youths and extension functionaries. Moreover, under the externally funded programmes sanctioned to the directorate, like RKVY-RAFTAAR and Agri-Business Incubator (R-ABI) sponsored by MoA and FW; ICAR-IGFRI, Jhansi, UP sponsored Project/Programme; Farmers FIRST Programme; ICAR NIBSM NEH programme, etc., a number of webinars, trainings, awareness camps, FLDs, method/result demonstrations, input distribution, Scientist-Farmers interaction programme, etc. were held by following Covid-19 protocol and

SOPs of respective State and Central Governments. COF R-ABI incubated pre-seed stage funded startup “GITA CHANDRA GROUP” received the “Statehood Day Award-Best Startup Entrepreneur Award (Fishery) 2022” on 21 January, 2022 from Government of Tripura, during the celebration of 50 years of Tripura’s Statehood Day.

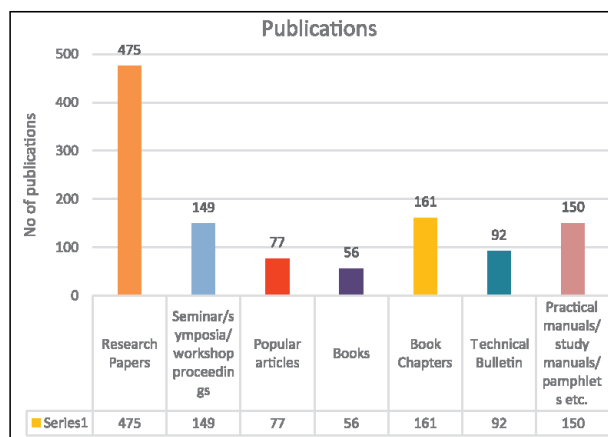
## Human Resource Development Activities

The University has total staff strength of 1,086 including 21 administrative, 312 teaching and 753 non-teaching positions. At the headquarters, there were 10 executive officers in the administrative positions supported by 35 technical and 107 non-technical staff. In the constituent colleges of the University, there were 11 administrative staff, 312 teaching and 611 non-teaching staff. A total of 465 trainings, workshops, conferences, seminars, summer schools, etc were organized at different constituent colleges of the University. Among faculty members, 45 were deputed for participation in international conference and seminar, 89 national conferences and seminars, 60 workshops and 27 long term training courses and 98 for short term training programmes. The 378 lectures, keynote address and invited talks were delivered by the faculties at various trainings, workshops and other programmes. Forty five faculty members served as external examiners at various institutes. Thirty four guest lectures were delivered by reputed scientists from other institutes at different constituent colleges of the University. Thirty eight faculty members served as external member and 18 served as expert committee member at various institutes. A total of 27 faculties of the University were also recognized for their excellence in research and developmental works and 10 MoU’s were signed with reputed institutes during the period for cooperative relationship through mutual assistance in the areas of education, research and extension activities.

As sanctioned by ICAR under IDP-NAHEP, 7 Photovoltaic On Grid Solar Power Plant KWP were installed and commissioned successfully in 7 campuses of the University including the headquarters. One Wastepaper Recycling Plant was also commissioned successfully in College of Agriculture, Iroishemba, Imphal as part of the environment sustainability plan. Workshop on Business management skills (3 nos. with 593 participants), 19 communication skills and personality development (816 participants), 19

trainings on entrepreneurship development (2,675 participants), 7 faculty development programme (256 faculty members), 1 innovation and leadership development programmes (220 participants) and 11 trainings on environment sustainability plan (776 participants) were conducted. Forty six students from different constituent college were going for 3 months foreign training at various foreign institutes.

### University Publications



### Major Activities

- Visit of Ms Shobha Karandlaje, Hon'ble Minister of State for Agriculture and Farmers' Welfare, GoI and Farmers Start-up FPOs Interaction Program held in her presence on 28 October, 2021 at College of Fisheries, Lembucherra, Tripura.



- Visit of Shri Narendra Singh Tomar, Hon'ble Union Minister of Agriculture and Farmers Welfare on 17 November, 2021 and showcasing of technology products-cum-interface meeting was held in his presence at College of Fisheries, Lembucherra, Tripura.





- Celebration of 30<sup>th</sup> Foundation Day Celebration of the University.



- Study visit of Parliamentary Standing Committee on Education, Women, Children, Youth and Sports on 27 April, 2022.



- National Level Meeting for developing syllabus and curricula on Natural Farming for Under Graduate and Post Graduate Level as per ICAR and NEP-2020 guidelines was held from 24 to 25 June, 2022 at College of Agriculture, CAU, Imphal.



- Visit of Padmashree Dr S Ayyappan, Chancellor of the University. The 21<sup>st</sup> Senior Officers Meeting of the University was held in his presence on 12-13 July, 2022.





- Visit by Hon'ble Union Minister Shri Parshottam Khodabhai Rupala, Minister of Fisheries, Animal Husbandry And Dairying on 12 June, 2022 at College of Veterinary Sciences and Animal Husbandry, Aizawl, Mizoram.



- Celebration of Azadi Ka Amrit Mahotsav by students and staffs of different constituent colleges of the University.



Prabhat Pheri



Har Ghar Tiranga Campaign

- Visit of Ms Shobha Karandlaje, Hon'ble Minister of State for Agriculture and Farmers' Welfare, GoI at College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool on 9 May, 2022.





- Visit of Shri Radha Mohan Singh, Hon'ble Member of Parliament and Chairperson, Parliamentary Standing Committee on Railways along with other Hon'ble Members of the committee visited the College of Post Graduate Studies in Agricultural Sciences, Umiam on 7 May, 2022.



- Visit of Shri Giriraj Singh, Hon'ble Minister of Rural Development and Panchaytiraj, Government of India, at College of Post Graduate Studies in Agricultural Sciences, Umiam, on 17 May, 2022.



- The University participated in the International Seminar on Sustainable Development Goals (SDGs) at Chitrakoot, Madhya Pradesh, jointly organized by Deendayal Research Institute, New Delhi on 15-17 April, 2022.



- Twenty second National Fish Farmers Day Celebration, held on 10 July, 2022 at College of Fisheries, CAU, Imphal, Lembucherra and inauguration of different infrastructures created under IDP-NAHEP by Dr RC Agarwal, DDG (Education), ICAR.





## DR. RAJENDRA PRASAD CENTRAL AGRICULTURAL UNIVERSITY, PUSA, SAMASTIPUR, BIHAR

Dr Rajendra Prasad Central Agricultural University, Pusa established on 7 October 2016, which owes its legacy from Agricultural Research Institute and College, Pusa (1905) and Rajendra Agricultural University, Pusa (1970), is making all efforts for generating the pool of qualified human resources in agriculture and allied field, committed for developing crop varieties and technologies for different categories of farmers under diverse agro-ecological situations and transferring the technologies for decent livelihood of farming community, thereby improving the overall economy of the country. The University has its jurisdiction in teaching, research and extension education programmes which are extended to the entire country with special emphasis on the state of Bihar.

### Proud Moments

**2<sup>nd</sup> Convocation of DRPCA, Pusa:** Second convocation of Dr Rajendra Prasad Central Agricultural University was held on 7 November, 2021 at Pandit Deendayal Upadhyay College of Horticulture and Forestry campus, Piprakothi. Altogether, 291 undergraduate, 412 post-graduate and 35 PhD students were awarded with degrees along-with 40 gold medals to the toppers of the Post-graduate and Undergraduate students of respective departments at college and university levels in this Convocation. In the Convocation address, the Chief Guest, Shri Venkaiah Naidu, Hon'ble Vice-President applauded the scientific and technological advancements made in the field of agriculture and allied disciplines and appreciated the contributions of the University for the welfare of society. He emphasised upon further transformation in the agricultural education, research and entrepreneurship under the changing



global scenario. On this auspicious occasion Shri Phagu Chauhan, Hon'ble Governor, Bihar, Shri Nitish Kumar, Hon'ble Chief Minister, Bihar, and other dignitaries were also present.

**Release of postal envelope and stamp:** It was great honour and privilege for the DRPCA, Pusa when India Post released First Day Cover and stamp on Sukhet Model developed by university on 24 February, 2022 by Hon'ble Governor of Bihar at Mahamana Pandit Madan Mohan Malviya Postal Cultural Centre, Patna.

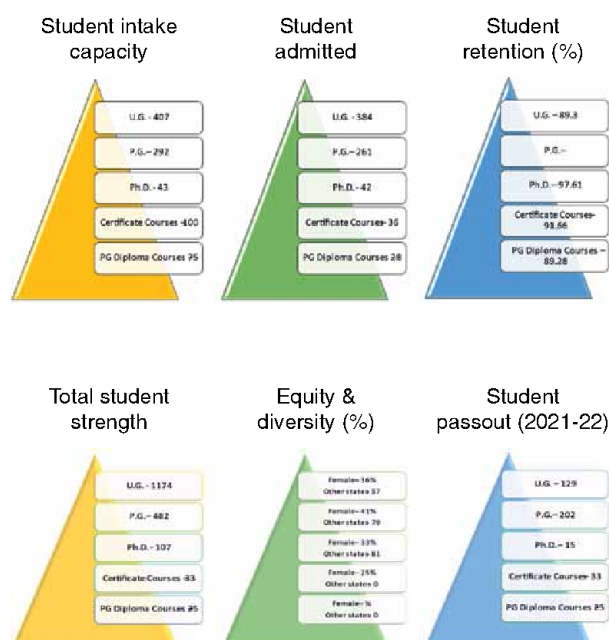


### Education Activities

The University has 8 colleges that run Graduate, Post Graduate and PhD programmes in Agriculture, Agricultural Engineering, Basic Sciences and Humanities, Community Science, Fisheries, Horticulture and Forestry and Agri-business and Rural Management. The University has also adopted flexibility in its academic programme by allowing the entry of student from school dropout (certificate) to PhD aspirants.

## Students' Profile

The University has introduced new courses in its academic programme of Ph D (3); PG (2) and UG (2) which further strengthened its academic programme up to 51 in its eight colleges located at Pusa Parishar (Samastipur), Dholi Parishar (Muzaffarpur) and Piprakothi Parishar (East Champaran). Total 125 students qualified national level examinations such as SRF (10), JRF (20), NET (64), GATE (14), CAT (02) and Government job (18).



## Student Placement

The Placement Cell, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur managed to place 33.12% of its final year students in reputed companies of the country. Some of them were M/s Yara Fertilizers Limited, M/s Nuziveedu Seeds Pvt Ltd, M/s Rallis India Limited, M/s V N R Seeds, Raipur, Chhattisgarh; M/s P I E Infocomm Pvt Ltd, Lucknow, M/s IFFCO Kisan Call Centre, Patna; M/s Corteva Agriscience, Bengaluru, M/s Agreeen Farming Pvt Ltd, M/s Kisanpro Agro-technology,



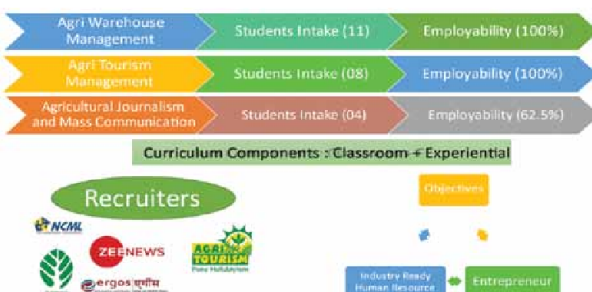
Ranchi; M/s Eximenia Organic Valley Pvt Ltd, Maharashtra; M/s Virbac Animal Health India Pvt Ltd, Patna; M/s Mother Dairy, New Delhi and PRADAN etc. where students got placed with average package of ₹ 4.83 lakhs per annum.

The Placement Cell also organized a soft skill training programme by SEVWA, New Delhi for two days, viz. 17-18 December, 2021 on the theme "High Impact Placement Readiness Program: Campus to Corporate". This programme was attended by the final year students of undergraduate degree courses and post graduate who rated it very successful.

### PLACEMENT RECORD

Average package	₹ 4.83 lakh
Highest package	₹ 8.10 lakh
No. of companies	14
No. of student in waiting list	1
No. of students	52

## Post Graduate Diploma Programmes



## Agriprenuers from Agri-ware management PG Diploma Programme

The College of Agricultural Engineering and Technology facilitated and extended technical support to two students of CAET pursuing their study in the PG Diploma Program in Agriwarehousing Management, namely Mr. Utpalkant Chaudhary and Mr. Sumit Kumar. They started their business model as a "Agriteria Farmers Producers Company" (FPC). They expanded their FPC in three Panchyats (Nirpur Mujauna, Garuaara and Bela) in Samastipur







Technical guidance from Dean, CAET, DRPCAU, Pusa to team Agriteria

district (Bihar) and outreached rapidly to new areas. Their trading for wheat and maize came up to 350 and 700 tonnes, respectively with a transaction of ₹2 crores in three months.

### Accreditation at DRPCAU: Visit of Peer Review Team

The Peer Review Team under the Chairmanship of Dr Gaya Prasad, Former VC, SVPPUAT, Modipuram along with Dr (Mrs) Sapna Gautam, Professor and Head, Community Science, CSKHPKV, Palampur; Dr Y M Shukla, Dean, Faculty of Agriculture, Anand, Gujarat; Dr P K Srivastava, Dean, Aspee College of Horticulture and Forestry, NAU, Navsari; Dr (Mrs) Aparna Chaudhary, OD, FGB, CIFE, Mumbai and Dr K M Manjaiha, IARI, New Delhi visited the University headquarters and various units during 3-7 March, 2022. During their 4-day stay, the Team visited all the colleges, departments, schools and available facilities. In course of visit, they interacted with all the Deans, Directors, Faculty members, Students as well as Staff and collected feedback. The visit was successfully concluded on 7 March, 2022. The accreditation was a major success and almost 80% of the course programme and most of the colleges were successfully accredited.



### National Education Policy, 2020

The University is making all effort to implement the recommendation of NEP, 2020 in true spirit with a view to develop entrepreneurship and industry ready personnel for agriculture and allied sectors. The University has already started one year-PG Diploma course in three disciplines and one-year Certificate course in eight disciplines and introduced three more certificate courses in the current year.

### University Ranking

The University has the honor to find a place under top 10 (9<sup>th</sup> rank) among Government Universities of the country by India Today-MDRA Survey, 2022 for 3<sup>rd</sup> consecutive year. The university also got 5<sup>th</sup> spot in faculty-student ratio.

TOP 10 GENERAL UNIVERSITIES (GOVT)					
RANK 2022	RANK 2021	RANK 2020	RANK 2019	RANK 2018	UNIVERSITY
1	1	1	1	1	JAWAHARLAL NEHRU UNIVERSITY, NEW DELHI
2	2	NP	NP	2	UNIVERSITY OF DELHI, DELHI
3	3	2	2	3	UNIVERSITY OF HYDERABAD, HYDERABAD
4	4	3	3	5	ALIGARH MUSLIM UNIVERSITY, ALIGARH
5	6	8	7	7	JAMIA MILLIA ISLAMIA, NEW DELHI
6	5	5	5	NP	UNIVERSITY OF CALCUTTA, KOLKATA
7	NP	4	4	4	OSMANIA UNIVERSITY, HYDERABAD
8	8	9	NP	NP	TATA INSTITUTE OF SOCIAL SCIENCES, MUMBAI
9	9	10	NP	NP	DR RAJENDRA PRASAD CENTRAL AGRICULTURAL UNIVERSITY, PUSA, SAMASTIPUR
10	10	7	9	9	COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY, KOCHI

### Research Activities

The University has well equipped laboratories and library with scientific manpower, and state-of-the-art infrastructure for research. A total of 149 research projects comprising of 35 AICRPs, 4 International projects, 16 Government of India projects, 6 Government of Bihar projects, 82 university projects and 6 other projects funded by seven foreign agencies and rest by national agencies

were devoted for the development of crop varieties and innovative technologies to enhance farmers' income and their decent livelihood. During the report period, 2 patents were granted, 3 licensed and 8 patents applications filed for innovative technologies and value-added products.

### Patents Granted

Two patents have been granted in the name of Dr. Rajendra Prasad Central Agricultural University which are given as follows:

**Rotary power paddy weeder (Patent No. 379307):** The light weight rotary power paddy weeder removes the weed from root and mase the end plants with soil. The weeder is suitable for all type of soil condition, i.e. saturated with inundation of water up to 3-4 cm depth and dry soil. The field capacity is 1.2/acres day and cost of weeding ₹1,000-1,200 per acre. The machine also facilitates earthing operation which helps in prevention of lodging of plants in case of storm.



**Hand crank improved chakki Design No. 342101-001 :** Hand-crank improved chakki is suitable for making dal, daliya, atta, sattu and grits at household level. It is higher in capacity and much better in comfort than traditional chakki. The chakki gives very high recovery of dal than any other mill in pulse milling. It produces nutritious food products and thus has the ability to be adopted at household level.

### Varieties Developed

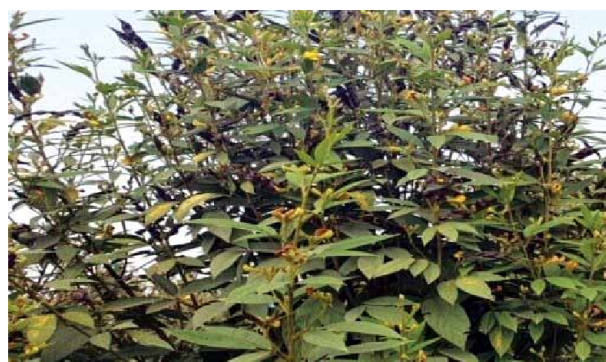
**Released and notified by CVRC-02**

**Variety: Rajendra Arhar 2**

- Year of recommendation/ notification: 2020



- Recommendation/Notification agency: RCM
- Notification No./Date/ Year: 2020
- Gazette notification year: 2022
- Pedigree/Parentage: Bahar × ICP 9174
- Breeding method
- Released for the Area/ state: Bihar



**Sugarcane: (Rajendra Ganna 2)**

- Year of notification: 2022
- Recommendation/notification agency: CVRC
- Pedigree/Parentage: BO 55 × BO 43
- Breeding method: Clonal selection
- Released for the area/state: Eastern Uttar Pradesh, Bihar, West Bengal, Jharkhand and Assam
- Salient features: It exhibited an average cane yield of 77.68 tonnes/ha. It is tolerant to lodging.





### Technologies/Products Developed and Adopted

**Hand tool for okra harvesting:** A hand tool for Okra harvesting was released by DRPCA, Pusa at the 11<sup>th</sup> Research Council Meeting. The technology was designed and developed at CAET, having specific features—ease of operation, minimum hand injuries and increased shelf life of the harvested okra. Capacity and cost of the tool are 13.64 kg/h and ₹ 200, respectively.



### Infrastructure Developed

Five newly constructed/ established facilities, viz. Deshi Govansh Sanrakshan evam Samvardhan Kendra, Madhopur; Swadeshi Gau Nasl ka Kshetriya Utkrishtata Kendra, Piprakothi; Pandit Deen Dayal Upadhyay Udyaniki evam Vaaniki Mahavidyalay, Gandaki Mahila Chhatravaas and Pandit Rajkumar Shukla Chhatravaas were inaugurated by the Hon'ble Vice-President in gracious presence of Hon'ble Vice-Chancellor and other dignitaries assembled on the occasion of 2<sup>nd</sup> Convocation held at PDDUC&H at Piprakothi.



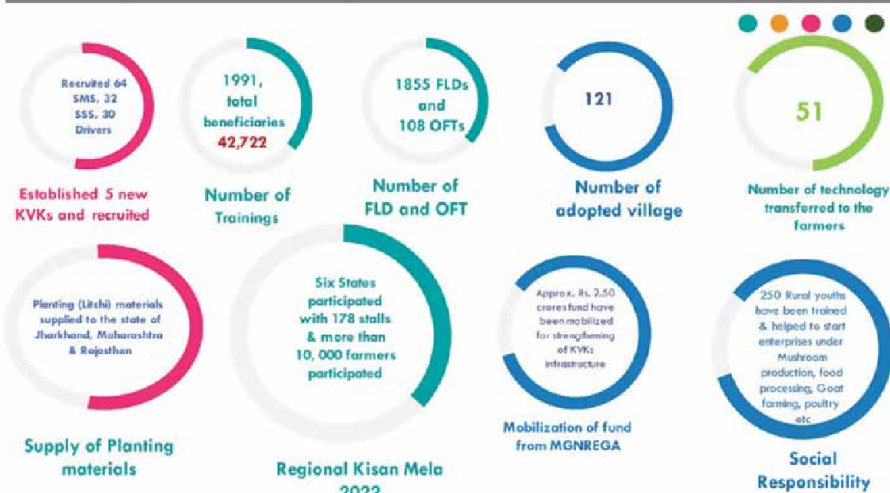
### Biodiversity Park

Biodiversity Park established at Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar covers an area of 7.5 ha area. The park consists of 9 cultural vans; Navgraha Van, Shiv Panchayta, Panch Pallav, Panchavati, Nakshatra Van, Shriparni Van, Rashi Van, Tirthankar Van, Saptarshi Van. Two blocks are planted with important medicinal trees and unconventional fruits respectively. A Bambusetum with about 65 bamboo species is also newly established. Blocks comprising rattan (can) and natural forests tree species is also accommodated. A lawn with fountain and seasonal flowers is maintained to attract the visitors. Several ponds are also created within the park to serve different purposes of pisciculture, aquatic plants and recreation activities. A VIP plantation block is reserved for eventual plantation by esteemed visitors. Several varieties of Cactus, Adenium and Roses are grown to increase the aesthetics of the park. A separate block is also maintained as Butterfly Park which accommodates several suitable floras for local butterfly species. Overall, the Biodiversity Park aims to impart education and realization of the importance of conserving natural resources. A biodiversity park was inaugurated on 1 June, 2022 by Shri Santosh Kumar Mall, Principal Secretary, Department of Tourism, Government of Bihar in the presence of Dr RC Srivastava, Hon'ble Vice Chancellor, DRPCA, Pusa and other dignitaries.



## EXTENSION ACTIVITIES

## EXTENSION 2021-22



## Seminars, Workshops and Training Programmes

The 55<sup>th</sup> Annual Convention and International Symposium of Indian Society of Agricultural Engineers was organized by the CAE (DRPCA) during 23-25 November, 2021 at Patna (Bihar). Shri Tarkishore Prasad, Hon'ble Deputy Chief Minister, Government of Bihar was the chief guest of the inaugural function. More than 350 delegates from different states and abroad participated physically, and about 300 academicians/scientists/students/



engineers were connected virtually. Further, as part of HRD development, faculty staff were allowed to attend 146 Seminars, 128 Conferences, 69 Workshops and 85 Trainings.

## Inter-College and Inter-University Elocution Competition

The elocution competition for XV Agricultural Science Congress 2021 was organized by Directorate of Students' Welfare, DRPCA, Pusa on 25 and 27 October, 2021 at the Panchatantra Hall. The topic of Elocution competition was "Optimization of energy for sustainable agriculture." The winner of inter-college elocution was Ms Megha from CoF and runner-up was Ms Aleena Antony from CoF, Dholi.

The inter-university competition was held on 27 October, 2021 under the Chairmanship of Hon'ble Vice Chancellor as a zonal coordinator for Zone IV. Students from 12 universities participated in this event. The winner was Mr Soham Shao from OUAT, Bhubneshwar, second



position was bagged by Mr Raunak Singh from BAU, Kanke, Ranchi, and the third and fourth position were bagged by DRPCA, Pusa. The first two winners got nominated for XV Agricultural Congress to be held from 13-16 November, 2021 at BHU, Varanasi.

### Revenue Generation



### Memorandum of Understandings

#### MoU between DRPCA and RRF

CAET faculty and students attended the MoU signed between DRPCA and Research for Resurgence Foundation (RRF) held on 20 July, 2022 at Vidyapati Sabhagar. The session was chaired by renowned educationist Mr Mukul Kanetkar, Secretary, Bharatiya Shikshan Mandal. He addressed students on relevance of ancient education system to modern India.



#### MoU between DRPCA and different ICAR institutes

MoU Signing Ceremony in between DRPCA and (i) ICAR-Indian Institute of Sugarcane Research, Lucknow, (ii) Institute of Forest Productivity, Ranchi; (iii) Forest Research Centre for Eco Rehabilitation, Prayagraj and (iv) ICAR-National Bureau of Agriculturally Important Microorganisms, Mau on 28 July, 2022.

- DRPCA, Pusa has signed 3 MoUs on 4 June, 2022 with M/s Devvati Jaivik Udhiyan, Muzaffarpur for Jaivik farming; M/s Doke Tea and Agro, Pothia (Bihar) for Tea and Agritourism Development and M/s Cislunar Janki Pvt Ltd, Patna for Banana fiber based sanitary pads.

### Visit of Secretary, DARE DG, ICAR

- Dr T Mohapatra, Secretary DARE and DG, ICAR visited university campus on 8 November, 2021. He inaugurated girls hostel at Dholi, laid foundation stone of two boys hostels and one lecture theatre complex as well as dedicated university hospital. Besides these, he visited College of Fisheries, School of AB and RM and Heritage Museum, and later on addressed the faculty members.



## RANI LAKSHMI BAI CENTRAL AGRICULTURAL UNIVERSITY, JHANSI

The Rani Lakshmi Bai Central Agricultural University is the first Agricultural University in the Country, which was established as an institution of national importance by an Act of Parliament by Government of India on 5 March, 2014. Within the provision of the University Act, its headquarters and constituent College of Agriculture and College of Horticulture and Forestry are located at Jhansi. Two colleges, namely College of Veterinary and Animal Sciences, and College of Fisheries are being established at Datia, Madhya Pradesh. The University made stupendous growth in all the spheres of its mandated activities in academics, research and extension education including development of infrastructure. The University took several initiatives to foster sustained growth and quality outcomes by improving efficiency, infrastructure, instruction materials, laboratories and human resources.

### Academic Activities

The on-going three undergraduate programmes for the degree of B Sc (Hons) Agriculture, BSc (Hons) Horticulture and BSc (Hons) Forestry continued, besides PG programme in eight subjects (Genetics and Plant Breeding, Agronomy and Plant Pathology Soil Science, Entomology, Vegetable Science, Fruit Science and Silviculture and Agroforestry). PG course curricula revised by ICAR have been implemented. The University along with its constituent colleges, viz. College of Agriculture and College of Horticulture and Forestry has been accredited by the ICAR-National Agricultural Education Accreditation Board (NAEAB). Students for various PG/UG programmes are admitted through ICAR-All India Entrance Examination within the statutory framework of the reservation policy of Government of India. Despite the outbreak of Covid-19 global pandemic, best possible efforts were made to continue the academic activities with least disruptions. All final undergraduate and PG students completed their degree requirements within the stipulated timeframe. The faculty and students participated in Swachh Bharat Abhiyan, National Social Service, National festivals, games and sports, Hindi Pakhwara, and other extra-curricular activities. The 100% girl students successfully cleared NCC C-Certificate examination.

### Research Activities

Six research-cum-development projects under Rashtriya Krishi Vikas Yojana (RKVY)-Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (Raftaar) component by UP State Level Sanctioning Committee (SLSC) with an outlay of ₹854.90 Lakhs has been sanctioned. These projects are mandated to promote bee keeping, low-cost mushroom production and protected cultivation of high-value cut-flowers in addition to establishment of plant-health clinic and hi-tech nurseries for quality planting material.

Agro-techniques were standardized for efficient use of irrigation and rain water and crop diversification for climate resilient agriculture in Bundelkhand. Ridge and furrow system was found most promising for *in situ* rainwater harvesting and resulted in generating maximum crop and water productivity. Seeds of 100 varieties and germplasm accessions of cowpea obtained from different sources were screened for post emergence herbicide tolerance of Imazethapyr in *kharif* 2020. Mullugo was found to be the major weed followed by Commelina. Imazethapyr effectively controlled the weed population from average 4 to 9 weeds per m<sup>2</sup> taken at 10 different locations in the treatment. Weed control efficiency was maximum at 81.61%, with the application of Imazethapyr @ 80 g a.i./ha. Two sprays with azoxystrobin 23 EC @ 0.5 ml/lit water and two sprays with *Bacillus subtilis* @ 4 g/litre water was found most effective in minimizing the *Corynespora* leaf spot disease, whereas copper oxychloride 50 WP @ 2 g/litre water + streptomycin 100 ppm resulted in minimum reduction in disease severity of 30.8 and 14.8 due to bacterial blight.

Research work under various ICAR-AICRPs, viz. on Chickpea, and Rapeseed-Mustard, besides, voluntary trials in the purview of AICRP-Maize, Barley, Pearl millet, MULLaRP and Sesame and Niger were also undertaken towards enhancing productivity and production of these crops through development of high-yielding, multiple disease-resistant varieties for central India. The 1,136 q seed was produced for different crops, including millets, oilseeds, pulses and cereals at University farm and in farmers' participatory mode, during 2020-21. Three Seed-Hub Projects on Pulses, Oilseeds and Millets have been executed at University to take-

up seed production of different crops. Keeping in mind the cropping pattern of Bundelkhand region, the highest seed production was taken-up for pulses (485 q) followed by oilseeds (395 q), cereals (235 q) and millets (21 q).

### Extension Activities

Front Line Demonstrations (721) were organized at farmer's field on mustard (100), pea and lentil (10), chickpea (15), wheat (3), groundnut (30), maize (100), urd (120), mung-bean (5), aerobic rice (15), sesame (45), millets (100), medicinal plant (48), marigold (10), fruits (20), agro-forestry (100) at Jhansi, Lalitpur districts of Uttar Pradesh and Datia, Tikamgarh and Niwari districts of Madhya Pradesh. FLDs on rapeseed and mustard displayed 21.44% increase in average yield over the local practices with additional mean monetary benefit of ~ ₹ 1,3030/ha. Chickpea variety RVG 202 exhibited yield of 13.40 q/ha against the local check yield with net return of ₹33,761/ha. Lentil IPL316 and Field pea (Aman) disported yield advantage of 29.90 and 41.0% over the local check with higher gross returns of ₹ 58,212 and ₹ 12,648/ha, respectively.

Farmers 1858 participated in off-campus training conducted in Jhansi, Lalitpur, Tikamgarh Niwari and Datia for scientific farming and propagation of medicinal and aromatic plants, improved field crops, package of practices, nutrient management, plant protection, garden, nursery, etc. In-campus training were also organised to popularize value added and herbal industry-oriented cultivation of medicinal plants (160 farmers), scientific production technology of rapeseed and mustard for extension workers (20), Climate smart agricultural Technologies in Bundelkhand (115), reforms in agricultural marketing (86) and training, exhibition and distribution of medicinal and aromatic plants (80).

The faculty members delivered 40 radio talks and participated in TV show on farm related topics for creating awareness about soil health, crop insurance, and other welfare schemes for the welfare of farmers and rural audiences. The University organised exhibition centred at nutri-ayur natural health products of medicinal and aromatic plants and participated in technology and machinery demonstration meet-cum-farmers' fair at neighbouring ICAR Institutes. Useful implements (knapsack sprayer, storage bin, fork-shovel and wheel barrow) were distributed among beneficiaries



under SCSP programmes. University maintained a regular communication among farmers of Bundelkhand region with the help of print media and ICT based farm advisories (243) based on seasonal requirements. State governments, NGOs, and FPOs sponsored visits of farmers, villagers, youth and other interested stakeholders (588) to the University campus and research farm to get hands on information, knowledge and learning experience about recent developments in agricultural farming and associated opportunities to enhance farm income.

### Infrastructure Development

Construction of Extension of Girls' hostel, Faculty residences [T-III (12)/IV/T-V (12), Community centre and Guest house, farm and external development, etc. at Jhansi and Academic Block (for establishment of Colleges of Veterinary and Animal Sciences and Fisheries), Boys and Girls hostel and Residences-VI (2)/T-V (4)/T-IV (12)/T-III (12)/ T-II (12) at Datia (MP) are in full swing and likely to be completed by the end of this academic year.

Farm development work was continued at Jhansi and Datia campus research farms for ensuring 100% rainwater harvesting by constructing check dams and ponds at lowermost points of the farm. One dozen farm ponds and check dams covering 8 ha area were developed at the University Research Farm at Jhansi and two ponds at its Datia Campus in an area of 1 ha. These water bodies have been brought under fisheries production and recreational purposes, besides ensuring round the year water availability for irrigation.



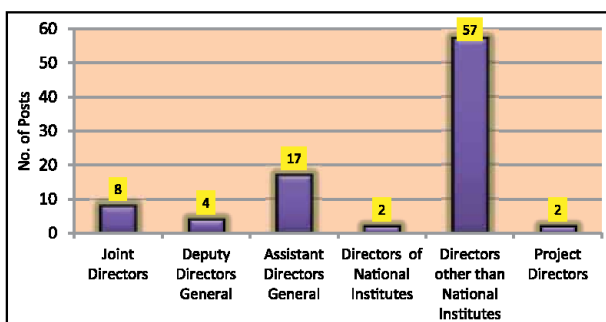
Type III quarters and Girls hostel at Jhansi



## AGRICULTURAL SCIENTISTS RECRUITMENT BOARD

### Direct Recruitment/Lateral Entry

During the period, Board advertised 90 Research Management Positions (RMP) vide Advt. No.1/2021 dated 5 November, 2021, comprising Deputy Directors General, Directors of National Institutes, Assistant Directors General, Directors of other than National Institutes, Project Directors and Joint Directors of the National Institutes. Position-wise breakup of various posts advertised during the year 2022-23 is given below.

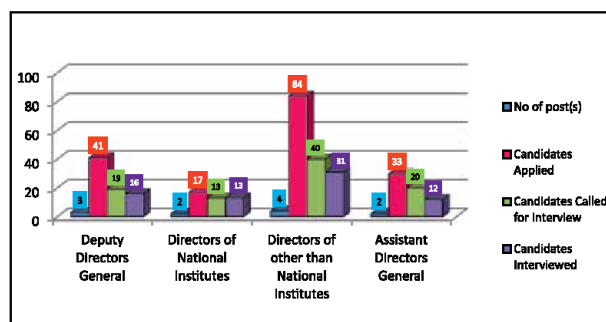


Number. of Research and Management posts advertised

Recruitment process for senior scientific posts (both RMPs and non RMPs) of ICAR was put on hold in February., 2021 due to revamping of the scorecards. The process of recruitment was started again in November 2021 after redesigning and approval of new scorecards for RMP positions.

The aim of revamping was to make it more objective by minimizing interventions and discretion of human experts in evaluation of application

and to computerize the process of inviting online applications and screening of applications at ASRB. The scorecards for RMP positions were finalized and accordingly RMP posts were advertised in the month of November., 2021. Applications were invited online for the above mentioned 90 RMP positions of the ICAR research institute and ICAR Headquarters. The Board completed the recruitment process for 11 posts of senior RMP positions till August, 2022.



Details of direct recruitment process completed during the period

In all, the Board screened 175 applications and called 92 candidates for interview for these 11 posts. Only 72 candidates out of 92 attended the interview. As per rule, Board invites only top 10 ranking candidates obtaining minimum qualifying marks in the scorecard evaluation for interview for each post. However, average number of candidates called for interview for each post was around 8.36 for these 11 posts.



Interview in progress for selection of RMP posts

### Summary of Direct Recruitment process completed during the period

Category	No. of post(s)	Candidates applied	Candidates called for interview	Candidates interviewed	Recommended for appointment
Deputy Directors General	3	41	19	16	3
Directors of National Institutes	2	17	13	13	2
Directors of other than National Institutes	4	84	40	31	4
Assistant Directors General	2	33	20	12	2
<b>Total</b>	<b>11</b>	<b>175</b>	<b>92</b>	<b>72</b>	<b>11</b>

## Recruitment through Examination

**ARS Examination 2021:** A combined examination of ARS (Prelims)/NET/STO-2021 was held in online mode from 23-27 August, 2021. A total of 38,022 candidates registered for the ARS examination and only 27,433 candidates appeared in preliminary examination. As per the result, 2,792 candidates qualified for main examination in 48 disciplines. The main examination was held on 28 November, 2021.

**Senior Technical Officer (STO):** A total of 17,805 candidates registered for STO examination – 2021, but only 12,920 candidates actually appeared in the examination. Based on result of the combined examination of ARS (Prelims)/NET/STO-2021, only 304 candidates were called for interview for 65 posts of Senior Technical Officer (STO) (T-6). Interview for the posts of STO was held from 2–15 March, 2022, and a total of 63 candidates were recommended for appointment to the posts of Senior Technical Officer (T-6) under Indian Council of Agriculture Research (ICAR). Two vacancies could not be filled due to the non-availability of suitable candidates.

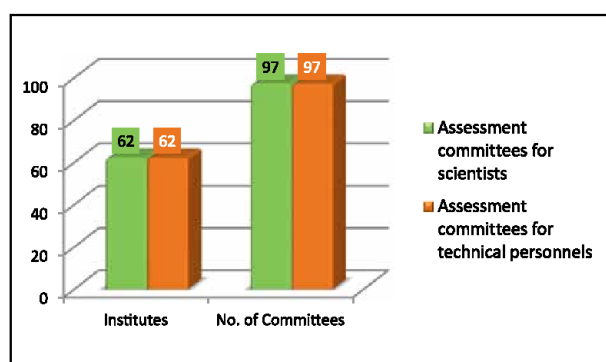
**National Eligibility Test 2021:** A total of 11,058 candidates qualified in National Eligibility Test (NET) held from 23-27 August, 2021 in 60 disciplines. NET is an essential prerequisite qualification for determining eligibility for recruitment of Lecturers/Assistant Professors in State Agricultural Universities (SAUs) and other General Universities with Agricultural Faculty.

**Administrative Officer (AO) and Finance & Accounts Officer (F&AO) Examination-2021:** The Tier-I examination was conducted on 10-21 May, 2022 for filling up 44 vacancies of Administrative Officer (AO) and 21 vacancies of Finance and Accounts Officer (F and AO) in online mode. A total of 882 candidates for

Administrative Officer and 421 for Finance and Account Officer qualified for Tier II examination, which was conducted in conventional pen and paper (descriptive test) mode on 28-30 December, 2022.

## Constitution of Technical Committees for Assessment under Career Advancement Scheme (CAS) for ARS Scientists (RGP ₹ 6000 to ₹ 9000) and Promotion of Technical Personnel

The Chairman, ASRB nominated Chairman and Members of Assessment Committees for 62 ICAR Research Institutes for assessment of scientists from RGP ₹6,000 to ₹7,000, RGP ₹7000 to ₹8000 and from ₹8000 to ₹9000. The Chairman, ASRB constituted 97 assessment committees for assessment of technical personnel working in different technical categories for the ICAR institutes including ICAR Headquarters.



Details of assessment committees for scientists and technical personnel

## Advice to Council on Tenure Renewal and Departmental Promotion

During the year, Board regularly participated in all the tenure renewal committee meetings of the Deputy Directors General (DDG)/Assistant Directors General (ADG) and Directors and departmental promotion committee meetings for the promotion of officials of ICAR.

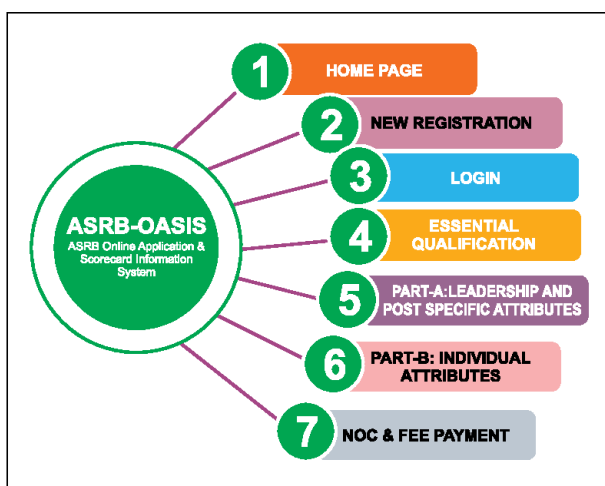


Interview in progress for selection of STO posts

## Reforms

**Revision of Scorecard:** During the year, scorecard for RMP and non- RMP positions of ICAR Institutes for direct selection to Research Management Positions (RMP)-2021 and Non RMP-2022 positions of Indian Council of Agricultural Research (ICAR) on lateral entry basis have been revamped in order to make it more objective.

**Developing of Score Cards Application Software for Inviting Online Applications for Direct Selection to Senior Scientific Positions on Lateral Entry Basis:** Online Application Forms for direct recruitment have been revised in consonance with revised scorecards and the applications were made applicable from advertisement 01/2021. Online Software Application is named as OASIS (Online Application and Scorecard Information System) and can be accessed online on URL-<https://asrbapplication.in>.



Features of OASIS application software

**Promotion of Hindi (Rajbhasha):** ASRB is committed to promote progressive use of Hindi in its office to fulfill targets fixed in the annual official language programme 2022-23 as per the official language policy of Department of Official Language, Ministry of Home Affairs, Government of India. The Board ensures that bilingual requirements of the circulars, reports, question papers and other documents, as per the provisions of the Act and Rules, are meticulously complied with.

## Quarterly meetings of Official Language Implementation Committee (OLIC):

Quarterly meetings of official language implementation committee of ASRB were conducted regularly under the chairmanship of Chairman, ASRB who is the Nodal Officer for implementation of the official language policy in the Board. During the reporting period, four meetings were conducted in June, September, December, 2021 and March 2022. Various issues pertaining to official language implementation were discussed and decisions were taken in these meetings.

The quarterly report of ASRB for the quarter ending 30 June 2022 for the progressive use of Official Language showed that:

- The performance of official language implementation under Section 3(3) was 100%. Similarly, the reply of letters sent by ASRB to A and B regions were also 100%.
- Correspondence in Hindi with region A and B was 100% and C was 96.55%, while target for region C was 65%.
- Overall performance of noting in Hindi was 96.26%, which exceeded the set target of 75%.

**Celebration of Hindi Pakhwada:** During the year, ASRB organized “Rajbhasha- Hindi Pakhwada” in September, 2022. All officers and staff of ASRB were present on this occasion. Dr Shiv Prasad Kimothi, Member, ASRB presided over the function, and in his formal address, he advised that we should promote use of Hindi in our office to fulfil targets as fixed in the annual official language programme 2022-23. Member (PS) and Member (NRM) were also present in the meeting.

**Awards received by ASRB:** ASRB was awarded with the First Prize (category of 11 to 50 employees) in “A” Region for best performance in promotion and implementation of official language and Hindi work for the year 2018-19 during Regional Rajbhasha Sammelan and Award distribution function held at Kailash Bhawan Auditorium, Chandra Shekhar Azad University, of Agriculture and Technology Kanpur (UP) on 27 November, 2021. The Award was presented by Hon’ble Union Minister of State, Ministry of home





Officials of ASRB receiving the awards during Regional Rajbhasha Sammelan

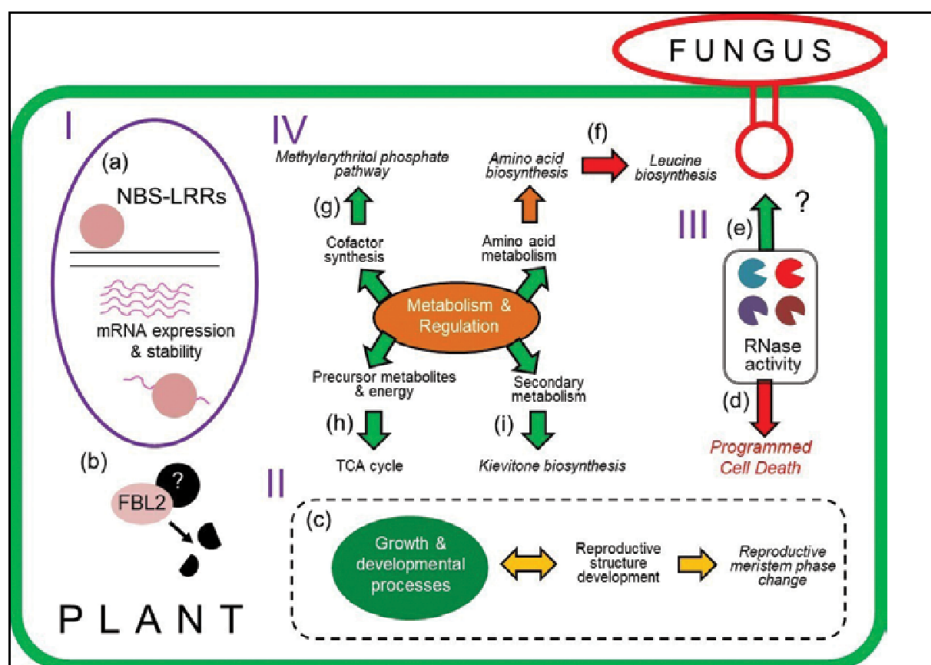


Officials of ASRB receiving the Rajbhasha Samman-2022

Affairs Shri Ajay Kumar Mishra in the presence of Secretary (Rajbhasha) Government of India.

**Rajbhasha Samman-2022:** Nine officials of ASRB have been awarded Rajbhasha Samman-2022 for doing original work in official language Hindi

in the first technical conference held for Central Secretariat Official Language Service on 18 May, 2022 at Ambedkar Bhavan, Delhi. The awards were presented by Hon'ble Union Minister of State Shri Ajay Kumar Mishra and in the presence of Secretary (Rajbhasha), Government of India.



Schematic representation of the role of maize constitutive gene network in fungal resistance.

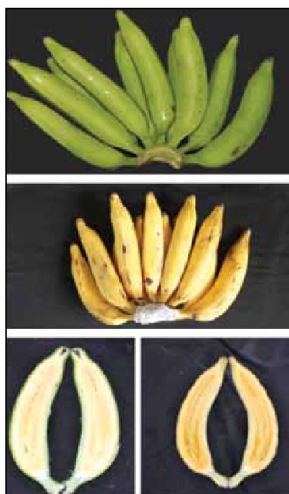
### Improved varieties of various horticultural crops



Narendera Bael-11



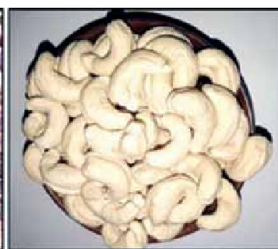
Coconut Kalpa Vajra



Fruits of Kaveri Kanchan (NCR 17)



Nethra Jumbo 1 cashew hybrid



SreeKaveri Cassava



Potato MP / 09-45



tannia variety IGS GTN-1



Small cardamom IC 349537

genic-SSR markers for winged bean was developed from the publicly available RNA seq data sets and 58811 unigenes were assembled, and 4,107 perfect SSRs were identified. Effect of Zn deficiency was evaluated in BKS-41 (high seed zinc) and Sadabahar

(low seed zinc). Higher shoot length, root length, longer root hair zone, high root hair density, higher relative chlorophyll content and dry weight were observed in BKS-41 as compared to Sadabahar under zinc deficient condition. The study to identify



regulatory genes associated with RFOs biosynthesis in peanut (*Arachis hypogaea*) suggested Raffinose Synthase (RS) for the differential accumulation of RFOs. four varieties of faba bean, i.e. *Swarna Suraksha*, *Swarna Safal*, *Swarna Gaurav* and *Pusa Sumeet* were evaluated as a natural source of L-Dopa. Higher amount of L-Dopa was found in immature leaf and flowers. A screening method was designed for amylose estimation in maize kernels. The proposed method is rapid and simple for screening of maize kernels with varied amylose amounts, and gets completed in 1 min. Meta-QTL analysis for fungal disease resistance in maize revealed 128 QTLs associated with resistance against 12 fungal diseases (SLB, NCLB, BLSB, GLS, HS, FSR, FER, GER, AER, PLS, CS, SDM) across the maize genome. Application for an Indian patent (Application No. 202211015547) on rapid differentiation of normal maize from Quality Protein Maize was filed. The developed method requires 5 minutes for differentiating normal maize from QPM, when a milled sample is provided. Genome editing for early flowering and seed size displayed increase in leaf size, stem length and seed weight in edited chickpea lines as compared to their normal control types. Full-length gene sequence of grasspea oxalyl-CoA synthetase and ODAP synthase, enzymes functional in OAP synthesis in grass pea, were identified and submitted to Genbank with accession No. MH469748 and MZ127288, respectively. Two QTLs/genomic region on chromosome 2 and 8 were mapped for Fusarium wilt resistance in pigeonpea.

CRISPR/Cas technology was utilized to edit the cytokinin oxidase (*OsCKX2*) gene of indica rice cultivar controlling the grain number in order to increase the yield of Samba Mahsuri. The genome-edited lines showed 200 to 496 grains/panicle in comparison to ~150 grains/panicle in wild-type or non-edited Samba Mahsuri plants while T1 lines showed desired characters like strong culm and early maturity. To create novel variants for morphological, physiological, and biotic stress tolerance traits, induced mutations were created in the background of Samba Mahsuri (BPT 5204). The mutant lines showed enhanced tolerance to important biotic stresses (YSB, ShB and BLB). Multiple abiotic stress responsive genes were identified using transcriptomics in sugarcane. A chromosome-level reference genome assembly (2.93 Gb; 97.66% Coverage) of Indian Tea (*Camellia assamica* var. Masters cv. TV-1) genome was generated anchoring 99.4% of super-scaffold level assembly into

15 clusters or pseudomolecules by Hi-C data with the size of clusters ranging from 303.18 Mb to 119.95 Mb. A novel abiotic stress responsive gene LOC\_Os06g10210 (*OsCHI2*) isolated from a drought tolerant rice cv. Nagina 22 (N22) which showed upregulation in response to drought stress was identified. miR156 site in *Ideal Plant Architecture 1 (IPA1)* gene in rice variety, Swarna, was edited. Panicle architecture and spikelets/panicle improved significantly in edited lines. Presence of Protein Body 1 and 2 under different post-harvest processing conditions of grains of high protein rice CR Dhan 310 was identified. In order to identify the high resistant starch rice, 100 rice lines were analyzed which revealed variation in the range of 0.28% to 2.94% with Gayatri rice line showing the highest resistant starch content of 2.94% over the years (2019 to 2022).

To screen large number of genotypes for vivipary, laboratory method was proved efficient considering the correlation with field observation data, outstanding genotypic difference and convenience of testing. Mutants of BPT 5204 with robust root system architecture, early seedling vigour index, and higher yield under limiting water conditions identified which are suitable for the dry direct seeding under aerobic system of rice cultivation. Genomes of rice restorer line KMR3 (salinity-sensitive) and its salinity tolerant introgression line IL50-13 were sequenced. Draft genome of yellow stem borer *Scirpophaga, incertulas* an agriculturally important pest with 46,057 genes and estimated size of 308 Mb was generated. During 2021-22, breeder seed production in field crops was 101617.5 quintals against the indent of 77260.1 quintals and total production of quality seed was 349596.6 quintals against the target of 312584.7 quintals. In addition, 234.5 lakh planting material and 5.4 lakh tissue culture plantlets were produced against the targets of 174.3 and 4.7 lakh, respectively.

