



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

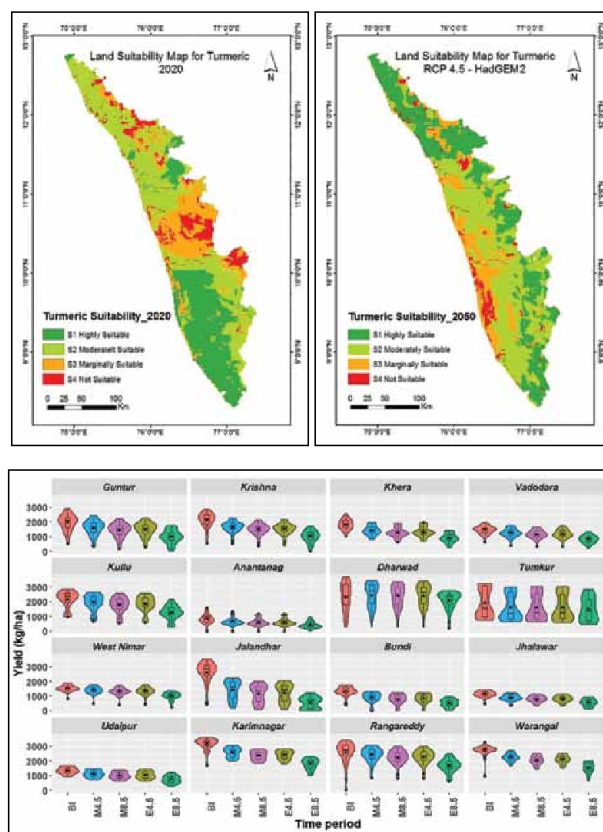
and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which 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 ≥ 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 ± 3.38 g) showed advanced maturation (GSI 2.24 ± 0.025) compared to wild male (238.67 ± 4.67 g) with maturing phase (GSI 0.768 ± 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



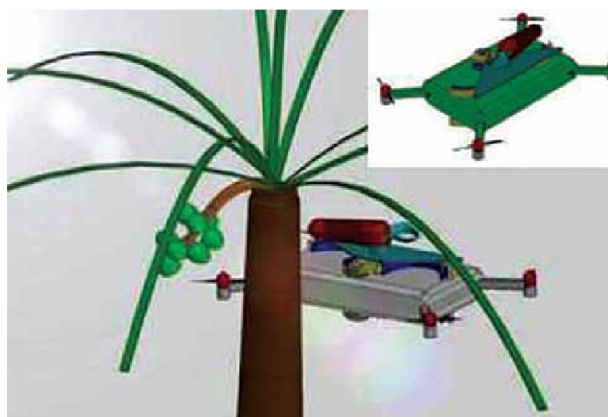
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), 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 P₂O₅ requirement and 99% of the total K₂O 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', '75th 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 21st 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 29th 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

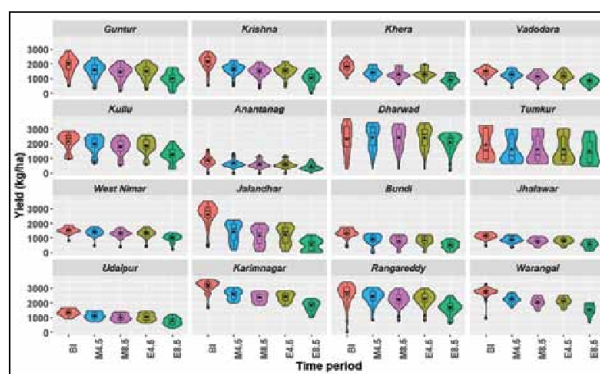
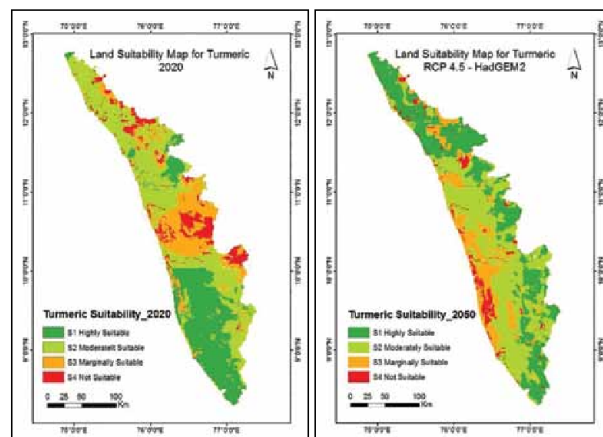
and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which 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 ≥ 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 ± 3.38 g) showed advanced maturation (GSI 2.24 ± 0.025) compared to wild male (238.67 ± 4.67 g) with maturing phase (GSI 0.768 ± 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



