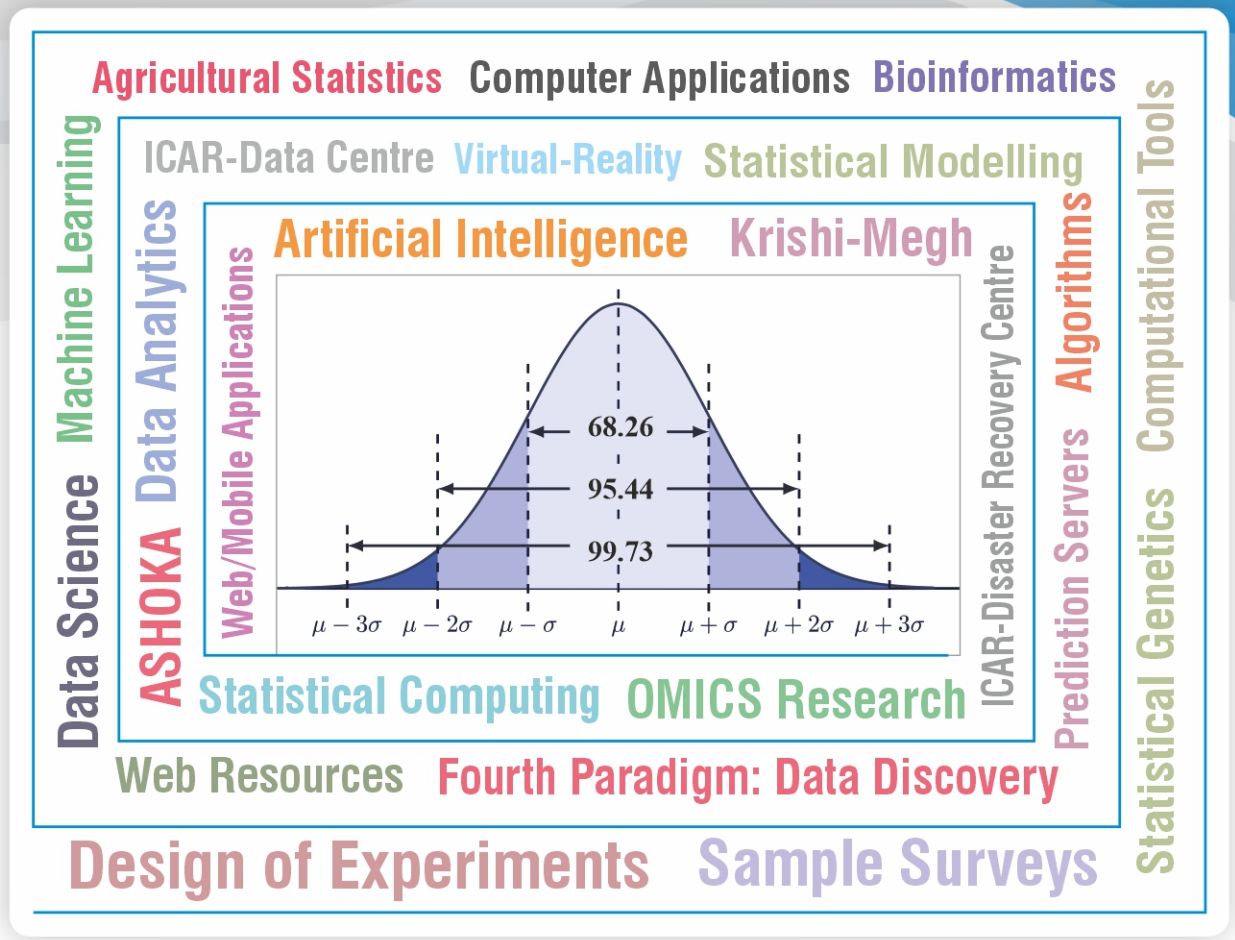
IASRI

Annual Report-2022



ICAR-Indian Agricultural Statistics Research Institute
Library Avenue, Pusa, New Delhi - 110012
https://iasri.icar.gov.in
ISO/IEC-20000-2018 & ISO/IEC 27001: 2013 Certified Data Centre

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Vision

Statistics and Informatics for enriching the quality of Agricultural Research

Mission

To undertake research, education and training in Agricultural Statistics, Computer Application and Bioinformatics for Agricultural Research

Mandate

- To undertake research, education and training in agricultural statistics, computer applications in agriculture and agricultural bioinformatics
- To provide advisory/consultancy services / methodological support / computational solutions to NARES/NASS (National Agricultural Research and Education System/ National Agricultural Statistics System)

Preface

It is a matter of proud privilege, immense pleasure and great satisfaction to present the Annual Report 2022 (January-December) of ICAR-Indian Agricultural Statistics Research Institute. The Institute has been using the power of Statistics, as a science, blended with Informatics and their judicious fusion in agricultural sciences for enhancing the quality of agricultural research and policy planning. The Institute has made notable contributions to research, education and training in the fields of Design of Experiments, Sample Surveys, Statistical Genetics, Forecasting Techniques, Statistical Modelling, Statistical Computing, Computer Applications and Agricultural Bioinformatics. The Institute has made its presence visibly felt in NARES and also occupies a place of pride for methodological development in the National Agricultural Statistics System (NASS). The Institute has been playing the leading role in development of robust Agricultural Knowledge Management Systems for NARES and providing web hosting and e-governance services to all ICAR Institutes through ICAR Data Centre and Disaster Recovery Centre.

This publication highlights some of the glimpses of the research achievements made, new methodologies/ information systems/portals developed, significant advisory services provided, dissemination of knowledge acquired and human resource development.

To fulfill objectives and mandate of the Institute, the research was carried out under 76 research projects (33 Institute funded and 43 outside funded). This year 10 projects have been completed and 18 new projects have been initiated. The Institute also has a Network Project on Agricultural Bioinformatics and Computational Biology with 20 ICAR Institutes as partners. The Institute is also working on NAHEP funded project Resilient Agricultural Education System. A total of 201 Research Papers (02 research papers in 10+ Thompson Reuter Impact Factor Journals) with an average 2.5+ papers per scientist, 15 R-Packages and 19 webserver/databases/ computational tools have been published. The Institute received 13 Copyrights. For strengthening collaborations, 06 MoUs (Memorandum of Understanding) and LoA (Letter of Agreement) have been signed with various Institutions.

The Institute has adapted itself to the needs and demands of present era and is working on a couple of projects relating to Artificial Intelligence (AI) in agriculture and making efforts to develop a Virtual Centre of Excellence on AI in Agriculture. The Institute has developed an android app, AI-DISC (Artificial Intelligence based Disease Identification System for Crops) which identifies 50 diseases in 19 major crops, once an image with natural background is uploaded. Insights and alerts have been provided on KCC-CHAKSHU Portal using 30 million+ query call logs of Kisan Call Centres derived from Open Government Data Platform. AgrIntel, an Artificial Intelligence-based framework has been developed to process nationwide farmers' helpline data. A deep learning approach, Yield-SpikeSegNet developed for the yield estimation in wheat using visual images. The Institute is also partnering in Network Project on Precision Agriculture.

For digital dissemination of technologies/information/ advisory to farmers, the Institute is implementing KISAN SARATHI for two-way communication system between farmers and agricultural experts and also added new functionalities in KVK Portal. KRISHI Portal (Agricultural Knowledge Resources and Information System Hub for Innovations) has been shown in good practices in Data Governance Quality Index (DGQI)2.0 report of Development Monitoring and Evaluation, an attached office of NITI Aayog. An android-based application-*eLISS* data collection app has been used Pan India by Department of Animal Husbandry and Dairying, Govt. of India to conduct Integrated Sample Survey for estimation of production of four major livestock commodities.

One of the thrust areas of the Institute is to develop trained manpower in the country in statistical sciences for meeting the challenges of agricultural research in the newer emerging areas. Seventeen training programmes (1211 participants), 6 Hindi workshops (147 participants) and 8 sensitization programmes have been organized. This year, 33 students (M.Sc. and Ph.D.) completed their respective degree programmes in Agricultural Statistics, Computer Application and Bioinformatics. Data Science courses which include statistical computing combined in a packaged format along with R, Python and other computing solutions is the demand of industry. The Institute is also planning several human resource development programmes in Data Science.

I am happy to note that some of our colleagues/ alumni received academic distinctions from different professional societies and Govt. organisations which include ICAR-Rafi Ahmad Kidwai Award, NAAS-Associateship, Fellow of Indian Society of Agricultural Statistics, Fellow of the West Bengal Academy of

Science and Technology, Dr. G.R. Seth Memorial Young Scientist Award and ICAR-Jawaharlal Nehru Award for best Ph.D. thesis in social sciences. The scientists of the Institute have also been contributing as experts in several national level committees. Former Secretary, DARE & Director General, ICAR gave the glimpses of achievements of ICAR in twenty points, it is satisfying to see that in seven points out of twenty included achievements that are related to the Institute.

I would like to express my gratitude to all senior officers in ICAR Headquarters for their valuable guidance, encouragement, inspiration and support. I would like to express my sincere appreciations to all Heads of Divisions, scientists and other staff of the Institute for their devotion, whole-hearted support and cooperation in carrying out various functions and activities of the Institute. The services of the colleagues in PME Cell specifically, Dr. Ajit, in compiling and timely publication of the Annual Report are highly appreciated.

I am hopeful that the information contained in this publication would be useful and informative to all stakeholders. We look forward to any suggestions and comments for improvement in presentation of the information.

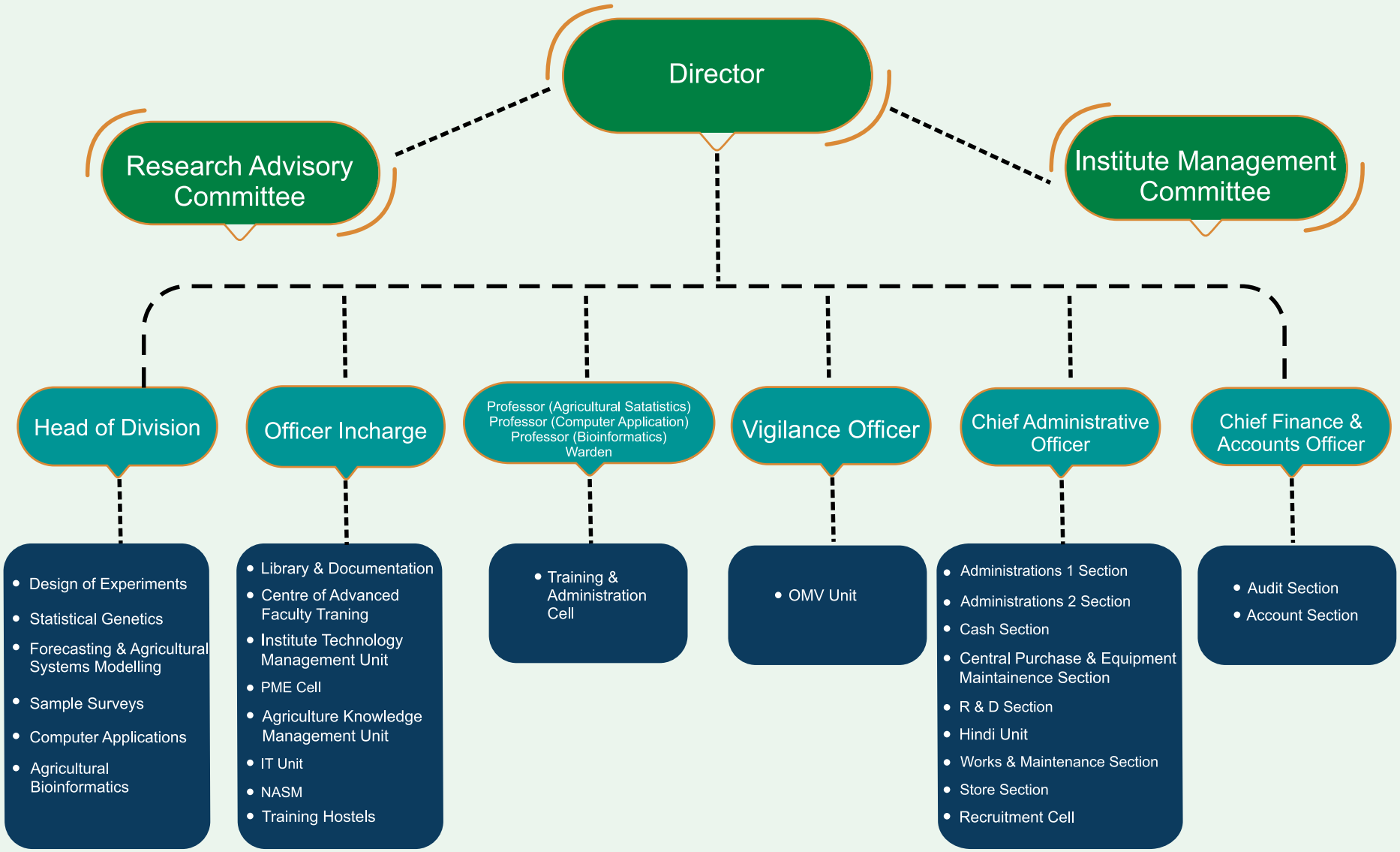
(Rajender Parsad)
Director

Milestones

1930	*	Statistical Section created under ICAR (then Imperial Council of Agricultural Research)
1940	*	Activities of the Section strengthened with the appointment of Dr. PV Sukhatme
1943	*	Research in developing techniques for crop yield estimation based on the methods of random sampling initiated
1945	*	Re-organisation of Statistical Section into Statistical Branch headed by a Statistical Advisor as a centre for research and training in the field of Agricultural Statistics and Junior Certificate Course and Senior Certificate Courses started
1949	*	Statistical Branch rechristened as Statistical Wing of ICAR
1952	*	Activities of Statistical Wing further expanded and diversified with the recommendations of FAO experts, Dr. Frank Yates and Dr. DJ Finney
1955	*	Statistical Wing moved to its present campus in own building (presently Sample Survey Block) and Hostel (presently Panse Hostel)
1956	*	Collaboration with AICRP initiated
1959	*	Re-designated as Institute of Agricultural Research Statistics (IARS)
1964	*	Installation of IBM 1620 Model-II Electronic Computer
	*	Panse Hostel for Students
	*	Signing of MOU with IARI, New Delhi to start M.Sc. and Ph.D. degree programmes in Agricultural Statistics
1970	*	Status of a full-fledged Institute in the ICAR system, headed by Director
	*	New Hostel for students (presently Sukhatme Hostel)
1977	*	Three storeyed Computer Centre Building inaugurated
	*	Installation of third generation computer system, Burroughs B-4700
1978	*	Re-named as Indian Agricultural Statistics Research Institute (IASRI)
1983	*	Identified as Centre of Advanced Studies in Agricultural Statistics and Computer Applications under the aegis of the United Nations Development Programme (UNDP)
1985-86	*	M.Sc. (Computer Application in Agriculture) degree programme initiated
1989	*	Commercialization of SPAR 1.0
1991	*	Burroughs B-4700 system replaced by a Super Mini COSMOS LAN Server
1992	*	Administration-cum-Training Block of the Institute inaugurated
1993-94	*	Nomenclature of M.Sc. (Computer Application in Agriculture) degree changed to M.Sc.(Computer Application)
1995	*	Centre of Advanced Studies in Agricultural Statistics & Computer Application established by Education Division, ICAR
1996	*	Establishment of Remote Sensing & GIS lab
	*	Outside funded projects initiated
1997	*	Senior Certificate Course in 'Agricultural Statistics and Computing' revived
	*	Establishment of modern computer laboratories
	*	First software in India for generation of design along with its randomised layout SPBD release 1.0
1998	*	Four Divisions of the Institute re-named as Sample Survey, Design of Experiments, Biometrics and Computer Applications
	*	Training programmes in Statistics for non-statisticians in National Agricultural Research System initiated
1999	*	Strengthening of LAN & Intranet with Fibre optics & UTP cabling
2000	*	Two Divisions re-named as Division of Forecasting Techniques and Division of Econometrics
2001	*	Data Warehousing: INARIS project under NATP initiated
2002	*	Development of PIMSNET (Project Information Management System on Internet) for NATP
2003	*	Development of PERMISnet (A software for Online Information on Personnel Management in ICAR System)
	*	First indigenously developed software on windows platform Statistical Package for Factorial Experiments (SPFE) 1.0 released.
2004	*	National Information System on Agricultural Education (NISAGENET) Project launched
	*	Training Programme for private sector initiated and conducted training programme for E.I. DuPont India Private Limited.
	*	E-Library Services initiated.
2005	*	Statistical Package for Augmented Designs (SPAD) and Statistical Package for Agricultural Research (SPAR) 2.0 released
	*	Design Resources Server with an aim to provide E-advisory in NARES initiated

2007	*	Establishment of Agricultural Bioinformatics Laboratory (ABL)
2008	*	Software for Survey Data Analysis (SSDA) 1.0 released
2009	*	Golden Jubilee Celebration Year of the Institute
	*	Strengthening Statistical Computing for NARS initiated
	*	Expert System on Wheat Crop Management launched
	*	International Training Hostel inaugurated
2010	*	Establishment of National Agricultural Bioinformatics Grid (NABG) in ICAR and Centre for Agricultural Bioinformatics [CABin] initiated
	*	Division of Biometrics re-named as Division of Biometrics and Statistical Modelling
	*	Division of Forecasting Techniques and Division of Econometrics merged to form Division of Forecasting and Econometrics Techniques
2011	*	Indian NARS Statistical Computing Portal initiated
	*	M.Sc. degree in Bioinformatics initiated
2012	*	Software for Survey Data Analysis (SSDA) 2.0 released
	*	Division of Biometrics and Statistical Modelling re-named as Division of Statistical Genetics
	*	Division of Forecasting & Econometrics Techniques re-named as Division of Forecasting & Agricultural Systems Modelling
	*	Development of Management Information System (MIS) including Financial Management System (FMS) in ICAR initiated
	*	Half-Yearly Progress Monitoring (HYPM) System in ICAR implemented
	*	Sample Survey Resources Server initiated
2013	*	Advanced Supercomputing Hub for OMICS Knowledge in Agriculture (ASHOKA) and National Biocomputing Portal inaugurated
	*	Ph.D. degree in Computer Application initiated
	*	ICAR-ERP system implemented
	*	Ph.D. degree in Bioinformatics initiated
	*	IASRI Campus Wi-Fi enabled
2014	*	FAO Sponsored Study under the Global Strategy for Improvement of Agricultural Statistics initiated (FAO Consultancy in Institutional Mode)
2015	*	KRISHI: Agricultural Knowledge Resources and Information System Hub for Innovations portal launched as ICAR centralized data repository system
	*	Declared as National Level Agency (NLA) under MIDH (Mission for Integrated Development of Horticulture).
	*	ICAR Data Centre, Unified Communication and Web Hosting Services for ICAR established with ISO/IEC 20000 and ISO/IEC 27001 certification. Inaugurated on December 21, 2016
2016	*	KVK-Portal (Krishi Vigyan Kendra Knowledge Network) and Mobile Application (http://kvk.icar. gov.in/) developed and launched.
	*	Developed sampling methodologies for estimation of crop area and yield under mixed and continuous cropping for different situations and field tested in three countries identified by the FAO.
	*	Developed Personnel Management System, for managing the cadre strength and transfer of the scientific staff and implemented in ICAR.
2017	*	Guidelines for estimating post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries)/fish products
2018	*	Education Portal-ICAR (https://education.icar.gov.in) developed and launched.
	*	Development of Mobile Apps initiated
2019	*	Webserver and Mobile App, VISTa (Variety Identification System of *Triticum aestivum*) developed
2020	*	Gold Icon Award in Open Data Championship Category from Ministry of Electronics and Information Technology, Govt. of India for ICAR Research Data Management Initiative
		KRISHI-MEGH: The Cloud Hardware Infrastructure and Software Services, as a step forward towards digital agriculture of the 'New India' has been commissioned and launched.
		IT Unit created
2021	*	KISAAN 2.0 (Krishi Integrated Solution for Agri Apps Navigation) App
	*	Established Virtual Classroom in 18 Agricultural Universities & Agri-Diksha Web Education Channel
	*	Kisan-SARATHI- System of Agri-information Resources Auto-transmission and Technology Hub Interface, initiated in collaboration with Digital India Corporation, MEITY, Govt. of India
		"eLISS Web Portal" and "eLISS Data Collection App" for Integrated Sample Survey Solutions of Major Livestock Products:
2022	*	KCC-CHAKSHU (Kisan Call Centre Collated Historically Aggregated Knowledge-based System with Hypertext User-interface) launched
	*	AI-DISC (Artificial Intelligence based Disease Identification System for Crops) App developed

ORGANOGRAM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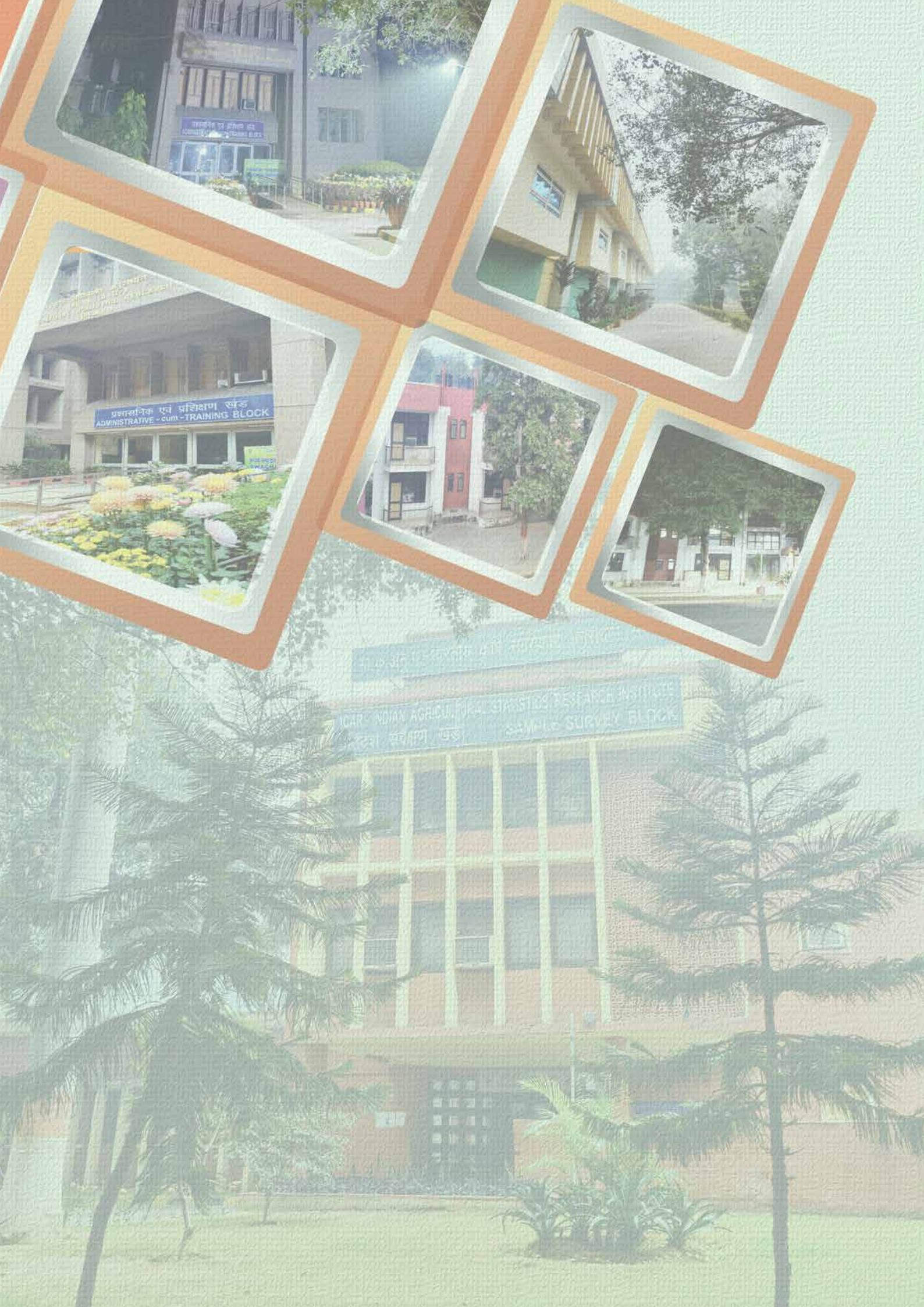
Research Advisory Committee
Institute Management Committee
Head of Division
Officer Incharge
Professor (Agricultural Satatistics)
Professor (Computer Application)
Professor (Bioinformatics)
Warden
Vigilance Officer
Chief Administrative Officer
Chief Finance & Accounts Officer
Design of Experiments
Statistical Genetics
Forecasting & Agricultural Systems Modelling
Sample Surveys
Computer Applications
Agricultural Bioinformatics
Library & Documentation
Centre of Advanced Faculty Traning
Institute Technology Management Unit
PME Cell
Agriculture Knowledge Management Unit
IT Unit
NASM
Training Hostels
Training & Administration Cell
OMV Unit
Administrations 1 Section
Administrations 2 Section
Cash Section
Central Purchase & Equipment Maintainence Section
R & D Section
Hindi Unit
Works & Maintenance Section
Store Section
Recruitment Cell
Audit Section
Account Section


प्रशासनिक एवं प्रशिक्षण खंड
ADMINISTRATIVE - cum - TRAINING BLOCK

1. Executive Summary

ICAR-Indian Agricultural Statistics Research Institute (ICAR-IASRI) since its inception is mainly responsible for conducting research in Agricultural Statistics to bridge the gaps in the existing knowledge. The Institute has used the power of Statistics, as a science, blended judiciously with Informatics and has contributed significantly to improving the quality of Agricultural Research. The Institute has also been providing education/training in Agricultural Statistics and Informatics to develop trained manpower in the country. The research and education are being used in improving the quality and meeting the challenges of agricultural research in newer emerging areas.

To achieve its goal and mandate, research was carried out under **76** research projects in the Institute {33 Institute funded (26 of the Institute and 07 in collaboration with other Institutes), 43 outside funded} in various thrust areas. This year **10** projects were completed, and **18** new projects {15 Institute funded (10 of the Institute and 05 in collaboration with other Institutes) and 03 outside funded} have been initiated.

Some other salient research achievements are:

- For the experimental situations, in which new products are prepared by adding multiple number of components and the order in which these components are to be added to prepare a product is important for the resultant product to have a desirable property, an algorithm has been developed to obtain designs for order-of-addition experiments under component position model. Component orthogonal arrays have been obtained for 3, 4, 5 and 7 components.
- Introduced nearly balanced treatment incomplete block (BTIB) designs which can act as a useful alternative to BTIB designs when the later is not available for a given parametric combination for the experimental situations for comparing test versus a single control treatment.
- Obtained two series of partially balanced t-designs which are useful in integrated farming system research involving both crop and livestock components.
- Developed modules for online data submission and analysis of OFR 1 and online data submission of OFR 2 & 3 experiments have been merged for AICRP on IFS. A software module has been developed for online data submission and analysis of on station experiments.
- Defining nutrient management zones (MZs) is crucial for the implementation of site-specific management. The determination of MZs is based on several factors, including crop, soil, climate, and terrain characteristics. For north-eastern Himalayan region of India, MZs and their maps are developed employing a geostatistical approach.
- ARIMAX-ANN based forewarning system for soybean semi-looper for Maharashtra has been developed. Beta regression model based disease pest infestation forewarning model has been developed for whitefly population.
- Co-integration among the prices of different commodities plays a pivotal role in the price decision mechanism. The existing time delay neural network (TDNN) has been improved by incorporating the error correction term (ECT) as an auxiliary information in the model. The *ECTTDNN,* R package has been developed to perform the analysis using the proposed model.
- An android-based application-*eLISS* data collection app has been developed and made available on google play store to capture data from the field, which was used to be collected manually using paper-based schedules by the enumerators, to provide an end-to-end solution of estimating production for four major livestock commodities, viz. milk, meat, egg and wool. It is being widely used Pan India by Department of Animal Husbandry and Dairying, Govt. of India.
- Developed a new estimator for finite population proportion for geo-referenced binary survey data. Variance and estimate of variance of the proposed spatial logistic generalised regression estimator of population proportion has been developed using Taylor Linearization Technique.
- Developed procedure of unbiased estimation of variance of finite population mean from Level-0 ranked set sampling.

- Developed web genomic resource of buffalo (BuffGR) in association with ICAR-CIRB, Hisar which is useful in buffalo improvement programmes and disease/breed management.
- Developed a novel method, MetaConClust, using coverage information for grouping of contigs and automatically finding the optimal number of clusters for binning of metagenomics data using a consensus-based clustering approach.
- The Institute identified heat stress-responsive miRNA and their target genes, which have a critical role in gene regulation during grain filling under heat stress conditions in wheat. Comparative transcriptome analysis has been performed, unfolding the pathways regulating the seed-size trait in cultivated lentil.
- An online prediction tool ASRmiRNA has also been developed which would supplement the existing effort for identification of abiotic stress-responsive miRNAs and Pre-miRNAs.
- A prediction server P/DBPred for DNA-binding protein (DBP) prediction in plant has been developed based on a comprehensive computational model for plant specific DBPs identification.
- To identify novel interactions between Acr and Cas proteins, propopsed a machine learning-based predictive model using an ensemble strategy with more than 95% accuracy.
- Developed a step-by-step workflow for processing and analyzing the single cell sequencing unique molecular identifier (UMI) data. It has been shown that the zero-inflation associated with UMI data had no or minimal role in clustering, while it had significant effect on identifying differentially expressed genes.
- Developed a methodology for identification of informative genes by implementing the bootstrap technique along with Support Vector Machine Recursive Feature Elimination and Maximum Relevancy and Minimum Redundancy.
- In association with ICAR-IVRI, developed an Online Vet Clinic App as an extension of Referral Veterinary Clinic services offered at IVRI premises.
- AgrIntel, a framework consisting of multiple artificial intelligence-based pipelines has been developed to process nationwide farmers' helpline data and obtain spatio-temporal insights on plant protection.
- A deep learning approach, "Yield-SpikeSegNet," has been developed for the yield estimation in the wheat plant using visual images.
- Published Agricultural Research Data Book (ARDB) 2022, twenty fifth edition in the series. It is divided into 10 sections for the purpose of convenience of the users. It provides information on natural resources, agricultural inputs, animal husbandry, dairying, fisheries, horticulture, production, productivity, agricultural engineering, export, import, place of India in world agriculture, investment in agricultural research and human resources.
- Developed AI-DISC (Artificial Intelligence based Disease Identification System for Crops) that can automatically identify plant diseases with visible symptoms. User has to install the mobile app, capture the disease image in natural background and click to identify and get the remedy advisory of the diseases. Presently the application is capable of identifying 50 diseases in 19 major crops.
- ICAR-IASRI in association with IPTM Unit, ICAR Headquarters developed a workflow-based application for Trademark and Design obtained by ICAR Institutes as Part of ICAR IPR Repository.
- KKC-CHAKSHU (Kisan Call Centre-Collated Historically Aggregated Knowledge based System using Hypertext User Interface) has been developed. It provides insights and Alerts based on 30 million+ queries call logs records with the 11 attributes received from KCC data (available through APIs on the open data platform).
- KVK portal has been strengthened by adding new functionality to add information on yield gap index and to view state and district wise report in the portal. Functionality have also been developed to view the month wise progress report (MPR) for the particular year in the portal. The report is added under the MPR menu at the KVKs level. Information of new KVKs and event category have been added in the master database tables. Month wise KVK KPIs data is submitted in DARPAN dashboard for the

following KPIs: Farmer Training, Mobile Agro Advisories and Agriculture Extension Activities.

- E-Learning portal has been developed with an objective to strengthen the Agriculture Higher Education in India by developing and disseminating the e-courses for undergraduate and postgraduate courses (70 postgraduate and 141 undergraduate courses).
- Virtual Reality (VR)/ Augmented Reality (AR) facilities have been established in 10 Agricultural Universities.
- Financial Management Software (FMS) has been implemented in two Agricultural Universities namely RLBCAU, Jhansi and BASU, Patna.
- Two mobile applications namely NIBPP (National Image Base for Plant Protection) and NIBLD (National Image base for Livestock Diseases) have been developed for collecting, validating, annotating, securely storing of images of plants and animal stresses respectively.
- AMS (Academic Management System) has been implemented in 56 Universities (06 of these in the year 2022). AMS is a web-based application that is aimed at automating administrative and academic activities of SAUs to enhance the efficiency of the overall system.
- Research Leadership Building System (RLBS) has been developed for inviting online applications to the position of ICAR-National Fellow/National Professor/Emeritus Scientist/ Emeritus Professor.
- ASRB OASIS (ASRB-Online Application & Scorecard Information System) has been developed streamlining the recruitment process for RMP and Non-RMP positions of agricultural scientists in ICAR while providing easy access to application submission and scorecard information.
- During the reported period of 2022, 15 R-Packages (eemdARIMA, NBBDesigns, mkssd, WaveletRF, iRoCoDe, vmdTDNN, VMDML, Auto-Weather-Indices, pRepDesigns, PolycrossDesigns, OptiSembleForecasting, GETdesigns, ResPBIBD, ARIMAANN, MetaConClus) and 19 webserver/databases (ASRpro, BSCM2TDb, BtChiLCVDb, SCMVTDb, ParkRoxTDB, SIReDAM, Levidb, Millet SSR, PMDIncRDB, LncR-CsExSLDb, OYVMVTDb, EqSNPDb, CerealESTdb, TiGeR, DeepAProt, BuffGR, GIpred, ASRmiRNA, P/DBPred) have been developed in different areas of Agricultural Statistics, Computer Applications and Agricultural Bioinformatics.
- The Institute received 13 Copyrights during the year. The Institute has published 201 research papers in national and international peer reviewed journals along with other publications.
- The Institute has signed 06 MoUs (Memorandum of Undestanding) and LoAs (Letter of Agreement) with various institutions viz. University of Agricultural Sciences (UAS) GKVK Campus, Bengaluru; Punjab Agricultural University, Ludhiana; Association of Innovation Development for Entrepreneurship in Agriculture Centre for Agri-Innovation (a-IDEA) ICAR-NAARM, Hyderabad; CSIR- National Botanical Research Institute, Lucknow; The Food and Agriculture Organization of the United Nations (FAO-India) and Agricultural Scientists Recruitment Board (ASRB), New Delhi.
- During the reported period of 2022, in all thirty-three (33) students completed their study programs (9 and 5 students of M.Sc. and Ph.D. courses in Agricultural Statistics; 7 and 4 students of M.Sc. and Ph.D. courses in Computer Application; 5 and 3 students of M.Sc. and Ph.D. courses in Bioinformatics).
- Various training programmes and workshops were conducted during the year in different area of Agricultural Statistics and Informatics. Over all 17 training programmes (1211 participants), 6 Hindi workshops (147 participants) and 8 sensitization programmes were conducted by the Institute. Also 11 students of different Universities/Institutes worked in internship programmes as project trainees for their Graduation/Post Graduation dissertation work.
- Dr. G.P. Samanta, Chief Statistician of India & Secretary, Ministry of Statistics and Programme Implementation, Government of India was the Chief Guest of the function and delivered 32th **Nehru Memorial Lecture on the topic Sustainable Development Goals** during the Annual Day Celebrations of the Institute on July 02, 2022 and Professor Bikas Sinha, Former

Member, National Statistical Commission and Retired Professor, Indian Statistical Institute, Kolkata was the Guest of Honour.

- Organized a brainstorming session of Mainstreaming Agricultural Curriculum in School Education to create greater sensitization among school goers at primary, secondary & higher secondary levels about the importance and scope of agriculture & allied sectors. This was inaugurated by Union Minister of Agriculture and Farmers Welfare. Experts from the ICAR, NCERT, CBSE along with the various School Principals and Teachers participated and deliberated on the need & process for the introduction of Agriculture as a subject in the school curriculum.
- Organized online International symposium on Data Driven Agriculture and Natural Resource Management – Opportunities and Challenges as an associate partner in collaboration with Indian Society of Agricultural Information Technology.
- Organized workshops on (i) Skill Development through Impact Analysis of Emerging Data with Agricultural Technology in Population Sciences jointly with Assam Agricultural University (International); (ii) Sampling Design and Analysis (AICRP on EAAI) and (iii) Breeding Informatics in Plant Breeding jointly with ICAR-IARI and Excellence in Breeding (EiB), CIMMYT.
- The Institute also celebrated National Girl Child Day, National Science Day, International Women's Day, International Yoga Day, 16th National Statistics Day, Independence Day, Teachers Day, Fit India Run 3.0, Vigilance Awareness Week, Constitution Day, Sadbhawana Diwas and Kisan Diwas. Hindi Pakhwada was organized during September 14-30, 2022. 09 webinars were also organized on various topics.
- Dr. Anindita Datta and Dr. Pankaj Das received Dr. G.R. Seth Memorial Young Scientist Award from Indian Society of Agricultural Statistics.
- Dr. Bishal Gurung received Best Scientist Award in Agricultural Statistics at 7th International Conference on Opportunities and Challenges in Agriculture, Environmental & Biosciences for Global Development organized at Goa. Dr. Md. Yeasin was awarded Young Scientist Award (2022) by the Agricultural and Environmental Technology Development Society.
- Dr. Tanuj Mishra, Ph.D. student in the discipline of Computer Applications received Jawaharlal Nehru Award for best Ph.D. thesis in social sciences and Dr. A.R. Rao, Alumni and former faculty of ICAR-IASRI received ICAR Rafi Ahmad Kidwai Award.
- Dr. M.A. Iquebal elected as Fellow of the West Bengal Academy of Science and Technology in the year 2022 in the field of Genomics and Bioinformatics and Dr. Prabina Kumar Meher received NAAS-Associateship and selected as member of the National Academy of Sciences India (NASI).
- Dr. Ranjit Kumar Paul was awarded Eminent Scientist Award (2022) by the Agricultural and Environmental Technology Development Society and ISAS-Fellow by Indian Society of Agricultural Statistics.
- Former Secretary-DARE & Director General, ICAR presented glimpses of achievements of ICAR in twenty points in July 2022. Seven points out of 20 included achievements that were related to the Institute.
- KISAN SARATHI, KRITIGYA Hackathon Portal, Clean and Green Campus Award Portal and IT Systems in Agricultural Education found a place in the presentation made by Honourable Secretary, DARE and Director General, ICAR on ICAR Foundation Day 2022.
- Tree Saplings of Chandan (*Santalum Album*) were planted by Ms Alka Arora Nangia, Financial Advisor, ICAR; Deputy Director General (Agricultural Education), Deputy Director General (Natural Resource Management), Director-ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi and Director, ICAR-IASRI, New Delhi.

2. Introduction

ICAR-Indian Agricultural Statistics Research Institute (IASRI) started its journey as a Statistical Section in 1930 in the then Imperial Council of Agricultural Research, has grown in size and stature to a premier Institute to conduct research, education and training in the field of Statistical Sciences (Statistics, Computer Applications and Bioinformatics). ICAR-IASRI has been mainly responsible for conducting research in Agricultural Statistics and Informatics to bridge the gaps in the existing knowledge. The Institute also conducts M.Sc. and Ph.D. degree courses in Agricultural Statistics, Computer Applications and Bioinformatics in collaboration with PG School, IARI, New Delhi. The Institute also conducts customized and sponsored training courses in Agricultural Statistics and Informatics at National and International level so as to be a leading Centre of Excellence in Human Resource Development. The Institute provides advisory and consultancy services for strengthening the National Agricultural Research and Education System (NARES) and undertakes sponsored research and consultancy for National and International organizations. The methodological support is also provided for strengthening National Agricultural Statistics System (NASS). The Institute has been playing the leading role in development of robust Agricultural Knowledge Management Systems for NARES.

The Institute has used the power of Statistics, as a science, blended with Informatics and their judicious fusion in agricultural sciences for enhancing quality agricultural research, to meet the challenges of agricultural research in newer emerging areas and informed policy decision making. The present main thrust of the Institute is to conduct basic, applied, adaptive, strategic and anticipatory research in Agricultural Statistics and Informatics, to develop trained manpower and to disseminate knowledge and information produced so as to meet the methodological challenges of agricultural research in the country.

ICAR-IASRI has also become a leader in innovative data management by establishing Advanced Supercomputing Hub for Omics Knowledge in Agriculture (ASHOKA), ICAR-Data Center, Krishi Megh (National Agricultural Research & Education System-Cloud Infrastructure and Services). Setting up an advanced teaching-learning environment in Agricultural Higher Education through Academic Management System (AMS), Agri-Diksha Web Education Channel, Virtual Classrooms in all AUs, and AR/VR Experience Centers is providing new age educational technologies in NARES. ICAR received Gold Icon Award in open data championship category-2020 from Ministry of Electronics and Information Technology (MEITY), Govt. of India for ICAR Research Data Management (KRISHI Portal).

Food and Agriculture Organization (FAO) of the United Nations has given several research and/or consultancy projects to the Institute. Besides, many research projects of Government and Public Sector agencies like Department of Science and Technology, Directorate of Economics and Statistics, Department of Animal Husbandry and Dairying, Department of Biotechnology, Department of Agriculture and Farmers Welfare, Planning Commission, Network for Scientific Cooperation for Food Safety and Applied Nutrition (NetSCoFAN), Food Safety and Standards Authority of India (FSSAI), Mahalanobis National Crop Forecast Centre (MNCFC), Ministry of Statistics and Programme Implementation (MoSPI), Coconut Development Board, have been undertaken by the Institute. Some of these projects were taken on request from several Government agencies and others were awarded through competitive bidding. The Institute works in close collaboration with all NARES organizations (All ICAR Institutes, SAUs, AICRPs and KVKs) and many projects are being run in collaboration with All India Co-ordinated Research Projects, ICAR Institutes and SAUs. Further linkages with the CGIAR organizations such as CIMMYT, IRRI, ICARDA, ICRAF and BMGF have been developed. For further strengthening the collaborations, in last three years, the Institute has signed 06 MoUs (Memorandum of Understanding) and LoAs (Letter of Agreement) with various institutions which include University of Agricultural Sciences (UAS) GKVK Campus, Bengaluru and Punjab Agricultural University, Ludhiana for virtual reality modules; Association of Innovation Development for Entrepreneurship in Agriculture, Centre for Agri-Innovation (a-IDEA) ICAR-NAARM, Hyderabad; CSIR- National Botanical Research Institute, Lucknow for genomic data analysis generated on cotton crop yield; Food and Agriculture Organization of the United Nations (FAO-India) to Review Food Loss Index estimates and Agricultural Scientists Recruitment Board (ASRB), New Delhi; RLB CAU, Jhansi and BASU, Patna for FMS

development; Agricultural Scientists Recruitment Board for development of Online Application & Scorecard Information System.

The Institute organized VIII International Conference on Agricultural Statistics (ICAS) during 18-21 November 2019, in which 500+ delegates from 108 countries participated. The Conference was inaugurated by Mr. Bill Gates.

Significant Research Achievements and Impact

The Institute has made some outstanding and useful contributions to research in Agricultural Statistics (Design of Experiments, Statistical Genetics, Forecasting Techniques, Statistical Modelling, Sample Surveys), Computer Applications, and Agricultural Bioinformatics. The Institute has conducted basic and original research on many topics of interest and has published number of papers in national and international journals of repute. The Institute has been providing and continues to provide support to the NARES by way of analyzing voluminous data using advanced and appropriate analytical techniques. The Institute has also been very actively pursuing advisory services that have enabled the Institutes to enrich the quality of agricultural research in the NARS. Through its advisory, the Institute has made its presence visibly felt in NARS and now experimenters look to IASRI for designing experiments and analysis of experimental data. The Registrar Copyrights Authority of India has granted copyrights to 73 publications/softwares/ information-systems/web resources/portals/ databases, etc. with the Institute as lead Centre and 12 as collaborator with other organizations as lead. The scientists of the Institute have also been co-developers for 04 wheat germplasms registered by Plant Germplasm Registration Committee, ICAR for drought tolerance with higher antioxidant (1.8 fold) activity; resistant to stripe rust pathotypes 46S119 and 47S103 for resistant to terminal heat tolerance (2) respectively.

A brief discussion on the research achievements of the Institute in different areas of Agricultural Statistics and Informatics are outlined below.