In horticultural crops, 122 varieties were notified for cultivation under different agroclimatic conditions. These included 15 varieties of fruits, 1 of plantation crops, 97 of vegetables, 2 of tropical tubers and 7 of spices. The molecular linkage maps of two grape varieties (Carolina Black Rose and Thompson Seedless) were developed. Genome assembly of Indian pomegranate cv. Bhagawa was released. Varietal signature for genetic purity of spices were identified and identity of nutmeg varieties IISR Vishwashree, IISR Keralashree and Sindhushree was established. Marker free late blight resistant transgenic line KJ66 of potato was



identified. A total 1047 activation tagged lines were generated in potato cv. Kufri Jyoti and Kufri Chipsona 1 using activation tagging vector pSKI015. Targeted editing of potato genome was done to develop variety specific True Potato Seed (TPS). A total of 16 lines of potato with mutation within MiMe genes (StOSD, StREC8 and StSP011) were generated. Molecular identification and diversity of 25 *Pleurotus* mushrooms were investigated. Seven new hybrid strains of *Pleurotus* were developed by mating single spores from *Pleurotus treatment* (DMRP 30) and *Pleurotus florida* (DMRP 49). The biological efficiency was recorded maximum for hybrid P18102 (79.00%) in two flushes compared to parents and check on pasteurized wheat straw.

**2. Livestock Improvement:** The evidence of selection signatures in the datasets of 284 individuals of Tharparkar cattle along with 11 other indigenous and exotic cattle breeds were demonstrated. Significant candidate genes were identified related to various important traits such as ADRB2 in Tharparkar; HERC5, SCC25A48 in Gir; CA8 in Ongole and KIAI217 in Sahiwal for milk production; PARN in Holstein; ZBTB20 in Sahiwal; and APBB1 in Tharparkar for reproduction; SP110 in Brown Swiss; HSP90AB1 in Tharparkar and Red Sindhi for thermo-tolerance trait.

The influence of X-linked genes on the sperm functional parameters and field fertility rate in the cattle and Murrah buffalo bulls was studied. The sperm transcriptome studies revealed that the total number and the expression levels of X-linked genes in the mature sperm were very low in both species, and only 23.3% of these genes were commonly expressed between them. The X-linked genes related to embryonic organ development and reproduction were enriched in cattle and buffalo sperm, respectively. The expression levels of X-linked genes in cattle RPL10 and ZCCHC13, and buffalo AKAP4, TSPAN6, RPL10 and RPS4X were significantly correlated with sperm kinematics. Evidently, the expression level of RPL10 and RPS4X was significantly correlated with the field fertility rate in cattle and buffalo, respectively. Multivariate regression models and receiver operating curve analysis suggested that the expression levels of X-linked genes may be useful in predicting the bull fertility rate.

An egg yolk-free, ready to use, semen extender for cattle and buffalo with higher shelf-life ( $\geq 18$  months,  $4^{\circ}\text{C}$ ) for cryopreservation of buffalo semen was developed for the first time in India. The post-



CARI-Prabal



thaw progressive motility of cryopreserved buffalo sperm in the new egg-yolk free semen extender was significantly higher. A farm-to-fork block chain-based buffalo meat traceability system, BuffTrace, was developed for buffalo meat industry in collaboration with a private company. The system helps in collection of post-slaughter information and retrieval of the traceability information based on the label details.

The complete mitochondrial genome sequences of 88 Indian sheep representing 22 breeds/population were analyzed for the first time to get a comprehensive picture of the maternal diversity in the sheep genetic resources of India. The mitochondrial DNA sequence of all Indian sheep was observed to be 16617 bp long and contained 37 genes, including 13 protein coding genes, 2 rRNA genes, 22 tRNA genes, and a control region. Network Project on Sheep Improvement (NWPSI) and Mega Sheep Seed Project (MSSP) with major objective of improvement of indigenous sheep breeds were initiated.

Concurrent transcriptome and methylome analysis of pig breeds (Mali and Hampshire) with varying muscularity was done to obtain insights into myogenesis. Muscle transcriptome identified 20226 mRNAs out of which 15170 were present across the samples. Developed economic and nutritionally balanced silage-based pig feed following standard procedure from vegetable wastes adding jaggery (gur) at the rate of 3 kg per 100 kg raw chaffed

vegetable waste for suitable anaerobic fermentation in silage bags. A total of 1,934 liquid boar semen doses were produced and supplied for artificial insemination in pigs at the farmers' field and organized farms.

Three climate resilient dual type hardy birds, CARI-Dhawal, CARI-Prabal and CARI-Saloni were developed for efficient egg and meat production. To overcome the antibiotic growth promoters used in poultry feed, CARI-HERBIGROW, a natural product was developed with the property of antioxidants, immune enhancer, stress reducer and helps chicken to improve overall production. CARI-HERBISTRESSMIN, a phyto-genic feed additive was developed by CARI to reduce effect of heat stress and improve immunity of birds during hot and hot-humid summer. Alternatives for antibiotic growth promoters (AGPs) in feed and alternate protein meal and biofortified maize in poultry diet (black soldier fly (BSF) larva meal) were also developed.

Inhibin alpha gene editing by CRISPR/Cas in Nicobari indigenous chicken led to efficiency of production. The egg production up to 72 weeks of age increased by 203% from 261 eggs in edited birds as compared to 128 egg in control birds. Immunochromatography-based chicken detection kit (ICDK) was developed for the authentication of chicken. Genomic diversity was estimated in Arunachali yak population based on data generated using ddRAD sequencing. Three indices, viz. nucleotide diversity (0.041 in 200 bp windows), effective population size ( $N_e = 83$ ) and runs of homozygosity (>90% were short and medium length) revealed that the genomic diversity in Arunachali yak breed as of now is optimum.

**3. Fish Improvement:** Successful natural spawning of green snapper, *Lethrinus nebulosus*, was achieved in recirculatory aquaculture system (RAS). It is a large tropical marine fish species that grows to 80 cm in length and 8.4 kg in weight. *Lethrinus nebulosus* were collected from wild and developed into functional broodstock in 10 t RAS system. Simple non-invasive breeding and culture protocols were developed for four indigenous ornamental fishes of the Western Ghat, viz. *Pethia setnai*, *Pethia nigripinnis*, *Dawkinsia tambraparniei* and *Dawkinsia arulius*. Similarly, breeding technique were standardized for two endangered species of genus *Dawkinsia*, viz. *Dawkinsia tambraparniei*, the Tambraparniei barb and *Dawkinsia arulius*, the Arulius barb. Two



Hatchery produced seeds of *Lethrinus nebulosus*

backyard recirculating aquaculture system (RAS) models of rearing tanks size 3 and 7 cubic metre with production capacity of 30 kg per m<sup>3</sup> were designed, fabricated and validated for small-scale farming of rainbow trout by the farmers of hill states to reduce the initial cost of investment.

**4. Genetic Resources:** Total 890 accessions (450 cultivated and 440 wild) including unique landraces of cereals, pulses, oilseeds, vegetables and germplasms of wild edible fruits and wild relatives of the cultivated crops were collected through 18 explorations. Under National Gene bank, 5,152 accessions of orthodox seed species added for long-term storage resulting into the total of 4,62,923 accessions in its present base collection. In Cryogene bank, 404 accessions of seeds and pollen genomic resources of different crop species were cryopreserved, making the total collection of 12,480 accessions. Total of 41,557 accessions were imported from 37 countries and 14,641 entries from trails/nurseries from CG centres. Imported samples numbering 133,673 were processed for quarantine clearance. One plant quarantine database and two web-based applications were developed. ICAR-NBAIM, the nodal agency for developing DNA fingerprints of microbial cultures to be registered as biopesticides developed fingerprints of more than 487 samples for accurate identity. A total of 26 microbes were accessioned under safe deposition and 72 cultures were sold to academia and companies fetching ₹ 291600 revenue to the institute.

In horticulture, a total of 3,346 accessions were collected and 26 accessions showing unique traits were registered as novel genetic stock. Five genotypes of longan of fruit size (8.1 – 8.5g/fruit), an oilpalm cross progeny number 483 (599NATP × 33D) promising for more oil to bunch ratio (21.37%) and 175 fungal mushroom accessions were identified. A QR coded gene bank exclusively for wild genetic resources of banana established at



ICAR-NRC-Banana, Tiruchirappalli. This is the first of its kind in India for conservation of genetic diversity and identify resistant sources to various biotic and abiotic stresses in banana.

#### Germplasm accessions of horticultural crops showing unique traits



Banana 22060



Pea INGR 21139



Tomato INGR 21150



Radish INGR 21220



Chrysanthemum INGR 21108



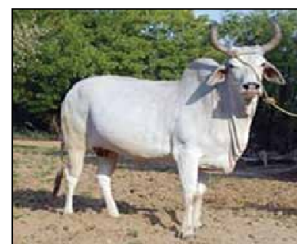
Tuberose INGR 22056

In livestock, 10 new breeds of indigenous livestock species, Kathani cattle (Maharashtra), Sanchori cattle (Rajasthan) and Masilum cattle (Meghalaya); Purnathadi buffalo (Maharashtra); Sojat goat (Rajasthan), Karauli goat (Rajasthan) and Gujarati goat (Rajasthan); Banda pig (Jharkhand), Manipuri Black pig (Manipur) and Wak Chambil (Meghalaya) were registered making total number of registered indigenous breeds to 212. A total of 44,860 semen doses of 17 native livestock breeds, including nine of cattle (Red Sindhi, Badri, Red Kandhari, Nimari, Deoni, Gaolao, Bhijarpuri, Ghumsari, Khariar) and 8 of goat (Ganjam, Jamnapari, Beetal, Berari, Osmanabadi, Sirohi, Sangamneri and Barbari) were cryopreserved. Also, 1,020 somatic cell vials of 7 native breeds--Purnea, Mewati, Hariana and Shweta Kapila of cattle, Konkani Kanyal of goat, Doom and Purnea of pig were added for cryopreservation. Presently,

#### Newly registered livestock breeds



Purnathadi buffalo



Sanchori cattle



Karauli goat



Banda pig

National Gene Bank has repository of 61 native breeds/populations of livestock and poultry in form of semen, and 28 in form of somatic cells. Under the Mission Zero Non-descript AnGR, 22 new populations of native livestock and poultry have been identified. These are being characterized in their respective breeding tracts.

In fisheries, 3 freshwater species *Amblycephalus molaii* from Kailash river, Mizoram; *Pangasius icaria*, from Cauvery river, Karnataka; and *Tor satalensis* from Satal Lake, Uttarakhand and 5 marine fish/shrimp *Eptatretus wadgensis*,

#### Marine fish/shrimp species



*Amblycephalus molaii* sp. nov.



*Pangasius icaria*



*Tor satalensis*



*Eptatretus wadgensis*



*Dussumieria modakandai* sp. nov*Ariosoma melanospilos**Ariosoma albimaculatum**Ariosoma indicum**Ariosoma maurostigma**Actinimenes koyas*

*Dussumieria modakandai*, *Ariosoma albimaculatum*, *Ariosoma melanospilos* and *Actinimenes koyas* were discovered. Canary top wrasse, *Halichoeres leucoxanthus*, previously distributed in Maldives, Myanmar, Christmas Island (Australia), Thailand and Western Indonesia was found for the first time in Indian waters. For the first time, recorded catch of marine/deep sea fish species like *Aluterus monoceros*, *Antennarius indicus*, *Ariomma indica*, *Diodon hystrix*, *Labotes surinamensis*, *Nemipterus randalli*, *Priacanthus prolixus*, *Seriolina nigrofasciata*, in Hooghly- Matlah estuary. Indian oil sardine's whole genome assembly is 1.077 GB (31.86 Mb scaffold N50) in size with repeated content of 22.84%. The sequences were deposited in NCBI, GeneBank. The cell lines from rainbow trout heart and snow trout muscles were developed, authenticated and deposited in ICAR-NBFGR National Repository of Fish Cell Lines.

**5. Crop Management:** Application of consortium of methane utilizing bacteria (MUB) formulation comprising of *Methylobacterium oryzae* MNL7 and *Paenibacillus polymyxa* MaAL

70 through seedling root dip technology and as spray reduced methane emission by 5 to 25% in flooded rice. Rise in temperature by 1.7°C with elevated CO<sub>2</sub> showed an increase in grain yield across two wheat varieties. Elevated CO<sub>2</sub> (ECO<sub>2</sub>) with elevated O<sub>3</sub> (EO<sub>3</sub>) alleviated the negative effect of ozone on grain yield. Durum and bread wheat were exposed to leaf compost (LC) and vermicompost (VC) enriched with polyvinyl chloride (PVC) and poly propylene (PP). The microplastics in the farm inputs altered the nutrient availability and uptake. Satellite based crop health indices were developed for whole of India. The spatial layer of active fire points of rice residue burning (October-December) was uploaded on ICAR KRISHI Geoportal on daily basis. Near real time crop condition monitoring was developed using google earth engine platform and moderate resolution satellite data.

Real time soil moisture-based irrigation scheduling of green pea revealed water saving of 44-50% against surface irrigation practice. Conservation practice, permanent beds with residue recorded highest grain yield of *kharif* crops followed by zero tillage and CT. Sugarcane based Integrated farming system developed by ICAR-IISR fetched additional income of ₹ 2,65,902.5/ha in autumn planted sugarcane and ₹ 2,63,020/ha in spring planted sugarcane. The wireless smart trap developed for real time pest monitoring in cotton showed a weekly mean trap catch of 19.8 (*P. gossypiella*), 6.18 (*S. litura*), 0.19 (*H. armigera*) and 0.08 (*E. vittella*) during 2021-22.

Four mVOCs formulations evaluated @ 5 ppm concentration on the attraction of 4 sucking pests -whiteflies, jassids, aphids, and thrips in cotton using yellow sticky traps (YST) trapped 232%, 1517%, 709%, and 237% higher whiteflies, jassids, aphids, and thrips, respectively as compared to the control. Insect bioassay (*in vitro*) conducted to study the efficacy of the native strain of the *M. rileyi* on FAW indicated *M. rileyi* as potential microbial agent for management of the fall armyworm in sorghum. The survey conducted to understand the infestation and distribution of common bruchid species in legumes, indicated 5 bruchid species infesting pulses, 3 of which were *Callosobruchus*. Among *Callosobruchus* species, *C. analis* was distributed on 50% of the samples and locations, followed by *C. maculatus* and *C. chinensis*.

The formulations based on two *Trichoderma* species having excellent quality to protect the rice



CICR Wireless Smart Trap



Untreated control



Bio Pulse + Sulphur



Eco-pesticide + Sulphur

#### Effect of microbial technologies on disease incidence in grape

plant against soil and seed-borne diseases and excellent growth promotion capability developed and tested at farmers' fields. They were highly effective in maize, finger millet, niger and rice. Entomopathogenic nematode (EPN) biopesticide formulation technology was commercialized to 5 companies with a license fee of ₹10 lakhs. Efficacy of fungicide against rice bakanae disease was tested. Spraying of propiconazole @ 2 ml l of water at 15 DAT resulted in the lowest incidence of bakanae disease and higher yield of rice.

Soil application of mycorrhizal consortium @ 20 kg along with 500 kg of compost/ha at the time of sugarcane planting proved an effective bio-control of parasitic weed *Striga* spp. in sugarcane. A multi-residue analysis method was developed for simultaneous determination of 30 herbicides in agricultural commodities using LC-MS/MS. Similarly, a multi-residue analysis method using TLC with the detection limit of <0.01 µg/g was also developed for determination of herbicide combination products namely, pretilachlor + pyrazosulfuron, cyhalofop-p-butyl + penoxsulam and traifmaone + ethoxysulfuron. A user friendly multi-lingual mobile app named 'Herb Cal' for application of herbicides was developed. After entering the herbicide information such as crop, area, dose and herbicide formulation to be used, the app automatically calculates the amount of herbicide and quantity of water to be taken for spray. Biological control of alien invasive weed *Salvinia molesta* in a 20 ha *Salvinia* infested pond in village Padua of Katni district was achieved by releasing 2000 adult weevils of a host specific insect *Cyrtobagous salviniae*. With the increase of bioagent population 50, 80 and 100% control of *S. molesta* was achieved by 8, 11 and 18 months, respectively.

In grapes, microbe-based technologies, Eco-pesticide, Bio-Pulse, UBSTH-501 and Bio-Care 24 were evaluated against *Erysiphe necator*

grape powdery mildew and integrated these technologies with a safer fungicide (sulfur). The percent disease index (PDI) reduced significantly in grape leaves treated with Eco-Pesticide®/sulfur (22.37) followed by Bio-Pulse®/sulfur (22.62) and Bio-Care 24®/sulfur (24.62). An efficient technology for multiplication of clonal rootstock of apple through cutting under greenhouse conditions using soilless rooting medium was standardized. Field application of Nanoparticles of iron and zinc showed a significant increase in leaf Fe and Zn content after 14 and 28 days of application over conventional fertilizers. The performance of Crimson Seedless, Manjari Kishmish and Manjari Medika grapevines grafted on Dogridge and 110R was found superior over other rootstocks. A microbial consortium CISHD ecomposer has potential to accelerate the composting rate. DRIS indices and critical leaf nutrient concentrations were developed for oil palm plantations. Coconut-based Integrated Farming System (CBIFS) realized a net return of ₹ 6,53,853/ha.

Application of customized fertilizers in sweet potato was best for higher tuber yield (22.74 t/ha) compared to present POP (19.67 t/ha). Low cost technology for the paddy straw mushroom cultivation was developed. Vertical farming was standardized for growing important high value flower crops by utilization of 11 feet vertical space of the polyhouse. Nutritional and chemical finger prints of popular turmeric varieties were developed. The effects of nanoZnO (nZnO) on the compositional and functional responses of bacterial communities in soils were examined using high throughput sequencing. Microbial consortia for enhancing the growth and yield of cumin and coriander was identified. Organic nutrient management practices for Sarpagandha were developed. New insect-pests in banana (Fall armyworm, *Spodoptera frugiperda*; Bondar's nesting whitefly, *Paraleyrodes bondari* and bagworm, *Manatha albipes* were identified. Litchi stink bug (*Tessaratoma javanica*) and

the Flower webber were recorded as emerging insect pest attaining major pest status of litchi. An algorithm based on object detection approach was developed for surveillance of rhinoceros beetle infestation using unmanned aerial vehicle (UAV or drone).

An entomopathogenic fungus isolated from infected *H. theivora* was identified as *M. anisopliae* TMBMA1 and found effective in mirid management in cocoa. Competitive regulation and biological control of rugose spiralling whitefly by the Bondar's nesting whitefly (BNW) during 2021 was observed. Incidence of Fusarium wilt disease, tropical race 4 (Foc TR4) in banana in West Bengal was identified. Citrus microbiome was utilized in rejuvenating Khasi Mandarin plants affected by important citrus diseases. Etiology of emerging diseases in plantation crops was established. A rapid and novel mycelium inoculation technique for inducing *Ganoderma lucidum* infection in coconut and arecanut seedlings was developed. A native plant growth promoting isolate of *Trichoderma asperellum* (isolate AT172) having antagonistic activity against arecanut basal stem rot pathogen *G. lucidum* was identified and characterized.

The cashew leaf blight disease caused by *Neopestalotiopsis sclavispora* was identified for the first time in cashew. RPA-lateral flow assay (RPA-LFA) method was standardized for the on-site detection of the piper yellow mottle virus infecting black pepper. Singleplex and duplex recombinase polymerase amplification (RPA) assays were optimized for specific and sensitive detection of *Pythium* spp. and *Ralstonia pseudosolanacearum* from ginger rhizomes. Marker free late blight resistant transgenic line KJ66 was identified. Prototype of a remote operated unmanned ground (UGV) vehicle was designed and developed for spraying of agrochemicals on potato crop. Sodium alginate-based bead formulation of fungal mycelia and conidia for long term storage of fungal cultures were developed.

**6. Livestock Management:** Thirteen healthy buffalo calves (seven males and six females) were produced from semen of two cloned bulls. This technology will lead to future sustainable milk production in the country. Prototype of intra-vaginal wireless sensor device was developed for remote monitoring of calving process in dairy cows. This could help in predicting the calving time in cattle. NADRESv2, a dynamic geographic information and remote sensing-enabled expert system maintained

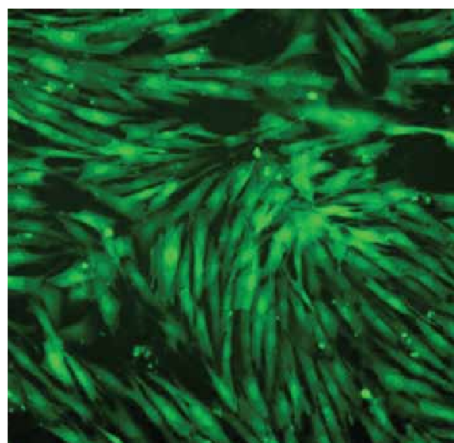
by ICAR-NIVEDI was updated in the NADRES database, and a total of 5655 predictions for major livestock diseases were communicated to State Animal Husbandry Departments and Department of Animal Husbandry and Dairying (DAHD), GoI, in the form of risk maps, bulletins, and post-prediction maps for necessary preparedness. Nation-wide sampling plans for sero-surveillance and sero-monitoring of foot and mouth disease (FMD), brucellosis, *Peste des Petits Ruminants* (PPR) and classical swine fever (CSF) for each state/UTs of the country were formulated and provided to DAHD, GoI, for strengthening the surveillance system. Screening of serum samples (32,257) for important livestock diseases from different animal species submitted to various NADEN units and State Animal Husbandry Departments was carried out. The sero-diagnostic services were provided for infectious bovine rhinotracheitis (IBR), trypanosomiasis and pasteurellosis with 28.9%, 49% and 4.5% positivity, respectively in ruminants. Brucella post-vaccination sero-monitoring is one of the major activities to evaluate the impact of the control program. Towards this, a total of 14,611 sera collected from different states were screened, of which, 64.45% were positive for anti-brucella antibodies.

Under FMD sero-surveillance, 98,185 bovine serum samples from around the country were analyzed and an overall sero-positivity in 16.6% of the tested samples was reported. The state FMD centers were provided with three main test kits (3AB3 indirect DIVA ELISA for 1,75,583 samples, Solid Phase Competitive ELISA (SPCE) for 1,56,778 samples, and Sandwich ELISA for 3893 samples. Clinical samples (2824) were analyzed for serotype identification in 378 FMD outbreaks. During 2021, all three FMD virus serotypes were documented, with serotype O leading the outbreak scenario followed by serotype A. Overall, the disease incidences have increased compared to previous year. A total of 113 FMD virus isolates (102 O, 10 A and 1 Asia 1) revived in BHK-21 cell system were added to the National Repository of FMD Virus maintained at International Centre for FMD, Bhubaneswar and Mukteswar Laboratory. PPR Ab Check kit for the detection of PPR Virus nucleocapsid protein antibodies in the serum samples and PPR Ag Check kit for the detection of PPR virus in Clinical specimens of sheep and goats; Recombinant nucleocapsid protein based indirect ELISA kit for detection of Anti SARS CoV-antibodies in canines (CAN-CoV-2 iELISA



kit) and Multi recombinant proteins based ELISA Kit for diagnosis of *Trypanosoma evansi* infection in animals; TaqMan-probe-based realtime RT-PCR assays (RT-qPCR) for pan-serotype detection of FMDV; Recombinase polymerase assay for detection of African swine fever virus in pigs; Multiplex PCR to differentiate *Mycobacterium tuberculosis* complex species; Rapid colorimetric assay for detection of the extended spectrum  $\beta$ -lactamase producing bacteria; Lateral flow assays (LFAs) for detection of CD virus antigen and antibody were developed. Among the vaccines, Ancovax for SARS-CoV2 infection; LSD vaccine named Lumpi-ProVacInd against LSD; Inactivated Low Pathogenic Avian Influenza (H9N2) vaccine for chickens; Thermostable serotype O vaccine for FMD were developed. Mesenchymal stem cells (MSCs) with or without egg shell membrane, bioactive collagen gel, collagen powder, platelet rich plasma, and MSC laden Nano-scaffolds of hydroxyapatite and multiwalled carbon nanotubes were evaluated for skin wound, bone and nerve healing in animal models, and showed promising results. p38 mitogen activated protein kinase inhibition suppresses buffalopox virus (BPXV) protein synthesis by targeting p38-MNK1-eIF4E signaling pathway. The P60-SB239063 virus exhibited significant resistance to SB239063 as compared to the P60-Control virus. This is a rare evidence, wherein a virus was shown to bypass the dependency on a critical cellular factor under selective pressure of a drug. An online database management system named MHC Database was created (<http://www.mhcdbs.in/>) to allow easy access and use of immune polymorphism data. This system also allows user to upload as well as download the indigenous Ovar MHC allelic database for sheep breeds in FASTA format. CRISPR/CAS9 mediated knock-in of human Erythropoietin gene in the goat fibroblast cells was done and the transgenic goat fetal fibroblast cells expressed hEPO gene fused with green fluorescent protein (GFP) gene. ICAR-NRCE, Hisar is actively involved in glanders surveillance, providing diagnostic support, capacity building of state diagnostic laboratories/ RDDLs. For rapid and efficient execution of surveillance activities, Hcp1 ELISA kit developed by NRCE is being used for glanders diagnosis. A total of 1737 equine serum samples from 8 states were tested for equine infectious anemia (EIA), equine influenza (EI), Equine Herpes Virus-1 (EHV-1), Japanese Encephalitis/ West Nile Virus (JEV/ WNV), *Trypanosoma evansi* (Trypanosomiasis),

piroplasmosis *Salmonella*, *Abortus equi* and brucellosis. Highest sero-prevalence was observed for equine piroplasmosis (38.40%) followed by EHV-1 (7.80%), JE/WNV (7.40%), and *Trypanosoma evansi* (2.15%). Stallion seminal plasma proteins were profiled and the proteins and pathways associated with sperm motility were identified. Purification, molecular characterization and ligand binding properties of the major donkey seminal plasma protein (DSP-1) isolated from donkey (*Equus hemionus*) seminal plasma was done. Transgenic chickens were produced through sperm mediated gene transfer (SMGT) method with an efficiency of 5.4%. In the transgenic birds, human interferon alpha 2b gene was introduced at the germ line stage in the chicken genome. The transgenic hens laid 132 eggs with an average content of 30-40 mg of interferon alpha 2b protein in each egg. Characterization of colostrum of native cattle and yak of high-altitude region of Leh-Ladakh was done in comparison to Sahiwal (SAC). Samples from LSD suspected outbreaks in 20 States/UTs of the country were tested to identify laboratory confirmed cases of LSDV infection for undertaking prevention and control measures against LSD in India. A total 2456 bovine (cattle



Transgenic goat fetal fibroblast cells expressing hEPO gene fused with green fluorescent protein (GFP) gene



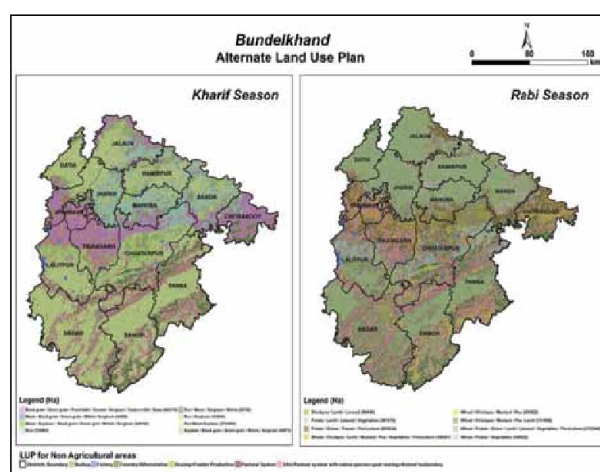
MCRV infected *S. serrata* displaying grey colour shell discolouration

and buffalo) samples were tested, of which, 1156 cattle samples from 19 States/UTs tested positive for LSDV. First whole genome analysis of Indian African swine fever viruses revealed potential genetic determinants to differentiate closely related ASFV circulating in Asia. Global alignment of the complete genome sequences showed nucleotide identity of 99.96% amongst the two Indian isolates (IND/AS/SD-02/2020 and IND/AR/SD-61/2020). The results showed the importance of the 14 ORFs in understanding the evolution of ASFV in Asian countries and their divergence from prototype ASFV Georgia/2007. Whole Genome Sequencing of 12 Bovine coronaviruses isolated from cow (3) and buffalo (9) nasal and faecal samples collected in 2020-21 revealed two different subgroups: subgroup GIa having 9 viruses cluster from across the world and GIb subgroup having 3 other viruses cluster which has majorly the isolates of France in 2017. A food-grade meat decontaminant spray was developed by using the extracts of Ashwagandha roots and Guava leaf spray which could reduce the microbial load many folds in retail fresh chicken. Phytochemicals (thymol and cinnamaldehyde) conjugated silver nanoparticles (AgNPs) were tested for their efficacy against Enterococcal *Escherichia coli* (EAEC) and non-typhoidal *Salmonella*. Assays revealed the antimicrobial activity of the encapsulated compounds (EAgC and EAgT) and appeared to be safe.

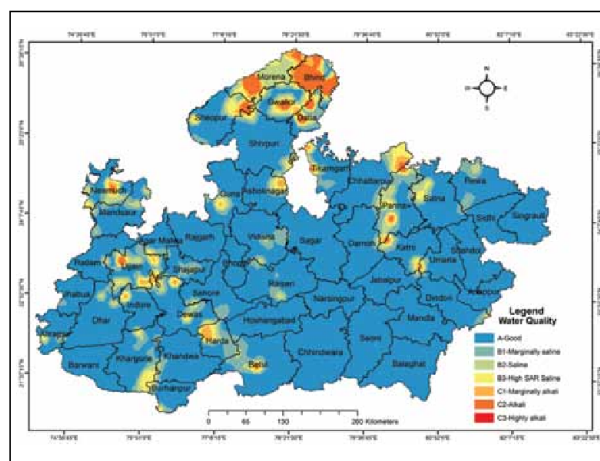
**7. Fisheries Management:** A web-GIS application for location-specific riverine fisheries management was developed. It provides an interactive and user-friendly interface which contains environmental data of 300 sampling stations covering 20 major rivers of India. The portal's database and customized reports will facilitate various researchers, planners and policymakers to make judicious planning/strategies for the betterment of fisheries resources. Mud crab, *Scylla serrata*, is an economically important crustacean species which is also being cultured. Mud Crab Reo Virus (MCRV) is an emerging viral pathogen in mud crab culture. On RT-PCR screening, MCRV were detected in gills and hepatopancreatic tissues. Herpes viralhaematopoietic necrosis disease (HVHND) is caused by CyHV-2, which causes severe mortality in goldfish. A rapid and sensitive RPA (Recombinase Polymerase Amplification) assay, coupled with lateral flow dipsticks (LFD) was developed by designing specialized RPA primer, LFA primers and probes. The RPA-LFD assay

developed presents a simple, rapid and sensitive method for point-of-care diagnosis of CyHV-2, especially under resource limited conditions. A Coliphage cocktail for controlling antimicrobial resistant (AMR) *E. coli*, containing 10 coliphages, selected based on their broad host range, varied location and their ability to lyse AMR *E. coli* was developed. The Coliphage cocktail has a phage titer of  $\sim 10^{12}$  to  $10^{14}$  pfu/ml and can be used for the control of *E. coli* and AMR *E. coli* on food contact surfaces. The Coliphage cocktail can be stored under chilled conditions ( $<4^{\circ}\text{C}$ ) condition for a minimum period of 3 months.

## 8. Soil and Water Productivity: Micro level



Proposed alternate land use plan for Bundelkhand



Groundwater quality map of Madhya Pradesh for irrigation



agricultural land-use planning, soil and water conservation, water harvesting, storage and groundwater recharge, improvement in water productivity and nutrients use efficiency, integrated nutrient management, resource conservation technologies, chemical free agriculture, integrated farming system, waste-water use, dryland, hill and coastal agriculture, weed management, precision agriculture, climate resilient agriculture, abiotic stress management was given special thrust. The land resource inventory (1:10,000 scale) for Bundelkhand region prepared for sustainable land use, spectral signature library of the soils of India for quick and inexpensive acquisition of surface soil properties, potential crop planning zones of Telangana, and land suitability analysis for turmeric in Kerala under projected climate change scenarios were accomplished. The groundwater quality map of M.P. for irrigation and groundwater recharge plan for Korba and Janjgir-Champa districts in the upper Mahanadi Basin developed. ICAR-CSSRI and NTPC joint study on efficiency of flue gas desulfurization gypsum (FGDG) revealed 8-11% decline in saline soil pH after one year of FGDG surface application (0-15 cm depth) and neutralization of soil alkalinity improved paddy yield by ~40%. A Solar Irrigation Pump Sizing Tool (SIPS) was developed for large scale adoption by farmers and support the PM-KUSUM initiatives. To promote organic farming, packages for 5 cropping systems for Gujarat, Rajasthan and Uttarakhand were developed. ICAR-NIASM developed beta version of the Abiotic Stress Information system (ASIS) consisting of modules on Atmospheric and Soil Stress information for generating query based geo-spatial maps. The new salt tolerant varieties in rice (CSR 76) and mustard (CS 61 and CS 62) were developed.

#### 9. Mechanization and Energy Management:

A tractor operated side trencher was developed to make trench up to 300 mm depth. The effective field capacity and field efficiency of the trencher were 0.2 ha/h and 71%, respectively when operated to dig a trench of 300 mm deep in 3 m wide vineyard at 2.0 km/h forward speed. The cost of operation of tractor operated side trencher is about ₹ 560/hr. It economizes the cost of operation, labour and time by 72, 94 and 80%, respectively as compared to manual digging of trench with hand tools. The tractor operated FYM applicator of 1 tonne capacity was developed for placing FYM near the plant. The cost of operation of tractor operated FYM applicator is about ₹ 645/hr which

saves labour, time and cost of operation by 98, 80 and 88%, respectively as compared to manual method. Manual operations of raised bed forming, drip lateral and plastic mulch laying, and planting seeds in a plastic mulch requires about 29 man-days/ha. A tractor operated drip lateral and plastic mulch layer-cum-planter was developed to perform raised bed formation, drip lateral and plastic mulch laying etc. in single pass of the tractor. The total cost of equipment is ₹3,00,000 with operational cost of ₹1,500/hr. The payback period of equipment is 1.9 years. A self-propelled walk-behind maize harvester for snapping the maize cobs from the maize plants and simultaneously cutting the plants has been developed. The effective field capacity of the harvester is 0.2 ha/hr and the cost of operation of the maize harvester is ₹ 2,850/ha. The saving in cost of operation, time and labour are 25, 96 and 91%, respectively compared to manual harvesting. A remote-controlled electronic system was developed for ride-on rice transplanter to reduce human drudgery. It can be remotely operated at a distance of 200 m. The field capacity of remote-controlled ride-on rice transplanter is 0.24 ha/hr. To ease the digging of garlic, a tractor operated harvester was developed which can harvest garlic crop planted on raised beds. The harvesting efficiency of the harvester is 97% and bulb damage is <0.5%. A small tractor-mounted hydraulic pruner for orchards was developed with the pruning capacity of 120 plants/hr. The cost and operating cost of the pruner is ₹ 4,50,000 and ₹ 4,910/ha, respectively. ICAR-CIAE had developed a low-cost SPAD meter 2.0. It measures SPAD values for crops such as rice, wheat, maize, etc. with leaves up to 1 mm thickness. The SPAD values, measured with the device, can be used to generate recommendations for top-dressing of nitrogen fertilizer dose. A small tractor operated boom sprayer was developed for orchard crops. The cost of the spraying system is ₹ 30,000. The discharge rate of boom sprayer is 608 l/hr at 0.3 MPa pressure. The application rate and turning time of the spraying system was 475 l/ha and 12 s, respectively. A power tiller operated groundnut digger was developed with field capacity of 0.07-0.11 ha/h and digging efficiency of 97.6%. A tractor operated potato digger developed which performs three operations, viz. digging of potato tubers (two rows), separation of potatoes from soil and collection of potatoes in the collection unit. The average field capacity and output capacity are 0.12 ha/hr, 2700 kg/hr for sandy loam soil and 0.11 ha/hr, 2685 kg/hr for loamy soil, respectively. A digital flume with the Internet of Things (IoT) connectivity





Unmanned Rice Transplanter



SPAD Meter 2.0

was developed and tested to continuously measure the flow rates in open channels. Utilizing the IoT, the developed digital flume measures the discharge and transmits data wirelessly for storage on cloud (ThingSpeak). It was tested in the field under varying discharge conditions in the field channel. It can be utilized for irrigation water measurement in the field channel for management of available irrigation water.

**10. Post-Harvest Management and Value-Addition:** Post-harvest treatments machine for pre-cooling, washing, warm water treatment, anti-microbial treatment, anti-browning, and pulsed light treatment to the freshly harvested fruits and vegetables was developed. It also has an inspection conveyor to sort out the deformed and damaged products. The capacity of the machine is 1.2 t/hr for capsicum, 1.0 t/hr for apple at a linear belt speed of 5 m/min. The peeling machine for medicinal tuber crops was developed with peeling efficiency of ~92% for *Safed musli* and 55% for *Shatavari* and capacity of ~15-20 kg/hr which is 30 times higher than manual operation. An electronic sensing system (e-Nose) has been developed in collaboration with C-DAC Kolkata for the real-time health monitoring of the onions, potatoes, and tomatoes in storage. The machine for popping of sorghum, amaranth, finger millet, kodo millet, and other small grains including rice, and corn developed with a capacity of 1.4-2 kg/hr and 60-70% popping recovery for sorghum and amaranth. To provide easy, fast and non-destructive method for detection of pea flour adulteration in *besan*, near infra-red spectroscopy (NIRS) model was developed which can be used to predict adulteration of *besan* with pea flour. A novel process based on microbial precipitation process to produce protein isolates/concentrates from oilseed cakes/meals was developed. This method increased 5% yield as compared to the chemical process. The protein produced is superior in terms of solubility, wettability, water absorption capacity and degree of hydrolysis. Multi-nutrient biscuits with high satiety value, appealing taste

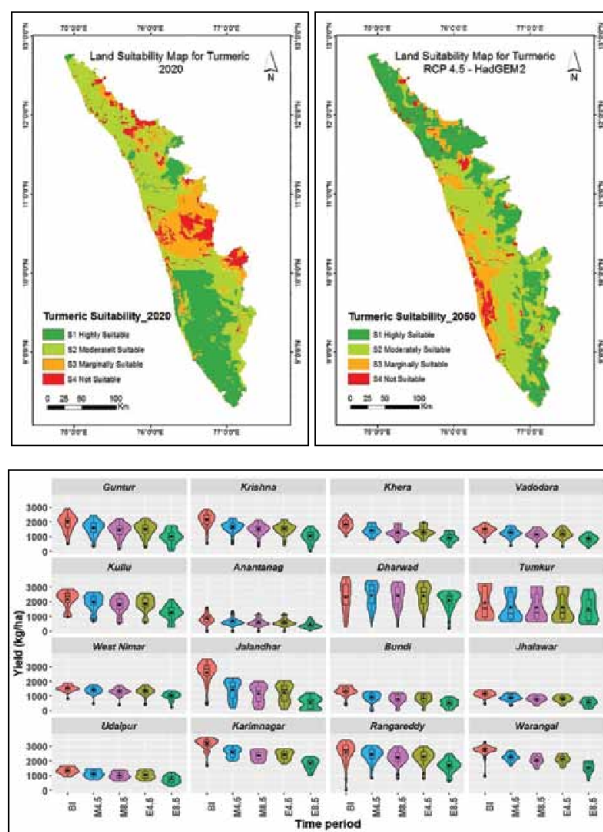
and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which makes it rich in protein (5 g), minerals (1.4 g), iron (4.5 mg) with good antioxidant activity for 100 g of cake. This is a unique egg less preparation and best suited for people who have gluten allergy. Re-using the existing fibres and textiles, reduces the need for newly manufactured fibres and saves water, energy, dyes and chemicals, which reduces the carbon footprint. The fibres were extracted from pre-consumer cotton knitted fabric waste and converted into yarn by blending this recycled cotton fibre (RF) with virgin cotton (VC) fibre in different blend proportions. The blending in 50:50 (RF:VC) provided better yarn properties and more suitable for home textiles applications such as bed linen, furnishing fabrics, interior decoration accessories etc. Electro spun nanofiber-based micronutrient delivery matrix was developed to enhance the nutrient use efficiency, as compared to bulk nutrient application. The needle electrospinning machine was used to produce zinc sulphate impregnated electro spun nanofiber mat. The banana pseudo stem has potential for extraction of textile fibres, sap for dyeing and finishing, and other portion for making paper-based products. Semi-solid banana plant biomass was used for making paperboard, similar to paper with higher areal density and they are comparable with conventional handmade paper. Application of activated carbon derived from jute stick, NINFET-JAC, as an alternative to graphitized carbon black, was found effective for pesticide residue analysis in various crops like okra, spinach, pomegranate, tea etc. Sheep wool contains about 95% keratins which have huge applications in medical and pharmaceutical industries. Coarser grade wool having no textile use can be used for



Electronic nose (e-Nose) Near Infra-Red spectroscopy (NIRS)

extraction of keratin. ICAR-NINFET had developed a microbial protocol for keratin extraction from animal hair. Fibre producing species of nettle are European nettle and Himalayan nettle. NINFET has developed 100% nettle, nettle/viscose (75:25, 50:50, 25:75), and nettle/polyester (75:25, 50:50, 25:75) blended yarn and also union fabrics using cotton yarn in warp and these nettle-based yarns in the weft. These blended fabrics are suitable for fashion apparel, garments, shawls, stole, scarf, saree etc.

**11. Climate Resilient Agriculture:** In recent years, land-atmosphere coupling in many parts of the world had been identified to have raised temperatures and aridity. Studies using consistent methodology and metrics from multiple data sources established that the drying land surface turns into a source of heat generation and drought exacerbation due to reduced evaporative cooling and increases atmospheric heating from sensible heat flux. The land suitability for turmeric cultivation in Kerala was analyzed using Had GEM2 Model based on the Representative Concentration Pathway (RCP)-4.5 for climate projection scenario of turmeric in 2050. The projections revealed increase in highly suitable area by 5% from 28% to 33% and decrease of 4% from 11% to 7% in non-suitable areas of turmeric which could positively contribute to its production. The spatio-temporal changes in maize yield were studied using multi-model ensemble climate change projection derived from 30 general circulation models in 16 major maize growing districts of India. The projected reduction in maize yield is 16% to 46% under RCP4.5 and 21-80% under RCP8.5 without adaptation strategy. The combined adaptation strategies might reduce the loss in yield or even increase by 5-15% under RCP4.5 scenario. Rice-based IFS model for lowland conditions of West Coast and IFS model for dryland of



Land suitability maps of turmeric in Kerala for 2020 and 2050.

Karnataka and transitional plain of Luni basin was developed. Swarna Unnat Dhan (IET 27892), rice variety with multiple stress tolerance developed for irrigated transplanted condition of Bihar, Odisha, West Bengal, Madhya Pradesh and Maharashtra. Genome editing technology (CRISPR-Cas9) was used to create loss of function in mutants of the drought and salt Tolerance (DST) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. Three homozygous mutants developed with reproductive stage tolerance to salinity stress. These lines were evaluated further for yield under drought stress and non-stress conditions. Under drought



**Genome editing of DST gene enhanced tolerance to drought stress (-75KPa) of rice.** Photographs shows drought stress effect on visible appearance of plants (left panel) and grain yield of plants (right panel). WT, MTU1010; D2bp, genome edited line of MTU1010.



stress (-75 KPa), genome edited mutants showed significantly higher grain yield as compared with MTU 1010.

## 12. Human Resource Development:

Strengthening and development of higher agricultural education and quality assurance of AUs through accreditation and ranking process are the two major areas supported by ICAR. The strengthening of ICT facilities in AUs, emphasis on capacity building of the students and faculties through various training programmes under ICAR scheme as well as NAHEP helped enhance the capabilities of the faculties in various upcoming areas and improved the publications. AUs were also supported for encouraging holistic development of students, through creation of placement cells, support for sports facilities. The centralized admissions and national/international fellowships by ICAR helped improve academic ecosystem, and encouraged merit across AUs. National Professorial Chairs and National Fellow Scheme for promotion of excellence in research, Emeritus Scientist/Emeritus Professor Schemes as a structural method of utilizing skill bank of the outstanding superannuated professionals in various disciplines to address faculty shortage. NAARM contributes immensely on wide range of issues of national and global importance apart from various courses on capacity building. The Academy has also been promoting online and digital education, startups for agripreneurship. The key components of NAHEP,

viz. Centres for Advanced Agricultural Sciences and Technology (CAAST), Institutional Development Plan (IDP), and Innovation Grants have contributed to enhanced entrepreneurship opportunities and other reforms in AUs.

**13. Social Science:** The impact of different risk management strategies on farm productivity and its resilience to climatic shocks was estimated. Measures were categorized into risk-mitigating, risk-transferring and risk-coping strategies. A Study was under taken to estimate productivity and risk effects of crop insurance vis-à-vis irrigation to explain the low uptake of crop insurance. Both crop insurance and irrigation positively impact farm productivity, but their gains differ significantly. The structure of rural employment is undergoing a change. The withdrawal of the agricultural workforce has further accelerated, and an additional 28 million workers left between 2011-12 and 2017-18. In the recent decade, the agricultural sector has experienced all-time high growth of 3.5%, and the growth has been driven by the animal husbandry and fisheries. The feasibility of a uniform water pricing policy and a differentiated water pricing policy was assessed. A notable shift in cropping patterns will take place when a volumetric and differential water pricing policy is adopted. Possibilities of reducing import dependence to meet the edible oil demand by increasing domestic production, adopting yield-enhancing technologies, and raising import tariffs, was investigated.



Graduation Ceremony at NAARM



Ranking of Agricultural Universities initiated by ICAR

A general method of construction of row-column designs with two rows for orthogonal estimation of main effects and two factor interactions in minimum number of runs was given for orthogonal parameterization. An alternative sampling methodology for estimation of area and production of horticultural crops developed by ICAR was adopted by Department of Horticulture, Government of Haryana. Developed a support vector machine-based prediction model for predicting GIGANTEA proteins in plants. Based on the developed methodology, a prediction server GIPred was also established which is freely accessible (<http://cabgrid.res.in:8080/gipred/>) for proteome-wide recognition of GIGANTEA proteins. Developed machine learning-based models for identification of abiotic stress responsive miRNAs and Pre-miRNAs in plants. Developed a comprehensive machine learning based computational model for discovery of DNA binding proteins in plants (PIDBPred) that play crucial roles in numerous cellular processes.





Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.

A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to





Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behig in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

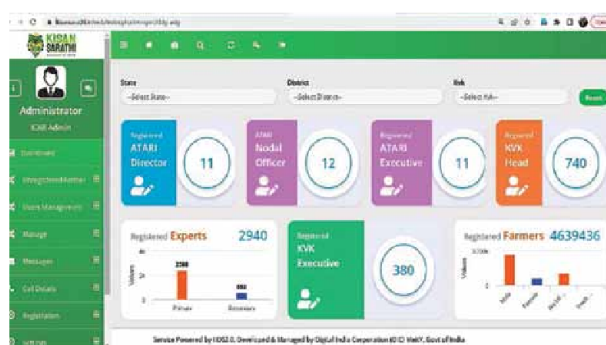
Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI



and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti



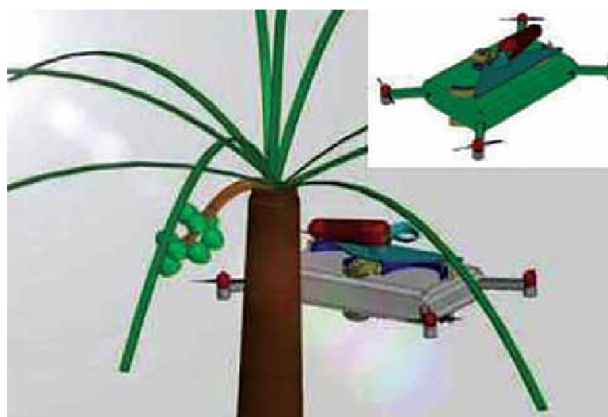
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028



released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with

Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR



Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.



03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**



## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.

In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth– Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested

for managing veterinary services, supply chain solutions, challenges in veterinary science education and role of extension services in mitigating the impact of the pandemic.

- A Brainstorming Session on ‘Scaling up Innovative Agricultural Extension Models Sector’ was organized on 12 September, 2022 under the Convenorship of Dr Ashok K Singh.
- A Brainstorming Session on ‘Beyond Price Support and Subsidies’ was organized on 30 September, 2022 under the Convenorship of Dr Pratap S BIRTHAL.

**Special Webinar:** The Academy organized a special webinar on ‘Transforming Agriculture in Asia’ by Dr Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on 20 December 2021. The webinar was based on the report prepared by the ADB to show how agriculture has minimized the impact of Covid-19.

**National Science Day:** The Academy celebrated National Science Day on 28 February 2022, with an online lecture by Prof. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai.

**International Women’s Day:** The Academy celebrated International Women’s Day on 8 March 2022, by organizing an online panel discussion on ‘R&D Innovations for Sustainable Agriculture in India’.

**World Biodiversity Day:** On 22 May 2022, the NAAS observed World Biodiversity Day by organising a discussion on Global Genebanks and Biodiversity Management for Sustainable Agriculture. Some of the eminent speakers were Dr Hugh Pritchard, Kew Botanic Garden, UK; Dr Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Ashok K Singh, Director, ICAR-IARI, New Delhi; Mr Kent Nnadozie, Secretary of the International Treaty, FAO, Rome; Dr Murukarthick Jayakodi, Group Leader, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany; Prof. Rajeev Varshney, International Chair in Agriculture and Food Security, Food Futures Institute, Murdoch University, Australia. Over 350 delegates participated in this programme.

**XV Agricultural Science Congress:** The Academy organized the XV Agriculture Science Congress on the theme ‘Energy and Agriculture: Challenges in 21<sup>st</sup> Century’ jointly with the Banaras Hindu University, Varanasi, from 13-16 November,

2021. In view of the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047. More than 1,800 delegates (900 in-person including 300 farmers) participated including fellows of the academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations and exchanged their ideas on various themes and sub-themes of the Congress. A national-level elocution contest was also organized on the theme of the Congress for the students selected from all over the country. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services for the benefit of farmers.

## II. Foundation Day Programme/Annual General Body Meeting

During 2021-22, the Foundation Day Programme/AGB Meeting was held on 4-5 June, 2022 at New Delhi. Besides usual AGB business session, following science-based activities were organized:

- Scientific presentations by newly elected fellows.
- The Presidential Address was delivered by Dr T Mohapatra, President, NAAS in 29<sup>th</sup> AGM. In his address, he drew attention to the fact that although India has made remarkable progress in food production, ensuring food and nutrition security, increasing agricultural exports, and improving agricultural sustainability remain important in the process of transformation of food system in view of the changing consumers’ preferences and social aspects of food consumption.
- The Foundation Day Lecture: On the occasion of its Foundation Day on 5 June, 2022, the Academy organized in hybrid mode a lecture by Prof P Balaram, Former Director, Indian Institute of Science, Bengaluru. He spoke on ‘Reflections on Science in the age of the Corona Virus’ and presented an excellent account on the evolutionary history of corona virus and highlighted the interdependence of biology and chemistry. He explained how chemistry and biology together can reveal the unknown in the nature. He defined science as the study of nature. Citing the examples of the telescope



and the microscope in pursuing the science of cosmology and microbiology, respectively, he said that science is often driven by new technology than by new concepts. He cited the example of rDNA technology, which facilitated development of genetically modified crops. Prof Balaram highlighted that scientists should keep striving to unravel the mystery of nature and search nature-based solutions for human welfare through innovations in agricultural sciences. As we have learnt immensely from the corona virus pandemic, we should prepare ourselves for a better life in future through an integrated approach based on the basics of chemistry, physics and biology. He concluded by reminding us of the lessons that we must learn from the corona virus pandemic, and the that we should respect the nature.