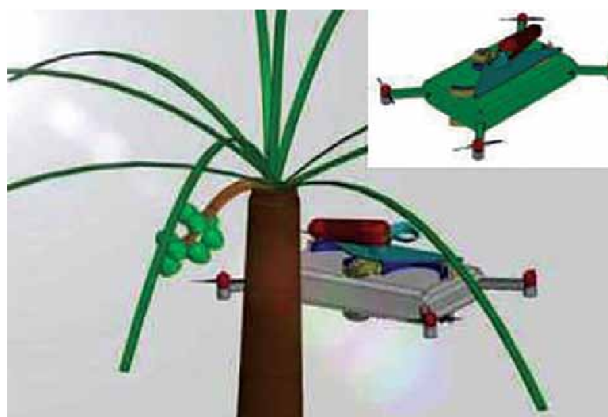
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), 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 P₂O₅ requirement and 99% of the total K₂O 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', '75th 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 21st 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 29th 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) 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:

45th Vice Chancellors' Convention: The 45th 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 45th 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 14th 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 14th 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.

5th 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

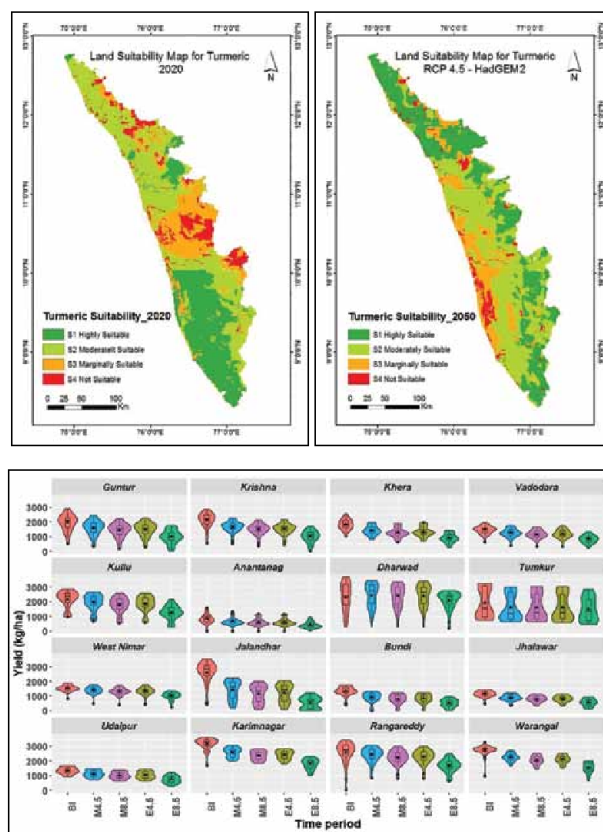
and 21% higher acceptability on a sensory scale over commercial biscuits were prepared. The cake formulation consists of malted *ragi*, *amaranth* and sprouted soybean forming gluten free flour, banana and yoghurt as egg replacer complex and cholesterol free vegetable oil instead of saturated fat which 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.