Design of Experiments

The Institute has made many notable contributions in both basic research and innovative applications of the theory of statistical designs and analysis of experimental data. Experimental designs have helped in navigating from varietal trials to varieties and package of practices, translating varieties into enhanced crop production, by harnessing and detecting technologies and identifying conditions that optimize the response. Some significant developments are

- Designs for Single Factor Experiments which include variance balanced; efficiency balanced block designs; α-designs; designs for making test treatments-control treatment(s) comparison; designs with nested factors; structurally incomplete row-column designs; row-column designs in two-rows; semi-latin squares; designs for multi-response experiments; designs for 2-line and 4-line crosses, crossover designs; neighbour balanced designs and optimality and robustness aspects of designs.
- Designs for Factorial Experiments which include confounded designs for symmetrical and asymmetrical factorials; block designs with orthogonal factorial structure and balance useful for crop sequence experiments; designs for incomplete factorial treatment structure and fractional factorial designs for scarce experimental resources; response surface designs; mixture experiments for single and multifactor experiments; orthogonal main effect plans; orthogonal arrays and supersaturated designs.
- Computer aided construction of efficient designs for various experimental settings.
- Designs for biological assays; designs for microarray experiments; designs for agroforestry experiments; designs for multistage trials and designs for integrated farming systems research.
- Diagnostics in designed field experiments led to improvement in statistical designing and data analytical techniques in NARES.
- Planning, designing and analysis of several AICRPs including IFS Research (both on station and on farm trials), Soil Test Crop Response, Long Term Fertilizer Experiments, Vegetable Crops, Sorghum, Small Millets, Maize, Oilseeds, Weed Management and others.
- Rigorous advisory and persuasion efforts have led to the adoption of modern efficient designs for experimentation and sophisticated analytics of the data generated by the researchers in the NARES, which has helped in improving the quality of agricultural experimentation. The bulletin on significance of statistical designs in agricultural research is a pocket diary for agricultural scientists as it defines the designs actually used. Following efficient designs and

analytical techniques have been adopted by the researchers in NARES:

- Resolvable Block Designs {alpha-(α-) designs, Rectangular Lattice designs, Reinforced Lattice designs} for varietal improvement programmes adopted in crop improvement trials and led to reduction in coefficient of variation of the initial varietal trials and enhanced precision on treatment comparisons.
- Designs for crop sequence experiments (extended group divisible designs, balanced confounded factorial designs) have been helpful in estimation of the residual and direct effects of treatments applied in different seasons with more precision. Fractional factorial plans have also been used in experiments conducted to prepare super absorbent composites.
- Modified and/or second order rotatable response surface designs with equispaced doses are being used in food processing experiments and for determining optimum combination of input factors. Semi-latin square type response surface design is used by AICRP on STCR for obtaining fertilizer response relationship and obtaining contribution of organic manures in smaller number of experimental units.
- Balanced incomplete block designs was adopted by then AICRP on Cropping Systems Research in On-Station Research Programmes, IIFSR (earlier Project Directorate of Cropping Systems Research), Modipuram.
- Linear programming approach developed for estimating/ projecting energy requirements in agricultural sector has been exploited for the analysis of countrywide data by then AICRP on Energy Requirement of Agricultural Sector.
- Variance component estimation from unbalanced data has encouraged the experimenters in NARES in the usage of incomplete block designs.
- Statistical analytical techniques of experimental data from experiments in which it is difficult to change the levels of one of the factors has helped in drawing statistically valid conclusions from post-harvest storage studies on fruits, vegetables, flowers, seed technology experiments and experiments with different water regimes.
- Experiments with mixtures have been used for experiments with fixed quantity of inputs and ready to serve fruit beverage experiments etc.
- Analytical techniques based on mixed effects models and SREG biplot developed for the analysis of data generated from farmers participatory trials for resource conservation agriculture have been used by rice-wheat consortium for Indo-Gangetic plains for drawing statistically valid conclusions.

Sample Surveys

The subject of sampling techniques helps in providing the methodology for obtaining precise estimates of parameters of interest. The Institute is involved in evolving suitable sample survey techniques for estimation of various parameters of interest relating to crops, livestock, fishery, forestry, horticulture, perishable commodities like flowers, vegetables and allied fields.

- Significant contributions made in theoretical aspects of sample surveys include successive sampling; systematic sampling; cluster sampling; sampling with varying probabilities; controlled selection; balanced sampling plans excluding contiguous units; distance balanced sampling plans; ranked set sampling; inclusion probability inversely proportional to size sampling; nested stratified sampling; non-sampling error; analysis of complex surveys; various methods of estimation such as ratio, regression and product methods of estimation; use of combinatorics in sample surveys; innovative approaches for small area estimation in skewed data situations for agricultural, income and expenditure surveys; for spatial non-stationarity under area level model; other socio-economic and food insecurity parameters as well as use of calibration approach in developing improved estimators.
- Following sampling methodology have been developed and widely used for
  - crop yield estimation using crop cutting experiments (CCE) has been adopted in general crop estimation surveys in India and is also being widely adopted in African and Latin American Countries.
  - cost of cultivation studies for major crops is being used in 19 states of the country.
  - Integrated sample surveys (ISS) for livestock products estimation is being used throughout the country by Department of Animal Husbandry and Dairying, Govt. of India.
  - estimation of harvest and post-harvest losses of major crops and commodities have been successfully adopted in AICRP on

Post Harvest Technology, Ministry of Food Processing, Govt. of India in 3 National Level Surveys.

- estimation of post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish, field tested in Mexico, Zambia, Nepal and Thailand and accepted by FAO and UN member countries.
- estimation of crop area, yield and production under mixed, repeated and continuous cropping, field tested in Indonesia, Rwanda and Jamaica and accepted by FAO.
- Agriculture Census and generating estimates for parameters of interests for Lao, PDR has been implemented.
- Integrated methodology for estimation of multiple crop area of different crops in north-eastern hilly regions using remote sensing data has been used in Meghalaya, Tripura and North-Eastern States
- estimation of cotton production using double sampling approach has been used in nine major cotton growing states.
- Alternative methodology for estimation of area and production of horticultural crops has been used by Haryana.

- The sample survey methodology for imported fertilizer quality assessment, estimation of private food grains stock at farmers level, estimation of fish catches from marine and inland resources, flower production estimation, fruits and vegetable survey, estimation of seed, feed and wastage ratios of major food grains, etc. has been developed and passed on to the user agencies.
- Reappraisal of sampling methodologies, evaluation and impact assessment studies like studies to make an assessment of integrated area development programmes, sampling methodologies for identifying constraints of adoption in high yielding varieties and evaluating the impact of Green Revolution, dairy improvement programmes, evaluation of cotton production estimation methodology etc. have been undertaken. Most of the methodologies developed are being adopted for estimation of respective commodities by the concerned state departments.
- The Institute is regularly publishing the Agricultural Research Data Book since 1996. It contains information pertaining to agricultural research, education and other related aspects compiled from different sources.
- The methodologies developed have potential applications in (a) AICRP on (i) Residues; (ii) Ergonomics; (iii) Energy in Agriculture and Agro-based industries and (b) integration of technologies and CCEs for providing estimates at GP (Gram-Panchayat) level for PMFBY (Pradhan Mantri Fasal Bima Yojna).

Statistical Genetics and Bioinformatics

The Institute has made very significant contributions in statistical genetics/ bioinformatics/genomics for improved and precise estimation of genetic parameters, classificatory analysis, genetic divergence and computational biology, etc.

- Developed procedures for estimation of genetic parameters from military dairy farm data; construction of selection indices; studying G × E interactions; progeny testing and sire evaluations; detection of QTLs, classification of genotypes using molecular marker data and QTL environments interactions etc. These procedures are being used in crop and animal improvement programmes.
- The modification in the procedure of estimation of genetic parameters has been suggested for incorporating the effect of unbalancedness, presence of outliers, aberrant observations and non-normality of data sets.
- The Institute has initiated research in the newer emerging area of statistical genomics such as rice genome functional elements information system; comparative genomics and whole genome association analysis.
- Supercomputing facility (Advanced supercomputing Hub for OMICS Knowledge in Agriculture) for high performance computing in the field of agricultural bioinformatics and computational biology has been established.
- Developed National Agricultural Biocomputing Portal for a single point of access to High Performance Computing (HPC) resources for all NARES users. It has given a big leap in terms of computational biology and developed 100+ biological databases/ analytical tools, web servers, prediction tools which include 16 microsatellite databases; 27 genomic and proteomic resources; 14 Transcriptome Databases; 45 Software tools and web servers and 09 Algorithms and Methodologies. Prominent among them is Identification of Variety based on DNA Signatures.

- A network project on Agricultural Bioinformatics and Computational Biology with 20 ICAR Institutes as partner is also being implemented for generation of lab data and also validation of results based on in-silico analysis. The Institute has also been established Centre for Bioinformatics and Computational Biology in Agriculture-BIC (Funded by Department of Biotechnology).

Statistical Modelling and Forecasting

Forecasting of crop yields, prices, production and forewarning of pests and diseases is carried out using linear and non-linear models, discriminant function approach, markov chain approach, Bayesian approach, within year growth models, non-parametric regression, structural time series, fuzzy regression, neural network and machine learning approaches. Pre-harvest forecasting models of crop yields have been developed using data on weather parameters, agricultural inputs, plant biometric characters and farmers' appraisal. Following have been widely adopted.

- Weather Indices based models have been used for forecasting agricultural output using space, agrometeorology and land based observations (FASAL) by Indian Meteorological Department. This model has also been integrated in Weather Indices based Automated Yield Forecasting System (WIAYFS).
- Methodologies for forewarning important pests and diseases of different crops have been developed which can enable the farmers to use plant protection measures judiciously and save cost on unnecessary sprays. Forewarning models for aphid (mustard) have been used by Directorate of Rapeseed and Mustard Research, Bharatpur to provide forewarning to farmers consecutively for three years. Forewarning models for Powdery mildew (Mango crop) have been used by ICAR-CISH, Lucknow.
- Developed models have potential applications in long term projections of food grain production, aphid population, marine fish production etc.
- Technology forecasting methods such as scenario creation, Delphi survey and cross impact analysis, technology road-mapping, analytic hierarchy process (AHP) etc. have been employed in various sub-domains of agriculture.

The Institute has also made significant contributions in understanding the complex economic relationship of the factors like transportation, marketing, storage, processing facilities; constraints in the transfer of new farm technology to the farmers' field under different agroclimatic conditions of the country. Some of the important contributions of the Institute are measurement of indemnity and premium rates under crop revenue insurance, production efficiency and resource use, impact of micro-irrigation, technological dualism/ technological change, return to investment in fisheries research and technical efficiency of fishery farms, the impact of technological interventions, price spread and market integration, price volatility and the dietary pattern of rural households.

Information Communication Technology: Infrastructure and Applications

The Institute has a rich legacy of computing starting from 1964 with IBM-1620 Model-II Electronic Computer in Data Processing System to a third-generation computer Burroughs B4700 Mainframe Computer in 1977. It was upgraded to Burroughs B4700 Mainframe Computer with 14 Terminals in 1983. Personal computers were introduced in 1991 with Pentium in 1997. In 2002, RISC servers were introduced.

In 1960s and 1970s, when the computing facilities were not or scarcely available elsewhere, the entire NARES depended on the computing facilities of the Institute and many agricultural researchers used this facility for advancement of new technologies. This has been further enhanced by creating a healthy Strengthening Statistical Computing Environment for NARES in 2010, Web Resources such as Design Resources Server, Sample Survey Resources Server for e-advisory and e-learning and Indian NARS Statistical Computing Portal for providing service-oriented computing.

A National Agricultural Bioinformatics Grid (NABG), the first supercomputing hub for Indian Agriculture i.e. Advanced Supercomputing Hub for OMICS Knowledge in Agriculture (ASHOKA) built in a state-of-art Data-Centre for high performance computing in the field of agricultural bioinformatics and computational biology was established in 2013. Out of nine super-computers of this grid, two super-computers were then ranked at 11 and 24 in the then list of top super-computers of India. At present ASHOKA has: 30 Nodes/1200 cores ~92 TF), 16 Nodes/192 cores as Big Data; 03 GP-GPU Nodes (~34 TF); 144 cores with 3.0 TB RAM as SMP (~10TF); 128 cores with 1.0 TB Ram as SMP; 64 cores with 1.5 TB RAM as SMP and Storage Capacity: 700 TB + 100 TB. GP-GPU and

SMP Clusters are being upgraded with enhanced capacity.

ICAR Data-Centre is operational since September 10, 2014 was inaugurated on December 21, 2016. ICAR Data Centre is certified as ISO/IEC 27001:2013 for Information Security Management System and ISO/IEC 20000:2011 for IT Service Management System. The facilities are built in a state-of-art Data Centre, currently equipped with industry standard 3165 Core Computer, 26798 GB RAM, 6872 TB Storage, 351 devices, Software, Application, Tools and other related technologies. Out of this 1362 Core, 7726 GB RAM, 400 TB Storage is for traditional computing; and 1563 Core,17792 GB RAM, 6451 TB storage for hyperconverged infrastructure (HCI) computing. To pace with the emerging technologies and to provide computational solutions to NARES, Artificial Intelligence (AI) resources have been built in ICAR-DC at the institute having 240 Core, 17 Tesla V100 GPU, 84070 CUDA Core, 10880 Tensor Cores, 21 TB SSD, 1280 GB RAM having buddle of latest AI/Deep learning software /tools kits.

ICAR DC has been continuously providing the unified communication (and webhosting service to ICAR and its Institutes. For unified icar.gov. in domain email ID, there are 24,000+ users. The listed DNS, Portals, Websites, Modules, Systems and Applications are being maintained and hosted at ICAR-DC. At present 350+ applications are hosted on DC. ICAR email is being used as 'Single Sign on' using LDAP authentications in various applications like e-Office, e-HRMS, SPARROW, PMS, FVMS, TMIS, KRISHI Portal, ARMS and others hosted on ICAR-DC.

In the continued expansion of ICAR DC, Cloud Computing (KRISHI Megh) at ICAR-IASRI along with Disaster Recovery Centre (DRC) at NAARM, Hyderabad was established in August 2020. For providing transparency in day-to-day work of the ICAR/Institute, ICAR-ERP (Enterprises Resources Planning) system has been implemented with the MIS-FMS (Financial Management, Project Management, Material Management, Human Resource Management and Payroll System modules). The Institute has developed/ implemented/ maintains critical ICT applications of the Council through ICAR DC, Disaster Recovery Centre and ASHOKA which includes e-Office, SPARROW, ICAR-ERP/FMS/MIS, etc. During Covid period, for smooth functioning of academic activities, MS Teams services were provided through Enterprise-wide complementary license.

Notable contributions have been made in introducing computer culture in agricultural research and human resource development in information technology in the ICAR. The Institute has the capability of development of Information Systems, Decision Support Systems, Expert Systems, Portals, Mobile Apps and Artificially-Intelligence-based applications. The Institute has so far developed 65+ web applications including 27 Mobile apps with 15 million+ page views. More than 50+ R Packages have been developed. These systems are helpful in taking the technologies developed to the doorsteps of the farmers. The stakeholders for these applications are students, scientists, government officials, farmers, etc. Some important among these are:

Web-based Knowledge Resources, Statistical Packages and Service Oriented Computing

- For dissemination, e-learning and e-advisory for scientists in NARES, developed Design Resources Server (https://drs.icar.gov.in) and other web solutions for generation of experimental designs and online analysis of experimental data for different experimental settings which are being viewed across the globe and have helped in changing the status of experimentation/survey in NARES.
- Indian NARS Statistical Computing Portal for service-oriented data analysis which is available to NARES researchers through their Campus/ Institute network
- Statistical Packages developed by the Institute include Statistical Package for Balanced Incomplete Block Designs (SPBD); Statistical Package for Factorial Experiments (SPFE); Statistical Package for Augmented Designs (SPAD); Software for Survey Data Analysis (SSDA); Statistical Package for Animal Breeding (SPAB) and Statistical Package for Agricultural Research (SPAR). Besides the above SAS macros/R Packages have also been developed.
- Other web resources include estimation of compound growth rate, Fuzzy C-means clustering and GRAPES: General R-shiny based Analysis Platform Empowered by Statistics (With KAU, Vellayani); Online Analysis of Block Designs, Web Generation and Analysis of Partial Diallel Crosses, Web Generation of Designs Balanced for Indirect Effects of Treatments. etc.

Knowledge and Data Management Portals

- KRISHI Portal: Agricultural Knowledge Resources and Information System Hub for Innovations Empowering Knowledge Management as Central Research Data Repository for publications, technologies, unit level data, video, audio, mobile apps, IP resources (patents, copyrights, variety registration), varieties developed, image, geo-portal;, MasterVocab, Infogaraphics Dashboard including Institute and Scientist Profile; single window access to ICT initiatives. Received Gold Icon Award in Open Data Champion category from MEITY, Govt. of India. This has also been referred as Good Practice for ICAR/DARE as Central Data Repository in Data Governance Quality Index 2.0 report of Development Monitoring and Evaluation Office (DMEO), NITI AAYOG.
- KCC-CHAKSHU (Kisan Call Centre- Collated Historcally Aggregated Knowledge-based System with Hypertext User-interface): Provides Insights and Alerts: 35 Million+ Queries call logs from KCC data (available through APIs on the open data platform).
- Artificial Intelligence based Disease Identification System for Crops (AI-DISC App): Identifies 50 diseases of 19 crops (Rice, Wheat, Maize, Tomato, Mustard, Cotton, Brinjal, Apple, Peach, Kinnow, Mandarin, Assam Lemon, Chickpea, Green gram, Cluster bean, Moth bean, Chilli, Coriander etc.) once the image in natural background is uploaded.
- KVK Portal and KVK App: provides basic information and facilities of KVK, District Agricultural Contingency Plan, Upcoming, Ongoing and Past Events organized by KVKs, Package of Practices related to Crop, Horticulture and other enterprises, access to Agrometeorological advisory and Agricultural Commodity Market prices to farming community. Information also shared with Kisan Suvidha App.
- KISAN SARATHI: System of Agri-information Resources Auto-transmission and Technology Hub Interface, ICAR Powered by: Interactive Information Dissemination System (IIDS), DIC, MeitY, Govt. of India: (ICT based platform for two-way multi-lingual communication system between Farmers and Agricultural Experts for transmission of agricultural technology/ information and advisory in the form of Text, Images, Audios and Videos)
- eLISS Web Portal and mobile app for an end-to-end solution for Integrated Sample Survey (ISS) Solutions for Major Livestock Products (Milk, Meat, Egg and Wool) having 3 modules viz., sample selection module, data entry and analysis module and GIS map module. It is being used Pan India by Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India.
- KISAAN 2.0 (Krishi Integrated Solution for Agri Apps Navigation): aggregator mobile app and provides information on 270+ agricultural related apps with interface in 11 language.
- ASRB OASIS (ASRB-Online Application & Scorecard Information System, system for streamlining the recruitment process for agricultural scientists while providing easy access to application submission and scorecard information
- Education Portal is a single window platform for providing vital education information/ announcements/event schedules/e-learning resources from Agricultural Universities across the country to the rural youth in an easy and fast way on their doorsteps.
- Academic Management System is a web enabled system for management of all academic activities of the university. The system caters to the needs of different users: Dean, Registrar, Professor, Head, Guide, Faculty, Teacher, Student, Administrators and Officials. At present implemented in 55+ Agricultural Universities
- E-Krishi Shikha provides access to UG Level interactive & multimedia e-Courseware contents in seven disciplines viz. Agricultural Science; Fisheries Science; Dairy Science; Veterinary and Animal Husbandry; Horticulture; Home Science and Agricultural Engineering. 325+ online courses available on this resource.
- Virtual Classrooms have been established across 74 Agricultural Universities to improve the quality of education and widen the access to education by all students, while up-skilling teaching faculty across the country. Agri-Diksha, Agri Web Education Channel has also been initiated. AR/VR experience labs have been established to enhance learning experience for students.
- Information Systems for 14 AICRPs for single crops, multi-crop and observational studies, have

been developed, which resulted in use of efficient design of experiments, saving of manpower time and resources and creating Research Data Repository and standardization of analysis of experimental data.

- Other Information systems and portals are: ICAR DARE Foreign Visit Management System (FVMS); PMS portal (Personnel Management Information System); LRMS (Land Record Management System); E-Learning portal; Student READY Portal; KRITAGYA for Agri-Hackathons; Accreditation Portal for accreditation of Higher Agricultural Educational Institutions (HAEIs), KVC-ALNET (Krishi Vishwavidyalaya Chhatr Alumni Network); AURS (Agricultural University Ranking System); GRMS (ICAR-AU-Grievance Redressal & Monitoring System); Green and clean Campus portal; Plant Trees Portal; AU-PIMS (Agricultural University Project Information Management System); FFP (Farmer First Project) Portal; CBP Portal (Capacity Building Portal); TMIS (Training Management Information System); RLBS (Research Leadership Building System); DBT DARE MIS (Direct Benefit Transfer Management Information System); MIS-PIMI FMS (Web application to automate the financial operations in two Agricultural Universities); BARP (BRICS Agricultural Research Platform); AEIS (Agriculture Experts Information System); ANIS (Agricultural Nutrition Information System); ARMS (Agricultural Research Management System earlier Half Yearly Monitoring System); PMTS (Project Monitoring and Tracking System); E-Platform for Seed Spices, etc.; Expert Systems on Wheat, Maize, Tomato, Mushroom, Tobacco, Seed spices; Phenomics Pipeline- for Analysis of High Throughput Image Analysis; Knowledge Management System for DUS.
- Mobile apps developed include KVK App; ICAR Technologies; KISAAN-2.0 app; AI-DISC; e-LISS data collection app; NIBPP(National Image Base for Plant Protection); NIBLD (National Image Base for Livestock Disease); Phytochemical Management App; FAW Recorder App; FFP Mobile App; IVRI-Veterinary Clinical Care App; IVRI-Pig Farming App; IVRI-Vaccination Guide App; IVRI-Animal Reproduction; IVRI-Pig Ration App; IVRI-Disease Control App; IVRI-Artificial Insemination App; IVRI-Dairy Manager App; IVRI-Online Veterinary Clinic; CARI-Backyard Poultry Farming App; IVRI- Waste Management Guide App ; IVRI-Zoonoses App; IVRI-Biosecurity and Biosafety App; IVRI-Technologies & Services App ; IVRI-Antimicrobial Resistance App; IVRI-Extension Methods Tutorial Quiz ; IVRI - Landlly Pig App; IVRI- Research Methods Tutorial App, etc.

Human Resource Development

One of the major thrust areas of the Institute is to develop trained manpower in the country in Statistical sciences for meeting the challenges of agricultural research in the newer emerging areas. A humble beginning in the area of development of trained manpower was made in 1945 with the initiation of two regular certificate courses, one course of six-month duration, called Junior Certificate Course (JCC) and the other course of one year duration called Senior Certificate Course (SCC). Besides, there was another course of one-year duration known as Professional Statisticians' Certificate Course (PSCC) that was introduced to train professional statisticians. Subsequently, a Diploma course involving a research project of one year duration, in addition to PSCC consisting of one year course work in agricultural statistics, was also introduced. These certificate courses helped in strengthening the linkages of the Institute with the State Departments of Agriculture and Animal Husbandry. The certificate courses started in 1945 were discontinued by the Indian Council of Agricultural Research (ICAR) in 1985-86. However, during 1997, the Senior Certificate Course in Agricultural Statistics and Computing was revived. This course is now of six-month duration and lays more emphasis on statistical computing using statistical software. The course is divided into two modules viz. (i) Statistical Methods and Official Agricultural Statistics, and (ii) Use of Computers in Agricultural Research, of three-month duration each. Since 1997, 100 participants have completed both the modules, 41 have completed module-I only and 24 have completed module-II only.

The year 1964 witnessed tremendous changes in the activities of the Institute when a Memorandum of Understanding (MOU) was signed with Indian Agricultural Research Institute (IARI), New Delhi to start new degree courses leading to M.Sc. and Ph.D. in Agricultural Statistics. In 1981, a two-year Diploma Course in Advanced Computer Programming was introduced. On the recommendations of UNDP, this course was soon discontinued and in 1985 another new course leading to M.Sc. degree in Computer Applications in Agriculture was initiated in collaboration with IARI, New Delhi. This course was re-designated as M.Sc. degree in Computer

Application during 1993-94. A new degree course M.Sc. in Agricultural Bioinformatics has been initiated from academic year 2011-12. Ph.D. degree course in Computer Application and Bioinformatics were initiated in 2013-14 and 2014-15 respectively.

The Institute has so far produced 228 Ph.D. and 383 M.Sc. students in Agricultural Statistics; 09 Ph.D. and 161 M.Sc. students in Computer Application; 13 Ph.D. and 40 M.Sc. students in Bioinformatics. The alumni are well placed in NARES, academia, Government, Corporate sector and occupying very high positions globally. IASRI provides unique opportunities to the aspiring post graduate students to learn the cutting edge and new technologies by offering them an ambient academic environment, practical exposure, professional learning and analytical skills.

The functioning of the Institute as a Centre of Advanced Studies in Agricultural Statistics and Computer Application during October 1983 to March 1992 under the aegis of United Nations Development Programme was another landmark in the history of the Institute. The purpose of this programme was to develop the Institute as a Centre of Excellence with adequate infrastructure and facilities to undertake advanced training programmes and to carry out research in various emerging areas of Agricultural Statistics and Computer Application. Under this programme, a number of illustrious statisticians and computer scientists from abroad visited the Institute with a view to interact with the scientists, giving seminars/ lectures and suggesting gaps in the research programmes of the Institute. Under the programme some scientists of the Institute received training for capacity building from abroad. Another singular development in the growth of the Institute was the Centre of Advanced Studies Programme in Agricultural Statistics and Computer Application established during the VIII Five Year Plan in 1995. Under this programme the Institute organized training programmes on various topics of current interest for the benefit of scientists of NARES. These training programmes covered specialized topics of current interest in statistics and agricultural sciences. The Centre of Advanced Studies (CAS) was renamed as Centre of Advanced Faculty Training (CAFT). So far 89 training programmes have been organized under the aegis of CAS/CAFT. In all a total of 1762 participants have been benefited. A total of 30 Summer/Winter Schools/Short courses have been organized which were attended by 705 participants.

There is yet another form of training courses, which are tailor–made courses and are demand driven. The coverage in these courses is need based and the courses are organized for specific organizations from where the demand is received. Such training programmes on various aspects of Statistical and Computation Techniques and ICT Tools impart necessary skills not only to researchers in NARES but also to Indian Statistical Service professionals. FAO, Afro-Asian Rural Development Organization, World bank for Government officials of Afghanistan, Ministry of Statistics and Programme Implementation, Indian Council of Forestry Research and Education, State Department of Agriculture, other national and international developmental agencies look at the Institute as a valuable partner and organize several national/international training programmes to the developing world. The Institute has broadened the horizon of capacity building by opening its doors to agro-based private sector, CGIAR organizations such as ICARDA, Rice-Wheat Consortium for Indo-Gangetic plains etc. Only few Institutes in ICAR have this distinction. A number of research workers from the Institute have served as consultants and advisors in Asian, African and Latin American countries. Also, a number of statisticians and students of the Institute are at present occupying high positions in universities and other academic and research institutions of USA, Canada and other countries.

It is a matter of great pride for the Institute that 05 of its scientist/alumni have received the most prestigious National Award in Statistics in memory of Late Dr. PV Sukhatme, for outstanding life time achievements in Statistics and 02 received National Award in Statistics in Honour of Professor CR Rao from Ministry of Statistics and Programme Implementation, Govt. of India. ICAR Rafi Ahmad Kidwai Award has been received by 03 of its faculty/ alumni. One scientist occupied the prestigious ICAR National Professor Chair, three scientists have been the National Fellow of the ICAR, 02 of faculty/alumni received (Indian National Science Academy (INSA) Fellowship and 13 faculty/alumni elected as National Academy of Agricultural Sciences (NAAS) Fellows. One scientist received the GP Chatterjee Memorial Lecture award from Indian National Science Academy (INSA); one scientist received the Shri Om Prakash Bhasin award for science and technology in the field of agriculture and allied sciences; one alumni received MS Randhawa Award from NAAS, 02 scientists received NAAS Recognition Award and one scientist received Cochran-Hansen Prize 2009 by International Association of Survey Statisticians. Eight scientists have been adjudged as the 'Best Teacher' of the PG School of IARI, New Delhi and 02 received Bharat Ratna Dr. C. Subramaniam Award

for Outstanding Teacher from ICAR. Six students received Jawahar Lal Nehru Award on Ph.D. Dissertation. Several of its scientists have received 'Young Scientist Award' from National Academy of Agricultural Sciences, Indian Council of Agricultural Research and many other scientific societies / associations. Several scientists have been the elected members and one scientist had been the Council member of the International Statistical Institute. Scientists are also Editors, Associate Editors and Members of the Editorial Board of many National and International Journals.

Other Infrastructural Development

There are various labs in the Institute for dedicated services like AKMU lab for training, Statistical computing lab, and Centre of Advanced Study lab or student lab. Business Intelligence Server has also been installed for statistical computing for NARES. A laboratory on Remote Sensing (RS) and Geographic Information System (GIS) was created in the Institute. The laboratory are equipped with latest state-of-art technologies like computer hardware and peripherals. Two smart/virtual class rooms have been setup to facilitate for online/ blended form of teaching. Videoconferencing lab and committee room have been setup to facilitate videoconferencing. Auditorium of the institute has been renovated with latest infrastructure.

The Library of the Institute is considered as a well-known and specialized library in the whole country in terms of its resources in the form of print and electronic format in the field of agricultural statistics, computer applications, bioinformatics and allied sciences. It is recognized as one of the regional libraries under NARES. During the XI Plan period, the library has undergone changes in terms of its resources. It has strengthened the resource base in terms of core foreign journals. With procurement of online and CD-ROM bibliographical databases, the awareness for the use of databases has increased and users are able to access scientific information in the field of their interest quickly by clicking of a button. Recently, all housekeeping activities of the library have been computerized and barcoded with hybrid-RFID system and all bonafide library users have been issued RFID-electronic membership cards. All M.Sc. and Ph.D. students thesis have been digitized and given access to users through LAN. The Library is equipped with hybrid-RFID Self-Checkout/Check-in System for the ease of users. Library of the Institute is associated with CeRA in terms of electronic document delivery services and Inter-Library Loan services are also available to all users through DELNET. The library reading room has been renovated with air conditioners to provide congenial environment for readers. All library users have been given training to access on-line services available in the library.

There are three well-furnished hostels, viz. Panse Hostel, Sukhatme Hostel and International Training Hostel to cater to the residential requirements of the trainees and students.

Organizational Set-up

The Institute is having six Divisions, two Units and three Cells to undertake research, training, consultancy, documentation and dissemination of scientific output.

Divisions	Design of Experiments
	Sample Surveys
	Forecasting and Agricultural Systems Modeling
	Statistical Genetics
	Computer Applications
	Agricultural Bioinformatics
Units	IT-Unit
	Institute Technology Management Unit (ITMU)
Cells	Prioritization, Monitoring and Evaluation Cell (PME)
	Training Administration Cell (TAC)
	Consultancy Processing Cell (CPC)

Financial Statement 2022-23

The Institute ensured optimal utilization of funds available in the budget. The actual utilization of the budget is furnished in the sequel.

Budget Allocation vis-à-vis Utilization (2022–23)

(Rs.in Lakh)

Head	Total R.E. 2022-23	Expenditure up-to 31.3.23	Total Closing Balance
1	2	3	4(2-3)
Total Grants in Aid-General	1651.00	1650.06	0.94
Total Grants in Aid-Capital	190.00	189.83	0.17
Total Grants in Aid-General-(SCSP)	112.00	112.00	0.00
Total Grants in Aid-Capital-(SCSP)	30.00	17.30	12.71
Total Grants in Aid-Salaries	3004.00	2974.19	0.01
Total Grants in Aid-Pension	599.74	598.54	0.00
Grand-Total (General+Capital+Salaries+Pension)	5586.74	5541.92	13.83

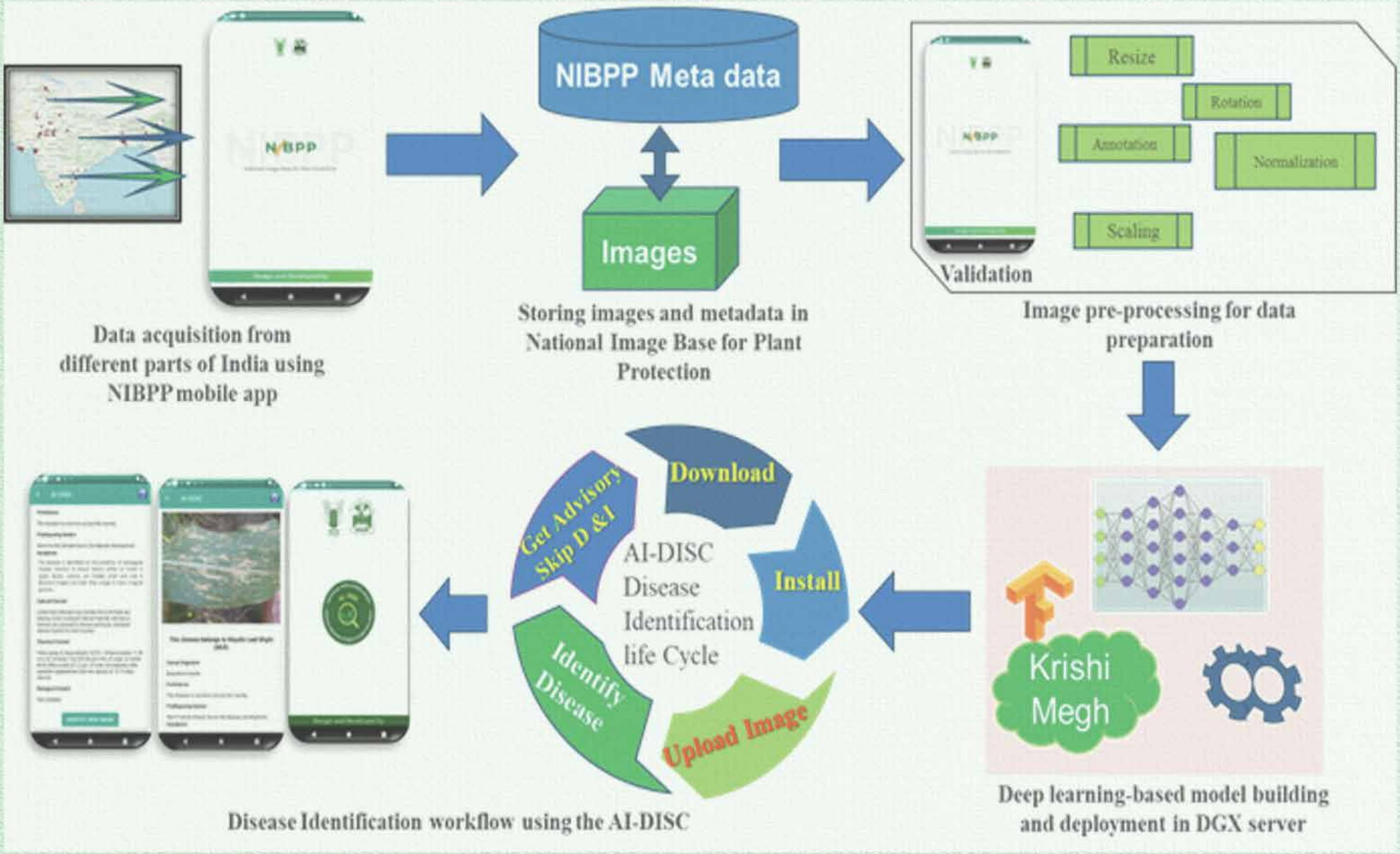
*An amount of Rs.29.80 Lakh & Rs.1.20 Lakh was refunded on 03.03.2023 under Grants in Aid-Salaries & Grants in Aid-Pension respectively.

Resource Generation 2022-23 (Rupees in Lakhs)	
Target	Achieved
29.20	31.44

Staff Position during 2022

Staff Strength							
S. N.	Cadre	31-12-2021			31-12-2022		
		Sanctioned Posts	In Position	Vacant Posts	Sanctioned Posts	In Position	Vacant Posts
1	Scientist	121	74	47	121	70	51
2	Administration	88	46	42	88	48*	43
3	Technical	174	32	142	170	32	138
4	SSS	39	21	18	39	17	22
5	Auxiliary Staff	14	5	9	14	5	9
	Total	436	178	258	432	169	263

*Three personnel are on deputation at Institute from other ICAR Instututes and two on deputation outside the Institute.


NIBPP Meta data
Images
Resize
Rotation
Annotation
Normalization
Scaling
Validation
Download
Install
Upload Image
Identify Disease
Get Advisory Skip D &I
AI-DISC
Disease
Identification
life Cycle
Krishi Megh
Data acquisition from different parts of India using NIBPP mobile app
Storing images and metadata in National Image Base for Plant Protection
Image pre-processing for data preparation
Deep learning-based model building and deployment in DGX server
Disease Identification workflow using the AI-DISC

3. RESEARCH ACHIEVEMENTS

The research targets set by the Institute were implemented by six Divisions of the Institute, viz. Design of Experiments, Sample Surveys, Statistical Genetics, Forecasting & Agricultural Systems Modelling, Computer Applications and Agricultural Bioinformatics. The basic, applied, adaptive and strategic research in Statistical Sciences (Agricultural Statistics, Computer Applications and Bioinformatics) is carried out under six broad programmes that cut across the boundaries of the Divisions and encourage interdisciplinary research. The six programmes are as under:

1. Development and analysis of experimental designs for agricultural system research
2. Forecasting and remote sensing techniques and statistical applications of GIS in agricultural systems
3. Development of techniques for planning and execution of surveys and analysis of data including economic problems of current interest
4. Modeling and simulation techniques in biological systems
5. Development of informatics in agricultural research
6. Teaching and training in Agricultural Statistics, Computer Application and Bioinformatics

Programme 1: DEVELOPMENT AND ANALYSIS OF EXPERIMENTAL DESIGNS FOR AGRICULTURAL SYSTEM RESEARCH

Nearly Balanced Treatment Incomplete Block Designs

In several experimental situations, the experimenter may be interested to compare a set of new treatments called test treatments with one established treatment called control. Often there may be a nuisance factor that needs to be taken care of during experimentation. Balanced treatment incomplete block (BTIB) designs are quite popular for comparing test versus a single control treatment. The class of BTIB designs has been extended by introducing nearly BTIB designs. Nearly BTIB designs can act as a useful alternative to BTIB designs when the latter is not available for a given parametric combination. An algorithm is proposed to construct nearly BTIB designs and a list of such designs is also provided in a practically useful parametric range.

Partially Balanced t-designs

Small and marginal farmers in India prefer an Integrated Farming System (IFS) approach i.e. a mixture of crop and livestock that enables them to maintain a stable income throughout the year. Identifying the best location-specific t-component crop-livestock combination to generate maximum profit is the major concern. Here, two series of partially balanced t-designs with some interesting characterization properties have been obtained by using the triangular association scheme. These designs have high application potential in crop and animal experimentation, especially in IFS research involving both crop and livestock components.

Row-column Designs with Two Rows

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 has been given for orthogonal parameterization. A catalogue of efficient row-column designs for 2^n ($2 \le n \le 9$) factorial in minimum number of replications has been prepared. A general procedure of obtaining efficient w-optimal row-column designs in two rows for n-factors mixed level factorial experiments based on baseline parameterization has also been developed and a catalogue of w-optimal row-column designs in two rows for n-factors mixed level factorial experiment based on baseline parameterization has been prepared.

Efficient Designs for Order-of-Addition Experiments

Experiments related to agriculture and allied sciences, new products are prepared by adding multiple number of components. The order in which these components are to be added to prepare a product such that the resultant product has some desirable properties is very important. For example, consider the situation when an animal nutritionist wants to prepare a cattle feed ration with several ingredients. Since the sequence in which feeds are added to the mixing equipment affects mixing adequacy, s/he wants to know in which order the components are to be added so that the final ration is properly formulated and mixed. This can be answered by a carefully conducted experiment.

An algorithm has been developed to generate efficient designs for order-of-addition experiments under pair-wise-order model and generated around 300 efficient designs. For order-of-addition experiments under component position model, component orthogonal arrays are found to be a promising class of designs in which each row is a permutation of *m* components and each pair of columns contains every permissible combination of two components equal number of times. An algorithm has been developed to obtain designs for order-of-addition experiments under component position model. Component Orthogonal Arrays (COAs) have been obtained for *m* = 3, 4, 5 and 7 components.

Efficient Designs for Double Cross Experiments under Fixed/Mixed Effects Model

Breeding experiments are conducted for acquiring information regarding the general combining ability (gca) effects of the individual lines involved as parents and the specific combining ability (sca) effects of the crosses based on these individual lines. The information collected on gca and sca forms a basis for the breeders to select the best parental lines precisely. There are many cases of plant and animal breeding where double crosses are the commonly used techniques of producing commercial hybrids. For such experimental situations, a general method of constructing partial double cross designs involving v (=$n(n-1)/2$) test lines and a control line in n (>4) blocks has been obtained. Following partial double cross design (Table given below) was constructed for 10 test (denoted as 1,2,…,10) and 1 control (denoted as C) maize lines involving 35 crosses arranged in 5 Blocks and suggested for field demonstration trial at ICAR-IARI, New Delhi.

A SAS code has been developed to compute the information matrix pertaining to gca and sca effects under a blocked design for double cross experiments.

Designing and Analysis of ON FARM Research Experiments Planned for AICRP on IFS

Small and marginal farmers in India prefer an Integrated Farming System (IFS) approach i.e., a mixture of crop and livestock that enables them to maintain a stable income throughout the year. The integrated approach leads to increased-per-capita income, improved standard of living and building the resilience of the community and natural resources. AICRP on IFS initiated the farmer participatory research in 32 districts of 21 States from 2011-12 to systematically characterize the existing farming systems, identify the constraints, make collective, compatible and convenient farm interventions and study the changes. In-depth data on all components are being collected from the farmers' fields and these need to be stored and analyzed properly to give suitable recommendations. As a voluntary centre of AICRP-IFS, the Institute handles analysis and software development for online data entry.

Improving the farming system to attain the household level self-sufficiency, land utilization efficiency and sustainable livelihood security depends on better socioeconomic and ecological aspects of the systems practiced by the small farmers in the semiarid regions of India. The higher sustainable livelihood security index (SLSI) in the integrated crops-livestock system helps to restore economic and ecological sustainability. The interaction of various modules of farming in different combinations with the diversification of existing systems has been studied. The ecological security index (ESI), economic efficiency index (EEI), and social equity index (SEI) to produce a SLSI of improved integrated farming system (IFS) compared with benchmark farming in semi-arid regions were computed. Different existing IFS comprising of seven modules (field crops, dairy, goats, poultry, horticulture, fishery, and apiary) in different combinations were examined. Results revealed that 72.5% farmers preferred to integrate two modules, where as 95% of farmers adopted field crops + dairy (FC + D) in preference to other modules. The sustainability indicators: ESI (+43.3%), EEI (+16.0%), SEI (+11.6%), and SLSI (+6.0%) were improved in the FC + D farming system as compared to other IFS module combinations. Similarly, improved IFS interventions also increased sustainability indicators over benchmark farming.

Block-1	Block-2	Block-3	Block-4	Block-5
(C×1)×(2×3)	(C×1)×(5×6)	(C×2)×(5×8)	(C×3)×(6×8)	(C×4)×(7×9)
(C×2)×(3×4)	(C×5)×(6×7)	(C×5)×(8×9)	(C×6)×(8×10)	(C×7)×(9×10)
(C×3)×(1×4)	(C×6)×(7×1)	(C×8)×(9×2)	(C×8)×(3×10)	(C×9)×(10×4)
(C×4)×(1×2)	(C×7)×(1×5)	(C×9)×(2×5)	(C×10)×(3×6)	(C×10)×(4×7)
(1×2)×(3×4)	(1×5)×(6×7)	(2×5)×(8×9)	(3×6)×(8×10)	(4×7)×(9×10)

A comparative study has been done for closely observing the increase in farmers' income due to IFS diversification based on data collected for the year (2018-19) as given in Tables 1a, 1b and 1c for clearly depicting high increase in profit (more than double), small (but may be significant) increase in profit as well as decrease in profit values, respectively. Here the "return" values are the profit of the farmers due to diversification after subtracting cost involved, but without excluding family consumption, i.e., net returns over variable cost.