### III. NAAS regional chapters' activities

Twelve Regional Chapters of the Academy are actively functioning at Barapani, Bengaluru, Bhopal, Coimbatore, Cuttack, Hyderabad, Karnal, Kolkata, Lucknow, Ludhiana, Pune and Varanasi.

Notwithstanding the grave situation arising due to the Covid 19 pandemic, the Regional Chapters made commendable efforts to promote scientific activities for addressing regional issues. Barring a few, most of the activities were held on virtual platforms. During the period, Regional Chapters organised highly successful events focussing on students. The high school, graduate, and post graduate students were exposed to different facets of agriculture such as rural bio-entrepreneurship, opportunities in agriculture under *Atma Nirbhar Bharat* scheme, and other contemporary issues related to health, nutrition and environment.

### IV. Publications

The crystallized views of the scientists emerging from the interactive sessions organized by the Academy are published as Policy/Status/Strategy Papers and Policy Briefs, which provide useful inputs to the policymakers, planners, educationists and decision-makers. Following policy documents were published for the period:

#### Policy/Status/Papers

- ♦ Policy Paper 99: New Agricultural Education Policy for Reshaping India

- ♦ Policy Paper 100: Strategies for Enhancing Soil Organic Carbon for Food Security and Climate Action
- ♦ Policy Paper 101: Big Data Analytics in Agriculture
- ♦ Policy Paper 102: WTO and Indian Agriculture: Issues, Concerns and Possible Solutions
- ♦ Policy Paper 103: Antimicrobial Resistance
- ♦ Policy Paper 104: One World One Health
- ♦ Policy Paper 105: Sugarcane-based Ethanol Production for Sustainable Fuel
- ♦ Ethanol Blending Programme
- ♦ Policy Paper 106: Utilization of Wastewaters in Urban and Peri-urban Agriculture
- ♦ Policy Paper 107: Certification of Quality Planting Material of Clonally Propagated Fruit Crops for Promoting Agricultural Diversification
- ♦ Policy Paper 108: Agri-startups in India: Opportunities, Challenges and Way Forward
- ♦ Policy Paper 109: Emergency Preparedness for Prevention of Transboundary Infectious Diseases in Indian Livestock and Poultry

#### Strategy Papers

- ♦ Strategy Paper 14: Innovations in Potato Seed Production
- ♦ Strategy Paper 15: Potential of Transgenic Poultry for Biopharming
- ♦ Strategy Paper 16: Need for Breeding Tomatoes Suitable for Processing
- ♦ Agricultural Research, the official Science Journal of the Academy (published by Springer India Pvt Ltd, Vol. 11, No. 1 and Vol. 12, No. 1 (quarterly).

### V. Recognizing and promoting excellence of individual scientists in the field of agriculture

- **Fellowship/Associateship:** The Fellowship of the Academy embodies a wide spectrum of national and international scientists. Fellows including Pravasi and Foreign Fellows are elected annually in recognition of their distinguished achievements in the field of agriculture and allied sciences. During 2022,

34 new Fellows including two foreign Fellows and three Pravasi Fellows were elected and inducted into the Academy. The Academy also has a scheme of NAAS Associates for encouraging promising young scientists below the age of 40 years, to be associated with the Academy activities. During the year, 11 young scientists were selected as Associates of the Academy based on their academic excellence and scientific contributions as reflected by publications, and products, processes and technologies developed, etc.

- **Academy Awards:** The National Academy of Agricultural Sciences has instituted following Awards for recognizing significant contributions of senior, middle level and young scientists to promote agricultural research and recognize scientists for excellence in research in Agricultural and Allied Sciences including Environment and Nutrition. Memorial, Endowment and Recognition awards are presented biennially at the time of Agricultural Sciences Congress. Young Scientist Awards are given annually and are presented in the Annual General Body meeting of the Academy.

(i) Memorial Awards (7)

(ii) Recognition Awards (6)

(iii) Young Scientists Awards (6)

(iv) Endowment Awards (3)

(v) Dr A B Joshi Memorial Lecture Award

During this year, the six Young Scientists' Awards for 2021 were presented on 5 June, 2022.

### Indian Agricultural Universities Association (IAUA)

Indian Agricultural Universities Association (IAUA) was established on 10 November, 1967 (Registration no. 3498). There were only nine founder member of agricultural universities: PAU, Chandigarh (now Ludhiana); APAU, Hyderabad, (now ANGRAU, Guntur); JNKVV, Jabalpur; UPAU (now GBPUAT), Pantnagar; UAS, Bengaluru; KU, Kalyani (now BCKV, Mohanpur); OUAT, Bhubaneswar; UU (now MPUAT), Udaipur; and IARI, New Delhi. Presently, the IAUA has 71 member universities.

The main objective of the Association is to promote agricultural research, education and

extension in the universities and the states, and thereby rural development in the country. It also acts as a bureau of information to facilitate communication, coordination and mutual consultation among agricultural universities. The Association also acts as a liaison between member universities and concerning government departments to facilitate communication and expedite the needed action in matters of importance.

A quarterly newsletter is being published by the Association since 2000, giving important news, events and achievements by member universities for the information of all the members and others stakeholders. An Annual Report is also being published documenting major activities of IAUA and member universities of the year.

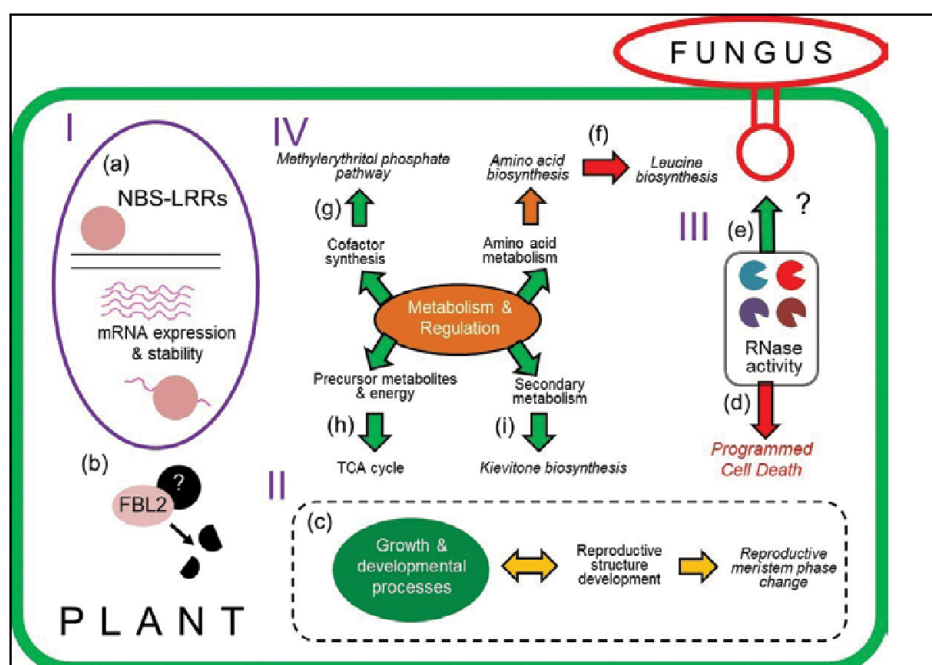
The information on events and proceedings are published through the host universities and the recommendations are uploaded on IAUA website ([www.iauaindia.org](http://www.iauaindia.org)) and also circulated to all the Vice Chancellors of member universities and other main stakeholders.

A brief description of important events organized by IAUA/member universities is given on the following pages:

**45<sup>th</sup> Vice Chancellors' Convention:** The 45<sup>th</sup> Vice Chancellors' Convention of Indian Agricultural Universities Association (IAUA) was organized on the theme 'Improving Standard, Sustainability and Societal Impact of Agricultural Universities' at Birsa Agricultural University (BAU), Ranchi on 20-21 December, 2021 in hybrid mode.

The Vice Chancellors of State Agricultural/Horticultural/Animal Science Universities, Central Agricultural Universities and Deemed Universities of India attended the Convention (off-/on-line), shared their experience, knowledge, expertise, and gave an overview on how to improve standards and social impact of Agricultural Universities. The deliberations were made to align research and education in agricultural and allied disciplines in India in view of NEP (2020) during following four technical sessions conducted on the sub-themes selected for the Convention:

- I. Achieving International Standard in Agricultural Education and Research in the Context of new National Education Policy, 2020.
- II. Strategies to Increase Agricultural Productivity



Schematic representation of the role of maize constitutive gene network in fungal resistance.

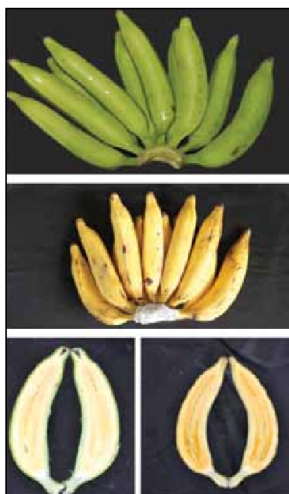
### Improved varieties of various horticultural crops



Narendera Bael-11



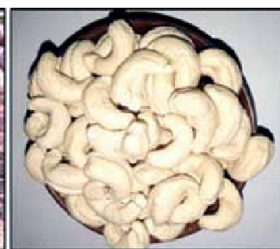
Coconut Kalpa Vajra



Fruits of Kaveri Kanchan (NCR 17)



Nethra Jumbo 1 cashew hybrid



SreeKaveri Cassava



Potato MP / 09-45



tannia variety IGS GTN-1



Small cardamom IC 349537

genic-SSR markers for winged bean was developed from the publicly available RNA seq data sets and 58811 unigenes were assembled, and 4,107 perfect SSRs were identified. Effect of Zn deficiency was evaluated in BKS-41 (high seed zinc) and Sadabahar

(low seed zinc). Higher shoot length, root length, longer root hair zone, high root hair density, higher relative chlorophyll content and dry weight were observed in BKS-41 as compared to Sadabahar under zinc deficient condition. The study to identify



regulatory genes associated with RFOs biosynthesis in peanut (*Arachis hypogaea*) suggested Raffinose Synthase (RS) for the differential accumulation of RFOs. four varieties of faba bean, i.e. *Swarna Suraksha*, *Swarna Safal*, *Swarna Gaurav* and *Pusa Sumeet* were evaluated as a natural source of L-Dopa. Higher amount of L-Dopa was found in immature leaf and flowers. A screening method was designed for amylose estimation in maize kernels. The proposed method is rapid and simple for screening of maize kernels with varied amylose amounts, and gets completed in 1 min. Meta-QTL analysis for fungal disease resistance in maize revealed 128 QTLs associated with resistance against 12 fungal diseases (SLB, NCLB, BLSB, GLS, HS, FSR, FER, GER, AER, PLS, CS, SDM) across the maize genome. Application for an Indian patent (Application No. 202211015547) on rapid differentiation of normal maize from Quality Protein Maize was filed. The developed method requires 5 minutes for differentiating normal maize from QPM, when a milled sample is provided. Genome editing for early flowering and seed size displayed increase in leaf size, stem length and seed weight in edited chickpea lines as compared to their normal control types. Full-length gene sequence of grasspea oxalyl-CoA synthetase and ODAP synthase, enzymes functional in OAP synthesis in grass pea, were identified and submitted to Genbank with accession No. MH469748 and MZ127288, respectively. Two QTLs/genomic region on chromosome 2 and 8 were mapped for Fusarium wilt resistance in pigeonpea.

CRISPR/Cas technology was utilized to edit the cytokinin oxidase (*OsCKX2*) gene of indica rice cultivar controlling the grain number in order to increase the yield of Samba Mahsuri. The genome-edited lines showed 200 to 496 grains/panicle in comparison to ~150 grains/panicle in wild-type or non-edited Samba Mahsuri plants while T1 lines showed desired characters like strong culm and early maturity. To create novel variants for morphological, physiological, and biotic stress tolerance traits, induced mutations were created in the background of Samba Mahsuri (BPT 5204). The mutant lines showed enhanced tolerance to important biotic stresses (YSB, ShB and BLB). Multiple abiotic stress responsive genes were identified using transcriptomics in sugarcane. A chromosome-level reference genome assembly (2.93 Gb; 97.66% Coverage) of Indian Tea (*Camellia assamica* var. Masters cv. TV-1) genome was generated anchoring 99.4% of super-scaffold level assembly into

15 clusters or pseudomolecules by Hi-C data with the size of clusters ranging from 303.18 Mb to 119.95 Mb. A novel abiotic stress responsive gene LOC\_Os06g10210 (*OsCHI2*) isolated from a drought tolerant rice cv. Nagina 22 (N22) which showed upregulation in response to drought stress was identified. miR156 site in *Ideal Plant Architecture 1 (IPAI)* gene in rice variety, Swarna, was edited. Panicle architecture and spikelets/panicle improved significantly in edited lines. Presence of Protein Body 1 and 2 under different post-harvest processing conditions of grains of high protein rice CR Dhan 310 was identified. In order to identify the high resistant starch rice, 100 rice lines were analyzed which revealed variation in the range of 0.28% to 2.94% with Gayatri rice line showing the highest resistant starch content of 2.94% over the years (2019 to 2022).

To screen large number of genotypes for vivipary, laboratory method was proved efficient considering the correlation with field observation data, outstanding genotypic difference and convenience of testing. Mutants of BPT 5204 with robust root system architecture, early seedling vigour index, and higher yield under limiting water conditions identified which are suitable for the dry direct seeding under aerobic system of rice cultivation. Genomes of rice restorer line KMR3 (salinity-sensitive) and its salinity tolerant introgression line IL50-13 were sequenced. Draft genome of yellow stem borer *Scirpophaga, incertulas* an agriculturally important pest with 46,057 genes and estimated size of 308 Mb was generated. During 2021-22, breeder seed production in field crops was 101617.5 quintals against the indent of 77260.1 quintals and total production of quality seed was 349596.6 quintals against the target of 312584.7 quintals. In addition, 234.5 lakh planting material and 5.4 lakh tissue culture plantlets were produced against the targets of 174.3 and 4.7 lakh, respectively.

In horticultural crops, 122 varieties were notified for cultivation under different agroclimatic conditions. These included 15 varieties of fruits, 1 of plantation crops, 97 of vegetables, 2 of tropical tubers and 7 of spices. The molecular linkage maps of two grape varieties (Carolina Black Rose and Thompson Seedless) were developed. Genome assembly of Indian pomegranate cv. Bhagawa was released. Varietal signature for genetic purity of spices were identified and identity of nutmeg varieties IISR Vishwashree, IISR Keralashree and Sindhushree was established. Marker free late blight resistant transgenic line KJ66 of potato was

identified. A total 1047 activation tagged lines were generated in potato cv. Kufri Jyoti and Kufri Chipsona 1 using activation tagging vector pSKI015. Targeted editing of potato genome was done to develop variety specific True Potato Seed (TPS). A total of 16 lines of potato with mutation within MiMe genes (StOSD, StREC8 and StSP011) were generated. Molecular identification and diversity of 25 *Pleurotus* mushrooms were investigated. Seven new hybrid strains of *Pleurotus* were developed by mating single spores from *Pleurotus treatment* (DMRP 30) and *Pleurotus florida* (DMRP 49). The biological efficiency was recorded maximum for hybrid P18102 (79.00%) in two flushes compared to parents and check on pasteurized wheat straw.

**2. Livestock Improvement:** The evidence of selection signatures in the datasets of 284 individuals of Tharparkar cattle along with 11 other indigenous and exotic cattle breeds were demonstrated. Significant candidate genes were identified related to various important traits such as ADRB2 in Tharparkar; HERC5, SCC25A48 in Gir; CA8 in Ongole and KIAI217 in Sahiwal for milk production; PARN in Holstein; ZBTB20 in Sahiwal; and APBB1 in Tharparkar for reproduction; SP110 in Brown Swiss; HSP90AB1 in Tharparkar and Red Sindhi for thermo-tolerance trait.

The influence of X-linked genes on the sperm functional parameters and field fertility rate in the cattle and Murrah buffalo bulls was studied. The sperm transcriptome studies revealed that the total number and the expression levels of X-linked genes in the mature sperm were very low in both species, and only 23.3% of these genes were commonly expressed between them. The X-linked genes related to embryonic organ development and reproduction were enriched in cattle and buffalo sperm, respectively. The expression levels of X-linked genes in cattle RPL10 and ZCCHC13, and buffalo AKAP4, TSPAN6, RPL10 and RPS4X were significantly correlated with sperm kinematics. Evidently, the expression level of RPL10 and RPS4X was significantly correlated with the field fertility rate in cattle and buffalo, respectively. Multivariate regression models and receiver operating curve analysis suggested that the expression levels of X-linked genes may be useful in predicting the bull fertility rate.

An egg yolk-free, ready to use, semen extender for cattle and buffalo with higher shelf-life ( $\geq 18$  months,  $4^{\circ}\text{C}$ ) for cryopreservation of buffalo semen was developed for the first time in India. The post-



CARI-Prabal



thaw progressive motility of cryopreserved buffalo sperm in the new egg-yolk free semen extender was significantly higher. A farm-to-fork block chain-based buffalo meat traceability system, BuffTrace, was developed for buffalo meat industry in collaboration with a private company. The system helps in collection of post-slaughter information and retrieval of the traceability information based on the label details.

The complete mitochondrial genome sequences of 88 Indian sheep representing 22 breeds/population were analyzed for the first time to get a comprehensive picture of the maternal diversity in the sheep genetic resources of India. The mitochondrial DNA sequence of all Indian sheep was observed to be 16617 bp long and contained 37 genes, including 13 protein coding genes, 2 rRNA genes, 22 tRNA genes, and a control region. Network Project on Sheep Improvement (NWPSI) and Mega Sheep Seed Project (MSSP) with major objective of improvement of indigenous sheep breeds were initiated.

Concurrent transcriptome and methylome analysis of pig breeds (Mali and Hampshire) with varying muscularity was done to obtain insights into myogenesis. Muscle transcriptome identified 20226 mRNAs out of which 15170 were present across the samples. Developed economic and nutritionally balanced silage-based pig feed following standard procedure from vegetable wastes adding jaggery (gur) at the rate of 3 kg per 100 kg raw chaffed

vegetable waste for suitable anaerobic fermentation in silage bags. A total of 1,934 liquid boar semen doses were produced and supplied for artificial insemination in pigs at the farmers' field and organized farms.

Three climate resilient dual type hardy birds, CARI-Dhawal, CARI-Prabal and CARI-Saloni were developed for efficient egg and meat production. To overcome the antibiotic growth promoters used in poultry feed, CARI-HERBIGROW, a natural product was developed with the property of antioxidants, immune enhancer, stress reducer and helps chicken to improve overall production. CARI-HERBISTRESSMIN, a phyto-genic feed additive was developed by CARI to reduce effect of heat stress and improve immunity of birds during hot and hot-humid summer. Alternatives for antibiotic growth promoters (AGPs) in feed and alternate protein meal and biofortified maize in poultry diet (black soldier fly (BSF) larva meal) were also developed.

Inhibin alpha gene editing by CRISPR/Cas in Nicobari indigenous chicken led to efficiency of production. The egg production up to 72 weeks of age increased by 203% from 261 eggs in edited birds as compared to 128 egg in control birds. Immunochromatography-based chicken detection kit (ICDK) was developed for the authentication of chicken. Genomic diversity was estimated in Arunachali yak population based on data generated using ddRAD sequencing. Three indices, viz. nucleotide diversity (0.041 in 200 bp windows), effective population size ( $N_e = 83$ ) and runs of homozygosity (>90% were short and medium length) revealed that the genomic diversity in Arunachali yak breed as of now is optimum.

**3. Fish Improvement:** Successful natural spawning of green snapper, *Lethrinus nebulosus*, was achieved in recirculatory aquaculture system (RAS). It is a large tropical marine fish species that grows to 80 cm in length and 8.4 kg in weight. *Lethrinus nebulosus* were collected from wild and developed into functional broodstock in 10 t RAS system. Simple non-invasive breeding and culture protocols were developed for four indigenous ornamental fishes of the Western Ghat, viz. *Pethia setnai*, *Pethia nigripinnis*, *Dawkinsia tambraparniei* and *Dawkinsia arulius*. Similarly, breeding technique were standardized for two endangered species of genus *Dawkinsia*, viz. *Dawkinsia tambraparniei*, the Tambraparniei barb and *Dawkinsia arulius*, the Arulius barb. Two



Hatchery produced seeds of *Lethrinus nebulosus*

backyard recirculating aquaculture system (RAS) models of rearing tanks size 3 and 7 cubic metre with production capacity of 30 kg per m<sup>3</sup> were designed, fabricated and validated for small-scale farming of rainbow trout by the farmers of hill states to reduce the initial cost of investment.

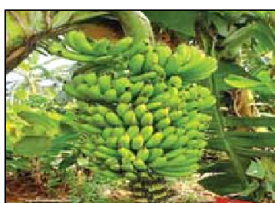
**4. Genetic Resources:** Total 890 accessions (450 cultivated and 440 wild) including unique landraces of cereals, pulses, oilseeds, vegetables and germplasms of wild edible fruits and wild relatives of the cultivated crops were collected through 18 explorations. Under National Gene bank, 5,152 accessions of orthodox seed species added for long-term storage resulting into the total of 4,62,923 accessions in its present base collection. In Cryogene bank, 404 accessions of seeds and pollen genomic resources of different crop species were cryopreserved, making the total collection of 12,480 accessions. Total of 41,557 accessions were imported from 37 countries and 14,641 entries from trails/nurseries from CG centres. Imported samples numbering 133,673 were processed for quarantine clearance. One plant quarantine database and two web-based applications were developed. ICAR-NBAIM, the nodal agency for developing DNA fingerprints of microbial cultures to be registered as biopesticides developed fingerprints of more than 487 samples for accurate identity. A total of 26 microbes were accessioned under safe deposition and 72 cultures were sold to academia and companies fetching ₹ 291600 revenue to the institute.

In horticulture, a total of 3,346 accessions were collected and 26 accessions showing unique traits were registered as novel genetic stock. Five genotypes of longan of fruit size (8.1 – 8.5g/fruit), an oilpalm cross progeny number 483 (599NATP × 33D) promising for more oil to bunch ratio (21.37%) and 175 fungal mushroom accessions were identified. A QR coded gene bank exclusively for wild genetic resources of banana established at

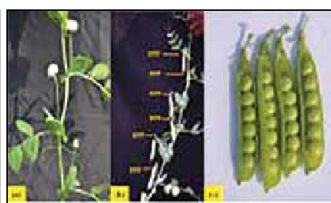


ICAR-NRC-Banana, Tiruchirappalli. This is the first of its kind in India for conservation of genetic diversity and identify resistant sources to various biotic and abiotic stresses in banana.

#### Germplasm accessions of horticultural crops showing unique traits



Banana 22060



Pea INGR 21139



Tomato INGR 21150



Radish INGR 21220



Chrysanthemum INGR 21108



Tuberose INGR 22056

In livestock, 10 new breeds of indigenous livestock species, Kathani cattle (Maharashtra), Sanchori cattle (Rajasthan) and Masilum cattle (Meghalaya); Purnathadi buffalo (Maharashtra); Sojat goat (Rajasthan), Karauli goat (Rajasthan) and Gujarati goat (Rajasthan); Banda pig (Jharkhand), Manipuri Black pig (Manipur) and Wak Chambil (Meghalaya) were registered making total number of registered indigenous breeds to 212. A total of 44,860 semen doses of 17 native livestock breeds, including nine of cattle (Red Sindhi, Badri, Red Kandhari, Nimari, Deoni, Gaolao, Bhijarpuri, Ghumsari, Khariar) and 8 of goat (Ganjam, Jamnapari, Beetal, Berari, Osmanabadi, Sirohi, Sangamneri and Barbari) were cryopreserved. Also, 1,020 somatic cell vials of 7 native breeds--Purnea, Mewati, Hariana and Shweta Kapila of cattle, Konkani Kanyal of goat, Doom and Purnea of pig were added for cryopreservation. Presently,

#### Newly registered livestock breeds



Purnathadi buffalo



Sanchori cattle



Karauli goat



Banda pig

National Gene Bank has repository of 61 native breeds/populations of livestock and poultry in form of semen, and 28 in form of somatic cells. Under the Mission Zero Non-descript AnGR, 22 new populations of native livestock and poultry have been identified. These are being characterized in their respective breeding tracts.

In fisheries, 3 freshwater species *Amblycephalus molaii* from Kailash river, Mizoram; *Pangasius icaria*, from Cauvery river, Karnataka; and *Tor satalensis* from Satal Lake, Uttarakhand and 5 marine fish/shrimp *Eptatretus wadgensis*,

#### Marine fish/shrimp species



*Amblycephalus molaii* sp. nov.



*Pangasius icaria*



*Tor satalensis*



*Eptatretus wadgensis*

*Dussumieria modakandai* sp. nov*Ariosoma melanospilos**Ariosoma albimaculatum**Ariosoma indicum**Ariosoma maurostigma**Actinimenes koyas*

*Dussumieria modakandai*, *Ariosoma albimaculatum*, *Ariosoma melanospilos* and *Actinimenes koyas* were discovered. Canary top wrasse, *Halichoeres leucoxanthus*, previously distributed in Maldives, Myanmar, Christmas Island (Australia), Thailand and Western Indonesia was found for the first time in Indian waters. For the first time, recorded catch of marine/deep sea fish species like *Aluterus monoceros*, *Antennarius indicus*, *Ariomma indica*, *Diodon hystrix*, *Labotes surinamensis*, *Nemipterus randalli*, *Priacanthus prolixus*, *Seriolina nigrofasciata*, in Hooghly- Matlah estuary. Indian oil sardine's whole genome assembly is 1.077 GB (31.86 Mb scaffold N50) in size with repeated content of 22.84%. The sequences were deposited in NCBI, GeneBank. The cell lines from rainbow trout heart and snow trout muscles were developed, authenticated and deposited in ICAR-NBFGR National Repository of Fish Cell Lines.

**5. Crop Management:** Application of consortium of methane utilizing bacteria (MUB) formulation comprising of *Methylobacterium oryzae* MNL7 and *Paenibacillus polymyxa* MaAL

70 through seedling root dip technology and as spray reduced methane emission by 5 to 25% in flooded rice. Rise in temperature by 1.7°C with elevated CO<sub>2</sub> showed an increase in grain yield across two wheat varieties. Elevated CO<sub>2</sub> (ECO<sub>2</sub>) with elevated O<sub>3</sub> (EO<sub>3</sub>) alleviated the negative effect of ozone on grain yield. Durum and bread wheat were exposed to leaf compost (LC) and vermicompost (VC) enriched with polyvinyl chloride (PVC) and poly propylene (PP). The microplastics in the farm inputs altered the nutrient availability and uptake. Satellite based crop health indices were developed for whole of India. The spatial layer of active fire points of rice residue burning (October-December) was uploaded on ICAR KRISHI Geoportal on daily basis. Near real time crop condition monitoring was developed using google earth engine platform and moderate resolution satellite data.

Real time soil moisture-based irrigation scheduling of green pea revealed water saving of 44-50% against surface irrigation practice. Conservation practice, permanent beds with residue recorded highest grain yield of *kharif* crops followed by zero tillage and CT. Sugarcane based Integrated farming system developed by ICAR-IISR fetched additional income of ₹ 2,65,902.5/ha in autumn planted sugarcane and ₹ 2,63,020/ha in spring planted sugarcane. The wireless smart trap developed for real time pest monitoring in cotton showed a weekly mean trap catch of 19.8 (*P. gossypiella*), 6.18 (*S. litura*), 0.19 (*H. armigera*) and 0.08 (*E. vittella*) during 2021-22.

Four mVOCs formulations evaluated @ 5 ppm concentration on the attraction of 4 sucking pests -whiteflies, jassids, aphids, and thrips in cotton using yellow sticky traps (YST) trapped 232%, 1517%, 709%, and 237% higher whiteflies, jassids, aphids, and thrips, respectively as compared to the control. Insect bioassay (*in vitro*) conducted to study the efficacy of the native strain of the *M. rileyi* on FAW indicated *M. rileyi* as potential microbial agent for management of the fall armyworm in sorghum. The survey conducted to understand the infestation and distribution of common bruchid species in legumes, indicated 5 bruchid species infesting pulses, 3 of which were *Callosobruchus*. Among *Callosobruchus* species, *C. analis* was distributed on 50% of the samples and locations, followed by *C. maculatus* and *C. chinensis*.

The formulations based on two *Trichoderma* species having excellent quality to protect the rice





CICR Wireless Smart Trap



Untreated control



Bio Pulse + Sulphur



Eco-pesticide + Sulphur

#### Effect of microbial technologies on disease incidence in grape

plant against soil and seed-borne diseases and excellent growth promotion capability developed and tested at farmers' fields. They were highly effective in maize, finger millet, niger and rice. Entomopathogenic nematode (EPN) biopesticide formulation technology was commercialized to 5 companies with a license fee of ₹10 lakhs. Efficacy of fungicide against rice bakanae disease was tested. Spraying of propiconazole @ 2 ml l of water at 15 DAT resulted in the lowest incidence of bakanae disease and higher yield of rice.

Soil application of mycorrhizal consortium @ 20 kg along with 500 kg of compost/ha at the time of sugarcane planting proved an effective bio-control of parasitic weed *Striga* spp. in sugarcane. A multi-residue analysis method was developed for simultaneous determination of 30 herbicides in agricultural commodities using LC-MS/MS. Similarly, a multi-residue analysis method using TLC with the detection limit of  $<0.01 \mu\text{g/g}$  was also developed for determination of herbicide combination products namely, pretilachlor + pyrazosulfuron, cyhalofop-p-butyl + penoxsulam and traifmaone + ethoxysulfuron. A user friendly multi-lingual mobile app named 'Herb Cal' for application of herbicides was developed. After entering the herbicide information such as crop, area, dose and herbicide formulation to be used, the app automatically calculates the amount of herbicide and quantity of water to be taken for spray. Biological control of alien invasive weed *Salvinia molesta* in a 20 ha *Salvinia* infested pond in village Padua of Katni district was achieved by releasing 2000 adult weevils of a host specific insect *Cyrtobagous salviniae*. With the increase of bioagent population 50, 80 and 100% control of *S. molesta* was achieved by 8, 11 and 18 months, respectively.

In grapes, microbe-based technologies, Eco-pesticide, Bio-Pulse, UBSTH-501 and Bio-Care 24 were evaluated against *Erysiphe necator*

grape powdery mildew and integrated these technologies with a safer fungicide (sulfur). The percent disease index (PDI) reduced significantly in grape leaves treated with Eco-Pesticide®/sulfur (22.37) followed by Bio-Pulse®/sulfur (22.62) and Bio-Care 24®/sulfur (24.62). An efficient technology for multiplication of clonal rootstock of apple through cutting under greenhouse conditions using soilless rooting medium was standardized. Field application of Nanoparticles of iron and zinc showed a significant increase in leaf Fe and Zn content after 14 and 28 days of application over conventional fertilizers. The performance of Crimson Seedless, Manjari Kishmish and Manjari Medika grapevines grafted on Dogridge and 110R was found superior over other rootstocks. A microbial consortium CISHD ecomposer has potential to accelerate the composting rate. DRIS indices and critical leaf nutrient concentrations were developed for oil palm plantations. Coconut-based Integrated Farming System (CBIFS) realized a net return of ₹ 6,53,853/ha.

Application of customized fertilizers in sweet potato was best for higher tuber yield (22.74 t/ha) compared to present POP (19.67 t/ha). Low cost technology for the paddy straw mushroom cultivation was developed. Vertical farming was standardized for growing important high value flower crops by utilization of 11 feet vertical space of the polyhouse. Nutritional and chemical finger prints of popular turmeric varieties were developed. The effects of nanoZnO (nZnO) on the compositional and functional responses of bacterial communities in soils were examined using high throughput sequencing. Microbial consortia for enhancing the growth and yield of cumin and coriander was identified. Organic nutrient management practices for Sarpagandha were developed. New insect-pests in banana (Fall armyworm, *Spodoptera frugiperda*; Bondar's nesting whitefly, *Paraleyrodes bondari* and bagworm, *Manatha albipes* were identified. Litchi stink bug (*Tessaratoma javanica*) and



the Flower webber were recorded as emerging insect pest attaining major pest status of litchi. An algorithm based on object detection approach was developed for surveillance of rhinoceros beetle infestation using unmanned aerial vehicle (UAV or drone).

An entomopathogenic fungus isolated from infected *H. theivora* was identified as *M. anisopliae* TMBMA1 and found effective in mirid management in cocoa. Competitive regulation and biological control of rugose spiralling whitefly by the Bondar's nesting whitefly (BNW) during 2021 was observed. Incidence of Fusarium wilt disease, tropical race 4 (Foc TR4) in banana in West Bengal was identified. Citrus microbiome was utilized in rejuvenating Khasi Mandarin plants affected by important citrus diseases. Etiology of emerging diseases in plantation crops was established. A rapid and novel mycelium inoculation technique for inducing *Ganoderma lucidum* infection in coconut and arecanut seedlings was developed. A native plant growth promoting isolate of *Trichoderma asperellum* (isolate AT172) having antagonistic activity against arecanut basal stem rot pathogen *G. lucidum* was identified and characterized.

The cashew leaf blight disease caused by *Neopestalotiopsis sclavispora* was identified for the first time in cashew. RPA-lateral flow assay (RPA-LFA) method was standardized for the on-site detection of the piper yellow mottle virus infecting black pepper. Singleplex and duplex recombinase polymerase amplification (RPA) assays were optimized for specific and sensitive detection of *Pythium* spp. and *Ralstonia pseudosolanacearum* from ginger rhizomes. Marker free late blight resistant transgenic line KJ66 was identified. Prototype of a remote operated unmanned ground (UGV) vehicle was designed and developed for spraying of agrochemicals on potato crop. Sodium alginate-based bead formulation of fungal mycelia and conidia for long term storage of fungal cultures were developed.

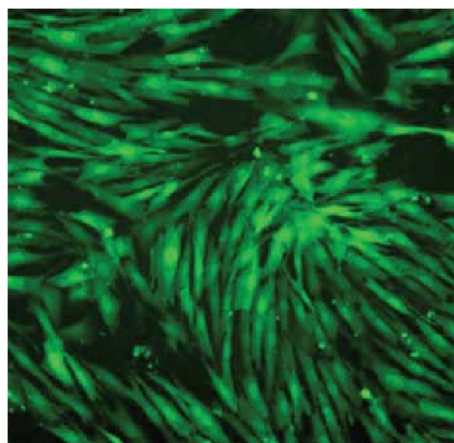
**6. Livestock Management:** Thirteen healthy buffalo calves (seven males and six females) were produced from semen of two cloned bulls. This technology will lead to future sustainable milk production in the country. Prototype of intra-vaginal wireless sensor device was developed for remote monitoring of calving process in dairy cows. This could help in predicting the calving time in cattle. NADRESv2, a dynamic geographic information and remote sensing-enabled expert system maintained

by ICAR-NIVEDI was updated in the NADRES database, and a total of 5655 predictions for major livestock diseases were communicated to State Animal Husbandry Departments and Department of Animal Husbandry and Dairying (DAHD), GoI, in the form of risk maps, bulletins, and post-prediction maps for necessary preparedness. Nation-wide sampling plans for sero-surveillance and sero-monitoring of foot and mouth disease (FMD), brucellosis, *Peste des Petits Ruminants* (PPR) and classical swine fever (CSF) for each state/UTs of the country were formulated and provided to DAHD, GoI, for strengthening the surveillance system. Screening of serum samples (32,257) for important livestock diseases from different animal species submitted to various NADEN units and State Animal Husbandry Departments was carried out. The sero-diagnostic services were provided for infectious bovine rhinotracheitis (IBR), trypanosomiasis and pasteurellosis with 28.9%, 49% and 4.5% positivity, respectively in ruminants. Brucella post-vaccination sero-monitoring is one of the major activities to evaluate the impact of the control program. Towards this, a total of 14,611 sera collected from different states were screened, of which, 64.45% were positive for anti-brucella antibodies.

Under FMD sero-surveillance, 98,185 bovine serum samples from around the country were analyzed and an overall sero-positivity in 16.6% of the tested samples was reported. The state FMD centers were provided with three main test kits (3AB3 indirect DIVA ELISA for 1,75,583 samples, Solid Phase Competitive ELISA (SPCE) for 1,56,778 samples, and Sandwich ELISA for 3893 samples. Clinical samples (2824) were analyzed for serotype identification in 378 FMD outbreaks. During 2021, all three FMD virus serotypes were documented, with serotype O leading the outbreak scenario followed by serotype A. Overall, the disease incidences have increased compared to previous year. A total of 113 FMD virus isolates (102 O, 10 A and 1 Asia 1) revived in BHK-21 cell system were added to the National Repository of FMD Virus maintained at International Centre for FMD, Bhubaneswar and Mukteswar Laboratory. PPR Ab Check kit for the detection of PPR Virus nucleocapsid protein antibodies in the serum samples and PPR Ag Check kit for the detection of PPR virus in Clinical specimens of sheep and goats; Recombinant nucleocapsid protein based indirect ELISA kit for detection of Anti SARS CoV-antibodies in canines (CAN-CoV-2 iELISA

kit) and Multi recombinant proteins based ELISA Kit for diagnosis of *Trypanosoma evansi* infection in animals; TaqMan-probe-based realtime RT-PCR assays (RT-qPCR) for pan-serotype detection of FMDV; Recombinase polymerase assay for detection of African swine fever virus in pigs; Multiplex PCR to differentiate *Mycobacterium tuberculosis* complex species; Rapid colorimetric assay for detection of the extended spectrum  $\beta$ -lactamase producing bacteria; Lateral flow assays (LFAs) for detection of CD virus antigen and antibody were developed. Among the vaccines, Ancovax for SARS-CoV2 infection; LSD vaccine named Lumpi-ProVacInd against LSD; Inactivated Low Pathogenic Avian Influenza (H9N2) vaccine for chickens; Thermostable serotype O vaccine for FMD were developed. Mesenchymal stem cells (MSCs) with or without egg shell membrane, bioactive collagen gel, collagen powder, platelet rich plasma, and MSC laden Nano-scaffolds of hydroxyapatite and multiwalled carbon nanotubes were evaluated for skin wound, bone and nerve healing in animal models, and showed promising results. p38 mitogen activated protein kinase inhibition suppresses buffalopox virus (BPXV) protein synthesis by targeting p38-MNK1-eIF4E signaling pathway. The P60-SB239063 virus exhibited significant resistance to SB239063 as compared to the P60-Control virus. This is a rare evidence, wherein a virus was shown to bypass the dependency on a critical cellular factor under selective pressure of a drug. An online database management system named MHC Database was created (<http://www.mhcdbs.in/>) to allow easy access and use of immune polymorphism data. This system also allows user to upload as well as download the indigenous Ovar MHC allelic database for sheep breeds in FASTA format. CRISPR/CAS9 mediated knock-in of human Erythropoietin gene in the goat fibroblast cells was done and the transgenic goat fetal fibroblast cells expressed hEPO gene fused with green fluorescent protein (GFP) gene. ICAR-NRCE, Hisar is actively involved in glanders surveillance, providing diagnostic support, capacity building of state diagnostic laboratories/ RDDLs. For rapid and efficient execution of surveillance activities, Hcp1 ELISA kit developed by NRCE is being used for glanders diagnosis. A total of 1737 equine serum samples from 8 states were tested for equine infectious anemia (EIA), equine influenza (EI), Equine Herpes Virus-1 (EHV-1), Japanese Encephalitis/ West Nile Virus (JEV/ WNV), *Trypanosoma evansi* (Trypanosomiasis),

piroplasmosis *Salmonella*, *Abortus equi* and brucellosis. Highest sero-prevalence was observed for equine piroplasmosis (38.40%) followed by EHV-1 (7.80%), JE/WNV (7.40%), and *Trypanosoma evansi* (2.15%). Stallion seminal plasma proteins were profiled and the proteins and pathways associated with sperm motility were identified. Purification, molecular characterization and ligand binding properties of the major donkey seminal plasma protein (DSP-1) isolated from donkey (*Equus hemionus*) seminal plasma was done. Transgenic chickens were produced through sperm mediated gene transfer (SMGT) method with an efficiency of 5.4%. In the transgenic birds, human interferon alpha 2b gene was introduced at the germ line stage in the chicken genome. The transgenic hens laid 132 eggs with an average content of 30-40 mg of interferon alpha 2b protein in each egg. Characterization of colostrum of native cattle and yak of high-altitude region of Leh-Ladakh was done in comparison to Sahiwal (SAC). Samples from LSD suspected outbreaks in 20 States/UTs of the country were tested to identify laboratory confirmed cases of LSDV infection for undertaking prevention and control measures against LSD in India. A total 2456 bovine (cattle



Transgenic goat fetal fibroblast cells expressing hEPO gene fused with green fluorescent protein (GFP) gene



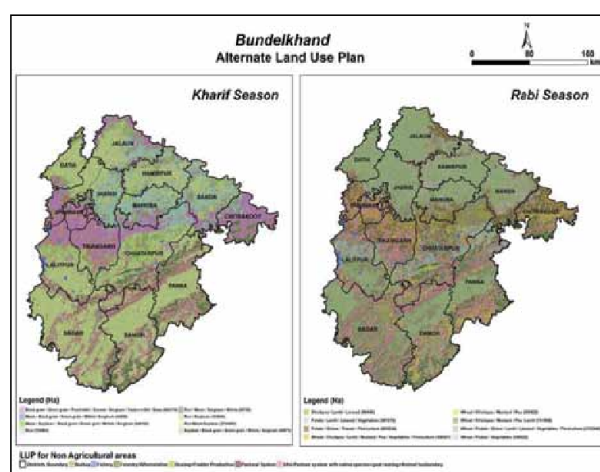
MCRV infected *S. serrata* displaying grey colour shell discolouration

and buffalo) samples were tested, of which, 1156 cattle samples from 19 States/UTs tested positive for LSDV. First whole genome analysis of Indian African swine fever viruses revealed potential genetic determinants to differentiate closely related ASFV circulating in Asia. Global alignment of the complete genome sequences showed nucleotide identity of 99.96% amongst the two Indian isolates (IND/AS/SD-02/2020 and IND/AR/SD-61/2020). The results showed the importance of the 14 ORFs in understanding the evolution of ASFV in Asian countries and their divergence from prototype ASFV Georgia/2007. Whole Genome Sequencing of 12 Bovine coronaviruses isolated from cow (3) and buffalo (9) nasal and faecal samples collected in 2020-21 revealed two different subgroups: subgroup GIa having 9 viruses cluster from across the world and GIb subgroup having 3 other viruses cluster which has majorly the isolates of France in 2017. A food-grade meat decontaminant spray was developed by using the extracts of Ashwagandha roots and Guava leaf spray which could reduce the microbial load many folds in retail fresh chicken. Phytochemicals (thymol and cinnamaldehyde) conjugated silver nanoparticles (AgNPs) were tested for their efficacy against Enterococcal *Escherichia coli* (EAEC) and non-typhoidal *Salmonella*. Assays revealed the antimicrobial activity of the encapsulated compounds (EAgC and EAgT) and appeared to be safe.

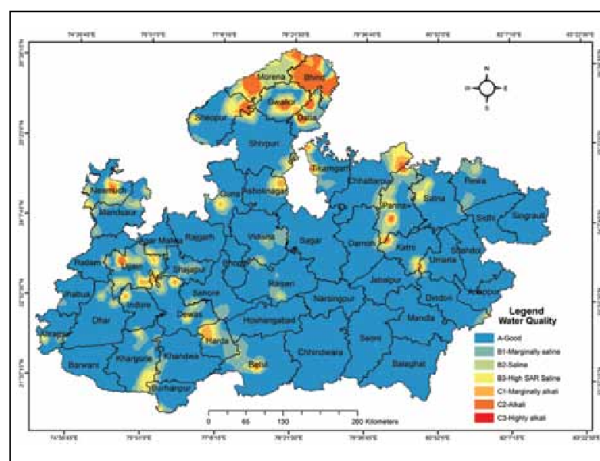
**7. Fisheries Management:** A web-GIS application for location-specific riverine fisheries management was developed. It provides an interactive and user-friendly interface which contains environmental data of 300 sampling stations covering 20 major rivers of India. The portal's database and customized reports will facilitate various researchers, planners and policymakers to make judicious planning/strategies for the betterment of fisheries resources. Mud crab, *Scylla serrata*, is an economically important crustacean species which is also being cultured. Mud Crab Reo Virus (MCRV) is an emerging viral pathogen in mud crab culture. On RT-PCR screening, MCRV were detected in gills and hepatopancreatic tissues. Herpes viral haematopoietic necrosis disease (HVHND) is caused by CyHV-2, which causes severe mortality in goldfish. A rapid and sensitive RPA (Recombinase Polymerase Amplification) assay, coupled with lateral flow dipsticks (LFD) was developed by designing specialized RPA primer, LFA primers and probes. The RPA-LFD assay

developed presents a simple, rapid and sensitive method for point-of-care diagnosis of CyHV-2, especially under resource limited conditions. A Coliphage cocktail for controlling antimicrobial resistant (AMR) *E. coli*, containing 10 coliphages, selected based on their broad host range, varied location and their ability to lyse AMR *E. coli* was developed. The Coliphage cocktail has a phage titer of  $\sim 10^{12}$  to  $10^{14}$  pfu/ml and can be used for the control of *E. coli* and AMR *E. coli* on food contact surfaces. The Coliphage cocktail can be stored under chilled conditions ( $<4^{\circ}\text{C}$ ) condition for a minimum period of 3 months.

## 8. Soil and Water Productivity: Micro level



Proposed alternate land use plan for Bundelkhand



Groundwater quality map of Madhya Pradesh for irrigation





agricultural land-use planning, soil and water conservation, water harvesting, storage and groundwater recharge, improvement in water productivity and nutrients use efficiency, integrated nutrient management, resource conservation technologies, chemical free agriculture, integrated farming system, waste-water use, dryland, hill and coastal agriculture, weed management, precision agriculture, climate resilient agriculture, abiotic stress management was given special thrust. The land resource inventory (1:10,000 scale) for Bundelkhand region prepared for sustainable land use, spectral signature library of the soils of India for quick and inexpensive acquisition of surface soil properties, potential crop planning zones of Telangana, and land suitability analysis for turmeric in Kerala under projected climate change scenarios were accomplished. The groundwater quality map of M.P. for irrigation and groundwater recharge plan for Korba and Janjgir-Champa districts in the upper Mahanadi Basin developed. ICAR-CSSRI and NTPC joint study on efficiency of flue gas desulfurization gypsum (FGDG) revealed 8-11% decline in saline soil pH after one year of FGDG surface application (0-15 cm depth) and neutralization of soil alkalinity improved paddy yield by ~40%. A Solar Irrigation Pump Sizing Tool (SIPS) was developed for large scale adoption by farmers and support the PM-KUSUM initiatives. To promote organic farming, packages for 5 cropping systems for Gujarat, Rajasthan and Uttarakhand were developed. ICAR-NIASM developed beta version of the Abiotic Stress Information system (ASIS) consisting of modules on Atmospheric and Soil Stress information for generating query based geo-spatial maps. The new salt tolerant varieties in rice (CSR 76) and mustard (CS 61 and CS 62) were developed.

### 9. Mechanization and Energy Management:

A tractor operated side trencher was developed to make trench up to 300 mm depth. The effective field capacity and field efficiency of the trencher were 0.2 ha/h and 71%, respectively when operated to dig a trench of 300 mm deep in 3 m wide vineyard at 2.0 km/h forward speed. The cost of operation of tractor operated side trencher is about ₹ 560/hr. It economizes the cost of operation, labour and time by 72, 94 and 80%, respectively as compared to manual digging of trench with hand tools. The tractor operated FYM applicator of 1 tonne capacity was developed for placing FYM near the plant. The cost of operation of tractor operated FYM applicator is about ₹ 645/hr which

saves labour, time and cost of operation by 98, 80 and 88%, respectively as compared to manual method. Manual operations of raised bed forming, drip lateral and plastic mulch laying, and planting seeds in a plastic mulch requires about 29 man-days/ha. A tractor operated drip lateral and plastic mulch layer-cum-planter was developed to perform raised bed formation, drip lateral and plastic mulch laying etc. in single pass of the tractor. The total cost of equipment is ₹3,00,000 with operational cost of ₹1,500/hr. The payback period of equipment is 1.9 years. A self-propelled walk-behind maize harvester for snapping the maize cobs from the maize plants and simultaneously cutting the plants has been developed. The effective field capacity of the harvester is 0.2 ha/hr and the cost of operation of the maize harvester is ₹ 2,850/ha. The saving in cost of operation, time and labour are 25, 96 and 91%, respectively compared to manual harvesting. A remote-controlled electronic system was developed for ride-on rice transplanter to reduce human drudgery. It can be remotely operated at a distance of 200 m. The field capacity of remote-controlled ride-on rice transplanter is 0.24 ha/hr. To ease the digging of garlic, a tractor operated harvester was developed which can harvest garlic crop planted on raised beds. The harvesting efficiency of the harvester is 97% and bulb damage is <0.5%. A small tractor-mounted hydraulic pruner for orchards was developed with the pruning capacity of 120 plants/hr. The cost and operating cost of the pruner is ₹ 4,50,000 and ₹ 4,910/ha, respectively. ICAR-CIAE had developed a low-cost SPAD meter 2.0. It measures SPAD values for crops such as rice, wheat, maize, etc. with leaves up to 1 mm thickness. The SPAD values, measured with the device, can be used to generate recommendations for top-dressing of nitrogen fertilizer dose. A small tractor operated boom sprayer was developed for orchard crops. The cost of the spraying system is ₹ 30,000. The discharge rate of boom sprayer is 608 l/hr at 0.3 MPa pressure. The application rate and turning time of the spraying system was 475 l/ha and 12 s, respectively. A power tiller operated groundnut digger was developed with field capacity of 0.07-0.11 ha/h and digging efficiency of 97.6%. A tractor operated potato digger developed which performs three operations, viz. digging of potato tubers (two rows), separation of potatoes from soil and collection of potatoes in the collection unit. The average field capacity and output capacity are 0.12 ha/hr, 2700 kg/hr for sandy loam soil and 0.11 ha/hr, 2685 kg/hr for loamy soil, respectively. A digital flume with the Internet of Things (IoT) connectivity



Unmanned Rice Transplanter



SPAD Meter 2.0

was developed and tested to continuously measure the flow rates in open channels. Utilizing the IoT, the developed digital flume measures the discharge and transmits data wirelessly for storage on cloud (ThingSpeak). It was tested in the field under varying discharge conditions in the field channel. It can be utilized for irrigation water measurement in the field channel for management of available irrigation water.