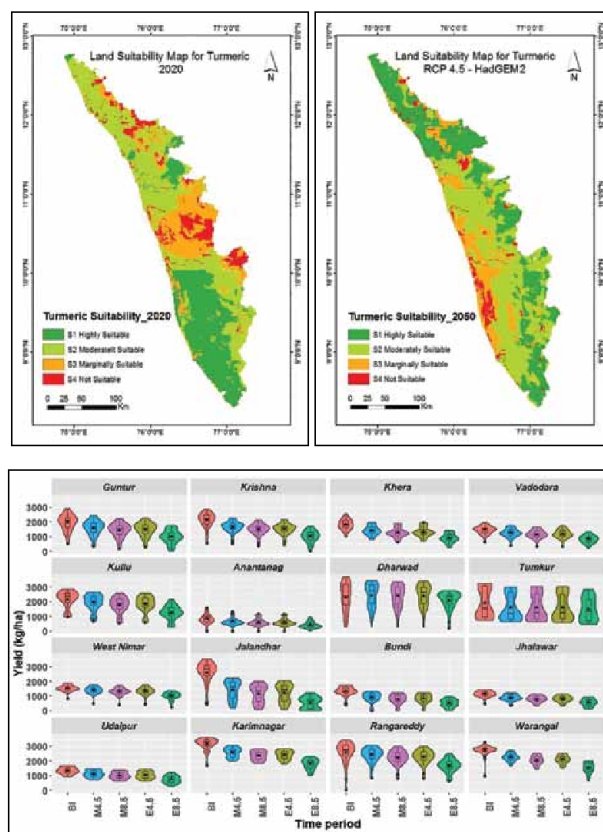
Karnataka and transitional plain of Luni basin was developed. Swarna Unnat Dhan (IET 27892), rice variety with multiple stress tolerance developed for irrigated transplanted condition of Bihar, Odisha, West Bengal, Madhya Pradesh and Maharashtra. Genome editing technology (CRISPR-Cas9) was used to create 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.

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 ≥ 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.

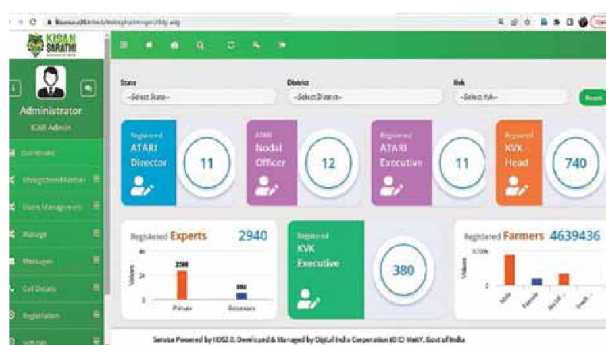
Dendritic cell platforms for *in vitro* and *in vivo* studies of antigen processing and presentation in cattle for combined vaccine antigens using FMD virus and *Pasteurella multocida* as model were generated. To exploit the adjuvant potential of mesoporous silica nanoparticles (MSN) to thermo stabilize 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 ± 3.38 g) showed advanced maturation (GSI 2.24 ± 0.025) compared to wild male (238.67 ± 4.67 g) with maturing phase (GSI 0.768 ± 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



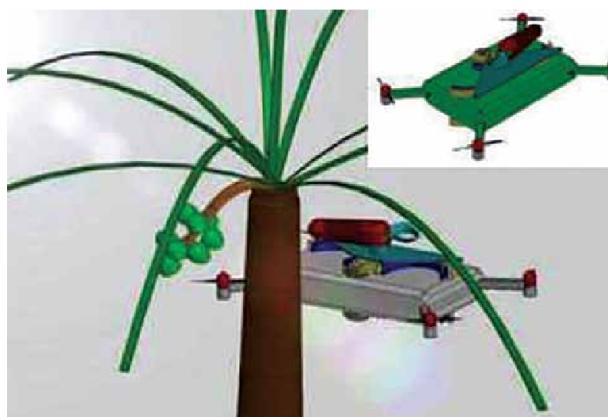
2.89 lakh farmers and 497.40 lakh quality planting materials of elite species of field and horticultural crops, medicinal and aromatic plants and forest species to 5.01 lakh farmers were provided. The bio-products such as bio-agents (998.59 q), bio-pesticides (1455.16 q), bio-fertilizers (23767.38 q), 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 P₂O₅ requirement and 99% of the total K₂O 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', '75th 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 BIRTHAL, 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 Birlhal.

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 21st 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 29th 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) 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:

45th Vice Chancellors' Convention: The 45th 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 45th 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 14th 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 14th 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, Sonipat; Aruazone, Hyderabad; Criyagen Agri and Biotech Pvt Ltd, Bengaluru also actively participated in the symposium.

5th 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 45th 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 14th 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 14th 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.

5th 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