Table 1a: Farming system-wise comparison of benchmark vs. diversified profit values {Cases with profit showed a high increase}

S. No.	Farming System	Centres	Benchmark Return	Diversified Return	p-value, B ver. D	% change in D over B [(D-B)*100/B]
1.	Crop+Dairy	Chikkaballapura	59901	490690	0.125	719.2
		Dahod	45341	109094	0.031**	140.6
		Fatehpur	18095	80000	<0.001***	342.1
		Hingoli	11265	59299	0.297	426.4
		Nadia	11	53215	0.008***	483672.7
		Satara	15941	112612	0.125	606.4
3.	C+D+Po	Bhawanisagar	90941	288962	0.002***	217.7
		Chikkaballapura	7484	350579	0.250	4584.4
4.	C+D+Po+G	Bhawanisagar	114034	241521	0.009***	111.8
5.	C+D+Sh	Chikkaballapura	127508	305767	0.063*	139.8
6.	C+D+H+Sh +Po	Chikkaballapura	157551	11560725	0.219	7237.8
7.	C+D+H	Fatehpur	21149	108048	<0.001***	410.9
		Medak	24560	66880	0.188	172.3
		Dausa	86121	207838	0.008***	141.3
		Nadia	180	65793	0.002***	36451.7
10.	C +G/Sh.+Po	East Singhbhumi	20374	90382	<0.001***	343.6
14.	C+Se	Hingoli	12243	30634	0.375	150.2
15.	C+H	Hingoli	22001	56467	0.125	156.7
16.	C+G	Hingoli	18894	42633	0.910	125.6
20.	C+D+Sh+H	Medak	58400	140267	0.250	140.2
21.	C+D+F	Nadia	11315	38151	0.250	237.2
26.	H+Po	Vellayani	96576	198430	<0.001***	105.5

C: Crop; D: Dairy; H: Horticulture; Po: Poultry; G: Goat; Sh: Sheep; F: Fish; Se: Sericulture; Pi: Piggery

Table 1b: Farming system-wise comparison of benchmark vs. diversified profit values {Cases with profit showed small increase}

S. No.	Farming System	Centres	Benchmark Return	Diversified Return	p-value, B ver. D	% change in D over B [(D-B)*100/B]
1.	Crop+Dairy	Annupur	37747	51614	0.002***	36.7
		Dausa	368065	414018	0.383	12.5
		Mirzapur	28262	31203	0.305	10.4
		Nalanda	24950	35992	0.090*	44.3
		Vizianagaram	45632	47258	0.844	3.6
2.	Crop+Goat+Poultry	Annupur	43258	72863	0.063*	68.4
3.	C+D+Po	Dungarpur	53214	54422	0.424	2.3
4.	C+D+Po+G	Yethapur	100227	196769	0.012**	96.3

S. No.	Farming System	Centres	Benchmark Return	Diversified Return	p-value, B ver. D	% change in D over B [(D-B)*100/B]
5.	C+D+Sh	Medak	118551	176801	0.625	49.1
7.	C+D+H	Dharwad	28955	35435	0.685	22.4
		Vellayani	268506	363441	0.008***	35.4
8.	C+D+G	Dahod	64330	72340	0.194	12.5
		Dausa	128144	167753	0.109	30.9
9.	C+D+G+Po	Dahod	116581	120901	1.000	3.7
		Satara	95102	118388	0.563	24.5
10.	C +G/Sh+Po	Kanker	100374	112916	0.375	12.5
11.	C+F+Pi+Po	Goalpara	101439	107360	0.875	5.8
17.	C+D+F+Pi	Kanker	90985	98713	0.625	8.5
18.	C +Po	Kanker	64742	75134	0.175	16.1
19.	C+D +G+ Pi	Kanker	69626	88549	0.125	27.2
22.	C+Po+F	Nadia	11910	23450	1.000	96.9
27.	H+D	Vellayani	378287	456147	0.125	20.6

Table 1c: Farming system-wise comparison of benchmark vs. diversified profit values Table {Cases with profit showed decrease}

S. No.	Farming System	Centres	Benchmark Return	Diversified Return	p-value, B ver. D	% change in D over B [(D-B)*100/B]
1.	Crop+Dairy	Adiya	319614	167317	0.119	-47.7
		Bilashpur	38549	29518	0.573	-23.4
		Dharwad	41160	33935	0.465	-17.6
		Dungarpur	71551	12084	0.250	-83.1
		Fatehabad	170704	140014	<0.001***	-18.0
		Jammu	27420	11611	<0.001***	-57.7
		Medak	230008	99078	0.813	-56.9
		Muzaffarnagar	515516	107952	0.002***	-79.1
		Nagpur	37587	-37955	0.063*	-201.0
		Patiala	3517369	230749	0.132	-93.4
		Ratnagiri	31583	13820	0.001***	-56.2
		Udham Singh Nagar	38363	34088	0.365	-11.1
		Umaria	51090	42556	0.073*	-16.7
3.	C+D+Po	Goalpara	38809	16243	0.313	-58.1
		Medak	165037	77443	0.063*	-53.1
		Satara	213056	137734	0.578	-35.4
		Vizianagaram	82786	51411	0.844	-37.9
		Yethapur	127629	95739	1.000	-25.0
7.	C+D+H	Dungarpur	46649	39235	0.945	-15.9
		Chikkaballapura	329370	191060	1.000	-42.0
		Muzaffarnagar	161992	122687	0.125	-24.3
		Nagpur	9420	-37643	0.016**	-499.6
8.	C+D+G	Satara	94519	91926	0.938	-2.7
		Yethapur	182213	140300	0.563	-23.0

S. No.	Farming System	Centres	Benchmark Return	Diversified Return	p-value, B ver. D	% change in D over B [(D-B)*100/B]
10.	C+G/Sh.+Po	Goalpara	84760	26474	0.875	-68.8
12.	C+Pi+Po	Goalpara	82674	33990	0.125	-58.9
13.	C+D+Pi+Po	Goalpara	73911	35239	0.219	-52.3
15.	C+H	Nalanda	29716	8370	0.125	-71.8
18.	C +Po	Ratnagiri	-2138	14603	0.001***	-783.0
		Vizianagaram	88687	74557	0.380	-15.9
23.	C+H+BP	Nagpur	16934	-52536	0.063*	-410.2
24.	C+BP	Nagpur	13876	-49536	0.016**	-457.0
25.	C	Udham Singh Nagar	124133	82259	0.027***	-33.7

Three software modules have been developed for online data submission and analysis of OFR 1 and online data submission of (OFR 2 & 3) experiments were brought together (https://aicrp.icar.gov.in/onfarm/)

Online Data Submission Module AICRP on IFS (on Farm)

Planning, Designing and Analysis of Experiments Planned On Stations Under AICRP on IFS

Analysis of data received from 32 centers via Experiment 1(a) for the year 2019-20 have been carried out. A new experiment for *Identification of cropping systems module for different farming systems* has been initated with the following objectives: (i) to evaluate the cropping systems in ecological, nutritional, feed and economic perspective (ii) to identify the cropping system module for specific farming systems and (iii) to assess the resource dynamics of identified cropping system module. SAS code has been developed for analyzing the data pertaining to this experiment and for pairwise treatment comparison for soil health, family nutrition, livestock nutrition, and income economic for different experimental stations.

Online Data Submission and Analysis Module AICRP on IFS (on Station)

A software module has been developed for online data submission and analysis of on station experiments available at https://aicrponstation.icar.gov.in

Planning, Designing and Analysis of Data Relating to Experiments for AICRP on Long Term Fertilizer Experiments

Combined analysis of four centres namely Akola, Barrackpore, Palampur and Raipur have been carried out. 100% NPK + FYM at 5 t/ha is best treatment for grain yield sustainability in both sorghum and wheat in Akola region. Application of zero fertilizer cannot sustain grain yield in either crop. In the soil type of Barrackpore, application of 100% NPK coupled with FYM is able to maintain very good productivity level of rice. 100% N alone cannot sustain grain yield in maize and wheat in the soil type of Palampur. Similarly, zero fertilizer application also cannot sustain grain yield in maize and wheat in the soil type of Palampur. 100% NPK + FYM gives highest grain yield in these two crops. 150% NPK and 100% NPK + FYM gives best grain yield in rice and wheat crop in Raipur centre.

Combined analysis of Pantnagar centre has been performed for grain yield for Kharif and Rabi crops based on 37 years of data (1983-84 to 2019-20). It was observed that T8 (100% NPK + FYM) gives highest grain yield (51.3 q/ha) followed by T5 (100%

NPK + Zn) which gives 48.7 q/ha and T8 and T5 are statistically significantly different from each other for rice (Kharif) crop. Lowest grain yield of 17.8 q/ha was observed for T11 (Control) for rice crop. For wheat (Rabi), again T8 (100% NPK + FYM) gave highest grain yield (45.7 q/ha) followed by T5 (100% NPK + ZN) with 41.4 q/ha and these are significantly different. Lowest grain yield (12.1 q/ha) was observed for T11 (Control) for wheat (rabi). Analysis of 15 years (2001-02 to 2015-16) of grain yield data for kharif crop rice reveals that treatment T3 (150%NPK) gives highest grain yield of 61.23 q/ha followed by treatment T8 (100% NPK + FYM) which gives 59.9 q/ha and both are statistically at par at 5 % level of significance. Lowest grain yield (32.5 q /ha) is recorded for treatment T11 (Control). Similarly, combined analysis was performed for 14 years (2001-02 to 2014-15) of grain yield data for Rabi crop Rice. Highest grain yield of 61.8 q/ha was observed for T3 (150%NPK) followed by 57.3 q/ha for T8 (100% NPK + FYM). Lowest grain yield of 27.4 q/ha was seen for T11 (Control). This clearly reveals that 100% NPK + FYM at 5 t/ha is best for grain yield sustainability in rice in both kharif and rabi in Jagtial region. Application of zero fertilizer will lead to decrease in crop yields.

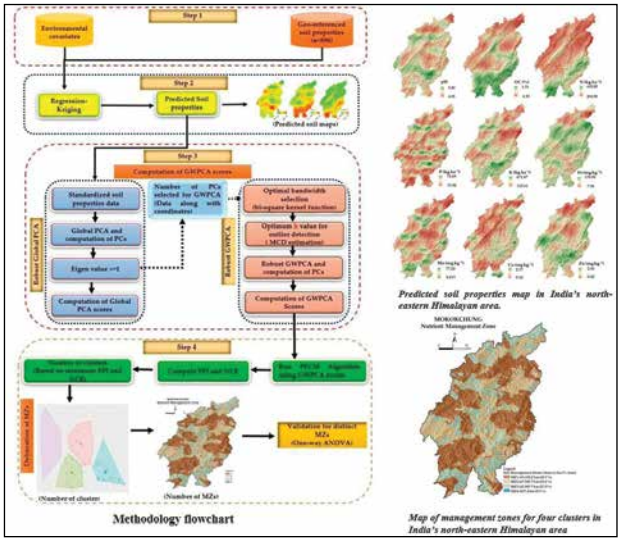
Sustainable Biochar Production and Use through Rice-Cotton based Agroforestry System in Odisha: A Climate-Resilient Soil Management Approach (Funded by ICRAF and GIZ)

For cotton crop, an experiment was conducted for evaluation of biochar with 8 treatments. It was found that highest average yield was recorded for the treatment biochar with feed stock type 1 with recommended dose of fertilizer (RDF) and farmyard manure (FYM) and for the treatment biochar with feed stock type 3 including RDF and FYM. Lowest average yield was observed for farmers' practice. For pigeon pea, no significant difference was observed for treatments with biochar and without biochar. In case of experiments in vegetable crops, it was found that treatment biochar with RDF and FYM gives highest yield and farmers' practice gives lowest yield. For paddy crop, experiment was planned to be conducted using randomized complete block design. However, sowing could not be done in most of the plot and hence, the data was analyzed using incomplete block design set-up and it was found that treatment effects are not significantly different for the seven treatments considered for the character yield per acre.

Programme 2: FORECASTING AND REMOTE SENSING TECHNIQUES AND STATISTICAL APPLICATIONS OF GIS IN AGRICULTURAL SYSTEMS

Geospatial Modelling for Delineation of Crop Management Zones Using Local Terrain Attributes and Soil Properties

Defining nutrient management zones (MZs) is crucial for the implementation of site-specific management. The determination of MZs is based on several factors, including crop, soil, climate, and terrain characteristics. This study aims to delineate MZs by means of geo-statistical and fuzzy clustering algorithms considering remotely sensed and laboratory data and, subsequently, to compare the zone maps in the north-eastern Himalayan region of India. For this study, 896 grid-wise representative soil samples (0–25 cm depth) were collected from the study area (1615 km^2). The soils were analysed for soil reaction (pH), soil organic carbon and available macro (N, P and K) and micronutrients (Fe, Mn, Zn and Cu). The predicted soil maps were developed using regression kriging, where 28 digital elevation model-derived terrain attributes and two vegetation derivatives were used as environmental covariates. Further, to define the management zones a statistical approach was developed, based on which the optimum number of clusters were identified. The management zones were constructed considering the total pixel points of 30 m spatial resolution (17, 86,985 data points). The area was divided into four distinct zones, which could be differently managed. MZ 1 covers the maximum (43.3%), followed by



Outline of different steps followed for delineation of Crop Management Zones

MZ 2 (29.4%), MZ 3 (27.0%) and MZ 4 (0.3%). The developed computational approach and the maps generated are provided here. The MZs map thus would not only serve as a guide for judicious location-specific nutrient management but would also help the policymakers to bring sustainable changes in the north-eastern Himalayan region of India.

Forecasting Onion Prices Using Deep Learning Techniques

Among the different deep learning models, convolutional neural network (CNN) based deep learning model outperformed all the counterparts followed by Long short-term memory (LSTM) and its variants in the univariate time series modelling framework. Multivariate LSTM models performed better as compared to univariate LSTM model. The findings have also revealed the superiority of deep learning models over statistical and machine learning models in terms of forecast accuracy measure criteria.

Prediction of Pest Incidence based on Weather Variables

Influence of weather variables on occurrence of spiders in pigeon pea across locations of seven agro-climatic zones of India was studied in addition to development of forecast models with their comparisons on performance. Algorithms based on combinations of wavelet decomposition and regression model (wavelet–regression) and wavelet decomposition and artificial neural network (ANN) technique (wavelet-ANN) have been proposed. The prediction accuracy of wavelet–ANN has been found to be better than the other.

Prediction of Pest Incidence based on Weather Variables by Time Series Model

Insect pest and weather relations analysed using statistical models empower crop pest management through their capacity to forewarn abundance or their damage during season of crop cultivation. Field datasets of eight seasons (2010–2017) of Maharashtra (India) used to study the influence of weather factors lagged by one week on soybean semilooper pest status based on Kendall's correlations revealed significant and positive influence of maximum temperature (MaxT), MaxT deviation, minimum temperature (MinT), MinT deviation and rainfall (RF) with relative humidity (RH) influence significantly negative. Nonlinear models individually and in hybrid mode fitted and tested using datasets indicated the best performance of hybrid of autoregressive integrated moving average with exogenous variable (ARIMAX) with artificial neural network (ANN) i.e. ARIMAX-ANN over ANN or ARIMAX models. Performance of the non-linear models were evaluated based on statistical measures of mean square error (MSE) and root mean square error (RMSE).

Development of Spatio-Temporal Neural Network Models for Forecasting Space-Time Data

The Spatio-Temporal Neural Network model and the Spatio-Temporal Wavelet Network model have been proposed. These approaches have been demonstrated using annual precipitation data from six districts in the northern region of West Bengal, India. The results indicate that the Spatio-Temporal Wavelet Network model provides improved accuracy in modelling and forecasting compared to the Spatio-Temporal Neural Network model and traditional Space Time Auto Regressive Moving Average (STARMA) model.

Modelling of Proportional Data for Forewarning Pest Attacks in Crops

The cause and effect relationship are generally studied using simple regression model or nonlinear regression models. But in situations where data are not in ratio scale, then regression may not be appropriate as it violates the assumption of normality and constant variance. In such situations, beta regression model may be employed as it takes into consideration all the properties of the data. A disease forewarning model was developed. The Beta regression model is used to capture the variability in pest infestation data based on weather variables and whitefly population. The developed Tomato leaf curl virus (ToLCV) forewarning model could potentially be used by the farming community to develop a good management strategy to mitigate ToLCV.

Impact of COVID-19 on Price of Pulses

The COVID-19 pandemic has impacted almost all the sectors including agriculture in the country. The impact of COVID-19 induced lockdown on both wholesale and retail prices of major pulses in India is explored on five major pulses namely Lentil, Moong, Arhar, Urad and Gram for five major markets in India namely Delhi, Mumbai, Kolkata, Chennai and Hyderabad. To see the impact of lockdown on price and price volatility, time series model namely autoregressive integrated moving average (ARIMA) model with error following generalized

autoregressive conditional heteroscedastic (GARCH) model incorporating exogenous variable as lockdown dummy in both mean as well variance equations employed. It is observed that in almost all the markets, lockdown has significant impact on price of the pulses whereas in few cases, it has significant impact on price volatility.

The Export Advantages of Horticultural Commodities

The export advantages of horticultural commodities based on competitiveness, trade balance and seasonality dimensions has been explored. The study delineated horticultural commodities in terms of comparative advantage, examined temporal shifts in export advantages (mapping) and estimated seasonality. It is found that cucumbers/gherkins, onions, preserved vegetables, fresh grapes, shelled cashew nuts, guavas, mangoes, and spices emerged as the most favourable horticultural products. India has a strong seasonal advantage in dried onions, cucumber/gherkins, shelled cashew nut, dried capsicum, coriander, cumin, and turmeric.

Volatility Spillover of Agricultural Prices

The interdependency of market prices of agricultural commodities is studied. Two variants of multivariate generalized autoregressive conditional heteroscedastic models, namely Dynamic Conditional Correlation (DCC) and Baba, Engle, Kraft and Kroner (BEKK) model, have been applied for modelling the price volatility of potato in five major markets in India, i.e. Agra, Delhi, Bengaluru, Mumbai and Ahmedabad. It is observed that the Agra market has the highest price variability, whereas Mumbai has the least. Volatility impulse response function has been used to assess the impacts of a specific shock on the price volatility spill overs of potatoes among the studied markets.

Market Integration and Price Transmission of Wheat

Horizontal and vertical integration was carried out on the wholesale and retail prices of wheat in the major markets of India. On confirming co-integration between the wholesale and retail prices of wheat in all needs, the vector error correction model (VECM) was applied to find the speed of adjustment in the corresponding price channel. The results revealed that price signals are transmitted across regions, indicating that price changes in one market are consistently related to price changes in other markets and can influence the prices in other markets. In addition to studying co-integration, threshold autoregressive (TAR) and momentum TAR (MTAR) models were applied to test for asymmetric co-integration. Hasen and Seo's test was used to test for the presence of threshold cointegration. It revealed a significant presence of asymmetric and nonlinear co-integration in many markets. Accordingly, a threshold VECM (TVECM) model with two regimes was applied. The results indicate that the retail price significantly responds to the deviations from the long-run equilibrium compared to the wholesale price.

Decomposition based Machine Learning Technique for Price Forecasting

Most of the agricultural time series data in general and price data in particular are non-linear, non-stationary, non-normal and heteroscedastic in nature. Therefore, application of usual linear and nonlinear parametric models and their component models fail to capture the variability present in the series. It is also very difficult to extract actual signal from noisy time series observations. The nonparametric wavelet technique has the advantage of pre-processing the series to extract the actual signal. Optimizing level of decomposition and choosing appropriate wavelet filter can represent the series with high chaotic nature and sophisticated nonlinear structure more effectively. The decomposition can describe the useful pattern of the series from both global as well as local perspective. The wavelet decomposed components can be modelled using machine learning techniques like Artificial Neural Network (ANN) to result in wavelet-based hybrid models and eventually, inverse wavelet transform can be carried out to obtain the prediction of original series. The above algorithm has been applied for modelling monthly modal wholesale price of tomato for Burdwan market, West Bengal, India. Haar and D4 wavelet filters have been applied using two levels of decomposition i.e. 3 and 6. The prediction accuracy of the hybrid model is compared empirically with that of ARIMA, GARCH and ANN model and it is observed that hybrid algorithm outperformed the other models.

Multi-Step Forecast using Wavelet Analysis

Wavelet-based multiresolution analysis can decompose a time series into a set of components in order to improve the accuracy of forecasts. The wavelet based multiresolution analysis augmented

method is applied to expand wheat yield in Punjab, Haryana, and Bihar during the period 1966 to 2017 into a group of hierarchical series in a meaningful manner. Essentially, a regression model based on the Ordinary Least Squares (OLS) technique is used to reconcile the forecasts at different level of decomposition. Therefore, predictions at higher-level are computed by taking sum of lower-level predictions. The forecasting has been done for different rolling windows and different forecast horizons. The improvement in forecasting performance of the multi-step forecasts obtained using multiresolution analysis has been shown in terms of minimum values of mean absolute error (MAE) and root mean square error (RMSE). Moreover, a comparative study for predictive performance is also carried out between wavelet-based multi resolution augmented method and corresponding conventional approach i.e. autoregressive integrated moving average (ARIMA) model and wavelet based artificial neural network (Wavelet-ANN) hybrid model. It revealed that the wavelet based multiresolution augmented method outperforms the other approaches for the data under consideration.

Improved Co-integration based Time Delay Neural Network Model for Price Forecasting

Co-integration among the prices of different commodities plays a pivotal role in the price decision mechanism. The existing time delay neural network (TDNN) has been improved by incorporating the error correction term (ECT) as an auxiliary information in the model. The *ECTTDNN,* R package has been developed to perform the analysis using the proposed model. The empirical study using monthly wholesale price indices of fruit and crude oil for the period January 2005 to November 2020, clearly indicated the superiority in terms of forecasting ability of the proposed hybrid model as compared to the usual TDNN model.

WIAYFS: Weather Indices based Automated Yield Forecasting System

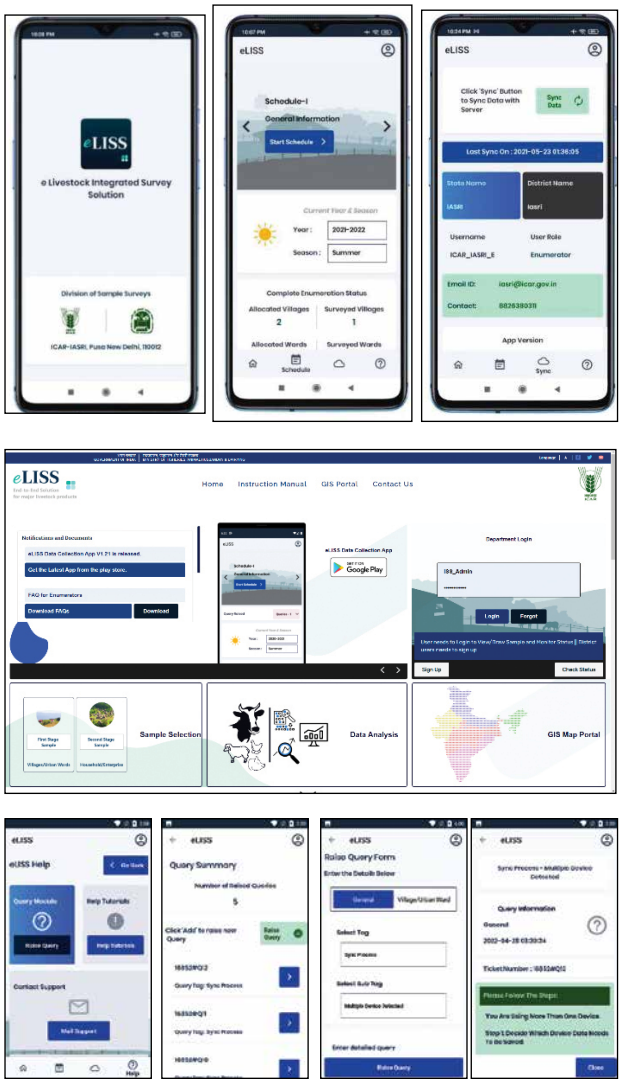
Weather Indices based Automated Yield Forecasting System (WIAYFS) has been developed. Stepwise regression model based on weather variables along with other models such as ARIMAX, LASSO regression, Bayesian regression model and Random Forest technique have been implemented in this application and is available at http://wiayfs.icar.gov.in/wiayfs

Programme 3: DEVELOPMENT OF TECHNIQUES FOR PLANNING AND EXECUTION OF SURVEYS AND ANALYSIS OF DATA INCLUDING ECONOMIC PROBLEMS OF CURRENT INTEREST

"eLISS Web Portal" and "eLISS Data Collection App" for Integrated Sample Survey Solutions of Major Livestock Products:

An android-based application-*eLISS* data collection app has been developed and is available on google play store to capture data from the field, which was collected manually using paper-based schedules by the enumerators to provide an end to end solutions for estimating number of animals and production for four major livestock commodities, viz. Milk, Meat, Egg and Wool. All the eight schedules of *Integrated Sample Survey* (*ISS*) scheme have been captured by the app. This data collection app also selects second stage sample of households/enterprises in the selected villages/urban wards. The data captured through this app is synced to server. The collected data is verified at higher level, which can be viewed by the States/UTs. After verification, this data is used to estimate the number of animals and production of Milk, Meat, Egg and Wool at District/State/UT/National level using the developed web portal running live on *https://iss.icar.gov.in.*

The major features of the app are that it records the location at which data is collected which provides real time monitoring and offline data collection. Using *eLISS* app, during the period under report, around 70 lakh households/enterprises have been surveyed in 47,000 villages/urban wards and data from more than 33,000 commercial poultry farms has been captured, around 752 slaughter-houses have been surveyed. More than 22,000 enumerators, 7,500 supervisors, 730 District Nodal Officers (DNOs) and 36 State officials are actively involved in collecting data using *eLISS app* in all districts of the country. The *eLISS* web portal and *eLISS* data collection app are now operational in all the states/UTs of the country for the data collection and estimation for the year 2021-22.



eLISS Web Portal" and "eLISS Data Collection App

An Alternative Sampling Methodology for Estimation of Area and Production of Horticultural Crops

An alternative sampling methodology for estimation of area and production of horticultural crops developed under CHAMAN project has been accepted by Ministry of Agriculture & Farmers Welfare, Govt. of India for adoption in all the states of the country. Department of Horticulture, Haryana State Government has been generating estimates of area and production of horticultural crops using this methodology since 2019-20 onwards under the Technical Guidance of ICAR-IASRI.

Sampling Design for Collection of Data for ICAR-AICRP on EAAI

The sampling design for collection of data for ICAR-AICRP on Energy for Agriculture and Agro-based Industries (EAAI) has been standardized. A non-parametric data envelopment analysis (DEA) technique has been applied to distinguish efficient and non-efficient farmers in the study area.

Development of Novel Estimator of Finite Population Proportion for Geo-Referenced Binary Survey Data.

A new estimator for finite population proportion has been developed for geo-referenced binary survey data. Variance and estimate of variance of the proposed Spatial Logistic Generalised Regression Estimator (SLGREG) estimator of population proportion has been developed using Taylor linearization technique. The parameter estimation of super-population spatial logistic model is done using modified pseudo maximum likelihood estimation (PML) method under Geographical Weighted Regression (GWR) framework and Newton Raphson numerical search algorithm has been developed for estimation of the GWR logistic parameters.

Variance Estimation of Level-0 Ranked Set Sampling under Finite Population Framework

Ranked Set Sampling (RSS) is used for circumstances where any preliminary ranking of sampled units is possible for variable of interest using visual inspection or some other means without physically measuring the units. Further, the RSS has been classified into three sampling protocols named as Level-0, Level-1 and Level-2. The procedure of obtaining unbiased estimate of the variance of Level-0 RSS estimator of finite population mean has been developed using two distinct rescaling bootstrap with replacement methods known as Strata-based rescaling bootstrap with-replacement (SRBWR) method and Cluster-based rescaling bootstrap with-replacement (CRBWR). Rescaling factors are obtained for both the proposed methods to estimate the variance of the Level-0 RSS estimator unbiasedly. The results of the simulation analysis, together with real data application support that proposed methods are capable of estimating the variance of the Level-0 RSS estimator almost unbiasedly. The developed SRBWR method performs better than the CRBWR method considering relative stability (RS) and percentage relative nias (%RB) for various combinations of set size (m) and several cycles (r).

Sample Survey Design for Assessment of Adoption of Renewable Energy Systems

Renewable energy technologies are promoted in many parts of the world for various agriculture applications for mitigating CO_2 emissions associated with fossil fuels. Tea (*Camellia sinensis*) is the most manufactured beverage consumed in the world and global tea market has been valued at 15 billion dollars. India ranks second (after China) among the tea producing countries across the World. A pilot study was conducted in the north eastern states of India, which is major tea growing region of the country, to explore the use of non-renewable sources of energy and amount of CO_2 emission from the conventional energy sources as well as the feasibility of renewable energy system in tea estates. Response from nearly 26 tea factories and 24 tea gardens were received after collection of data. The survey design used was stratified uni-stage sampling design and estimates were produced using the proposed sampling design. It has been observed that there is huge scope for adoption of renewable energy systems i.e. solar energy in tea estates of the north eastern region which will be beneficial both for the tea estates as well as the environment as a step towards SDG 7.2.

Agricultural Research Data Book 2022

Agricultural Research Data Book (ARDB) 2022 was released on 02 July, 2022 on the eve of Institute's Annual Day Function. This ARDB 2022 is twenty fifth edition in the series. It is divided into 10 sections for the purpose of convenience of the users. It provides information on natural resources, agricultural inputs, animal husbandry, dairying, fisheries, horticulture, production, productivity, agricultural engineering, export, import, place of India in world agriculture, investment in agricultural research and human resources. It has 178 tables on different aspects of agriculture. The ARDB 2022 contains the latest information/data as available by the end of June 2022 in the country. The first edition of the ARDB was published in 1996 consisting of the information up to the end of 1995. Subsequently, an updated version of ARDB is being brought out every year regularly. The ARDB 2022 has some value additions like predicting the future year production of foodgrains, pictorial/ graphical representations of data, depicting state-wise data and thematic maps using Geographical Information System (GIS). This issue of the publication has been enriched with latest available information on emerging areas in agriculture sectors. The ARDB 2022 is available

e-Databook format for Agricultural Research Data Book

in both Hardcopy and e-Databook format. The e-Databook can be accessed from the following URL. http://apps.iasri.res.in/agridata/22data/HOME.HTML

Programme 4: MODELING AND SIMULATION TECHNIQUES IN BIOLOGICAL SYSTEMS

Machine-Learning Computational Model for Identifying Proteins Associated with Multiple Abiotic Stress in Plants

Developed an AI-based computational model for identifying genes responsive to six abiotic stresses viz. cold, drought, heat, light, oxidative, and salt. The predictions were performed using support vector machine (SVM), random forest (RF), adaptive boosting (ADB), and extreme gradient boosting (XGB), where the autocross covariance (ACC) and *K*-mer compositional features were used as input. The SVM achieved higher accuracy of ~60–77, ~75–86, and ~61–78% using ACC, *K*-mer, and ACC + *K*-mer compositional features, respectively.

Abiotic Stress-Responsive miRNA Prediction in Plants using Machine Learning Algorithms with Pseudo K-Tuple Nucleotide Compositional Features

Developed an AI-based computational method for prediction of miRNAs and Pre-miRNA associated with abiotic stresses. The pseudo *K*-tuple nucleotide compositional features were used as input for prediction using support vector machine (SVM). The area under receiver operating characteristics curve (auROC) of 70.21, 69.71, 77.94 and area under precision-recall curve (auPRC) of 69.96, 65.64, 77.32 percentages were obtained for miRNA, Pre-miRNA, and Pre-miRNA + miRNA datasets, respectively.

Computational Tool for Prediction of GIGANTEA Proteins using Machine Learning Algorithm

Developed an AI-based computational model for fast and accurate prediction of GIGANTEA (GI) proteins. Ten different supervised learning algorithms viz., support vector machine (SVM), random forest (RF), k-nearest neighbour (KNN), lazy Bayesian rule (LBR), propositional rule learner RIPPER (JRIP), partial decision tree algorithm (PART), C4.5 decision trees, logistic model trees (LMT), Bagging (BAG) and LogitBoost (LGB) were employed for prediction, where the amino acid composition (AAC), FASGAI features and physico-chemical (PHYC) properties were used as numerical inputs for the learning algorithms. Higher accuracies i.e., 96.75% of area under receiver operating characteristics curve and 86.7% of area under precision recall curve were observed for SVM coupled with AAC + PHYC feature combination.

Improved Identification of Splice sites incorporating Secondary Structure Features

Developed a Machine learning based prediction algorithm through which the splice site prediction accuracy can be improved in plant species by incorporating the secondary structures of the nucleotide sequence. For this, the support vector machine (SVM) has been employed for splice site recognition in *Arabidopsis thaliana,* which is a model plant species. The prediction accuracies were also evaluated with other machine learning methods such as LogitBoost, Random Forest (RF), AdaBoost and XGBoost. The prediction accuracies of SVM, AdaBoost and XGBoost were observed to be at par and higher than that of RF and LogitBoost algorithms. All the computer programming codes written in R are available at https://github.com/meher861982/SSFeature

Machine Learning Approach to Pofile miRNAs using only RNA-seq Data (miRbiom)

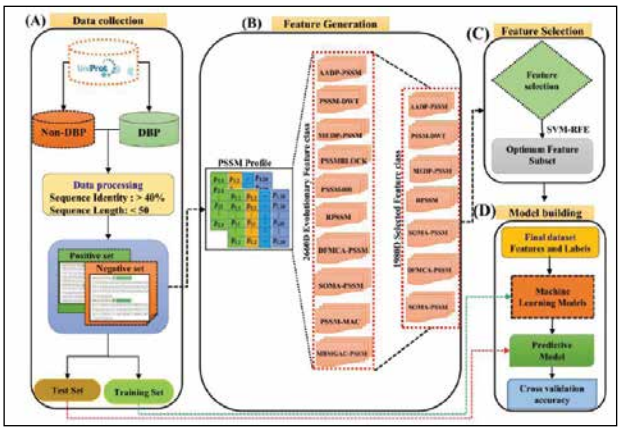
Formation of mature miRNAs and their expression is a highly controlled process. It is very much dependent upon the post-transcriptional regulatory events. Deciphering of conditional networks for these RBP-miRNA interactions may help to reason the spatio-temporal nature of miRNAs which can also be used to predict miRNA profiles. The miRNA profile prediction system has been implemented as a webserver available at https://scbb.ihbt.res.in/miRbiom-webserver/. Also the standalone version available at Github (https://github.com/SCBB-LAB/miRbiom).

Identification of Cis- and Trans-Expression Quantitative Trait Loci using Bayesian Framework

Finding the cis- and trans- eQTLs that capture significant changes in the expression of distant genes is a critical component of genomics. The identification of eQTLs has helped us better understand gene regulation and complex trait analysis. An integrated hierarchical Bayesian approach was developed to identify the cis- and trans-eQTLS. Variations inside or near the gene are hypothesized to determine the genetic variances that reflect transcript levels. The present study has been validated using two different datasets (barley and mouse).

P/DBPred: A Novel Computational Model for Discovery of DNA Binding Proteins in Plants

Developed a comprehensive computational model for plant specific DNA Binding Proteins (DBPs) identification. Five shallow learning and six deep learning models were initially used for prediction, where shallow learning methods outperformed deep learning algorithms. In particular, support vector machine achieved highest repeated 5-fold cross-validation accuracy of 94.0% area under receiver operating characteristic curve (AUC-ROC) and 93.5% area under precision recall curve (AUC-PR). With an independent dataset, the developed approach secured 93.8% AUC-ROC and 94.6% AUC-PR. While compared with the state-of-art existing tools by using an independent dataset, the proposed model achieved much higher accuracy. Overall results suggest that the developed computational model is more efficient and reliable as compared to the existing models for the prediction of DBPs in plants. For the convenience of the majority of experimental scientists, the developed prediction server P/DBPred is publicly accessible at https://iasri-sg.icar.gov.in/pldbpred/.



Brief Outline of different steps followed to developed P/DBPred

Hydrothermal Time Model of *Pine Radiata* Seed Germination

Hydrothermal time model for *pine radiata* seed germination has been developed. The parameters of base seed water potential like stress tolerance and uniformity of germination has been used to quantify the proportion of non-dormant seeds. To this end, a generalized linear model has been considered to transform the proportion of germinated seeds using logit, probit and complementary log-log function for tolerance distribution being logistic, Gaussian and extreme valued. The temperatures considered are 12.5, 15, 17.5, 20, 22.5,25, 27.5, 32.5^{c}, which has been used upon proportion of seeds germinated under five or four water potentials. It has been found that germination occurs under less stress with high water potential under lower temperatures while germination can occur under more stress with higher temperature. R code has been written using the *Nlcoptim* function to estimate optimum base temperature for developing thermal time models of seed germination of early, mid, late and very late genotypes of with four varieties in each genotype.

Dietary Alterations in Shrimp for Abiotic Stresses Using Nutrigenomics Approach

Various abiotic and biotic stresses affect growth and development of culture animals. Among abiotic stresses, pond salinity and temperature are reported to be vital. Variations in aquaculture pond water salinity and temperatures cause stress to the animal and that stress in many cases would manifest in to disease. The molecular responses due to acute salinity and temperature stresses in *P. indicus* through RNAseq approach have been investigated.

For salinity experiment, acute salinity stress was induced by shifting the animals from control water salinities of 30 ppt to low and high adjusted water salinity tanks of 5 ppt and 45 ppt respectively. Similarly, in temperature experiment, shrimp were shifted from control temperature of 27^{o}C to low temperature tank and high temperature tanks with adjusted water temperatures of 22^{o}C and 32^{o}C, respectively. Animals were directly shifted to experimental tanks from the control tank without gradual acclimatization to experimental temperatures and salinities. No mortalities were observed during the experiment. After 3 hours of creating acute stress in both experiments hepatopancreas tissue samples were collected and RNA-seq data was generated. Differential gene expression analysis revealed a total of 793 and 910 genes to be differentially expressed in salinity and temperature experiments respectively. Clustering of differentially expressed genes resulted four clusters among upregulated salinity stress conditions. Carbohydrate & amino acid metabolism, cuticle protein, lipid metabolism and cellular processes were represented by cluster one, two, three and four respectively. While, signaling pathway and purine metabolism cluster was significant in temperature experiment. Enriched KEGG pathways for low salinity include glycine serine and threonine metabolism represented upregulation of lipid metabolism. And in high salinity, stress response metabolisms like metabolism of xenobiotics by cytochrome P450, histidine metabolism, cysteine and methionine metabolism were found to be upregulated. The functional annotation of temperature stress revealed pathway associations of lipid metabolism, stress response and regulatory processes.

Mainstreaming Sesame Germplasm for Productivity Enhancement and Sustainability through Genomics Assisted Core Development and Trait Discovery

Manually curated general information such as taxonomy, vernacular names, production statistics, diversity and general information are incorporated in the portal. SNP mining has been performed for different abiotic and biotic stresses data available in public domain. Also development a web portal on sesame project for collection and uploading of the project data is in progress. Sesame Wikipedia contains information including species, varieties, wild cultivar, package of practice, variety selection, weather requirement, soil requirement, soil preparation, seed treatment, sowing, intercropping, cropping sequences, irrigation manure & fertilizer, weed management, pest management, disease management, nutrition deficiency, harvesting, post harvesting etc. (URL: http://backlin.cabgrid.res.in/sesame)

Database for Sesame Germplasm information

Development of an Integrated Framework for the Analysis of Biogeochemical Cycles from Metagenomic Data

Impacts of category diversity, k-mer size, and category-wise frequencies of ITS sequences on fungal ITS sequence classification by CNN have been assessed based on various performance metrics. It is found that CNN architecture with 2 convolution layers of kernel size 3 and filter numbers 32 and 64 in first and second layer respectively is the best classifier for fungi barcode sequences while using hexanucleotide features. CNN_FunBar is also found to be the most efficient taxonomy classification method among all existing machine learning algorithms and software.

Methodology for Optimum Number of Clusters for Binning of Metagenomics Data

Developed a novel method, *MetaConClust*, using coverage information for grouping of contigs and automatically finding the optimal number of clusters for binning of metagenomics data using a consensus-based clustering approach. Performance of *MetaConClust* is compared with recent methods and tools using benchmarked low complexity simulated and real metagenomic datasets and is found better for unsupervised and comparable for hybrid methods.

Best Linear Unbiased Prediction and Bayesian Methods for Genomic Prediction

Evaluated the performances of various BLUP and Bayesian methods for genomic prediction by using real and simulated datasets. The Bayesian alphabets performed better for the traits governed by a few genes/QTLs with relatively larger effects. On the contrary, the BLUP alphabets exhibited higher genomic prediction accuracy for the traits controlled by several small-effect QTLs. The genomic prediction accuracy increased with an increase in trait heritability, irrespective of the sample size, marker density, and the QTL type (major/minor effect).

Epsilon Toxin based Novel Vaccine against Enterotoxaemia in Goats

Epsilon toxin (ETX) causes enterotoxaemia (ET), a highly lethal disease with major impacts on the farming of domestic ruminants, particularly sheep and goat is caused by *Clostridium perfringens* type B and D strains. The binding of ETX to the host cell receptor is an important event that initiates the cellular pathogenesis, which is poorly understood. Hence, in this study, we employed a comparative modeling approach to define the structural features of Myelin and lymphocytic (MAL) protein' of goat. We induced mutations of aromatic amino acid residues of ETX with aliphatic residues at domains I and II. We performed protein-protein interactions (PPI) between ETX (wild)-MAL, ETX (mutated)-MAL protein and predicted the domain sites of ETX structure. Subsequently the binding efficiency between 'ETX (wild)-MAL protein' and 'ETX (mutated)-MAL protein complex' interactions were compared and shown that the former having stronger interactions and binding efficiency due to higher stability of the complex than the latter. The MD analysis showed destabilization and higher fluctuations in the PPI of mutated heterodimeric ETX-MAL complex which is otherwise essential for its functional conformation. The findings from this study could definitely provide the impetus in designing novel vaccine for Enterotoxaemia in goats.

Biocomputational Assessment of Natural Compounds as Potent Inhibitor to Quorum Sensors in *Ralstonia Solanacearum*

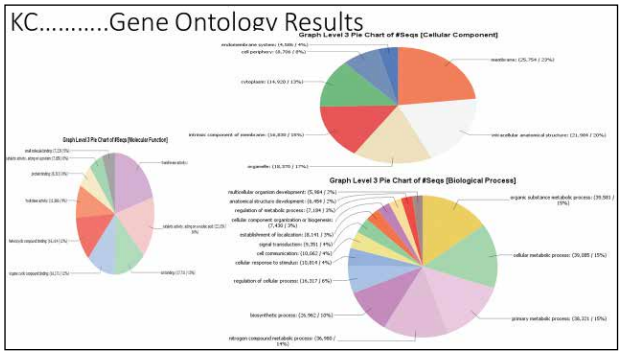
Ralstonia solanacearum is among the most damaging bacterial phytopathogens with a wide number of hosts and a broad geographic distribution worldwide. The pathway of phenotype conversion (Phc) is operated by quorum-sensing signals and modulated through the (R)-methyl 3-hydroxypalmitate (3-OH PAME) in *R. solanacearum*. However, the molecular structures of the Phc pathway components are not yet established, and the structural consequences of 3-OH PAME on quorum sensing are not well studied. 3D structures of quorum-sensing proteins of the Phc pathway (PhcA and PhcR) were computationally modeled, followed by the virtual screening of the natural compounds library against the predicted active site residues of PhcA and PhcR proteins that could be employed in limiting signaling through 3-OH PAME. Two of the best scoring common ligands ZINC000014762512 and ZINC000011865192 for PhcA and PhcR were further analyzed utilizing orbital energies such as HOMO and LUMO, followed by molecular dynamics simulations of the complexes to determine the ligands binding stability. The findings indicate that ZINC000014762512 and ZINC000011865192 may be capable of inhibiting both PhcA and PhcR. We believe that, after further validation, these compounds may have the potential to disrupt bacterial quorum sensing and thus control this devastating phytopathogenic bacterial pathogen.

In-Silico and *In-Vitro* Investigation of STAT3-PIM1 Heterodimeric Complex: Its Mechanism and Inhibition by Curcumin for Cancer Therapeutics

The functional activity among STAT3 and PIM1, are key signalling events for cancer cell function. Curcumin, a diarylheptanoid isolated from turmeric, effectively inhibits STAT3 signaling. Selectively, interactions of STAT3, PIM1 and Curcumin for therapeutic intervention have been studied using *in-silico* and *in vitro* experimental approaches. Firstly, protein-protein interactions (PPI) between STAT3-PIM1 by molecular docking and secondly, molecular dynamics simulations of heterodimeric STAT3-PIM1 complex with curcumin revealed binding of curcumin on PIM-1 interface of the complex. These PPIs have been confirmed *in vitro* by immunoprecipitation assays in MDA-MB-231 cells. It has been observed that PIM1 interacts with STAT3 and these functional interactions are disrupted by curcumin. The present study revealed the role of curcumin in STAT3/PIM1 signaling and its binding affinity to the complex for design of advanced cancer therapeutics.

Assessing Genetic Variability in Duck of Eastern States

Assembly and annotation of four different duck species i.e., White Pekin, Khaki Campbell, Chhattisgarhi and Maithili received from ICAR-RCER, Patna was carried out. All these sequences were proceeded for assembly after QC check and trimming. Both approaches for assembly, i.e. reference based and *de novo* was used. For reference based assembly, *Anas platyrhynchos* (mallard) ZJU1.0 was taken as reference and assembly was performed using soap2. *De novo* assembly was done using soapdenovo. After assembly, quality of assembly was assessed using QUAST. Assembly was further proceeded for gene prediction using glimmer. Gene ontology analysis has been done for all the predicted genes using BLAST2GO.