**10. Post-Harvest Management and Value-Addition:** Post-harvest treatments machine for pre-cooling, washing, warm water treatment, anti-microbial treatment, anti-browning, and pulsed light treatment to the freshly harvested fruits and vegetables was developed. It also has an inspection conveyor to sort out the deformed and damaged products. The capacity of the machine is 1.2 t/hr for capsicum, 1.0 t/hr for apple at a linear belt speed of 5 m/min. The peeling machine for medicinal tuber crops was developed with peeling efficiency of ~92% for *Safed musli* and 55% for *Shatavari* and capacity of ~15-20 kg/hr which is 30 times higher than manual operation. An electronic sensing system (e-Nose) has been developed in collaboration with C-DAC Kolkata for the real-time health monitoring of the onions, potatoes, and tomatoes in storage. The machine for popping of sorghum, amaranth, finger millet, kodo millet, and other small grains including rice, and corn developed with a capacity of 1.4-2 kg/hr and 60-70% popping recovery for sorghum and amaranth. To provide easy, fast and non-destructive method for detection of pea flour adulteration in *besan*, near infra-red spectroscopy (NIRS) model was developed which can be used to predict adulteration of *besan* with pea flour. A novel process based on microbial precipitation process to produce protein isolates/concentrates from oilseed cakes/meals was developed. This method increased 5% yield as compared to the chemical process. The protein produced is superior in terms of solubility, wettability, water absorption capacity and degree of hydrolysis. Multi-nutrient biscuits with high satiety value, appealing taste

and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which makes it rich in protein (5 g), minerals (1.4 g), iron (4.5 mg) with good antioxidant activity for 100 g of cake. This is a unique egg less preparation and best suited for people who have gluten allergy. Re-using the existing fibres and textiles, reduces the need for newly manufactured fibres and saves water, energy, dyes and chemicals, which reduces the carbon footprint. The fibres were extracted from pre-consumer cotton knitted fabric waste and converted into yarn by blending this recycled cotton fibre (RF) with virgin cotton (VC) fibre in different blend proportions. The blending in 50:50 (RF:VC) provided better yarn properties and more suitable for home textiles applications such as bed linen, furnishing fabrics, interior decoration accessories etc. Electro spun nanofiber-based micronutrient delivery matrix was developed to enhance the nutrient use efficiency, as compared to bulk nutrient application. The needle electrospinning machine was used to produce zinc sulphate impregnated electro spun nanofiber mat. The banana pseudo stem has potential for extraction of textile fibres, sap for dyeing and finishing, and other portion for making paper-based products. Semi-solid banana plant biomass was used for making paperboard, similar to paper with higher areal density and they are comparable with conventional handmade paper. Application of activated carbon derived from jute stick, NINFET-JAC, as an alternative to graphitized carbon black, was found effective for pesticide residue analysis in various crops like okra, spinach, pomegranate, tea etc. Sheep wool contains about 95% keratins which have huge applications in medical and pharmaceutical industries. Coarser grade wool having no textile use can be used for

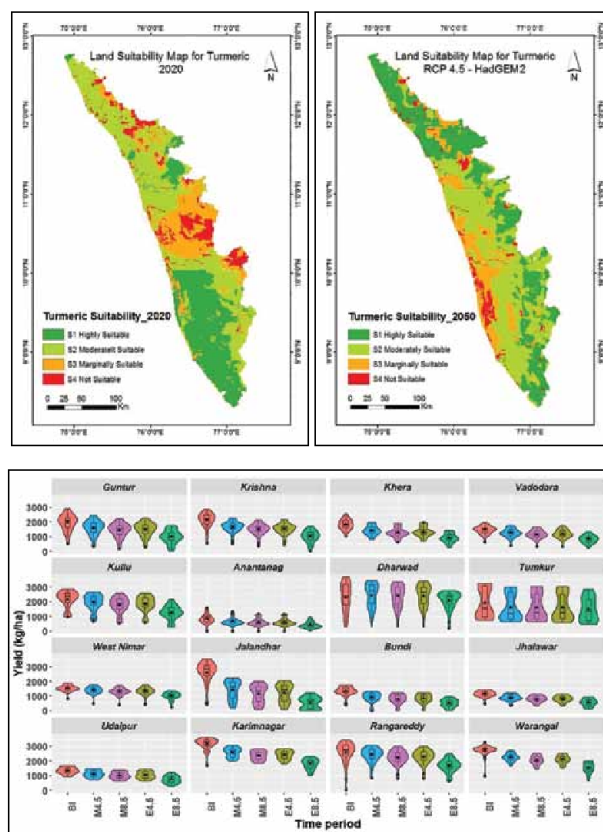


Electronic nose (e-Nose) Near Infra-Red spectroscopy (NIRS)



extraction of keratin. ICAR-NINFET had developed a microbial protocol for keratin extraction from animal hair. Fibre producing species of nettle are European nettle and Himalayan nettle. NINFET has developed 100% nettle, nettle/viscose (75:25, 50:50, 25:75), and nettle/polyester (75:25, 50:50, 25:75) blended yarn and also union fabrics using cotton yarn in warp and these nettle-based yarns in the weft. These blended fabrics are suitable for fashion apparel, garments, shawls, stole, scarf, saree etc.

**11. Climate Resilient Agriculture:** In recent years, land-atmosphere coupling in many parts of the world had been identified to have raised temperatures and aridity. Studies using consistent methodology and metrics from multiple data sources established that the drying land surface turns into a source of heat generation and drought exacerbation due to reduced evaporative cooling and increases atmospheric heating from sensible heat flux. The land suitability for turmeric cultivation in Kerala was analyzed using Had GEM2 Model based on the Representative Concentration Pathway (RCP)-4.5 for climate projection scenario of turmeric in 2050. The projections revealed increase in highly suitable area by 5% from 28% to 33% and decrease of 4% from 11% to 7% in non-suitable areas of turmeric which could positively contribute to its production. The spatio-temporal changes in maize yield were studied using multi-model ensemble climate change projection derived from 30 general circulation models in 16 major maize growing districts of India. The projected reduction in maize yield is 16% to 46% under RCP4.5 and 21-80% under RCP8.5 without adaptation strategy. The combined adaptation strategies might reduce the loss in yield or even increase by 5-15% under RCP4.5 scenario. Rice-based IFS model for lowland conditions of West Coast and IFS model for dryland of



Land suitability maps of turmeric in Kerala for 2020 and 2050.

Karnataka and transitional plain of Luni basin was developed. Swarna Unnat Dhan (IET 27892), rice variety with multiple stress tolerance developed for irrigated transplanted condition of Bihar, Odisha, West Bengal, Madhya Pradesh and Maharashtra. Genome editing technology (CRISPR-Cas9) was used to create loss of function in mutants of the drought and salt Tolerance (DST) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. Three homozygous mutants developed with reproductive stage tolerance to salinity stress. These lines were evaluated further for yield under drought stress and non-stress conditions. Under drought



**Genome editing of DST gene enhanced tolerance to drought stress (-75KPa) of rice.** Photographs shows drought stress effect on visible appearance of plants (left panel) and grain yield of plants (right panel). WT, MTU1010; D2bp, genome edited line of MTU1010.



stress (-75 KPa), genome edited mutants showed significantly higher grain yield as compared with MTU 1010.

## 12. Human Resource Development:

Strengthening and development of higher agricultural education and quality assurance of AUs through accreditation and ranking process are the two major areas supported by ICAR. The strengthening of ICT facilities in AUs, emphasis on capacity building of the students and faculties through various training programmes under ICAR scheme as well as NAHEP helped enhance the capabilities of the faculties in various upcoming areas and improved the publications. AUs were also supported for encouraging holistic development of students, through creation of placement cells, support for sports facilities. The centralized admissions and national/international fellowships by ICAR helped improve academic ecosystem, and encouraged merit across AUs. National Professorial Chairs and National Fellow Scheme for promotion of excellence in research, Emeritus Scientist/Emeritus Professor Schemes as a structural method of utilizing skill bank of the outstanding superannuated professionals in various disciplines to address faculty shortage. NAARM contributes immensely on wide range of issues of national and global importance apart from various courses on capacity building. The Academy has also been promoting online and digital education, startups for agripreneurship. The key components of NAHEP,

viz. Centres for Advanced Agricultural Sciences and Technology (CAAST), Institutional Development Plan (IDP), and Innovation Grants have contributed to enhanced entrepreneurship opportunities and other reforms in AUs.

**13. Social Science:** The impact of different risk management strategies on farm productivity and its resilience to climatic shocks was estimated. Measures were categorized into risk-mitigating, risk-transferring and risk-coping strategies. A Study was under taken to estimate productivity and risk effects of crop insurance vis-à-vis irrigation to explain the low uptake of crop insurance. Both crop insurance and irrigation positively impact farm productivity, but their gains differ significantly. The structure of rural employment is undergoing a change. The withdrawal of the agricultural workforce has further accelerated, and an additional 28 million workers left between 2011-12 and 2017-18. In the recent decade, the agricultural sector has experienced all-time high growth of 3.5%, and the growth has been driven by the animal husbandry and fisheries. The feasibility of a uniform water pricing policy and a differentiated water pricing policy was assessed. A notable shift in cropping patterns will take place when a volumetric and differential water pricing policy is adopted. Possibilities of reducing import dependence to meet the edible oil demand by increasing domestic production, adopting yield-enhancing technologies, and raising import tariffs, was investigated.



Graduation Ceremony at NAARM



Ranking of Agricultural Universities initiated by ICAR

A general method of construction of row-column designs with two rows for orthogonal estimation of main effects and two factor interactions in minimum number of runs was given for orthogonal parameterization. An alternative sampling methodology for estimation of area and production of horticultural crops developed by ICAR was adopted by Department of Horticulture, Government of Haryana. Developed a support vector machine-based prediction model for predicting GIGANTEA proteins in plants. Based on the developed methodology, a prediction server GIPred was also established which is freely accessible (<http://cabgrid.res.in:8080/gipred/>) for proteome-wide recognition of GIGANTEA proteins. Developed machine learning-based models for identification of abiotic stress responsive miRNAs and Pre-miRNAs in plants. Developed a comprehensive machine learning based computational model for discovery of DNA binding proteins in plants (PIDBPred) that play crucial roles in numerous cellular processes.



Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.



A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to





Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behigh in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI

and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti





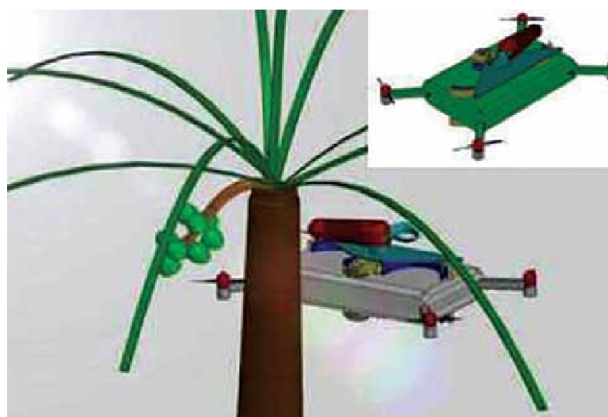
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028



released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with

Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR

Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.





03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**

## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.

In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth- Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested



for managing veterinary services, supply chain solutions, challenges in veterinary science education and role of extension services in mitigating the impact of the pandemic.

- A Brainstorming Session on ‘Scaling up Innovative Agricultural Extension Models Sector’ was organized on 12 September, 2022 under the Convenorship of Dr Ashok K Singh.
- A Brainstorming Session on ‘Beyond Price Support and Subsidies’ was organized on 30 September, 2022 under the Convenorship of Dr Pratap S BIRTHAL.

**Special Webinar:** The Academy organized a special webinar on ‘Transforming Agriculture in Asia’ by Dr Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on 20 December 2021. The webinar was based on the report prepared by the ADB to show how agriculture has minimized the impact of Covid-19.

**National Science Day:** The Academy celebrated National Science Day on 28 February 2022, with an online lecture by Prof. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai.

**International Women’s Day:** The Academy celebrated International Women’s Day on 8 March 2022, by organizing an online panel discussion on ‘R&D Innovations for Sustainable Agriculture in India’.

**World Biodiversity Day:** On 22 May 2022, the NAAS observed World Biodiversity Day by organising a discussion on Global Genebanks and Biodiversity Management for Sustainable Agriculture. Some of the eminent speakers were Dr Hugh Pritchard, Kew Botanic Garden, UK; Dr Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Ashok K Singh, Director, ICAR-IARI, New Delhi; Mr Kent Nnadozie, Secretary of the International Treaty, FAO, Rome; Dr Murukarthick Jayakodi, Group Leader, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany; Prof. Rajeev Varshney, International Chair in Agriculture and Food Security, Food Futures Institute, Murdoch University, Australia. Over 350 delegates participated in this programme.

**XV Agricultural Science Congress:** The Academy organized the XV Agriculture Science Congress on the theme ‘Energy and Agriculture: Challenges in 21<sup>st</sup> Century’ jointly with the Banaras Hindu University, Varanasi, from 13-16 November,

2021. In view of the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047. More than 1,800 delegates (900 in-person including 300 farmers) participated including fellows of the academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations and exchanged their ideas on various themes and sub-themes of the Congress. A national-level elocution contest was also organized on the theme of the Congress for the students selected from all over the country. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services for the benefit of farmers.

## II. Foundation Day Programme/Annual General Body Meeting

During 2021-22, the Foundation Day Programme/AGB Meeting was held on 4-5 June, 2022 at New Delhi. Besides usual AGB business session, following science-based activities were organized:

- Scientific presentations by newly elected fellows.
- The Presidential Address was delivered by Dr T Mohapatra, President, NAAS in 29<sup>th</sup> AGM. In his address, he drew attention to the fact that although India has made remarkable progress in food production, ensuring food and nutrition security, increasing agricultural exports, and improving agricultural sustainability remain important in the process of transformation of food system in view of the changing consumers’ preferences and social aspects of food consumption.
- The Foundation Day Lecture: On the occasion of its Foundation Day on 5 June, 2022, the Academy organized in hybrid mode a lecture by Prof P Balaram, Former Director, Indian Institute of Science, Bengaluru. He spoke on ‘Reflections on Science in the age of the Corona Virus’ and presented an excellent account on the evolutionary history of corona virus and highlighted the interdependence of biology and chemistry. He explained how chemistry and biology together can reveal the unknown in the nature. He defined science as the study of nature. Citing the examples of the telescope



Unmanned Rice Transplanter



SPAD Meter 2.0

was developed and tested to continuously measure the flow rates in open channels. Utilizing the IoT, the developed digital flume measures the discharge and transmits data wirelessly for storage on cloud (ThingSpeak). It was tested in the field under varying discharge conditions in the field channel. It can be utilized for irrigation water measurement in the field channel for management of available irrigation water.

**10. Post-Harvest Management and Value-Addition:** Post-harvest treatments machine for pre-cooling, washing, warm water treatment, anti-microbial treatment, anti-browning, and pulsed light treatment to the freshly harvested fruits and vegetables was developed. It also has an inspection conveyor to sort out the deformed and damaged products. The capacity of the machine is 1.2 t/hr for capsicum, 1.0 t/hr for apple at a linear belt speed of 5 m/min. The peeling machine for medicinal tuber crops was developed with peeling efficiency of ~92% for *Safed musli* and 55% for *Shatavari* and capacity of ~15-20 kg/hr which is 30 times higher than manual operation. An electronic sensing system (e-Nose) has been developed in collaboration with C-DAC Kolkata for the real-time health monitoring of the onions, potatoes, and tomatoes in storage. The machine for popping of sorghum, amaranth, finger millet, kodo millet, and other small grains including rice, and corn developed with a capacity of 1.4-2 kg/hr and 60-70% popping recovery for sorghum and amaranth. To provide easy, fast and non-destructive method for detection of pea flour adulteration in *besan*, near infra-red spectroscopy (NIRS) model was developed which can be used to predict adulteration of *besan* with pea flour. A novel process based on microbial precipitation process to produce protein isolates/concentrates from oilseed cakes/meals was developed. This method increased 5% yield as compared to the chemical process. The protein produced is superior in terms of solubility, wettability, water absorption capacity and degree of hydrolysis. Multi-nutrient biscuits with high satiety value, appealing taste

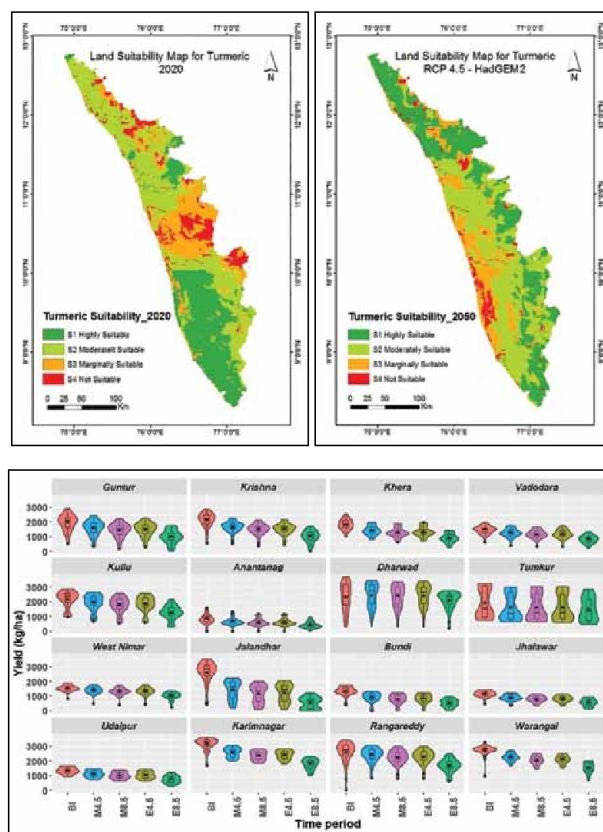
and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which makes it rich in protein (5 g), minerals (1.4 g), iron (4.5 mg) with good antioxidant activity for 100 g of cake. This is a unique egg less preparation and best suited for people who have gluten allergy. Re-using the existing fibres and textiles, reduces the need for newly manufactured fibres and saves water, energy, dyes and chemicals, which reduces the carbon footprint. The fibres were extracted from pre-consumer cotton knitted fabric waste and converted into yarn by blending this recycled cotton fibre (RF) with virgin cotton (VC) fibre in different blend proportions. The blending in 50:50 (RF:VC) provided better yarn properties and more suitable for home textiles applications such as bed linen, furnishing fabrics, interior decoration accessories etc. Electro spun nanofiber-based micronutrient delivery matrix was developed to enhance the nutrient use efficiency, as compared to bulk nutrient application. The needle electrospinning machine was used to produce zinc sulphate impregnated electro spun nanofiber mat. The banana pseudo stem has potential for extraction of textile fibres, sap for dyeing and finishing, and other portion for making paper-based products. Semi-solid banana plant biomass was used for making paperboard, similar to paper with higher areal density and they are comparable with conventional handmade paper. Application of activated carbon derived from jute stick, NINFET-JAC, as an alternative to graphitized carbon black, was found effective for pesticide residue analysis in various crops like okra, spinach, pomegranate, tea etc. Sheep wool contains about 95% keratins which have huge applications in medical and pharmaceutical industries. Coarser grade wool having no textile use can be used for



Electronic nose (e-Nose) Near Infra-Red spectroscopy (NIRS)

extraction of keratin. ICAR-NINFET had developed a microbial protocol for keratin extraction from animal hair. Fibre producing species of nettle are European nettle and Himalayan nettle. NINFET has developed 100% nettle, nettle/viscose (75:25, 50:50, 25:75), and nettle/polyester (75:25, 50:50, 25:75) blended yarn and also union fabrics using cotton yarn in warp and these nettle-based yarns in the weft. These blended fabrics are suitable for fashion apparel, garments, shawls, stole, scarf, saree etc.

**11. Climate Resilient Agriculture:** In recent years, land-atmosphere coupling in many parts of the world had been identified to have raised temperatures and aridity. Studies using consistent methodology and metrics from multiple data sources established that the drying land surface turns into a source of heat generation and drought exacerbation due to reduced evaporative cooling and increases atmospheric heating from sensible heat flux. The land suitability for turmeric cultivation in Kerala was analyzed using Had GEM2 Model based on the Representative Concentration Pathway (RCP)-4.5 for climate projection scenario of turmeric in 2050. The projections revealed increase in highly suitable area by 5% from 28% to 33% and decrease of 4% from 11% to 7% in non-suitable areas of turmeric which could positively contribute to its production. The spatio-temporal changes in maize yield were studied using multi-model ensemble climate change projection derived from 30 general circulation models in 16 major maize growing districts of India. The projected reduction in maize yield is 16% to 46% under RCP4.5 and 21-80% under RCP8.5 without adaptation strategy. The combined adaptation strategies might reduce the loss in yield or even increase by 5-15% under RCP4.5 scenario. Rice-based IFS model for lowland conditions of West Coast and IFS model for dryland of



Land suitability maps of turmeric in Kerala for 2020 and 2050.

Karnataka and transitional plain of Luni basin was developed. Swarna Unnat Dhan (IET 27892), rice variety with multiple stress tolerance developed for irrigated transplanted condition of Bihar, Odisha, West Bengal, Madhya Pradesh and Maharashtra. Genome editing technology (CRISPR-Cas9) was used to create loss of function in mutants of the drought and salt Tolerance (DST) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. Three homozygous mutants developed with reproductive stage tolerance to salinity stress. These lines were evaluated further for yield under drought stress and non-stress conditions. Under drought



**Genome editing of DST gene enhanced tolerance to drought stress (-75KPa) of rice.** Photographs shows drought stress effect on visible appearance of plants (left panel) and grain yield of plants (right panel). WT, MTU1010; D2bp, genome edited line of MTU1010.



stress (-75 KPa), genome edited mutants showed significantly higher grain yield as compared with MTU 1010.

## 12. Human Resource Development:

Strengthening and development of higher agricultural education and quality assurance of AUs through accreditation and ranking process are the two major areas supported by ICAR. The strengthening of ICT facilities in AUs, emphasis on capacity building of the students and faculties through various training programmes under ICAR scheme as well as NAHEP helped enhance the capabilities of the faculties in various upcoming areas and improved the publications. AUs were also supported for encouraging holistic development of students, through creation of placement cells, support for sports facilities. The centralized admissions and national/international fellowships by ICAR helped improve academic ecosystem, and encouraged merit across AUs. National Professorial Chairs and National Fellow Scheme for promotion of excellence in research, Emeritus Scientist/Emeritus Professor Schemes as a structural method of utilizing skill bank of the outstanding superannuated professionals in various disciplines to address faculty shortage. NAARM contributes immensely on wide range of issues of national and global importance apart from various courses on capacity building. The Academy has also been promoting online and digital education, startups for agripreneurship. The key components of NAHEP,

viz. Centres for Advanced Agricultural Sciences and Technology (CAAST), Institutional Development Plan (IDP), and Innovation Grants have contributed to enhanced entrepreneurship opportunities and other reforms in AUs.

**13. Social Science:** The impact of different risk management strategies on farm productivity and its resilience to climatic shocks was estimated. Measures were categorized into risk-mitigating, risk-transferring and risk-coping strategies. A Study was under taken to estimate productivity and risk effects of crop insurance vis-à-vis irrigation to explain the low uptake of crop insurance. Both crop insurance and irrigation positively impact farm productivity, but their gains differ significantly. The structure of rural employment is undergoing a change. The withdrawal of the agricultural workforce has further accelerated, and an additional 28 million workers left between 2011-12 and 2017-18. In the recent decade, the agricultural sector has experienced all-time high growth of 3.5%, and the growth has been driven by the animal husbandry and fisheries. The feasibility of a uniform water pricing policy and a differentiated water pricing policy was assessed. A notable shift in cropping patterns will take place when a volumetric and differential water pricing policy is adopted. Possibilities of reducing import dependence to meet the edible oil demand by increasing domestic production, adopting yield-enhancing technologies, and raising import tariffs, was investigated.



Graduation Ceremony at NAARM



Ranking of Agricultural Universities initiated by ICAR

A general method of construction of row-column designs with two rows for orthogonal estimation of main effects and two factor interactions in minimum number of runs was given for orthogonal parameterization. An alternative sampling methodology for estimation of area and production of horticultural crops developed by ICAR was adopted by Department of Horticulture, Government of Haryana. Developed a support vector machine-based prediction model for predicting GIGANTEA proteins in plants. Based on the developed methodology, a prediction server GIPred was also established which is freely accessible (<http://cabgrid.res.in:8080/gipred/>) for proteome-wide recognition of GIGANTEA proteins. Developed machine learning-based models for identification of abiotic stress responsive miRNAs and Pre-miRNAs in plants. Developed a comprehensive machine learning based computational model for discovery of DNA binding proteins in plants (PIDBPred) that play crucial roles in numerous cellular processes.



Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.



A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to





Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behig in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI

and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti





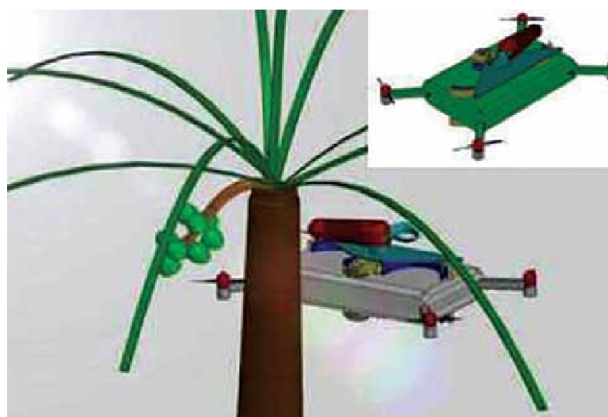
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028



released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with

Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR

Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.





03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**

## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.

In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth– Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested



for managing veterinary services, supply chain solutions, challenges in veterinary science education and role of extension services in mitigating the impact of the pandemic.

- A Brainstorming Session on ‘Scaling up Innovative Agricultural Extension Models Sector’ was organized on 12 September, 2022 under the Convenorship of Dr Ashok K Singh.
- A Brainstorming Session on ‘Beyond Price Support and Subsidies’ was organized on 30 September, 2022 under the Convenorship of Dr Pratap S BIRTHAL.

**Special Webinar:** The Academy organized a special webinar on ‘Transforming Agriculture in Asia’ by Dr Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on 20 December 2021. The webinar was based on the report prepared by the ADB to show how agriculture has minimized the impact of Covid-19.

**National Science Day:** The Academy celebrated National Science Day on 28 February 2022, with an online lecture by Prof. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai.

**International Women’s Day:** The Academy celebrated International Women’s Day on 8 March 2022, by organizing an online panel discussion on ‘R&D Innovations for Sustainable Agriculture in India’.

**World Biodiversity Day:** On 22 May 2022, the NAAS observed World Biodiversity Day by organising a discussion on Global Genebanks and Biodiversity Management for Sustainable Agriculture. Some of the eminent speakers were Dr Hugh Pritchard, Kew Botanic Garden, UK; Dr Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Ashok K Singh, Director, ICAR-IARI, New Delhi; Mr Kent Nnadozie, Secretary of the International Treaty, FAO, Rome; Dr Murukarthick Jayakodi, Group Leader, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany; Prof. Rajeev Varshney, International Chair in Agriculture and Food Security, Food Futures Institute, Murdoch University, Australia. Over 350 delegates participated in this programme.

**XV Agricultural Science Congress:** The Academy organized the XV Agriculture Science Congress on the theme ‘Energy and Agriculture: Challenges in 21<sup>st</sup> Century’ jointly with the Banaras Hindu University, Varanasi, from 13-16 November,

2021. In view of the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047. More than 1,800 delegates (900 in-person including 300 farmers) participated including fellows of the academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations and exchanged their ideas on various themes and sub-themes of the Congress. A national-level elocution contest was also organized on the theme of the Congress for the students selected from all over the country. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services for the benefit of farmers.

## II. Foundation Day Programme/Annual General Body Meeting

During 2021-22, the Foundation Day Programme/AGB Meeting was held on 4-5 June, 2022 at New Delhi. Besides usual AGB business session, following science-based activities were organized:

- Scientific presentations by newly elected fellows.
- The Presidential Address was delivered by Dr T Mohapatra, President, NAAS in 29<sup>th</sup> AGM. In his address, he drew attention to the fact that although India has made remarkable progress in food production, ensuring food and nutrition security, increasing agricultural exports, and improving agricultural sustainability remain important in the process of transformation of food system in view of the changing consumers’ preferences and social aspects of food consumption.
- The Foundation Day Lecture: On the occasion of its Foundation Day on 5 June, 2022, the Academy organized in hybrid mode a lecture by Prof P Balaram, Former Director, Indian Institute of Science, Bengaluru. He spoke on ‘Reflections on Science in the age of the Corona Virus’ and presented an excellent account on the evolutionary history of corona virus and highlighted the interdependence of biology and chemistry. He explained how chemistry and biology together can reveal the unknown in the nature. He defined science as the study of nature. Citing the examples of the telescope

and the microscope in pursuing the science of cosmology and microbiology, respectively, he said that science is often driven by new technology than by new concepts. He cited the example of rDNA technology, which facilitated development of genetically modified crops. Prof Balaram highlighted that scientists should keep striving to unravel the mystery of nature and search nature-based solutions for human welfare through innovations in agricultural sciences. As we have learnt immensely from the corona virus pandemic, we should prepare ourselves for a better life in future through an integrated approach based on the basics of chemistry, physics and biology. He concluded by reminding us of the lessons that we must learn from the corona virus pandemic, and the that we should respect the nature.

### III. NAAS regional chapters' activities

Twelve Regional Chapters of the Academy are actively functioning at Barapani, Bengaluru, Bhopal, Coimbatore, Cuttack, Hyderabad, Karnal, Kolkata, Lucknow, Ludhiana, Pune and Varanasi.

Notwithstanding the grave situation arising due to the Covid 19 pandemic, the Regional Chapters made commendable efforts to promote scientific activities for addressing regional issues. Barring a few, most of the activities were held on virtual platforms. During the period, Regional Chapters organised highly successful events focussing on students. The high school, graduate, and post graduate students were exposed to different facets of agriculture such as rural bio-entrepreneurship, opportunities in agriculture under *Atma Nirbhar Bharat* scheme, and other contemporary issues related to health, nutrition and environment.

### IV. Publications

The crystallized views of the scientists emerging from the interactive sessions organized by the Academy are published as Policy/Status/Strategy Papers and Policy Briefs, which provide useful inputs to the policymakers, planners, educationists and decision-makers. Following policy documents were published for the period:

#### Policy/Status/Papers

- ♦ Policy Paper 99: New Agricultural Education Policy for Reshaping India

- ♦ Policy Paper 100: Strategies for Enhancing Soil Organic Carbon for Food Security and Climate Action
- ♦ Policy Paper 101: Big Data Analytics in Agriculture
- ♦ Policy Paper 102: WTO and Indian Agriculture: Issues, Concerns and Possible Solutions
- ♦ Policy Paper 103: Antimicrobial Resistance
- ♦ Policy Paper 104: One World One Health
- ♦ Policy Paper 105: Sugarcane-based Ethanol Production for Sustainable Fuel
- ♦ Ethanol Blending Programme
- ♦ Policy Paper 106: Utilization of Wastewaters in Urban and Peri-urban Agriculture
- ♦ Policy Paper 107: Certification of Quality Planting Material of Clonally Propagated Fruit Crops for Promoting Agricultural Diversification
- ♦ Policy Paper 108: Agri-startups in India: Opportunities, Challenges and Way Forward
- ♦ Policy Paper 109: Emergency Preparedness for Prevention of Transboundary Infectious Diseases in Indian Livestock and Poultry

#### Strategy Papers

- ♦ Strategy Paper 14: Innovations in Potato Seed Production
- ♦ Strategy Paper 15: Potential of Transgenic Poultry for Biopharming
- ♦ Strategy Paper 16: Need for Breeding Tomatoes Suitable for Processing
- ♦ Agricultural Research, the official Science Journal of the Academy (published by Springer India Pvt Ltd, Vol. 11, No. 1 and Vol. 12, No. 1 (quarterly).

### V. Recognizing and promoting excellence of individual scientists in the field of agriculture

- **Fellowship/Associateship:** The Fellowship of the Academy embodies a wide spectrum of national and international scientists. Fellows including Pravasi and Foreign Fellows are elected annually in recognition of their distinguished achievements in the field of agriculture and allied sciences. During 2022,

34 new Fellows including two foreign Fellows and three Pravasi Fellows were elected and inducted into the Academy. The Academy also has a scheme of NAAS Associates for encouraging promising young scientists below the age of 40 years, to be associated with the Academy activities. During the year, 11 young scientists were selected as Associates of the Academy based on their academic excellence and scientific contributions as reflected by publications, and products, processes and technologies developed, etc.

- **Academy Awards:** The National Academy of Agricultural Sciences has instituted following Awards for recognizing significant contributions of senior, middle level and young scientists to promote agricultural research and recognize scientists for excellence in research in Agricultural and Allied Sciences including Environment and Nutrition. Memorial, Endowment and Recognition awards are presented biennially at the time of Agricultural Sciences Congress. Young Scientist Awards are given annually and are presented in the Annual General Body meeting of the Academy.

(i) Memorial Awards (7)

(ii) Recognition Awards (6)

(iii) Young Scientists Awards (6)

(iv) Endowment Awards (3)

(v) Dr A B Joshi Memorial Lecture Award

During this year, the six Young Scientists' Awards for 2021 were presented on 5 June, 2022.

### Indian Agricultural Universities Association (IAUA)

Indian Agricultural Universities Association (IAUA) was established on 10 November, 1967 (Registration no. 3498). There were only nine founder member of agricultural universities: PAU, Chandigarh (now Ludhiana); APAU, Hyderabad, (now ANGRAU, Guntur); JNKVV, Jabalpur; UPAU (now GBPUAT), Pantnagar; UAS, Bengaluru; KU, Kalyani (now BCKV, Mohanpur); OUAT, Bhubaneswar; UU (now MPUAT), Udaipur; and IARI, New Delhi. Presently, the IAUA has 71 member universities.

The main objective of the Association is to promote agricultural research, education and

extension in the universities and the states, and thereby rural development in the country. It also acts as a bureau of information to facilitate communication, coordination and mutual consultation among agricultural universities. The Association also acts as a liaison between member universities and concerning government departments to facilitate communication and expedite the needed action in matters of importance.

A quarterly newsletter is being published by the Association since 2000, giving important news, events and achievements by member universities for the information of all the members and others stakeholders. An Annual Report is also being published documenting major activities of IAUA and member universities of the year.

The information on events and proceedings are published through the host universities and the recommendations are uploaded on IAUA website ([www.iauaindia.org](http://www.iauaindia.org)) and also circulated to all the Vice Chancellors of member universities and other main stakeholders.

A brief description of important events organized by IAUA/member universities is given on the following pages:

**45<sup>th</sup> Vice Chancellors' Convention:** The 45<sup>th</sup> Vice Chancellors' Convention of Indian Agricultural Universities Association (IAUA) was organized on the theme 'Improving Standard, Sustainability and Societal Impact of Agricultural Universities' at Birsa Agricultural University (BAU), Ranchi on 20-21 December, 2021 in hybrid mode.

The Vice Chancellors of State Agricultural/Horticultural/Animal Science Universities, Central Agricultural Universities and Deemed Universities of India attended the Convention (off-/on-line), shared their experience, knowledge, expertise, and gave an overview on how to improve standards and social impact of Agricultural Universities. The deliberations were made to align research and education in agricultural and allied disciplines in India in view of NEP (2020) during following four technical sessions conducted on the sub-themes selected for the Convention:

- I. Achieving International Standard in Agricultural Education and Research in the Context of new National Education Policy, 2020.
- II. Strategies to Increase Agricultural Productivity





Hon'ble Governor, Jharkhand, Shri Ramesh Bais (*centre*) and dignitaries releasing the Souvenir during Inauguration of 45<sup>th</sup> VCs Convention.

and Profitability with Development and Application of Appropriate Technologies.

III. Enabling Farmers' Access to Technology, Market, Credit and Extensions Services.

IV. Creating Favourable Ecosystem for Entrepreneurship Development in Agricultural and Allied Sectors.

The Vice Chancellors, their representatives made technical presentations. Panel discussions were conducted in above mentioned four technical sessions and the plenary session of the Convention. The Convention was inaugurated by His Excellency, Governor and Chancellor of Universities, Jharkhand Shri Ramesh Bais.

### IAUA 14<sup>th</sup> National Symposium, June 2022:

The dynamic and continuing transformative landscape of agriculture needs to build neo-generation human resources. This requires ingenious perspective in the agri-education sector to cater to an emerging new set of client farmers whose technology usage and literacy may be at par with the agri-professionals.

Therefore, the onus to build appropriate skill sets in human resources streaming out of institutions of higher agricultural education will be on the education administrators and planners under the umbrella of NAREES. In consonance with new National Educational Policy (NEP)-2020, a formalized convergence platform of technology driven courses with social sciences and agri-business would be an ideal premise. Such competent and trained human resources, equipped with cognitive, technical and managerial skills can create a positive impact at societal level. This responsibility also entails to develop necessary infrastructure, linkages and training opportunities for teaching faculty and policy makers for a seamless deployment and integration

of convergence platforms into existing agricultural education network. With this background, the 14<sup>th</sup> National Symposium of Indian Agricultural Universities Association (IAUA) was organized on 'Creating and Enabling Ecosystem in Agricultural Universities for Agri tech Innovations: Challenges and Opportunities' by Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad in collaboration with IAUA on 9-10 June, 2022. The Symposium included:

- Inaugural Session,
- Session I- Potential for Emerging Technologies in the Agri-food Value Chain and Allied Sectors,
- Session II- Agriculture 4.0 (Smart Farming) Ready Manpower: Stakeholder Perspective,
- Session III- Gearing Up for the Emerging Technologies Driven Ecosystem – Challenges and Opportunities for Agricultural Universities, and
- Session IV- Converging Partnerships – Academia – Industry Incubators and Startup Journeys.

The Vice chancellors (20) from various State Agricultural, Horticultural and Veterinary Universities attended the symposium. Besides, representatives of Vice Chancellors and senior officials from various organizations such as-IIM, Ahmedabad; World Economic Forum, Navi Mumbai; ICAR-IARI, New Delhi; ICAR-NAARM, Hyderabad; ITE&T Department, Telangana; Coromandel International Ltd, Hyderabad; Agri Watch, New Delhi; ISB, Mohali; AG Biosystems Bio Ltd., Hyderabad; NABARD, Hyderabad; NIFTEM, Sonapat; Aruazone, Hyderabad; Criyagen Agri and Biotech Pvt Ltd, Bengaluru also actively participated in the symposium.

**5<sup>th</sup> International Agronomy Congress:** The Fifth International Agronomy Congress (IAC) on 'Agri-innovation to Combat Food and Nutrition Challenges' organized jointly by Indian Society of Agronomy (ISA), New Delhi and PJTSAU, Hyderabad from 23 to 27 November, 2021 at PJTSAU Campus, Hyderabad. There were 14 sub themes in the conference, viz. climate resilient agriculture and ecosystem services, integrated farming system for sustainable peasant economy, agronomy innovation for tapping genetic potential, new vistas in biotic and abiotic stress management, secondary agriculture and farmers prosperity, soil-plant-animal and human health continuum, Big



Unmanned Rice Transplanter



SPAD Meter 2.0

was developed and tested to continuously measure the flow rates in open channels. Utilizing the IoT, the developed digital flume measures the discharge and transmits data wirelessly for storage on cloud (ThingSpeak). It was tested in the field under varying discharge conditions in the field channel. It can be utilized for irrigation water measurement in the field channel for management of available irrigation water.

**10. Post-Harvest Management and Value-Addition:** Post-harvest treatments machine for pre-cooling, washing, warm water treatment, anti-microbial treatment, anti-browning, and pulsed light treatment to the freshly harvested fruits and vegetables was developed. It also has an inspection conveyor to sort out the deformed and damaged products. The capacity of the machine is 1.2 t/hr for capsicum, 1.0 t/hr for apple at a linear belt speed of 5 m/min. The peeling machine for medicinal tuber crops was developed with peeling efficiency of ~92% for *Safed musli* and 55% for *Shatavari* and capacity of ~15-20 kg/hr which is 30 times higher than manual operation. An electronic sensing system (e-Nose) has been developed in collaboration with C-DAC Kolkata for the real-time health monitoring of the onions, potatoes, and tomatoes in storage. The machine for popping of sorghum, amaranth, finger millet, kodo millet, and other small grains including rice, and corn developed with a capacity of 1.4-2 kg/hr and 60-70% popping recovery for sorghum and amaranth. To provide easy, fast and non-destructive method for detection of pea flour adulteration in *besan*, near infra-red spectroscopy (NIRS) model was developed which can be used to predict adulteration of *besan* with pea flour. A novel process based on microbial precipitation process to produce protein isolates/concentrates from oilseed cakes/meals was developed. This method increased 5% yield as compared to the chemical process. The protein produced is superior in terms of solubility, wettability, water absorption capacity and degree of hydrolysis. Multi-nutrient biscuits with high satiety value, appealing taste

and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which makes it rich in protein (5 g), minerals (1.4 g), iron (4.5 mg) with good antioxidant activity for 100 g of cake. This is a unique egg less preparation and best suited for people who have gluten allergy. Re-using the existing fibres and textiles, reduces the need for newly manufactured fibres and saves water, energy, dyes and chemicals, which reduces the carbon footprint. The fibres were extracted from pre-consumer cotton knitted fabric waste and converted into yarn by blending this recycled cotton fibre (RF) with virgin cotton (VC) fibre in different blend proportions. The blending in 50:50 (RF:VC) provided better yarn properties and more suitable for home textiles applications such as bed linen, furnishing fabrics, interior decoration accessories etc. Electro spun nanofiber-based micronutrient delivery matrix was developed to enhance the nutrient use efficiency, as compared to bulk nutrient application. The needle electrospinning machine was used to produce zinc sulphate impregnated electro spun nanofiber mat. The banana pseudo stem has potential for extraction of textile fibres, sap for dyeing and finishing, and other portion for making paper-based products. Semi-solid banana plant biomass was used for making paperboard, similar to paper with higher areal density and they are comparable with conventional handmade paper. Application of activated carbon derived from jute stick, NINFET-JAC, as an alternative to graphitized carbon black, was found effective for pesticide residue analysis in various crops like okra, spinach, pomegranate, tea etc. Sheep wool contains about 95% keratins which have huge applications in medical and pharmaceutical industries. Coarser grade wool having no textile use can be used for

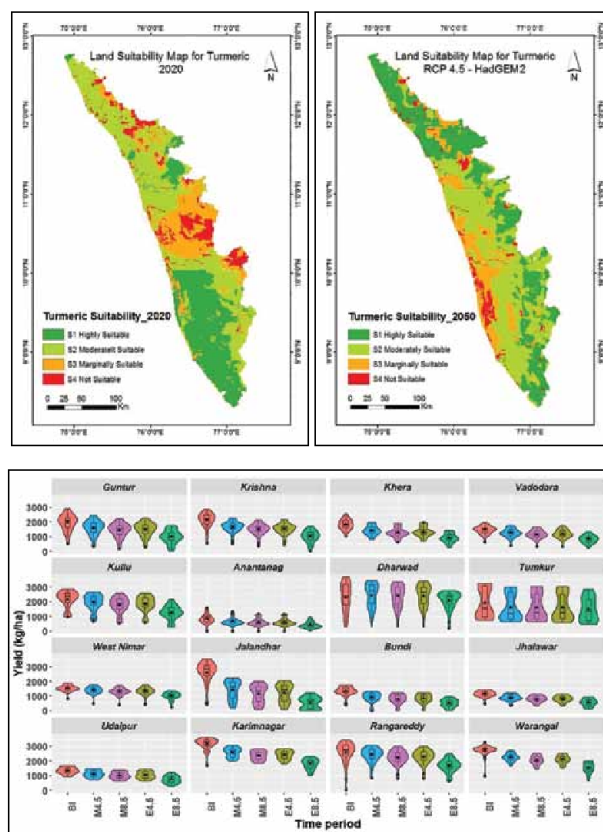


Electronic nose (e-Nose) Near Infra-Red spectroscopy (NIRS)



extraction of keratin. ICAR-NINFET had developed a microbial protocol for keratin extraction from animal hair. Fibre producing species of nettle are European nettle and Himalayan nettle. NINFET has developed 100% nettle, nettle/viscose (75:25, 50:50, 25:75), and nettle/polyester (75:25, 50:50, 25:75) blended yarn and also union fabrics using cotton yarn in warp and these nettle-based yarns in the weft. These blended fabrics are suitable for fashion apparel, garments, shawls, stole, scarf, saree etc.

**11. Climate Resilient Agriculture:** In recent years, land-atmosphere coupling in many parts of the world had been identified to have raised temperatures and aridity. Studies using consistent methodology and metrics from multiple data sources established that the drying land surface turns into a source of heat generation and drought exacerbation due to reduced evaporative cooling and increases atmospheric heating from sensible heat flux. The land suitability for turmeric cultivation in Kerala was analyzed using Had GEM2 Model based on the Representative Concentration Pathway (RCP)-4.5 for climate projection scenario of turmeric in 2050. The projections revealed increase in highly suitable area by 5% from 28% to 33% and decrease of 4% from 11% to 7% in non-suitable areas of turmeric which could positively contribute to its production. The spatio-temporal changes in maize yield were studied using multi-model ensemble climate change projection derived from 30 general circulation models in 16 major maize growing districts of India. The projected reduction in maize yield is 16% to 46% under RCP4.5 and 21-80% under RCP8.5 without adaptation strategy. The combined adaptation strategies might reduce the loss in yield or even increase by 5-15% under RCP4.5 scenario. Rice-based IFS model for lowland conditions of West Coast and IFS model for dryland of



Land suitability maps of turmeric in Kerala for 2020 and 2050.

Karnataka and transitional plain of Luni basin was developed. Swarna Unnat Dhan (IET 27892), rice variety with multiple stress tolerance developed for irrigated transplanted condition of Bihar, Odisha, West Bengal, Madhya Pradesh and Maharashtra. Genome editing technology (CRISPR-Cas9) was used to create loss of function in mutants of the drought and salt Tolerance (DST) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. Three homozygous mutants developed with reproductive stage tolerance to salinity stress. These lines were evaluated further for yield under drought stress and non-stress conditions. Under drought

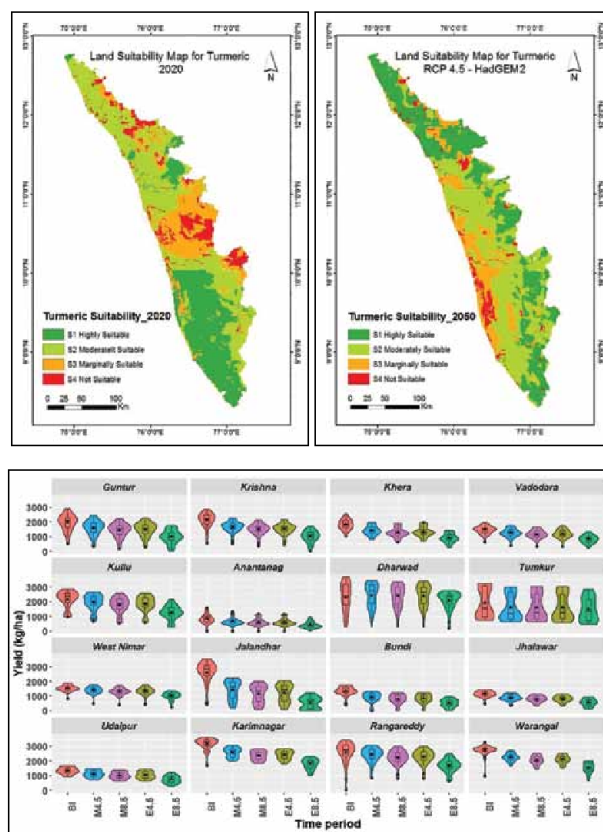


**Genome editing of DST gene enhanced tolerance to drought stress (-75KPa) of rice.** Photographs shows drought stress effect on visible appearance of plants (left panel) and grain yield of plants (right panel). WT, MTU1010; D2bp, genome edited line of MTU1010.



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stress (-75 KPa), genome edited mutants showed significantly higher grain yield as compared with MTU 1010.

## 12. Human Resource Development:

Strengthening and development of higher agricultural education and quality assurance of AUs through accreditation and ranking process are the two major areas supported by ICAR. The strengthening of ICT facilities in AUs, emphasis on capacity building of the students and faculties through various training programmes under ICAR scheme as well as NAHEP helped enhance the capabilities of the faculties in various upcoming areas and improved the publications. AUs were also supported for encouraging holistic development of students, through creation of placement cells, support for sports facilities. The centralized admissions and national/international fellowships by ICAR helped improve academic ecosystem, and encouraged merit across AUs. National Professorial Chairs and National Fellow Scheme for promotion of excellence in research, Emeritus Scientist/Emeritus Professor Schemes as a structural method of utilizing skill bank of the outstanding superannuated professionals in various disciplines to address faculty shortage. NAARM contributes immensely on wide range of issues of national and global importance apart from various courses on capacity building. The Academy has also been promoting online and digital education, startups for agripreneurship. The key components of NAHEP,

viz. Centres for Advanced Agricultural Sciences and Technology (CAAST), Institutional Development Plan (IDP), and Innovation Grants have contributed to enhanced entrepreneurship opportunities and other reforms in AUs.

**13. Social Science:** The impact of different risk management strategies on farm productivity and its resilience to climatic shocks was estimated. Measures were categorized into risk-mitigating, risk-transferring and risk-coping strategies. A Study was under taken to estimate productivity and risk effects of crop insurance vis-à-vis irrigation to explain the low uptake of crop insurance. Both crop insurance and irrigation positively impact farm productivity, but their gains differ significantly. The structure of rural employment is undergoing a change. The withdrawal of the agricultural workforce has further accelerated, and an additional 28 million workers left between 2011-12 and 2017-18. In the recent decade, the agricultural sector has experienced all-time high growth of 3.5%, and the growth has been driven by the animal husbandry and fisheries. The feasibility of a uniform water pricing policy and a differentiated water pricing policy was assessed. A notable shift in cropping patterns will take place when a volumetric and differential water pricing policy is adopted. Possibilities of reducing import dependence to meet the edible oil demand by increasing domestic production, adopting yield-enhancing technologies, and raising import tariffs, was investigated.



Graduation Ceremony at NAARM



Ranking of Agricultural Universities initiated by ICAR

A general method of construction of row-column designs with two rows for orthogonal estimation of main effects and two factor interactions in minimum number of runs was given for orthogonal parameterization. An alternative sampling methodology for estimation of area and production of horticultural crops developed by ICAR was adopted by Department of Horticulture, Government of Haryana. Developed a support vector machine-based prediction model for predicting GIGANTEA proteins in plants. Based on the developed methodology, a prediction server GIPred was also established which is freely accessible (<http://cabgrid.res.in:8080/gipred/>) for proteome-wide recognition of GIGANTEA proteins. Developed machine learning-based models for identification of abiotic stress responsive miRNAs and Pre-miRNAs in plants. Developed a comprehensive machine learning based computational model for discovery of DNA binding proteins in plants (PIDBPred) that play crucial roles in numerous cellular processes.





Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.



A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to



Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behig in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

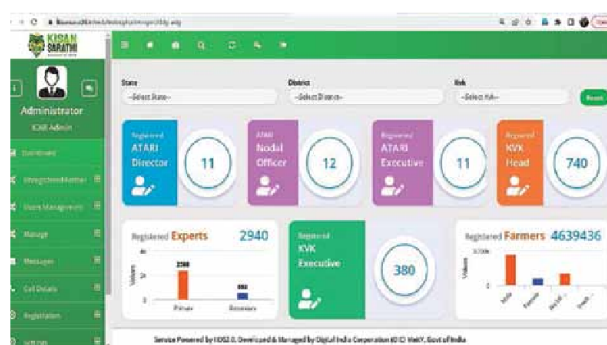
Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI



and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti





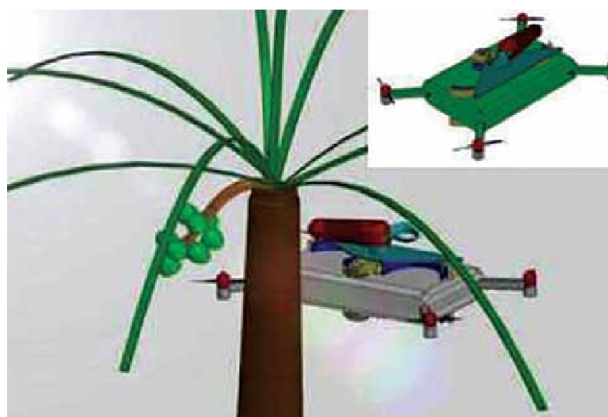
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028

released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with

Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR



Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.



03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**

## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.



In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth– Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested

for managing veterinary services, supply chain solutions, challenges in veterinary science education and role of extension services in mitigating the impact of the pandemic.

- A Brainstorming Session on ‘Scaling up Innovative Agricultural Extension Models Sector’ was organized on 12 September, 2022 under the Convenorship of Dr Ashok K Singh.
- A Brainstorming Session on ‘Beyond Price Support and Subsidies’ was organized on 30 September, 2022 under the Convenorship of Dr Pratap S BIRTHAL.

**Special Webinar:** The Academy organized a special webinar on ‘Transforming Agriculture in Asia’ by Dr Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on 20 December 2021. The webinar was based on the report prepared by the ADB to show how agriculture has minimized the impact of Covid-19.

**National Science Day:** The Academy celebrated National Science Day on 28 February 2022, with an online lecture by Prof. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai.

**International Women’s Day:** The Academy celebrated International Women’s Day on 8 March 2022, by organizing an online panel discussion on ‘R&D Innovations for Sustainable Agriculture in India’.

**World Biodiversity Day:** On 22 May 2022, the NAAS observed World Biodiversity Day by organising a discussion on Global Genebanks and Biodiversity Management for Sustainable Agriculture. Some of the eminent speakers were Dr Hugh Pritchard, Kew Botanic Garden, UK; Dr Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Ashok K Singh, Director, ICAR-IARI, New Delhi; Mr Kent Nnadozie, Secretary of the International Treaty, FAO, Rome; Dr Murukarthick Jayakodi, Group Leader, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany; Prof. Rajeev Varshney, International Chair in Agriculture and Food Security, Food Futures Institute, Murdoch University, Australia. Over 350 delegates participated in this programme.

**XV Agricultural Science Congress:** The Academy organized the XV Agriculture Science Congress on the theme ‘Energy and Agriculture: Challenges in 21<sup>st</sup> Century’ jointly with the Banaras Hindu University, Varanasi, from 13-16 November,

2021. In view of the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047. More than 1,800 delegates (900 in-person including 300 farmers) participated including fellows of the academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations and exchanged their ideas on various themes and sub-themes of the Congress. A national-level elocution contest was also organized on the theme of the Congress for the students selected from all over the country. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services for the benefit of farmers.

## II. Foundation Day Programme/Annual General Body Meeting

During 2021-22, the Foundation Day Programme/AGB Meeting was held on 4-5 June, 2022 at New Delhi. Besides usual AGB business session, following science-based activities were organized:

- Scientific presentations by newly elected fellows.
- The Presidential Address was delivered by Dr T Mohapatra, President, NAAS in 29<sup>th</sup> AGM. In his address, he drew attention to the fact that although India has made remarkable progress in food production, ensuring food and nutrition security, increasing agricultural exports, and improving agricultural sustainability remain important in the process of transformation of food system in view of the changing consumers’ preferences and social aspects of food consumption.
- The Foundation Day Lecture: On the occasion of its Foundation Day on 5 June, 2022, the Academy organized in hybrid mode a lecture by Prof P Balaram, Former Director, Indian Institute of Science, Bengaluru. He spoke on ‘Reflections on Science in the age of the Corona Virus’ and presented an excellent account on the evolutionary history of corona virus and highlighted the interdependence of biology and chemistry. He explained how chemistry and biology together can reveal the unknown in the nature. He defined science as the study of nature. Citing the examples of the telescope

and the microscope in pursuing the science of cosmology and microbiology, respectively, he said that science is often driven by new technology than by new concepts. He cited the example of rDNA technology, which facilitated development of genetically modified crops. Prof Balaram highlighted that scientists should keep striving to unravel the mystery of nature and search nature-based solutions for human welfare through innovations in agricultural sciences. As we have learnt immensely from the corona virus pandemic, we should prepare ourselves for a better life in future through an integrated approach based on the basics of chemistry, physics and biology. He concluded by reminding us of the lessons that we must learn from the corona virus pandemic, and the that we should respect the nature.

### III. NAAS regional chapters' activities

Twelve Regional Chapters of the Academy are actively functioning at Barapani, Bengaluru, Bhopal, Coimbatore, Cuttack, Hyderabad, Karnal, Kolkata, Lucknow, Ludhiana, Pune and Varanasi.

Notwithstanding the grave situation arising due to the Covid 19 pandemic, the Regional Chapters made commendable efforts to promote scientific activities for addressing regional issues. Barring a few, most of the activities were held on virtual platforms. During the period, Regional Chapters organised highly successful events focussing on students. The high school, graduate, and post graduate students were exposed to different facets of agriculture such as rural bio-entrepreneurship, opportunities in agriculture under *Atma Nirbhar Bharat* scheme, and other contemporary issues related to health, nutrition and environment.

### IV. Publications

The crystallized views of the scientists emerging from the interactive sessions organized by the Academy are published as Policy/Status/Strategy Papers and Policy Briefs, which provide useful inputs to the policymakers, planners, educationists and decision-makers. Following policy documents were published for the period:

#### Policy/Status/Papers

- ♦ Policy Paper 99: New Agricultural Education Policy for Reshaping India

- ♦ Policy Paper 100: Strategies for Enhancing Soil Organic Carbon for Food Security and Climate Action
- ♦ Policy Paper 101: Big Data Analytics in Agriculture
- ♦ Policy Paper 102: WTO and Indian Agriculture: Issues, Concerns and Possible Solutions
- ♦ Policy Paper 103: Antimicrobial Resistance
- ♦ Policy Paper 104: One World One Health
- ♦ Policy Paper 105: Sugarcane-based Ethanol Production for Sustainable Fuel
- ♦ Ethanol Blending Programme
- ♦ Policy Paper 106: Utilization of Wastewaters in Urban and Peri-urban Agriculture
- ♦ Policy Paper 107: Certification of Quality Planting Material of Clonally Propagated Fruit Crops for Promoting Agricultural Diversification
- ♦ Policy Paper 108: Agri-startups in India: Opportunities, Challenges and Way Forward
- ♦ Policy Paper 109: Emergency Preparedness for Prevention of Transboundary Infectious Diseases in Indian Livestock and Poultry

#### Strategy Papers

- ♦ Strategy Paper 14: Innovations in Potato Seed Production
- ♦ Strategy Paper 15: Potential of Transgenic Poultry for Biopharming
- ♦ Strategy Paper 16: Need for Breeding Tomatoes Suitable for Processing
- ♦ Agricultural Research, the official Science Journal of the Academy (published by Springer India Pvt Ltd, Vol. 11, No. 1 and Vol. 12, No. 1 (quarterly).

### V. Recognizing and promoting excellence of individual scientists in the field of agriculture

- **Fellowship/Associateship:** The Fellowship of the Academy embodies a wide spectrum of national and international scientists. Fellows including Pravasi and Foreign Fellows are elected annually in recognition of their distinguished achievements in the field of agriculture and allied sciences. During 2022,



34 new Fellows including two foreign Fellows and three Pravasi Fellows were elected and inducted into the Academy. The Academy also has a scheme of NAAS Associates for encouraging promising young scientists below the age of 40 years, to be associated with the Academy activities. During the year, 11 young scientists were selected as Associates of the Academy based on their academic excellence and scientific contributions as reflected by publications, and products, processes and technologies developed, etc.

- **Academy Awards:** The National Academy of Agricultural Sciences has instituted following Awards for recognizing significant contributions of senior, middle level and young scientists to promote agricultural research and recognize scientists for excellence in research in Agricultural and Allied Sciences including Environment and Nutrition. Memorial, Endowment and Recognition awards are presented biennially at the time of Agricultural Sciences Congress. Young Scientist Awards are given annually and are presented in the Annual General Body meeting of the Academy.

(i) Memorial Awards (7)

(ii) Recognition Awards (6)

(iii) Young Scientists Awards (6)

(iv) Endowment Awards (3)

(v) Dr A B Joshi Memorial Lecture Award

During this year, the six Young Scientists' Awards for 2021 were presented on 5 June, 2022.

### Indian Agricultural Universities Association (IAUA)

Indian Agricultural Universities Association (IAUA) was established on 10 November, 1967 (Registration no. 3498). There were only nine founder member of agricultural universities: PAU, Chandigarh (now Ludhiana); APAU, Hyderabad, (now ANGRAU, Guntur); JNKVV, Jabalpur; UPAU (now GBPUAT), Pantnagar; UAS, Bengaluru; KU, Kalyani (now BCKV, Mohanpur); OUAT, Bhubaneswar; UU (now MPUAT), Udaipur; and IARI, New Delhi. Presently, the IAUA has 71 member universities.

The main objective of the Association is to promote agricultural research, education and

extension in the universities and the states, and thereby rural development in the country. It also acts as a bureau of information to facilitate communication, coordination and mutual consultation among agricultural universities. The Association also acts as a liaison between member universities and concerning government departments to facilitate communication and expedite the needed action in matters of importance.

A quarterly newsletter is being published by the Association since 2000, giving important news, events and achievements by member universities for the information of all the members and others stakeholders. An Annual Report is also being published documenting major activities of IAUA and member universities of the year.

The information on events and proceedings are published through the host universities and the recommendations are uploaded on IAUA website ([www.iauaindia.org](http://www.iauaindia.org)) and also circulated to all the Vice Chancellors of member universities and other main stakeholders.

A brief description of important events organized by IAUA/member universities is given on the following pages:

**45<sup>th</sup> Vice Chancellors' Convention:** The 45<sup>th</sup> Vice Chancellors' Convention of Indian Agricultural Universities Association (IAUA) was organized on the theme 'Improving Standard, Sustainability and Societal Impact of Agricultural Universities' at Birsa Agricultural University (BAU), Ranchi on 20-21 December, 2021 in hybrid mode.

The Vice Chancellors of State Agricultural/Horticultural/Animal Science Universities, Central Agricultural Universities and Deemed Universities of India attended the Convention (off-/on-line), shared their experience, knowledge, expertise, and gave an overview on how to improve standards and social impact of Agricultural Universities. The deliberations were made to align research and education in agricultural and allied disciplines in India in view of NEP (2020) during following four technical sessions conducted on the sub-themes selected for the Convention:

- I. Achieving International Standard in Agricultural Education and Research in the Context of new National Education Policy, 2020.
- II. Strategies to Increase Agricultural Productivity



Hon'ble Governor, Jharkhand, Shri Ramesh Bais (*centre*) and dignitaries releasing the Souvenir during Inauguration of 45<sup>th</sup> VCs Convention.

and Profitability with Development and Application of Appropriate Technologies.

III. Enabling Farmers' Access to Technology, Market, Credit and Extensions Services.

IV. Creating Favourable Ecosystem for Entrepreneurship Development in Agricultural and Allied Sectors.

The Vice Chancellors, their representatives made technical presentations. Panel discussions were conducted in above mentioned four technical sessions and the plenary session of the Convention. The Convention was inaugurated by His Excellency, Governor and Chancellor of Universities, Jharkhand Shri Ramesh Bais.

### IAUA 14<sup>th</sup> National Symposium, June 2022:

The dynamic and continuing transformative landscape of agriculture needs to build neo-generation human resources. This requires ingenious perspective in the agri-education sector to cater to an emerging new set of client farmers whose technology usage and literacy may be at par with the agri-professionals.

Therefore, the onus to build appropriate skill sets in human resources streaming out of institutions of higher agricultural education will be on the education administrators and planners under the umbrella of NAREES. In consonance with new National Educational Policy (NEP)-2020, a formalized convergence platform of technology driven courses with social sciences and agri-business would be an ideal premise. Such competent and trained human resources, equipped with cognitive, technical and managerial skills can create a positive impact at societal level. This responsibility also entails to develop necessary infrastructure, linkages and training opportunities for teaching faculty and policy makers for a seamless deployment and integration

of convergence platforms into existing agricultural education network. With this background, the 14<sup>th</sup> National Symposium of Indian Agricultural Universities Association (IAUA) was organized on 'Creating and Enabling Ecosystem in Agricultural Universities for Agri tech Innovations: Challenges and Opportunities' by Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad in collaboration with IAUA on 9-10 June, 2022. The Symposium included:

- Inaugural Session,
- Session I- Potential for Emerging Technologies in the Agri-food Value Chain and Allied Sectors,
- Session II- Agriculture 4.0 (Smart Farming) Ready Manpower: Stakeholder Perspective,
- Session III- Gearing Up for the Emerging Technologies Driven Ecosystem – Challenges and Opportunities for Agricultural Universities, and
- Session IV- Converging Partnerships – Academia – Industry Incubators and Startup Journeys.

The Vice chancellors (20) from various State Agricultural, Horticultural and Veterinary Universities attended the symposium. Besides, representatives of Vice Chancellors and senior officials from various organizations such as-IIM, Ahmedabad; World Economic Forum, Navi Mumbai; ICAR-IARI, New Delhi; ICAR-NAARM, Hyderabad; ITE&T Department, Telangana; Coromandel International Ltd, Hyderabad; Agri Watch, New Delhi; ISB, Mohali; AG Biosystems Bio Ltd., Hyderabad; NABARD, Hyderabad; NIFTEM, Sonapat; Aruazone, Hyderabad; Criyagen Agri and Biotech Pvt Ltd, Bengaluru also actively participated in the symposium.

**5<sup>th</sup> International Agronomy Congress:** The Fifth International Agronomy Congress (IAC) on 'Agri-innovation to Combat Food and Nutrition Challenges' organized jointly by Indian Society of Agronomy (ISA), New Delhi and PJTSAU, Hyderabad from 23 to 27 November, 2021 at PJTSAU Campus, Hyderabad. There were 14 sub themes in the conference, viz. climate resilient agriculture and ecosystem services, integrated farming system for sustainable peasant economy, agronomy innovation for tapping genetic potential, new vistas in biotic and abiotic stress management, secondary agriculture and farmers prosperity, soil-plant-animal and human health continuum, Big



Hon'ble Governor, Jharkhand, Shri Ramesh Bais (*centre*) and dignitaries releasing the Souvenir during Inauguration of 45<sup>th</sup> VCs Convention.

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Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.

A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to





Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behigh in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI



and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti



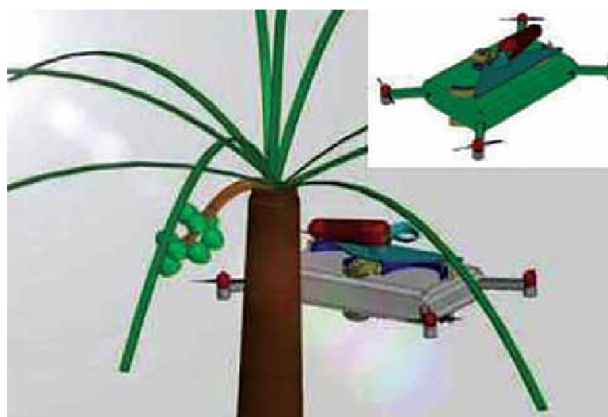
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028



released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with



Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR

stress (-75 KPa), genome edited mutants showed significantly higher grain yield as compared with MTU 1010.

## 12. Human Resource Development:

Strengthening and development of higher agricultural education and quality assurance of AUs through accreditation and ranking process are the two major areas supported by ICAR. The strengthening of ICT facilities in AUs, emphasis on capacity building of the students and faculties through various training programmes under ICAR scheme as well as NAHEP helped enhance the capabilities of the faculties in various upcoming areas and improved the publications. AUs were also supported for encouraging holistic development of students, through creation of placement cells, support for sports facilities. The centralized admissions and national/international fellowships by ICAR helped improve academic ecosystem, and encouraged merit across AUs. National Professorial Chairs and National Fellow Scheme for promotion of excellence in research, Emeritus Scientist/Emeritus Professor Schemes as a structural method of utilizing skill bank of the outstanding superannuated professionals in various disciplines to address faculty shortage. NAARM contributes immensely on wide range of issues of national and global importance apart from various courses on capacity building. The Academy has also been promoting online and digital education, startups for agripreneurship. The key components of NAHEP,

viz. Centres for Advanced Agricultural Sciences and Technology (CAAST), Institutional Development Plan (IDP), and Innovation Grants have contributed to enhanced entrepreneurship opportunities and other reforms in AUs.

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Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.





03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**

## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.

In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth– Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested



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Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.



A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to





Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behig in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI

and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti





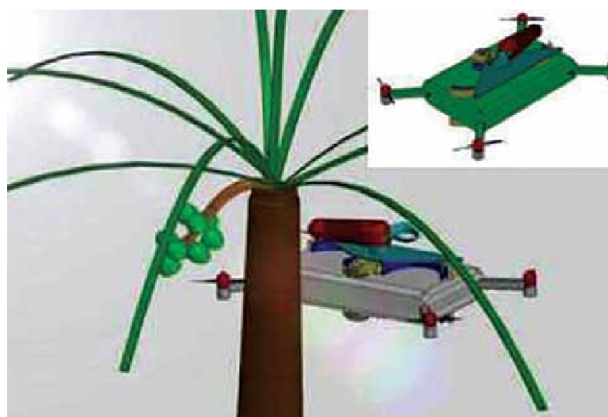
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028



released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with

Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR

Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.





03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**

## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.

In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth- Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested



for managing veterinary services, supply chain solutions, challenges in veterinary science education and role of extension services in mitigating the impact of the pandemic.

- A Brainstorming Session on ‘Scaling up Innovative Agricultural Extension Models Sector’ was organized on 12 September, 2022 under the Convenorship of Dr Ashok K Singh.
- A Brainstorming Session on ‘Beyond Price Support and Subsidies’ was organized on 30 September, 2022 under the Convenorship of Dr Pratap S BIRTHAL.

**Special Webinar:** The Academy organized a special webinar on ‘Transforming Agriculture in Asia’ by Dr Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on 20 December 2021. The webinar was based on the report prepared by the ADB to show how agriculture has minimized the impact of Covid-19.

**National Science Day:** The Academy celebrated National Science Day on 28 February 2022, with an online lecture by Prof. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai.

**International Women’s Day:** The Academy celebrated International Women’s Day on 8 March 2022, by organizing an online panel discussion on ‘R&D Innovations for Sustainable Agriculture in India’.

**World Biodiversity Day:** On 22 May 2022, the NAAS observed World Biodiversity Day by organising a discussion on Global Genebanks and Biodiversity Management for Sustainable Agriculture. Some of the eminent speakers were Dr Hugh Pritchard, Kew Botanic Garden, UK; Dr Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Ashok K Singh, Director, ICAR-IARI, New Delhi; Mr Kent Nnadozie, Secretary of the International Treaty, FAO, Rome; Dr Murukarthick Jayakodi, Group Leader, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany; Prof. Rajeev Varshney, International Chair in Agriculture and Food Security, Food Futures Institute, Murdoch University, Australia. Over 350 delegates participated in this programme.

**XV Agricultural Science Congress:** The Academy organized the XV Agriculture Science Congress on the theme ‘Energy and Agriculture: Challenges in 21<sup>st</sup> Century’ jointly with the Banaras Hindu University, Varanasi, from 13-16 November,

2021. In view of the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047. More than 1,800 delegates (900 in-person including 300 farmers) participated including fellows of the academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations and exchanged their ideas on various themes and sub-themes of the Congress. A national-level elocution contest was also organized on the theme of the Congress for the students selected from all over the country. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services for the benefit of farmers.

## II. Foundation Day Programme/Annual General Body Meeting

During 2021-22, the Foundation Day Programme/AGB Meeting was held on 4-5 June, 2022 at New Delhi. Besides usual AGB business session, following science-based activities were organized:

- Scientific presentations by newly elected fellows.
- The Presidential Address was delivered by Dr T Mohapatra, President, NAAS in 29<sup>th</sup> AGM. In his address, he drew attention to the fact that although India has made remarkable progress in food production, ensuring food and nutrition security, increasing agricultural exports, and improving agricultural sustainability remain important in the process of transformation of food system in view of the changing consumers’ preferences and social aspects of food consumption.
- The Foundation Day Lecture: On the occasion of its Foundation Day on 5 June, 2022, the Academy organized in hybrid mode a lecture by Prof P Balaram, Former Director, Indian Institute of Science, Bengaluru. He spoke on ‘Reflections on Science in the age of the Corona Virus’ and presented an excellent account on the evolutionary history of corona virus and highlighted the interdependence of biology and chemistry. He explained how chemistry and biology together can reveal the unknown in the nature. He defined science as the study of nature. Citing the examples of the telescope

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Unmanned Rice Transplanter



SPAD Meter 2.0

was developed and tested to continuously measure the flow rates in open channels. Utilizing the IoT, the developed digital flume measures the discharge and transmits data wirelessly for storage on cloud (ThingSpeak). It was tested in the field under varying discharge conditions in the field channel. It can be utilized for irrigation water measurement in the field channel for management of available irrigation water.

**10. Post-Harvest Management and Value-Addition:** Post-harvest treatments machine for pre-cooling, washing, warm water treatment, anti-microbial treatment, anti-browning, and pulsed light treatment to the freshly harvested fruits and vegetables was developed. It also has an inspection conveyor to sort out the deformed and damaged products. The capacity of the machine is 1.2 t/hr for capsicum, 1.0 t/hr for apple at a linear belt speed of 5 m/min. The peeling machine for medicinal tuber crops was developed with peeling efficiency of ~92% for *Safed musli* and 55% for *Shatavari* and capacity of ~15-20 kg/hr which is 30 times higher than manual operation. An electronic sensing system (e-Nose) has been developed in collaboration with C-DAC Kolkata for the real-time health monitoring of the onions, potatoes, and tomatoes in storage. The machine for popping of sorghum, amaranth, finger millet, kodo millet, and other small grains including rice, and corn developed with a capacity of 1.4-2 kg/hr and 60-70% popping recovery for sorghum and amaranth. To provide easy, fast and non-destructive method for detection of pea flour adulteration in *besan*, near infra-red spectroscopy (NIRS) model was developed which can be used to predict adulteration of *besan* with pea flour. A novel process based on microbial precipitation process to produce protein isolates/concentrates from oilseed cakes/meals was developed. This method increased 5% yield as compared to the chemical process. The protein produced is superior in terms of solubility, wettability, water absorption capacity and degree of hydrolysis. Multi-nutrient biscuits with high satiety value, appealing taste

and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which makes it rich in protein (5 g), minerals (1.4 g), iron (4.5 mg) with good antioxidant activity for 100 g of cake. This is a unique egg less preparation and best suited for people who have gluten allergy. Re-using the existing fibres and textiles, reduces the need for newly manufactured fibres and saves water, energy, dyes and chemicals, which reduces the carbon footprint. The fibres were extracted from pre-consumer cotton knitted fabric waste and converted into yarn by blending this recycled cotton fibre (RF) with virgin cotton (VC) fibre in different blend proportions. The blending in 50:50 (RF:VC) provided better yarn properties and more suitable for home textiles applications such as bed linen, furnishing fabrics, interior decoration accessories etc. Electro spun nanofiber-based micronutrient delivery matrix was developed to enhance the nutrient use efficiency, as compared to bulk nutrient application. The needle electrospinning machine was used to produce zinc sulphate impregnated electro spun nanofiber mat. The banana pseudo stem has potential for extraction of textile fibres, sap for dyeing and finishing, and other portion for making paper-based products. Semi-solid banana plant biomass was used for making paperboard, similar to paper with higher areal density and they are comparable with conventional handmade paper. Application of activated carbon derived from jute stick, NINFET-JAC, as an alternative to graphitized carbon black, was found effective for pesticide residue analysis in various crops like okra, spinach, pomegranate, tea etc. Sheep wool contains about 95% keratins which have huge applications in medical and pharmaceutical industries. Coarser grade wool having no textile use can be used for

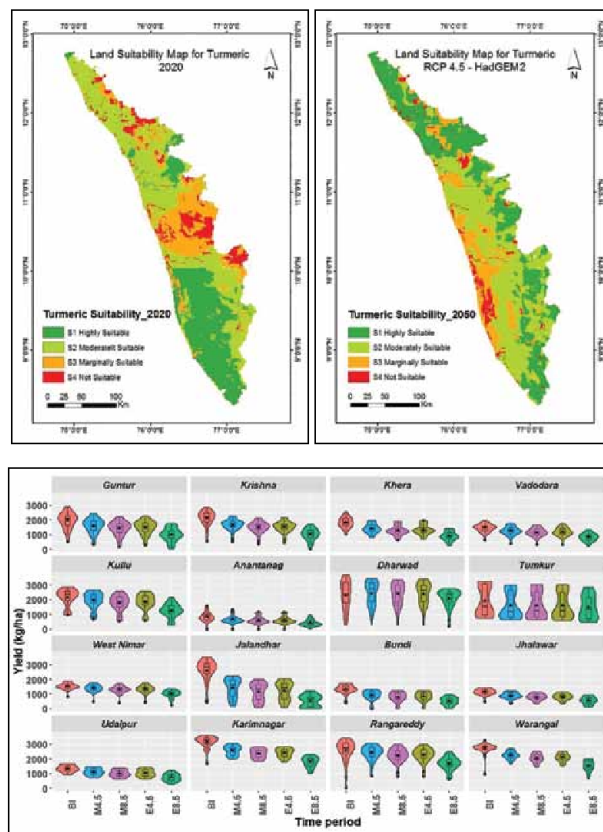


Electronic nose (e-Nose) Near Infra-Red spectroscopy (NIRS)



extraction of keratin. ICAR-NINFET had developed a microbial protocol for keratin extraction from animal hair. Fibre producing species of nettle are European nettle and Himalayan nettle. NINFET has developed 100% nettle, nettle/viscose (75:25, 50:50, 25:75), and nettle/polyester (75:25, 50:50, 25:75) blended yarn and also union fabrics using cotton yarn in warp and these nettle-based yarns in the weft. These blended fabrics are suitable for fashion apparel, garments, shawls, stole, scarf, saree etc.

**11. Climate Resilient Agriculture:** In recent years, land-atmosphere coupling in many parts of the world had been identified to have raised temperatures and aridity. Studies using consistent methodology and metrics from multiple data sources established that the drying land surface turns into a source of heat generation and drought exacerbation due to reduced evaporative cooling and increases atmospheric heating from sensible heat flux. The land suitability for turmeric cultivation in Kerala was analyzed using Had GEM2 Model based on the Representative Concentration Pathway (RCP)-4.5 for climate projection scenario of turmeric in 2050. The projections revealed increase in highly suitable area by 5% from 28% to 33% and decrease of 4% from 11% to 7% in non-suitable areas of turmeric which could positively contribute to its production. The spatio-temporal changes in maize yield were studied using multi-model ensemble climate change projection derived from 30 general circulation models in 16 major maize growing districts of India. The projected reduction in maize yield is 16% to 46% under RCP4.5 and 21-80% under RCP8.5 without adaptation strategy. The combined adaptation strategies might reduce the loss in yield or even increase by 5-15% under RCP4.5 scenario. Rice-based IFS model for lowland conditions of West Coast and IFS model for dryland of



Land suitability maps of turmeric in Kerala for 2020 and 2050.

Karnataka and transitional plain of Luni basin was developed. Swarna Unnat Dhan (IET 27892), rice variety with multiple stress tolerance developed for irrigated transplanted condition of Bihar, Odisha, West Bengal, Madhya Pradesh and Maharashtra. Genome editing technology (CRISPR-Cas9) was used to create loss of function in mutants of the drought and salt Tolerance (DST) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. Three homozygous mutants developed with reproductive stage tolerance to salinity stress. These lines were evaluated further for yield under drought stress and non-stress conditions. Under drought



**Genome editing of DST gene enhanced tolerance to drought stress (-75KPa) of rice.** Photographs shows drought stress effect on visible appearance of plants (left panel) and grain yield of plants (right panel). WT, MTU1010; D2bp, genome edited line of MTU1010.

stress (-75 KPa), genome edited mutants showed significantly higher grain yield as compared with MTU 1010.

## 12. Human Resource Development:

Strengthening and development of higher agricultural education and quality assurance of AUs through accreditation and ranking process are the two major areas supported by ICAR. The strengthening of ICT facilities in AUs, emphasis on capacity building of the students and faculties through various training programmes under ICAR scheme as well as NAHEP helped enhance the capabilities of the faculties in various upcoming areas and improved the publications. AUs were also supported for encouraging holistic development of students, through creation of placement cells, support for sports facilities. The centralized admissions and national/international fellowships by ICAR helped improve academic ecosystem, and encouraged merit across AUs. National Professorial Chairs and National Fellow Scheme for promotion of excellence in research, Emeritus Scientist/Emeritus Professor Schemes as a structural method of utilizing skill bank of the outstanding superannuated professionals in various disciplines to address faculty shortage. NAARM contributes immensely on wide range of issues of national and global importance apart from various courses on capacity building. The Academy has also been promoting online and digital education, startups for agripreneurship. The key components of NAHEP,

viz. Centres for Advanced Agricultural Sciences and Technology (CAAST), Institutional Development Plan (IDP), and Innovation Grants have contributed to enhanced entrepreneurship opportunities and other reforms in AUs.

**13. Social Science:** The impact of different risk management strategies on farm productivity and its resilience to climatic shocks was estimated. Measures were categorized into risk-mitigating, risk-transferring and risk-coping strategies. A Study was under taken to estimate productivity and risk effects of crop insurance vis-à-vis irrigation to explain the low uptake of crop insurance. Both crop insurance and irrigation positively impact farm productivity, but their gains differ significantly. The structure of rural employment is undergoing a change. The withdrawal of the agricultural workforce has further accelerated, and an additional 28 million workers left between 2011-12 and 2017-18. In the recent decade, the agricultural sector has experienced all-time high growth of 3.5%, and the growth has been driven by the animal husbandry and fisheries. The feasibility of a uniform water pricing policy and a differentiated water pricing policy was assessed. A notable shift in cropping patterns will take place when a volumetric and differential water pricing policy is adopted. Possibilities of reducing import dependence to meet the edible oil demand by increasing domestic production, adopting yield-enhancing technologies, and raising import tariffs, was investigated.



Graduation Ceremony at NAARM



Ranking of Agricultural Universities initiated by ICAR

A general method of construction of row-column designs with two rows for orthogonal estimation of main effects and two factor interactions in minimum number of runs was given for orthogonal parameterization. An alternative sampling methodology for estimation of area and production of horticultural crops developed by ICAR was adopted by Department of Horticulture, Government of Haryana. Developed a support vector machine-based prediction model for predicting GIGANTEA proteins in plants. Based on the developed methodology, a prediction server GIPred was also established which is freely accessible (<http://cabgrid.res.in:8080/gipred/>) for proteome-wide recognition of GIGANTEA proteins. Developed machine learning-based models for identification of abiotic stress responsive miRNAs and Pre-miRNAs in plants. Developed a comprehensive machine learning based computational model for discovery of DNA binding proteins in plants (PIDBPred) that play crucial roles in numerous cellular processes.





Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.



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A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to





Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behig in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI

and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti





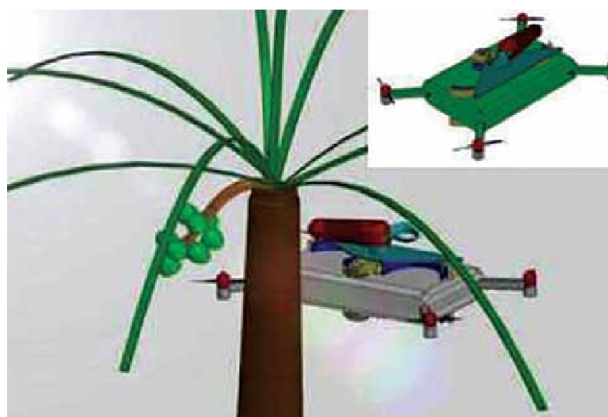
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028



released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with

Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR

Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.





03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**

## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.

In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth– Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested



for managing veterinary services, supply chain solutions, challenges in veterinary science education and role of extension services in mitigating the impact of the pandemic.

- A Brainstorming Session on ‘Scaling up Innovative Agricultural Extension Models Sector’ was organized on 12 September, 2022 under the Convenorship of Dr Ashok K Singh.
- A Brainstorming Session on ‘Beyond Price Support and Subsidies’ was organized on 30 September, 2022 under the Convenorship of Dr Pratap S BIRTHAL.

**Special Webinar:** The Academy organized a special webinar on ‘Transforming Agriculture in Asia’ by Dr Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on 20 December 2021. The webinar was based on the report prepared by the ADB to show how agriculture has minimized the impact of Covid-19.

**National Science Day:** The Academy celebrated National Science Day on 28 February 2022, with an online lecture by Prof. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai.

**International Women’s Day:** The Academy celebrated International Women’s Day on 8 March 2022, by organizing an online panel discussion on ‘R&D Innovations for Sustainable Agriculture in India’.

**World Biodiversity Day:** On 22 May 2022, the NAAS observed World Biodiversity Day by organising a discussion on Global Genebanks and Biodiversity Management for Sustainable Agriculture. Some of the eminent speakers were Dr Hugh Pritchard, Kew Botanic Garden, UK; Dr Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Ashok K Singh, Director, ICAR-IARI, New Delhi; Mr Kent Nnadozie, Secretary of the International Treaty, FAO, Rome; Dr Murukarthick Jayakodi, Group Leader, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany; Prof. Rajeev Varshney, International Chair in Agriculture and Food Security, Food Futures Institute, Murdoch University, Australia. Over 350 delegates participated in this programme.

**XV Agricultural Science Congress:** The Academy organized the XV Agriculture Science Congress on the theme ‘Energy and Agriculture: Challenges in 21<sup>st</sup> Century’ jointly with the Banaras Hindu University, Varanasi, from 13-16 November,

2021. In view of the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047. More than 1,800 delegates (900 in-person including 300 farmers) participated including fellows of the academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations and exchanged their ideas on various themes and sub-themes of the Congress. A national-level elocution contest was also organized on the theme of the Congress for the students selected from all over the country. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services for the benefit of farmers.

## II. Foundation Day Programme/Annual General Body Meeting

During 2021-22, the Foundation Day Programme/AGB Meeting was held on 4-5 June, 2022 at New Delhi. Besides usual AGB business session, following science-based activities were organized:

- Scientific presentations by newly elected fellows.
- The Presidential Address was delivered by Dr T Mohapatra, President, NAAS in 29<sup>th</sup> AGM. In his address, he drew attention to the fact that although India has made remarkable progress in food production, ensuring food and nutrition security, increasing agricultural exports, and improving agricultural sustainability remain important in the process of transformation of food system in view of the changing consumers’ preferences and social aspects of food consumption.
- The Foundation Day Lecture: On the occasion of its Foundation Day on 5 June, 2022, the Academy organized in hybrid mode a lecture by Prof P Balaram, Former Director, Indian Institute of Science, Bengaluru. He spoke on ‘Reflections on Science in the age of the Corona Virus’ and presented an excellent account on the evolutionary history of corona virus and highlighted the interdependence of biology and chemistry. He explained how chemistry and biology together can reveal the unknown in the nature. He defined science as the study of nature. Citing the examples of the telescope



Unmanned Rice Transplanter



SPAD Meter 2.0

was developed and tested to continuously measure the flow rates in open channels. Utilizing the IoT, the developed digital flume measures the discharge and transmits data wirelessly for storage on cloud (ThingSpeak). It was tested in the field under varying discharge conditions in the field channel. It can be utilized for irrigation water measurement in the field channel for management of available irrigation water.

**10. Post-Harvest Management and Value-Addition:** Post-harvest treatments machine for pre-cooling, washing, warm water treatment, anti-microbial treatment, anti-browning, and pulsed light treatment to the freshly harvested fruits and vegetables was developed. It also has an inspection conveyor to sort out the deformed and damaged products. The capacity of the machine is 1.2 t/hr for capsicum, 1.0 t/hr for apple at a linear belt speed of 5 m/min. The peeling machine for medicinal tuber crops was developed with peeling efficiency of ~92% for *Safed musli* and 55% for *Shatavari* and capacity of ~15-20 kg/hr which is 30 times higher than manual operation. An electronic sensing system (e-Nose) has been developed in collaboration with C-DAC Kolkata for the real-time health monitoring of the onions, potatoes, and tomatoes in storage. The machine for popping of sorghum, amaranth, finger millet, kodo millet, and other small grains including rice, and corn developed with a capacity of 1.4-2 kg/hr and 60-70% popping recovery for sorghum and amaranth. To provide easy, fast and non-destructive method for detection of pea flour adulteration in *besan*, near infra-red spectroscopy (NIRS) model was developed which can be used to predict adulteration of *besan* with pea flour. A novel process based on microbial precipitation process to produce protein isolates/concentrates from oilseed cakes/meals was developed. This method increased 5% yield as compared to the chemical process. The protein produced is superior in terms of solubility, wettability, water absorption capacity and degree of hydrolysis. Multi-nutrient biscuits with high satiety value, appealing taste

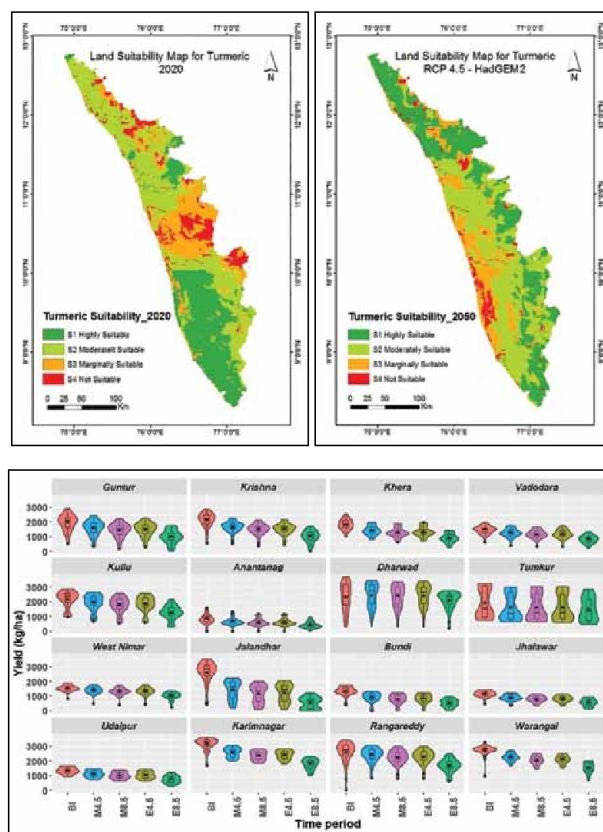
and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which makes it rich in protein (5 g), minerals (1.4 g), iron (4.5 mg) with good antioxidant activity for 100 g of cake. This is a unique egg less preparation and best suited for people who have gluten allergy. Re-using the existing fibres and textiles, reduces the need for newly manufactured fibres and saves water, energy, dyes and chemicals, which reduces the carbon footprint. The fibres were extracted from pre-consumer cotton knitted fabric waste and converted into yarn by blending this recycled cotton fibre (RF) with virgin cotton (VC) fibre in different blend proportions. The blending in 50:50 (RF:VC) provided better yarn properties and more suitable for home textiles applications such as bed linen, furnishing fabrics, interior decoration accessories etc. Electro spun nanofiber-based micronutrient delivery matrix was developed to enhance the nutrient use efficiency, as compared to bulk nutrient application. The needle electrospinning machine was used to produce zinc sulphate impregnated electro spun nanofiber mat. The banana pseudo stem has potential for extraction of textile fibres, sap for dyeing and finishing, and other portion for making paper-based products. Semi-solid banana plant biomass was used for making paperboard, similar to paper with higher areal density and they are comparable with conventional handmade paper. Application of activated carbon derived from jute stick, NINFET-JAC, as an alternative to graphitized carbon black, was found effective for pesticide residue analysis in various crops like okra, spinach, pomegranate, tea etc. Sheep wool contains about 95% keratins which have huge applications in medical and pharmaceutical industries. Coarser grade wool having no textile use can be used for



Electronic nose (e-Nose) Near Infra-Red spectroscopy (NIRS)

extraction of keratin. ICAR-NINFET had developed a microbial protocol for keratin extraction from animal hair. Fibre producing species of nettle are European nettle and Himalayan nettle. NINFET has developed 100% nettle, nettle/viscose (75:25, 50:50, 25:75), and nettle/polyester (75:25, 50:50, 25:75) blended yarn and also union fabrics using cotton yarn in warp and these nettle-based yarns in the weft. These blended fabrics are suitable for fashion apparel, garments, shawls, stole, scarf, saree etc.

**11. Climate Resilient Agriculture:** In recent years, land-atmosphere coupling in many parts of the world had been identified to have raised temperatures and aridity. Studies using consistent methodology and metrics from multiple data sources established that the drying land surface turns into a source of heat generation and drought exacerbation due to reduced evaporative cooling and increases atmospheric heating from sensible heat flux. The land suitability for turmeric cultivation in Kerala was analyzed using Had GEM2 Model based on the Representative Concentration Pathway (RCP)-4.5 for climate projection scenario of turmeric in 2050. The projections revealed increase in highly suitable area by 5% from 28% to 33% and decrease of 4% from 11% to 7% in non-suitable areas of turmeric which could positively contribute to its production. The spatio-temporal changes in maize yield were studied using multi-model ensemble climate change projection derived from 30 general circulation models in 16 major maize growing districts of India. The projected reduction in maize yield is 16% to 46% under RCP4.5 and 21-80% under RCP8.5 without adaptation strategy. The combined adaptation strategies might reduce the loss in yield or even increase by 5-15% under RCP4.5 scenario. Rice-based IFS model for lowland conditions of West Coast and IFS model for dryland of



Land suitability maps of turmeric in Kerala for 2020 and 2050.

Karnataka and transitional plain of Luni basin was developed. Swarna Unnat Dhan (IET 27892), rice variety with multiple stress tolerance developed for irrigated transplanted condition of Bihar, Odisha, West Bengal, Madhya Pradesh and Maharashtra. Genome editing technology (CRISPR-Cas9) was used to create loss of function in mutants of the drought and salt Tolerance (DST) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. Three homozygous mutants developed with reproductive stage tolerance to salinity stress. These lines were evaluated further for yield under drought stress and non-stress conditions. Under drought



**Genome editing of DST gene enhanced tolerance to drought stress (-75KPa) of rice.** Photographs shows drought stress effect on visible appearance of plants (left panel) and grain yield of plants (right panel). WT, MTU1010; D2bp, genome edited line of MTU1010.



stress (-75 KPa), genome edited mutants showed significantly higher grain yield as compared with MTU 1010.

## 12. Human Resource Development:

Strengthening and development of higher agricultural education and quality assurance of AUs through accreditation and ranking process are the two major areas supported by ICAR. The strengthening of ICT facilities in AUs, emphasis on capacity building of the students and faculties through various training programmes under ICAR scheme as well as NAHEP helped enhance the capabilities of the faculties in various upcoming areas and improved the publications. AUs were also supported for encouraging holistic development of students, through creation of placement cells, support for sports facilities. The centralized admissions and national/international fellowships by ICAR helped improve academic ecosystem, and encouraged merit across AUs. National Professorial Chairs and National Fellow Scheme for promotion of excellence in research, Emeritus Scientist/ Emeritus Professor Schemes as a structural method of utilizing skill bank of the outstanding superannuated professionals in various disciplines to address faculty shortage. NAARM contributes immensely on wide range of issues of national and global importance apart from various courses on capacity building. The Academy has also been promoting online and digital education, startups for agripreneurship. The key components of NAHEP,

viz. Centres for Advanced Agricultural Sciences and Technology (CAAST), Institutional Development Plan (IDP), and Innovation Grants have contributed to enhanced entrepreneurship opportunities and other reforms in AUs.

**13. Social Science:** The impact of different risk management strategies on farm productivity and its resilience to climatic shocks was estimated. Measures were categorized into risk-mitigating, risk- transferring and risk-coping strategies. A Study was under taken to estimate productivity and risk effects of crop insurance vis-à-vis irrigation to explain the low uptake of crop insurance. Both crop insurance and irrigation positively impact farm productivity, but their gains differ significantly. The structure of rural employment is undergoing a change. The withdrawal of the agricultural workforce has further accelerated, and an additional 28 million workers left between 2011-12 and 2017-18. In the recent decade, the agricultural sector has experienced all-time high growth of 3.5%, and the growth has been driven by the animal husbandry and fisheries. The feasibility of a uniform water pricing policy and a differentiated water pricing policy was assessed. A notable shift in cropping patterns will take place when a volumetric and differential water pricing policy is adopted. Possibilities of reducing import dependence to meet the edible oil demand by increasing domestic production, adopting yield-enhancing technologies, and raising import tariffs, was investigated.



Graduation Ceremony at NAARM



Ranking of Agricultural Universities initiated by ICAR

A general method of construction of row-column designs with two rows for orthogonal estimation of main effects and two factor interactions in minimum number of runs was given for orthogonal parameterization. An alternative sampling methodology for estimation of area and production of horticultural crops developed by ICAR was adopted by Department of Horticulture, Government of Haryana. Developed a support vector machine-based prediction model for predicting GIGANTEA proteins in plants. Based on the developed methodology, a prediction server GIPred was also established which is freely accessible (<http://cabgrid.res.in:8080/gipred/>) for proteome-wide recognition of GIGANTEA proteins. Developed machine learning-based models for identification of abiotic stress responsive miRNAs and Pre-miRNAs in plants. Developed a comprehensive machine learning based computational model for discovery of DNA binding proteins in plants (PIDBPred) that play crucial roles in numerous cellular processes.



Developed prediction server PIDBPred which is publicly accessible at <https://iasri-sg.icar.gov.in/pldbpred/>. The miRNA profile prediction system was implemented as a webserver available at <https://scbb.ihbt.res.in/miRbiom-webserver/> and also the standalone version available at Github (<https://github.com/SCBB-LAB/miRbiom>). Citation analysis of publication during 2007-2020 showed increase in that total number of publications, total citations, average citation per paper, impact factor per paper, number of papers in journals with impact factor  $\geq 4$ . ASRB-Online Application & Scorecard Information System (ASRB- OASIS) application (<http://www.asrb.org.in/>) was developed for inviting online applications for the RMP positions and Non-RMP positions. Academic Management System (AMS), a web-based application, aimed at automating administrative and academic activities of agricultural was adopted in 56 agricultural universities. ICAR carried out research activities focusing on farm women nutrition, livelihood enhancement, technological empowerment, drudgery reduction and entrepreneurship development. In rural areas, the participation of women (6yr+age) in overall agriculture, crop sector and livestock sector were 22.4, 13.3 and 10.7 % and their contribution were 30.8, 27.2 and 45.8 %, respectively. The survey conducted to understand the knowledge level of farm women

on nutritional aspects indicated that nutritional awareness among farm women increased to 60 % as compared to the pre-project status of 15.5 %. A pan-India nutri-smart village project was designed for promoting nutritional awareness, education and behavioural change in rural areas involving farm women and school children through local recipes to overcome malnutrition, implementing nutrition sensitive agriculture through homestead agriculture and nutri-gardens. Twenty-eight capacity building programmes were organized for potential women entrepreneurs in the identified areas which benefitted 902 rural women.

**14. Basic and Strategic Research:** Genome editing technology (CRISPR-Cas9) was used to create loss of function mutants of the drought and salt tolerance (*DST*) gene, a zinc finger transcription factor, in rice cultivar MTU 1010. *DST* gene mutants showed >25% increase in grain yield under normal conditions due to increase in reproductive tillers per plants and grain number per panicle. Phenotypic variance of 436 rice accessions from the sequenced panel of 3,000 rice genome accessions was assessed at multiple locations to identify superior donors and alleles for spikelet fertility and low grain chalkiness under thermal stress. Three rice accessions with consistently high spikelet fertility under high temperature, seven accessions with low chalk and eight accessions with cold tolerance were identified.



A panel of 150 diverse accessions from the 3K rice genome panel of IRRI was assembled and extensively phenotyped in the Phenomics Facility under well-watered (100% FC) and limited water (60% FC) conditions to identify QTLs for subcomponent traits of WUE. Fine mapping and marker-assisted breeding for alternative dwarfing genes *Rht14* and *Rht18* was done to develop semi dwarf wheat genotype suitable for conservation agriculture. Germplasm comprising 400 accessions including wild relatives and progenitors of wheat phenotyped for heat stress tolerance was genotyped using 35K Axiom SNP chip to identify the novel genes/QTLs. In order to identify the genomic regions and genes for drought and heat tolerance in groundnut, eight parents and 500 lines of the MAGIC population, 432 RILs of TMV2 × TMV2-NLM and 250 RILs of JL 24 × 55-437 were subjected to DNA sequencing.

The maize genotypes, viz. CML 44 BBB (3.0), DML 163-1 (3.5), IML 16-248 (4.0) were found promising against Fall Armyworm *Spodoptera frugiperda*. In order to impart resistance against Papaya Ring Spot Virus (PRSV), a high throughput papaya transformation and regeneration protocol towards genome editing of the eIF4E gene family was established and CRISPR/Cas9 mediated editing of eIF4E gene family was undertaken.