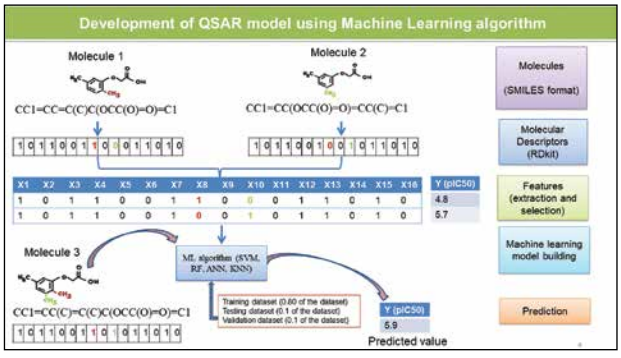
Gene ontology results for Khaki Campbell

Hybrid Approach for Imputing Missing Values in Proteomics Expression Data

A hybrid imputation approach for imputing missing values in proteomics expression data has been developed that can handle both types of missing values, i.e., missing at random (MAR) and missing not at random (MNAR). MAR specific methods such as k- Nearest Neighbors (KNN), Singular Value Decomposition (SVD), Bayesian Principal Component Analysis (BPCA) and Probabilistic Principal Component Analysis (PPCA) can be applied after identification of missing values due to MAR. For remaining missing values (due to MNAR), a novel imputation approach was developed using Gibbs sampling combined with advanced penalized regression techniques such as LASSO, elastic net, and ridge regression. The performance of proposed approach was compared with the existing approaches and found that performance of proposed method was at par or better than the existing approaches.

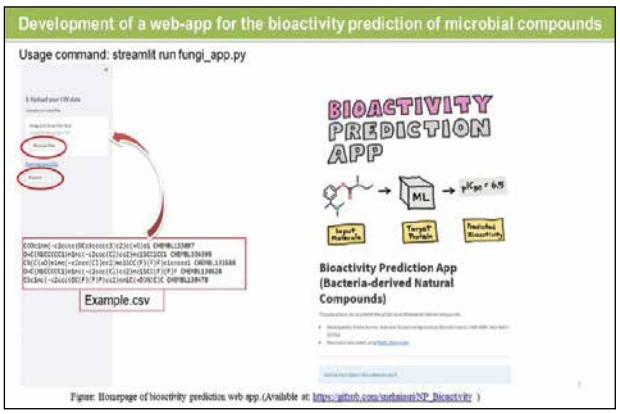
Artificial Intelligence-based Model for the Prediction of Bioactivity of Microbial-Derived Natural Products

Microbes synthesize a plethora of natural products which have wide and diverse applications in agriculture. However, due to its huge diversity and hardship in systematic purification, this resource is not yet comprehensively explored. Advance computational techniques such as artificial intelligence can be leveraged to expedite the exploration of microbe-derived natural compounds and their bioactivity. A quantitative structure-activity relationship (QSAR) model has been developed for predicting the bioactivity of microbial natural compounds using machine learning algorithms. Compounds with bioactivity data on pIC50 were collected and compiled for three classes of microbes, viz. bacteria, fungi, and viruses. Three distinct models for each class of dataset were

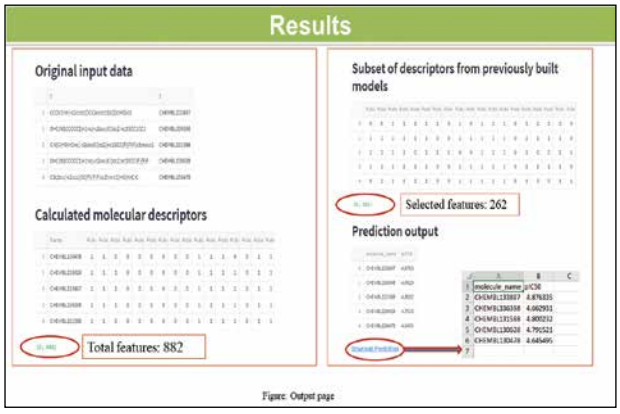


Workflow of the development of ML-based model for bioactivity prediction.

developed to predict the bioactivity of compounds. Results from various machine learning algorithms and different data split suggested that random forest was the best performing model in all the three aforementioned categories. The correlation coefficient ranged from 0.77 to 0.83, indicating the structure-activity relation was captured well. Based on the final model, a streamlit web application was developed. The user will have to provide the input file in .csv format containing the molecule name and its SMILES notation. As an output, user will be provided with the pIC50 value for each of the compounds in downloadable format.



Homepage of bioactivity prediction web app.



Output page of the bioactivity prediction web app

AcrCasPPI: Prediction of Protein–Protein Interactions between Anti-CRISPR and CRISPR-Cas using Machine Learning Technique

CRISPR-Cas system, responsible for bacterial adaptive immune response, has evolved as the game-changer in the field of genome editing and has revolutionized both animal and plant research owing to its efficiency and feasibility. CRSIPR-associated (Cas) protein, an integral component of the CRSIPR-Cas toolkit, cut the target genetic material for making the desirable edits. However, unchecked nuclease activity of Cas protein may lead to unforeseen off-target effects. Anti-CRISPR (Acr), small proteins usually found in phages and other mobile genetic elements, are the natural inhibitors of the Cas proteins that help phages to escape the immune system of the host. Acr proteins regulate the activity of the Cas nuclease by interacting with its different domains which results in the blockage of CRISPR activity. Thus, it is essential to understand the interactions between these two rival proteins in order to switch off the cutting machinery when needed.

The Institute has introduced the first machine learning-based predictive model to identify novel interactions between Acr and Cas proteins using an ensemble strategy. The proposed ensemble-RF model achieved a 97% of fivefold cross validation accuracy indicating its high predictive power. The developed predictor outperformed the existing tools in all the performance evaluation criteria using an independent dataset. Due to its encouraging results, to extend the support for diverse levels of end-users, a web application named AcrCasPPI was developed which is available at http://login1.cabgrid.res.in:5020/. Alternatively, a python package named acrcasppi-ml, is also available at https://pypi.org/project/acrcasppi-ml/.

Analysis of scRNA-seq

Described a step-by-step workflow for processing and analysing the scRNA-seq (single cell sequencing) unique molecular identifier (UMI) data jointly with the University of Louisville, USA. Through the statistical analysis, it has been shown that the zero-inflation associated with UMI data had no or minimal role in clustering, while it had significant effect on identifying differentially expressed genes.

Informative Gene Selection

Developed a methodology for informative gene selection, which takes care of the spurious relation by implementing the bootstrap technique along with Support Vector Machine Recursive Feature Elimination (SVM-RFE) and Maximum Relevancy and Minimum Redundancy (MRMR). It has been found that the performance of the developed methodology is better as compared to other existing techniques and select less number of more informative genes.

Development of Database for Transcriptome of Bada Gokhuru (*Pedalium murex L.*)

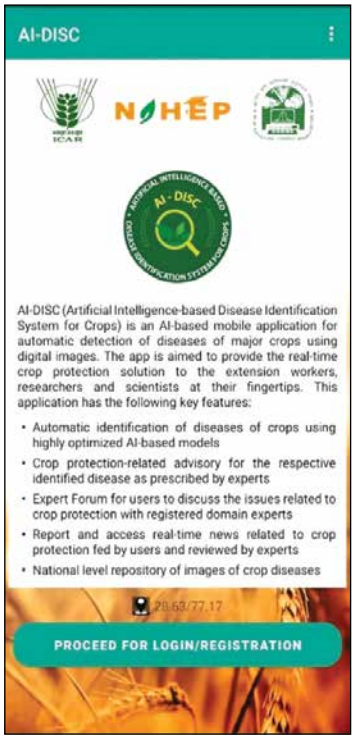
A database was developed for transcriptome data of Bada Gokhuru (*Pedalium murex L.*). *Pedalium murex* is one of the most valuable medicinal herbs, commonly known as “bada gokhuru” or “large calatrop” belonging to the *Pedaliaceae* family. Transcriptome data of *P. murex* was analyzed for identification of different transcripts and further microsatellite mining was done. A database was developed using LAMP approach. This database provides information about transcripts and different kinds of microsatellites (mono- to hexa-nucleotide and compound) repeats identified in this plant.

Database for transcriptome data of Bada Gokhuru (*Pedalium murex L.)*

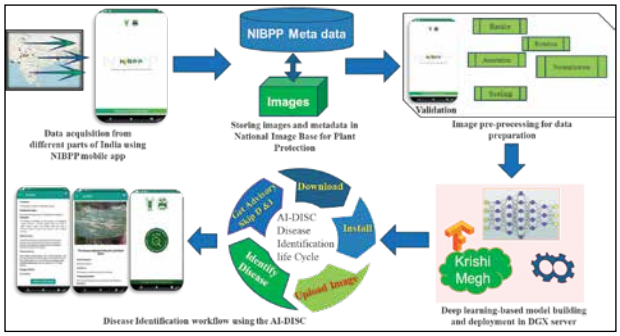
Programme 5: DEVELOPMENT OF INFORMATICS IN AGRICULTURAL RESEARCH

AI-DISC (Artificial Intelligence based Disease Identification System for Crops) Mobile App

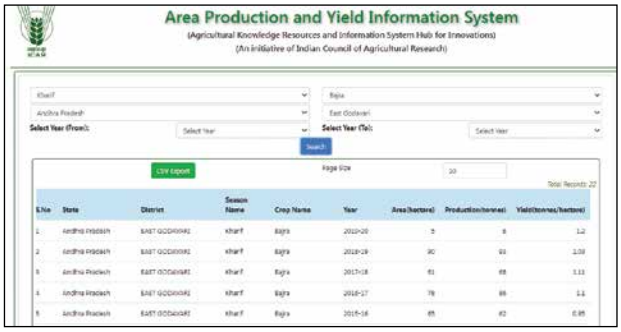
Developed an Artificial Intelligence (AI) based android mobile application system, called AI-DISC (Artificial Intelligence based Disease Identification for Crops available at https://play.google.com/store/apps/details?id=com.ai.ai_disc that can automatically identify plant diseases with visible symptoms. This is one of the premier AI applications of its kind in ICAR. Sophisticated deep learning techniques have been used for detection of the diseases with a simple, user-friendly interface. User has to install the mobile app, capture the disease image in natural background and click to identify and get the remedy advisory of the diseases. Presently the application is capable of identifying 50 diseases in 19 major crops. It also provides remedies along with the identified disease. Following is the list crops and diseases covered in AI-DISC.



- **Rice:** Bacterial Leaf Blight, Brown Spot, False Smut, Blast, Narrow Brown Leaf Spot, Tungro and Sheath Rot, Sheath Blight
- **Wheat:** Brown Rust, Black Rust, Yellow Rust
- **Maize:** Maydis Leaf Blight, Tucicum Leaf Blight, Common Rust, Brown Stripe, Downy Mildew, Curvularia Leaf Spot, Sorghum Downy Mildew, Banded Leaf & Sheath Blight
- **Greengram:** Powdery Mildew, Yellow Mosaic
- **Cluster Bean:** Bacterial Blight, Powdery Mildew
- **Mothbean:** Crinkle Virus, Yellow Vein Mosaic
- **Chickpea:** Collar Rot, Wilt and Root Rot
- **Mustard:** Downy Mildew, Powdery Mildew, White Rust
- **Cotton:** Bacterial Blight, Cotton Leaf Curl Virus, Wilt
- **Cucurbits:** Alternaria Leaf Spot
- **Tomato:** Early Blight, Late Blight, Leaf Curl and Target Leaf Spot
- **Coriander:** Powdery Mildew, Stem Gall
- **Brinjal:** Early Blight, Phomopsis Leaf Blight, Little Leaf and Phomopsis Leaf Blight
- **Chilli**: Anthracnose, Leaf Curl Virus
- **Apple:** Alternaria Leaf Blotch, Apple Mosaic Virus, Apple Scab, Marssonina Leaf Blotch
- **Peach:** Leaf Curl, Shot Hole
- **Kinnow:** Citrus canker, Fruit Rot, Greening
- **Assam Lemon:** Citrus Greening, Citrus Tristeza Virus
- **Mandarin:** Dieback, Sooty Mold



Disease identification workflow using the AI-DISC



Area Production and Yield Information System

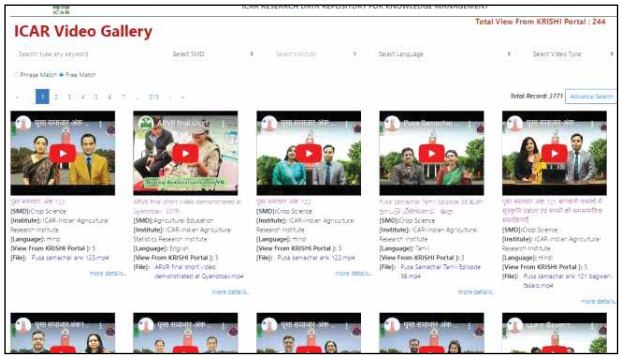
ICAR Research Data Repository for Knowledge Management

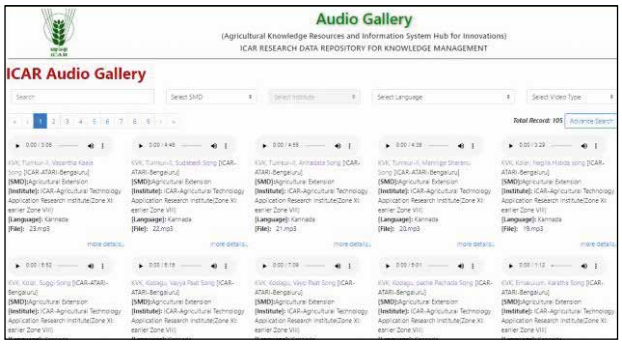
- **Strengthening and Maintenance of KRISHI Portal:** KRISHI Portal has been enriched through providing links of several online resources available/developed at different ICAR institutes. Added exact phrase match and free match search in Mobile App and Video Gallery. Individual user, Institute profile and infographics dashboard have been strengthened.
  - **User/Institute Profile:** ICAR User Profile has been enriched by adding NAAS Score of Journal in research papers. Also strengthened the interface of Institute's Profile by adding Publications, Technologies developed, Varieties developed, IPRs (copyright, patent, trademark, design), Varieties registered, Video, Audio, Mobile App, Images information submitted by the Institute along with Institute address, Web address, Social Media Address. Based on NAAS Score, following reports can be generated in User and Institute profile (i) Total NAAS Score and (ii) Year-wise total NAAS scores of the Institute, (iii) Institutes NAAS Rating by year (Maximum 10 Years can be selected for search) and (iv) Institute NAAS Rating by year.
  - **Dashboard**: Strengthened dashboard by adding Trademark and IPR Design database applications, Application of Area Production and Yield Information System.
- **Area Production and Yield Information System:** Website of Area Production and Yield Information System has been developed with https://krishi.icar.gov.in/dacnet/ with the facility of selection based search (like season, crop, state district) and separated specific search pages which contain filters like season, crop, state, district and from-to year. These filters work individually and in combination as per users requirement.
- **ICAR Image Gallery:** Workflow based application for ICAR Image Gallery 2.0 has been developed in spring boot CAS enabled system and deployed on server. Officer Incharge, Data Management can upload single/multiple images with delete and set thumbnail options for one image per event. The records can be filtered on the basis of SMD, Organization and keyword. Search can also be made, based on Keyword, date of event and description of image.

ICAR Image Gallery

- **Mobile APP Gallary:** Mobile Apps Gallery Application has enriched by adding dynamic sidebar menu and "Download Details from Google Play Store" in Mobile Apps Gallery Application. The report of Mobiles apps has been strengthened by adding fields on SMD, Institute within SMD, Enable Status etc. At present links of **369** Mobile Apps (355 reported (ICAR: 269; SAU/CAU: 40; KVK: 29 and Other Govt. Agencies: 30) are available for single window access. The 337 Mobile App files were also uploaded for archiving. At present 124 of mobile apps have 1000+ downloads. Out of these 124, 02 app have 50,000+downloads, Now, 22 have 10,000+ downloads, 19 have 5,000+ downloads and 81 have 1000+ downloads.
- **Video and Audio Gallery:** The reports showing the number of views, number of likes, number of subscribers, YouTube Channel name and uploaded date on YouTube for particular video

have been developed having the filter search based on SMD and Institute. Links of **3771** video**s** (2715 reported earlier) and 105 audio (80 reported earlier) available on gallery. The video files for **3640** videos (2670 reported earlier) were also uploaded for archiving.



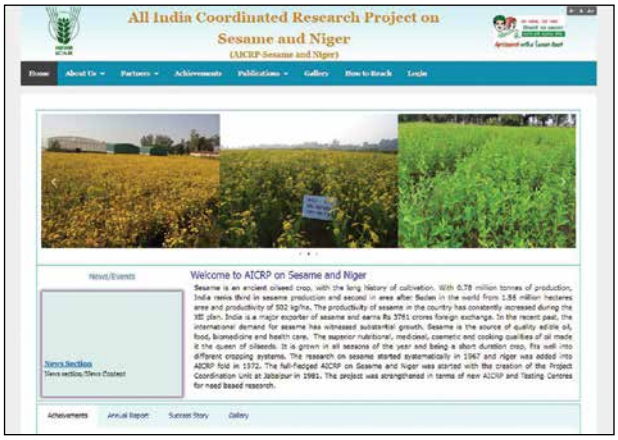


ICAR Video and Audio Gallery

- **Technology Repository:** At present **1980** technologies (1790 reported earlier) from 80 Institutes are available in public domain. ICAR Technology Mobile App now has 10000+ downloads.
- **Interportal Harvester:** In order to bring agricultural research publications collected by various organizations within and as well as outside of ICAR Meta Data has been harvested from Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) protocol enabled web applications. Unified search is ready for **37** repositories for **6,46,370** (**6,07,997** reported earlier**)** records at https://krishi.icar.gov.in/iph/.

Unit Level Data Repository

(a) CMS based Websites of AICRPs: Developed websites for following 02 new AICRPs with uniform formatting and contents using Content Management System and different level user authentications: (i) AICRP on Linseed: launched by Dr. T.R. Sharma, DDG (Crop Sciences), ICAR in the Annual Group Meeting of Safflower and Linseed on 18.08.2021, (ii) AICRP on Sesame and Niger and (iii) AICRP on EAAI.

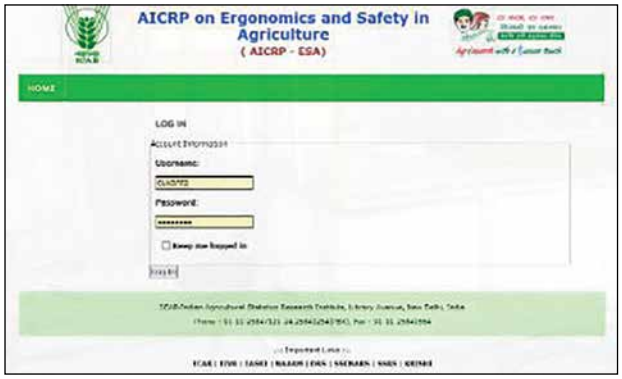


AICRP on Sesame and Niger

AICRP-EAAI

(b) Experimental Data Repository: Prototype information system for All-India Coordinated Research Projects to plan and design experiments, generate data, analyse and preparing report of AICRP experiments have been developed for

(i) AICRP on Sesame and Niger; (ii) AICRP on PEASEM (Plastic Engineering in Agriculture Structures & Environment Management); (iii) AICRP on Cotton; (iv) AICRP on Chickpea and (v) AICRP on ESA

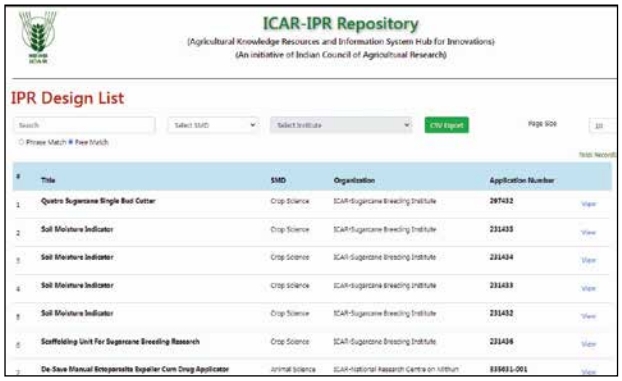


Information system for AICRPs

- **Publication and Data Inventory Repository:** Enriched through populating data by Nodal Officers and other researchers. **70720+** (64000+ reported earlier) publications and **1038** dataset (795 reported earlier) have been submitted from **110** Institutes. **2645** researchers (2529 reported earlier) other than Nodal officers have registered themselves as submitters. Since May 2017, there are more than **32,20,105** (18,15,000 reported earlier) downloads from this repository inclusive of those fetched through computer programmes by other sites. Added 2022 NAAS Journal scores also added name of 220 new Journal names not available in NAAS Journals list in the DSpace drop down list of publication repository.
- **ICAR Geo-Portal:** Strengthened Geo-portal by updated/uploaded daily layers of (i) All India crops residue burning points for the period are regularly being depicted on India map (by ICAR-IARI, New Delhi) since June 01, 2019 (latest depiction of points December 31, 2022). WMS layer of Agro-ecological region developed by ICAR-NBSSLUP, Nagpur has also been uploaded on ICAR Geo-Portal; (ii) Uploaded the layers of Farm Power availability (kw/ha) in Agriculture Engineering subheading Machinery & tools provided by ICAR-CIAE, Bikaner; (iii) Paddy Residue burning in states of Punjab, Haryana, UP, Delhi, Rajasthan and MP (latest depiction is of November 30, 2022); (iv) Satellite Crop Monitoring of (a) Vegetable Condition Index is uploaded by depicting on map till September 25, 2022; (b) Temperature Condition Index till September 20, 2022 and (c) Evaporative Stress Index till November 04, 2022
- **ICAR IPR Repository:** Two new workflow based applications developed on spring boot CAS enable system for Trademark (https://krishi.icar.gov.in/icaripdb/secureTrademarkForm/160)

and IPR Design (https://krishi.icar.gov.in/icaripdb/secureCBRdataForm/78.) obtained by ICAR Institutes. At present information on 122 trademarks from 30 Institutes and 58 IPR design from 10 ICAR Institutes is available in this repository. Export data through csv file facility of also available for both the applications.

ICAR IPR Repository (Trademark List)



ICAR IPR Repository(IPR Design List)

National Information System on Agricultural Education Network in India (NISAGENET-IV)

Following new modules have been developed and published in Education Portal:

- **Fellowship Module**: Fellowship Module has been made Live for "NetajiSubhas - ICAR International Fellowship". This fellowship support Indian/ Overseas nationals for pursuing doctoral degree in agriculture and allied sciences, in the identified priority areas, to the:
  - Indian candidates for study abroad in the identified overseas Universities/Institutions having strong research and teaching capabilities and,
  - Overseas candidates for study in the best Indian AUs in the ICAR-AUs system.

  Web forms have been designed for registration process, application process and approval process.

Agricultural Education Portal (Netaji Subhas - ICAR International Fellowship)

- **Student READY Module**: Student READY (Rural Entrepreneurship Awareness Development Yojana) programme is introduced as an integral part for one complete year in the last year of the degree programme for undergraduate education in various disciplines. This module comprises of web forms for:
  - Students to apply in programme and filling weekly & project reports
  - College and university nodal officers to approve student applications assign training & generate reports.
- **Grievance Redressal Mechanism** is a system to address and resolve complaints, disputes, or issues raised by individuals or groups. Its goal is to ensure fair and impartial resolution of grievances in a timely manner. The exact process and structure of the grievance redressal system is 15 days, but it is an important component of ensuring accountability and transparency.

Agricultural Education Portal (Grievance Redressal Mechanism)

- The **Agricultural University Ranking System (AURS)** has been strengthened with new reports and functionality. AURS system was opened for filling the data by different universities for the university ranking 2021 for third time. 67 universities participated in the ranking process.
- Following application programming interfaces (APIs) have been developed & deployed in Education Portal for fetching information from other portals.

- API to generate USID and UFID directly from the Academic Management System (AMS) or other application owned by university or college.
- API for fetching student related data from AMS like students admitted, gender-wise student intake, degree-wise student intake, category wise information etc.
- API for fetching faculty related information from AMS.
- API for course details from AMS or other applications operational in the university.

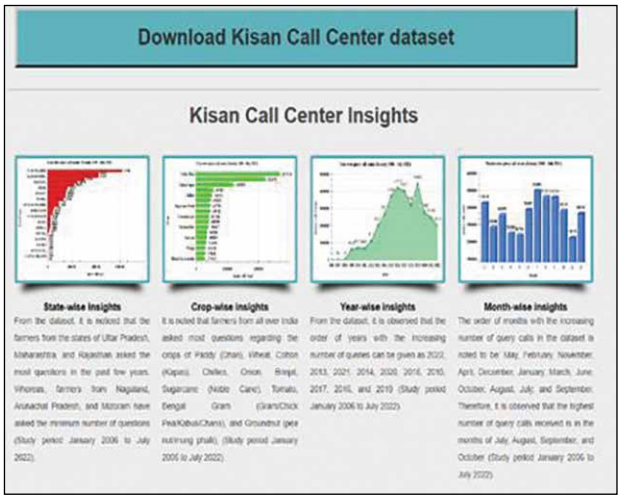
- New reports and forms have been designed and published in education portal:
  - Report for viewing Scheme-wise and Head-wise released fund
  - Release matrix forms
  - Report for TSP to view combined filled reports in ADG / Assistant level.
  - Forms and reports for getting faculty data discipline wise.
  - Forms to get TSP target and achievement data from the university nodal officer.
- Existing reports have been customised as per suggestions from Education division:
  - Fill unspent form
  - Included student count in the 'Student READY' sanction letter
  - Fill student detail (Intake, In roll, Pass out) forms and reports
  - Fill faculty details (Professor, Assistant Professor, Associate Processor) forms and reports

Cereal Systems Initiative for South Asia (CSISA) Integration with KVK Portal

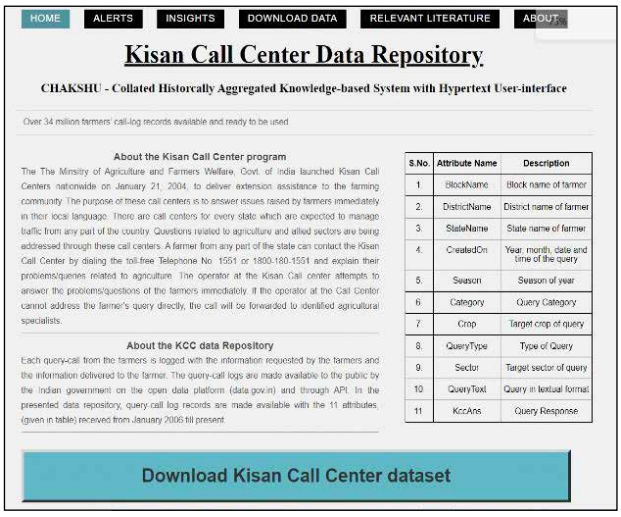
Data on Landscape Diagnostic Survey (LDS) have been captured through Open Data Kit (ODK) collect mobile app and pushed to ICAR Data Centre placed at IASRI after curation. With these data, a dynamic dashboard has been designed and developed for the data collected through LDS and hosted at https://kvk.icar.gov.in/CSISA.aspx. Multiple linear regression (MLR) model with stepwise selection technique has been applied to find out the factors determining the yield of rice and wheat in Bihar and Eastern Uttar Pradesh of India. Advanced machine learning methods viz. Support Vector Regression (SVR) and Random Forest (RF) have also been applied on these datasets for yield estimation. Based on statistical diagnostic measures, it has been found that RF outperformed SVR and MLR both in the case of rice and wheat.

KCC-CHAKSHU: Collated Historically Aggregated Knowledge-based System with Hypertext User-interface

The Ministry of Agriculture and Farmers Welfare, Govt. of India launched Kisan Call Center nationwide, to deliver extension assistance to the farming community. The purpose of these call centers is to answer issues raised by farmers immediately in their local language. There are call centers for every state which are expected to manage traffic from any part of the country. Questions related to agriculture and allied sectors are being addressed through these call centers. Each query-call from the farmers is logged with the information requested by the farmers and the information delivered to the farmer. The query-call logs are made available to the public by the Indian government on the open data platform (data.gov.in) and through API. Using this an online repository KKC-CHAKSHU (Kisan Call Centre-Collated Historically Aggregated Knowledge Based System using Hypertext User Interface



Kisan call center Insights



Kisan call center Data Repository

KCC- CHAKSHU Nation and Statewise Early Warning Alerts

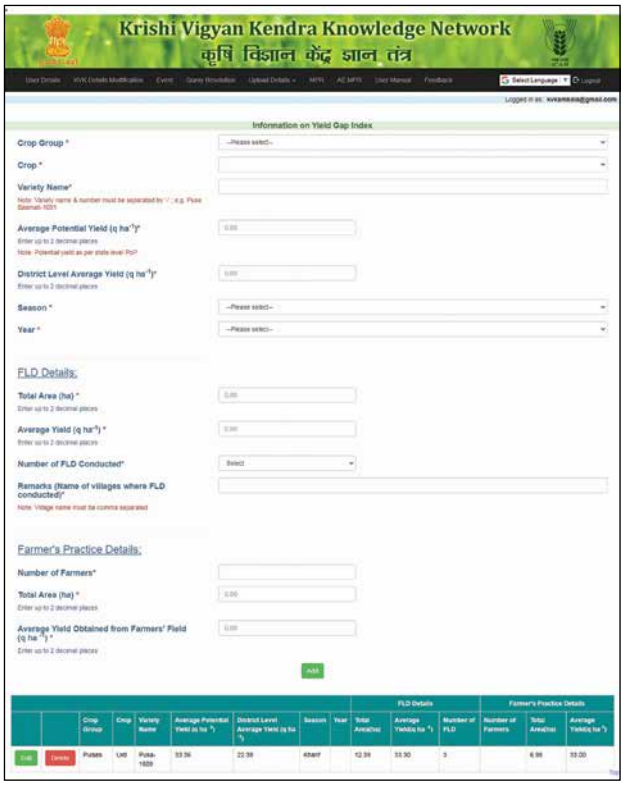
(*https://kcc-chakshu.icar.gov.in*) has been developed and launched on July 02, 2022 by Dr. G.P. Samanta, Chief Statistician of India and Secretary, Ministry of Statistics and Programme Implementation, Govt. of India. In the present data repository, 30 million+ query-call log records are made available with the 11 attributes such as the farmer's location (block, district and state), time of call (tear, month, date and time of call, season), the question asked by the farmer (query category, crop, type of query, target sector of query, query in text format) and, the solution provided by the Kisan Call Center operator, received from January 2006 till present.

The portal also gives access to nationwide and state-wise early warnings/alerts with query-count and query rate-based insights. The insights are helpful for timely planning for short-term extension activities, which can help reduce the yield gap due to delayed help to farmers.

Furthermore, various nationwide insights regarding the demand for help are also made available. For example, state-wise number of farmers' phone calls made by the Indian farmers are available. Similarly, crop-wise, year-wise, month-wise, sector-wise, category-wise, query type-wise, hour-wise, and many more insights are available through this platform. These insights can be helpful for other call centres and help policy-makers direct the national-level resources.

Knowledge Management System for Agriculture Extension Services in Indian NARES

- Functionality has been developed to add information on Yield Gap Index & to view state and district wise report for the same in the portal.



KVK Portal

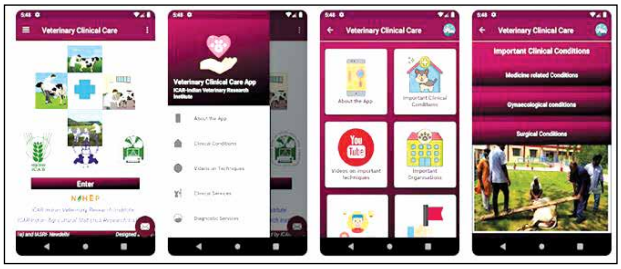
- Functionality have been developed to view the month wise MPR report for the particular year in the portal. The report is added under the MPR menu at the KVKs level. Information of new KVKs and event category have been added in the master database tables. Month wise KVK KPIs data is submitted in DARPAN dashboard for the following KPIs ‘Farmer Training’, ‘Mobile Agro Advisories’ and ‘Agriculture Extension Activities’. Jal Shakti Abhiyan(JSA) Phase II was initiated by Govt. Of India. KVK’s have organised training/awareness programs/events under JSA. Web API has been developed for sharing the data with NIC. District wise cumulative JSA data (from 29 April to 30 November 2022) in the JSON format was shared every week. A SQL job is created to automate the functionality to submit week wise 'Jal Shakti Abhiyan' 2022 data in the NIC Jal Shakti Portal. Functionality have been developed to view the monthly training report for the following training as 'Farmer and Farm Women', 'Skill Development' and 'School

Dropout Training'. The report is added at the agricultural extension division and admin level. Support has been provided for various issues related to data entry, login etc in the KVK portal.

Online Vet Clinic App and IVRI-Veterinary Clinical Care App

ICAR-IVRI in association with ICAR-IASRI developed an online Vet Clinic App which was released at ICAR-IVRI convocation on August 23, 2022. This app is an extension of referral veterinary clinic services offered at IVRI premises with the following features: (i) the animal owner with easy and hassle-free access to IVRI veterinary polyclinic services at any given point of time from the comfort of his/her home, (ii) direct access to consultancy/advice from the leading scientific experts in the fields of veterinary medicine, surgery, reproduction, pathology, parasitology, nutrition, breeding, and management, (iii) provision to the animal owner for sharing basic information like age, gender, and weight along with photos and videos of the animal(s) with the IVRI experts so as to enable accurate diagnosis of the condition and ensure effective prescription/remedies for the problem and (iv) multiple convenient communication channels to the animal owner for interaction with experts including voice calls, video calls, and chat which will install within animal owners a greater sense of belongingness. The mobile app is available at https://play.google.com/store/apps/details?id=net.iasri.ivri.animalscience.ovcca

Another mobile App developed namely IVRI-Veterinary Clinical Care App is targeted to impart knowledge and skills to graduating veterinarians & field veterinary officers about most frequent clinical conditions encountered in field conditions related to medicine (Mastitis, Bloat, TRP, Ketosis, Milk fever, Ruminal impaction & Calf diarrhoea), gynaecology (Pyometra, Anestrus, Repeat Breeding, Dystocia, RFM, Uterine torsion, Uterine prolapse, Cervico-vaginal prolapse & COD) & surgery (Urolithiasis, Caesarean Section, Hernia, Castration, Fracture & Wound). The App covers information about each of these conditions under the various subheads viz., About, Symptoms, Diagnosis, Treatment and Prevention & Control. Educational videos on important surgical procedures like Tube Cystostomy, External Skeletal Fixation etc have been included in the App for enhancing surgical skills in some advance surgeries.



IVRI-Veterinary Clinical Care App

Knowledge Management System for DUS Characteristics of Crops

A Web Based Knowledge Management System for DUS characteristics of crops (https://ppvfradus.icar.gov.in/HomePage.aspx) has been developed for implementation of functionalities followed in PPV&FRA and DUS Centers. Demonstration of the system was provided to the Registrar General, PPV&FRA. Meetings were conducted with the NIC team regarding data exchange through API and API's were exchanged with NIC.

Insect Detection Model for Maize

The insect detection model has been developed based on the concept of object detection techniques. First, images of the insects were curated and pre-processed for removing the noisy images. Next, images were annotated with rectangular bounding boxes using 'LabelImg' tool for localizing the insects within images. Here, around 4,954 images of three insects of maize viz. Fall Army worm (FAW), Spotted Stem Borer and Pink Stem borer were used for modelling. We developed an object detection model for the identification of Insects as well as their damage patterns of Maize crop. The developed model is based on the SOTA architecture of Yolov5s network. The average precision of 0.66 and mAP@0.5 of more than 0.50 on the test dataset was obtained. The following hyperparameters were used in this model development works such as: Image size of 512 x 512 pixels; yolo txt Annotation format; Batch size of 64 images; Epochs of 200 iterations and SGD Optimizer with learning rate of 0.0001.

Digital Initiatives for Agricultural Education

- **E-Learning:** The E-Learning Portal (https://education.icar.gov.in/eLearningHomePage.aspx) has been developed with an objective to strengthen the Agriculture Higher Education in India by developing and disseminating the e-courses for undergraduate and postgraduate agriculture courses. The portal allows agriculture higher education faculty to develop and revise digital learning content for undergraduate and postgraduate courses. In total 161 E-Courses have been created, enhanced and uploaded on Elearning Portal, out of which 56 are PG and 105 are UG E-Courses. 50 introductory videos have also been developed for the E-Courses.
- **AR/VR Module Development:** Virtual Reality (VR)/ Augmented Reality (AR) facilities have been established in 10 Agricultural Universities. 50 AR/VR kits, 1 MR Kit, and VR/AR/MR software licenses are set up. Following fourteen (14) Augmented Reality/Virtual Reality based teaching-learning Modules have been developed:

Table 3: List of Augmented Reality/Virtual Reality based teaching-learning Modules

S. No.	Name of the Module
1	Phenomics
2	Pusa-Farm Sun Fridge
3	Artificial Insemination
4	Fish Dissection and Anatomy
5	Paddy Straw Collector cum Chopper
6	Tractor Simulation
7	Uterine Torsion in Buffalo and Cattle
8	Protected Cultivation Technologies
9	Advanced Irrigation Methods and Technologies to Improve Water Use Efficiency
10	Nematology- Study of Nematodes
11	Histo-biochemical and Molecular Studies in Drought/Salinity Stress in Sugarcane during Various Growth Stages
12	Seed Life Cycle-Genesis, Science, Seed Parts, Germination
13	Assisted Reproductive Technologies (OPU-IVF and Cloning) in dairy animals.
14	Hydrophonics

AR/VR Lab at ICAR-IASRI

- **Agri-DIKSHA (AgriWeb Education Channel):** The Virtual Classroom facility is bundled with Agri-diksha web channel which is an interactive portal for facilitating teachers to develop and broadcast virtual learning modules. The lectures delivered in the virtual classrooms and other lectures delivered in workshops, training programmes etc. are recorded through the software VC system and stored in the Agri-diksha web channel. There are more than 2010 video lectures which have been recorded and stored in the repository. Various quick help videos have been developed for AMS and Agri-DIKSHA to guide users about the process.
- **Financial Management Software**: Financial Management Software (FMS) has been implemented in 2 agricultural universities namely RLBCAU Jhansi and BASU Patna. The system supports more than 200 users and has provisioning of MIS dashboards, Training of end-users at the selected universities and at ICAR-IASRI, and customization and enhancement of the functionality in the modules as per the requirements of the selected universities. ICAR – IASRI has successfully conducted the UAT and Go-Live of the FMS at aforementioned locations. The MoU has been signed by both the universities. FMS was launched at BASU, Patna on 16th March 2022. Facilitated multiple online and physical capacity-building training programs for process owners for the above-mentioned university
- **National Image Base for Plant Protection & National Image base for Livestock Diseases:** Two mobile applications namely "NIBPP (National Image Base for Plant Protection)" and "NIBLD (National Image base for Livestock Diseases) have been developed for collecting, validating, annotating, securely storing of images of plants and animal stresses respectively. Both the applications are hosted on Krishi Megh cloud

Launch events of Financial Management Software (FMS)

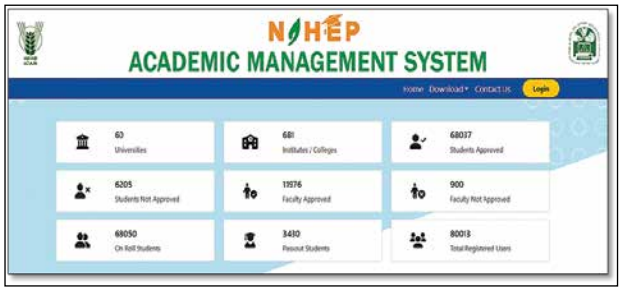
infrastructure. Around 3.77 lakhs images of 61 crops with 242 diseases and 277 pests have been collected from several ICAR institutes and State Agricultural Universities in the NIBPP mobile application. These images are being used for developing AI based models for disease identification. There are 37818 images of 27 diseases of 8 livestock that have been collected in the NIBLD application in collaboration with ICAR-IVRI, Izatnagar and other State Veterinary Universities.

- **Strengthening KRISHI MEGH:** Under NAHEP, various digital initiatives are established and planned for future implementation to enhance the teaching learning experience and strengthen the overall agricultural education system. Data Centre (DC) at ICAR – IASRI and Data Recovery Centre (DRC) at ICAR – NAARM have been established to support these ongoing and planned digital initiatives. These establishments are jointly known as Krishi Megh. Krishi Megh provides cloud ready multilayer physical and information security infrastructure to agricultural universities. It is further strengthened to provide uninterrupted services to run digital initiatives smoothly, efficiently and effectively. The total storage has been increased from 293 TB to 2006 TB, total cores have been increased from 1138 to 1761, RAM has been increased from 5087 GB to 7107GB and the physical nodes have been increased from 15 to 19.

Resilient Agricultural Education System (RAES)

- **Academy Management System (AMS)**: AMS (Academy Management System) for 60 Universities has been developed under project Investment in ICAR Leadership for Agriculture Higher Education under National Agricultural Higher Education Project Component. AMS is a web-based application that is aimed at automating administrative and academic activities of AUs to enhance the efficiency of the overall system. Since it works on Role-Based Access Control (RBAC), the AMS has been adopted by six main end-user groups i.e., Deans, Professors, Faculty, Students, Guides, and Administration. The AMS facilitates the automation of various academic processes of AUs like course management, hostel management, student management, faculty management, administration management, and e-learning. Currently, the AMS has a total of 60 universities registered on the system that have enabled 83,970 total registrations with 68037 students and 11976 faculty registered through AMS.

  In 2022, 100+ capacity building & upskilling sessions were conducted for more than 5000 participants. The AMS enables efficiency across the agricultural higher education system by saving time and efforts involved in manual processes. The AMS continues to be customized as per the respective needs of various AUs. AMS system has been implemented in five (5) more State Agricultural Universities in the year 2022. The system thus offers transparency, efficiency, user-friendliness, automated processes, robustness, and easy customization. Link: https://auams.in/. Payment gateway integration has been implemented (Paygov). To leverage the emerging technologies, AR/VR experience centres have been set up in remaining 64 AU's. Process to finalise the topics of new modules to be developed is underway. Strengthening of Krishi-Megh with HCI Nodes with required software has been completed.

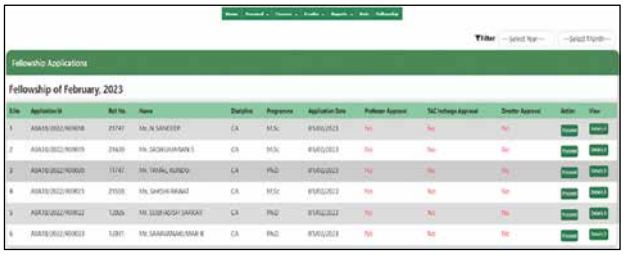


Academy Management System (AMS)

- **MIS-PIMI(Management Information system for Plan Implementation and Monitoring in ICAR)** (https://pimi.icar.gov.in/): The Plan Implementation and Monitoring (PIM) section is one of the oldest and most important sections of the ICAR. It is devoted to monitoring and evaluation of research, education and extension activities undertaken in plan schemes. At present, DARE/ICAR schemes module is activated in order to process SFCs/EFCs/CC/ RCEs documents with participation of SMDs and Institutes. The SFC/EFC/CC document preparation and processing will lead to organization of SFC/EFC/CC meetings for their appraisal, approval and preparations of financial sanctions of DARE/ICAR schemes for plan periods.

MIS-PIMI

- **End-To-End Digital Solution for the ICAR-DARE DBT Scheme 'Agedn':** IASRI Scholarship for M.Sc. and Ph.D. has been designed, developed and integrated with the Academic Management System (AMS) of IARI PG School (http://pgs.iasri.res.in/default.htm) in discussion with Education Division, ICAR. Bonafide students who avail IASRI scholarship will apply for fellowship one time in an academic year through this portal. The approval process will be done through workflow manners.



Digital Solution for the ICAR-DARE DBT Scheme

Capacity Building Program (CBP Vortal) (https://cbp.icar.gov.in)

CBP has been implemented for online management of all training programs (Centre for Advanced Faculty Training (CAFT), Summer-Winter Schools (SWS) and Short Courses (21/10 days duration)) under Capacity Building Program (CBP) sponsored by Agricultural Education Division, ICAR.