Targeted editing of the potato genome to develop variety specific True Potato Seed (TPS). A total of 285 banana mats/genotypes collected from different groves of North Eastern (NE) states were characterized for endogenous banana streak viruses (eBSV), which indicated the prevalence of distinct/novel alleles having similarity to endogenous banana streak OL virus (eBSOLV), banana streak IM virus (eBSIMV), banana streak GF virus (eBSGFV) and *Musa balbisaina* PKW type activable alleles, the allelic positions of which make them activable. Full genome sequence of a new badnavirus banana streak MH virus (BSMHV) associated with streak disease of banana cultivar *MeteiHei* (ABB) grown in Manipur was achieved. Soil Zn application as nano-ZnO (nZnO) or bulk ZnO (bZnO) induced marked shifts in bacterial community structure, with dominance of *Sphingomonas* and *Nitrospira* under nZnO exposed soils, while *Bryobacter*, *RB41*, *Candidatus solibacter* and *Flavi solibacter* dominated under bZnO exposed soils. A sensor was developed for the efficient detection of Cr (VI) in water with a linearity range 100 ppb to 1 ppm. The sensor was incorporated into a hand-held prototype device. Another aptamer-based biosensor was developed for the detection of fish pathogenic

bacteria *Aeromonas veronii*. The sensor is able to specifically detect *Aeromonas veronii* and shows no cross-reactivity with other bacteria. 'Ekel decomposer' consortia was prepared; and the drum type composting unit and shredder machine viz. 'EkelCompostr' and 'EkelShredr' were also fabricated, which help in accelerating the decomposition of different bio-waste. The 'Ekel decomposer capsule' was also developed and released. The four bio filters were designed and prototypes were developed for safe wastewater irrigation. Thirteen clones of 6 superior breeding male and one elite buffalo female were produced. A calf of an earlier cloned bull Hisar-Gaurav was also successfully re-cloned. A targeted immobilization method was developed, using iron nano particles conjugated with the developed antibodies (polyclonal), to immobilize the Y-Chromosome bearing spermatozoa. Cattle embryos produced through developed immobilization technique resulted in production of 72- 76% of female embryos. Similarly, a model for assessment of sperm-oviduct binding was developed for cattle. CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo was done. An inexpensive, yet efficient, methodology for microinjection of CRISPR/Cas9 constructs into mouse zygotes was developed. Two approaches were attempted for the production of embryos. The embryo production rates (30-35%) were similar to non-edited control cells. The transfection and handmade cloning protocols were optimized in goats. indigenous transfection buffer was developed and tested in buffalo and goats. Developed buffer has 20-25% genome editing efficiency, and can be efficiently used to deliver CRISPR components/transfection materials into any mammalian somatic cells.

A recombinant nucleocapsid protein (NP) based indirect enzyme-linked immunosorbent assay (iELISA) kit Can-CoV-2 ELISA Kit was developed for detection of antibodies against SARS-CoV-2 in canines. The assay is 95.66% sensitive and 93% specific. The phytochemical conjugated silver nanoparticles (AgNPs) were encapsulated to achieve targeted delivery using chitosan-alginate polymers by ionic gelation method to combat antimicrobial resistance in poultry. All the tested encapsulated leads appeared to be safe (secondary cell line-based MTT assay and commensal gut lactobacilli. Evaluation of selenium in the diet of male growing goats under endotoxin-induced stress conditions indicated that crude protein digestibility tended to



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Progenies born through artificial insemination using semen of cloned bull



Can-CoV-2 ELISA Kit'

behig in higher selenium-fed animals, however, no effects on growth, nutrient intake, and digestibility were reported.

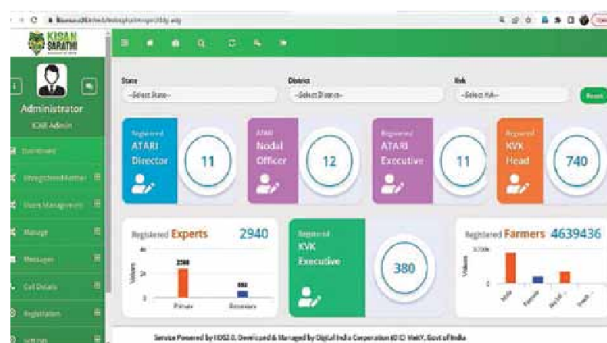
Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize the PPR vaccine virus (PPRV), four types of MSN were synthesized and characterized. Captive brood stocks of hilsa, *Tenualosa ilisha* were developed at three locations with fresh water system at Rahara, intermediate water system at Kolaghat and brackish water system at Kakdwip. Females collected from both captive and river were in similar stage of reproductive maturity while the captive male (av. body weight  $122.33 \pm 3.38$  g) showed advanced maturation (GSI  $2.24 \pm 0.025$ ) compared to wild male ( $238.67 \pm 4.67$  g) with maturing phase (GSI  $0.768 \pm 0.002$ ). An automated anesthetic device was developed for safe handling and performing procedures related to reproductive interventions under stress condition and tested on wild and pond-reared hilsa. It can deliver optimum amount of anesthetic solution with desired flow over the gills through buccal cavity. Two qRT-PCR

assays targeting TiLV genome segments 1 and 10 were standardized and employed to determine the viral load in liver, brain and spleen tissues of experimentally-infected tilapia. The assays detected higher viral load in liver than that determined in spleen and brain at all-time points post-infection. The study revealed an increasing trend in the viral load in the early stages of infection and a steady decline in the later stages. Further, the newly designed real-time PCR assay targeting TiLV genome segment 10 showed high sensitivity and can be used for the reliable detection of the virus. The four models of technology delivery through FPO were developed for seed production, vegetable production, organic farming and natural resource management for eastern region of India. The communication pattern of FPO and Non-FPO farmers was assessed through Social Network Analysis. The cohesiveness, sparsity and degree of influence of FPO were better than non-FPO farmers. An android mobile application-CIBA ShrimpKrishiApp was developed and launched for handholding the shrimp farmers to make real-time based informed decisions at farm level. The app is free and available in four languages, viz. English, Hindi, Tamil and Telugu.

**15. Information, Communication and Publicity Services:** The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of non-scientific ICAR employees introduced in 2022 for filling, submission, reporting



Dashboard of ICAR-SPARROW



KISAN SARATHI



and reviewing of APAR. Similarly, eHRMS, ICAR eOffice, ICAR DARPAND ashboard, Land Record Management Information System, KISAN SARATHI, NePPA, etc have been developed for facilitating the official work.

**16. Technology Assessment, Demonstration and Capacity Development:** During the period under reporting, 7 new KVKs were established taking the total number of KVKs in the country to 731. A total of 6,198 technological options in different crops were assessed at farmers' fields under 31,532 trials at 14,155 locations focusing on varietal evaluation, INM and IPM thematic areas. About 1,097 technological options pertaining to nutrition and other thematic areas in livestock production and management at 2,516 locations through 6,210 trials; 471 technologies under farm and non-farm enterprises at 1,040 locations through 6,124 trials; and 371 technologies pertaining to farm women under 3,222 trials at 756 locations were also assessed. Health and nutrition and value addition were the major thematic areas of technologies assessed with an aim to promote women empowerment.

The demonstrations on improved technologies of pulses and oilseeds numbering 48,473 and 46519 on 17973.95 ha and 18301.31 ha respectively were conducted during reporting period. Among

33,588 cereal crops, 10661 FLDs were conducted on 231 technology options in wheat varieties and management technologies in 3724.04 ha area; in rice 504 varietal and technology options under 18848 FLDs in 4625.52 ha; 3616 FLDs on 131 varietal and technology options in maize on 1074.76 ha area. Among 3,030 FLDS on millets, 48 varietal and technology options were demonstrated on finger millet by 52 KVKs in 1278 FLDs. Varieties and technologies on pearl millet (35) and sorghum (35) demonstrated in 633 and 500 FLDs, respectively. In pulses, total 12206 FLDs were conducted on 533 varietal and production technologies options. It included 3463 FLDs on chickpea, 2461 on blackgram, 1911 on green gram, 1702 on Lentil and 1415 on pigeon pea. A total of 9353 FLDs on 439 varieties and management technologies of oilseed crops conducted including 2311 on mustard, 2088 on rapeseed, 1636 on soybean, and 1507 on groundnut. In horticultural crops, altogether, 27215 FLDs were conducted on 1635 varieties and technologies comprising of vegetables (18514), fruits (3628), spices (3071), flowers (594) and medicinal and aromatic crops (143) in 5342.1 ha area. In commercial crops, 1530 FLDs in sugarcane and 1074 FLDs in cotton were conducted. Demonstrations on forage crops such as berseem, maize, sorghum, Napier grass, etc., were conducted at 3738 farmers' fields on an area of 495.3 ha. KVKs conducted 7973 FLDs on 310 hybrids covering an area of 2375 ha in cereals, millets, oilseeds, pulses, fodder crops, commercial crops and horticultural crops. Total 777 technology options on improved tools and farm implements were demonstrated in 17121 demonstrations covering an area of 9750.37 ha. In animal husbandry & dairying and fisheries, 16983 and 1617 demonstrations were conducted. KVKs conducted 16880 demonstrations on 20 enterprises which facilitated establishment of 23383 enterprise units. Total of 21.16 lakh farmers/farm women, rural youth and extension personnel were trained on various aspects through 69550 training programmes including the sponsored training courses. Besides, KVKs also organized 5.68 lakh extension programmes and disseminated the latest technologies of agriculture and allied sectors among 163.54 lakh participants (160.38 lakh farmers and 3.42 lakh extension personnel).

One of the important services that KVKs offers to farmers is proving quality seeds and planting materials to them free of cost or on a nominal charge. During the year, 1.76 lakh quintal seeds of improved varieties and hybrids various crops to



Kisan Sanghoshti





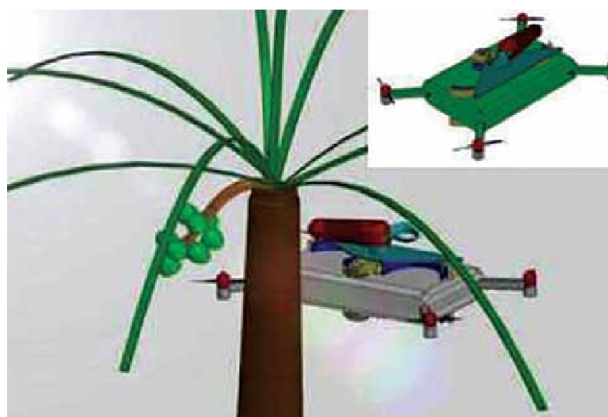
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), vermi-compost, mineral mixture etc., were produced and supplied benefiting 2.71 lakh farmers. Improved breeds of cow, sheep, goat, buffalo and breeding bull were produced and supplied to 56203 farmers. Different strains/breeds/eggs of poultry birds to 44170 farmers and improved breeds of pigs to 729 farmers were also provided. The KVKs also enabled 105 farmers to establish small rabbit rearing units by providing 915 rabbits. A total of 289.24 lakh fish fingerlings were produced and supplied to 9586 farmers. For soil, plant and water health management, KVKs tested 3.10 lakh samples including 2.63 lakh soil samples, 8368 plant samples, 37956 water samples and 383 other samples like fertilizers, manures, food etc. benefiting 3.12 lakh farmers of 50914 villages. A total of 2.22 lakh Soil Health Cards were issued to farmers.

During 2021-22, 4.33 lakh farmers visited ATICs for obtaining solutions related to their agricultural problems and purchasing crucial farm inputs. In addition, 30.19 lakh farmers benefited from technological services provided by various ATICs. During the year, 4,340 entrepreneurial units were established benefiting 6,610 rural youth under ARYA. Under NICRA, 6477, 13931, 7187 demonstrations were conducted covering 5695.81, 6807.6 and 265.65 ha of area under NRM, Crop and Livestock modules, respectively.

Mera Gaon Mera Gaurav (MGMG) programme was implemented through 127 institutions including ICAR institutes and SAUs by 1,054 groups of 4,315 scientists and covered 3,680 villages. Altogether, 37982 field activities conducted and 27,958 advisories sent benefiting 5,05,303 farmers. Under Farmers 36,496 demonstrations and 2,649 extension programmes were organized. TSP KVKs conducted 4634 training attended by 121809 farmers. Under NATI programme, 16,681 nutri-gardens were established benefiting 30,310 farm families. KVKs also organized activities for promotion of nutrition garden, nutri-*thali*, value addition, biofortified crops, etc. Total 2,657 training programs benefiting 81,633 participants and 4,161 extension activities benefiting 1,37,674 participants on nutrition literacy were conducted. Total 6811 training conducted under SCSP which were attended by 118485 farmers.

Seed-hubs were set-up at 95 KVKs for production of quality seeds of major pulse crops. During the year, 42,835.07 q seeds of pulses were produced and made available to farmers. For crop residue management, demonstrations on CRM machinery on >20,000 ha including 3000 demonstrations on decomposer technology was conducted. Total 3,778 IFS units were established on 88,406.19 ha. Total 5,894 IFS demonstrations and 9,512 trainings were conducted for 75,058 and 1,17,010 farmers respectively. Advisories on crop and livestock production/protection technologies in 15 different regional languages were circulated among farmers. Total 2,351 interventions to facilitate information about marketing of farm produce benefitting 5.42 lakh farmers were undertaken.

**17. Research for Tribal and Hill Regions:** For promotion of quality seeds of improved varieties in these disadvantaged areas, 16.138 tones breeder seed of 46 varieties/ inbreds of 17 crops was produced and 13.121 t breeder seed supplied to seed producing agencies for further multiplication. Besides, 1,313 kg nucleus seed of 49 varieties of 17 crops and 655 kg Truthfully Labeled seed of 20 varieties of 13 crops were produced. Including the carry-over stock, about 402 kg TL seed was supplied to different stakeholders. VLQPM Hybrid maize



Fly Cocobot: A drone-based coconut harvester



VL Gehun 2028

released for cultivation in North Western Hill Zone and North Eastern Hill Region. VL *Dhan* 69 released for Uttarakhand, Sikkim and J&K. For Uttarakhand, Maize, VLQPM Hybrid 61 and VLQPM Hybrid 63; wheat, VL *Gehun* 2028 and VL *Gehun* 3010; rice, VL *Dhan* 210, VL *Dhan* 211 and VL *Dhan* 70; lentil, VL 150; and field pea, VL 64 were notified. A total eight micro watersheds comprising dairy-based land use, mixed forestry, silvi-pastoral land use, agro-pastoral system, agri-horti-silvi-pastoral, silvi-horticultural system, natural forest block and timber-based land-use system developed and evaluated on a long term basis in Meghalaya. The integration of crops and livestock resulted in maximum income (₹ 2,71,400) and employment generation (252 man-days excluding family labour). For jhum improvement, one agri-horti-silvi-pastoral system in 1.58 ha developed. The system produced 6,846 kg of rice equivalent yield with a net return of ₹ 62,961. Integrated Organic Farming System (IOFS) models were established at Tripura and Meghalaya. The Tripura model gave a net return of about ₹ 73,990 and employment of 67 days which is quite high compared to existing farming systems. About 70% of the nutrient requirement of the model was met from nutrient recycling within the model. The Meghalaya model recorded a total net return of ₹ 83,360 per year which is much higher than the region's farmer common practices of rice mono-cropping or improved practice of the rice-vegetables cropping system. Approximately 96% of the total N requirement, 87% of the total P<sub>2</sub>O<sub>5</sub> requirement and 99% of the total K<sub>2</sub>O requirement could be met within this model thus making it a self-sustainable one. Ten high yielding stress tolerant crop varieties were released for north eastern hill region. Fly Cocobot-a drone-based remotely controlled unmanned gender-friendly coconut harvesting and crown-clearing machine for safe harvesting of coconuts was developed. This device can be used in mixed cropping plantation of coconut and black pepper. The machine is conceptualized jointly by ICAR-CCARI and Goa University and have operational efficiency of 12-15 palms/hr.

**18. IP, Organization and Management:** During the period under report, 78 new Patent Applications were filed making total to 1,455 applications. Indian Patent Office (IPO) had published ICAR's 37 patent applications in this period and granted 47 patent applications, taking ICAR's cumulative number of granted patents to 455. In this process, 31 ICAR institutes were involved to protect their innovations. To protect the Plant Varieties, 23 varieties (19 extant

and 4 new varieties) were filed at Plant Varieties and Farmers' Rights Authority (PPV&FRA). For applications filed earlier, 60 varieties (52 extant and 8 new) were granted registration certificates. The cumulative total for plant variety protection applications rose to 1,407. Total 650 formal Licensing Agreements were formed up with 442 public and private organizations and entrepreneurs involving 55 ICAR institutes. Eighteen ICAR institutions entered into 80 agreements for consultancy/contract research and services with 75 public and/or private organizations. To enhance the agri-business environment, 494 stakeholders were facilitated by 50 ABIs for their business incubation activities and motivated 42 entrepreneurs/startups to initiate their own business. These centres also organized 209 Entrepreneur Development Programmes (EDPs) and supported 366 Innovation/technology/products.

The Rajbhasha saptah/pakhwara/mah was organized at ICAR Headquarters and its institutes. The RajbhashaUllas Pakhwara was organized during 16 to 29 September 2022 which was marked by inspiring messages of Hon'ble Minister of Agriculture and Farmers Welfare and the Minister of State for Agriculture and Farmers Welfare and appeal by Director General, ICAR to use Hindi the maximum in their official work. Under the Cash Award Scheme of Official Language, 10 personnel were given cash awards for doing their maximum work in Hindi during 2021-22. The Council also implements three more awards at its own -*Rajarshi Tandon Rajbhasha Puskar Yojana*, *Ganesh Shankar Vidyarthi Hindi Patrika Puskar Yojana* and *Dr Rajendra Prasad Puraskar Yojana*. As per the instructions/orders of Ministry of Home Affairs, 38 Institutes (one-third of total) were inspected for assessing the progress of Hindi and suggestions were given to rectify the shortcomings observed. This also includes inspections of Parliamentary Committee on Official Language. Besides, all Parliamentary Matters, Annual Reports, Parliamentary Committee, Annual General body Meetings of ICAR Society, and their proceedings were prepared bilingually.

The Technical Coordination Unit prepared monthly Cabinet Summary for Cabinet Secretary; organized 'Standing Committee' meeting for grant of financial assistance to scientific societies and academic for organizing seminars/symposiums/conferences and publication of Journals; organized Director's Conference/prepared ATR and Agenda items; Coordinated and organized the ICAR Regional Committee Meetings; Collaborated with

Department of Science and Technology, Bureau of Indian Standards etc.; Dealt with the references received from Prime Minister's Office, President Secretariat etc.; Laying of ICAR Annual Report, Annual Accounts and Audited Report of ICAR in both the Houses of Parliament; acted as Nodal Point for e- Samiksha portal for DARE/ICAR and Releasing funds for Swachhta Action Plan (SAP); Quarterly Reports on SAP Portal. Various ICAR Awards for 15 different categories were given to 94 awardees, comprising of 71 scientists (including 7 women) and 11 farmers (including 2 women farmers).

**19. Training and Capacity Building:** Fifteen specialized online/offline training programmes, viz. Training Workshop for Vigilance Officers of ICAR Institutes; MDP on PME in Agricultural Research Projects, MDP for Effective Implementation of Training Functions; Good Agricultural Practices (GAPs) for Higher Productivity, Profitability and Resource-use Efficiency; Appropriate Sampling Techniques Including Sample Preparation and Preservation for Soil, Water, Plant and Air Samples for Various Analyses; Experimental Data Analysis; Cyber Security; Statistical Techniques for Agricultural Data Analysis; E-governance Application in ICAR; Pension and Retirement Benefits; Capacity Building Programme Towards a Secure and Resilient Workplace at ICAR; Accrual Accounting; Assets Management; Repair and Maintenance of Office, Residential Building including Guest Houses and Establishment Matters for UDCs and LDCs were organized by 8 Competent ICAR-Institutes. In these programmes, 794 employees of various categories as per programme participated. An online Training Programme on "Living Heartfulness: Heartfulness Practices for Well-being and Harmony" was organized by HRM Unit, ICAR HQs with the support of Heartfulness Institute, Telangana in which about 35 Officers/officials of ICAR HQs participated.

During the reporting period, 1467, 621, 507 and 239 scientists, technical, administrative including finance, and SSS were trained, respectively. Compared to 2013-14, ICAR-Institutes organized 19.4 and 640.0% more training programmes for technical and skilled support staff, respectively during 2021-22. The new Training Modules for all four categories of employees, i.e. Scientific, Technical, Administrative and SSS, designed, developed and organized from 2015-2020 based on TNA have been documented and published. ICAR also nominated 734 employees of various categories

in training and capacity building programmes organized by various ICAR/non ICAR-Institutes, out of which 492 employees attended the training programmes.

**20. Publications and Social Media:** ICAR-DKMA encourages ICT-driven technology and create information dissemination systems to serve as agricultural knowledge repository. The Indian Journal of Agricultural Sciences (IJAgS) and Indian Journal of Animal Sciences (IJAnS) are multi-disciplinary journals, with the impact factor and H index 0.37 and 29 and 0.31 and 23, respectively. These journals have wide readership and subscription. A total of 3,500 submissions in IJAg S and 1,928 in IJAnS were received during 2022. Popular periodicals like *Indian Farming* and *Indian Horticulture* were brought out for outreach to the masses with special issues on Farmer FIRST Success Stories, Reimagining Rainfed Agro-ecosystems and International Year of Millets and Plantation Crops. Digital Object Identifier (DOI) allotment to the articles for both the research journals was introduced which will benefit the authors as well as journal immensely. To check the plagiarism, software iThenticate was subscribed. For facilitating publication of the books, e-book platform was developed. During the year, ten new titles were published under the books, Stingless Bees – An Unexplored Pollinator in India; Textbook of Ergonomics and Safety in Agriculture; Textbook on Forages; Ravine Land Management : Principles, Practices and Strategies; Textbook of Pet Animal Management; Textbook of Fundamentals of Agricultural and Animal Husbandry Extension; Textbook on Physical Chemistry and Mineralogy of soils; Textbook of Principles and Practices of Weed Management; Textbook of Environmental Agrometeorology; Sugarcane Crop Management Practices in India.

The Hindi journals *Kheti* (monthly) and *Phalphul* (bimonthly) are published to disseminate the latest technologies. These journals are circulated offline and online. During the year, six special issues of *Kheti*, viz. 'success stories of farmers', 'livestock', 'climate change and agriculture', '75<sup>th</sup> year of publication of *Kheti*', 'Nutrition' and 'Millets' were published. The two special issues of *Phalphul*, on Fruits, and vegetables were also published. To add the publication of the Hindi journals, e-patrika portal was developed. The gross revenue of approximately ₹ 62.0 lakhs was realized from sale of publications during the period. To disseminate information in real-time, the ICAR



Website is updated on a regular basis. Total 4,250 pages were updated and 51,89,432-page views from more than 200 countries recorded. ICAR Twitter Handle has more than 1,94,458 Followers. On an average, 3 tweets are posted every day and a total of 1,020 tweets were posted during the year.

**21. Administration and Finance:** During the year, following posts were filled up under the promotion quota: 6 Joint Secretary/Joint Director (Admin), 3 Joint Secretary (Finance)/Senior Comptroller, 8 Director/CAO (Senior Grade), 4 Director (F)/Comptroller, 1 Director (Official Language), 15 Deputy Secretary / CAO, 1 Deputy Director (Finance), 3 Joint Director (OL), 2 Senior Principal Private Secretary, 5 Under Secretary, 1 Senior Administrative Officer, 5 Senior Finance and Account Officer, 48 Principal Private Secretary, 6 Deputy Director (OL), 43 Administrative Officer, 17 Finance and Accounts Officer, 13 Section Officer, 11 Private Secretary and 22 Assistants at ICAR

Headquarters. During the year, 10 eligible officers and Staff of ICAR were granted the benefits of financial up-gradation under the Modified Assured Career Progression scheme. The RE of DARE/ICAR for 2021-22 was ₹ 8,513.62 crores. An internal resource of ₹ 352.2 crores (including interest on Loans and Advances, income from Revolving Fund Schemes and interest on Short Term Deposits) was generated during the year 2021-22. The total BE for 2022-23 is ₹ 8,513.62 crores.

ICAR, for its services to nation and contribution towards furtherance of science, has won several accolades in the past, viz Global Gene Stewardship Award 2018 of the Borlaug Global Rust Initiative; International King Bhomibol Word Soil Day Award of FAO, 2020; and Digital India Awards 2020. ICAR is working concomitantly with other national and international organizations in the field of agriculture.



03

**DARE  
INTERNATIONAL  
COOPERATION  
ACTIVITIES**

## IC-I Section

(Including NAAS and IAUA)

### Major Activities

- About 3 cases of foreign deputation including short term and long term deputations were approved during 2022-23.
- About 12 cases of Cabinet note were processed during 2022-23.
- About 20 cases for grant of approval/NOC to various organizations for organizing International Conferences/Workshops, etc. in India were approved during 2022-23.
- Approval for 1 case of international consultancy project at various ICAR Institutes was granted during 2022-23.
- A number of cases related to grant of permission to foreign nationals for undergoing research work under various Post-Doctoral and Doctoral Fellowships were processed and approved.
- The details of the fund released to concerned SAU/ICAR Institute in respect of African students and Afghanistan Fellowship during October, 2021 to September, 2022 is given below.

S No.	Name of Fellowship Scheme(s)	Fund released during October, 2021 to September, 2022
1.	India-Afghan Fellowship Scheme	₹16,84,960/-
2.	India-Africa Forum Summit-III	₹ 28,66,267/-

- Applications of 9 Nepalese candidates have been received from Ministry of External Affairs for admission under India-Nepal Fund Scheme and process for their admission in various SAUs is under progress through Agricultural Education Division, ICAR.
- Grant-in-aid to the tune of ₹0.99 crore was released to National Academy of Agricultural Sciences, New Delhi.
- Grant-in-aid to the tune of ₹30.40 lakh was released to Indian Agricultural Universities Association, New Delhi.
- Ministry of Finance, D/o Expenditure vide O.M. No. 7(105)/EMC Cell/2020 (Part-III) dated 10 March, 2022 in the meeting held on 25 February, 2022 chaired by AS (PFS), Department of Expenditure directed for phase

wise disintegration of IAUA and NAAS during period of 3 years and 4 years, respectively. Subsequently, phase-wise disengagement of Indian Agricultural Universities Association (IAUA) and National Academy of Agricultural Sciences (NAAS) and gradual reduction of Grant-in-aid has been carried out as per direction of the communication of DoE, MoF dated 10 March, 2022 in the following manner:

### For NAAS

- 2022-23 - ₹ 93,00,000/-
- 2023-24 - ₹ 62,00,000/-
- 2024-25 - ₹ 31,00,000/-
- 2025-26 onwards – Nil

### For IAUA

- 2022-23 - ₹ 25,20,000/-
- 2023-24 - ₹ 14,40,000/-
- 2024-25 onwards - NIL

### National Academy of Agricultural Sciences (NAAS)

The National Academy of Agricultural Sciences (NAAS), a national think-tank and platform for science-policy interface, leads in promoting excellence and convergence of agricultural research (science), education and extension for the growth of national economy with a vibrant farm sector. In pursuance of this mission, the Academy has been organizing agricultural science congresses, conferences, brainstorming sessions, consultations, round-table discussions and dialogues on important research and development related policy issues, for the benefit of the concerned stakeholders for promoting ecologically sustainable, economically vibrant and socially equitable agriculture. The Academy has played a significant role in providing vital and timely inputs on several critical policy issues for active consideration of the Government.

During the period, the Academy organised 15 brainstorming sessions, strategy workshops, experts' meet and expert consultations in virtual and/or hybrid mode, besides organising a number of lectures on contemporary issues on Indian agriculture. Publications were brought out based on the recommendations from these events with action points for policymakers, Central and State governments, institutions of higher learning, farmers and other stakeholders.



In pursuance of its mandate, the NAAS carried out activities during 2021-22 as described here:

### **I. Brainstorming sessions/strategy workshops/consultation meetings**

- A Brainstorming session on WTO and Indian Agriculture was organized under the Convenorship of Dr P S Birlhal, Dr Sachin Sharma and Prof Abhijit Das on 7 October, 2021, to generate feedback for policymakers to effectively manage challenges at the WTO.
- A Brainstorming session was organized on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' on 21 October 2021 under the Convenorship of Dr S N Jha.
- A Brainstorming session on 'Agri-startups in India: Opportunities, Challenges and Way Forward' was organized under the Convenorship of Dr Ch Srinivasa Rao and Dr Ranjit Kumar on 5 November, 2021 to deliberate on different aspects of the agri-startup ecosystem and create an enabling environment.
- A Roundtable Discussion on the Global Hunger Index was organized with leaders and academicians in fields of nutrition, medical science, statistics and economics on 8 November, 2021 under the Convenorship of Dr Mahtab S Bamji, Dr P K Joshi and Dr Rajender Parsad. The objective of the discussion was to (i) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (ii) propose the way forward on the 'Hunger Index'.
- A Strategy workshop on 'Waste to Wealth– Use of Food Industry Waste as Animal Feed and Beyond' was organized on 3 December, 2021 to explore opportunities to convert food waste into animal feed under the Convenorship of Dr N K S Gowda.
- A Brainstorming session on 'Road Map to Rehabilitate 26 million ha Degraded Lands by 2030' was organized under the Convenorships of Dr Ch Srinivasa Rao, Dr J C Katyal and Dr Anil K Singh on 9 December, 2021.
- The Academy organized a Brainstorming session on 'Entrepreneurship for Quality Fodder Production' on 17 December, 2021 under the Convenorship of Dr Ajoy Kumar Roy, Dr Amaresh Chandra and Dr D R Malaviya to identify potential areas for developing enterprises for quality fodder production and marketing.
- A Stakeholders consultation on 'Draft Regulation for Genetically Modified (GM) Food and Feed Imports and Detection of Unauthorized GM Food Events' was organized by the Academy on 10 January, 2022 under the Convenorship of Prof K C Bansal and Co-convenorship of Dr Gurinderjit Randhawa.
- A Strategic consultation on 'Preparedness for Prevention of Transboundary Infectious Diseases of Livestock and Poultry in South Asian Countries' was organized on 15 February, 2022 jointly with the International Livestock Research Institute (ILRI), the South Asian Association for Regional Cooperation (SAARC) and the Bangladesh Academy of Agriculture (BAAG) under the Convenorship of Dr U S Singh and Dr H Rahman.
- A Brainstorming Session on 'Food Fortification Issues and Way Forward' was organized on 11 March, 2022 under the Convenorship of Dr K Madhavan Nair to deliberate upon the issues emerging from the new recommendations on nutrient requirements and dietary allowances by the ICMR-NIN 2020, a nationwide study on the status of micronutrients (anaemia, iron, vitamin A and D, folic acid and vitamin B12, and iodine) among children aged between 1-19 and adolescents (CNNS 2019); and urban diet and nutrient survey (NNMB 2017).
- An Experts meet on 'Self-sufficiency in Edible Oil Production' was organized under the Convenorship of Dr Sanjeev Gupta on 28 March, 2022.
- A Brainstorming Session on 'Sustaining Pulses Revolution in India' was organized on 5 April, 2022 under the Convenorship of Dr Anjani Kumar. Participants included researchers, policymakers, representatives from the private sector, government organisations, civil societies, farmers groups and emerging agri-preneurs. The brainstorming session deliberated on various aspects to chalk-out strategies and action plan for accelerating and sustaining production of pulses and improving its consumption.
- A Brainstorming Session on 'Impact of Covid-19 on Livestock and Poultry Sector' was organized on 24 June, 2022 under the Convenorship of Dr R K Singh. Sector-specific presentations were made on the impact of Covid-19 on dairy, poultry, fisheries, feed and meat industries as well as on breeding and health. Specific policy inputs were suggested

for managing veterinary services, supply chain solutions, challenges in veterinary science education and role of extension services in mitigating the impact of the pandemic.

- A Brainstorming Session on ‘Scaling up Innovative Agricultural Extension Models Sector’ was organized on 12 September, 2022 under the Convenorship of Dr Ashok K Singh.
- A Brainstorming Session on ‘Beyond Price Support and Subsidies’ was organized on 30 September, 2022 under the Convenorship of Dr Pratap S BIRTHAL.

**Special Webinar:** The Academy organized a special webinar on ‘Transforming Agriculture in Asia’ by Dr Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on 20 December 2021. The webinar was based on the report prepared by the ADB to show how agriculture has minimized the impact of Covid-19.

**National Science Day:** The Academy celebrated National Science Day on 28 February 2022, with an online lecture by Prof. R. Ramakumar from the Tata Institute of Social Sciences, Mumbai.

**International Women’s Day:** The Academy celebrated International Women’s Day on 8 March 2022, by organizing an online panel discussion on ‘R&D Innovations for Sustainable Agriculture in India’.

**World Biodiversity Day:** On 22 May 2022, the NAAS observed World Biodiversity Day by organising a discussion on Global Genebanks and Biodiversity Management for Sustainable Agriculture. Some of the eminent speakers were Dr Hugh Pritchard, Kew Botanic Garden, UK; Dr Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Ashok K Singh, Director, ICAR-IARI, New Delhi; Mr Kent Nnadozie, Secretary of the International Treaty, FAO, Rome; Dr Murukarthick Jayakodi, Group Leader, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben, Germany; Prof. Rajeev Varshney, International Chair in Agriculture and Food Security, Food Futures Institute, Murdoch University, Australia. Over 350 delegates participated in this programme.

**XV Agricultural Science Congress:** The Academy organized the XV Agriculture Science Congress on the theme ‘Energy and Agriculture: Challenges in 21<sup>st</sup> Century’ jointly with the Banaras Hindu University, Varanasi, from 13-16 November,

2021. In view of the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047. More than 1,800 delegates (900 in-person including 300 farmers) participated including fellows of the academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations and exchanged their ideas on various themes and sub-themes of the Congress. A national-level elocution contest was also organized on the theme of the Congress for the students selected from all over the country. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services for the benefit of farmers.

## II. Foundation Day Programme/Annual General Body Meeting

During 2021-22, the Foundation Day Programme/AGB Meeting was held on 4-5 June, 2022 at New Delhi. Besides usual AGB business session, following science-based activities were organized:

- Scientific presentations by newly elected fellows.
- The Presidential Address was delivered by Dr T Mohapatra, President, NAAS in 29<sup>th</sup> AGM. In his address, he drew attention to the fact that although India has made remarkable progress in food production, ensuring food and nutrition security, increasing agricultural exports, and improving agricultural sustainability remain important in the process of transformation of food system in view of the changing consumers’ preferences and social aspects of food consumption.
- The Foundation Day Lecture: On the occasion of its Foundation Day on 5 June, 2022, the Academy organized in hybrid mode a lecture by Prof P Balaram, Former Director, Indian Institute of Science, Bengaluru. He spoke on ‘Reflections on Science in the age of the Corona Virus’ and presented an excellent account on the evolutionary history of corona virus and highlighted the interdependence of biology and chemistry. He explained how chemistry and biology together can reveal the unknown in the nature. He defined science as the study of nature. Citing the examples of the telescope

and the microscope in pursuing the science of cosmology and microbiology, respectively, he said that science is often driven by new technology than by new concepts. He cited the example of rDNA technology, which facilitated development of genetically modified crops. Prof Balaram highlighted that scientists should keep striving to unravel the mystery of nature and search nature-based solutions for human welfare through innovations in agricultural sciences. As we have learnt immensely from the corona virus pandemic, we should prepare ourselves for a better life in future through an integrated approach based on the basics of chemistry, physics and biology. He concluded by reminding us of the lessons that we must learn from the corona virus pandemic, and the that we should respect the nature.

### III. NAAS regional chapters' activities

Twelve Regional Chapters of the Academy are actively functioning at Barapani, Bengaluru, Bhopal, Coimbatore, Cuttack, Hyderabad, Karnal, Kolkata, Lucknow, Ludhiana, Pune and Varanasi.

Notwithstanding the grave situation arising due to the Covid 19 pandemic, the Regional Chapters made commendable efforts to promote scientific activities for addressing regional issues. Barring a few, most of the activities were held on virtual platforms. During the period, Regional Chapters organised highly successful events focussing on students. The high school, graduate, and post graduate students were exposed to different facets of agriculture such as rural bio-entrepreneurship, opportunities in agriculture under *Atma Nirbhar Bharat* scheme, and other contemporary issues related to health, nutrition and environment.

### IV. Publications

The crystallized views of the scientists emerging from the interactive sessions organized by the Academy are published as Policy/Status/Strategy Papers and Policy Briefs, which provide useful inputs to the policymakers, planners, educationists and decision-makers. Following policy documents were published for the period:

#### Policy/Status/Papers

- ♦ Policy Paper 99: New Agricultural Education Policy for Reshaping India

- ♦ Policy Paper 100: Strategies for Enhancing Soil Organic Carbon for Food Security and Climate Action
- ♦ Policy Paper 101: Big Data Analytics in Agriculture
- ♦ Policy Paper 102: WTO and Indian Agriculture: Issues, Concerns and Possible Solutions
- ♦ Policy Paper 103: Antimicrobial Resistance
- ♦ Policy Paper 104: One World One Health
- ♦ Policy Paper 105: Sugarcane-based Ethanol Production for Sustainable Fuel
- ♦ Ethanol Blending Programme
- ♦ Policy Paper 106: Utilization of Wastewaters in Urban and Peri-urban Agriculture
- ♦ Policy Paper 107: Certification of Quality Planting Material of Clonally Propagated Fruit Crops for Promoting Agricultural Diversification
- ♦ Policy Paper 108: Agri-startups in India: Opportunities, Challenges and Way Forward
- ♦ Policy Paper 109: Emergency Preparedness for Prevention of Transboundary Infectious Diseases in Indian Livestock and Poultry

#### Strategy Papers

- ♦ Strategy Paper 14: Innovations in Potato Seed Production
- ♦ Strategy Paper 15: Potential of Transgenic Poultry for Biopharming
- ♦ Strategy Paper 16: Need for Breeding Tomatoes Suitable for Processing
- ♦ Agricultural Research, the official Science Journal of the Academy (published by Springer India Pvt Ltd, Vol. 11, No. 1 and Vol. 12, No. 1 (quarterly).

### V. Recognizing and promoting excellence of individual scientists in the field of agriculture

- **Fellowship/Associateship:** The Fellowship of the Academy embodies a wide spectrum of national and international scientists. Fellows including Pravasi and Foreign Fellows are elected annually in recognition of their distinguished achievements in the field of agriculture and allied sciences. During 2022,



34 new Fellows including two foreign Fellows and three Pravasi Fellows were elected and inducted into the Academy. The Academy also has a scheme of NAAS Associates for encouraging promising young scientists below the age of 40 years, to be associated with the Academy activities. During the year, 11 young scientists were selected as Associates of the Academy based on their academic excellence and scientific contributions as reflected by publications, and products, processes and technologies developed, etc.

- **Academy Awards:** The National Academy of Agricultural Sciences has instituted following Awards for recognizing significant contributions of senior, middle level and young scientists to promote agricultural research and recognize scientists for excellence in research in Agricultural and Allied Sciences including Environment and Nutrition. Memorial, Endowment and Recognition awards are presented biennially at the time of Agricultural Sciences Congress. Young Scientist Awards are given annually and are presented in the Annual General Body meeting of the Academy.

(i) Memorial Awards (7)

(ii) Recognition Awards (6)

(iii) Young Scientists Awards (6)

(iv) Endowment Awards (3)

(v) Dr A B Joshi Memorial Lecture Award

During this year, the six Young Scientists' Awards for 2021 were presented on 5 June, 2022.

### Indian Agricultural Universities Association (IAUA)

Indian Agricultural Universities Association (IAUA) was established on 10 November, 1967 (Registration no. 3498). There were only nine founder member of agricultural universities: PAU, Chandigarh (now Ludhiana); APAU, Hyderabad, (now ANGRAU, Guntur); JNKVV, Jabalpur; UPAU (now GBPUAT), Pantnagar; UAS, Bengaluru; KU, Kalyani (now BCKV, Mohanpur); OUAT, Bhubaneswar; UU (now MPUAT), Udaipur; and IARI, New Delhi. Presently, the IAUA has 71 member universities.

The main objective of the Association is to promote agricultural research, education and

extension in the universities and the states, and thereby rural development in the country. It also acts as a bureau of information to facilitate communication, coordination and mutual consultation among agricultural universities. The Association also acts as a liaison between member universities and concerning government departments to facilitate communication and expedite the needed action in matters of importance.

A quarterly newsletter is being published by the Association since 2000, giving important news, events and achievements by member universities for the information of all the members and others stakeholders. An Annual Report is also being published documenting major activities of IAUA and member universities of the year.

The information on events and proceedings are published through the host universities and the recommendations are uploaded on IAUA website ([www.iauaindia.org](http://www.iauaindia.org)) and also circulated to all the Vice Chancellors of member universities and other main stakeholders.

A brief description of important events organized by IAUA/member universities is given on the following pages:

**45<sup>th</sup> Vice Chancellors' Convention:** The 45<sup>th</sup> Vice Chancellors' Convention of Indian Agricultural Universities Association (IAUA) was organized on the theme 'Improving Standard, Sustainability and Societal Impact of Agricultural Universities' at Birsa Agricultural University (BAU), Ranchi on 20-21 December, 2021 in hybrid mode.

The Vice Chancellors of State Agricultural/Horticultural/Animal Science Universities, Central Agricultural Universities and Deemed Universities of India attended the Convention (off-/on-line), shared their experience, knowledge, expertise, and gave an overview on how to improve standards and social impact of Agricultural Universities. The deliberations were made to align research and education in agricultural and allied disciplines in India in view of NEP (2020) during following four technical sessions conducted on the sub-themes selected for the Convention:

- I. Achieving International Standard in Agricultural Education and Research in the Context of new National Education Policy, 2020.
- II. Strategies to Increase Agricultural Productivity



Hon'ble Governor, Jharkhand, Shri Ramesh Bais (*centre*) and dignitaries releasing the Souvenir during Inauguration of 45<sup>th</sup> VCs Convention.

and Profitability with Development and Application of Appropriate Technologies.

III. Enabling Farmers' Access to Technology, Market, Credit and Extensions Services.

IV. Creating Favourable Ecosystem for Entrepreneurship Development in Agricultural and Allied Sectors.

The Vice Chancellors, their representatives made technical presentations. Panel discussions were conducted in above mentioned four technical sessions and the plenary session of the Convention. The Convention was inaugurated by His Excellency, Governor and Chancellor of Universities, Jharkhand Shri Ramesh Bais.

### IAUA 14<sup>th</sup> National Symposium, June 2022:

The dynamic and continuing transformative landscape of agriculture needs to build neo-generation human resources. This requires ingenious perspective in the agri-education sector to cater to an emerging new set of client farmers whose technology usage and literacy may be at par with the agri-professionals.

Therefore, the onus to build appropriate skill sets in human resources streaming out of institutions of higher agricultural education will be on the education administrators and planners under the umbrella of NAREES. In consonance with new National Educational Policy (NEP)-2020, a formalized convergence platform of technology driven courses with social sciences and agri-business would be an ideal premise. Such competent and trained human resources, equipped with cognitive, technical and managerial skills can create a positive impact at societal level. This responsibility also entails to develop necessary infrastructure, linkages and training opportunities for teaching faculty and policy makers for a seamless deployment and integration

of convergence platforms into existing agricultural education network. With this background, the 14<sup>th</sup> National Symposium of Indian Agricultural Universities Association (IAUA) was organized on 'Creating and Enabling Ecosystem in Agricultural Universities for Agri tech Innovations: Challenges and Opportunities' by Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad in collaboration with IAUA on 9-10 June, 2022. The Symposium included:

- Inaugural Session,
- Session I- Potential for Emerging Technologies in the Agri-food Value Chain and Allied Sectors,
- Session II- Agriculture 4.0 (Smart Farming) Ready Manpower: Stakeholder Perspective,
- Session III- Gearing Up for the Emerging Technologies Driven Ecosystem – Challenges and Opportunities for Agricultural Universities, and
- Session IV- Converging Partnerships – Academia – Industry Incubators and Startup Journeys.

The Vice chancellors (20) from various State Agricultural, Horticultural and Veterinary Universities attended the symposium. Besides, representatives of Vice Chancellors and senior officials from various organizations such as-IIM, Ahmedabad; World Economic Forum, Navi Mumbai; ICAR-IARI, New Delhi; ICAR-NAARM, Hyderabad; ITE&T Department, Telangana; Coromandel International Ltd, Hyderabad; Agri Watch, New Delhi; ISB, Mohali; AG Biosystems Bio Ltd., Hyderabad; NABARD, Hyderabad; NIFTEM, Sonapat; Aruazone, Hyderabad; Criyagen Agri and Biotech Pvt Ltd, Bengaluru also actively participated in the symposium.

**5<sup>th</sup> International Agronomy Congress:** The Fifth International Agronomy Congress (IAC) on 'Agri-innovation to Combat Food and Nutrition Challenges' organized jointly by Indian Society of Agronomy (ISA), New Delhi and PJTSAU, Hyderabad from 23 to 27 November, 2021 at PJTSAU Campus, Hyderabad. There were 14 sub themes in the conference, viz. climate resilient agriculture and ecosystem services, integrated farming system for sustainable peasant economy, agronomy innovation for tapping genetic potential, new vistas in biotic and abiotic stress management, secondary agriculture and farmers prosperity, soil-plant-animal and human health continuum, Big



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**5<sup>th</sup> International Agronomy Congress:** The Fifth International Agronomy Congress (IAC) on 'Agri-innovation to Combat Food and Nutrition Challenges' organized jointly by Indian Society of Agronomy (ISA), New Delhi and PJTSAU, Hyderabad from 23 to 27 November, 2021 at PJTSAU Campus, Hyderabad. There were 14 sub themes in the conference, viz. climate resilient agriculture and ecosystem services, integrated farming system for sustainable peasant economy, agronomy innovation for tapping genetic potential, new vistas in biotic and abiotic stress management, secondary agriculture and farmers prosperity, soil-plant-animal and human health continuum, Big

14<sup>th</sup> National Symposium: Participants

data for smart agriculture, conversation agriculture, smart mechanization and energy use, agronomic education: a paradigm shift in the offing, advances in soil-microbes-plant-water and environmental technologies, farmers-scientist interface and scientists-industry-farmer interface. Eminent scientists from around the globe delivered their lectures during the conference. Few prominent names include Prof. Rattan Lal, World Food Prize Awardee; Prof. J J Volenec, President American Society of Agronomy; Prof. P V Vara Prasad, President, Crop Science Society of America and Dr Jacqueline d'Arros Hughes, Director General, ICRISAT, Hyderabad. About 600 participants attended the conference in physical mode while 700 participants attended through virtual mode. 1,000 posters and 50 oral rapid presentations were made during the conference. Apart from these, 14 key note, 49 lead and 8 plenary lectures were scheduled during the conference. The congress was inaugurated on 23 November, 2021 at the University Auditorium, Rajendranagar. The Guests of honour include Prof. Samunder Singh, President International Weed Science Society, Brazil; Prof. P V Vara Prasad, President, Crop Science Society of America, USA; Prof. Panjab Singh, Chancellor, RLBCAU and welcome address was given by Dr V. Praveen Rao, Vice Chancellor and President, ISA. Dr U V Mahadkar, Vice President, ISA and Dr V K Singh, Secretary, ISA participated in the inaugural session. Inaugural address was delivered by Dr Trilochan Mohapatra, Secretary, DARE and DG, ICAR, New Delhi. An exhibition was arranged with 50 stalls comprising of Industries, Universities (Agriculture, Horticulture and Veterinary) and ICAR institutes for the benefit of the farmers, students and delegates of the conference. More than 100 farmers from various districts attended the scientist-industry-farmer interface during the

conference. Valedictory session was conducted on 27 November, 2021 which was presided over by Dr Ashok Dalwai, CEO, NRAA, Government of India.

### **International Horticulture Conference:**

The International Horticulture Conference (IHC 2021) – 'Next Generation Horticulture' was organized by Horticultural College and Research Institute, TNAU, Coimbatore in collaboration with Society for Promotion of Horticultural Science and Technology on 16 September, 2021. Dr B M C. Reddy, Former Vice Chancellor, Dr Y S R Horticultural University, Andhra Pradesh delivered the keynote address and Shri D Sathiyam, IFS, Secretary, Spices Board, Cochin delivered the special address. The 'Life time Achievement' award was conferred on Dr Jayasankar Subramanian, 'Best Farmer' award was given to Mr Pavala Rajan, Farmer of Pattiveeranpatti, Dindigul district, 'Outstanding Contribution in Horticulture' award to Dr L Pugalandhi, Dean, HC&RI, Coimbatore and Dr T. Saraswathi, Professor (Horticulture) and 'Young Scientist' award was presented to Dr A. Subbiah, Assistant Professor and Head, Grapes Research Station, Theni and to Dr C Kavitha, Assistant Professor, Department of Fruit Science, HC&RI, Coimbatore. A total of 350 National and International participants attended the conference.

### **Global Conference on Agricultural Genomics:**

Centre for Plant Molecular Biology and Biotechnology of TNAU organized an International Conference on 'Agricultural Genomics 2021: Progress and Prospects' during 21 to 23 October, 2021. Dr Aravind Kumar, Deputy Director General of ICRIS AT, Hyderabad, the Chief Guest of this function appreciated the research initiatives from





TNAU in the field of genomics and gene editing techniques. Padma Vibhusan Dr M S Swaminathan, Founder, MSSRF offered his greetings and blessings. Totally, 294 participants attended the conference besides 31 International and National scientists (both from academic and private sectors) deliberated on their genomics works.

**Mobile Application “Butting Animal Science” Launched:** Navsari Agricultural University, Navsari developed and launched a mobile application named ‘Butting Animal Science’ under NAHEP-CAAST project on 29 November, 2021. The purpose of developing this mobile application is to provide a platform for all UG and PG students aspiring to appear in ICAR PG Scholarship exam, ICAR-NTS (UG/PG), ICAR-JRF/SRF, ICAR-NET as well as ARS and other competitive examinations in the subject of Veterinary and Animal Science. Presently the app has 4,000 questions from different subjects of Animal Science which may be updated up to 7,000-8,000 in future. This feature-loaded App can be used by students in Formative or Mock test modes, and will be available for both Android and iOS platforms. This app will be available to all users free of cost so that maximum students can benefit from this initiative.



## IC –II Section

### Foreign Deputation Cases

- (i) Processing of applications for various training programs abroad under various foreign governments, announced by DBT/DST etc. GoI against open advertisements, UN/ International organizations, International agencies in various fields of agricultural research and education.
- (ii) Processing of applications for various fellowships/scholarships announced by ICAR, HRD, foreign governments, etc for higher studies/ research / Ph D/ Post Doctoral Research abroad.
- (iii) Processing of applications of the Scientists for foreign assignments in foreign governments and International organizations.
- (iv) Circulation of vacancies notified by CGIAR organizations, other International organizations/ agencies such as ADB, World Bank, Commonwealth Secretariat, UN, etc.
- (v) A list of ICAR scientists (total 28 scientists) who were granted permission by this department for various fellowships/training at foreign organizations/institutes. Permission was granted to 3 scientists for extension of fellowship/ training in international organizations and permission was granted to 05 scientists for rescheduling of fellowship/ training in international organizations (Table 1).
- (vi) NOC was granted to 13 ICAR scientists to apply in different training/fellowship in international organizations.
- (vii) A list of ICAR scientists (total 79 scientists) who were granted permission by this department for Adhoc Visit at foreign organizations/ institutes is placed in Table 2.

### Germplasm Exchange

1. The cases of export of germplasm are processed in IC- Division as per the provisions/guidelines of the Biological Diversity Act, 2002 and the Biological Diversity Rules, 2004 also subject to guidelines/notifications issued by Ministry of Environment and Forests, from time to time.

The six Bureaus/Institutes under ICAR system have been designated by Ministry of Environment and Forests to act as repositories under the BD Act, 2002 for different categories of biological resources:



- (i) NBPGR- for exchange of plant germplasm.
  - (ii) NBAGR- for exchange of animal germplasm.
  - (iii) NBFGR- for exchange of fish germplasm
  - (iv) NBAIR- for exchange of germplasm of agriculturally important insects
  - (v) NBAIM- for exchange of germplasm of agriculturally important micro- organism
  - (vi) IARI- for exchange of germplasm of algae and fungi.
2. Cases of germplasm exchange are processed in DARE for approval of the competent authority in consultation with the Bureaus/Institute/ Subject Matter Divisions.
  3. In the area of exchange of genetic resources, cases from concerned scientists of ICAR through authorized national bureaus on the basis of signed/agreed collaborative research projects involving ICAR, were processed in accordance with the provisions of Biodiversity Act and further guidelines notified in this regard.
  4. Approval of competent authority was conveyed to ICAR-NBPGR, New Delhi for supply of 312 fruit crops germplasm and varieties to

Uzbekistan under DST funded and DARE approved Collaborative Research Project 'Augmentation of Plant genetic resources and capacity building of researchers in India and Uzbekistan.'

- i. Annual Membership contribution to Centre for Sustainable Agricultural Mechanization, CSAM (Regional Institution of UN ESCAP) Beijing, China amounting to US \$ 15,000 (₹11,49,859,) was released for the year 2020-21 on 16 March, 2022.
  - ii. Annual contribution to International Seed Testing Laboratory (ISTA), Switzerland on behalf of Seed Testing Laboratory, IARI, New Delhi amounting to 4,692 CHF (Swiss Franc) ₹3,95,967 was released on 15 December, 2021 for the year.
  - iii. Annual contribution to CABI, UK amounting to 56,000 GBP (₹ 57,17,486) was released on 3 March, 2022.
- Approval of 2 MoUs between State Agriculture Universities in India and Foreign Institutes (Table 3).

**Table 1. List of ICAR Scientists permitted for Foreign fellowships****Annexure:I**

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute Country Visited	Duration	Funding	Date
1	Mr Debasis Galui, Scientist, ICAR-IARI, New Delhi	Foreign visit for attending Fullbright Nehru Fellowship 21-22	North Dakota State University, USA	08/11/2021 To 07/11/2022	United States-India Educational Foundation (USIEF)	12-10-2021
2	Mr. Saurabh Kadyal, Scientist, ICAR-NDRI	Attending Graduate research assistantship	Florida State University, Tallahassee, USA	05/01/2022 To 04/01.2025	DARE/ICAR Institute	16-12-2021
3	Sri Sumanta Chatterjee, Scientist, ICAR-NRRI, Cuttack	Extension of Fellowship	University of Wisconsin, USA	6 Months beyond 14-01-2022	DARE/ICAR Institute	22-12-2021
4	Dr Manoj Srivastava, Principal Scientist, ICAR-IARI, New Delhi	Foreign visit for attending Fullbright Nehru Fellowship 21-22	University of Texas, USA	21-02-2022 To 20-08-2022	United States India Education Foundationm	28-12-2021
5	Dr Vikram Singh, Scientist, ICAR Headquarters, New Delhi	For attending Master's Degree Programme	Republic of Korea	01-02-2022 To 16-02-2022	DARE/ICAR Institute	10/02/2022
6	Mr Bhenderkar Mukesh Kumar Parasram, Scientist, ICAR-NIASM	Foreign visit for attending Netaji Subhash ICAR International Fellowship (NS-ICAR-IF) 2019-20	University of the Basque Country, Spain	12-02-2022 to 09-02-2025	DARE/ICAR Institute	10/02/2022
7	Dr Mahajan Gopal Ramdas, ICAR-Central Coastal Agricultural Research Institute, Goa	Foreign visit for attending Fullbright Nehru Fellowship 21-22	University of California, Riverside, USA	31-03-2022 to 30-12-2022	United States India Education Foundation	15-02-2022
8	Dr Shashank Principal Scientist, ICAR-Indian Agricultural Research Institute, New Delhi	Foreign visit for availing fellowship	Florida Museum of Natural History University of Florida, USA	01-04-2022 to 31-0-2022	University of Florida, USA	08-03-2022
9	Dr Ranjan Bhattacharya, Principal Scientist, ICAR- Indian Agricultural Research Institute, New Delhi	Grant of NOC for earning a DSc	University of Wolverhampton, UK	07-03-2022 to 10-03-2022		08-03-2022
10	Dr Amol Kumar U Solanki, Scientist, ICAR- National Institute for Plant Biotechnology, New Delhi	Foreign visit for hands on training on analysis of metabolites enhancing agriculture productivity and nutritional quality.	Purdue University, USA	16-04-2022 to 30-04-2022	Institute (ICAR)	29-03-2022
11	Dr Nimmy M S, Scientist, ICAR-National Institute for Plant Biotechnology, New Delhi	Foreign visit for hands on training on analysis of metabolites enhancing agriculture productivity and nutritional quality.	Purdue University, USA	16-04-2022 to 30-04-2022	Institute (ICAR)	29-03-2022
12	Dr Dwijesh Chandra Mishra, Senior Scientist, ICAR-IASRI	Foreign visit for attending Doctoral Fellowship	University of Louisville, USA	04-04-2022 to 03-04-2023	University of Louisville /Self	29-03-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute Country Visited	Duration	Funding	Date
13	Dr Raj Mukhopadhyay, Scientist, ICAR-Central Soil Salinity Research Institute, Karnal	Grant of NOC for attending Fullbright Nehru Postdoctoral Research Fellowship 2022-23	Stony Brook University, USA	01-10-2022 to 30-09-2024		30-03-2022
14	Dr Dharmendra Kumar, Senior Scientist, ICAR-Central Institute for Research on Buffaloes, Hisar	Foreign visit for availing DAAD Fellowship	Institute of Farm Animal Genetics, Germany	01-05-2022 to 31-07-2022	DAAD-Deutscher Akademischer Austauschdienst, Germany	08-04-2022
15	Dr Mehak Singh, Scientist, ICAR- ICAR Research Complex for NEH Region, Umiam	Grant of NOC for ICMR-DHR International Fellowship	Spain	01-07-2022 to 30-06-2023	ICMR-DHR-long Term International Fellowship for Young Indian Biomedical Scientists	31-05-2022
16	Dr Geetika Malik, Scientist, ICAR-Central Institute of Temperate Horticulture, Srinagar	Availing Training on Soil Health and Nutrient Management in Vegetable Crops	Department of Horticulture, Michigan State University, USA	01-07-2022 to 31-08-2022	Self from Salary	31-05-2022
17	Dr C M Senthil Kumar, Principal Scientist, ICAR-Indian Institute of Pulses Research, Kanpur	Grant of NOC for attending Fullbright Nehru Fellowship 2023-24	California Institute of Technology, USA	15-01-2024 to 10-07-2024	United States-India Educational Foundation (USIEF)	27/08/2021
18	Dr Amol Kumar U Solanki, Scientist, ICAR- National Institute for Plant Biotechnology, New Delhi	Rescheduling of Foreign visit for hands on training on analysis of metabolites enhancing agriculture productivity and nutritional quality	Purdue University, USA	11/10/2022 to 25/10/2022 instead of earlier from 16-04-2022 to 30-04-2022	Institute (ICAR)	29-06-2022
19	Dr Nimmy MS, Scientist, ICAR- National Institute for Plant Biotechnology, New Delhi	Rescheduling of Foreign visit for hands on training on analysis of metabolites enhancing agriculture productivity and nutritional quality	Purdue University, USA	11/10/2022 to 25/10/2022 instead of earlier from 16-04-2022 to 30-04-2022	Institute (ICAR)	29-06-2022
20	Dr Arjun Singh, Scientist, ICAR-Central Soil Salinity Research Institute, Karnal	Training	Global Innovative Centre for Advanced Nanomaterials, Newcastle Institute for Energy and Resources, The University Newcastle (Uon), Australia	20/07/2022 to 20/01/2023	SERB, DST, New Delhi	24-06-2022
21	Mr Mahesh Rao, Scientist, ICAR- National Institute for Plant Biotechnology, New Delhi	Availing SERB Fellowship under SERB International Research Experience 2022-23	The University of Bonn, Germany	1/07/2022 to 31/12/2022	SERB, DST Government of India under SERB International Research Experience (SIRE)	24-06-2022



S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute Country Visited	Duration	Funding	Date
22	Dr Basavaprabhu L Patil, Principal Scientist, ICAR-Indian Institute of Horticultural Research, Bengaluru	Applying for Fulbright Nehru Fellowship	The Genome Center Life Science Building, One Shields Avenue, University of California, Davis, USA	31/07/2022 to 30/04/2023	Nehru- Fulbright Academic and Professional Excellence Fellowship of United States Government	27-06-2022
23	Dr C M Senthil, Senior Scientist, ICAR- Indian Institute of Spices Research, Kerala	Grant of NOC for applying for Fullbright Nehru Fellowship 2023-24	California Institute of Technology, California, USA	15/01/2024 to 10/7/2024		27-06-2022
24	Dr Binsila B Krishnan, Scientist, ICAR- National Institute of Animal Nutrition and Physiology, Bangalore	For availing SERB Fellowship under SERB International Research Experience 2022-23	The Roslin Institute, RDSVS, University of Edinburgh, United Kingdom	02/08/2022 to 01/10/2022	SERB, DST Government of India under SERB International Research Experience (SIRE)	08-07-2022
25	Mr. Manoj Kumar, Scientist, ICAR- Central Institute for Research on Cotton Technology, Mumbai	SERB Fellowship under SERB International Research Experience 2022-23	East Carolina University, Greenville, USA	01/08/2022 to 31/01/2023	SERB, DST Government of India under SERB International Research Experience (SIRE)	08-07-2022
26	Mr Rajkumar Uttamrao Zunjare, Scientist, ICAR-Indian Agricultural Research Institute, New Delhi	For availing SERB Fellowship under SERB International Research Experience 2022-23	Department of Agronomy, Iowa State University, USA	01/08/2022 to 31/01/2023	SERB, DST Government of India under SERB International Research Experience (SIRE)	08-07-2022
27	Mr Ranjit Singh, Scientist, ICAR- IARI, Jharkhand	Foreign visit for attending Netaji Subhash ICAR International Fellowship 2021-22	Department of Food Engineering and Bioprocess Technology, Asian Institute of Technology, Thailand	08/08/2022 to 07/08/2025	Netaji Subhash ICAR International Fellowship	13-07-2022
28	Dr Vijay Pooniya, Scientist, ICAR-IARI, New Delhi	Grant of NOC for applying for Fullbright Nehru Academic and Professional Excellence Fellowship 2023-24	USDA ARS- Dale Bumpers National Rice Research Centre, Stuttgart, USA	01-05-2023 to 30-10-2023		13-07-2022
29	Dr C N Neeraja, Principal Scientist, ICAR-Indian Institute of Rice Research, Hyderabad	Grant of NOC for applying for Fullbright Nehru Fellowship 2023-24	USDA ARS Dake Bumpers National Rice Research Centre, USA	03/10/2023 to 02/04/2024		18-07-2022
30	Mr Balaji S J, Scientist, ICAR- National Institute of Agricultural Economics and Policy Research, New Delhi	For availing Fullbright Nehru Post Doctoral Fellowship 2022-23	University of Georgia, Athens, USA	01/09/2022 to 31/08/2023	United States India Educational Foundation (USIEF)	21-07-2022
31	Dr Neetu Shahi, Scientist, ICAR- Directorate of Coldwater Fisheries Research, Bhimtal	For attending post-doc fellowship	Kasetsart University, Bangkok, Thailand	27/08/2022 to 30/07/2023	Kasetsart University, Bangkok, Thailand	21-07-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute Country Visited	Duration	Funding	Date
32	Dr Reshma K J, Scientist, ICAR-Central Marine Fisheries Research Institute, Kochi	International Institute to pursue Postdoctoral Degree	Institute of Biological Sciences, Germany	15-08-2022 to 14-08-2025	Netaji Subhash-ICAR International Fellowship	29-07-2022
33	Dr Malik Arjun J, Scientist, ICAR-National Institute of Biotic Stress Management, Raipur	Grant of NOC For applying for Fullbright Nehru Fellowship 2023-24	USA	01-02-2024 to 31-10-2024		29-07-2022
34	Mr Amiya Ranjan Sahu, Scientist, ICAR- Central Coastal Agricultural Research Institute, Goa	Grant of NOC For applying for Fullbright Nehru Postdoctoral Research Fellowship 2023-24	University of Florida, USA	01-08-2023 to 31-07-2024		01-08-2022
35	Dr S R Mohanty, Senior Scientist, ICAR- Indian Institute of Soil Sciences, Bhopal	Fulbright Nehru Academic and Professional Excellence Fellowship 2019-20	University of California, Berkeley, USA	26-09-2022 to 25-11-2022	United States India Educational Foundation (USIEF)	01-08-2022
36	Dr Vikram Singh, Senior Scientist, ICAR, New Delhi	Grant of NOC for applying for the LLM Programme in IPR	University of Turin, Italy through WIPO Scholarship	29/08/2022 to 27/08/2023		03-08-2022
37	Mr Kalnar Yogesh Bhaskar, Scientist, ICAR-Central Institute on Post/harvest Engineering and Technology, Ludhiana	International Institute to pursue Postdoctoral Degree	Leibniz Institute for Agricultural Engineering and Bio-economy (ATB), Potsdam, with registration at Technical University, Berlin, Germany	28/10/2022 to 28/10/2025	Netaji Subhash ICAR International Fellowship	04-08-2022
38	Dr Shashank P R, Scientist, ICAR-Indian Agricultural Research Institute, New Delhi	Extension of foreign visit for availing fellowship	Florida Museum of Natural History, University of Florida, USA	Till 30-09-2022	University of Florida, USA	10-08-2022
39	Rescheduling of Mahesh Rao, Scientist, ICAR-NIPB, New Delhi	Availing SERB Fellowship under SERB International Research Experience 2022-23	The University of Bonn, Germany	01-09-2022 to 2-02-2023 Instead of earlier 1/07/2022 to 31/12/2022	SERB, DST Government of India under SERB International Research Experience (SIRE),	23-08-2022
40	Rescheduling of Dr Arjun Singh, Scientist, ICAR-Central Soil Salinity Research Institute, Karnal	Training	Global Innovative Centre for Advanced Nanomaterials, Newcastle Institute for Energy and Resources, The University Newcastle (Uon), Australia	20/07/2022 to 20/01/2023	SERB, DST, New Delhi	26-08-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute Country Visited	Duration	Funding	Date
41	Rescheduling of Mr Ranjit Singh, Scientist, ICAR- IARI, Jharkhand	Foreign visit for attending Netaji Subhash ICAR International Fellowship 2021-22	Department of Food Engineering and Bioprocess Technology, Asian Institute of Technology, Thailand	05-09-2022 to 4-09-2025 Instead of earlier 08/08/2022 to 07/08/2025	Netaji Subhash ICAR International Fellowship	30-08-2022
42	Dr Manoj Choudhary, Scientist, ICAR- NCIPM, New Delhi	Extension of foreign visit for completing Ph.D Programme	University of Florida, USA	Till 25-12-2022		02-09-2022
43	Dr Misha Soman, Scientist of ICAR- Central Institute Brackishwater Aquaculture, Chennai	For availing Netaji Subhash ICAR International Fellowship 2021-22	Auburn University College of Agriculture, School of Fisheries, Aquaculture and Aquatic Sciences Alabama, USA	11-01-2023 to 10-01-2026	Netaji Subhash ICAR International Fellowship	05-09-2022
44	Mr Raja Aadil Hussain Bhat, Scientist ICAR- Directorate of Coldwater Fisheries Research	Attending Marie Skodowska- Curie Actions Fellowship	Karadeniz Technical University, Trabzon, Turkey	01-10-2022 to 30-09-2023	The TUBITIK Co-Funded Brain Circulation 2 Scheme is Co-funding international programme under the new European Commission Horizon 2020	22-09-2022
45	Mr Lohith Kumar, Scientist, ICAR- Central Inland Fisheries Research Institute, Vadodara	For availing Netaji Subhash, ICAR International Fellowship 2021-22 for pursuing PhD	University of Berlin, Berlin Germany and Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany	01-11-2022 to 31-10-2025	Netaji Subhash- ICAR International Fellowship	22-09-2022
46	Dr Kandeepan G, Senior Scientist, ICAR- NRCM, Hyderabad	Grant of NOC for applying for SERB Fellowship	Oklahoma State University, USA	01-01-2023 to 30-06-2023		22-09-2022
47	Dr. S.K. Maiti, Principal Scientist, ICAR- IVRI, Izatnagar	Grant of NOC for applying for INSA Fellowship	University of Rio Grande do Sul, Porto Alegre, Brazil	01-02-2023 to 28-02-2023		22-09-2022
48	Dr Dwijesh Chandra Mishra, Scientist, ICAR- IASRI, New Delhi	Attending Post Doctoral Fellowship	Department of Environmental and Public Health Sciences, University of Cincinnati, Ohio State, USA	10-10-2022 to 09-10-2023	Host Institute	28-09-2022
49	Dr Kandeepan G, Senior Scientist, ICAR- NRCM, Hyderabad	Grant of NOC for applying for INSA Fellowship	Brazil	01-08-2023 to 28-08-2023		28-09-2022



Table 2. List of ICAR Scientists permitted for foreign visits

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
1	Dr B Dayakar Rao, Principal Scientist, ICAR- Indian Institute of Millets Research, Hyderabad	For attending Dubai Expo 2020	Dubai Expo 2020, Dubai, United Arab Emirates	17-02-2022 to 19-02-2022	ICAR-IIMR, Hyderabad	14-02-2022
2	Dr R Solomon Rajkumar, Scientist, ICAR- Central Coastal Agricultural Research Institute, Goa	IAFP International Student Award	Pennsylvania, USA	31-07-2022 to 03-08-2022	By the Organizers	03-03-2022
3	Dr J V N S Prasad, Senior Scientist, ICAR-Central Research Institute of Dryland Agriculture, Hyderabad	Partner's Meeting on the " Consortium for Scaling-up Climate Smart Agriculture in South Asia"	Kathmandu, Nepal	23-03-2022 to 24-03-2022	The International Food Policy Research Institute	17-03-2022
4	Mr. Kiran Kumara T M Scientist, ICAR- National Institute of Agricultural Economics and Policy Research, New Delhi	Agricultural Economics Society Annual Conference	Belgium	04-04-2022 to 06-04-2022	International Travel Support (ITS) Scheme of Science & Engineering Research Board, DST, Government of India	01-04-2022
5	Dr V Niraj, Principal Scientist, ICAR- Central Plantation Crops Research Institute, Kerala	Participate as a Team Member, Considering his expertise in coconut breeding and management of coconut germplasm and as a curator of ICG-SAME	Brazil	11-04-2022 to 14-04-2022	ICC-COGNET	08-04-2022
6	Dr Sunil Archak, Principal Scientist, ICAR- National Bureau of Plants Genetics Resources, New Delhi	Attending a Meeting on "Developing Standardized Methods for sharing Digital Sequence Information"	The Rockefeller Foundation, Bellagio Centre, Italy	02-05-2022 to 06-05-2022	The Rockefeller Foundation, Bellagio Centre	28-04-2022
7	Dr Anjani Kumar, Scientist, ICAR- National Rice Research Institute, Cuttack	Attending Knowledge exchange on rice farming greenhouse gas emissions and mitigation options	Norwegian Institute of Bioeconomy Research, Norway	17-05-2022 to 21-05-2022	Norwegian Institute of Bioeconomy Research, Norway	29-04-2022
8	Dr Rakesh Chandra Agarwal, DDG (Agricultural Education) ICAR Headquarters, New Delhi	Attending Consultative Workshop for curriculum development	Cornell University, Ithaca, USA	26-05-2022 to 27-05-2022		02-05-2022
9	Dr Om Parkash Yadav, Principal Scientist, ICAR- Central Arid Zone Research Institute, Jodhpur	Attending 15th session of conference	Abidjan Cote D'Ivoire	09-05-2022 to 20-05-2022	ICAR-Central Arid Zone Research Institute, Jodhpur	06-05-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
10	Dr M Madhu, Director, ICAR-Indian Institute of Soil and Water Conservation, Dehradun	Attending 15th session of conference	Abidjan Cote D'Ivoire	09-05-2022 to 20-05-2022	Indian Institute of Soil and Water Conservation, Dehradun	06-05-2022
11	Dr Muhammed Ashraf P, Principal Scientist, ICAR-Central Institute of Fisheries Technology, Cochin	ADHOC Conference on the title "ACS Research Conference: Chemistry and Chemical Engineering in MENA"	Ritz Carlton Hotel, Doha, Qatar	09-05-2022 to 11-05-2022	By the Individual	06-05-2022
12	Dr Prasenjit Ray, Scientist, ICAR-Indian Agricultural Research Institute, New Delhi	Availing 8th Intensive Training Course on Soil Micromorphology	Spain	09-05-2022 to 20-05-2022	SERB-DST	09-05-2022
13	Dr J Syama Dayal, Principal Scientist, ICAR-Central Institute of Brackishwater Aquaculture, Chennai	Attend Adhoc Workshop on "International Aquaculture Feed Formulation Database workshop and Training	U S Soybean Export Council organizing at Dubai, UAE	30/05/2022 to 31/05/2022	U S Soybean Export Council, UAE	09-05-2022
14	Dr. Rakesh Chandra Agarwal, DDG (Agricultural Education), ICAR Headquarters, New Delhi	Attending Consultative Workshop for curriculum development	Cornell University, Ithaca, USA	26-05-2022 to 27-05-2022	By Host Institute	13-05-2022
15	Dr Mahesh Chander, Principal Scientist, ICAR- Indian Veterinary Research Institute, Izatnagar	Attend 4th International Conference on Organic Agriculture in Mediterranean Climates: Threats and Solutions	Turkey	27-05-2022 to 29-05-2022	By Host Institute	23-05-2022
16	Dr Muthu Kr, Senior Scientist, ICAR-National Research Centre on Meat, Hyderabad	Attend ADHOC Conference on Agri Benchmark beef/ Buffalo and Sheep Conference 2022	Thunen Institute of Farm Economics, Braunschweig, Germany	16-06-2022 to 22-06-2022		
17	Dr Babita Chaudhary, Principal Scientist, ICAR- Central Potato Research Institute, Modipuram	To attend Consultation meeting as delegate	Germany	07-06-2022 to 11-06-2022	ADT Project Consulting GmbH Bonn, Germany and Air fare (to and fro) by PPVFRA, New Delhi	31-05-2022
18	Dr Dalamu Scientist, ICAR-Central Potato Research Institute, Modipuram	To attend Consultation meeting as delegate	Germany	07-06-2022 to 11-06-2022	ADT Project Consulting GmbH Bonn, Germany and Air fare (to and fro) by PPVFRA, New Delhi	31-05-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
19	Dr Raj Kumar, Principal Scientist, ICAR-Central Potato Research Institute, Modipuram	To attend Consultation meeting as delegate	Germany	07-06-2022 to 11-06-2022	ADT Project Consulting GmbH Bonn, Germany and Air fare (to and fro) by PPVFRA, New Delhi	31-05-2022
20	Dr M P Ramesan, Principal Scientist, ICAR-Central Institute of Fisheries Technology, Cochin	Participate in Dive test of Fine-Tuned CIFT-TED	NOAA National Marine Fisheries Service Laboratory, Panama City, Florida, USA	06-06-2022 to 22-06-2022	The Marine Product Export Development Agency, Ministry of Commerce and Industry, Kochi	31-05-2022
21	Dr Archana Verma, Scientist, ICAR-Central Arid Zone Research Institute, Jodhpur	To attend 5 <sup>th</sup> World Congress on Agroforestry	Université Laval Qubec City, Canada	17/7/2022 to 20/7/2022	ICAR	08-06-2022
22	Dr Dudhe Mangesh Yuvaraj, Senior Scientist, ICAR-Indian Institute of Oilseeds Research, Hyderabad	To attend 20 <sup>th</sup> International Sunflower Conference	Institute of Field and Vegetable Crop in Novi Sad Serbia and Montenegro	20/06/2022 to 23/6/2022	Host/Indian National Science Academy	08/06/2022
23	Priyabrata Santra, Pr. Scientist, ICAR-Central Arid Zone Research Institute, Jodhpur	To Participate in International Conference Agrivoltaics 2022	Piacena, Italy	12/6/2022 to 18/6/2022	by Indo-German Energy Forum (IGEF) support office, Berlin, Germany	08/06/2022
24	Dr Anand Kumar Singh, DDG (Horticulture), ICAR, New Delhi	To attend International Conference on Sustainable Agriculture for Food Security - AFS 2022, as a keynote speaker for a plenary session	Tien Giang University, Tien Giang Province, Vietnam	23-06-2022 to 24-06-2022	Host Institute	13/06/2022
25	Dr G K Sivaraman, Principal Scientist, ICAR-Central Institute of Fisheries Technology, Cochin	To attend Indo-German workshop on "Agricultural Management Practice Effects on Soil and Plant associated bacterial communities and their resistome"	Germany	20/06/2022 to 23/06/2022	The Indo-German Science and Technology Centre (IGSTC)	15/06/2022
26	Dr B Ramakrishnan, Principal Scientist, ICAR-Indian Agricultural Research Institute, New Delhi	To attend Adhoc Workshop on 'Agricultural Management Practice Effects on Soil- and Plant-Associated Bacterial Communities and their Resistance'	Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Potsdam, Germany	20/06/2022 to 22/06/2022	Indo-German Science and Technology Centre (IGSTC), New Delhi	17/06/2022



S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
27	Ms Aneet Kour, Scientist, ICAR-NRC on Yak, Dirang	To attend World Congress on Genetics Applied to Livestock Production	Rotterdam, The Netherlands	03-07-2022 to 08-07-2022	ICAR Institute/ DST	23-06-2022
28	Dr Ranjan Paul, Scientist, ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur	To attend AIPEA - XVII International Clay Conference organized jointly by the Clay Science Society (Turkey) and The Clay Minerals Society, USA	Hilton Maslak, Istanbul, Turkey	23/07/2022 to 31/07/2022	AIPEA (International Association for the Study of Clays),	24-06-2022
29	Dr Salini S, Scientist, ICAR-National Bureau of Agricultural Insect Resources, Bengaluru	To attend Adhoc Conference on 7 <sup>th</sup> Quadrennial meeting of the International Heteropterists' Society	Barcelona, Spain	04/07/2022 to 08/07/2022	DST, SERB, New Delhi	24-06-2022
30	Dr S V Ramarao, Principal Scientist, ICAR-Directorate of Poultry Research, Hyderabad	To attend 26 <sup>th</sup> World Poultry Congress, 2022	Palais des congrès, Paris France	07/08/2022 to 11/08/2022	SERB, DST Government of India/Self	08-07-2022
31	Dr M V L N Raju, Principal Scientist, ICAR- Directorate of Poultry Research, Hyderabad	To attend 26 <sup>th</sup> World Poultry Congress, 2022	Palais des congrès, Paris, France	07/08/2022 to 11/08/2022	SERB, DST Government of India/Self,	08-07-2022
32	Dr K Banerjee, Principal Scientist, ICAR-National Research Centre for Grapes, Maharashtra	To attend adhoc Workshop on Food Safety Laboratory Capacity Building for the Sub-Saharan African Countries"	Dubai Municipality Central Laboratory, Umm Hurair Road, Al Karama, Dubai, United Arab Emirates, UAE	23/07/2022 to 04/08/2022	The Food Risk Analysis and Regulatory Excellence Platform (PARERA)	08-07-2022
33	Dr Shyam S Salim, Principal Scientist, ICAR-Central Marine Fisheries Research Institute, Kochi, Kerala	To attend the IIFET -2022 - Managing a changing environment	Vigo, Spain	18-07-2022 to 22-07-2022	The economical air fare from the nearest International airport from his home to Vigo, Spain and lodging shall be borne by The International Institute of Fisheries Economics and Trade (IIFET) and the additional expenditure will be met from the personal savings of the scientist	

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
34	Dr Rokade Jaydip Jaywant, Scientist, ICAR-Central Avian Research Institute, Izatnagar	To attend World's Poultry Congress 2022	World Poultry Science Association, Paris, France	07/08/2022 to 11/08/2022	World Poultry Science Association, will reimburse the travel cost and also will provide registration, food and accommodation during the event	18-07-2022
35	Dr S K Bhanja, Principal Scientist, ICAR- Central Avian Research Institute, Izatnagar	To attending World's Poultry Congress 2022	Paris, France	07/08/2022 to 11/08/2022	World Poultry Science Association, The Netherlands has given travel grant which includes air fare (both way), accommodation and food expenses, Registration fee will be borne by the applicant	18-07-2022
36	Dr S K Mishra, Principal Scientist, ICAR-Directorate of Poultry Research, Hyderabad	World's Poultry Congress-2022	World Poultry Science Association, Paris, France	07/08/2022 to 11/08/2022	By the applicant	21-07-2022
37	Dr Rudra Nath Chatterjee, Director, ICAR-Directorate of Poultry Research, Hyderabad	World's Poultry Congress 2022	World Poultry Science Association, Paris, France	07/08/2022 to 11/08/2022	By the applicant	21-07-2022
38	Dr Ashok Kumar Singh, DDG (Agricultural Extension), ICAR Headquarters, New Delhi	To attend India-Ethiopia knowledge exchange of pluralistic Extension systems	Ethiopia	25/07/2022 to 29/07/2022	The World Bank, New Delhi	21-07-2022
39	Dr Anup Kumar Misra, Principal Scientist, ICAR New Delhi	To attend 7 <sup>th</sup> Meeting of the Ministers of Agriculture of the Shanghai Corporation Organization (SCO) and the exhibition "Sunny Uzbekistan"	Uzbekistan"	22/07/2022 to 27/07/2022	₹ 113,000/- International Travel Head of ICAR Headquarter	21-07-2022
40	Dr. Joykrushna Jena, DDG (Fisheries), Indian Council of Agricultural Research, New Delhi	To attend the session of PWEF (SCO meeting (24 July, 2022) and Agriculture Ministers of SCO Member States (25 July, 2022)	Tashkent, Uzbekistan	22/07/2022 to 27/07/2022	ICAR (₹ 440,000/- from International Head of ICAR Headquarters	22-07-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
41	Dr Vinod Kumar Sharma, Senior Scientist, ICAR-National Bureau of Plant Genetics Resources, New Delhi	For attending International Society of Horticultural Sciences, International Horticultural Congress 2022	France	14-0-2022 to 20-08-2022	DBT/ Biodiversity International, New Delhi/ Self	29-07-2022
42	Dr RituMawar, Principal Scientist, ICAR-Central Arid Zone Research Institute, Jodhpur	For attending 7 <sup>th</sup> Asian PGPR International conference for sustainable agriculture 2022	Kuala Lumpur, Malaysia	23-08-2022 to 26-08-2022	DST and Scientist	29-07-2022
43	Ms Subhashree Sahu, Scientist, ICAR- Indian Agricultural Research Institute, New Delhi	ADHOC Conference to present paper entitled "Issue and challenges in the cotton supply chain and way forward" in world cotton research conference-7	Cairo, Egypt	04-10-2022 to 07-10-2022	Host Institute and Personal/ DBT/DST/ ICSSR	01-08-2022
44	Dr P K Asokan, Principal Scientist, ICAR- Central Marine Fisheries research Institute, Kochi	To attend a Workshop on aquaculture jointly organised by Goa University and ZMT, Bremen	Leibniz Centre for Tropical Marine Research, Bremen, Germany	20-08-2022 to 26-08-2022	Indo-German Science and Technology Centre, India	04-08-2022
45	Dr Dinesh Singh, Principal Scientist, ICAR- IARI, New Delhi	Adhoc Conference on the title 7 <sup>th</sup> Asian PGPR International Conference for Sustainable Agriculture on Regenerating Agriculture through Beneficial Microbes for Improvement of Crop Productivity	Faculty of Agriculture, University Putra, Kuala Lumpur, Malaysia	23-08-2022 to 26-08-2022	SERB, DST Government of India/Self	16-08-2022
46	Dr V Govindasamy, Scientist, ICAR- IARI, New Delhi	Adhoc Conference on the title 7 <sup>th</sup> Asian PGPR International Conference for Sustainable Agriculture on Regenerating Agriculture through Beneficial Microbes for Improvement of Crop Productivity	Faculty of Agriculture, University Putra, Kuala Lumpur, Malaysia	23-08-2022 to 26-08-2022	By the applicant	10-08-2022
47	Dr Livleen Shukla, Principal Scientist, ICAR- IARI, New Delhi	Adhoc Conference on 7 <sup>th</sup> Asian PGPR International Conference for Sustainable Agriculture on Regenerating Agriculture through Beneficial Microbes for Improvement of Crop Productivity	Faculty of Agriculture, University Putra, Kuala Lumpur, Malaysia	23-08-2022 to 26-08-2022	By the applicant	10-08-2022



S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
48	Dr Niranjana M, Scientist, ICAR-IARI, New Delhi	Adhoc Conference	National Institute of Agricultural Botany (NIAB), Cambridge, UK	31/08/2022 to 02/09/2022		
49	Dr Matyar Raheman Khan, Principal Scientist, ICAR-IARI, New Delhi	To attend The Global Symposium on "TYMIRIUM® technology-Global Network of Experts"	Basel/Stein Switzerland	29/08/2022 to 02/09/2022	All expenses (cost of travel, food and accommodation) were supported for attending the Global Symposium	
50	Dr Vijaysinha Dhansingrao Kakade, Scientist, ICAR-National Institute of Abiotic Stress Management	Visit Nominated by Secretary DARE and DG ICAR	Centre of Agriculture, Water and Environment, Galilee International Management Institute, Israel	13/09/2022 to 19/09/2022	ICAR HQs Scheme-HRM budget head for financial year 2022-23	22-08-2022
51	Mr Chaitanya Prasad Nath, Scientist, ICAR-Indian Institute of Pulses Research	To Attend Visit Nominated by Secretary DARE and DG ICAR	Galilee International Management Institute, Israel	13/09/2022 to 19/09/2022	ICAR, New Delhi	22-08-2022
52	Mr Chandrakant Madhav Awachare, Scientist, ICAR-National Research Centre for Pomegranate	Applied for training	Galilee International Management Institute, Israel	13/09/2022 to 19/09/2022	DARE	17-08-2022
53	Dr Kailash Prajapat, Scientist, ICAR-Central Soil Salinity Research Institute	Visit Nominated by Secretary DARE and DG ICAR	Galilee International Management Institute, Nahalal, Israel	13/09/2022 to 19/09/2022	ICAR HQs Scheme-HRM budget head for 2022-23. Domestic TA/DA shall be met out from source of salary/HRD fund of the institute.	17-08-2022
54	Dr N A Deshmukh, Scientist, ICAR-National Research Centre for Grapes	To Attend Visit Nominated by Secretary DARE and DG ICAR	Centre for Agriculture Water and Environment, Galilee International Management Institute, Israel	13/09/2022 to 19/09/2022	ICAR HQs Scheme-HRM budget head for 2022-23 Domestic TA/DA shall be met out from source of salary/HRD fund of the Centre, i.e. ICAR-NRCG, Pune	23-08-2022
55	Dr M L Kamboj, Principal Scientist, ICAR-National Dairy Research Institute	To attend Adhoc Congress	Macedonia, The Former Yugoslav Republic	04/09/2022 to 08/09/2022	The applicant himself from his personal savings	29-08-2022
56	Dr Pawan Singh, Principal Scientist, ICAR-National Dairy Research Institute	To Attend Adhoc Congress	Macedonia, The Former Yugoslav Republic	04/09/2022 to 08/09/2022	The applicant	29-08-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
57	Dr Amit Kumar, Scientist, ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora	For attending a study visit on New Agricultural Innovation Programme on Achieving Food Security Using Smart Farming Solutions	Centre of Agriculture, Water and Environment, Galilee International Management Institute, Nahalal, Israel	13/09/2022 to 19/09/2022	ICAR under ICAR HQs Scheme-HRM budget head for Financial year 2022-23	29-08-2022
58	Mr Santanu Basak, Scientist, ICAR-National Institute of Natural Fibre Engineering and Technology, Kolkata	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee ICAC/self	09-09-2022
59	Dr Rajiv Arvind Marathe, Director, ICAR-National Research Centre for Pomegranate, Solapur	To attend 4 <sup>th</sup> International Conference on 'Global Efforts on Agriculture, Forestry, Environment and Food Security (GAFF-2022) on 'Pomegranate an ideal crop for marginal lands of Himalayan Region	Institute of Forestry, Tribhuvan University, Pokhara Campus Pokhara, Nepal	17/09/2022 to 19/09/2022	the budget of ongoing Contract Research Projects at ICAR-NRC on Pomegranate, Solapur	15-09-2022
60	Dr Rajendran S, Scientist, ICAR-Indian Institute of Horticultural Research	For attending 4 <sup>th</sup> International Conference on Global Agriculture, Forestry, Environment and Food Security	Institute of Forestry, Tribhuvan University, Pokhara Campus, Pokhara, Nepal	17/09/2022 to 19/09/2022	Main Institute Recurring Contingency fund of ICAR-Indian Institute of Horticultural Research, Bengaluru	16-09-2022
61	Dr A S Sirohi, Principal Scientist, ICAR-Central Institute for Research on Cattle, Meerut	To attend 30 <sup>th</sup> International Symposium Animal Science Days 2022 at University of Zagreb, Faculty of Agriculture	Kolovare hotel, Zadar, Croatia	21/09/2022 to 23/09/2022	SERB, Department of Science & Technology (DST), Govt. of India/ ICAR-CIRC, Meerut as stated in IDC recommendation attached in supporting documents	16-09-2022
62	Dr Gulsar Banu, Principal Scientist, ICAR-Central Institute of Cotton Research, Regional Station, Coimbatore	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Researchers Association (ICRA), Washington DC/ self	16-09-2022
63	Dr Rishi Kumar, Principal Scientist, ICAR-CICR, Regional Station, Sirsa	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee ICAC/self	16-09-2022

S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
64	Dr G Balasubramani, Principal Scientist, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee (ICAC), Washington DC	16-09-2022
65	Dr M V Venugopalan, Principal Scientist, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee ICAC/self	16-09-2022
66	Dr S Usha Rani, Principal Scientist, ICAR-Central Institute of Cotton Research Coimbatore	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee (ICAC)	16-09-2022
67	Mr M Sabesh, Scientist, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee (ICAC)	14-09-2022
68	Dr Y G Prasad, Director, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee (ICAC)	19-09-2022
69	Dr A H Prakash, Principal Scientist, ICAR-Central Institute of Cotton Research, Regional Station, Coimbatore	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee (ICAC)	19-09-2022
70	Dr Raghavendra K P, Senior Scientist, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee (ICAC)	19-09-2022
71	Dr Chinna Babu Naik V, Scientist, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee (ICAC)	19-09-2022
72	Dr Ponnam Naresh, Scientist, ICAR-Indian Institute of Horticultural Research, Bengaluru	To attend 25 <sup>th</sup> International Pepper Conference	Tuscon Marriott University Park, The University of Arizona, Tucson, Arizona, USA	26/09/2022 to 28/09/2022	Science and Engineering Research Board, Department of Science and Technology (DST), Government of India	09-09-2022
73	Dr Mahesh Chander, Principal Scientist, ICAR-Indian Veterinary Research Institute, Izatnagar	To attend IFOAM 50 <sup>th</sup> Anniversary Commemorative International Conference	Goesan County, South Korea	30/09/2022 to 04/10/2022	The IFOAM Asia will bear the cost of participation as an inviting organization	22-09-2022



S. No.	Name, Designation, Institute Name	Subject of the Fellowship	Name of the Institute & Country Visited	Duration	Funding	Date
74	Dr D V Patil, Senior Scientist, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Researchers Association (ICRA), Washington DC/self	22-09-2022
75	Dr K Sankamarayanan, Principal Scientist, ICAR-Central Institute of Cotton Research, Regional Station, Coimbatore	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Advisory Committee, Washington DC	22-09-2022
76	Dr Vandana Tripathy, Senior Scientist, ICAR-IARI, New Delhi	To attend 3 <sup>rd</sup> Global Food Summit 2022 in conjunction with the 21 <sup>st</sup> IUFOST World Congress of Food Science & Technology	Singapore	31/10/2022 to 01/11/2022	Host organization, Ms Shimadzu (Asia Pacific) Pte Ltd	29-09-2022
77	Dr Raghavendra Singh, Principal Scientist, ICAR-Indian Institute of Pulses Research, Kanpur	To attend 5 <sup>th</sup> Organic Asia Congress and the 10 <sup>th</sup> IFOAM Asia Anniversary	Goesan County, South Korea	13/10/2022 to 15/10/2022	IFOAM Organics Asia	29-09-2022
78	Dr Anitha Karun Acting Director, (DCR Puttur), ICAR-Central Plantation Crops Research Institute	To attend The "50 <sup>th</sup> International Cocotech Conference and Exhibition"	Kuala Lumpur Convention Center, Kuala Lumpur, Malaysia	07/11/2022 to 11/11/2022	International Coconut Community will provide economy class round trip air ticket from point of origin to Kuala Lumpur, Malaysia and the prescribed Daily Subsistence Allowance (DSA) for the duration of the Conference, which would cover hotel accommodation and meals	29-09-2022
79	Dr J Amudha, Principal Scientist, ICAR-Central Institute of Cotton Research, Nagpur	To attend World Cotton Research Conference (WCRC-7)	Cairo, Egypt	04/10/2022 to 07/10/2022	International Cotton Researchers Association (ICRA), Washington DC, USA and other expenses shall be borne by the applicant	30-09-2022

**Table 3. List MoUs**

S.No.	Subject	Approved on/Date
1	MoU between PAU, Ludhiana and The Research Institute of Organic farming FIBL, Switzerland F. No. 6-03-2019-IC-II	03-11-2021
2	MoU between TANU, Coimbatore and Horizon 2020 Consortium for Innovation (H2CI) Limited, Cork, Ireland F.No 5-22 /2018 IC-III	14-06-2022

## IC-III Section

International Cooperation-III Section deals with processing of Memorandum of Understandings (MoUs) signed by Department of Agricultural Research and Education (DARE) and Indian Council of Agricultural Research (ICAR) with foreign governments, foreign institutions and foreign Universities for collaboration in the field of Agricultural Research and Education through:

- Exchange of scientists and technologists,
- Exchange of germplasm and breeding material,
- Exchange of scientific literature, information and methodology,
- Exchange of scientific equipment as available and required in programme of common interest as may be mutually agreed upon, etc.

### Memorandum of Understanding (MoUs)

The MoUs are implemented through jointly developed Work Plans which describe specifically the activities to be carried out under the MoU.

The following MoUs signed in the recent past with the foreign organizations/universities for collaboration in Agricultural Research and Education are under process in consultation with ICAR for implementation:

- MoU between Indian Council of Agricultural Research, New Delhi and Asia and Pacific Seed Alliance, Singapore for cooperation in agricultural research and education.
- MoU between the Indian Council of Agricultural Research, New Delhi and The College of Agriculture and Natural Resources, Michigan State University (MSU), East Lansing Michigan, USA for cooperation in Agricultural Research and Education has been extended for five years on 26 December, 2021.

### India-Africa Forum Summit

Department of Agricultural Research and Education (DARE) has been designated as the Nodal Department for setting up of various projects under the India-Africa Forum Summit. ICAR-Indian Institute of Soil Sciences (IISS), Bhopal is the nodal institute designated for setting up of a Soil, Water and Tissue Testing Laboratory (SWTTL) in Tunisia under the India-Africa Forum Summit. The establishment of Soil Water Tissue Testing Laboratory under Indian expertise will facilitate the conservation of soil resources and ensure balanced fertilizer applications to crops grown in Tunisia. The proposal is being finalized in consultation with Ministry of External Affairs, Government of India.

### India's Annual Contribution to APAARI and NACA

- **India's Annual Contribution to Asia-Pacific Association of Agricultural Research Institutions (APAARI), Bangkok, Thailand:** Asia-Pacific Association of Agricultural Research Institutions (APAARI) is a Food and Agricultural Organization (FAO) led initiative and is an apolitical, neutral, non-profit forum of National Agricultural Research Systems (NARS) and Agricultural Research institutions in the Asia-Pacific Region, in the pursuit of common objectives. The mission of APAARI is to promote and develop National Agricultural Research Systems (NARS) in the Asia-Pacific Region through facilitation of intra-regional, inter-institutional and international cooperation/partnership. The overall objective of the association is to foster agricultural research for development in the Asia-Pacific Region so as to help address the concerns of hunger, poverty, environmental degradation and sustainability of agricultural production.

Indian Council of Agricultural research (ICAR) is a founder member of APAARI since its establishment in 1990 at Bangkok, Thailand under the auspices of FAO. DARE/ICAR is being benefitted tremendously by joining APAARI as a regular member through increased participation in the workshops, conferences, expert consultations, policy dialogues and meetings organized by APAARI.

India's Annual Contribution of US\$ 10,000 is being paid to Asia-Pacific Association of Agricultural Research Institutions (APAARI), Bangkok, Thailand.

**India's Annual Contribution to Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, Thailand:** The Network of Aquaculture Centres in Asia-Pacific (NACA) is an Inter-Governmental organisation formed in 1988, which is based at Bangkok, Thailand and has been greatly involved in aquaculture development in the Asia-Pacific region. The current member governments of NACA are: Australia, Bangladesh, Cambodia, China, Hong Kong SAR (China), India, Indonesia, Iran, Korea (DPR), Lao PDR, Malaysia, Maldives, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

The objectives of NACA are to promote development of aquaculture through increase in fish production as a food security, poverty alleviation by improving rural income, employment and socio-economic conditions of fish farmers, diversify farm production and the environment and resource management.

The core activities of NACA are Capacity building through education and training, collaborative research and development through networking among centres; development of information and communication networks; policy guidelines and support to policies and institutional capacities; aquatic animal health and disease management and genetics and biodiversity.

NACA has been playing a leadership role in the overall aquaculture development in the region through the active participation of its member countries. The programmes operated by NACA have been able to connect the countries, and the lessons learned by one country is easily transferred to others through the network. Besides, aquaculture development, its role in aquatic animal health and disease management, and genetics and biodiversity studies has been found substantial.

During the last several years, the support received by India, especially in developing programmes on fish disease surveillance, its execution through the expertise of NACA has been acclaimed and acknowledged.

NACA has been providing all possible support through the participation of its experts in different programmes organised in the country and the platform of NACA has been providing scope to highlight the intellectual capacity of India and work programmes of ICAR institutes, before the member countries, thereby building a huge image of ICAR/DARE and the country. Besides, the support received on the human resource development of our researchers from time to time in different subject areas is also quite substantial. The recognition of ICAR-CIFA as one of the four NACA Lead Centres and the scope of presenting the work of the institute before the Network members itself has also elevated the image of the country.

India's Annual Contribution of US \$60,000 per annum is being paid to Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, Thailand.

### Incoming Visits under the Collaborative Research Project

In the Collaborative Research Project the following visit has done:

- 1) Incoming Visit of two Scientists from Uzbekistan to ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar and ICAR- National Bureau of Plant Genetic Resources (NBPGR), New Delhi under the project "Augmentation of plant genetics resources and capacity building of researchers in India and Uzbekistan".
- 2) Incoming Visit of 4 Scientists from JIRCAS, Japan and Republic of Korea to ICAR-Central Soil Salinity Research Institute, Karnal in connection with ongoing project "Development of sustainable resources management system in water vulnerable areas of India".

### Outgoing Visits under the Collaborative Research Project

In the Collaborative Research Project the following visit were done:

- 1) Deputation of Dr Satya Nand Sushil, Principal



- Scientist, ICAR-Indian Institute of Sugarcane Research, Lucknow to Dhaka, Bangladesh for imparting training during a training programme hosted by APAARI, Bangkok, Thailand under the USDA funded project on “Improving phytosanitary trade compliance in Bangladesh” during 05/6/2022 to 17/06/2022 (excluding journey time).
- 2) Deputation of Dr Arun Gupta, Principal Scientist, ICAR-Indian Institute of Wheat and Barley Research, Karnal to attend a study visit and consultation meeting and training on DUS testing on Wheat and Barley to be held during 20-24 June, 2022 at Germany (excluding journey time).
  - 3) Deputation of Dr M Prabhakar, Principal Scientist, ICAR-Central Research Institute of Dryland Agriculture (CRIDA), Hyderabad to Bonn, Germany as a member of Inter Ministerial delegation to the UN Climate Change Conference, the 56<sup>th</sup> Subsidiary Bodies (SBs) session under the United Nations Framework Convention on Climate Change (UNFCCC) during 6-16 June, 2022 (excluding journey time).
  - 4) Deputation of Dr Charan Singh, Senior Scientist, ICAR-Indian Institute of Wheat and Barley Research, Karnal to attend a study visit and consultation meeting and training on DUS testing on Wheat and Barley to be held during 20-24 June, 2022 at Germany (excluding journey time).
  - 5) Deputation of Dr Hariom Kumar Sharma, Senior Scientist, ICAR-Directorate of Rapeseed and Mustard Research, Sear, Bharatpur, Rajasthan to attend a study visit consultation meeting and training on DUS testing on Mustard and Rapeseed to be held during 26 June to 02 July, 2022 at Germany (including journey time).
  - 6) Deputation of Dr Harita Bollinedi, Scientist, ICAR-Indian Agricultural Research Institute, New Delhi for attending Training on the analysis of Glycaemic Index (GI) in rice using Nutrascen Gut analyser organised by Next Instruments during 29 August-3 September, 2022 at Bankstown in Sydney, Australia (excluding journey time).
  - 7) Deputation of Dr Javid Iqbal Mir, Senior Scientist, ICAR-Central Institute of Temperate Horticulture (CITH), Srinagar to attend exchange visit program under the collaborative research project “Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan” to be held at Uzbekistan from 25-31 July, 2022 (excluding journey time).
  - 8) Deputation of Dr Narender Negi, Scientist, ICAR-National Bureau of Plant Genetic Resources, Regional Station, Shimla to attend exchange visit programme under the collaborative research project “Augmentation of plant genetic resources and capacity building of researchers in India and Uzbekistan” to be held at Uzbekistan from 25-31 July, 2022 (excluding journey time).
  - 9) Deputation of Dr Rabi Narayan Sahoo, Principal Scientist, ICAR-Indian Agricultural Research Institute (IARI) to attend APAARI-GEAR Project kick-off meeting on “Regional Collective Action on Inclusive Digital Transformation of Agriculture in Asia Pacific” organised by Asia-Pacific Association of Agricultural Research Institutions (APAARI), Bangkok, Thailand during 4-5 August, 2022 (excluding journey time).
  - 10) Deputation of Dr Satya Nand Sushil, Principal Scientist, ICAR-Indian Institute of Sugarcane Research, Lucknow to attend adhoc workshop organized during 31 August to 5 September, 2022 at Dhaka, Bangladesh followed by exposure visit and training in Bangkok during 5-16 September, 2022.
  - 11) Proposal of Dr Javed Iqbal Mir, Senior Scientist and Dr Waseem Hassan Raja, Scientist, ICAR-Central Institute of Temperate Horticulture, Srinagar to Germany for attending Study visit and consultation meeting to Germany related to DUS testing on Apple and Pear organized by Indo-German cooperation on Seed Sector Development, ADT Project Consulting BONN, Germany from 25 September to 1 October, 2022 (excluding journey time).