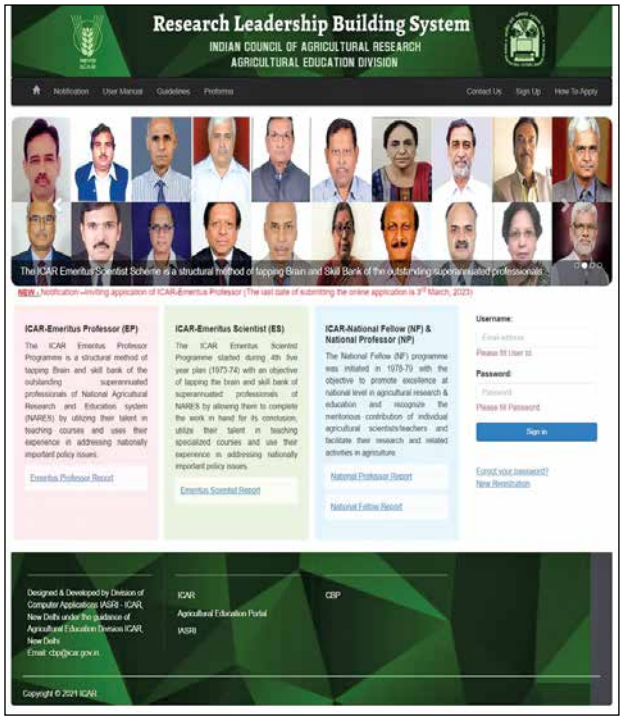
- During the year 2022-23, a total of 624 training program proposals were received online, out of which 76 programs have been organized using portal and it was attended by 1692 personnel. Training proposals were also invited through the system.
- New functionality developed for evaluation of training at the level of DDG user.
- Functionality for Approval of training has been provided at the ADG level.
- Sanction letter has been updated in accordance to the online and offline mode.
- Liaison with Course Coordinators and users for the problem faced by them and solution via email and phone.

CBP Vortal

Research Leadership Building System (RLBS)

RLBS has been developed for inviting online applications to the position of ICAR-National Fellow(NF)/National Professor(NP)/Emeritus Scientist(ES)/Emeritus Professor(EP). The system can be accessed from the URL(https://rlbs.icar.gov.in).

- RLBS portal was opened for inviting applications for National professor in online mode for the year 2021-22. 47 applications were received online.
- In 2022-23, Portal has been redesigned for streamlining the process for application for multiple schemes. New design leverages the latest technologies and design pattern to provide enhanced user experience.
- User profile creation functionality provided to applicants so that basic details of users need not be re-entered when applying in different schemes.
- For application evaluation, process flow has been developed so that application can be submitted to DDG or Expert level along with system generated letters for evaluation. Functionality for evaluation has been developed.
- Reports for monitoring the application status have been provided at ADG level Dashboard.
- Liaison with Course Coordinators and users for the problem faced by them and solution via email and phone.
- In 2022-23, the new designed RLBS portal has been opened up for Emeritus Professor Scheme.



Research Leadership Building System (RLBS)

ASRB- Online Application & Scorecard Information System (ASRB - OASIS)

ASRB-OASIS application has been developed for inviting online applications for the RMP and Non-RMP positions advertised by ASRB. Regular meetings were held with ASRB officials for requirement analysis of RMP and Non-RMP score cards. Accordingly, ASRB-OASIS version-2 was conceived and designed to improve the user experience and to minimize the support required to fill the application. Database has been extended for Non-RMP positions as well as to introduce security features like IP address capturing and log maintenance. Different forms and dashboard have been designed, developed and integrated in the system for Deputy Director General, Assistant Director General and Head of Department and Senior Scientist scorecards. Application has been designed in a manner that user has to fill the information only once for different positions of the same level. MIS reports have been developed at different levels for ASRB officials to automate their internal working and help them in decision making. Payment gateway has been re-implemented so that the user can make the payment any time during the filling of the application. In version 1, the user can make the payment only at the end after attaching the NoC from the office. Logic has been developed into system to compute the scores automatically as per filled information for different RMP and Non-RMP positions. Meetings were held with ASRB Officials for system demonstration and validation. Security audit of the system was conducted as per Government of India. A module has been developed for inviting experts for technical evaluation of the filled application. User Manuals were prepared and made available at the ASRB-OASIS website. System was made live for inviting applications for various positions of RMP and Non-RMP advertised by ASRB in November 2022. Extensive support was provided for queries raised by the users. With the help of ASRB-OASIS, ASRB could complete the recruitment process in record time of two months for the RMP positions. The system brought much needed transparency in the system and reduced the court cases to zero for the advertised RMP positions. The implementation of ASRB-OASIS is a fine example of the impact of e-Governance systems developed by ICAR-IASRI.

ASRB- Online Application & Scorecard Information System

AgrIntel: Spatio-Temporal Profiling of Nationwide Plant-Protection Problems using Kisan Call Centre Helpline Data

Sustainable development of the national food system must ensure the introduction of adequate food security interventions and policies. However, several high-end technological developments remain unexplored, which can be used to gain explicit information regarding agricultural problems. In this direction, AgrIntel, a framework consisting of multiple AI-based pipelines has been proposed to process nationwide farmers' helpline data and obtain spatiotemporal insights regarding food-production problems on an extensive scale. AgrIntel overcomes several limitations of the existing methods used for similar objectives, including limited scalability, low frequency, and high cost. The call-logs dataset used is obtained from the nationwide network of farmers' helpline centers, managed by the Ministry of Agriculture & Farmers' Welfare, Government of India and available on Open Government Data Platform through APIs. The spatio-temporal profile of one of India's highest food grain-affecting diseases, i.e. blast in rice crop has demonstrated the utility of the AgrIntel pipelines. First, the proposed framework extracts and clusters the precise geographical locations of farmers calling for help corresponding to the target agricultural problem. Next, the temporal modeling of the problem helps extract the critical dates corresponding to the crop disease/pest spread. Furthermore, by incorporating the historical agroclimatological data, a new medium has been introduced to extract the favourable weather conditions corresponding to the targeted disease/pest outbreak. In addition, the potential of Deep Learning models (based on Artificial Neural Network, Convolutional Neural Network, Gated Recurrent Unit and Long short-term memory unit) has been explored to efficiently predict the futuristic demand for assistance regarding target problems (RMSE of ≈1.5 and MAE of ≈0.9 query calls). The obtained results expose unrevealed insights regarding food production problems, significantly boosting the food security policy-designing procedure.

Yield-SpikeSegNet: An extension of SpikeSegNet Deep-Learning Approach for the Yield Estimation in the Wheat Using Visual Images

High-throughput plant phenotyping integrated with computer vision is an emerging topic in the domain of non-destructive and non-invasive plant breeding. Analysis of the emerging grain spikes and the grain weight or yield estimation in the wheat plant for a huge number of genotypes in a non-destructive way has achieved significant research attention. A deep learning approach, "Yield-SpikeSegNet," has been developed for the yield estimation in the wheat plant using visual images. This approach consists of two consecutive modules: "Spike detection module" and "Yield estimation module." The spike detection module is implemented using a deep encoder-decoder network for spike segmentation and output of this module is spike area and spike count. In yield estimation module, machine learning models have been developed using artificial neural network and support vector regression for the yield estimation in the wheat plant. The model's precision, accuracy, and robustness are found satisfactory in spike segmentation as 0.9982, 0.9987, and 0.9992, respectively. The spike segmentation and yield estimation performance reflect that the Yield-SpikeSegNet approach is a significant step forward in the domain of high-throughput and nondestructive wheat phenotyping.

ICAR- Land Records Management System (LRMS)

Strengthened ICAR- Land Records Management System (LRMS) an integrated system which provides land record information of all institutions along with their Regional Stations and accessible at https://lrms.icar.gov.in/. The system keeps the online record as total land area, land utilization details (farm area, research area, area under building, area under sports ground/park/green area, forest area, vacant land), ownership description as per revenue record, date of possession as per revenue record, date acquisition, free hold land/leased hold, lease period, date start for lease, date of renewal of lease etc. It also generates advisory and sends email to the Director of the Institute, Head of Administration along with Director (Works) about expiry of lease where lease would expire within one year. In total

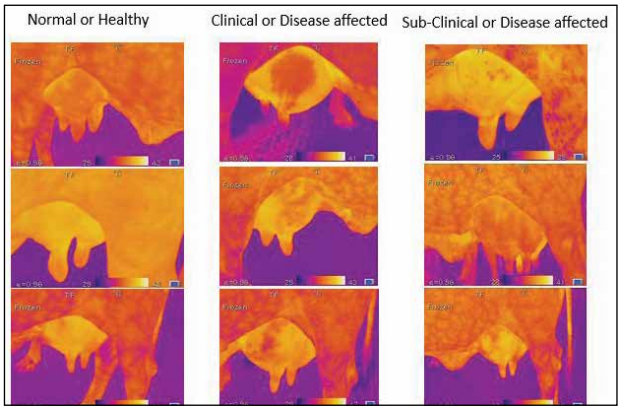
236 institutes/ KVKs/ Regional stations have filled their land record data into the system, so far.

Kisan SARATHI - System of Agri-information Resources Auto-transmission and Technology Hub Interface

The Kisan SARATHI is being implemented and strengthened by ICAR-IASRI in association with Digital India Corporation, Ministry of Electronic and Communication Technology (MeitY), Government of India. Initially the services have been started in four major states of India viz. Bihar, Madhya Pradesh, Maharashtra and Utter Pradesh later on the services were extended to two more states viz. Andhra Pradesh and Telangana. Subsequently the services of Kisan Sarathi were made available to all the States and UTs in the month of June, 2022. This is an on call advisory services for farmers of India, where any farmer can call or record their query in his own language automatically directed to respective KVK/ATARI for query redressal. The queries are being responded in the same language by the concerned KVK either online or by call later on based on the recorder queries of the farmer. This platform supports multilingual messaging system where bulk or individual SMS can be send to group of farmers based on either their location of the crops they cultivate. KVK use this facility to send advisories to the large chunk of farmer in a go. This system provides the services through IVR based service on toll free number- 1800-123-2175 and a short number 14426 to the farmers of all states. Presently, services of Kisan SARATHI are being provided by more than three thousand agriculture experts from 731 KVKs across the country to more than fifty-two lakh registered farmers which covered more than 1.48 Lakhs villages. Till now more than 1.20 lakh calls have been made by the farmers to Kisan SARATHI, in which most of the calls have been resolved. Agricultural advisories have also been sent from time to time to the farmers through KVK from Kisan SARATHI and so far more than 2.5 *crore* agricultural advisories have been sent through SMS.

Intelligent Decision Support System for Precision Agriculture under ICAR Network Program on Precision Agriculture (ICAR-NePPA).

- **Artificial Intelligence based mastitis disease identification in Cow:** The symptoms of this disease are seen in mammary glands of cow (teat part) and received thermal images of Sahiwal breed of cow from ICAR-National Dairy Research Institute, Karnal. These thermal images are in three categories i.e., normal means healthy animal, clinical means infected animal and sub-clinical means initial stage of infection in animals. The size of each image was 320*240 pixels and each category comprises with around 3000 images. The category wise images are 2721, 3287 and 2719 under clinical, subclinical and normal categories.

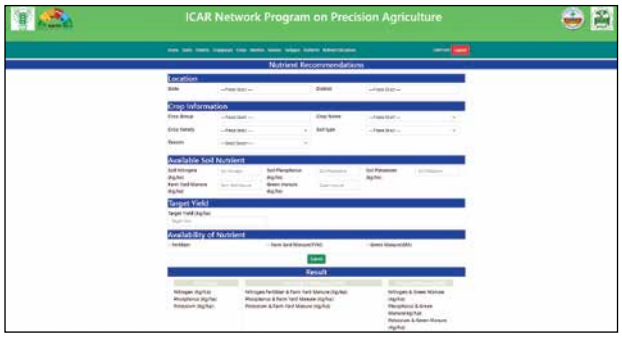


Sample images under various categories of Sahiwal breed of Cow

Deep Learning based CNN model was applied and model trained in two conditions namely Normal vs Clinical and Normal vs Subclinical. Training and Validation Accuracy was observed around 95% under Normal vs Clinical Model whereas it is around 85% under Normal vs Subclinical respectively. This difference may be due to infection was in early stage and difficult to capture under subclinical stage. Further, this model was also compared with VGG16, VGG19 and ResNet network. A web based tool was also developed by implementing these models and options were provided to user to upload the thermal image of udders for identification of mastitis disease in the animal.

Web interface for the identification of Mastitis disease in Sahiwal breed of Cow

- **Decision Support system for nutrient recommendation:** Recommended doses of nutrition have been determined based on the developed Soil Test Crop Response (STCR) models which were developed by AICRP on STCR of ICAR-Indian Institute of Soil Science Bhopal. These models have been developed for different soil conditions, different varieties and for different seasons based on target yield and existing nutrient status of the soil. A web based system has been developed for nutrient recommendation based on STCR models. These models can be updated by the lead center.



GUI based web interface for Nutrient Recommendation in Crops

Management and Impact Assessment of Farmer FIRST Project

Graphical dashboard has been developed at Principal Investigator (PI) level. Support is being provided to PIs for uploading the information on the portal and technical issues have been resolved over email. The details of 1407 interventions, 1186 events, 3452 images, 124 videos and 475 publications related to FFP are available on the portal. The portal has been visited by 86991 users since February 2018.

E-governance Services

Web hosting services through ICAR Data Centre were provided. At present 350+ web applications are hosted on ICAR Data Centre. The SPARROW, an online system for Annual Performance Appraisal Report (APAR) of administrative and technical ICAR employees introduced in 2022 for filling, submission, reporting and reviewing of APAR. Similarly, services for ICAR eOffice, ICAR DARPAN Dashboard are being provided. Following 04 portals: PBS Portal, CLC-Bio Portal, DSS Portal, Bio Computing Portal, Sequence Submission Portal along with 177 web resources are managed and maintained through Advanced Supercomputing Hub for OMICS Knowledge in Agriculture (ASHOKA).

Developed R-packages: 15

1. **eemdARIMA:** EEMD Based Auto Regressive Integrated Moving Average Model available at https://CRAN.R-project.org/package=eemdARIMA
2. **NBBDesigns:** Neighbour Balanced Block Designs (NBBDesigns) Version 1.0.0 available at https://cran.r-project.org/package=NBBDesigns
3. **mkssd:** Efficient Multi-Level k-Circulant Supersaturated Designs and is available at https://cran.r-project.org/web/packages/mkssd/index.html
4. **WaveletRF:** The Wavelet Decomposition followed by Random Forest Regression (RF) models for time series forecasting. This is available at https://CRAN.R-project.org/package=WaveletRF
5. **iRoCoDe:** For the generation of the row-column design (https://cran.r-project.org/web/packages/iRoCoDe/index.html).
6. **vmdTDNN:** Forecasting univariate time series with Variational Mode Decomposition (VMD) based time delay neural network models. (https://cran.r-project.org/web/packages/vmdTDNN/)
7. **VMDML:** Variational Mode Decomposition based on Machine Learning models for univariate time series forecasting (https://cran.r-project.org/web/packages/VMDML/)
8. **Auto-Weather-Indices:** Calculating Weather Indices **(**https://cran.r-project.org/web/packages/AutoWeatherIndices/index.html-)This package provides the user with weather indices from the weather variables
9. **pRepDesigns:** Partially replicated (p-Rep) designs for early generation breeding trials, available at https://cran.r-project.org/package=pRepDesigns
10. **PolycrossDesigns**: This package generates nine types of polycross designs suitable for various experimental situations, available at https://CRAN.R-project.org/package=PolycrossDesigns
11. **OptiSembleForecasting:** In this package, ensembled based optimization technique using 13 models have been implemented. A PCA based error index has been proposed to select a group of best models using MCS algorithms. After selecting the models, the forecasts from these models have been ensembled using optimization techniques. Available at https://CRAN.R-project.org/package=OptiSembleForecasting
12. **GETdesigns:** Generalized Extended Triangular Designs. Available at: https://CRAN.R-project.org/package=GETdesigns

13. **ResPBIBD:** Resolvable Partially Balanced Incomplete Block Designs (PBIBDs), available at https://CRAN.R-project.org/package=ResPBIBD
14. **ARIMAANN**: Time Series Forecasting using ARIMA-ANN Hybrid Model, available at https://CRAN.R-project.org/package=ARIMAANN
15. **MetaConClus:** Unsupervised Binning of Metagenomics Data using Consensus Clustering. https://CRAN.R-project.org/package=MetaConClust

Developed Webservers/ Databases: 19

1. **ASRpro:** Online prediction server for identifying genes responsive to six abiotic stresses: cold, drought, heat, light, oxidative, and salt and freely available at https://iasri-sg.icar.gov.in/asrpro/.
2. **BSCM2TDb:** A database on water buffalo that contain the data generated from differential DNA methylation extracted from MeDIP-seq data available at http://webtom.cabgrid.res.in/BSCM2TDb.
3. **BtChiLCVDb:** *Bemisia tabaci* Asia II transcriptome database in response to chilli leaf curl virus (ICAR-IARI and ICAR-IASRI)
4. **SCMVTDb:** Transcriptome-based Mosaic Virus Database in small or green cardamom that contains the information of differential expressed genes, microsatellites, variants, transcriptional factors, pathways, domain and families avilable at http://webtom.cabgrid.res.in/scmvtdb/
5. **ParkRoxTDB:** Tree Bean (*Parkia roxburghii*) Transcriptome Database (http://backlin.cabgrid.res.in/parkroxtdb/)
6. **SIReDAM:** Systematic Information Resources for Dairy Animal Management: A dedicated Management Information System (MIS) for bovines (http://webtom.cabgrid.res.in/SIReDAM/)
7. **Levidb:** Genomics of Virus in Legume Crops: Viral diagnostics of legume crop (http://webtom.cabgrid.res.in/levidb/)
8. **Millet SSR:** This computational tool stores catalogue of microsatellites fetched (http://webtom.cabgrid.res.in/millet_ssr_db/) from Pearl Millet, Fox Millet, Proso Millet and Sorghum Millet genome.
9. **PMDlncRDB:** Pearl millet lncRNAs database: A web genomic resource, Pearl millet lncRNAs database available at http://webtom.cabgrid.res.in/pmdlncrdb/
10. **LncR-CsExSLDb:** LncRNA based Extended Shelf-Life Database for predicted lncRNA and circular RNA in cucumber (*Cucumis sativus*) transcriptome available at http://webtom.cabgrid.res.in/lncrcsexsldb .
11. **OYVMVTDb:** Okra (*Abelmoschus esculentus*) Yellow Vein Mosaic Virus Transcriptome Database (in collaboration with ICAR-IARI and ICAR-NIPB)
12. **EqSNPDb:** Equine SNP marker database (in collaboration with ICAR-NRC-on-Equines)
13. **CerealESTdb:** An interactive database to provide information on assembled and annotated ESTs from four major crop plants, namely wheat, rice, maize, and sorghum (http://cabgrid.res.in/CerealESTDb)
14. **TiGeR:** Tilletia indica genomic resource freely accessible at http://backlin.cabgrid.res.in/tiger/.
15. **DeepAProt:** Abiotic stress protein classification tool using Deep Learning in cereal freely accessible at http://login1.cabgrid.res.in:5000/ .
16. **BuffGR:** Web genomic resource of buffalo accessible at http://backlin.cabgrid.res.in/buffgr.
17. **GIpred:** Online prediction server GIGANTEA proteins in plants. GIpred is freely accessible at http://cabgrid.res.in:8080/gipred/ for proteome-wide recognition of GIGANTEA protein.
18. **ASRmiRNA:** Machine learning-based prediction server for identification of abiotic stress responsive miRNAs, and is freely available at http://cabgrid.res.in:8080/asrmirna/
19. **P/DBPred:** Machine learning based online prediction server for discovery of DNA binding proteins in plants and is freely available at https://iasri-sg.icar.gov.in/pldbpred/

4. Education and Training

The Institute conducts post graduate teaching and in-service courses in Agricultural Statistics, Computer Application and Bioinformatics for human resource development. Institute is conducting M.Sc. and Ph.D. programmes in Agricultural Statistics, Computer Application and Bioinformatics in collaboration with the Post Graduate School of Indian Agricultural Research Institute (IARI), New Delhi which has the status of a Deemed University. Both Ph.D. and M.Sc. students are required to study courses not only in their area of specialization but also in Agricultural Sciences like Genetics, Agronomy, Agricultural Economics, etc. The Courses in Mathematics, Agricultural Statistics, Computer Application and Bioinformatics, are offered at this Institute while the courses in Agricultural Sciences are offered at IARI.

Year of start, Number of students admitted / completed various degree courses during the period under report are

S. No.	Course	Beginning Year	No. of Students	
			Admitted 2022-23*	Passed Out in 2022**
1	Ph.D. (Agricultural Statistics)	1964	10	05
2	M.Sc. (Agricultural Statistics)	1964	11	09
3	Ph.D. (Computer Application)	2013-14	05	04
4	M.Sc. (Computer Application)	1985-86	02	07
5	Ph.D. (Bioinformatics)	2014-15	06	03
6	M.Sc. (Bioinformatics)	2011-12	04	05

*students admitted as on 09.02.2023; **students who received degrees in 2022 convocation

FACULTY MEMBERS OF P.G. SCHOOL, IARI in

(i) Discipline of AGRICULTURAL STATISTICS

S. No.	Name	Year of Induction
1.	Dr. Rajender Parsad, Director	1995
2.	Dr. Cini Varghese, Professor (Agricultural Statistics)	2000
3.	Dr. Anil Rai, Principal Scientist	1995
4.	Dr. Tauqueer Ahmad, Principal Scientist	1998
5.	Dr. Amrit Kumar Paul, Principal Scientist	1998
6.	Dr. Girish Kumar Jha, Principal Scientist (at IARI)	1999
7.	Dr. Prachi Misra Sahoo, Principal Scientist	2002
8.	Dr. Prawin Arya, Principal Scientist	2003
9.	Dr. Amrender Kumar, Principal Scientist (at IARI)	2003
10.	Md. Wasi Alam, Principal Scientist	2003
11.	Dr. Himadri Ghosh, Principal Scientist	2004
12.	Dr. Anil Kumar, Principal Scientist	2010
13.	Dr. K.N. Singh, Principal Scientist	2011
14.	Dr. Ajit, Principal Scientist	2015
15.	Dr. V. Ramasubramanian, Principal Scientist	1999-2013 & 2017
16.	Dr. Ranjit Kumar Paul, Senior Scientist	2011
17.	Dr. B.N. Mandal, Senior Scientist (transferred to IARI, Jharkhand on 20.08.2022)	2011
18.	Dr. Susheel Kumar Sarkar, Senior Scientist	2011
19.	Dr. Mir Asif Iqubal, Senior Scientist	2011
20.	Dr. Kaustav Aditya, Senior Scientist	2012
21.	Dr. Sukanta Dash, Senior Scientist	2013
22.	Dr. Arpan Bhowmik, Senior Scientist (transferred to IARI, Assam on 08.04.2022)	2014
23.	Dr. Ankur Biswas, Senior Scientist	2015
24.	Dr. Anindita Datta, Scientist	2017
28.	Dr. Sarika, Senior Scientist	2018
29.	Mr. Deepak Singh, Scientist	2018
30.	Dr. Achal Lama, Scientist	2018

31.	Dr. Mrinmoy Ray, Scientist	2018
32.	Dr. Raju Kumar, Scientist	2019
34.	Dr. Kanchan Sinha, Scientist	2019
35.	Dr. Prabina Kumar Meher, Senior Scientist	2022
36.	Dr. Mohd. Harun, Scientist	2022

(ii) Discipline of COMPUTER APPLICATION

S. No.	Name	Year of Induction
1.	Dr. Alka Arora, Professor (Computer Application)	2001
2.	Dr. Sudeep Marwaha, Principal Scientist	2002
3.	Dr. K.K.Chaturvedi, Principal Scientist	2002
4.	Dr. Anshu Bhardwaj, Principal Scientist	2004
5.	Dr. S.B. Lal, Principal Scientist	2004
6.	Dr. Rajni Jain, Principal Scientist (at NIAP)	2007
7.	Dr. A.K. Mishra, Principal Scientist (at IARI)	2014
8.	Dr. Mukesh Kumar, Principal Scientist	2014
9.	Dr. Shashi Dahiya, Senior Scientist	2001
10.	Md. Samir Farooqi, Senior Scientist	2001
11.	Dr. Anu Sharma, Principal Scientist	2004
12.	Dr. Sangeeta Ahuja, Scientist	2002
13.	Ms. Shaloo, Scientist (at WTC, IARI)	2016
14.	Dr. S.N. Islam, Scientist	2018
15.	Dr. Soumen Pal, Senior Scientist	2019
16.	Dr. Chandan Kumar Deb, Scientist	2021

(iii) Discipline of BIOINFORMATICS

S. No.	Name	Year of Induction
1.	Dr. Rajender Parsad, Director	2010
2.	Dr. Anil Rai, Professor (Bioinformatics)	2010
3.	Dr. S.S. Marla, Principal Scientist	2010
4.	Dr. Sudeep Marwaha, Principal Scientist	2010
5.	Dr. Kishore Gaikwad, Principal Scientist (at NRCPB)	2010
6.	Dr. P.K. Singh, Principal Scientist (at IARI)	2010
7.	Dr. A.K. Mishra, Principal Scientist (at IARI)	2010
8.	Dr. Sunil Archak, Principal Scientist (at NBPGR)	2010
9.	Dr. S.B. Lal, Principal Scientist	2010
10.	Dr. Monendra Grover, Principal Scientist	2013
11.	Dr. K.K. Chaturvedi, Principal Scientist	2014
12.	Dr. U.B. Angandi, Principal Scientist	2014
13.	Mohd. Samir Farooqi, Senior Scientist	2010
14.	Dr. Anu Sharma, Senior Scientist	2010
15.	Dr. D.C. Mishra, Senior Scientist	2010
16.	Dr. Sarika, Senior Scientist	2010
17.	Sh. Sanjeev Kumar, Scientist	2010
18.	Dr. Mir Asif Iquebal, Senior Scientist	2013
19.	Dr. M.G. Mallikarjuna, Scientist (at IARI)	2017
20.	Dr. Yasin Jeshma K., Scientist (at NBPGR)	2018
21.	Dr. Sudhir Shrivastava, Senior Scientist	2019
22.	Dr. Neeraj Budhlakoti, Scientist	2022
23.	Dr. Ratna Prabha, Scientist	2022
24.	Dr. Bharti Pandey, Scientist	2022

DISSERTATIONS APPROVED

Ph.D. (Agricultural Statistics)

Name of Student: Srikant Bairi
Roll No: 10724
Guide: Dr. A.R. Rao

Development of Empirical Approaches for Estimating Breeding Values in Genomic Selection under Incomplete Data Situations

In DNA sequencing, genotype-by-sequencing (GBS) is meant for discovering SNPs in order to perform genotyping studies. The most common problem in GBS is the presence of missing observations, which standard statistical models often fail to handle. Thus, imputation of missing data is required. The imputation accuracy of six imputation techniques viz. Mean Allele Frequency Imputation (MNI), Singular Value Decomposition Imputation (SVDI), k-Nearest Neighbour Imputation (kNNI), locally weighted linear regression imputation (LWI), Expectation Maximization Imputation (EMI) and Random

Forest Imputation (RFI) was assessed based on correlation coefficient, mean square prediction error and imputation time. RFI, EMI and SVDI performed with high imputation accuracy under varying levels of missing observations (5%, 10%, 15% and 20%). The prediction accuracies of Genomic Selection (GS) models based on machine learning algorithms (RF, Reproducing Kernel Hilbert Space (RKHS) and Multivariate Kernelized Reproducing Kernel Hilbert Space (MKRKHS)) out performed Bayesian models such as BayesA, BayesB, BayesC, Bayes LASSO, and Bayes ridge regression and Best Linear Unbiased Prediction (BLUP). The imputation techniques (RFI, EMI and SVDI) were integrated with several GS models to assess their performance in estimating Genomic Estimated Breeding Values (GEBVs). RFI with prior fitting of GS models outperformed the EMI and SVDI with all GS models at different levels of missing data. The RFI with RF GS model showed highest prediction accuracy. The consistency in performance of the identified combination of imputation technique and GS model was tested under both simulated data at different levels of heritability (0.3, 0.4 and 0.5) as well as real data with 20% level of missing values. The prediction accuracy increased with increase in the heritability value of the trait. Recommendations are, RFI for imputing missing values and RF based regression for predicting GEBVs at different levels of missing values in GBS data.

Name of Student: Sumeet Saurav
Roll No: 10585
Guide: Dr. Cini Varghese

Robust Designs for Bioequivalence Trials

Evaluation of veterinary medicinal products is one of the important areas where bioequivalence trials are conducted to investigate the degree to which clinically important outcomes after receiving a new formulation resembles to those of a previously well-established formulation. For making test versus reference formulations comparisons with as much precision as possible, special designs are required. In usual practice, due to constraints in the availability of homogeneous experimental subjects for experimentation, the same set of subjects is used for repeated evaluation, resulting in trend effects. General condition for a design to be trend-free has been derived and method of construction of such designs has been developed. Also, if a sequence of formulations is applied to a subject and observations are measured from the same subject over different periods of time, there may be dependency in the observations. Different types of correlation structures have been considered and impact of autocorrelation has been studied. Another problem commonly encountered in bioequivalence trials is that the subjects under study may not respond similarly after receiving the same formulation. For the detection of an outlying subject in bioequivalence trials, likelihood distance and estimated distance test procedures have been developed. These extreme values in datasets may have dramatic effects on the bioequivalence test and therefore, for the detection of such outlier observations, Cook statistic has also been derived.

Name of Student: Md Yeasin
Roll No: 10974
Guide: Dr. K.N. Singh

Bayesian Estimation for Time Series Models with Exogenous Variables

The Bayesian technique is a powerful statistical methodology, surpassing traditional frequency or point estimation. As the Indian economy relies heavily on agriculture, accurate forecasts of various aspects like agriculture, health, and economy are essential for planning schemes to develop the economy. Time series analysis is effective in meeting this need, but lacks the ability to consider exogenous variables' impact. However, time series models with exogenous variables, like the Seasonal Auto-Regressive Integrated Moving Average (SARIMA-X) model, can capture environmental influences. Similarly, the Generalized Autoregressive Conditional Heteroskedasticity model (GARCH) is valuable for volatility modeling. Despite their merits, issues arise when assumptions of traditional models are unmet, leading to unreliable parameter estimation. To address these challenges, this study incorporated prior knowledge through Bayesian techniques, enhancing the applicability of SARIMA-X and GARCH-X models in practical scenarios. The study explored various types of priors (informative, non-informative, and conjugate) and employed the Markov Chain Monte Carlo (MCMC) method for parameter estimation. The results conclusively showed that models estimated under the Bayesian framework outperform those under classical approaches, offering superior forecasting accuracy and reliability for planning and decision-making processes.

Name of Student: Nitin Varshney
Roll No: 10586
Guide: Dr. Tauqueer Ahmad

Resampling Methods of Variance Estimation for Two Phase Sampling

Sample survey is a cost-effective mean to collect reliable information about a finite population. Two-phase sampling is generally used for estimating population mean or total under two different situations in order to reduce the number of sampled units which require more expensive objective methods. Prediction approach is applied to predict the non-sampled units in surveys. In the present study, a new estimator of finite population total based on prediction approach in the context of two-phase sampling has been proposed. Although, an approximate variance of the proposed prediction-based estimator is obtained, it can be observed that the variance expression is very complicated and tedious to obtain. Therefore, Proportionate Rescaling Bootstrap Without Replacement (PRSBWOR) for variance estimation of the proposed prediction-based estimator has been proposed. Missing values are a common phenomenon in survey data which may arise when some or all of the responses are not collected from a sampled element. Thus, the proportional bootstrap without replacement in the context of variance estimation of the proposed prediction-based estimator under two-phase sampling in presence of missing values considering different imputation techniques (zero, mean, random substitution, ratio and regression method of imputation) has been proposed. In order to study the performance of the proposed prediction-based estimator and proposed bootstrap variance estimation techniques, a comprehensive simulation study was carried out, which shows superiority of the proposed methods.

Name of Student: Rajeev Kumar
Roll No: 10587
Guide: Dr. Anil Rai

Rescaling Bootstrap Technique for Variance Estimation in Dual Frame Surveys

Multiple frames (MF) are preferably used when it is difficult to obtain a single sampling frame that covers the whole population. Dual frame (DF) surveys are a special case of MF surveys considering two frames covering the entire population. Unbiased variance estimation for estimation of various population parameters is difficult and complicated for multiple frame surveys as compared to sample from single frame. Therefore, three different rescaled unbiased variance estimation procedures for estimation of variance of population total unbiasedly under different cases of dual frame surveys namely, (i) Stratified Rescaling Bootstrap with Known Domain size (StRBKD), (ii) Post-stratified Rescaling Bootstrap with Known Domain size (PstRBKD) and (iii) Post-stratified Rescaling Bootstrap with Unknown Domain size (PstRBUD) methods have been developed. Under these proposed procedures, resamples are taken domain-wise as well as frame-wise respectively and rescaling factors are obtained for each case under a dual frame survey. It has been proved theoretically that the proposed variance estimation procedures are almost unbiased for the variance of the estimator of population total under dual frame survey. Further, statistical properties of the proposed bootstrap procedures were evaluated through a simulation study. It was concluded that the variance estimation following the StRBKD method is more efficient and stable than the PstRBKD method for different sample sizes. A Proportional Stratified Bootstrap Method (PSBM) for the case of missing observations has also been developed.

M.Sc (Agricultural Statistics)

Name of Student: Satyam Verma
Roll No: 21236
Guide: Chairman: Dr. Arpan Bhowmik

Trend Resistant Constant Block-Sum Partially Balanced Incomplete Block Designs

In agricultural experimentation under block design set up, response of a plot in a block may be affected by trend effects. Although remote, trend effects may be incorporated into the model for proper model specification. Partially balanced incomplete block (PBIB) designs have profound application in agricultural research. Constant block sum PBIB designs, where block sum with respect to treatments for all blocks remain constant, are gaining rapid momentum. Here, some aspects of trend resistant constant block sum PBIB designs have been highlighted. The necessary and sufficient conditions for a design to be completely trend resistant *i.e.*, trend free has been derived. Methods of construction of trend free constant block sum PBIB designs have been developed. Statistical properties of the designs obtained under the present investigation was also investigated. Further, efficiencies of existing constant block sum PBIB designs were calculated in the presence of trend effects and it was observed that they do not provide good resistance against trend effects.

Name of Student: Katore Pramod Balkrushna
Roll No: 21237
Guide: Dr. B.N. Mandal

Position Balanced Block Designs for Sensory Studies and Consumer Experiments

In many experiments, allocating treatments randomly within a given block at any position is a common practice. However, in sensory studies and consumer experiments, positions of treatments are important. In both the cases, panelists are required to rate and give scores to different products according to various attributes and/or overall acceptability. Rating given to a product may depend on whether it is being given at the beginning, middle, or end of the session and hence there may be position or order effect. Similar considerations also apply for consumer experimentation. Generally, in consumer experiments all samples are given to each panelist in a single session, forcing to use a complete block design since blocking factor is panelists. However, there are significant benefits of using incomplete block designs like more number of products can be evaluated, reducing consumer fatigue, etc. For such experimental situations, algorithms for obtaining position balanced and nearly position balanced BIB designs have been developed.

Name of Student: Manoj Verma
Roll No: 21238
Guide: Dr. K.N. Singh

Forecasting Crop Yield using Feature Selection and Machine Learning Algorithms

Crop yield forecast is valuable to stakeholders in the agri-food chain, including farmers, agronomists, merchants, and policymakers. To enhance prediction accuracy, irrelevant variables must be identified and eliminated. Feature selection improves prediction accuracy and reduced computational complexity. Crop yield, influenced by land use, water management, fertilizer application, practices, and weather, poses challenges for statistical models due to their assumptions. In contrast, machine learning techniques offer flexibility and data-driven approaches. This study applied various feature selection algorithms (Forward Selection, Backward Selection, Random Forest (RF), Least Absolute Shrinkage and Selection Operator (LASSO), and Correlation Based Feature Selection (CBFS)) in 3 different datasets. Regression forecasting models were developed using selected features, and machine learning techniques such as Random Forest regression (RFR) and Support Vector Regression (SVR) were used. Different statistical measures such as Root Mean Squared Error (RMSE), Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) were utilized to evaluate prediction performance of different machine learning techniques in different feature selection set up. CBFS, LASSO, and RF were identified as the best feature selection algorithms for regression models across datasets, while SVR outperformed other techniques except for Medak district rice yield.

Name of Student: Krishna
Roll No: 21239
Guide: Dr. Tauqueer Ahmad

Estimation of Crop Yield using Calibration Approach under Stratified Two Stage Two Phase Sampling Design

In this study, a methodology for estimation of crop yield at district level using calibration approach under stratified two-stage-two-phase sampling has been developed. Separate and combined regression type calibration estimators of the population total and mean under stratified two-stage-two-phase sampling have been developed when size of all psu's is known. Also, calibration approach in case of stratified two-stage-two-phase sampling has been developed when size of psu's is unknown. Approximate variance and estimate of variance of the developed estimators have been derived. An empirical evaluation of the proposed calibration estimator using real data application for estimation of cotton yield has been carried out. Cotton yield has been estimated along with percentage standard error (%SE) at district level for two districts each of Maharashtra and Andhra Pradesh states using the developed methodology as well as using different existing approaches. The estimate obtained using the developed methodology is more efficient, reliable and almost at par with the estimates obtained using General Crop Estimation Survey (GCES) methodology. The developed methodology will save cost of the survey significantly and will also be operationally more convenient than GCES procedure.

Name: Kaushal Kumar Yadav
Roll No: 21240
Guide: Dr. Sukanta Dash

Row-column Designs for Two-level Factorial and Fractional Factorial Experiments

Row-column designs (RCDs) are highly beneficial in experimental scenarios involving two cross-classified sources of heterogeneity in the experimental

material. These designs allow comparison of multiple factors within a row-column setup. However, there are situations where a complete factorial design is not feasible, leading the researchers to consider fractional factorial approaches. Additionally, practical constraints may limit the inclusion of more than two experimental units in a column of a RCD. For instance, RCDs with two rows find particular utility in two-color microarray experiments. In such cases, experimenters may have an interest in estimating all main effects and selected two-factor interactions. Consequently, it becomes crucial to obtain efficient RCDs with two rows to address these experimental scenarios. A general construction method of RCDs with two rows has been developed, facilitating the orthogonal estimation of all main effects and two-factor interactions under orthogonal parameterization. Additionally, a catalogue of RCDs for 2^n ($2 \leq n \leq 9$) factorial experiments with reduced replication requirements has been prepared.

Name of Student: A Praveen Kumar
Roll No: 21241
Guide: Dr. Wasi Alam

Improvement of Time Varying Smoothing Models using Hybrid Machine Learning Techniques

Time series modelling and forecasting is a vibrant research field that has attracted the interest of the scientific community in recent decades. Forecasts of agricultural prices are proposed to be useful for farmers, governments and agribusiness industries. In this study, a hybrid time varying smoothing model was proposed for forecasting agricultural prices. In moving average model, equal weights are allotted to all the observations and in case of exponential smoothing, weights are assigned in exponential manner as recent observations obtain more weights than the older ones. As a result, it does not capture the complete pattern in the time series, and the properties of the time series cannot be properly explained. Exponential smoothing model with time varying parameter have been developed with weights as minimum by maximum values, minimum by simple moving average and minimum by weighted moving average of two lagged observations. The monthly price series of Tea in Kolkata market was used for this study. These three cases of time varying models were compared with Autoregressive Integrated Moving Average (ARIMA) model and Holt's linear trend method using accuracy measures like Root Mean Squared Error (RMSE), Mean Absolute Percentage Error (MAPE), Mean Absolute Error (MAE). It is showed that model with weights as minimum by simple moving average outperformed all other models. The residuals of the best model were fitted with time delay neural networks for predicting nonlinear patterns in the time series. Finally, the hybrid time varying smoothing model is compared with simple time varying smoothing model and achieved better results.

Name of Student: Ashtosh Dalal
Roll No: 21242
Guide: Dr. Seema Jaggi

Construction of Response Surface Designs with Mixed Levels of Factors Incorporating Neighbouring Effects

In agriculture and allied subjects, the treatment combination administered to one experimental plot may affect the response on neighboring plots, known as neighbour effects, and integrating them in the response surface model improves the experiment's precision. A response surface with n_1, n_2 and n_3 factors at s_1, s_2 and s_3 levels each, resulting in combinations has been considered here. The methodology for response surface with mixed levels of factors incorporating neighbour effects has been described for particular cases. The model considered is a $(s_i\text{-}1)^{th}$ order model without interaction terms, where s_i is the level of the i^{th} highest factor. Conditions required for the near orthogonal estimation of coefficients of response model and also for the constancy of variances have been derived. Further, conditions for rotatability under these models have also been obtained. The design satisfying these properties are called as Mixed Level Response Surface Design with Neighbour Effects (MLRDNE). Method of constructing MLRDNE and its particular cases has been developed. The developed designs are either rotatable or partially rotatable depending on the model considered.

Name: Naveen G.P.
Roll No: 21243
Guide: Dr. Prachi Misra Sahoo

Crop Yield Estimation using Random Forest Spatial Interpolation Technique

In this study, attempt has been made to develop crop yield estimation procedures using spatial random forest technique including the spatial variables like distance and nearest neighbour as covariates. The study was conducted in Barabanki

district of UP, which consists of six tehsils using Crop Cutting Experiment (CCE) data under General Crop Estimation Surveys (GCES). For this, initially the original complete dataset consisting of the yield of all the CCE plots in each tehsil was considered. The tehsil level estimate of average yield under wheat crop was computed. The district level estimates were also obtained by pooling area under wheat crop in each tehsil along with estimate of standard error (SE) and percentage SE. In this dataset, the yield of 30%, 50% and 70% plots was randomly missed in order to generate dataset with missing yield values, which was predicted using Random Forest Spatial Interpolation (RFSI) technique. In order to compare the performance of RFSI technique, predictions were also made using kriging and IDW techniques following similar approach. From this study, the estimates obtained using RFSI were found to be at par with kriging and better than IDW. RFSI was found to be faster particularly for large training datasets. The proposed methodology will save cost of the survey significantly and will also be operationally more convenient than GCES procedure.

Name of Student: Anushka Garg
Roll No: 21096
Guide: Dr. K.N. Singh

Study on Multiple Component Models for Forecasting Price Volatility for Agricultural Commodities

The Autoregressive Integrated Moving Average (ARIMA) model proposed by Box-Jenkins is widely accepted for analyzing time series data, due to its statistical properties, ease of application, and strong forecasting ability. However, the ARIMA model assumes a rapid decay of the autocorrelation function, which may not hold in all cases. In such situations, the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model, which allows for additive volatility components, is often used. The focus has now shifted to multiple component models, particularly the Generalized Autoregressive Conditional Heteroscedasticity Mixed-Data Sampling (GARCH-MIDAS) model, which is useful in analyzing the relationship between financial volatility and the macroeconomic environment. This model incorporates explanatory variables and bridges the gap between high-frequency volatility and low-frequency explanatory variables, such as monthly or quarterly data. In this study, the modified GARCH-MIDAS model has been developed to forecast volatility in agricultural commodities by identifying key explanatory variables. A comparative analysis was conducted with standard GARCH models using onion price data collected from various markets in Maharashtra. The prediction accuracy measures revealed that the GARCH-MIDAS model outperformed the other benchmark models, achieving approximately 10% better performance across markets.

Ph.D. (Computer Application)

Name of Student: Kamalika Nath
Roll No: 10599
Chairman: Dr. Rajni Jain

Nature Inspired Algorithms for Optimization of Crop Plan

Agricultural crop planning makes a significant contribution to increase production, income, and the quality of life in the farming community. Proper policy planning and scientific tools are essential for turning agriculture into a profitable profession. This study investigated the development of an optimal crop plan using nature-inspired optimization techniques such as genetic algorithms (GA) and differential evolution (DE). Variants of differential evolution algorithms are investigated to discover an optimal crop plan. The results from each algorithm are analyzed, and revealed that DE techniques are more profitable than existing patterns. The multi-objective differential evolution (MODE) method is used to construct and solve problems with two objective functions: maximization of profit and minimization of groundwater utilization, both of which are constrained. MODE's Pareto fronts are compared to NSGA-II, a popular multi-objective evolutionary algorithm based on genetic algorithm, and MODE performed better than NSGA-II. The crop plans generated using multiple nature-inspired algorithms, linear programming (LP), and the existing pattern showed that nature-inspired methods outperformed the existing crop plan. For single-objective and multi-objective optimization, a web-based user interface is developed and validated using real data set. This study can be useful for policymakers, researchers as well as for farmers.The crop plans generated using multiple nature-inspired algorithms, linear programming (LP), and the existing pattern showed that nature-inspired methods outperformed linear programming and the existing crop plan.

Name of Student: Md. Ashraful Haque
Roll No: 10783
Guide: Dr. Sudeep

Image-based Diagnosis of Disease Severity Stages in Maize Using Deep Convolution Neural Networks

In India, maize crop is quite vulnerable to several diseases. The diseases are needed to be identified accurately as well as in the early severity stages for reducing production losses. In recent years, deep learning techniques have become very popular in the field of agriculture. This research work was aimed at proposing a novel deep learning based approaches for identifying the Maydis Leaf Blight (MLB), Turcicum Leaf Blight (TLB) and Banded Leaf & Sheath Blight (BLSB) disease and for identifying the severity stages of MLB disease of maize crop. In this work, around 5,939 digital images of maize leaves were captured in real in-field conditions in a non-destructive manner from experimental fields of ICAR-IIMR, Ludhiana. In this work, two Deep Convolution Neural Networks (CNN) models were developed: Firstly, a deep CNN model (Inception-v3_ GAP) was proposed for identification of three diseases of maize crop. This model achieved the testing accuracy of 95.71% on separate test dataset for classifying the images into respective classes. Secondly, another deep CNN model (improved Inception Residual Neural Network (ResNet)) was developed based on the 'Inception ResNet' architecture, for identification of disease severity stages of MLB disease. The proposed improved Inception ResNet model achieved the testing accuracy of 92.49% on testing dataset. Next, an AI-enabled mobile application (Severity Checker) has been developed by integrating the developed Deep CNN models for facilitating the automated identification of diseases and their severity stages. This mobile application can be a handy tool for identifying the diseases and their severity stages through the mobile phones in agricultural fields.

Name of Student: Shbana Begam
Roll No: 10784
Guide: Dr. Rajni Jain

Development of Particle Swarm Optimization based Model for Crop Planning

Crop planning is one of the methods for increasing crop production. In earlier times, farmers used to plan the crops based on their own estimates. However, due to severe changes in climatic situations and the continued depletion of available resources, crop planning at a broad scale with optimizing the resources and utilizing computational techniques is required. Evolutionary computation performs well in single as well as multi-objective optimization problems. However, there have been few attempts in the literature in this area due to a lack of experience in agriculture, crop planning, and evolutionary algorithms and no online agricultural planning tools are available. In this study Particle Swarm Optimization (PSO) is used to develop a crop planning model for single objective and multi-objective function at regional level. Developed models validated with two different regions i.e. rainfed and irrigated. Sensitivity analysis is done with respect to some % of changes in water availability and working capital, which denote the increase of the water and working capital at a certain level will enhance the net returns. A multi-objective approach was designed using the multi-objective particle swarm optimization algorithm using crowding distance (MOPSOCD) algorithm to obtain the more optimal solution using the crowding distance mechanism. The diverse scenarios with combinations of objective functions are described and results are compared with each other. The multi-objective PSO results outperform the other similar evolutionary algorithm i.e. Non-dominated sorting genetic algorithm II (NSGA-II) . Finally, an online software is developed as a teaching aid or a research tool for planning the crops at the regional level.

Name of Student: Ms. Sanchita Naha
Roll No: 10597
Guide: Dr. Sudeep

Ontology Driven Context Aware Recommender System for Maize Cultivation

To successfully grow a crop up to its maximum yield potential, farmers require suggestions about which variety to grow, where to buy seeds from, where to sell the produce, weather information and the correct cultivation practices to be followed. Farmers either reach out to their nearest Krishi Vigyan Kendras (KVKs), other government organizations or contact their fellow farmers for information. The major drawback in the process is not only its time taking but mostly farmers are given a generalized and broader advisory which does not suit their individual requirements. This creates a major gap in adoption of new technologies to farmer's field. Keeping this in mind, a recommendation algorithm has been developed which recommends management practices to the farmers based on their current context (e.g., farm conditions, soil status, budget availability, labour affordability, season of cultivation,

purpose of planting, availability of water sources, power availability etc). A multi agent based mobile application has been developed to identify and capture the relevant context parameters for each and every management practice followed for maize cultivation. Farmer's preferences of a particular management practice under certain context have been gathered to help recommend suitable management practices to other farmers having similar contextual conditions. An ontology has been developed for mapping the context and their suitability to various cultivation practices of maize. The developed context aware system provides better recommendations to farmers than the currently available crop advisory services.

M.Sc. (Computer Application)

Name of Student: Shubhasish Sarkar
Roll No: 21261
Guide: Dr. Mukesh Kumar

Mobile based Decision Support System for Nutrition and Health Assessment Using Anthropometry Techniques

Farmers are the assets of any country in the globe since they generate food for the people, but what if they become unwell or malnourished which will stifle the country's progress. As a result, both farmers and government agencies must keep track on the nutritional health of their constituents in order to provide the best possible service to them. In this context, this research focuses on the creation of an Android-based mobile application that will assist in evaluating the nutritional state of farmers using several anthropometric measurements that are effective in providing a basic overview of their health status and guiding them. This Android-based mobile application was created using a variety of software tools, including the Android Studio development environment, Java programming language, eXtensible Markup Language for application user-end development and a MySQL server as a backend database to store the farmers details data and the various index values of all the farmers. A mobile-based decision support system called '*NutriGuide*' was created for this purpose, and it will assist them in assessing their physical fitness and nutritional state, as well as provide them with a quick note on the value of different types of foods for different age groups. It also has the function that allows you to download the data in excel file for additional examination. Other than all this the application provides a brief details containing suggestions regarding food requirement for nutritional sufficiency.

Name of Student: Apoorva B.M
Roll No: 21263
Guide: Dr. S.B. Lal

Mobile App based Management of Grape Cultivation in Subtropical Region

Mobile apps are potential digital tools that can be used to reach a large number of farmers in a short period with agricultural information. They can be used to boost farm income and productivity by providing accurate information, better input and farm management, easy marketing, and connecting with government agencies to provide policy support to farmers, among other things. In this study, an attempt has been made to develop a mobile application named "GrapeCulture" for Indian farmers. This mobile application is aimed to provide valid and detailed information on vineyard management practices like spacing, planting, training, pruning, maturing, and fertilization, irrigation. It suggests the varieties suitable for the subtropical region. It gives information on pests and diseases along with management practices and recommends suitable pesticides for particular pests and diseases. It provides information on the physiological disorder and nutritional deficiencies. This application suggests the number of vines that can be accommodated in a given spacing. 'GrapeCulture' mobile application was created using the Android Studio IDE, Java programming language, and XML for application user-end development and SQLite as a backend database to store the information of the subtropical grapes. This mobile application aids in farm management, resulting in increased agricultural yield and farm maintenance, propelling agriculture to new heights.

Name of Student: Bharat Kumar N.
Roll No: 21264
Guide: Md. Samir Farooqi

Development of Mobile App for Management of Cole Crops

Cole crops such as Cabbage, Cauliflower, Broccoli, Brussel Sprouts, Kale, and Kohlrabi are rich source of vitamin A, Vitamin C, beta carotene, antioxidants and phytochemicals which can help in preventing cancer and heart diseases. Infestation by insect pests and damage caused by diseases are the major factors responsible for the low productivity of cole crops. Therefore, there is need to develop mobile

application which provides detailed information about cultivation practices, different varieties, insect-pests, diseases, physiological disorders and weeds in major cole crops. Thus mobile app on Cole Crops 'ColeApp' has been developed with the objectives "To develop a mobile app for cultivation practices and management of major cole crops", "To populate the database for management of major cole crops". The 'ColeApp' mobile application was created using the Android Studio IDE, Java programming language, and XML for application user-end development and SQLite as a backend database to store the information of package of practices of major cole crops. This 'ColeApp' application contains features such as description of cultivation practices, different varieties which are resistant to particular disease or pest and which are not resistant to disease and pest, different types of the insect-pests, diseases that cause damage through decrease in yield as well as productivity, available measures to control pests and diseases such as Integrated Pest Management (IPM) and Integrated Disease Management (IDM) practices at each stage of crop, nematodes which cause damage with their control methods, different weeds which cause damage to decrease yield and their management practices of major cole crops. The developed mobile application 'ColeApp' would be helpful to the farmers to reduce the crop losses and also to increase the yield and making the farming a profitable venture.

Name of Student: Pratiksha Subba
Roll No: 21265
Guide: Dr. S.N. Islam

Development of Mobile Application on Integrated Farming System

The marginal and small farmers do not get the desired output due to the lack of knowledge and information about the cropping systems. Most of them follow mono-cropping system and traditional way of farming that lacks diversification. Integration of multiple enterprises such as livestock, poultry, fisheries, mushroom production, and bee keeping along with traditional crops is needed for a better income for farmers. However, farmers are not aware about the cropping system to be followed with the available land and resources that can fetch him a better return. Multiple models of integrated farming system have been developed based on agro climatic condition, area, resources available and factors that effects production, productivity and returns. These models need to be reached out to the farmers in a scientific way so that they may adopt it for a better return. There is a need for the development of mobile application to guide the farmers to choose different enterprise and follow different cropping sequence that will help them obtain maximum output with sustainable lifestyle. The developed mobile application is a decision support system for the farmers to select the right IFS model according to their need. It guides them about the different enterprise to be followed up and also about the cropping sequence that may be adopted for a better return. The decision support system has been developed by using Android Studio 2.3, Java and XML has been used to programming. Tools used to develop this decision support system are SQLite, Android Studio IDE and Android Device Monitor. This app provides user friendly interface that helps the user to select the suitable IFS model.

Name of Student: Bhavesh Kumar Chaubisa
Roll No: 20962
Guide: Dr. Anu Sharma

Development of a Deep Learning-based Classification Model and Web-based Application for Prediction of LncRNA in Crops

Ribonucleic acid (RNA) is mainly of two types, coding RNA and non-coding RNA. Coding RNAs are messenger RNAs (mRNAs) that encode proteins. A non-coding RNA (ncRNA) molecule is one that is not translated into a protein. There are various types of non-coding RNAs in which long non-coding RNA is also a type of non-coding RNA. Long non-coding RNAs (LncRNAs) are a form of RNA that are commonly characterized as transcripts with more than 200 nucleotides that are not translated into protein. Plant LncRNAs regulate embryogenesis, root organogenesis, reproduction, and gene silencing through DNA methylation. So, there is a need to uncover the function of LncRNA in crop plants. For this purpose firstly we need prediction tool, which can predict sequence as LncRNA or other type of RNA. There are many tools available for classification between LncRNA and coding RNA but most generally they were related to humans and other organism. Also these tools were alignment based, so they were very hard to use. But, in this study we developed a web application named as "PLNC-Predictor" by using deep learning based binary classification model CNN. The accuracy of model is 93.40%. The developed model is deployed as web application by using anvil software, a platform for Python for making web application.

Name of Student: Lalsab Momin
Roll No: 21372
Guide: Dr. S.N. Islam

Development of Web-based Application for Predicting Market Price of Agricultural Commodities Using Machine Learning Techniques

For farmers, Agricultural commodities market price information is essential for smooth and active operation of marketing system. A web-based application has been developed. This application is aimed to predict agricultural commodities market price that can help to safeguard the farmers from market fluctuation and mitigates the risk of loss in profit. Hence the farmers can plan better for releasing their agricultural commodities to market. This web application is based on 3-tier architecture. The front-end interface development carried out using front end technology tools such as Hypertext Markup Language (HTML), Cascading Style Sheets (CSS) and Java Script. Sever side implemented python programming language, Django framework. For prediction purpose implemented 4 machine learning techniques such as Autoregressive Integrated Moving Average (ARIMA), Artificial Neural Network (ANN), Support Vector Regression (SVR) and Random Forest Regression (RFR). ARIMA model imported from *Pmdarima* python module and supervised learning models ANN, SVR and RFR imported from *scikit-learn* python module. Then all models' performance were evaluated by performance parameters such as , Root Mean Squared Error (RMSE) and Mean Absolute Percentage Error (MAPE). Developed web application has been tested by using sample data collected from Ghaziabad market rice crop arrival price as well predicted market prices with all the models.

Ph.D. (Bioinformatics)

Name of Student: Chiranjib Sarkar
Roll No: 10434
Guide: Dr. Rajender Parsad

A Study on Gene Regulatory Network for Rice Blast Disease

Study of gene regulatory network (GRN) helps in understanding complex biological processes. Inferring GRN is a very challenging task as it involves computationally complex steps. The consensus GRN has been constructed using Fisher's weighted method which combines the results obtained from correlation, principal component regression (PCR), partial least squares (PLS), ridge regression-based scoring methods. The consensus GRN has been constructed using the gene expression datasets of rice leaves under blast infected condition to understand the resistance mechanism in the crop occur during blast fungus infection. Differentially expressed genes (DEG) have been identified using one-way analysis of variance (ANOVA). The DEGs have been considered for computing pair wise connectivity score using correlation, PCR, PLS and ridge regression. The significant edges have been combined by Fisher's weighted method. 74 significant edges and 40 nodes (genes) have been found in the consensus GRN at 1% level of significance with 8 degrees of freedom of chi-square distribution. The evaluation of GRN has been performed using Hamiltonian distance-based criteria, hub genes in the network and QTL analysis. The performance of consensus GRN is better than the individual methods correlation, PCR, PLS and ridge regression. The consensus GRN construction combining the results obtained from correlation, PCR, PLS and ridge regression will be helpful for biological research for understanding pathways of diseases. An interactive and user-friendly web tool has been developed for consensus GRN construction. The web tool can take gene expression data as input and the output results are provided as downloadable format in result window. The interactive web tool can be very useful and less time-consuming for constructing GRN.

Name of Student: Bulbul Ahmed
Roll No: 10781
Guide: Dr. Anil Rai

Development of a Deep Learning based Methodology for Functional Protein Classification

Cereals, belonging to *poaceae* family, are staple crops widely cultivated across the world. Production of these crops is highly affected by biotic and abiotic stresses, adversely affecting the crop growth and development, leading to economic loss, thus warranting the study of such genes. The genes start adapting under stress factors and produce proteins that can tolerate such changes by changing signaling pathways in protein-protein interaction. Finding these proteins are highly expensive, time consuming and require skilled person. To overcome these constraints, rapid classification and prediction of such proteins using computation approaches is required. Different machine learning techniques, *namely,* support

vector machine(SVM), random forest (RF) and deep learning (long short-term memory (LSTM)) were applied for development of classification models for protein sequences associated with four major abiotic stresses (heat, cold, salinity and drought). Besides, an activation function, *i.e.,* Gaussian Error Linear Unit with Sigmoid function (SiELU) was developed for deployment in the deep learning model, which showed an increased accuracy and performance of the model. Lastly, a web-based tool, "*DeepAProt: Crop specific abiotic stress protein classification tool using Deep Learning"* available at http://login1.cabgrid.res.in:5000/ has been developed for prediction of these abiotic stress associated proteins from poaceae family implementing the proposed LSTM deep learning methodology with *SiELU* activation function and tuning of other hyper-parameters. This tool can classify the functional proteins associated with abiotic stresses which would be useful for breeders in endeavor of better management and improvement.

Name of Student: Priyanka Guha Majumdar
Roll No: 10717
Guide: Dr. A.R. Rao

Development of Models for Classification and Characterization of RNAs

In this study, different machine learning algorithms were employed for classification of coding and non-coding RNAs (ncRNAs), followed by classifications of ncRNAs into different classes. Besides, involvement of ncRNAs in gene regulatory mechanisms of biotic and abiotic stress responses were also studied. Initially, feature selection algorithms such as random forest (RF) variable importance and Boruta were deployed on 1472 sequence-derived features of RNA to extract the most significant features. Then, support vector machine (SVM), RF, artificial neural network (ANN), and deep neural network (DNN) were trained with extracted features for discriminating coding RNAs (cRNAs) from ncRNAs. In addition, autoencoder, a representation learning algorithm, with DNN classifier was applied for binary classification of RNAs. Furthermore, the ncRNAs were classified into nine classes using SVM, RF, ANN and DNN models. Ten-fold cross-validation approach was adopted to evaluate the performance of learning algorithms. The results revealed that, among the binary classifiers, RF model exhibited highest average classification accuracy followed by autoencoder feature-based DNN, DNN, ANN and SVM. Among the multiclass classifiers, SVM exhibited highest classification accuracy, followed by RF, DNN and ANN. With regard to the multi-class classification using independent dataset, the prediction accuracy was found highest for SVM followed by RF, DNN and ANN. The findings from annotation of targeted genes of classified ncRNAs and identified endogenous target mimics- eTMs reveal the likely involvement of targeted genes in important cellular components, molecular processes and biological processes. A further downstream analysis on targeted genes reveals their role in various biotic and abiotic stress response mechanisms such as early blight, defense against viruses, rice blast, osmotic stress, heat, cold, drought and salinity stresses. Finally, a prediction server "RNAClass" was developed based on the binary and multiclass classification models trained with data from plant RNAs.

M.Sc. (Bioinformatics)

Name: Bibek Saha
Roll No: 21255
Guide: Dr. D.C. Mishra

Identification and Characterization of LncRNA in Ricebean (*Vigna umbellata*)

Ricebean, *Vigna umbellata* is a Kharif-season annual legume. Its seeds are consumed as pulse. It is considered as a minor legume as it is grown in limited areas as an intercrop with maize and sorghum. It is mostly grown in Northern part of India (mainly Uttarakhand) and North-eastern part of India (mainly Assam). Its seed contains a good amount of protein and other nutrients. The protein-coding RNA of developing stages of seed largely regulated by non-coding RNA specifically long non-coding RNA. Long non-coding RNAs (lncRNAs) are a large and diverse class of transcribed RNA molecules with a nucleotide length of more than 200 bp and open reading frame (ORF)<100 bp that do not encode proteins. It is one of the types of regulatory non-coding RNA. LncRNAs are important regulators of gene expression by DNA methylation and chromatin remodeling, and in some cases, they act as miRNA (Micro RNA) sponges to enhance the expression of mRNA targeted by miRNA. LncRNAs are thought to have a wide range of functions in cellular and developmental processes. LncRNA may be positioned beside protein coding genes or in between genes even it overlaps with coding genes. There has been hardly any work reported for the identification of lncRNA with respect to the Ricebean crop. This study aims to identify lncRNA and annotate its targets for the developing stages of Ricebean seed.

A total of 906 novel lncRNAs have been identified. Out of these 906 novel lncRNAs, 82 lncRNAs have targets of 15 miRNAs. It was observed that different lncRNAs could have similar miRNA targets. These 15 microRNAs had targets of 15 mRNAs. Lastly, annotation of 15 mRNAs was carried out and it was found that these mRNAs regulate different biological, cellular, metabolic processes of the developmental stages of Rice bean seed. 'RbLncDB', a web resource has also been developed under the present study to help future researchers in regard to Ricebean seed transcriptome.

Name: Laldhari Patel
Roll No: 21256
Guide: Sh. Sanjeev Kumar

Deep Learning for Predicting Breeding Value using High-Throughput (HTP) Genotyping and Phenotyping

Wheat is India's most important staple crop, coming in second only to rice. It is primarily consumed in the country's north and north-western regions. It provides a balanced diet to millions of people every day because it is high in protein, vitamins, and carbohydrates. Efforts have been made to improve wheat varieties since the time of the green revolution. Wheat is subjected to a variety of biotic and abiotic stresses, with drought being one of the abiotic stresses that causes senescence and, as a result, a decrease in yield. Traditional statistical methods have been widely utilized for modeling genotype effects and predicting phenotypes. These statistical methods usually assume that genotype random effects follow a prior distribution such as Gaussian etc., and the contribution of each genotype to the associated phenotype is considered as an independent feature. It was observed that these statistical assumptions can be overcome by application of deep learning in predicting the breeding values using high throughput genotyping. In this research a deep learning-based convolutional neural network (CNN) model has been used for the prediction of breeding value using high throughput genotyping and phenotyping data. For this we have taken wheat dataset which consist of 184 recombinant inbred lines (RILs), and each RILs contains 3121 filtered SNPs. Total six traits was taken for the prediction of breeding value. For each trait, the data had been collected in two environments i.e., controlled and drought condition. The whole dataset was divided into two parts one is training dataset and other is testing dataset. The training dataset contains 80% of data while testing dataset contains 20% of the data. Two parameters were taken to evaluate the performance of our deep learning model, first is correlation coefficient while other one is mean square error. After calculating the correlation coefficient and mean square error for each trait, the deep learning model was compared with the existing statistical model i.e., Genomic best linear unbiased prediction (GBLUP), ridge regression best linear unbiased prediction (rrBLUP) and Bayesian Least Absolute Selection and Shrinkage Operator (Bayesian LASSO). The result shows that deep learning model performs better as compared to statistical method.

Name of Student: Shivdarshan Shrishail Jirli
Roll No: 21258
Guide: Dr. Monender Grover

Identification and Characterization of bZIP and Dof Gene Families from Developing Seeds of *Vigna umbellata*

Basic leucine zipper (bZIP) gene family is one of the largest transcription factor gene families in plants and plays crucial roles in various biological processes, such as light signaling, seed maturation, plant growth, development as well as biotic and abiotic stresses. Currently no information is available regarding bZIP gene family in ricebean. In this study, 46 bZIP genes have been identified from draft genome of *Vigna umbellata*. All the members of VubZIP family were divided into 9 subfamilies based on phylogenetic relationship with *Arabidopsis thaliana* bZIPs. This was further supported by analysis of their conserved motifs and gene structures. VubZIP genes were characterized in terms of subcellular localization, primary structure analysis, secondary structure prediction and topology prediction. Promoter sequence analysis showed that VubZIP genes harbour many cis-elements related to stress responses. DNA binding with one fingers (Dof) proteins are plant specific transcriptional factors, which play important role in plant growth, development and various stress responses like drought, salt, osmotic and cold stress. Currently no information is available for this gene family in ricebean. In this study, bioinformatics analyses revealed 35 Dof genes in the draft genome of *Vigna umbellata*. All Dof genes were characterized that includes conserved protein domains, conserved motif analyses, subcellular localization, intron-exon analysis, primary structure analysis, secondary structure prediction and topology prediction. Although these Dof genes are variable in their length, molecular weight, iso-electric point etc. these genes contain a conserved structure called zf-Dof domain.

All the members of this gene family are divided into 5 subfamilies based on phylogenetic relationship with *Glycine max*, *Phaseolus vulgaris* Dofs. The promoter sequence of VuDof genes were analysed for cis-elements, which are responsible for tolerating stress condition in plants.

Name of Student: Asif Ali V.K.
Roll No: 21259
Guide: Dr. Anu Sharma

Phylogenetic Marker Genes based Approach for Binning of Metagenomics Data

Binning of metagenomic sequence is one of the important steps of metagenomic data analysis so as to produce meaningful 'bins' or groups. There are several techniques for grouping, among which binning is most widely used. Binning indicates to the process of classification of DNA sequences into clusters that might be the true representative of an individual genome or genomes from taxonomically related microorganisms. Binning uses different clustering techniques available such as K-Means, Density-based spatial clustering of applications with noise (DBSCAN), spectral clustering, hierarchical clustering, etc. But each of these clustering techniques has its own drawbacks. In the past, only few efforts have been made on the use of single-copy phylogenetic marker genes for the clustering of metagenomic data. The phylogenetic marker genes are protein encoding genes that are universal, single-copy marker genes and are rarely subjected to horizontal gene transfer (HGT). They have been used to accurately and consistently delineate prokaryotic species. In this study, a semi-supervised clustering approach is adopted to cluster the metagenomic data using marker genes. Initially, contigs harbouring marker genes are identified by running the Prodigal, FetchMG and USEARCH applications sequentially. Then the K-Means clustering technique is applied on the metagenomic data which has been already reduced to two dimensions using Barnes-Hut implementation of the t-Distributed Stochastic Neighbor Embedding (BH-TSNE) algorithm. In the end, correction of the generated clusters was carried out based on the sequences harbouring marker genes with the help of spectral clustering. K-Means clustering itself generated 8 clusters with a rand index of 0.973, a F1 score of 0.71 and an overall accuracy of 0.9 for a 10s genome dataset using tetra-nucleotide frequency as initial input feature matrix. While cluster correction resulted in the generation of 10 clusters with a rand index of 0.981, a F1 score of 0.91 and an overall accuracy of 0.95 for the same dataset. In a nutshell, the cluster correction using sequences harbouring marker genes produced better clustering results.

Name of Student: Chandana V.
Roll No: 21260
Guide: Dr. S.B. Lal

Prediction of Enzymes Involved in Bioremediation using Aquatic Metagenomes

Dye, hydrocarbon and plastics degrading enzymes have been identified using metagenomics data from 4 different sites of river Ganga such as Nawabganj, Kanpur; Jajmau, Kanpur; Below Farakka bridge, West Bengal and Paharghati, West Bengal with the help of RemeDB tool. The abundance of these enzymes have also been identified using MG-RAST pipeline (https://www.mg-rast.org/) and have also inferred which place is more polluted and which is less. Metabolic pathways of these enzymes have been identified using KEGG pathways (https://www.kegg.jp/kegg/pathway.html). A web-based search tool has been developed containing all the enzymes, organism name, pollutant they degrade and identity percentage of 4 different sites of river Ganga. Using the web-tool, one can search by entering enzyme name, place name, pollutant they degrade or identity and result can be viewed accordingly.

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3.	Dr. Ramasubrananian V, Principal Scientist	Member
4.	Dr. Ranjit Kumar Paul, Senior Scientist	Member
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6.	Mr. Vinay Kumar L.N, Student	Students' Representative

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3.	Dr. A.K.Paul, Principal Scientist	
4.	Dr. Anu Sharma, Principal Scientist	
5.	Dr. M.A.Iquebal, Senior Scientist	

AWARDS TO STUDENTS

Following students received Nehru Memorial Gold Medal 2021 for being the Best M.Sc. student for the session 2019-2021: (i) Mr. Manoj Varma, M.Sc. (Agricultural Statistics); (ii) Ms. Pratiksha Subba, M.Sc. (Computer Application) and (iii) Mr. Bibek Saha, M.Sc. (Bioinformatics).

ANNUAL DAY CELEBRATIONS

The Annual Day of the Institute was celebrated on July 02, 2022 in online mode. **Dr. G.P. Samanta**, Chief Statistician of India & Secretary, Ministry of Statistics and Programme Implementation, Government of India was the Chief Guest of the function and delivered **32th** Nehru Memorial Lecture **on the topic Sustainable Development Goals** and Professor Bikas Sinha, Former Member, National Statistical Commission and Retired Professor, Indian Statistical Institute, Kolkata was the Guest of Honour. Agricultural Research Data Book 2022, ISO Certificates of ICAR-Data Centre were released and Kisan Call Centre Data Repository-Collated Historically Aggregated Knowledge based System with Hypertext User-Interface (KCC-Chakshu Portal: https://kcc-chakshu.icar.gov.in/) was launched on the occasion. Certificate of Appreciation were also given to following authors for publishing research papers in Journals with 10+ IF: (i) Dr. Hukum Chandra (Posthumously); (ii) Dr. Vandita Kumari and (iii) Dr. Sudhir Srivastava.

TEACHER'S DAY CELEBRATIONS

The Institute celebrated Teacher's Day on September 05, 2022 in Hybrid mode (both Offline and Online). Dr. (Mrs.) Pankaj Mittal, Secretary General, Association of Indian Universities presented the Teacher's day lecture; Dr. Murari Singh, Former Senior Biometrician, International Centre for Agricultural Research in Dry Areas (ICARDA) was honoured as Inspiring Teacher. Dr. R.C. Agarwal, DDG (Agricultural Education), ICAR presided over the function. Students organized cultural programme

and decorated the different buildings with beautiful Rangoli's.

RESEARCH FELLOWSHIPS

During 2022, 58 Ph.D. and 34 M.Sc. students received research fellowship. Among Ph.D. students, 40 students received IASRI fellowship @ Rs.31,000/- (First and Second Year), 35,000/- (Third Year) per month in addition to Rs.10,000/- per annum as the contingency grant; 5 Ph.D. students received UGC fellowship @ 31,000/- per month and Contingency Rs.10,000/- per annum, and 12 students received ICAR-SRF fellowship @ Rs.31,000/-(First and Second Year), 35,000/- (Third Year) per month in addition to Rs.12,500/- per annum as the contingency grant. Among the M.Sc. students, 12 students received ICAR Junior Research Fellowship @ Rs.12,640/- per month in addition to Rs.7,500/- per annum as contingency grant; 22 students received IASRI fellowship @ Rs.7,560/- per month and Rs.6,000/- per annum as contingency grant, and 1 student received ST fellowship from Ministry of Tribal Affairs@ Rs. 28,000/- per month and 20,500 per annum.

NATIONAL / INTERNATIONAL TRAINING PROGRAMME

Senior Certificate Course in Agricultural Statistics and Computing

Senior Certificate Course in Agricultural Statistics and Computing was organized for the benefit of research workers engaged in handling statistical data collection, processing, interpretation and employed in research Institute of the Council, State Agricultural Universities and State Government Departments. The researchers of foreign countries including SAARC countries were also availed this course. The main objective of the course was to train the participants in the use of latest statistical techniques as well as use of computers and software packages. The course was organized during the period August 23, 2022 to January 25, 2023. The Course comprises of two independent modules of three months duration each. Module-I was organized during August 23, 2022 to November 05, 2022. Module-II was organized during November 14, 2022 to January 25, 2023. Three officers participated in Module-I and Three officer participated in Module-II. The course covered under both the modules included Statistical Methods and Official Agricultural Statistics, Use of Computers in Agricultural Research, Sampling Techniques, Econometrics and Forecasting Techniques, Design of Experiments and Statistical Genetics. Dr Sudeep was the course coordinator of the course.

Training Programmes Organized

S.No	Title and Coordinators	Period	Number of Participants
1	Metagenomic Data Analysis (Online) (Coordinators: Anu Sharma, Mohammad Samir Farooqi)	January 19-24, 2022	56
2	Statistical and Computational Methods for Biological Data Analysis in Agriculture (Online) (Coordinators: Sudhir Srivastava, U.B. Angadi and Sneha Murmu)	January 27-29, 2022	15
3	Short Course on Statistical Development for Data Analytics in Agricultural Experimentation (Online) (Coordinators: Arpan Bhowmik, Susheel Kumar Sarkar and Anindita Datta) *Sponsored by Education Division, ICAR*	January 27-February 05, 2022	27
4	Winter School on Artificial Intelligence in Agriculture (Online) (Coordinators: Sudeep, Alka Arora and Anshu Bharadwaj) *Sponsored by Education Division, ICAR*	February 15-March 07, 2022	47
5	QTL Analysis and Genome-wide Association Studies (Coordinators: MA Iquebal, Sarika and UB Angadi)	February 15- 24, 2022	133
6	Prediction of non-coding RNA (Online) (Coordinators: Anil Rai, Monendra Grover and S.B. Lal)	February 16-18, 2022	25

S.No	Title and Coordinators	Period	Number of Participants
7	Price Forecasting of Agricultural Commodities (Online) (Coordinators: Ranjit Kumar Paul)	February 21-March 02, 2022	40
8	Cyber Security for ICAR Technical Personnel (Online) (Coordinators: Mukesh Kumar and KK Chaturvedi)	March 02-07, 2022	19
9	Statistics and Informatics in experimental Data Management & Analysis (Online) (Coordinators: Sudeep, Sanjeev Kumar, Soumen Pal and Aninditta Datta)	March 14-21, 2022	208
10	Genome-Wide Association Studies and its Application In Agriculture (Online) (Coordinators: Sarika and MA Iquebal)	March 15-24, 2022	110
11	Data Analysis and Interpretation for 43rd and 44th batch of Indian Statistical Service (ISS) Probationers (Coordinators: B.N. Mandal and Ankur Biswas) *Sponsored by NSSTA, MoSPI, Government of India*	April 18-29, 2022	30
12	Experimental Design and Analysis of data through Statistical Software (Coordinators: Anil Kumar, Susheel Kumar Sarkar, Sukanta Dash and SC Negi from CSKHPKV): organized at CSKHPKV, Palampur jointly with ICAR-IASRI, New Delhi	May 24-30, 2022	312
13	Data Analysis and Interpretation for43rd and 44th batch of Indian Statistical Service (ISS) Probationers (Coordinators: Ramasubramanian V, Kaustav Aditya) *Sponsored by NSSTA, MoSPI, Government of India*	June 06-17, 2022	29
14	Metagenomic Data Analysis under CRP Genomics Platform (Online) (Coordinators: Anu Sharma, Md. Samir Farooqi and Ritwika Das)	October 18-21, 2022	33
15	Prominent Statistical tools for Data Science in Agriculture using R and Python (Coordinators: R.K. Paul, Prakash Kumar and Md. Yeasin) *CAFT sponsored by Education Divison, ICAR*	October 09-29, 2022	25
16	RNA World: Advance Bioinformatics for Deciphering Regulatory Molecules (Coordinators: Anu Sharma, Samir Farooqi and Ritwika Das)	November 03-09, 2022	53
17	Computer Applications for ICAR Technical Personnel (Online) (Coordinators: Shashi Dahiya, Chandan Kumar Deb and Akshay Dheeraj)	December 15-21, 2022	49
	हिन्दी कार्यशाला		
18	कृषि में जैविक डेटा विश्लेषण के लिए सांख्यिकीय और कम्प्यूटेशनल विधियां (ऑनलाइन) (समन्वयकरू सुधीर श्रीवास्तव एवं यू बी अंगड़ी)	जनवरी 27.29, 2022	19
19	कृषि शिक्षण एवंप्रशिक्षण में संगणक अनुप्रयोग (ऑनलाइन) (समन्वयकरू शशि दहिया एवं समर्थ गोदारा)	मार्च 26, 2022	20
20	परीक्षणात्मक अभिकल्पनाएँ एवं विश्लेषण (ऑनलाइन) (समन्वयकरू सुकांत दाश, अनिंदिता दत्ता, मो. हारून)	जून 14.16, 2022	19
21	बुनियादी सांख्यिकीय तकनीक और आनुवंशिकी में इसका अनुप्रयोग(ऑनलाइन) (समन्वयकरू आर.के. पॉल, मो. यासीन एवं प्रकाश कुमार)	अगस्त 03.05,2022	25
22	साइबर जागरूकता (समन्वयकरू सुभाष चंद एवं जय भगवान)	अक्टूबर 06, 2022	47

S.No	Title and Coordinators	Period	Number of Participants
23	कृषि आंकड़ों के लिए समय श्रंखला पूर्वानुमान और मशीन लरनिंग मौडल का अवलोकन (ऑनलाइन) (समन्वयकरू बिशाल गुरुंग, कंचन सिंह एवं अचल लामा)	दिसंबर 20.22, 2022	17

Other sensitization programme organized

- AR-VR Demo Modules organized online on February 07, 2022 (Sudeep and Anshu Bharadwaj): 51 participants
- AU-PIMS organized online for University of Horticultural Sciences, Bagalkot on (i) March 22, 2022 and (ii) July 22, 2022 (Sudeep and Alka Arora): 47 (10+37) Participants
- Eleven online training programmes of one day duration each on AgriDIKSHA at ICAR-IASRI New Delhi (online), during the year 2022 (April 7, 21, 28; May 5, 12, 19; June 2, 4, 9, 23, 30; July 07, 21, 2022) (Anshu Bharadwaj): 1216 (460+172+87+48+58+53+35+10+42+115+43+56+37) Participants
- Content creation using E-learning" organized online on April 20, 2022. (Shashi Dahiya): 170 Participants
- One day hands on training on NIBLD (05-05-2000) at ICAR-IASRI New Delhi (Chandan Kumar Deb, Sudeep Marwaha, Madhu): 3 participants
- One day online training programme on Land Record Management System (LRMS) on July 14, 2022 for Institutes of ICAR including their regionals stations and KVKs (SB Lal, Mukesh Kumar and K.K. Chaturvedi)
- AMS training at SKUAST, Srinagar under NAHEP (November 10-11, 2022) (Sudeep Marwaha); Participants: 30
- Operationalization of AMS, Virtual Classroom, AR/VR and other activities on-going under NAHEP Component-2 Project was organized on September 09, 2022 for general and November 23-24, 2022 at RLBCAU Jhansi. (Alka Arora and Anshu Bharadwaj): 60 (30+30) Participants

Internship Programme

During the year 2022, following 11 students of different Universities/Institutes worked at ICAR-IASRI as project trainee for their Graduation/Post Graduation dissertation work.

S. No.	Name of Student and Organisation	Title of the study	Name of the Mentor	Duration
1	Arushi Agarwal, Amity University of Biotechnology	Trait specific genome-wide marker discovery using computational approach	Sarika	February 14- May 13 2022
2	Yashwardhan Agarwal, Manipal University, Jaipur	Speaker recognition using Keras and TensorFlow	Soumen Pal	August 24-September 23, 2022
3	Abhishek Kumar Sahu, Odisha University of Agriculture and Technology	A Computational Study on DNA Binding Protein Prediction Based on Machine Learning Algorithm	P.K. Meher	August 20-December 19, 2022
4	Soumya Ranjan Sahu, Odisha University of Agriculture and Technology	A Computational Study on Sub-cellular Localization of mRNA	P.K.Meher	August 20-December 19, 2022
5	Ankita Mahapatra, Odisha University of Agriculture and Technology	Some investigations of microbial system on Indian river using metagenomics approach	D.C. Mishra	August 20-December 19, 2022
6	Manisha Sahu, Odisha University of Agriculture and Technology	Some investigation on identification of effector proteins for Sclerotinia stem rot disease of mustard	D.C. Mishra	August 20-December 19, 2022

Training Programmes Attended

- Geo-Spatial Analysis using QGIS & R organized by ICAR-NAARM, Hyderabad during February 14-19, 2022. (Soumen Pal, Shashi Dahiya, Bhartiand Md. Yeasin)
- QTL Analysis and Genome-wide Association Studies organized by Division of Agricultural Bioinformatics, ICAR-IASRI, New Delhi under DBT funded project during February 15-24, 2022. (Sneha Murmu)
- Artificial Intelligence in Agriculture organized by ICAR-IASRI in Online mode during February 15-March 07, 2022. (Ratna Prabha)
- Application of Remote Sensing and GIS in Land Resource Management for Sustainable Agriculture Programme organized by ICAR−National Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata during March 02-21, 2022. (Md Yeasin)
- Big Data Analytics under Futute Skills PRIME project by the Ministry of Electronics and Information Technology (MeitY), GoI organized by C-DAC, Noida during March 21-25, 2022. (Sneha Murmu, Soumya Sharma and Ritwika Das)
- Analytical Techniques for Impact Evaluation Methods organized by International Food Policy Research (IFPRI), South Asia Regional Office, New Delhi at the Institute of Agricultural Sciences, Banaras Hindu University (BHU) during April 25-30, 2022. (Raju Kumar)
- Introduction to ENVI Analytics organized by ESRI India from June 29–July 1, 2022. (Sapna Nigam)
- Executive Development Programme for Leadership Development organized by ICAR-NAARM, Hyderabad during July 04-09, 2022. (Rajender Parsad)
- Bhuvan Portal (https://bhuvan.nrsc.gov.in) utilization organized online by ISRO during July 12-14, 2022. (Ankur Biswas, Pankaj and Bharti)
- Public Procurement (Basic) at Arun Jaitley National Institute of Financial Management, Faridabad during August 29 - September 3, 2022. (Alka Arora)


मुख्य धारा में लाना
स्कूली शिक्षा में कृषि पाठ्यक्रम को मुख्य धारा में लाना

5.
Awards and Recognitions

Awards

Anindita Datta

- **Dr. GR Seth Memorial Young Scientist Award-2022** from Indian Society of Agricultural Statistics for the following paper.
  - Anindita Datta, Seema Jaggi, Cini Varghese, Eldho Varghese, Mohd. Harun and Arpan Bhowmik. Row-column designs with multiple units per cell balanced for spatial effects.

Pankaj Das

- **Dr. G.R. Seth Memorial Young Scientist Award 2022** from Indian Society of Agricultural Statistics for the following paper.
  - Pankaj Das, Achal Lama, G.K. Jha. Variational mode decomposition based machine learning models optimized with genetic algorithm for price forecasting.

Ankur Biswas and Deepak Singh

- **InSc Young Researcher Award 2022** by InSc Institute of Scholars. The award is given on the quality of research work published in reputed national or international research journals.

Bishal Gurung

- **Outstanding Scientist Award** by VDGOOD Professional Association on August 31, 2022.
- **Best Scientist Award in Agricultural Statistics** by Agro-Environmental Development Society, Majhra Ghat, Rampur UP.

Md Yeasin

- **Young Scientist Award** (2022) by Agricultural & Environmental Technology Development Society, U. S. Nagar, Uttarakhand, India.

Best Paper Award (Published, Oral/ Poster Presentation)

Anil Kumar

- **Best research paper award** at the National Conference on Landscape Management for Preventing Flood and Reservoir Sedimentation organized at BAU, Ranchi during September 22-24, 2022, for the following paper published in *Indian Journal of Soil Conservation*
  - Suresh Kumar, D.R. Singh, B. Mondal and Anil Kumar (2021). Farm level investments and factors affecting adoption of multiple soil and water conservation technologies in semi-arid tropics of India. *Indian Journal of Soil Conservation*, **49(2)**, 130-138.

Ramasubramanian V.

- **Dr. Anamitra Saha prize** for the paper entitled 'Surge Pricing and Catch-Income Sustainability Paradox in Marine Fisheries in Maharashtra (Dinesh Singh* Naorem, Nilesh Pawar, V.R. Kiresur, N. Sivaramane, V. Ramasubramanian and M. Krishnan) published in the July-September 2020 issue of *Indian Journal of Agricultural Economics*.
- **2nd Rank** in the oral presentation on Generative Adversarial Networks (GANs) for agricultural stock market prediction (G. Avinash*, Ramasubramanian V., Mrinmoy Ray and Nitesh Sharma) in the session on 'Global and Regional Policy Transformation' organized in the International conference on "Advances in Agriculture and Food System towards Sustainable Development Goals" during

August 22-24, 2022 by University of Agricultural sciences, Bangalore (jointly with ICAR and All India Agricultural Students Association, New Delhi)

Ankur Biswas

- **Professor R.N. Pillai best paper presentation award – 2022** for the paper entitled 'Proportion estimation under geographically weighted logistic regression model from survey data' in the Eighth International Conference on Statistics for Twenty-first Century-2022, organized by International Statistics Fraternity, School of Physical and Mathematical Sciences and Department of Statistics, University of Kerala, Trivandrum, during December 16-19, 2022,

Kaustav Aditya

- **Certificate of the session award** for best Oral presentation for the paper entitled Study on penetration possibility of renewable energy in tea estates of North Eastern India (Kaustav Aditya*, Raju Kumar, Vandita Kumari and Sandip Sanyal) at 7th International Conference on Opportunities and Challenges in Agriculture, Environmental and Biosciences for Global Development, Goa during October 29-31, 2022.

Sapna Nigam, Sudeep Marwaha and Alka Arora

- **Best poster award** for the paper entitled 'Image based wheat rust severity estimation using deep learning' in the International symposium on 'Advances in Plant Biotechnology and Nutritional Security' organized at ICAR-NIPB, New Delhi during April 28-30, 2022.

Anindita Datta

- **Best paper presentation award** for the paper 'Trend free constant block sum PBIB designs using magic Square (Satyam Verma, Arpan Bhowmik, Seema Jaggi, Eldho Varghese, Cini Varghese and Anindita Datta)' in the National E-conference on Mathematical Sciences for Applied and Agricultural Research on February 22, 2022 at Department of Mathematics & Statistics CCS Haryana Agricultural University Hisar.

Mohd Harun

- **Dr. R.K. Arora best paper award** (2021) from Indian Society of Plant Genetic Resources for the following paper.
  - Anil Patidar, Mahesh C Yadav, JyotiKumari, Shailesh Tiwari, Munesh K Kushwah, Mohammed Harun, Vijay Paul and BS Tomar (2021). Morphophysiological characterization of bread wheat accessions for heat stress tolerance under late sown conditions of North Western plain zone of India. *Indian Journal of Plant Genetic Resources,* **34(2)**, 258-273.

Pankaj Das

- **Best oral presentation award** for the paper entitled Optimal energy utilization and Greenhouse emissions for pear producer for North West India using data envelopment analysis (Pankaj Das, J.S. Brar and T. Adhikary) in the VII International conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences at BAU, Ranchi during November 21-23, 2022.

Sanchita Naha

- **Best poster presentation** for the paper entitled Ontology driven context aware recommender system for maize cultivation (Sanchita Naha, Sudeep Marwaha and Alka Arora) in the International symposium on 'Advances in Plant Biotechnology and Nutritional Security' organized by ICAR-NIPB, New Delhi during April 28-30, 2022.

Ratna Prabha

- **Best oral presentation award** for the presentation on 'Metagenomics insights into reproductive tract of White Pekin and Khaki Campbell ducks (Ratna Prabha)' in the "International Conference on Biotechnological Trends and Prospects", organized by University of Agricultural Sciences, GKVK, Bangalore, during September 13-15, 2022.

Sneha Murmu

- **Best oral presentation award** for the paper entitled 'Prediction of protein-protein interactions between anti-CRISPR and CRISPR-Cas' in the International Conference on 'Advances in

Agricultural, Veterinary and Allied Sciences for Improved Livelihood and Environment Security' jointly organized by ICAR-IGFR, RRS, Srinagar, ICAR-NAHEP, BAU, Ranchi and NADCL, Baramulla at University of Kashmir, Hazratbal in an online mode on September 30, 2022.

Congratulations to Our Alumni

- Dr. Tanuj Mishra, Ph.D. student in the discipline of Computer Applications for receiving **Jawaharlal Nehru Award** for best Ph.D. thesis in social sciences and Dr. A.R. Rao, former Faculty at ICAR-IASRI for receiving **Rafi Ahmad Kidwai Award** from ICAR on July 16, 2022.