## IC-IV Section

Consultative Group on International Agricultural Research (CGIAR) is a global partnership that unites international organizations engaged in research for a food-secured future. CGIAR research is dedicated to reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring sustainable management of natural resources. Out of the 15 Centres, ICAR/DARE has strong collaboration in the field of agricultural research,

education and capacity building with IRRI, IFPRI, CIMMYT, ICARDA, ICRAF, IWMI, ILRI, ICRIAT WFC, CIP, Bioversity and CIAT alliance.

Now, the CGIAR is going through a transition/change process and research will now be grouped in different initiatives under the One-CGIAR (effective January 2022, after the termination of the CGIAR Research Programs by 31 December 2021). The new initiatives are working on identified areas, bringing together relevant CG Centers and the global demand, innovation and scaling partners.

India is a donor member country to CGIAR from decades and also a voting member in CGIAR System Council, representing South Asia Constituency of the Council alongwith two alternate partner countries, viz. Bangladesh and Sri Lanka. India has assumed important role in CGIAR System as a permanent voting member.

The IC-CG (now merged with IC-IV) Section processes all work relating to CG Centres including processing of MoU, Work Plan and foreign visits of scientists/officials of ICAR/DARE, payment of annual contribution to CGIAR and collaborative projects between ICAR and CGIAR Centres.

## Major Activities

### Work Plan

- Work Plan signed on 2 December, 2021 for the period 2021-25 between Indian Council of Agricultural Research (ICAR) and Bioversity and CIAT Alliance under the Existing Memorandum of Agreement Scientific and Technical Cooperation in Research and Training to deliver research-based solutions that harness agricultural biodiversity sustainably transform Food systems to improve people's lives in a climate crisis.
- Work Plan signed on 2 September, 2022 for the period 2022-27 between Indian Council of Agricultural Research (ICAR) and International Wheat and Maize Improvement Centre (CIMMYT) developed in accordance with the MoU signed between ICAR and CIMMYT.

### Projects

- Extension of time to the Collaborative research project entitled, Cereal Systems Initiative for South Asia (CSISA) Phase-III- on Zero budget.

- Approval of collaborative research project entitled, Modifying the lignin composition in biomass sorghum and its deployment for enhanced ligno-cellulosic (2G) biofuel production.
- Collaborative research project entitled, "Modifying the lignin composition in biomass sorghum and its deployment for enhanced ligno-cellulosic (2G) biofuel production.
- Extension of time to the approved project entitled "Biofortification of rice" under Harvest Plus program for next 3 years funding under Harvest Plus Programme of CGIAR coordinated by Centre for Tropical Agriculture (CIAT) and International Food Policy Research Institute (IFPRI).
- Collaborative Research project entitled, International Mungbean Improvement Network Phase-2 (IMIN-2) for the period of five year funded by ACIAR in collaboration with ICAR- IIPR, Kanpur; AVRDC, Taiwan and ACIAR, Australia and to authorize Director, ICAR-IIPR, Kanpur to sign the Research Collaborative Agreement (RCA) on behalf of ICAR.
- Collaborative project between ICAR and Cereal System Initiative for South Asia (CSISA) Phase-IV of International Wheat and Maize Research Organization CIMMYT.
- Establishment of Nitrogen-efficient Wheat Production Systems in Indo-Gangetic Plains by the deployment of BNNI-technology in collaboration with the Indian Council of Agricultural Research (ICAR), Borlaug Institute for South Asia (BISA) and Japan International Cooperation Agency (JICA) for a period of five years.
- Collaborative research project entitled, Tree Outside Forests in India (TOFI) in collaboration with ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi; ICAR-Central Agroforestry Research Institute (CAFRI), Jhansi and International Centre for Research in Agroforestry (ICRAF) funded by United States Agency for International Development (USAID), USA for a period of five years.
- Collaborative research project entitled Consumption of Resilient Orphan Crops and Products for Healthier Diets (CROPS4HD) and authorization to ICAR-NBPGR to sign sub-agreement for a period of period of three years.

## MoUs/MoAs

- Project Agreement between the GIZ and the World Agroforestry, (ICRAF) for initiating pilot project entitled, “Sustainable Biochar Production and Use through Agroforestry Systems in Madhya Pradesh, Maharashtra and Odisha: A Climate-Resilient Soil Management Approach”, Short title: “Sustainable Biochar Production through Agroforestry System.”
- Tripartite MoU between the World Agro-forestry (ICRAF), Kenya, Department of Agriculture, Marketing and Cooperation, Government of Andhra Pradesh and Indian Council of Agricultural Research (ICAR) to develop and implement a joint research program.
- Cooperative agreement between Progressive Environmental and Agricultural Technologies (PEAT), Hannover, Germany and ICRISAT and Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad.

## Foreign Visits

- Virtual participation of Dr Reena Rani, Scientist (Genetics and Plant Breeding), ICAR-CAZRI, Jodhpur for attending an International conference entitled 2<sup>nd</sup> International Agrobiodiversity Congress to be held virtual mode at Rome, Italy hosted by Italian Government and the Alliance of Bioversity International and CIAT during 15-18 November, 2021.
- Virtual participation of Dr Muhammed Nissar V A, Scientist, ICAR-Indian Institute of Spices Research, Kerala in the 2<sup>nd</sup> International Agro biodiversity Congress to be held virtual in Rome during 15-18, November, 2021.
- Virtual participation of Dr Anil Patidar, Scientist, ICAR-Central Arid Zone Research Institute, Jodhpur (Rajasthan) for participation and post presentation in the ongoing 2<sup>nd</sup> International Agrobiodiversity Congress being held virtual mode in Rome during 15-18, November 2021.
- Deputation proposal of Dr S Uma, Director, ICAR-National Research Centre for Banana, Tiruchirappalli to participate in the Annual review meeting of the ICAR approved project entitled ‘Accelerated Breeding of Better Bananas - Phase II’ and present the progress report of the project from 23-30 May, 2022 (excluding journey period) to be held in Tanzania.
- Deputation proposal of Dr Salej Sood, Scientist, ICAR-Central Potato Research Institute (CPRI), Shimla for participation in the 11<sup>th</sup> World Potato Congress from 30 May, 2022 to 2 June, 2022 (excluding journey period) to be held in Ireland.
- Deputation proposal of Dr Manjeet Kumar, Scientist, ICAR-IARI, New Delhi for participation in the training on Wheat Pathology and Breeding to Accelerate Genetic Gains during 15 July to 15 December, 2022 (excluding journey period) being organized by the CIMMYT in Mexico.
- Deputation proposal of Dr Kamble Umesh Ravindra, Scientist, ICAR-IIWBR, Karnal for participation in the training on Wheat Pathology and Breeding to Accelerate Genetic Gains during 15 July to 15 December, 2022 (excluding journey period) to be organized by CIMMYT in Mexico.
- Deputation proposal of Dr Bandana, Senior Scientist, ICAR-Central Potato Research Institute (CPRI), Shimla for participation in the training on Cryopreservation and Nutritional Profiling during 11-19 September, 2022 (excluding journey period) in Lima, Peru.
- Deputation proposal of Dr Nishant Kumar Sinha, Scientist, ICAR-Indian Institute of Soil Sciences (ICAR-IISS), Bhopal for participation in the World Congress of Soil Science 2022 (WCSS 22) from 31 July to 5 August, 2022 (excluding journey period) to be held at Glasgow, U K.
- Deputation/visit of Dr Vinod Kumar Singh, Director, ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad for participation in the Technical Workshop on climate change of G20 MACS 2022 and present a country report during 3-5 August 2022 (excluding journey time) to be held at Bogor, Indonesia
- Deputation/visit of Dr G Prathibha, Principal Scientist, ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad for participation in the Technical Workshop on climate change of G20 MACS 2022 and present a country report during 3-5 August, 2022 (excluding journey time) to be held at Bogor, Indonesia.
- Rescheduling visit of Dr Manjeet Kumar, Scientist, ICAR-IARI, New Delhi for participation in the training on Wheat Pathology and Breeding to Accelerate Genetic Gains from



- 17 August to 15 December, 2022 (excluding journey period) instead of 15/07/2022 to 15/12/2022 in Mexico.
- Rescheduling visit of Dr Kamble Umesh Ravindra, Scientist, ICAR-IIWBR, Karnal for participation in the training on Wheat Pathology and Breeding to Accelerate Genetic Gains from 16 August to 15 December, 2022 (excluding journey period) instead of 15/07/2022 to 15/12/2022 in Mexico
  - Deputation/visit of Dr Basanta Kumar Das, Director, ICAR-Central Inland Fisheries Research Institute (CIFRI), Barrackpore for attending the 2022 Fish Base and Sea Life Base Symposium from 5-6 September, 2022 (excluding journey period) to be held in Penang, Malaysia.
  - Deputation/visit of Dr S K Swain, Director (I/c), ICAR- CIFA, Bhubaneshwar for attending 2<sup>nd</sup> International Conference on Sustainable Fisheries and to chair a session and deliver the keynote address on Aquaculture and Nutrition during 16-18 September, 2022 (excluding journey time) in Bangladesh.
  - Deputation proposal of Dr Madhu Patial, Scientist, ICAR-Indian Agricultural Research Institute Regional Centre, Shimla for participation in the training on Wheat Pathology and Breeding to Accelerate Genetic Gains during 20 September to 19 December, 2022 (excluding journey period) in Mexico.
  - Deputation/visit of Dr Vikas Mangal, Scientist, ICAR-Central Potato Research Institute (CPRI), Shimla for participation in the training on Cryopreservation and Nutritional Profiling during 11-19 September, 2022 (excluding journey period) in Lima, Peru.
  - Deputation of Dr Anand Kumar Naorem, Scientist, ICAR-Central Arid Zone Research Institute (CAZRI), Jodhpur to participate virtually in the X International Congress on Cactus Pear and Cochineal during 26-29 September, 2022 (excluding journey time) to be held in Brazil.
  - Deputation/visit of Dr Senguttuvel P, Senior Scientist, ICAR- IIRR, Hyderabad for attending Hybrid Rice Development Consortium Annual Meeting during 21-23 September, 2022 (excluding journey period) in Philippines.





# 04

## PROGRESSIVE USE OF HINDI



During financial year 2022-23 up to 30 September, 2022 DARE has ensured compliance of the provisions of the Official Language Act, 1963, Official Language Rules, resolution, general orders, notifications, administrative or other reports, or press communiques, issued or made by the Central Government or by a Ministry, Department or office thereof or company, company owned or controlled by the Central Government or by any office of such corporation and various orders/instructions issued by Department of Official Language from time to time on progressive use of Hindi for official purposes in the Department and autonomous bodies coming under its purview. Efforts are being made for progressive use of Hindi in DARE as well as its attached offices.

Targets and achievements, in brief, accomplished by Hindi Section of DARE with regard to progress of Official Language and implementation of Official Language Policy are detailed below :

**Policy Implementation:** The Official Language Division of the Department, manned by an officer of the level of Assistant Director (OL) and one supportive staff have made continuous efforts towards implementation of the instructions issued by the Department of Official Language in this Department and Autonomous Bodies under its purview. In this regard, effective check points have been prepared for compliance of the implementation of the Official Language Policy and circulated to all officers to ensure more and more use of Hindi while disposing off their official work. Emphasis has also been given to achieve the targets of correspondence in Hindi with offices located in “A”, “B” and “C” Regions.

**Notification of Institutions/Offices under Rule 10(4) of the Official Rules 1976:** Institutes/Offices of DARE and its Organisation (ICAR) where 80% of staff have acquired working knowledge/proficiency in Hindi are notified under Rule 10(4) of the Official Language Rules, 1976. Overall 144 offices and attached stations with regional offices of

ICAR have been notified till date.

**Meetings of OLIC:** Quarterly meetings of Joint Official Language Implementation Committee (OLIC) of DARE and ICAR have been conducted under the chairmanship of Additional Secretary (DARE) and Secretary, ICAR, who is the nodal officer for implementation of the Official Language Policy in DARE. Four meetings have been organized upto 30 September, 2022 and follow up action has been taken in compliance with the decisions taken in these meetings.

**Reports related to Official Language Policy:** Annual Assessment Report and Quarterly Progress Reports regarding use of Rajbhasha in the Department have been sent to the Department of Official Language, MHA.

**Inspections w.r.t. Official Language Policy:** During the year, up to 30 September, 2022, Four sections of DARE and an Organisation namely Central Agricultural University, Imphal (Manipur) have been inspected to review the Progressive use of Hindi and suggestions have been given to solve practical problems being faced by the employees of these sections while working in Hindi.

**Translation Work:** Translation of documents falling under section 3(3) of Official Language Act, 1963 has been done by Official Language wing of this Department. Documents like Cabinet Notes, Resolutions, Notifications, MoU/Agreements/Work-Plans in the field of Agriculture with other Institutes have been translated in Hindi within the stipulated time-frame based on their priority.

**Hindi Fortnight (Pakhwada):** Hindi Pakhawada has been observed from 14 September, 2022 to 30 September, 2022 in the Department in association with ICAR. On the occasion of “Hindi Diwas”, a message of Additional Secretary (DARE) and Secretary (ICAR) regarding progressive use of Hindi was circulated. In addition, various Hindi competitions were also organized during Hindi Fortnight.



# 05

## DEPARTMENTAL ACCOUNTING ORGANISATION

## ACCOUNTING ORGANIZATION OF DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION

The Secretary as Chief Accounting Authority in the Department of Agricultural Research and Education discharges his functions with the assistance of Financial Adviser and Chief Controller of Accounts.

1. As per Rule 70 of GFR 2017, the Secretary of a Ministry/Department as Chief Accounting Authority of the Ministry/Department shall:

- (i) Be responsible and accountable for financial management of his Ministry or Department;
  - (ii) Ensure that the public funds appropriated to the Ministry or Department are used for the purpose for which they were meant;
  - (iii) Be responsible for the effective, efficient, economical and transparent use of the resources of the Ministry or Department in achieving the stated project objectives of that Ministry or Department, whilst complying with performance standards;
  - (iv) Appear before the Committee on Public Accounts and any other Parliamentary Committee for examination;
  - (v) Review and monitor, regularly, the performance of the programmes and projects assigned to his Ministry to determine whether stated objectives are achieved;
  - (vi) Be responsible for preparation of expenditure and other statements relating to his Ministry or Department as required by regulations, guidelines or directives issued by Ministry of Finance;
  - (vii) Ensure that his Ministry or Department maintains full and proper records of financial transactions and adopts systems and procedures that shall at all time afford internal controls;
  - (viii) Ensure that his Ministry or Department follows the Government procurement procedure for execution of works, as well as for procurement of services and supplies, and implements it in a fair, equitable, transparent, competitive and cost-effective manner;
  - (ix) Take effective and appropriate steps to ensure his Ministry or Department:-
    - (a) Collects all money due to the Government, and
    - (b) Avoids unauthorized, irregular and wasteful expenditure.
2. As per Para 1.3 of Civil Accounts Manual, the

Chief Controller of Accounts for and on behalf of the Chief Accounting Authority is responsible for:

- (a) Arranging all payments through the Pay and Accounts Offices/Principal Accounts Office except where the Drawing and Disbursing Officers are authorized to make certain types of payments.
  - (b) Compilation and consolidation of accounts of the Ministry/Department and their submission in the form prescribed, to the Controller General of Accounts; preparation of Annual Appropriation Accounts for the Demands for Grants of his Ministry/Department, getting them duly audited and submitting them to the CGA, duly signed by the Chief Accounting Authority.
  - (c) Arranging internal inspection of payment and accounts record maintained by the various subordinate formations and Pay and Accounts Offices of the Department and inspection of records pertaining to transaction of Government Ministries/Departments, maintained in Public Sector Banks.
3. The Chief Controller of Accounts, Ministry of Agriculture and Farmers Welfare performs his duties with the assistance of Controller/ Assistant Controller of Accounts, three Principal Accounts Officers at HQ and 09 Pay and Accounts Offices. Four Pay and Accounts Offices are located in Delhi/NCR, one each in Mumbai, Chennai, Cochin, Kolkata and Nagpur. All payments pertaining to the Department /Ministry are made through PAOs/ CDDOs attached with respective PAOs. DDOs present their claims/bills to the designated PAOs/ CDDOs, who issue cheques/ release e-payment after exercising the necessary scrutiny as per provisions contained in Civil Accounts Manual, Receipt and Payment Rules and other order issued by Government from time to time.
4. As per Para 1.2.3 of Civil Accounts Manual, Principal Accounts Office at HQ functions under a Principal Accounts Officer who is responsible for:
- (a) Consolidation of the accounts of the Ministry/ Department in the manner prescribed by CGA;
  - (b) Preparation of Annual Appropriation Accounts of the Demands for Grants controlled by



- Ministry/Department, submission of Statement of Central Transactions and material for the Finance Account of the Union Government (Civil) to the Controller General of Accounts;
- (c) Payment of loans and grants to State Government through Reserve Bank of India and wherever this office has a drawing account, payment therefrom to Union Territory Government/Administrations;
  - (d) Preparation of manuals keeping in view the objective of management accounting system if any, and for rendition of technical advice to Pay and Accounts Offices, maintaining necessary liaison with CGA's Office and to effect overall coordination and control in accounting matters;
  - (e) Maintaining Appropriation Audit Registers for the Ministry/Department as a whole to watch the progress of expenditure under the various Grants operated on by the Ministry/Department; Principal Accounts Office/Officer also performs all administrative and coordinating function of the accounting organization and renders necessary financial, technical, accounting advice to department as well as to local Pay and Accounts offices and Out station Pay and Accounts offices.
5. As per provisions contained in Civil Accounts Manual,
- Pay and Accounts offices make payments pertaining to respective Ministries/Departments and in certain cases payments will be made by the departmental Drawing and Disbursing Officers (DDOs) authorized to draw funds, by means of cheques drawn on the offices/branches of accredited bank for handling the receipts and payments of the Ministry/Department. These payments will be accounted for in separate scrolls to be rendered to the Pay and Accounts Offices of Ministry/Department concerned. Each Pay and Accounts Office or Drawing and Disbursing Officer authorized to make payments by cheques/e-payments, will draw only on the particular branch/branches of the accredited bank with which the Pay and Accounts Office or the Drawing and Disbursing Officer as the case may be, is placed in account. All receipts of the Ministry/Department are also finally accounted for in the books of the Pay and Accounts Office. The Pay and Accounts office is the basic Unit of Departmentalized Accounting Organization. Its main function include:
- (a) Pre-check and payment of all bills, including those of loans and grants-in-aid, submitted by

Non-Cheque Drawing DDOs.

- (b) Accurate and timely payments in conformity with prescribed rules and regulations.
  - (c) Timely realization of receipts.
  - (d) Issue of quarterly letter of credit to Cheque Drawing DDOs and post check of their Vouchers/bills.
  - (e) Compilation of monthly accounts of receipts and expenditures made by them incorporating the accounts of the cheque Drawing DDOs.
  - (f) Maintenance of GPF accounts other than merged DDO and authorization of retirement benefits.
  - (g) Maintenance of all DDR Heads.
  - (h) Efficient service delivery to the Ministry/Department through banking arrangement by way of e-payment.
  - (i) Adherence to the prescribed Accounting Standards, rules and principles.
  - (j) Timely, accurate, comprehensive, relevant and useful financial reporting.
6. The overall responsibilities of Departmental Accounting Organization in respect of Ministry of Agriculture and Farmers Welfare are:
- (a) Consolidation of monthly accounts of Ministry and its submission to the CGA.
  - (b) Annual Appropriation Accounts.
  - (c) Statement of Central Transactions.
  - (d) Preparation of "Accounts at a Glance".
  - (e) Union Finance accounts which are submitted to the CGA, Ministry of Finance and Principal Director of Audit.
  - (f) Payments of grants-in-aid to Grantee Institutions/Autonomous Bodies, etc.
  - (g) Rendering technical advice to all PAOs and Ministry; if necessary in consultation with other organizations like DoPT, Ministry of Finance and CGA, etc.
  - (h) Preparation of Receipt Budget.
  - (i) Preparation of Pension Budget.
  - (j) Procuring and supplying of cheque books for and on behalf of PAOs/Cheque Drawing DDOs.
  - (k) To maintain necessary liaison with Controller General of Accounts office and to effect overall co-ordination and control in accounting matters and accredited Bank.
  - (l) To verify and reconcile all receipts and payments made on behalf of Ministry of Agriculture and Farmers Welfare through the accredited Bank, i.e. State Bank of India.

- (m) To maintain accounts with Reserve Bank of India relating to Ministry of Agriculture and Farmers Welfare and to reconcile the cash balances.
  - (n) To ensure prompt payments.
  - (o) Speedy settlement of Pension/Provident fund and other retirement benefits.
  - (p) Internal Audit of the Ministry, subordinate and attached offices under Ministry of Agriculture and Farmers Welfare and its Grantee institutions, Autonomous Bodies, etc.
  - (q) To make available accounting information to all concerned Authorities/Divisions.
  - (r) Budget co-ordination works of Ministry of Agriculture and Farmers Welfare.
  - (s) Monitoring of New Pension Scheme and revision of pension cases from time to time.
  - (t) Computerization of accounts and e-payment.
  - (u) Administrative and co-ordination function of the accounting organization.
  - (v) Roll out of PFMS under Central Sector Schemes in Grantee Institutions/Autonomous Bodies.
  - (w) Non-Tax Receipt Portal (NTRP) in Ministry of Agriculture and Farmers Welfare.
7. Accounting information and data are also provided to the Financial Advisor and Chief Accounting Authority to facilitate effective budgetary and financial control. Monthly and progressive expenditure figures under various sub-heads/object-heads of the grant of the Ministry of Agriculture and Farmers Welfare are furnished to Budget Section of the Ministry including Senior officers. Progress of expenditure against budget provisions are also submitted weekly to the Secretary and Addl. Secretary and Financial Advisor as well as Heads of Divisions of the Ministry, controlling the grant for purposes of better monitoring of expenditure in last quarter of the financial year.
  8. The Accounting organization also maintains accounts of long-term advances such as House Building Advance, Motor Car Advance and GPF accounts of employees of the Ministry.
  9. The verification and authorization of pensionary entitlement of officers and staff members is done by the Pay and Accounts Offices on the basis of service particulars and pension papers furnished by Heads of Offices. All retirement benefits and payments like gratuity, cash equivalent to leave salary as well as payments under Central Government Employees Group Insurance Scheme; General Provident Fund,

etc. are released by Pay and Accounts Offices on receipt of relevant information/bills from DDOs.

### Internal Audit Wing

- (a) The Internal Audit Wing carries out audit of accounts of various offices of the Ministry to ensure that rules, regulations and procedures prescribed by the government are adhered to by these offices in their day to day functioning. Internal Auditing is an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. It basically aims at helping the organization to accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control and governance processes. It is also an effective tool for providing objective assurance and advice that adds values, influence change that enhances governance, assist risk management, control processes and improve accountability for results. It also provides valuable information to rectify the procedural mistakes/deficiencies and thus, acts as an aid to the management. The periodicity of audit of a unit is regulated by its nature, volume of work and quantum of funds.
- (b) The Internal Audit Wing working under the overall guidance of Chief Accounting Authority and Financial Advisor has focussed on strengthening governance structures, capacity building and leveraging technology in appropriate manner to ensure an efficient and effective Internal Audit practice.
- (c) In pursuance of O/o Controller General of Accounts, Department of Expenditure, Ministry of Finance, OM no. G.25014/33/2015-16/MF.CGA/IAD/306-53 dated 15 May, 2017 and as per provisions contained in Generic Internal Audit Manual (Version 1.0) issued by O/o CGA, Audit Committee has been constituted in this Department under the Chairmanship of Secretary (DARE) and DG(ICAR) with the approval of Secretary (DARE) and DG (ICAR) and terms of reference of Internal Audit Committee has been defined in O/o CCA OM No. Agri/IAW/Audit Committee (DARE)/2022-23(Computer File No. 197946)/523-532 dated 15.09.2022.
- (d) During the financial year 2022-23, the focus of audit was to detect errors in fixation of Pay paid in excess as well as in short.

Department	Outstanding paras up to 31.03.2022	Paras raised from 01.04.2022 to 30.06.2022	Paras dropped from 01.04.2022 to 30.06.2022	Total outstanding Paras as on 30.06.2022
DARE	NIL	NIL	NIL	NIL
ICAR Units	NIL	NIL	NIL	NIL
Total	NIL	NIL	NIL	NIL
Department	Outstanding paras up to 30.06.2022	Paras raised from 01.07.2022 to 30.09.2022	Paras dropped from 01.04.2022 to 30.09.2022	Total outstanding Paras as on 30.09.2022
DARE	NIL	NIL	NIL	NIL
ICAR Units	NIL	32	NIL	32
Total	NIL	32	NIL	32

Status of Outstanding Internal Audit paras in the Department of Agricultural Research and Education (DARE) as on 30 September, 2022 are given below:

### Banking Arrangements

State Bank of India is the accredited bank for PAOs and its field offices in the Ministry of Agriculture and Farmers Welfare. e-payments processed by the PAOs/CDDOs are settled through CMP, SBI, Hyderabad in favour of the bank account of vendors/beneficiaries. In some cases, cheques issued by the PAOs/CDDOs are presented to the nominated branch of the accredited bank for payment. The receipts are also remitted to the accredited banks by the respective PAOs/CDDOs apart from Non-Tax-Receipt Portal (NTRP). Any change in accredited bank requires specific approval of Controller General of Accounts, Department of Expenditure, Ministry of Finance.

Principal Accounts Office has 09 (Nine) Pay and Accounts Offices. Four PAOs are located in Delhi/ NCR, One each in Mumbai, Chennai, Cochin, Kolkata and Nagpur. All payments pertaining to the Department/Ministry are made through PAOs/CDDOs attached with respective PAOs. Drawing and Disbursing officers present their claims/bills to the designated PAOs/CDDOs, who issue releases e-payment after exercising the necessary scrutiny as per provisions contained in Civil Accounts Manual, Receipt and Payment Rules and other orders issued by Government from time to time.

### Initiatives on e-payment

The payments system in all Pay and Accounts Offices of Ministry of Agriculture and Farmers Welfare had been successfully implemented from 2011 onwards.

### e-Payment System

Since, the IT Act, 2000 recognizes the digitally

signed documents or electronic records digitally authenticated by means of an electronic method or procedure in accordance with the provisions of Section 3 of the Act, the Controller General of Accounts had developed a facility in COMPACT for electronic payment (e-payment) through digitally signed electronic advices. This had replaced the existing system of payment through cheque while leveraging the COMPACT application running in all Pay and Accounts Offices in all Ministries/ Departments of Central Government.

The e-payment system developed was a fully secured web based system of electronic payment services which introduces transparency in government payment system. Payment of dues from the government under this system were made by credit of money directly into the bank account of payee through a digitally signed e-advices generated from COMPACT through the 'Government e-payment Gateway (GePG)' on a secured communication channel. Necessary functional and security certification were obtained from STQC Directorate for its roll out. The system was implemented in all Central Government Civil Ministries/ Departments in a phased manner.

GePG has further been upgraded to PFMS system, which is an integrated Financial Management System of Controller General of Accounts, for sanction preparation, bill processing, payment, receipt management, Direct Benefit Transfer, fund flow management and financial reporting.

### Public Financial Management System (PFMS)

Public Financial Management System (PFMS) was initially started as a Plan Scheme named CPSMS of the erstwhile Planning Commission in 2008-09 as a pilot in four states of Madhya Pradesh, Bihar, Punjab and Mizoram for four Flagship schemes, e.g MGNREGS, NRHM, SSA



and PMGSY. After the initial phase of establishing a network across Ministries/Departments, it has been decided to undertake National roll-out of CPSMS (PFMS) to link the financial networks of Central, State Governments and the agencies of State Governments. The scheme was included in 12<sup>th</sup> Plan initiatives of erstwhile Planning Commission and Ministry of Finance. Presently, PFMS is the scheme of Department of Expenditure, Ministry of Finance and being implemented by O/o Contoller General of Accounts across the country.

1. As per MoF, DoE, OM No.66 (29) PF-II/2016 dated 15/07/2016, Hon'ble Prime Minister has emphasized the need for improved financial management in implementation of Central Plan Schemes so as to facilitate 'Just-in-Time' releases and monitor the usage of funds including information on its ultimate utilization. The Public Financial Management System (PFMS) is administered by the O/o Contoller General of Accounts in the Department of Expenditure which is an end-to-end solution for processing payments, tracking, monitoring, accounting, reconciliation and reporting. It provides the scheme managers a unified platform for tracking releases and monitoring their last mile utilization.
2. In order to abide by the directions to implement Just-in-time releases and monitor the end usage of funds, it has been decided by Ministry of Finance to universalize the use of PFMS to cover all transactions/payments under the Central Sector Schemes. The complete monitoring of these schemes require mandatory registration of all Implementing Agencies (IAs), on PFMS and mandatory use of Expenditure Advances and Transfer (EAT) module of the PFMS by all IAs. The Implementation Plan covers the complete universe of Central Sector Schemes, which inter-alia requires the following steps to be taken by each Ministry/Department:
  - (i) All central schemes have to be mapped/ configured and brought on the PFMS platform.
  - (ii) All Implementing Agencies (IAs) receiving and utilizing funds needs to be mandatorily registered on PFMS.
  - (iii) Usage of PFMS modules has to be made mandatory for all registered agencies for making payments, advances and transfers.
  - (iv) All Departmental Agencies incurring expenditure in respect of Central Sector Schemes must register and compulsorily use the

PFMS Modules.

- (v) All Grantee Institutions have to adopt PFMS modules for making Payments/Transfers/ Advance from Grants received from the Central Government This will enable generation of on-line Utilization Certificates for claiming funds from the Central Government.
- (vi) Ministry has to take an action for integrating their respective systems/applications with the PFMS.

### **Modules to implement the Mandate**

Modules developed/under developed by PFMS for stakeholders as per the Union Cabinet approval and mandate are as under:

#### **Fund Flow Monitoring [EAT Modules]**

- (a) Agency registration
- (b) Expenditure management and fund utilization through PFMS EAT module
- (c) Accounting Module for registered agencies
- (d) Treasury Interface
- (e) PFMS-PRI fund flow and utilization interface
- (f) Mechanism for State Governments towards fund tracking for State schemes
- (g) Monitoring of Externally Aided Projects (EAP)

### **II. Direct Benefit Transfer (DBT) modules**

- (a) PAO to beneficiaries
- (b) Agency to beneficiaries
- (c) State treasuries to beneficiaries

### **III. Interfaces for Banking**

- (a) CBS (Core Banking Solutions)
- (b) India Post
- (c) RBI (Reserve Bank of India)
- (d) NABARD and Cooperative Banks

#### **Modules to Implement Enhanced mandate**

1. PAO Computerization-Online payments, receipts and accounting of Government of India
  - (a) Programme Division module
  - (b) DDO module
  - (c) PAO module
  - (d) Pension module
  - (e) GPF and HR module
  - (f) Receipts including GSTN
  - (g) Annual Financial Statements

- (h) Cash Flow Management
- (i) Interface with non-civil ministries
- 2. Non-Tax Receipt Portal.

### Other Departmental Initiatives

To leverage the capabilities of PFMS, several other departments have approached PFMS for developing utilities for their departmental need as follows:

- (i) CBDT PAN validation
- (ii) GSTN bank account validation

### Implementation Strategy

An Action Plan has been prepared and approved by Ministry of Finance for phased implementation of Public Financial Management System (PFMS).

### Improved Financial Management through

Just in Time (JIT) release of funds.

Monitoring of use of funds including ultimate utilization.

### Strategy

Universal roll-out of PFMS which inter alia includes

- Mandatory registration of all Implementing Agencies (IA) on PFMS.
- Mandatory use of Expenditure Advance and Transfer (EAT) Module of PFMS by all IAs.

### I. Implementation Strategy for Central Sector (CS) Schemes/Transaction

- Activities to be completed.
- Mandatory registration and use of EAT module by IAs.
- Mapping of all relevant information of schemes.
- Uploading of budget of each scheme on PFMS.
- Identify implementation hierarchy of each scheme.
- Integration of System Interface of specific schemes with PFMS, e.g. NREGASoft, AwasSoft.
- Deployment and training of trainers.

### II. Implementation Strategy for Centrally Sponsored Schemes

Activities to be undertaken by states:

- State Treasury Integration with PFMS
- Registration of all SIAs on PFMS (1<sup>st</sup> level and below)

- Mapping of state schemes with corresponding central schemes
- Configuration of State schemes on PFMS
  - ♦ Configuring State Schemes components
  - ♦ Identify and configure hierarchy of each state scheme
- Integration of PFMS with schemes specific software application.
- Deployment and training of trainers.
- Continuous support for implementation.

At present, all nine (09) Pay and Accounts Offices of M/o Agriculture farmer welfare, four (4) PAOs are located in Delhi/NCR, One each in Mumbai, Chennai, Cochin, Kolkata and Nagpur are functioning successfully on PFMS. All payments are routed through PFMS and e-payments being directly credited into the beneficiary's bank account.

**I. Employees Information System (EIS) Module of PFMS:** This module has been implemented in all Drawing and Disbursing Offices of Ministry of Agriculture and Farmer Welfare.

**II. CDDO Module of PFMS:** CDDO module of PFMS has been rolled out in all Cheque Drawing and Disbursing Offices of Ministry of Agriculture and Farmer Welfare.

### III. Online Portal (Bharatkosh) for collection of Non- Tax Revenue in the Ministry:

- The objective of Non-Tax Receipt Portal (NTRP) is to provide a one-stop window to Citizens/Corporate/Other users for making online payment of Non-Tax Revenue payable to Government of India (GoI).
- Non-Tax Revenue of Government of India comprise of a large bouquet of receipts, collected by individual departments/ministries. Primarily these receipts come from Dividends, Interest receipts, Spectrum charges, RTI application fee, purchase of forms/magazines by students and many other such payments by citizens/corporate/other users.
- The online electronic payment in a completely secured IT environment, helps common users /citizen from the hassle of going to banks for making drafts and then to Government offices to deposit the instrument for availing the services. It also helps avoidable delays in the remittance of these instruments into Government account as well as eliminates undesirable practices in the delayed deposit of these instruments into bank accounts.

- NTRP facilitates instant payment in a transparent environment using online payment technologies such as Internet Banking, Credit/Debit Cards.
- NTR Portal has been functional in Ministry of Agriculture and Farmers Welfare since inception in FY 2019-20.
- Expenditure, Advance and Transfer (EAT) Module of PFMS: All eight (08) Autonomous Bodies of Ministry of Agriculture and Farmers Welfare have been on-boarded on Expenditure Advance Transfer (EAT) module of PFMS.
- **Treasury Single Account (TSA)**
- The Expenditure Management Commission (EMC) vide Para 125 of its September, 2015 report has recommended that in order to minimize the cost of Government borrowings and to enhance efficiency in fund flows to Autonomous Bodies, Government should gradually bring all Autonomous Bodies (ABs) under the Treasury Single Account (TSA) System.

Under Department of Agricultural Research and Education, the TSA is implemented in the following:

- Indian Council of Agricultural Research (ICAR)
- Central Agricultural University, Imphal

The details of the Budgetary Provision and Expenditure their against is reflected below:

- Ministry of Finance, Department of Expenditure vide Office Memorandum F.No. 26(118)/EMC Cell/2016 dated 24.02.2022 has issued "Revised instructions on bringing Autonomous Bodies (ABs) under the Treasury Single Account (TSA) System".
- Ministry of Finance, Department of Expenditure vide Office Memorandum F.No. 26(118)/EMC Cell/2016 dated 20.10.2022 has issued "Amendment in revised guidelines for implementing Treasury Single Account (TSA) System in Autonomous Bodies (Abs)", which states that "these guidelines shall be applicable to Autonomous Bodies (ABs) including Statutory Bodies and Central Public Sector Enterprises (CPSEs) receiving more than

₹ 100.00 crores in a FY as Grants-in-Aid".

- This amendment will be effective from 1<sup>st</sup> April, 2023.

## New Developments in the Ministry

### I. Enforcement of enhanced security layers in online payment process in Public Financial Management System (PFMS)

In order to ensure safety measures on PFMS platform, the following features are being enforced for treasury operations:

- (a) Verification of each payment request with physical bill without fail before putting the digital signature by Pay and Accounts Offices (PAOs).
- (b) Use of NIC/GOV domain e-mail IDs for user registration by the officials dealing with PAO and DDO module of PFMS.
- (c) Immediate deactivation of user(s) found to be no longer active.
- (d) Deactivation of user ID/Digital key of PAO/AAO user type at the time of permanent transfer/ superannuation.)
- (e) Implementation of OTP based login system on PFMS in phased manner.

### (II) Implementation of electronic Bill (e-Bill) System of Public Financial Management System (PFMS)

In pursuance of the Digital India Initiative of Hon'ble Prime Minister, it was decided to develop a system to enable end to end digital processing of bills and claims from vendors, suppliers, contractors and all other types of payees of Government. The system was developed in the PFMS for the use in all Civil Ministries and Departments. With the initiative of e-bill, the complete payment system has become paperless.

- End-to-End electronic processing of claim and bill through PMFS on pilot-roll out of electronic Bill (e-Bill) system has been introduced in Department of Agricultural Research and Education w.e.f. 1 June, 2022.

## TSA Figures as on 30-09-2022

(₹ in Crore)

Name of ABs	Budget Estimate	Releases	% of Releases
Central Agricultural University, Imphal	268	134	50%
ICAR Headquarters	7872.89	3936.35	49.99%





# APPENDICES

*Appendix -I***Subjects allocated to DARE****Part-I**

The following subjects which fall within List I of the Seventh Schedule to the Constitution of India:

1. International cooperation and assistance in the field of agricultural research and education including relations with foreign and international agricultural research and educational institutions and organizations.
2. Fundamental, applied and operational research and higher education including coordination of such research and higher education in agriculture, agro-forestry, animal husbandry, dairying, fisheries, agricultural engineering and horticulture including agricultural statistics, economics and marketing.
3. Coordination and determination of standards in institutions for higher education or research and scientific and technical institutions in so far as they related to food and agriculture including animal husbandry, dairying and fisheries, Development of Human Resources in Agricultural Research/Extensions and Education.
4. Cell for financing to the Indian Council of Agricultural Research and the Commodity Research Programmes other than those relating to tea, coffee and rubber.
5. Sugarcane research.

**Part-II**

For Union Territories the subjects mentioned in Part I above, so far as they exist in regard to these Territories and in addition the following subject which falls within List II of the Seventh Schedule to the Constitution of India.

6. Agricultural Education and Research.

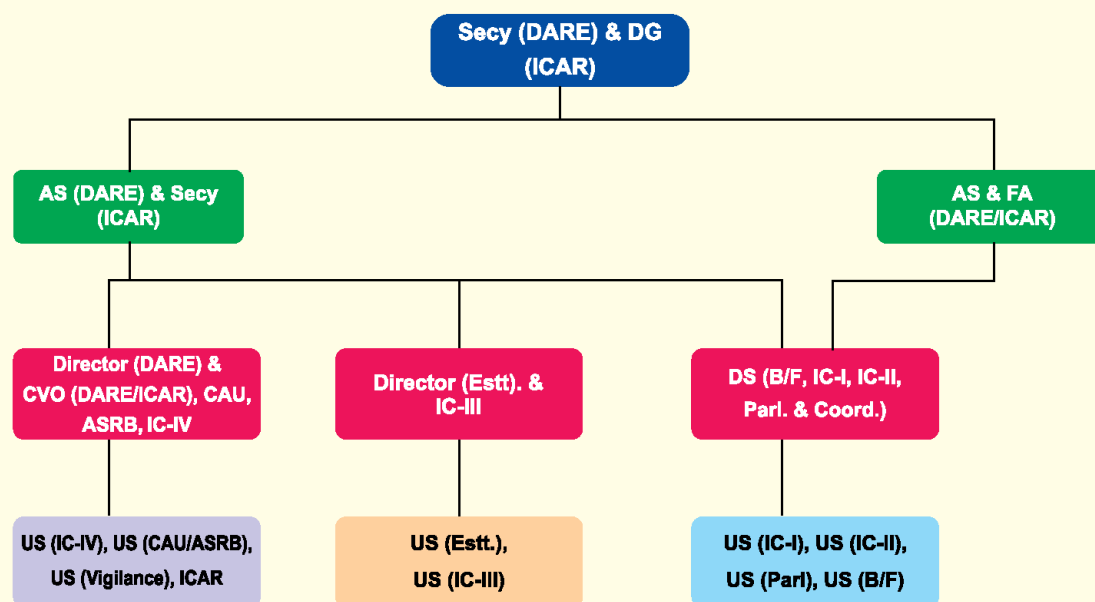
**Part-III**

General and Consequential:

7. Plant, animal and fish introduction and exploration.
8. All India Soil and Land Use Survey relating to research training, correlation, classification, soil mapping and interpretation.
9. Financial assistance to State Governments and Agricultural Universities in respect of Agricultural Universities in respect of agricultural research and educational schemes and programmes.
10. National demonstrations.
11. Indian Council of Agricultural Research and its constituent Institutes, National Research Centres, Project Directorates, Bureaux and All India Coordinated Research Projects.
12. Research and Development on production and improvement of bio-fuels plants.

### ORGANISATIONAL CHART

#### Department of Agricultural Research and Education





*Appendix -III***Sanctioned Staff Strength and in Position of DARE (as on 01.11.2022)**

Group	Designation	Sanctioned Strength	Filled up	Vacant
A	Secretary	1	1	0
A	Additional Secretary	1	1	0
A	Additional Secretary and Financial Advisor	1	1	0
A	Director	1	2	-1
A	Deputy Secretary	2	1	1
A	Senior PPS/ Principal Staff Officer	1	1	0
A	Joint Director	1	0	1
A	Under Secretary	7	6	1
A	Principal Private Secretary	3	0	3
A	Assistant Director (Official Language)	1	1	0
B	Private Secretary	2	1	1
B	Section Officer	8	2	6
B	Assistant Section Officer	5	2	3
B	Personal Assistant	4	2	2
B	Senior Hindi Translator	1	1	0
C	UDC-cum-Cashier	1	0	1
C	Senior Secretariat Assistant (UDC)	1	0	1
C	Stenographer Grade D	3	3	0
C	UDC-Hindi Typist	1	0	1
C	Staff Car Driver	1	1	0
C	Junior Secretariat Assistant (LDC)	1	0	1
C	Daftary	1	0	1
C	MTS	5	0	5
	<b>Total</b>	<b>53</b>	<b>26</b>	<b>27</b>

**Names of the Important Functionaries (as on 01.11.2022)**

S. No.	Name	Designation
1.	Dr. Himanshu Pathak	Secretary (DARE)
2.	Sh. Sanjay Garg	Additional Secretary (DARE)
3.	Mrs. Alka Nangia Arora	Additional Secretary and Financial Advisor DARE)
4.	Sh. Shaleen Agrawal	Director
5.	Sh. Khamkhan Pauva Guite	Director
6.	Sh. Mohinder Kumar	PSO
7.	Sh. Uday Shanker Pandey	DS
8.	Sh. Rajesh Kumar	US
9.	Sh. Balraj	US
10.	Sh. Prem Prakash Maurya	US
11.	Sh. AG Subramanian	US
12.	Sh. Shailendra Kumar Upadhyay	US
13.	Sh. Surajit Saha	US

## Budget Allocation: DARE/ICAR

(₹ in Crores)

S. No.	Name of the Scheme	Budget Estimate	Revised Estimate	Budget Estimate
		2021-22	2021-22	2022-23
1	Crop Science	708.00	615.00	526.08
2	Horticulture Science	212.00	183.00	157.53
3	ICAR Hqrs Admn including intellectual Property Rights Management and DKMA	5322.02	5561.48	5877.06
4	Agriculture Extension	328.00	284.00	243.72
5	Agriculture Education	355.00	300.00	263.77
6	Economic Statistics and Management	33.00	28.00	24.51
7	Agricultural Engineering	65.00	55.00	48.30
8	National Fund for Basic, Statistic and Frontier Application Research in Agriculture	48.00	42.00	35.67
9	National Agriculture Higher Education Project	225.00	225.00	167.18
10	Natural Resource Management Institutes including Agro-Forestry Research	195.00	168.00	144.90
11	Climate Resilient Agriculture Initiative	55.00	47.00	40.87
12	Animal Husbandry	302.00	262.00	224.41
13	Fisheries	160.00	138.00	118.89
	<b>Total ICAR-A</b>	<b>8,008.02</b>	<b>7,908.48</b>	<b>7,872.89</b>
14	International Cooperation-Other Programmes	6.73	7.02	7.03
15	Central Agricultural University, Imphal	210.00	263.00	268.00
16	CAU, Bundelkhand	110.95	112.95	126.45
17	Central Agricultural University, Bihar	150.00	187.00	205.00
18	National Academy of Agricultural Science and Indian Agricultural Universities Association	1.60	1.60	1.60
19	Agricultural Scientists Recruitment Board	19.00	26.50	24.75
20	Secretariat	7.32	7.07	7.90
	<b>Total DARE-B</b>	<b>505.60</b>	<b>605.14</b>	<b>640.73</b>
	<b>GRAND TOTAL = A+B</b>	<b>8,513.62</b>	<b>8,513.62</b>	<b>8,513.62</b>

## Budget of DARE (Proper)

(₹ in lakhs)

SI No.	Budget Head	Accounting Head	BE 2021-22	RE- 2021-22	BE- 2022-23
<b>I</b>	<b>DARE-Secretariat</b>				
	Salaries	345100090090001	560.00	590.00	625.00
	Medical Treatment	345100090090006	12.00	12.00	15.00
	DTE	345100090090011	30.00	20.00	25.00
	FTE	345100090090012	30.00	15.00	25.00
	Office Expenses	345100090090013	70.00	60.00	75.00
	OAE	345100090090020	30.00	10.00	25.00
	<b>Total: Secretariat</b>		<b>732.00</b>	<b>707.00</b>	<b>790.00</b>
<b>II</b>	<b>ASRB</b>				
	Secretariat-Economic Services (Major Head)	3451			
	Secretariat- ASRB (Minor Head)	00.091			
	(Sub Head)	020			
	(Object Head)				
	Salaries	01	NA	NA	675.00
	Wages	02	NA	NA	0.00
	Overtime Allowance	03	NA	NA	0.00
	Medical Treatments	06	NA	NA	10.00
	Domestic Travel Expenses	11	NA	NA	25.00
	Foreign Travel Expenses	12	NA	NA	2.00
	Office Expenses	13	NA	NA	215.00
	Publications	16	NA	NA	10.00
	Other Administrative Expenses	20	NA	NA	100.00
	Advertising and Publicity	26	NA	NA	10.00
	Professional Services	28	NA	NA	10.00
	Other Charges	50	NA	NA	463.00
	Major Works, Lands and Buildings	53	NA	NA	955.00
	<b>Total</b>				<b>2475.00</b>
<b>III</b>	<b>Membership Contributions</b>				
	CABI	241580798010032	60.00	60.00	60.00
	CCGIAR	241582798020032	550.00	580.00	580.00
	APAARI	241582798040032	10.00	10.00	10.00
	NACA	241580798050032	48.00	48.00	48.00
	ISTA	241580798070032	5.00	4.00	5.00
	<b>Total: Contribution</b>		<b>673.00</b>	<b>702.00</b>	<b>703.00</b>
<b>IV</b>	<b>Central Agricultural Universities</b>				

**01 GIA to Central Agricultural University, Imphal**

01.00.31 Grants-in-Aid General	2500.00	2500.00	2500.00
01.00.35 Grants for creation of Capital Assets	5500.00	5500.00	5500.00
01.00.36 Grants-in-Aid Salaries	13000.00	18300.00	18800.00
<b>Total- GIA General to Central Agricultural University, Imphal</b>	<b>21000.00</b>	<b>26300.00</b>	<b>26800.00</b>

**02 GIA to RLB Central Agricultural University, Bundelkhand (Jhansi)**

02.00.31 Grants-in-Aid General	550.00	550.00	550.00
02.00.35 Grant for creation of Capital Assets	9695.00	9695.00	10495.00



02.00.36 Grant-in-Aid Salaries	850.00	1050.00	1600.00
<b>Total-GIA to CAU, Bundelkhand, Jhansi</b>	<b>11095.00</b>	<b>11295.00</b>	<b>12645.00</b>
03 GIA to RP Central Agricultural University, Pusa, Bihar			
03.00.31 Grants-in Aid General	1500.00	1500.00	1500.00
03.00.35 Grants for creation of Capital Assets	4500.00	4500.00	4500.00
03.00.36 Grant-in-Aid Salaries	9000.00	12700.00	14500.00
<b>Total- GIA to Central Agricultural University, Bihar</b>	<b>15000.00</b>	<b>18700.00</b>	<b>20500.00</b>
<b>Total Budget : All three Central Agricultural Universities</b>	<b>47095.00</b>	<b>56295.00</b>	<b>59945.00</b>
<b>V. NAAS and IAUA</b>			
05.00.31 Grant-in-Aid general	160.00	160.00	160.00
<b>Total-GIA to NAAS and IAUA</b>	<b>160.00</b>	<b>160.00</b>	<b>160.00</b>
<b>VI. ASRB</b>			
06.00.31 Grants-in Aid General	900.00	900.00	NA
06.00.35 Grants for creation of Capital Assets	350.00	1150.00	NA
06.00.36 Grant-in-Aid Salaries	650.00	600.00	NA
<b>Total- GIA to ASRB</b>	<b>1900.00</b>	<b>2650.00</b>	

### Summary DARE (Proper)

(₹ in lakhs)

S. No.	Budget Head	BE (2021-22)	RE (2021-22)	BE (2022-23)
(i)	DARE Secretariat	732.00	707.00	790.00
(ii)	ASRB Secretariat	0.00	0.00	2475.00
(iii)	Membership Contribution	673.00	702.00	703.00
(iv)	CAUs	47095.00	56295.00	59945.00
(v)	NAAS and IAUA	160.00	160.00	160.00
(vi)	GiA to ASRB	1900.00	2650.00	0.00
	<b>Total</b>	<b>50560.00</b>	<b>60514.00</b>	<b>64073.00</b>









Department of Agricultural Research and Education  
Ministry of Agriculture and Farmers Welfare  
Government of India