ICAR Jawaharlal Nehru Award: Dr. Tanuj Mishra

ICAR Rafi Ahmad Kidwai Award: Dr. A.R. Rao

Recognitions

Rajender Parsad

- **Chairman**, (i) Dr. M.N. Das Memorial Young Scientist Award session; **Co-Chairman**, (i) Hukum Chandra Memorial Session and (ii) Lalmohan Bhar Memorial Session and **Organizer** for Keynote Address and Dr. M.N. Das Memorial Lecture during 24th National Conference organized jointly with ICAR-National Academy of Agricultural Research Management and Society of Statistics, Computer and Application during February 23-27, 2022.
- **Member**, Programme Steering and Monitoring Committee (PSMC) under the Biotech-Krishi Innovation Science Application Network (Biotech-KISAN).
- **Eminent Speaker** in the National webinar on Significance of Experimental Designs in Agricultural Research organized by the Department of Statistics, Mathematics & Computer Science under the aegis of NAHEP, SKN Agriculture University, Jobner on June 29, 2022.
- **Keynote Speaker** during Webinar organized by Department of Agricultural Statistics, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, West Bengal to celebrate National Statistics Day on June 29, 2022.
- **Guest of Honour** during inaugural function of the Training Programme on **Big Data Analysis and Research Methods using Statistical Softwares** organized by Division of Statistics and Computer Science under the aegis of IDP SKUAST-J, Jammu during July 26-August 01, 2022
- **Member**, Committee constituted by ICAR for Conducting AgriTech Hackathon on Speed Breeding for Crop Improvement, ICAR
- **Member**, Committee constituted by ICAR for ranking of the Agricultural Universities.
- **Member**, the Award Review Committee to review/ rationalize the awards instituted by the Ministry of Statistics & Programme Implementation, Govt. of India.
- **Moderator** for Session on Best Practices followed by the States in Crop Estimation during the National Conference on Crop Estimation Methodology organized by Directorate of Economics and Statistics on July 13, 2022 at AP Shinde Symposium Hall, NASC Complex, Pusa, New Delhi.
- **Guest of Honour**, during inaugural function of **DST-SERB** sponsored Karyashala on Statistical and Machine Learning Techniques for Agricultural Systems Modelling and Forecasting Using R organized by ICAR-Indian Institute of Rice Research, Hyderabad during July 18-30, 2022.

- **Chaired**, Technical Session on **Education and Applied Sciences** organized as part of 2nd International Conference on Hospitality and Tourism - Revival Strategies organized by Institute of Hotel Management, Catering and Nutrition, Pusa, New Delhi during August 24-26, 2022.
- **Member,** ICAR-NIPB Institute Management Committee.
- **Chief Guest,** on the occasion of Valedictory function of 03 days training programme organized for the Schedule cast farmers under the Schedule caste sub plan on **Role of Agroforestry in increasing Farmer's Income** organized by ICAR-Central Agroforestry Research Institute, Jhansi during October 19-21, 2022 under the aegis of SC Sub Plan of ICAR-IASRI, New Delhi
- **Member,** Advisory Committee for 73rd Annual Conference of Indian Society of Agricultural Statistics organized on **Statistics and Machine Learning for Big Data Analytics** by Division of Agricultural Statistics, FOH, SKUAST-Kashmir, Srinagar during November 14-16, 2022
- **Guest of Honour** during Inaugural function and **Convener,** (i) 56th Dr Rajendra Prasad Memorial Lecture on Statistics, AI/ML and Big Data Analytics delivered by Dr GP Samanta, Chief Statistician of India and Secretary Ministry of Statistics and Programme Implementation and (ii) 41st Dr VG Panse Memorial Lecture on Paradigm Shift in Agricultural Education to Meet Agriculture Revolution 4 in 73rd Annual Conference of Indian Society of Agricultural Statistics organized on **Statistics and Machine Learning for Big Data Analytics** by Division of Agricultural Statistics, FOH, SKUAST-K, Srinagar during November 14-16, 2022
- **Guest of Honour** during Launch of Academic Management System at OUAT, Bhubaneswar on December 07, 2022

Anil Rai

- **Chairman**, Technical Session International Symposium on Data Driven Agriculture and Natural Resource Management-Opportunities and Challenges organized by Indian Society of Agricultural Information Technology during January 21-22, 2022.
- **Chairman,** Technical Session in International Workshop on Smart Farming/Precision Agriculture organized by Shastri Indo-Canadian Institute on April 05, 2022.
- **Chairman,** Technical Session on Genome Sequencing, Bioinformatics in 43rd Annual Meeting of Plant Tissue Culture Association (India) & International Symposium on Advances in Plant Biotechnology and Nutritional Security on April 30, 2022.
- **Chairman** of Digital/ Hi-Tech Agriculture 'Technical Working Groups for assisting the UT Level Apex Committee (UTLAC) to frame the comprehensive Agriculture Policy for holistic Development of Agriculture and Allied Sectors in UT of J&K'.
- **Chairman**, Technical Session on Big Data Analytics, Machine Learning, Artificial Intelligence and their Applications in Agriculture in 73rd Annual Conference of ISAS held in SKUAST, Srinagar from November 14-16, 2022.

Tauqueer Ahmad

- **Expert Speaker** for Food Loss Measurement in India: A Sample Survey Approach developed by ICAR-IASRI for Session-3, Climate and Nutrition Considerations in Urban Food Systems on 31 March, 2022 in the World Bank-FAO Knowledge Session Series.
- **Subject Matter Expert** by Ministry of Food Processing Industries, Govt. of India for attending meetings (online) for evaluation and suggestions for the RFP of the proposed study on Level of Processing.

Amrit Paul and Susheel Sarkar

- Member, Organizing Committee 73rd Annual Conference of Indian Society of Agricultural Statistics organized by Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar during November 14-16, 2022.

M.A.Iqueabal

- **Fellow of the West Bengal Academy of Science and Technology in the year 2022** in the field of Genomics and Bioinformatics.

R.K. Paul

- **Fellowship** of Indian Society of Agricultural Statistics in the 73rd annual Conference of Indian Society of Agricultural Statistics organized by Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar during November 14-16, 2022.
- **Convener of Dr. Lalmohan Bhar Memorial Session during** 73rd Annual Conference of Indian Society of Agricultural Statistics.
- **Eminent Scientist Award-2022** by Agricultural & Environmental Technology Development Society (AETDS).

K.N. Singh

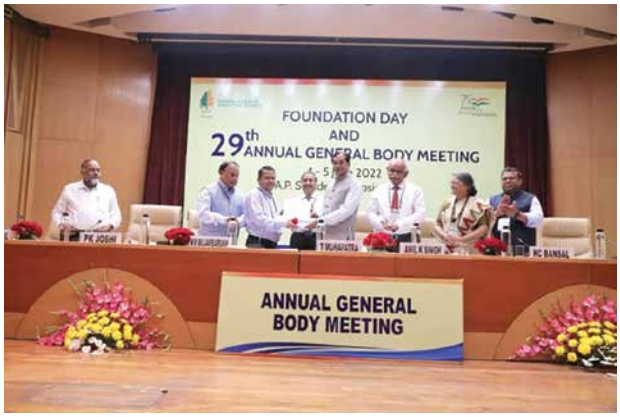
- Chairman contributed paper presentation session (on Statistical Modelling) during 73rd Annual Conference of Indian Society of Agricultural Statistics during November 14-16, 2022.

Susheel Kumar Sarkar and Ranjit Kumar Paul

- Chairman contributed paper presentation session (on Inference and Multivariate Methods) during 73rd Annual Conference of Indian Society of Agricultural Statistics during November 14-16, 2022.

Prabina Kumar Meher

- Received **NAAS Associateship** on June 05, 2022.
- **Selected Membership**, National Academy of Sciences India (NASI), 2022



Selected Candidates for NASI- Membership (Biological Sciences) Year-2022

Sr.no.	Name & Research Area	Gender	Designation & Address
1.	Dr. Rajarshi Kumar Gaur (Plant Biotechnology)	Male	Professor, Department of Biotechnology, D.D.U. Gorakhpur University-273009
2.	Prof. Ram Sagar (Ecology)	Male	Professor, Department of Botany, B.H.U, Varanasi-221005
3.	Dr. Mohan C. D. (Animal Molecular Biology-Cancer Biology)	Male	Assistant Professor, Department of Studies in Molecular Biology University of Mysore, Manasagangotri Mysore-570006, Karnataka, India
4.	Dr. Manoj Kumar Tripathi (Agricultural Engineering-Food Technology)	Male	Principal Scientist, ICAR-Central Institute of Agricultural Engineering, Nabi Bagh, Baresia Road, Bhopal
5.	Dr. Prabina Kumar Meher (Agricultural Bioinformatics)	Male	Scientist (Senior Scale), Division of Statistical Genetics, ICAR-Indian Agricultural Statistics Research Institute, New Delhi-110012
6.	Dr. Mahendar Thudi (Agricultural Bioinformatics)	Male	Associate Professor, Department of Agricultural Biotechnology and Molecular Biology, Dr. Rajendra Prasad Central University, Bihar
7.	Dr. Vikash Chandra (Veterinary Science)	Male	Senior Scientist ,Division of Physiology & Climatology ICAR-Indian Veterinary Research Institute, Izatnagar-243122 (UP)
8.	Dr. Shabir Hussain Wani (Agricultural Science)	Male	Assistant Professor, Sher E Kashmir University of Agricultural Science and Technology, Srinagar, J & K
9.	Dr. Vivek Singh (Medical-Ophthalmology)	Male	Senior Scientist, Centre for Ocular Regeneration ,LV Prasad Eye Institute, Hyderabad
10.	Dr. Vijay Gahlaut (Agricultural Biotechnology)	Male	DST INSPIRE Faculty, CSIR-Institute of Himalayan Bioresource Technology,Palampur-176061
11.	Dr. Mohhamad Salman Khan (Bioscience-Drug Target)	Male	Associate Professor, Department of Biosciences, Integral University, Lucknow
12.	Dr. Sonu Gandhi (Animal Biotechnology)	Female	Scientist-D, DBT-National Institute of Animal Biotechnology (NIAB) Gachibowli, Hyderabad, Telangana - 500032, India

- The scientists of the Institute also served as Executive President/ Vice President/Secretary/ Treasurer/Joint Secretary/Members on the Executive Council of various Professional Societies and Chair Editor/Coordinating Editor/ Executive Editor/Associate Editor for various International and National peer reviewed journals.

भारतीय कृषि सांख्यिकी अनुसंधान संस्थान
INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE

6. Linkages and Collaborations Including Outside Funded Projects

SN	Title	Collaborative /Funding agency	Date of Start	Date of completion
1.	Planning, designing and analysis of experiments planned ON STATION under AICRP on IFS	ICAR-IIFSR, Modipuram	01.04.2017	31.03.2023
2.	Designing and analysis of ON FARM research experiments planned under AICRP on IFS	ICAR-IIFSR, Modipuram	01.04.2017	31.03.2023
3.	Planning, designing and analysis of data relating to experiments for AICRP on Long Term Fertilizer experiments	ICAR- IISS, Bhopal	01.04.2017	31.03.2023
4.	ICAR research data repository for knowledge management as KRISHI: Agricultural Knowledge Resources and Information System Hub for Innovations (ICAR Headquarters component ICT including Data Centre & Research Data Repository)	ICAR-NAARM, Hyderabad; ICAR-NBSSLUP, Nagpur; ICAR-IARI, New Delhi; ICAR-CRIDA, Hyderabad; ICAR- CMFRI, Kochi; ICAR- DKMA, New Delhi as partners and all other ICAR Institutes as Nodal Centers	24.07.2015	31.03.2023
5.	Efficient designs for double cross experiments under fixed/mixed effects model	ICAR-DPR, Hyderabad; ICAR- IARI, New Delhi	11.11.2021	10.11.2024
6.	Application of next-generation breeding, genotyping, and digitalization approaches for improving the genetic gain in Indian staple crops.	ICAR-IIMR, Hyderabad; ICAR-IIPR, Kanpur; ICAR-CPRI, Shimla; ICAR-NRRI, Cuttack; ICAR-IIRR, Hyderabad; ICAR-IIWBR, Karnal; ICAR-Project Coordinating Unit (Pearl millet), ICRISAT(up to November, 2021), Excellences in Breeding, CIMMYT (since November 2021)	22.01.2019	31.10.2023
7.	Biomass and carbon mapping across altitudinal gradient of major Darjeeling and Sikkim Himalayan land uses: implications for carbon sink management and mitigation (DST funded)	UBKV, Cooch Behar	10.02.2021	09.02.2024
8.	Sustainable biochar production and use through Rice-Cotton based agroforestry system in Odisha: A climate resilient soil management approach	World Agroforestry Centre, International Center for Research in Agroforestry (ICRAF); ICAR-IISS, Bhopal	25.08.2021	31.05.2023
9.	Diversified farming through livestock and agriculture. (ICAR-CIRB Farmer First)	ICAR-CIRB, Hisar; ICAR-IARI, New Delhi	25.11.2021	31.03.2023
10.	Doubling farmers' income in India by 2021-22: Estimating farm income and facilitating the implementation of strategic framework.	Ministry of Agriculture and Farmers Welfare, Govt. of India	31.03.2017	31.03.2023

SN	Title	Collaborative /Funding agency	Date of Start	Date of completion
11.	Modelling insect pests and diseases under climate change and development of digital tools for pest management (NICRA Funded: CRIDA)	ICAR-NCIPM, New Delhi	20.06.2017	31.03.2023
12.	Integrated sample survey solution for major livestock products.	DAHDF, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India	27.03.2019	31.01.2023
13.	Knowledge management system for agriculture extension services in Indian NARES (ICAR-Extramural Research Project)	Agricultural Extension Division, ICAR	04.03.2016	31.03.2026
14.	Market information system	ICAR-NIAP, New Delhi	22.01.2022	31.03.2026
15.	Management and impact assessment of Farmer FIRST Project	ICAR-NIAP, New Delhi & Agricultural Extension Division, ICAR	01.02.2017	31.03. 2023
16.	Molecular markers for improving reproduction of cattle and buffaloes - Funded by Bill and Melinda Gates Foundation (BMGF)	ICAR-NDRI, Karnal; ICAR-CIRB, Hisar	19.09.2018	30.09.2023
17.	Molecular characterization, development of molecular markers and metabolite analysis of Tree bean (*Parkia roxburghii*) landraces of North-East India (DBT Funded)	ICAR-RC NEHR (Gangtok, Sikkim Centre) and UBKV, Cooch Behar	15.03.2019	14.03.2022
18.	Genomics assisted crop improvement and management - Centre for Advanced Agricultural Science and Technology (CAAST) project funded by National Agricultural Higher Education Project (NAHEP Funded)	ICAR-IARI, New Delhi; ICAR-NBPGR, New Delhi and ICAR-NIPB, New Delhi	26.09.2018	31.03.2023
19.	Genome wide association study in Indigenous poultry breeds/varieties	International Livestock Research Institute (ILRI), ICAR-DPR, Hyderabad	21.05.2020	31.12.2022
20.	Feasibility study for developing renewable energy systems for Tea plantations in Assam	Indian Institute Technology, Delhi	01.02.2020	31.03.2022
21.	Explicating genomic insights of Indigenous equines breed population through “Computational Genomics” and “Artificial Intelligence” based approaches	ICAR-NRCE, Hisar	17.08.2020	30.11.2022
22.	Mainstreaming rice landraces diversity in varietal development through genome wide association studies: A model for large-scale utilization of gene bank collections of rice (DBT Funded)	ICAR-IARI, New Delhi	01.05.2020	30.04.2025
23.	Germplasm characterization and trait discovery in wheat using genomics approaches and its integration for improving climate resilience, productivity and nutritional quality. (DBT Funded)	ICAR-NBPGR, New Delhi	01.04.2020	31.03.2025

SN	Title	Collaborative /Funding agency	Date of Start	Date of completion
24.	Minor oilseeds of Indian origin: Mainstreaming sesame germplasm for productivity enhancement and sustainability through genomics assisted core development and trait discovery (DBT Funded)	ICAR-NBPGR, New Delhi	01.03.2020	28.02.2025
25.	Identification and functional characterization of the key resistance/ susceptible determinants for Sclerotinia stem rot disease in oilseed Brassica (DST Funded).	ICAR-NIPB, New Delhi	30.12.2020	31.12.2023
26.	Forecasting Agricultural output using Space Agrometeorology and Land based observations (FASAL)	Indian Meteorological Department (IMD)	13.04.2016	30.09.2022
27.	Leveraging institutional innovations for inclusive and market led agricultural growth in eastern India. (NASF Funded)	ICAR-IARI, New Delhi; BHU, Varanasi; ICAR-NRRI, Cuttack; Ch. Charan Singh-National Institute of Agricultural Marketing-NIAM, Jaipur	01.12.2019	30.11.2022
28.	Characterization, evaluation, genetic enhancement and generation of genomic resources for accelerated utilization and improvement of minor pulses (DBT Funded).	Institute of Life Sciences, Bhubaneshwar, ICAR-NBPGR, New Delhi, UAS, Bangalore, PAU, Ludhiana, VNMKV, Parbhani, ICAR-CAZRI, Jodhpur, World Vegetable Centre, South Asia, Hyderabad	24.10.2018	23.10.2022
29.	Improving seed health and storage system.	ICAR- Indian Institute of Seed Science (IISS), Mau	25.01.2022	31.03.2026
30.	Assessing genetic variability in duck of Eastern states.	ICAR-RCER, Patna	08.02.2021	31.08.2022
31.	Potential irrigated area mapping through remotely sensed high resolution data.	ICAR-IIWM, Bhubaneswar; ICAR-NBSSLUP, Nagpur; Office of Climate Research and Services, IMD, Pune	05.09.2021	04.09.2024
32.	Network Program on Precision Agriculture (NePPA) at ICAR-IARI New Delhi	ICAR- IARI, New Delhi; ICAR-IIWBR, Karnal; ICAR-NRRI, Cuttack; ICAR-IIWM, Bhuabaneswar; ICAR- IIVR, Varanasi; ICAR-IISS, Bhopal; ICAR-CIAE, Bhopal; ICAR-NRCB, Tiruchirappalli; ICAR-CICR, Nagpur; ICAR-NBSSLUP, Nagpur; ICAR-NDRI, Karnal; ICAR- CIPHET, Ludhiana; ICAR- CIFE, Mumbai; ICAR-CIFA, Bhubaneswar; ICAR-CIFRI), Barrackpore	04.09.2021	31.03.2026
33.	Investments in Indian Council of Agricultural Research leadership on agricultural higher education under the National Agricultural Higher Education Project (NAHEP Funded)	ICAR-NAARM, Hyderabad; ICAR-NIAP, New Delhi	28.02.2019	30.11.2022
34.	Development of artificial intelligence integrated big-data based system for automatic query-response generation and analysis of Indian farmers' queries	ICAR-IARI, New Delhi	09.12.2021	08.12.2024

SN	Title	Collaborative /Funding agency	Date of Start	Date of completion
35.	AI and machine learning for supply forecasts	ICAR-NIAP, New Delhi	03.03.2022	31.03.2026
36.	Mining agricultural microbiome datasets for Antibiotic Resistance Genes (ARG) diversity and prediction of microbial resistome.	ICAR-NBAIM, Mau	03.10.2022	02.04.2025
37.	Development of an intelligent system for determining pig live weight	ICAR-IVRI, Izatnagar	02.06.2022	18.10.2023
38.	Development and assessment of conversational virtual agents 'Chatbots' for improving livestock, pet and poultry health and production	ICAR-IVRI, Izatnagar	10.10.2022	31.08.2025
39.	Computational and analytical solutions for high-throughput biological data (CRP Genomics).	ICAR-NBFGR, Lucknow	04.09.2015	30.10.2022
40.	Study on reviewing the food loss index estimates for India and preparing assessment report for inclusion of the SDG indicator12.3.1 in the National Indicator Framework (Consultancy from FAO, India)	FAO, India	11.11.2022	10.05.2023
41.	Knowledge Management System for DUS characteristics of crops (Contract research from PPVFRA, Ministry of Agriculture and Farmers Welfare)	PPVFRA, Ministry of Agriculture and Farmers Welfare, Govt. of India.	05.01.2019	31.03.2022

7. Publications

Research Papers

1. Adikary T and Das P (2022). Conventional and biotechnological approaches for enhancing shelf-life of horticultural crops. *भारतीय कृषि अनुसंधान पत्रिका*, **37(2)**, 114-120. https://doi.org/10.18805/BKAP398
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सांख्यिकी विमर्श, भा.कृ.अनु.प.–भारतीय कृषि सांख्यिकी अनुसंधान संस्थान पत्रिका 2021 में प्रकाशित लेख

- राहुल बनर्जी, भारती, पंकज दास एवं मनीष कुमार (2021). कृषि में साँख्यिकी का अनुप्रयोग, कृषि सेवा हिन्दी ऑनलाइन, ई–पत्रिका ।) https://wwww-krishisewa-com/)
- हरिमोहन मीना, रंजय कुमार सिंह, प्रियब्रत सान्त्रा एवं सी.बी. पाण्डेय । मिनी–लाइसीमीटर द्वारा सिंचाई के विभिन्न स्तरों पर ग्रीष्म ग्वार के वास्तविक वाष्पोत्सर्जन का अध्ययन, 11–15 ।

- टी.बी. पीटर, सिनी वर्गीस, सीमा जग्गी, मोहम्मद हारून, एल्दो वर्गीस एवं देवेन्द्र कुमार । वृक्ष–तंत्र संतुलन से युक्त कृषि–वानिकी परीक्षण, 16–21 ।
- मधु, सपना निगम, संचिता नाहा एवं चंदन कुमार देब। विशेषता निष्कर्षण तकनीकों और समानता आव्यूह की समीक्षाः सामग्री–आधारित छवि पुनप्राप्ति, 22–27 ।
- कौस्तव आदित्य, पंकज दास, भारती, अंकुर विश्वास, श्रीला दास एवं मंजू गौतम । फसल कटाई परीक्षणों की कम संख्या का उपयोग करके जिला स्तरीय प्रमुख फसल उपज अनुमान, 28–33।
- हिमाद्रि घोष एवं सविता वधवा । बहिर्जात चर के साथ गॉम्पर्ट्ज प्रसंभाव्य विभिन्नात्मक समीकरण पद्धति, 34–38।
- पंकज दास, कौस्तव आदित्य और भारती । कुमारस्वामी बंटनः प्रसामान्य बंटन की एक नई श्रेणी, 39–44।
- रंजीत कुमार पॉल, अमृत कुमार पॉल, दीपांकर मित्रा एवं एस. पी. सिंह। दीर्घकाल अनुस्मरण समय श्रृंखला मॉडल द्वारा भारत में चावल की कीमतों का पूर्वानुमान, 45–51।
- बिजोय चन्द, अर्पण भौमिक, सीमा जग्गी, एल्दो वर्गीस, सिनी वर्गीस, अनिंदिता दत्ता एवं देवेन्द्र कुमार। कृषि परीक्षण हेतु प्रचलन प्रतिरोधी लागत प्रभावी द्विस्तर घटकीय रन क्रम, 52–55।
- पंकज दास, भारती, कौस्तव आदित्य, एवं अमृत कुमार पॉल। पशुओं में गैर–रैखिक मिश्रित प्रभाव मॉडल का उपयोग करके वृद्धि मापदंडों का अनुमान और स्थिर प्रभाव मॉडल के साथ तुलना, 56–62 ।
- सपना निगम, अक्षय धीरज, संचिता नाहा, मो. अशराफुल हक, सौमेन पाल एवं मधु। स्मार्ट खेती में इन्टरनेट ऑफ थिंग्स का उपयोग, 63–66।
- सुकान्त दाश, अनिल कुमार, बैद्यनाथ मंडल, सुशील कुमार सरकार एवं देवेन्द्र कुमार। स्वसंयोजित लक्षण प्रतिचित्र का उपयोग करते हुए फसल जीन प्रारूप का वर्गीकरण, 67–72।
- राहुल बनर्जी, संगमित्रा पाल, तौकीर अहमद एवं भारती । रिपीटेड मेजरमेंट डेटा में प्रेडिक्शन दृष्टिकोण, 73–77।
- सुधीर श्रीवास्तव, स्नेहा मुर्मू, मो. समीर फारुकी, नीरज बुढ़लाकोटी, द्विजेश चंद्र मिश्र, यू.बी. अंगड़ि एवं के.के. चतुर्वेदी। प्रोटिओमिक्स आँकड़ों के विश्लेषण का संक्षिप्त विवरण, 78–84।
- प्रकाश कुमार, रंजीत कुमार पॉल, अमृत कुमार पॉल, राजू कुमार, राजीव रंजन कुमार, मृन्मय राय एवं मो. यासीन। स्थायित्व विश्लेषण– अप्राचालिक दृष्टिकोण, 85–91।
- रंजीत कुमार पॉल, तनिमा दास, अमृत कुमार पॉल, प्रकाश कुमार, मोहम्मद यासीन एवं एस.पी. सिंह। गार्च और एस वी आर के संयोजित मॉडल का उपयोग करके कृषि कमोडिटी की कीमतों में अस्थिरता का पूर्वानुमान, 92–95।
- मोहम्मद यासीन, के.एन. सिंह, अचल. लामा, बिशाल गुरुंग, रंजीत कुमार पॉल, प्रकाश कुमार, अमृत कुमार पॉल, हिमाद्रि शेखर रॉय एवं विशाल दिनकर। फसल उपज के पूर्वानुमान के लिए उन्नत मौसम सूचकांक आधारित बेसिअन समाश्रयण मॉडल, 96–103।
- भारती पाण्डेय, स्नेहा मुर्मू, सौम्या शर्मा, ऋत्विका दास, नीरज बुढ़लाकोटी, द्विजेश चंद्र मिश्र, दीपा भट्ट सुधीर श्रीवास्तव और मो. समीर फारुकी।। मैग्नापोर्थे ओरेजे से एफेक्टर प्रोटीन और चावल से माइटोकॉन्ड्रिया संबद्ध प्रोटीन कॉम्प्लेक्स के बीच परस्पर प्रभाव की जांच, 104–111।
- स्नेहा मुर्मू, सुधीर श्रीवास्तव, भारती पाण्डेय, सौम्या शर्मा, ऋत्विका दास, के.के.चतुर्वेदी और मो. समीर फारुकी। आणविक गतिशीलता सिमुलेशन का उपयोग करके मंकीपॉक्स प्रोटीन के विरुद्ध फाइटोकेमिकल अवरोधकों की पहचान, 112–118।

राष्ट्रीय बालिका दिवस

2022

24 January

8.

IRC, RAC, IMC and QRT

Institute Research Committee (IRC)

The Institute Research Committee (IRC) is an important forum to guide the scientists in the formulation of new research projects and it also prioritizes and reviews the progress of on-going research projects periodically. It also monitors the follow up action on the recommendations of the Quinquennial Review Team (QRT) and Research Advisory Committee (RAC) in respect of technical programmes of the Institute. Director, ICAR-IASRI is the Chairman and In-Charge, PME cell is the Member Secretary of the IRC. All scientists of the Institute are the members of IRC.

During the 93rd IRC meeting held during March 02-05, 2022, twenty-two new research projects (07 Institute funded, 05 in collaboration with other Institute and 10 outside funded) were approved and progress of 81 on-going research projects (27 Institute funded, 09 in collaboration with other Institute and 45 outside funded) were reviewed and 24 research projects were declared as complete.

Research Advisory Committee (RAC)

The new Research Advisory Committee was constituted vide Office Order No./ F.No.Agril.Edn.14 (18)/2021-A&P dated December 27, 2021. The 21st meeting of the Research Advisory Committee (RAC) was held on August 23, 2022. The meeting was Chaired by Professor Bikas K Sinha, Former Professor of Statistics, Indian Statistical Institute, Kolkata and Former Member, National Statistical Commission, Govt. of India. Professor K. Muralidharan, Professor, Department of Statistics, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat; Dr. Indrarnil Mukhopadhyay, Professor, Human Genetics Unit, Indian Statistical Institute, Kolkata; Dr. Mausam, Professor, Jai Gupta Chair, Department of Computer Science and Engineering, Indian Institute of Technology, Delhi; Dr. P.S. Pandey, Assistant Director General (Education Planning & Home Science), ICAR, New Delhi; Dr. Rajender Parsad, Director, ICAR-IASRI, New Delhi as Members also graced the occasion. Dr. Ajit as Member Secretary organized the meeting. Dr. Sitabhra Sinha, Institute of Mathematical Sciences, C.I.T Campus, Taramani, Chennai and Member-Research Advisory Committee, could not attend the meeting because of personal reasons. Head of Divisions and Professor of teaching disciplines were also present as invitees.

At the outset, Dr. Rajender Parsad, Director, ICAR-IASRI, welcomed all the members of RAC. He also presented brief bio-data of all esteemed members. Thereafter, Professor Bikas Sinha, Chairman welcomed all the members of the RAC and other invitees. At the outset, Professor Sinha congratulated all scientists of the Institute to work in the direction of fulfilling the recommendations of last RAC. He emphasized that the research programmes of the Institute are in accordance with the Government of India Programmes. He further said that although few projects are linked with Sustainable Development Goals (SDGs), yet more emphasis should be laid on linking the research projects with SDGs.

Action taken report on the recommendations of 20th RAC meeting were presented by the Member Secretary. The research, education, training and development activities of the Institute were presented by Director, ICAR-IASRI along with genesis and growth of the Institute. He appraised that the Institute is catering to the needs of (i) NARES; (ii) NASS ; (iii) E-Governance activities of ICAR and simultaneously prove to peers on Basic Research in Statistical Sciences. He emphasized that efficient design of experiments, statistical methodologies, information systems/portals, bioinformatics tools developed by the Institute are widely being adopted in National Agricultural Research and Education System (NARES), National Agricultural Statistics System (NASS) and several African and Latin American countries. The contributions of the Institute in terms of human resource development were also presented. He also presented the research, teaching and training activities of the Institute and summarized significant research achievements of the Institute (during the last two years).

RAC members highly appreciated the contributions and achievements made by the Institute in all spheres of research, teaching, training, advisory services and e-governance services. From the day long deliberations, presentations and discussions on the research, teaching and training activities of the Institute, the following action points/ recommendations emerged:

1. The Institute should put rigorous emphasis on enhancing the visibility of the Institute (a) improving contents/look-and-feel of the website, social-media-posting, ICAR-IASRI Wikipedia

page etc. (b) highlighting the impact factor of the papers published, h-index, placement of students, Further aspects of impact of research, teaching and training activities of the Institute also need to be studied.

2. The Institute should organize following two Workshops (i) "Meta-Data-Analysis" under the consultation and guidance of Prof. Bikas Sinha and (ii) "Data-Integration" under the consultation and guidance of Prof. Indranil Mukhopaddhyay and other members.
3. Policy paper on fertilizer recommendations based on data from Long Term Fertilizer Experiments (LTFE) data, organic farming, and various experiments and surveys should be brought out at the earliest possible by including the soil data from LTFE.
4. Proposal on virtual Centre of Excellence on Artificial Intelligence may be prepared and implemented at the earliest possible.
5. ICAR-IASRI should initiate PG Diploma/Diploma Courses on Data-Science.
6. Ecosystem for early warnings on agricultural crops/animals should be developed.

Institute Management Committee (IMC)

The new IMC was constituted vide F.No. Agril. Edn. 14(12)/2018-A&P dated February 24, 2022. The 70th Meeting of IMC (Institute Management Committee) was held online on December 28, 2022 under the Chairmanship of Dr. Rajender Parsad, Director, ICAR-IASRI. The distinguished members present in the meeting includes Dr. Seema Jaggi, ADG (HRD), ICAR, New Delhi; Dr. Abhijit Kar, Director, ICAR-NISA, Ranchi; Dr. A. Dhandapani, Principal Scientist, ICAR-NAARM, Hyderabad; Dr. P.K. Mandal, Principal Scientist, ICAR-NBPGR, New Delhi, Director(Fisheries), Panchkula; Dr. Prachi Mishra Sahoo, Principal Scientist, ICAR-IASRI, New Delhi and Sh. Abhishek Srivastava, Chief Administrative Officer & Member Secretary, ICAR-IASRI, New Delhi.

Action taken report on the recommendations of 69th IMC meeting were presented by Member Secretary. Director, ICAR-IASRI presented the research and other achievements of the Institute. Dr. Alka Arora presented a proposal on *Virtual Centre of Excellence on Artificial Intelligence* and Dr. Anil Rai made a presentation on new project entitled *Establishment of Centre for Bioinformatics and Computational Biology in Agriculture-BIC* approved by DBT. The committee appreciated the progress of the Institute. The other proposals put before the committee are the present status of rear block of SSM-Building and 15 Type-I quarters at Krishi-Niketan, Paschim Vihar. The committee agreed in principle for condemnation of the same. The committee also agreed in principle for the condemnation of Office-vehicle-Ambassador DL9CQ-7502 as per rules.

Quinquennial Review Team (QRT)

The QRT usually reviews the progress of the Institute for preceding five-year period. The last QRT Team reviewed the progress of the Institute for the period 01.04.2011 to 31.03.2018. The QRT submitted its report in 2020. Dr. G.C. Manna was the Chairman and the members include Professor Rita Saha Ray, Dr. Ashish Kumar, Dr. N. Balakrishna, Dr. B.V.S Sisodia, Dr. Sridhar Sivasubbu and Dr. Hukum Chandra as Member Secretary.

The recommendations of the QRT were approved by Governing Body (GB) in its 251st Meeting held on October 15, 2020. The recommendations are changing the mandate and nomenclature of two divisions viz Centre of Agricultural Bioinformatics and Statistical Genetics. The nomenclature of Centre of Agricultural Bioinformatics has been changed to Division of Agricultural Bioinformatics by ICAR-IASRI vide office order No. F/N. 20(11)/2010-Admin.1(170824) dated 27th December 2022. The appropriate action has been/is being taken on all the recommendations of QRT as per approval of GB.

9.

Conferences, Workshops, Webinars, Symposium, Meetings and Special Events Organized

Workshops/Symposium

- Online International symposium on **Data Driven Agriculture and Natural Resource Management – Opportunities and Challenges** as an Associate Partner in collaboration with Indian Society of Agricultural Information Technology (INSAIT) during 21-22 January, 2022. Major themes of the symposium were Data Driven Agriculture, Data Driven Natural Resource Management, Smart Farming Resource Management and High Performance Computing in Agriculture. (Conveners: Rajender Parsad and Alka Arora)

- International Workshop on **Skill Development through Impact Analysis of Emerging Data with Agricultural Technology in Population Sciences** jointly with Assam Agricultural University during March 11-17, 2022. A special session was organized on Skill Development for Youths through Data and Technology for the farmers and students on March 12, 2022. (Conveners: Mukesh Kumar and KK Chaturvedi)
- Workshop on **Sampling Design and Analysis** under the project AICRP on EAAI project on 20 October 2022 regarding determination of sample size and collection of data: 49 participants. (Convener: Kaustav Aditya)
- Workshop on **Breeding Informatics in Plant Breeding** organized jointly by ICAR-IARI, Excellence in Breeding (EiB), CIMMYT and ICAR-IASRI under the aegis of ICAR-BMGF collaborative project entitled 'Application of Next-Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic Gain in Indian Staple Crops' at ICAR-IASRI, New Delhi during December 28-30, 2022: 20 Participants. (Conveners: Susheel Kumar Sarkar and Anil Kumar)

Webinars

- **Statistics in Financial Services** by Dr. Venu Madhav Kandla, Director, Investment Management Data Science & Engineering was organized on January 22, 2022. The webinar was attended by 83 Faculty, students and Alumni of IASRI and other NARES organizations. (Convener: Dr. Rajender Parsad)
- **KRISHI Portal** to sensitize colleagues at ICAR-Indian Institute of Pulses Research, Kanpur on February 14, 2022. (Conveners: Rajender Parsad and Susheel Kumar Sarkar)
- **Creating a Winning Personality** by Ms. Chhawi Asthana, Image Consultant, Soft Skills Trainer & Leadership Development Coach, Chhawi Asthana Imaging Consultancy on February 28, 2022. The webinar was attended by 55+ participants from NARES. (Conveners: Alka Arora and Rajender Parsad)
- **My Journey through Fields Across Continents** by Dr. Bikas Sinha, Former Member, National Statistical Commission, Government of India and Former Professor, Indian Statistical Institute, Kolkata on March 11, 2022. The webinar was attended by 56 Faculty, students and Alumni of IASRI and other NARES organizations. (Conveners: Rajender Parsad and Anshu Bharadwaj)
- **Mega Opportunities in Indian Agriculture** by Mr. Sanjay Vidyarathi, Managing Director and CEO, Agritech Enablers on March 17, 2022. The webinar was attended by 54 Faculty, students and Alumni of IASRI and Other NARES organizations. (Convener: Anshu Bhardwaj)

- Collaborated as Resource Person in the programme on *किसान भागीदारी, प्राथमिकता हमारी* organized by KVK Narayangaon, Pune, Maharastra on April 26, 2022 in which 188 farmers participated. The lecture was delivered on ICT in Agriculture and Digital Initiatives of ICAR-IASRI including Kisan-Sarathi, Kisan App, KVK App, ICAR Video Gallery, ICAR Mobile App Gallery. (Convener: Alka Arora)
- **Digital Resources in Agriculture** including Kisan-Sarathi, KISAAN 2.0, KVK Portal and KVK App, ICAR Video Gallery, ICAR Mobile App Gallery etc. in the campaign *किसान भागीदारी, प्राथमिकता हमारी* at Village: Patla, Tehsil: Modinagar, District: Ghaziabad on April 28, 2022. The webinar was attended by 35 farmers. (Convener: Soumen Pal and Deepak Singh).
- **Balanced Soil Nutrition through Soil Test Crop Response Approach** by Dr. Pradip Dey, Project Coordinator, AICRP on Soil Test Crop Response Correlation, IISS, Bhopalas, part of National Level Campaign on Efficient and Balanced Use of Fertilizers (including nano fertilizers) was organized on June 21, 2022. The webinar was attended by 50 Faculty, Students of IASRI, and famers. 8 farmers (from Haryana, Punjab, Rajasthan and Bihar: Ganga Ram Sepat, Pravin, Ramji Sharma, Kapil, Sahil, Sandeep Sharma, Vikash Choudhary, SK Kakrliya) expressed their views. The points emerged were: Balanced fertilization is helpful for soil health. Nano Fertilizers are good and helpful in maintaining soil health and increasing income. There is a labour shortage for application of spray of nano-fertilizers. Also more intensive programmes may be organized to reach to the farmers those who are not linked to Institutes/KVKs. (Convener: Ajit)
- **Cyber Security Essentials in Education / Research Sector** by Sh. Ravi Badge, President and owner CMIT Solutions, New Jersey was organized on July 01, 2022: 85+ Participants. (Convener: Rajender Parsad).

Brainstorming Session

- **Mainstreaming Agricultural Curriculum in School Education** by PIU-NAHEP and ICAR-IASRI organized on June 14, 2022 to create awareness among school goers at primary, secondary & higher secondary levels about the importance and scope of agriculture & allied sectors. This was aimed to fulfil the requirement under the NEP - 2020

which focuses on redesigning the agricultural education system with a greater push towards developing professional courses including the agricultural science to impart better education. This was inaugurated by Union Minister of Agriculture and Farmers Welfare. Experts from the ICAR, NCERT, CBSE along with the various School Principals and Teachers participated and deliberated on the need & process for the introduction of Agriculture as a Subject in the School Curriculum. (Conveners: Anuradha Agrawal, Sudeep, Anshu Bharadwaj, Shashi Dahiya, and Alka Arora).

Special Events

Kisan Gosthi/Trainings under SC-Sub Plan Scheme

- Kisan Goshthi I: organized for 150+ SC community farmers on May 11, 2022 at Gram Panchyat-Pesri, Block- Dibai, District-Bulandshar, UP. Sh. Udaivir Singh, ACTO provided a brief about the programme and management of paddy crop. Dr. Mukesh Kumar highlighted the use of ICT in agriculture and provided a brief about the ICAR Mobile App Gallery and ICAR Video Gallery. Dr. Soumen Pal shared the information about KVK App and other IT applications available for farmers. Paddy seeds and kharif vegetable kits were distributed to SC community farmers. (Conveners: Mukesh Kumar, Soumen Pal and Udaivir Singh)
- Kisan Gosthi-II : organized for 15+ SC community farmers on May 21, 2022 at Village –Chirsi, District-Faridabad (Haryana). Sh. Vijay Pal Yadav, Coordinator, KVK Bhopani Faridabad provided a brief of the programme. Dr. Rajender Kumar, SMS Agronomy, KVK Bhopani, Faridabad shared information about the paddy crop management practices. Dr. Mukesh Kumar highlighted the use of ICT in Agriculture and

provided a brief about the ICAR Mobile App Gallery and ICAR Video Gallery. Paddy seeds and kharif vegetable kits were distributed to SC community farmers. (Convener: Mukesh Kumar)

- Organised two training programmes for Scheduled Caste farmers on Agroforestry for Increasing Farmers' Income at ICAR-Central Agro-forestry Research Institute, Jhansi during October 17-19, 2022 and November 22-24, 2022. 25 farmers participated in each training programme. During these training programmes Digital Resources Useful for farmers were also shared by faculty from ICAR-IASRI, New Delhi.

Celebrations

- **National Girl Child Day:** Celebrated National Girl Child Day on January 24, 2022 on the theme **Empowering Girl for Brighter Tomorrow**. This day was initiated by the Ministry of Women and Child Development, Government of India in 2008. The Guest Speaker was Ms Kavita Mathur, Chief People and Organization Officer, Tilegal, Gurugram. 93 participants attended the event. (Conveners: Rajender Parsad, Anshu Bharadwaj, Alka Arora)
- **National Science Day Celebration:** To celebrate National Science Day, a Webinar on **Agricultural Supply Chain Visibility using Graph Database Technologies** was organized on February 28, 2022. (Speakers: Sh. Amar Bafna, Managing Director, Accenture India; Sh. Hemanshu Gaur, Associate Director, Accenture India and Sh. Vipin Dubey, Manager, Accenture India). 100+ participants from NARES attended the webinar. (Conveners: Rajender Parsad, Anshu Bharadwaj and Alka Arora)
- **International Women's Day:** The Institute celebrated International Women's Day on the theme **Gender Equality Today for a Sustainable Tomorrow** on March 08, 2022. A webinar on Women in Technology lead to Sustainable Future was delivered by Dr. Swati Kaushal, Modern Work Lead, Education, Microsoft. On this occasion, women staff was felicitated with a green plant. 95 participants from NARES attended the programme. (Conveners: Rajender Parsad, Alka Arora, Anshu Bhardwaj, Sneha Murmu and Bharti Pandey)
- **16th National Statistics Day:** The Institute celebrated the 16th National Statistics Day online on June 29, 2022. Smt. R. Savithri, Additional Director General (Social Statistics Division) was the Chief Guest on the occasion and delivered the keynote address on the theme **Data for Sustainable Development**. Dr. S.D. Sharma, Former Director ICAR-IASRI and Former Vice Chancellor Dev Sanskriti Vishwavidyalaya, was the Guest of Honour. The event brought together the staff, students, and alumni of ICAR-IASRI and helped in creating awareness about the importance of Statistics in socio-economic planning and policy formulation. (Conveners: Rajender Parsad, Cini Varghese and Students)
- **International Yoga Day:** The Institute celebrated 8th International Yoga Day on June 21, 2022 with the theme **Yoga for Humanity** to achieve the objective of Yoga for peace and Harmony. (Convener: K.K. Chaturvedi and Jai Bhagwan)
- **Independence Day:** The Institute celebrated 75 years of Independence on August 15, 2022. Dr. Rajender Parsad, Director hoisted the National Flag at ICAR-IASRI, New Delhi and addressed the staff and students. The students and faculty presented a cultural programme on the occasion.
- **Vigilance Awareness Week:** Institute organized Vigilance Awareness week during October 31-November 06, 2022 on the theme **Corruption- free India for a Developed Nation**. Director, Scientists, Technical and Administrative personnel took Integrity Pledge on October 31, 2022. Dr. Pankaj Kumar, Director (Animal Science), ICAR, New Delhi delivered a seminar CCS (Conduct) Rules on November 02, 2022. Posters were also displayed in each building of the Institute during the week.
- **Kisan Diwas (National Farmers' Day) 2022:** Kisan Diwas was celebrated online on December 23, 2022. Dr. Rajender Parsad, Director, ICAR-IASRI explained the importance of Celebrating Kisan Diwas on the birthday of former Prime Minister of India in his inaugural address. He also welcomed the farmers (i) Sh. Pradeep Sheoran from Haryana; (ii) Sh. Anil Pharsawal from Uttar Pradesh, (iii) Sh. Manish from Punjab and (iv) Sh. Ranjit Sharma from Bihar. The invited farmers also delivered talks on the Kisan Diwas on various topics like Dairy and Dairy products, Organic agriculture, Climate smart agriculture, Seed production. Dr. Mukesh Kumar demonstrated ICAR Video Gallery, ICAR Mobile App Gallery and ICAR Technology Repository. Dr. Alka Arora made a presentation on Krishi Vigyan

Knowledge Network Portal (KVK Portal) and explained on how this portal is useful to interlink digitally farmers, scientists and domain experts of agriculture. She also explained on how to use the mobile app of KVK portal, what and how information can be gathered from this portal. She also shared information about KISAAN 2.0 (Krishi Integrated Solution for Agri Apps Navigation) which integrates 300+ Agricultural related apps developed by ICAR Institutes, SAUs, KVKs and other Govt. Departments. It is an aggregator mobile app that provides a single interface in multiple Indian languages for Indian farmers to access agricultural knowledge about crops, horticulture, livestock, fisheries, natural resource management, agricultural engineering etc. Dr. Soumen Pal presented the following mobile apps developed in collaboration with ICAR-Indian Veterinary Research Institute (IVRI), Izatnagar: (i) IVRI Animal Reproduction App; (ii) IVRI-Pig Farming App; (iii) IVRI-Vaccination Guide App, (iv) IVRI- Disease Control App; (v) IVRI-Artificial Insemination app and (vi) IVRI-Dairy manager app. Dr. K.K. Chaturvedi demonstrated Kisan Sarathi - System of Agri-information Resources Auto-transmission and Technology Hub Interface which is an Information Communication and Technology (ICT) based interface solution with an ultimate goal of supporting agriculture at local niche with national perspective. It is intended to provide a seamless, multimedia, multi-ways connectivity to the farmers with the latest agricultural technologies, knowledge base and the pool of a large number the subject matter experts. The farmers while expressing their views lauded the efforts of ICAR scientists and also stressed the need for further improvement in the farmer-research community interaction.

- **Tree Plantation Programme:** Saplings of Chandan (*Santalum Album*) were planted by **(i)** Dr. R.C. Agrawal, DDG (Agricultural Education), ICAR and Mrs. Alka Nangia Arora, Financial Advisor (DARE) on October 21, 2022; (ii) Dr. S.K. Chaudhari, DDG (Natural Resource Management) on November 01, 2022 and (iii) Dr. Pratap Singh Birthal, Director, ICAR-National Institute of Agricultural Economics and Policy Research on November 10, 2022.
- **Fit India Run 3.0:** Organized Fit India Freedom Run 3.0 on October 21, 2022. Staff and students of the Institute participated in Fit India Run through the campus.
- **Constitution Day 2022:** Institute celebrated Constitution Day on November 26, 2022. The staff and students read the Preamble along with Director, ICAR-IASRI, New Delhi.
- **Swachhata Pakhwada:** Swachhata Pakhwada was organized during December 16-31, 2022. Following activities were performed by Staff/ Students and Contractual manpower: stock taking on digitization of office records/e-office implementation was undertaken; review of progress on weeding out old records, disposing of old and obsolete furniture, junk materials and white washing/painting was conducted. Cleanliness and sanitation drives were carried out in residential colony near IASRI campus. The residents of the colony were counselled on cleaning of their premises and surroundings. Staff members were requested to perform cleaning in their respective residential colonies and nearby market places. Video shows on the following topics were organized: (i) Promoting clean and green technologies; (ii) Recycling water including treating sewage water to make it drinkable and treating kitchen waste water for reuse; (iii) Documentary film on Swachch Bharat Mission Grammeen; (iv) Bio-degrabable and non-biodegradable waste. A debate was also organized on the topic *Swachhata Mission has shown good progress since its inception and is on right track*. Swachhata committee addressed farm labours at ATIC Centre, ICAR-IARI, New Delhi. Chief Guest Dr. Prabhat Kumar, Horticulture Commissioner, Ministry of Agriculture and Farmers Welfare, Government of India stressed on relationship between traditional knowledge and Swachchata as Chief Guest during the Valedictory function.

Meetings Organized

- ICAR-ICT implementation and Operational Management Committee meeting on January 05, 2022. (Chair: Anil Rai, Co-Chair: Rajender Parsad)
- A meeting on Kisan-Sarathi and KISAN 2.0 on January 06, 2022 under the Chairmanship of Additional Secretary(DARE) and Secretary, ICAR. (Anil Rai and Rajender Parsad)
- ICAR ICT Steering Committee Meeting on January 12, 2022 under the Chairmanship of Secretary DARE and DG ICAR. (Anil Rai)

- Meeting about Kisan-SARATHI 2.0 under the Chairmanship of Honorable Minister of Agriculture and Farmers Welfare on February 22, 2022. (Anil Rai)
- Budget webinar strategies for implementation on 'SMART AGRICULTURE': (Sustainable, Modern/Mechanized, Aatmanirbhar, Resilient & Tech Driven Agriculture): Emerging Hi-tech & Digital Agri Ecosystem on February 24, 2022. (Anil Rai)
- Meeting on Kisan SARATHI under the Chairmanship of Secretary, DARE and Director General, ICAR on March 10, 2022. (Anil Rai and Sanjeev Kumar)
- Meeting of KVKs for all India launching of Kisan-SARATHI by Secretary, ICAR was organized on May 17, 2022. (Anil Rai, Sanjeev Kumar and Rajender Parsad)
- Joint meeting of Kisan-SARATHI 2.0 of senior officials from ICAR, DA&FW and Digital India Corporation under the Joint Chairmanship of Secretary, DARE and Director General, ICAR and Secretary DA&FW was organized on May 26, 2022. (Anil Rai)
- Meetings for the feedback, improvement, enrichment and resolving the issues of KVKs in Kisan SARATHI were organized on April 07, 2023 and April 21, 2023. (Sanjeev Kumar)
- Meeting along with the Director of the institute on Precision Agriculture on Farm Machinery on August 25, 2022 in ICAR-CIAE, Bhopal and August 26, 2022 at ICAR-IISS, Bhopal. (Anil Rai)
- Interaction meet of Officer Incharge Data Management under the project ICAR Research Data Repository for Knowledge Management on November 10, 2022. The meet was Chaired by DDG (NRM) and Chairman, Steering Committee and Co-Chaired by DDG (Education). (Rajender Parsad)
- ICT Steering Committee Meeting was organized under the Chairmanship of Secretary DARE and DG ICAR on December 05, 2022. (Anil Rai)
- Technical Review Committee Meeting of Horticulture Domain-Network Project on Agricultural Bioinformatics and Computational Biology under the Chairmanship of DDG (Horticulture), ICAR on December 27, 2022. (Anil Rai)

Stall in Pusa Krishi Vigyan Mela 2022

- The *Pusa Krishi Vigyan Mela - 2022* was organized from March 09-11, 2022 by the ICAR-Indian Agricultural Research Institute, New Delhi on the Theme - *"Self-sufficient Farmers with technological Knowledge"*. ICAR-IASRI demonstrated its developed technologies and advisories to farmers. Different technologies for welfare of farmers were displayed during this mela like KVK portal and KVK app, KRISHI Portal, Farmer FIRST (Farm, Innovations, Resources, Science and Technology) programme, National Agricultural Science Museum, Crop Cutting Experiments (CCE), End-to-End Solution for generation of estimates of Major Livestock Products and KISAN SARATHI. Visitors from various places visited the stall and nearly 525 farmers registered online in KISAN SARATHI portal at the stall.

Foreign Visit

- **Dr. Susheel Kumar Sarkar p**articipated in the TropAg conference held at the Brisbane Convention and Exhibition Centre in Australia during October 31- November 02, 2022. Interaction were held with experts of Breeding programme assessment tool (BPAT), University of Queensland.

10.

Paper Presentations in Conferences, Workshops and Symposium

Workshops/Symposium

- First International Symposium on Cereals for Food Security and Climate Resilience organized during January 18-20, 2022, through Online mode from ICAR-IIWBR, Karnal, India.
  - Sapna Nigam. Artificial intelligence based wheat stem rust identification and severity estimation. (Online poster presentation)
- Online International Symposium on Data Driven Agriculture and Natural Resource Management Opportunities and Challenges organized by Indian Society of Agricultural Information Technology and Associate Partners ICAR-IASRI, New Delhi; ICAR-NBSSLUP, Nagpur and ICAR-NIAP, New Delhi during January 21-22, 2022
  - Rajender Parsad. Research data management in ICAR. (Invited Talk)
  - Alka Arora. Computer vision approaches for plant phenotype parameter determination. (Invited Talk):
  - Anil Rai. Data driven agriculture for natural resource management: agricultural bioinformatics perspective (Lead Talk)
- National e-Conference on Mathematical Sciences for Applied and Agricultural Research organized by Department of Mathematics & Statistics, College of Basic Sciences & Humanities, CCSHAU, Hisar on February 22, 2022
  - Kaustav Aditya*. Feasibility of renewable energy system in tea estates - A survey in North East India.
  - Anindita Datta*, Seema Jaggi, Cini Varghese, Eldho Varghese, Arpan Bhowmik, and Mohd. Harun. Generalized row-column designs balanced for spatial indirect effects: construction and generation. (Virtual mode).
  - Satyam Verma, Arpan Bhowmik*, Seema Jaggi, Eldho Varghese, Cini Varghese and Anindita Datta. Trend free constant block sum PBIB designs using magic square. (Virtual mode).
  - Hemavathi, M.*, Eldho Varghese, Shashi Sekhar and Arpan Bhowmik. Sequential response surface designs: Experimentation order considerations.
- 24th Annual Conference of the Society of Statistics Computer and Applications on Recent Advances in Statistical Theory and Applications (RASTA-2022) organized at ICAR-National Academy of Agricultural Research Management Hyderabad during February 23-27, 2022
  - Vinayaka*, Rajender Parsad, B.N. Mandal and Sukanta Dash. Partially balanced nested block designs for making test treatments-control treatment comparisons. (Young Researcher Invited Session).
  - Cini Varghese*, Vinay Kumar LN, Mohd Harun, Seema Jaggi and Eldho Varghese. Partially replicated designs for breeding trials. (Invited talk)
  - Vinay Kumar L.N.*, Cini Varghese, Seema Jaggi and Mohd. Harun. A series of two replicate resolvable PBIB(3) designs in blocks of unequal sizes. (Young Researchers Invited talk)
  - Sukanta Dash*, Kushal Kumar Yadav, B.N. Mandal, Rajender Parsad and Anil Kumar. Row-Column designs for two level factorial experiments. (Invited talk)
  - Aditya K*, Guha S and Das P (2021). Food and nutrition in indo gangetic plain region-a disaggregate level analysis. (Invited Talk)
  - Md. Ashraful Haque*, Sudeep Marwaha, Alka Arora, Chandan Kumar Deb. Recognition of disease severity levels of crops using deep learning techniques.
  - Soumen Pal. E-governance of Krishi Kalyan Abhiyan through Krishi Vigyan Kendra Knowledge network.
  - Ramasubramanian V. Genetic algorithm based classification tree modelling in agricultural ergonomics. (Invited Talk)
  - Ramasubramanian V, Avinash G and Appaji P Naik*. Unravelling hidden markov models for data applications.
  - Shashi Dahiya. Publication recommendation system for scientific and academic community in agriculture. (Invited talk)
  - Anshu Bharadwaj. Leveraging the digital

technologies to achieve sustainable agriculture.
- Alka Arora. Agricultural University Ranking System(AURS): e Initiative.
- RK Paul. Wavelet decomposition and forecasting agricultural commodity prices
- Amrit Kumar Paul*, Himadri Shekhar Roy and Ranjit Kumar Paul. Estimation of heritability using half-sib model under correlated errors.
- S.B. Lal. Data management challenges in cloud computing.
- K.K. Chaturvedi. Role of big data in agriculture.
- D.C. Mishra. Trait associated genes prediction: some insights.
- Sayantani Karmakar*, Cini Varghese, Seema Jaggi and Mohd. Harun. 2-part incomplete block designs. (Young Researchers Invited talk)

- International Conference on Statistics and Data Science: Theory and Practice for Progress and Prosperity (ICSDS-2021) in conjunction with 41st annual convention of Indian Society of Probability and Statistics (ISPS) during March 11-13, 2022 (online mode):
  - B.N. Mandal*, Rajender Parsad and Sukanta Dash. Algorithmic construction of efficient designs for order-of-addition experiments.
  - Ranjit Kumar Paul. Deep learning techniques for forecasting agricultural commodity prices.
  - Ankita, Susheel Kumar Sarkar* and Shashi Shekhar. Variance component testing for continuous data from nested unbalanced designs.
  - P.K. Meher. Genomic prediction using Bayesian and BLUP alphabets: a comparative analysis.
  - Sukanta Dash*, B.N. Mandal, Rajender Parsad and Anil Kumar. Row column designs for two level fractional factorial experiments.
  - Kanchan Sinha. A comparative study of statistical, machine and deep learning approaches for prediction of onion prices in India.
  - Rajeev Ranjan Kumar. Extreme learning machine based hybrid model for agricultural price volatility forecasting in the presence of structural breaks.
  - Mrinmoy Ray. A hybrid model combining VMD and TDWNN for time series forecasting.
  - Prakash Kumar. Rrank based composite index for assessing high yielding stable crop varieties.
  - Anindita Datta*, Seema Jaggi, Cini Varghese, Eldho Varghese and Arpan Bhowmik. Web generation of generalized row-column designs (webGRC).
  - UK Pradhan. miRbiom: Machine-learning on Bayesian causal nets of RBP-miRNA interactions successfully predicts miRNA profiles.
  - Kaushal Kumar Yadav*, Sukanta Dash, B.N. Mandal and Rajender Parsad and Anil Kumar. Constructions of three associate constant block-sum PBIB designs.
  - P.B. Katore*, B.N. Mandal, Rajender Parsad and Sukanta Dash. Position balanced block designs for sensory studies and consumer experiments.
  - Bijoy Chanda and Arpan Bhowmik*, Seema Jaggi, Eldho Varghese, and Anindita Datta. Trend resistant cost efficient minimally changed factorial run orders involving hard-to-change factors.
- International Workshop on Skill Development through Impact Analysis of Emerging Data with Agricultural Technology in Population Sciences organized by Department of Agricultural Statistics and Department of Agricultural Engineering, Assam Agricultural University in collaboration with ICAR-Indian Agricultural Statistics Research Institute during March 11-17, 2022.
  - Alka Arora. KVK Portal.
  - Anshu Bharadwaj. Digital initiatives for AUs under NAHEP Comp-II.
  - Shashi Dahiya. Digital agriculture.
  - KK Chaturvedi. KISAN Sarathi.
- Webinar on use of AI and ICT in Agriculture Information Access and Dissemination organized by Centre for Development of Advanced Computing, Noida in association with CDAC Kolkata, Bihar Animal Science University Patna, and Birsa Agriculture University (BAU), Ranchi on March 14, 2022.
  - Alka Arora. Mobile App in agriculture information dissemination.
- First Indian Fisheries Outlook- 2022 Conference organized during March 22-24, 2022 at ICAR-CIFRI, Barrackpore.
  - C. Lloyd Chrispin*, P.S. Ananthan, V. Ramasubramanian, T. Velumani, P. Muthuvinayagam, Preetha Panikkar, S. Agnes Daney Angela and E. Suresh. Fisheries and its management in Krishnagiri reservoir in a session on fisheries extension, governance and policies.

- National webinar on Frontier Areas of Plant, Microbe and Environmental Research organised by Department of Botany, Dayalbagh Educational Institute, Agra, U.P. on March 24, 2022 (online).
  - D.C. Mishra. Bioinformatics and its application in agriculture: Some insights.
- Workshop on Geoportal Building Interoperability Infrastructure and Applications organized by ICAR-NBSS&LUP, Nagpur on March 30, 2022.
  - Anshu Bharadwaj. Overview of KRISHI Portal.
- ICAR Directors Conference organized at NASC Complex on on April 13, 2022
  - Anil Rai. ICT activities in ICAR
  - Alka Arora. ICT in Agriculture and initiatives taken by ICAR-IASRI.
- International Conference on Agriculture Science and Technology: Challenges and Prospects (AST-2022), organized by the Rani Lakshmi Bai Central Agricultural University, CARI and IGFRI, Jhansi during May 06-08, 2022.
  - D.C. Mishra. Informative genes prediction: concept and issues
  - Neeraj Budhlakoti. Enhancing the genomic prediction accuracy by handling the influential observations
- International Symposium on Advances in Plant Biotechnology and Nutritional Security-2022 organized by ICAR-NIPB, New Delhi, during April 28-30, 2022.
  - Prabina Meher. Machine learning driven prediction of multiple abiotic stress-responsive genes in plants: A novel computational model
  - UK Pradhan. PIDBPred: An Artificial Intelligence-based generalized computational model for discovery of DNA binding proteins in Plants
- National Seminar on Contemporary Issues in Fisheries and Aquaculture at Pantnagar during May 19-20, 2022.
  - M. Krishnan* and Ramasubramanian V. Fish processing, marketing and trade performance: potential and perspectives.
- XII Biennial National KVK Conference -2022 organized at Dr. YS Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh organized during June 01-02, 2022.
  - Anil Rai. Kisan Sarathi (Technical Session-II on Precision Agriculture, Diversification & Intensification).
- 6th International Conference on Current Issues in Agricultural, Biological & Applied Sciences for Sustainable Development (CIABASSD-2022) held at Kalimpong Science Centre, Deolo, Kalimpong, Darjeeling, West Bengal on June 11-13, 2022.
  - Bishal Gurung*, KN Singh and Achal Lama. Application of beta regression in forewarning pest attacks in crops. (Oral Presentations)
  - Achal Lama. Modelling volatile agricultural price series using Bayesian time series models.
- 5th International Conference in Hybrid Mode on Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2022) held at Himachal Pradesh University, Shimla, Himachal Pradesh, India organized by Society for Scientific Development in Agriculture and Technology during June 12-14, 2022.
  - Sarika. Identification of long non-coding RNAs in pearlmillet (*Pennisetum glaucum L.*)
  - Priyanka Jain, Ankita Singh, Mir Asif Iquebal*, Anil Rai, Sundeep Kumar, Dinesh Kumar. Whole genome-based identification of cytokinin dehydrogenase gene family in wheat (*Triticum aestivum L.*)
- Online Workshop of the Indonesian G20 Presidency, organized by the Ministry of Agriculture, Indonesia on Gap Analysis on Food Loss and Waste Indices for G20 countries supported by Food and Agriculture Organization of the United Nations (FAO), Rome, Italy on June 21, 2022
  - Tauqueer Ahmad. Food loss measurement in India: sampling methodology
- user! The R user conference. The annual meeting of the R Community (online) by Vanderbilt University Medical Centre, Department of Biostatistics, United States organized during June 20-23, 2022.
  - Ashutosh Dalal*, Seema Jaggi, Eldho Varghese, Arpan Bhowmik, Cini Varghese and Anindita Datta. NBBDesigns and rsdNE: R packages for the generation of designs and analysis of data incorporating neighbour effects. (Oral presentation in the session on Unique Applications and Methods).
  - Sayantani Karmakar* Md. Ashraful Haque, Cini Varghese, Seema Jaggi, Eldho Varghese and Mohd Harun. An R-package for generating Incomplete row-column designs.

(Poster presentation + elevator pitch (virtual) in the session Computing Frameworks)

- National webinar organized by the Department of Statistics, Mathematics & Computer Science under the aegis of NAHEP, SKN Agriculture University, Jobner on June 29, 2022.
  - Rajender Parsad. Significance of experimental designs in agricultural research.
- National webinar organized by Department of Agricultural Statistics, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, West Bengal to celebrate National Statistics Day on June 29, 2021.
  - Rajender Parsad. Significance of experimental designs in agricultural research (Keynote Address).
- Pusa Krishi's flagship incubation programs -- ARISE & UPJA 2021 organized by ZTM & BPD Unit, IARI, New Delhi on July 6, 2022
  - Alka Arora. ICAR Repository for Knowledge Management.
- DBT-sponsored workshop on AI in Modern Biology at ICGEB, New Delhi from August 23 -25, 2022
  - Sarika Sahu. Identification and characterization of ncRNAs and hands on session.
- International Conference on Systems Analysis for Enabling Integrated Policy Making organised by TIFAC during August 10-12, 2022
  - Das P*, Kumar S and George J. Application of machine learning techniques for prediction of soil properties.
- Online International Conference on Advances in Agriculture and Food System towards Sustainable Development Goals jointly organized by ICAR, AIASA and UAS Banglore at University of Agricultural Sciences, Bangalore during August 22-24, 2022
  - Bharti*, Mohammed J, Ahmad T and Bansal S. Application of randomized response technique in forestry – A case study to measure proportion of forest encroachment in Shimla district of Himachal Pradesh.
- Sneha Murmu. Bioactivity prediction of microbial-derived natural products using machine learning algorithm.
- International Conference on Biotechnological Trends and Prospects organized by University of Agricultural Sciences, GKVK, Bangalore during September 13-15, 2022
  - Ratna Prabha. Metagenomics insights into reproductive tract of White Pekin and Khaki Campbell ducks.
- International Conference on Mathematical Modelling, Analysis and Computing (MMAC-2022) organized by Department of Mathematics, Thiruvalluvar University, Vellore, Tamil Nadu in an Online Mode during September 14-16, 2022
  - Rahul Banerjee. Construction of saturated designs for mixture experiments.
- Conference on Molecular Biology and Bioinformatic Tools and its Application in Agriculture and Allied Sciences organized by Centre of Excellence in Agri Biotechnology, College of Biotechnology, SVPUAT, Meerut during September 08-21, 2022
  - Sarika. Gene Expression analysis using NGS data.
  - Mir Asif Iquebal. Marker discover using NGS data and its application in agriculture.
- International Conference on Advances in Agriculture, Veterinary and Allied Sciences for Improved Livelihood and Environment Security (AAVASILES-2022) organized jointly by ICAR-IGFRI, RRS, Srinagar, ICAR-NAHEP, BAU, Ranchi and NADCL, Baramulla at University of Kashmir, Hazratbal in an online mode during September 28-30, 2022
  - Sneha Murmu. Prediction of protein-protein interactions between anti-CRSIPR and CRISPR-Cas using machine learning technique.
- International conference of The Indian Ecological Society on Sustainable Agricultural Innovations for Resilient Agri-Foods System during October 13-15, 2022 at SKUAST-Jammu
  - Banerjee, R*., Pal, S and Ahmad, T. Prediction approach in repeated measurement survey
- 73rd Annual Conference of Indian Society of Agricultural Statistics on Statistics and Machine Learning for Big Data Analytics organized by Division of Agricultural Statistics, FOH, SKUAST-K, Srinagar during November 14-16, 2022
  - Anindita Datta*, Seema Jaggi, Cini Varghese, Eldho Varghese, Mohd Harun and Arpan Bhowmik. Row-column designs with multiple units per cell balanced for spatial effects (Dr GR Seth Young Scientist Award Session).

- Mohd Harun*. Cini Varghese, Seema Jaggi, Eldho Varghese and Anindita Datta. Augmented partial four-way crosses.
- Bijoy Chanda*, Arpan Bhowmik, Cini Varghese, Seema Jaggi, Eldho Varghese and Anindita Datta. Equivalent-estimation two levels split- plot designs.
- Rahul Banerjee*, Seema Jaggi, Eldho Varghese, Arpan Bhowmik, Cini Varghese, Anindita Datta and Shwetank Lall. Construction of saturated D-optimal designs for mixture experiments with a non normal response using an algorithmic search.
- Ankita Verma*, Seema Jaggi, Eldho Varghese, Arpan Bhowmik, Cini Varghese and Anindita Datta. Construction of third order rotatable designs using t design of unequal set sizes.
- Vinay Kumar L.N.*, Cini Varghese, Seema Jaggi and Mohd. Harun. Variance components estimation and BLUP in breeding programmes under p-Rep block designs.
- Nehatai W. Agashe*, Cini Varghese, BN Mandal and Mohd. Harun. Designs for breeding trials using doubly nested partially balanced incomplete block designs.
- Sayantani Karmakar*, Cini Varghese, Seema Jaggi and Mohd. Harun. On t-packing designs.
- Sukanta Dash. Designs for consecutive cropping sequence experiments.
- Hemant Kumar* and Susheel K Sarkar. Evaluation of artificial intelligence in plant breeding management tools.
- R.K. Paul. Decomposition based machine learning techniques for forecasting agricultural prices.
- Prakash Kumar*, Upendra Kumar Pradhan and Ravi Shankar. RbpRnaDB: A database for RNA-binding proteins and their combinatorial interactions with miRNA to explain the miRNA biogenesis model.
- Bishal Gurung* and KN Singh. An improved beta regression model for forewarning *Helicoverpa armigera* infestation.
- Rajeev Ranjan Kumar* and KN Singh. Performance evaluation of deep learning approaches for meteorological drought forecasting.
- Soumen Pal*, Alka Arora, Sudeep, Ajit, SN Islam and Ranjit Kumar Paul. Analytics dashboard for landscape diagnostic survey data under cereal systems initiative for South Asia.
- Chandan Kumar Deb*, Pabitra Mitra and Madhurima Das. Machine learning based mapping and its acreage calculation for rice crop using Sentinel 2 in Cooch Behar district of West Bengal, India.
- Madhu*, Chandan Kumar Deb, Ashraful Haque, Sudeep Marwaha, SN Islam, Achal Lama and Mrinmy Ray. Deep learning-based classification model for bovine disease detection.
- Alka Arora* and Mohit Kumar. Machine learning based approach for measuring senescence in wheat crop. (Invited Talk)
- Shashi Dahiya*, Sudeep Marwaha, P Ramasundaram and Anshu Bharadwaj. Online initiative for ranking of green and clean agricultural university campus. (Invited Talk)
- Sarika Jaiswal*, Bharti Aneja, Jaisri Jagannadham, Bharati Pandey, Rajender Singh,Chhokar, Subhash Chander Gill, Om Parkash Ahlawat, Anuj Kumar, UB Angadi, Anil Rai, Ratan Tiwari and Dinesh Kumar. Study on microbial diversity under varied agricultural field conditions of wheat crop.
- M.A. Iquebal. Whole genome-based identification of non-coding RNAs in black pepper (*Piper nigrum* L).
- Ritwika Das*. Identification of major biogeochemical cycle regulating genes in river Ganga and Yamuna through metagenomic approaches.
- Mohammad Samir Farooqi*, KK Chaturvedi, DC Mishra, Sudhir Srivastava, SB Lal, Anu Sharma and Neeraj Budhakoti. Prediction of biosynthetic gene clusters and drug discovery using metagenomics.
- Sudhir Srivastava*, Dwijesh Chandra Mishra, UB Angadi, KK Chaturvedi and Anil Rai. Hybrid approach for imputing missing values in proteomics expression data.
- Anu Sharma. Some contributions to machine learning for binning of metagenomics data.
- D.C. Mishra*, Sudhir Srivastava, Neeraj Budhlakoti, KK Chaturvedi, SB Lal and Anil Rai. Next generation sequencing data analysis: big data perspective.
- Neeraj Budhlakoti. Integrated approach for genomic prediction to handle diverse genetic architecture.
- Anshu Bharadwaj*, Sudeep, Alka Arora, Mukesh Kumar, Shashi Dahiya, S.N. Islam, Soumen Pal, Rajender Parsad, Anuradha Agrawal, R.C. Agrawal. Virtual Classroom and Agri-DIKSHA: Embracing the future

of Digital Learning in Agriculture Higher Education. (Invited Talk)
- Tauqueer Ahmad*, Prachi Mishra Sahoo and Ankur Biswas. Integrated sampling methodology for crop yield estimation using remote sensing, GIS, Geo-statistics and field surveys for Crop Insurance. (Invited Talk)
- Deepak Singh*, Pradip Basak, Raju Kumar and Tauqueer Ahmad. Development of survey weighted composite indices under complex surveys.
- Ankur Biswas*. Estimation of finite population proportion from geo-referenced survey data.
- Raju Kumar*, Deepak Singh and Tauqueer Ahmad. Survey weighted propensity score method for impact assessment.
- Pankaj Das*, Achal Lama and Girish Kumar Jha. Variational mode decomposition based machine learning models optimized with genetic algorithm for price forecasting.
- Hukum Chandra, Kaustav Aditya*, Swati Gupta, Saurav Guha and Bhanu Verma. Food and nutrition in Indo Gangetic plain region-A disaggregate level analysis. (Young Researcher Invited Talk)
- Ramasubramanian V*., Mrinmoy Ray and Md. Wasi Alam. Development of classification tree enhanced by genetic algorithm for forecasting in agricultural ergonomics.
- Mukesh Kumar*, Soumen Pal and Sudeep. Mobile applications for dissemination of knowledge in livestock farming.
- S.B. Lal*, KK Chaturvedi, Anu Sharma and Md. Samir Farooqi. Open-source big data databases.
- Vinayaka*, Rajender Parsad, B.N. Mandal and Sukanta Dash. Nested partially balanced treatment incomplete block designs. (Student Session: Contributed Paper)
- Sudeep*, Alka Arora, Anshu Bharadwaj, Shashi Dahiya, SN Islam, Chandan Kumar Deb, Ashraful Haque and Sanchita Naha. Modernizing agriculture education through IT interventions - Steps undertaken.

- IEEE International Conference on Computing, Communication and Intelligent Systems (ICCCIS-2022) organized by Sharda University, Greater Noida, India, during November 04-05, 2022
  - Madhu. Content-based image retrieval: feature extraction techniques and similarity metrics
- International Conference on Intelligent Vision and Computing (ICIVC 2022) organized at NIT Agartala during November 26-27, 2022
  - Akshay Dheeraj. Deep learning model for automated image based plant disease classification.
- International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2022) organized at BAU Ranchi during November 21-23, 2022
  - Deepak Singh*, Pradeep Basak, Raju Kumar and Taqueer Ahmad. Construction of survey weighted food consumption index.
  - JS Brar, Pankaj Das* and T Adhikary. Optimization of energy requirement and greenhouse gas emissions analysis for pear producers of North-West India using data envelopment analysis (DEA) approach
  - Bharti*, PK Mahajan and S Bansal. Marketing analysis of apple farming in high hills of Himachal Pradesh.
- National Conference on Innovations in Animal Genetics and Breeding for Sustainable Productivity of Livestock and Poultry organized at DPR, Hyderabad during December 02-03, 2022
  - D.C. Mishra. Innovations in genomics data in livestock and poultry.
- Eighth International Conference on Statistics for Twenty-first Century-2022 (ICSTC-2022) organized by International Statistics Fraternity (ISF), School of Physical and Mathematical Sciences and Department of Statistics, University of Kerala, Trivandrum during December 16-19, 2022
  - Bishal Gurung. ESTAR nonlinear models for modelling sunspot numbers and global temperatures and development of out-of-sample forecasts.
  - Mrinmoy Ray. FRBW-STNN: Fuzzy rule based weighted spatio-temporal neural network model with application to rainfall forecasting.
  - Achal Lama. Modelling volatility movement between Indian domestic and International edible oils price indices using Bayesian multivariate GARCH models.
  - Rajeev Ranjan Kumar. Wavelet multiple kernel extreme learning machine (W-MK-ELM) model for drought forecasting.
  - Prakash Kumar. A novel non-parametric stability measures for selection of stable genotypes to resolve the consequences of climate dynamics.

- Anindita Datta. Web generation of generalized row-column designs.
- Kaustav Aditya. Multivariate calibration estimation using nonlinear constraints under two stage sampling design.
- Ankur Biswas. Estimation under geographically weighted logistic regression model from survey data.
- Pankaj Das. Estimation of crop yield using random forest spatial interpolation technique.
- Vinayaka* and Rajender Parsad. Nested partially balanced incomplete block designs.

- International Indian Statistical Association conference (IISA-2022) organized at Indian Institute of Science, Bengaluru during 26-30 December, 2022
  - Sukanta Dash. Designing factorial experiments for cropping sequence experiments.
  - Mohd Harun. Generalized extended triangular association scheme and designs.
  - R.K. Paul. Wavelets and machine learning techniques for forecasting time series.
- International Conference on Knowledge Discoveries in Statistical Innovations and Recent Advances in Optimization (ICON-KSRAO) organized by Department of Statistics and Population Research Center, Andhra University, Visakhapatnam, Andhra Pradesh during 29-30 December 2022
  - R.K. Paul. Machine learning techniques for forecasting agricultural commodity prices.
  - Soumen Pal. Analytics dashboard for landscape diagnostic survey data under rice and wheat cropping system.
  - Md. Yeasin. Optimization based ensemble techniques for modelling potato price in markets of Odisha, India.
  - Vinayaka*, Rajender Parsad, B.N. Mandal, Sukanta Dash and Vinay Kumar L.N. Partially balanced bipartite block designs.

(*denotes who has presented the paper)

विशेषज्ञों ने किया कृषि विश्वविद्यालय के वर्चुअल क्लास एवं प्रयोगशाला का भ्रमण

छाया-आज

...भारी ...एवं ...ल्ली ...भ्रमण ...सको ...डॉ. ...निक, प्रभारी आईटी इकाई कंप्यूटर एप्लीकेशन डॉ मुकेश कुमार द्वारा आभासी क्लास एवं प्रयोगशाला का अवलोकन किया गया। यह आभासी क्लास/प्रयोगशाला एनएएचईपी घटक २ के अन्तर्गत झांसी विवि में स्थापित है। यह प्रयोगशाला आईसीटी सम्प्रेषण के माध्यम से कृषि शिक्षा को मजबूत करने के लिए कृषि विवि झांसी में विकसित की गई है। वीडियो व्याख्यान छात्रों को आभासी माध्यम से उपलब्ध करवाए जाते हैं। यह मात्र हार्डवेयर सेटअप ही नहीं है, अपितु मल्टी युटिलिटी एवी-दीक्षा पोर्टल और एक डेस्कटॉप एप्लिकेशन के साथ संलग्न है। इसे किसी भी प्लेटफॉर्म में इंस्टॉल किया जा सकता है एवं देश के किसी भी स्थान से छात्रों के द्वारा देखा जा सकता है। विशेषज्ञों ने विश्वविद्यालय के पुस्तकालय, वर्चुअल क्लास, प्रयोगशाला के रख रखाव से प्रशंसा की। इस अवसर पर निदेशक प्रसार शिक्षा डॉ. सती शंकर सिंह, अधिष्ठाता कृषि डॉ. एस.के. चतुर्वेदी, पुस्तकालयाध्यक्ष डॉ. एस.एस. कुशवाह, डॉ तनुज मिश्रा, डॉ. शैलेंद्र कुमार, पल्लवी शुक्ला उपस्थित रहीं।

SKUAST KASHMIR HOSTS 73rd ANNUAL CONFERENCE OF ISAS

Srinagar Nov. 15, 2022: The Division of Agricultural Statistics, Faculty of Horticulture, SKUAST-Kashmir is organizing three days 73rdAnnual Conference of Indian Society of Agricultural Statistics, New Delhi on Statistics and Machine Learning for Big Data Analytics w.e.f from14th to 16th November.The Chief Guest of the function, Prof. G.P Samanta Chief Statistician of India and Secretary Ministry of Statistics and Programme Implementation, Govt of India in his address briefed that more precise statistical tools are required to assess the impact and challenges in agricultural sector at regional as well as national Level. Guest of honor, Professor R.C. Agrawal, DDG (Agricultural Education), ICAR, New Delhi in his address briefed about the importance of big data analytics in the field of agriculture and stressed on importance of proper statistical methodology. The Chief Patron of the inaugural function, Prof. Nazir Ahmad Ganai, Vice Chancellor, SKUAST Kashmir in his address deliberated that the role of machine learning and big data will be a game changer in decision making in context to future policy and planning. He also deliberated that emerging concept of smart farming makes agriculture more efficient and effective with the help of high precision algorithms, which has emerged with big data technologies and high performance computing to create new opportunities to unravel, quantify and understand data intensive processes in agricultural operational environments.

Executive President of the Society Prof. PadamSingh andDr.RajenderParsad, Director, ICAR IASRI, New Delhi in their address briefed about the origin and contributions of ISAS in the field of agriculture and allied sectors with basic objective to disseminate research conducted in Agricultural Statistics to meet the challenges in agricultural research in the country.Earlier,

Prof. M.S.Pukhta, Head of the Division welcomed all the dignitaries as well as participants and also deliberated the audience about other activities conducted in the Division.

The conference is being attended by the eminent scientists across the country from various premier institutes of India. More than 200 participants registered in the present conference which is being organized in hybrid mode (offline/online). 56th Dr.Rajendra Prasad Memorial Lecture was delivered by Prof. G.P Samanta Chief Statistician of India and Secretary Ministry of Statistics and Programme implementation on "Statistics, Artificial Intelligence, Machine Learning and Big Data Analytics". 41stDr.V.G Panse Memorial Lecture was delivered by Dr. R.C. Agrawal, DDG (Education) ICAR, New Delhi on "Paradigm shift in Agricultural education to meet Agriculture Revolution". Dr. Imran Khan, Associate Professor, Division of Agricultural Sta-...

VC SKUAST-J terms Big Data crucial for future planning

■ TNN BUREAU

JAMMU: The division of Statistics and Computer Science has organized a training programme on Big Data Analysis and Research Methods using Statistical Softwares under the aegis of IDP, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu (SKUAST-J).

The Chief Guest of the function, Prof. J.P. Sharma, Vice...

...before.

The large datasets cannot easily be analysed by hand. The use of statistical software...

...future in terms of policy and planning at regional and National Level. He also briefed about the importance of data...

आज | झांसी महानगर | 2

हर मेड़ पर पेड़ आज की जरूरत है:डॉ. राजेन्द्र

(आज समाचार सेवा)

झांसी, १९ अक्टूबर। केन्द्रीय कृषिवानिकी अनुसंधान संस्थान, झांसी में अनुसूचित जाति उप योजना के अन्तर्गत अनुसूचित जाति के किसानों का तीन दिवसीय प्रशिक्षण जिसका शीर्षक 'किसानों की आमदनी बढ़ाने हेतु कृषिवानिकी' है का आज समापन हो गया। समापन समारोह के मुख्य अतिथि डॉ. राजेन्द्र प्रसाद, निदेशक, भारतीय कृषि सांख्यिकी अनुसंधान संस्थान, पूसा, नई दिल्ली ने कहा कि वातावरण को शुद्ध रखने में कृषिवानिकी का योगदान बहुत ही महत्वपूर्ण है। उन्होंने कहा कि हर मेड़ पर पेड़ आज की जरूरत है तथा किसानों की आमदनी बढ़ाने के लिए कृषिवानिकी बहुत ही अच्छा माध्यम है। उन्होंने कहा कि 33 प्रतिशत वृक्ष आवरण बढ़ाने के लिए कृषिवानिकी एक मात्र विकल्प है।

इस अवसर पर डॉ. मुकेश कुमार, नोडल ऑफिसर, (एस.सी.एस.पी.), भारतीय कृषि सांख्यिकी अनुसंधान संस्थान, नई दिल्ली ने अपने उद्बोधन में कहा कि कृषि पोर्टल, मोबाइल एप, किसान 2.0, किसान सुविधा, दामिनी, फार्म ट्री एप तथा वीडियो गैलरी के माध्यम से किसानों की विभिन्न समस्याएँ जैसे फसल, पशुधन, मुर्गी पालन, सूकर पालन इत्यादि की जानकारी कृषि सांख्यिकी संस्थान द्वारा 11 भाषाओं में उपलब्ध कराया जा रहा है। उन्होंने जानकारी दी कि किसान साथी में कृषि विज्ञान केन्द्र के माध्यम से पंजीकृत किसानों की समस्याओं का हल स्थानीय भाषा में उपलब्ध कराया जाता है।

कार्यक्रम में उपस्थित अतिथि व अन्य। छाया-आज

कार्यक्रम की अध्यक्षता करते हुए संस्थान के निदेशक डॉ. ए. अरुणाचलम ने बताया कि इस प्रशिक्षण के माध्यम से 25 प्रशिक्षणार्थियों (15 महिला एवं 10 पुरुष) जो कि ग्राम दतार नगर जिला झांसी से हैं को आपस में बात करके खेती बाड़ी के विषयों पर चर्चा करने का तीन दिन का शुभ अवसर मिला जिससे वे कृषिवानिकी की विभिन्न तकनीकियों, अनुसंधान प्रक्षेत्र भ्रमण तथा अनुसंधान प्रयोगशालाओं का नजदीकी से अवलोकन करके ज्ञान प्राप्त किया एवं नयी चीजों को सीखा। उन्होंने कृषिवानिकी के माध्यम से महिलाओं के सशक्तिकरण पर जोर दिया।

कार्यक्रम की शुरूआत आई.सी.ए.आर कुलगीत से हुई। तदोपरान्त डॉ. प्रियंका सिंह ने गणमान्य अतिथियों, प्रशिक्षणार्थियों एवं सभी उपस्थित अतिथियों का स्वागत किया गया। डॉ. इंदेश अनुरागी ने तीन दिवसीय प्रशिक्षण की संक्षिप्त आख्या सभी के सामने प्रस्तुत की। डॉ. आर. पी. द्विवेदी ने मुख्य अतिथि का संक्षिप्त परिचय सभी के सामने प्रस्तुत किया तथा संस्थान द्वारा आयोजित होने वाले कार्यक्रमों की विस्तृत जानकारी दी। मुख्य अतिथि के द्वारा प्रशिक्षणार्थियों को उनके उद्यमिता हेतु सिलाई मशीन, सिंचाई के पाइप एवं स्प्रेयर भी वितरित किये गये। इसके साथ ही साथ प्रशिक्षणार्थियों को कृषिवानिकी बहुउद्देशीय पौध भी वितरित किये गये। यह प्रशिक्षण भारतीय कृषि सांख्यिकी अनुसंधान संस्थान, नई दिल्ली द्वारा प्रायोजित किया गया है। कृषिवानिकी संस्थान द्वारा आज के ही दिन तीन दिवसीय (19-21 अक्टूबर, 2022) आन लाईन प्रशिक्षण कार्यक्रम का उद्घाटन किया गया जिसका विषय 'जलवायु परिवर्तन के परिपेक्ष्य में मृदा स्वास्थ्य सुनिश्चित करना' है। इस कार्यक्रम में देश भर से 80 वैज्ञानिक, प्रोफेसर एवं शोधकर्ताओं ने भाग लिया। कार्यक्रम का समन्वयन डा. राजेन्द्र प्रसाद, प्रधान वैज्ञानिक (मृदा) ने किया। यह प्रशिक्षण कार्यक्रम मैनेज, हैदराबाद द्वारा प्रायोजित किया गया है।

निदेशक ने मुख्य अतिथि तथा विशिष्ट अतिथियों को पुष्प गुच्छ एवं स्मृति चिन्ह देकर उनको सम्मानित किया गया। कार्यक्रम में संस्थान के वैज्ञानिक, अधिकारी, कर्मचारी, शोध अध्येता, शोध छात्र उपस्थित रहे। कार्यक्रम का संचालन एवं धन्यवाद ज्ञापन डा. सुशील कुमार द्वारा किया

दिल्ली के विशेषज्ञों का कृषि विश्वविद्यालय के वर्चुअल क्लास एवं प्रयोगशाला का भ्रमण

11.

संस्थान में हिन्दी के प्रगामी प्रयोग की रिपोर्ट

भा.कृ.अनु.प.–भारतीय कृषि सांख्यिकी अनुसंधान संस्थान में दिन प्रतिदिन हिन्दी के प्रगामी प्रयोग में अभिवृद्धि हो रही है। राजभाषा नीति को संस्थान में सुचारु रूप से कार्यान्वित किया जा रहा है। भारत सरकार, गृह मंत्रालय, राजभाषा विभाग द्वारा जारी वार्षिक कार्यक्रम में निर्धारित लक्ष्यों को संस्थान में लगभग पूरा कर लिया गया है। संस्थान द्वारा समस्त प्रशासनिक कार्य शत–प्रतिशत हिन्दी में किया जाता है तथा धारा 3(3) का भी पूर्ण रूप से अनुपालन किया जा रहा है।

संस्थान में राजभाषा हिन्दी की प्रगति का जायजा लेने के लिए उपमहानिदेशक (कृषि शिक्षा), भारतीय कृषि अनुसंधान परिषद् मुख्यालय द्वारा जनवरी 25, 2022य जून 15, 2022य अक्टूबर 21, 2022 एवं नवम्बर 29, 2022 को संस्थान का राजभाषा संबंधी निरीक्षण किया गया। उपमहानिदेशक (कृषि शिक्षा), ने निरीक्षण रिपोर्ट में संस्थान में हिन्दी में हो रहे कार्यों की प्रगति पर संतोष व्यक्त करते हुए संस्थान की सराहना की। संस्थान के अलग–अलग प्रभागों/अनुभागों में हिन्दी में किए जा रहे कार्यों की समीक्षा करने के लिए हिन्दी एकक के अधिकारियों द्वारा कुल 20 प्रभागों/अनुभागों का निरीक्षण किया गया।

संस्थान में प्रशासनिक कार्य के साथ – साथ वैज्ञानिक प्रकृति के कार्यों में भी हिन्दी के उपयोग को प्रोत्साहित किया जाता है। संस्थान के वैज्ञानिक प्रभागों द्वारा आयोजित प्रशिक्षण कार्यक्रमों की ई–संदर्भ पुस्तिकाओं में आमुख एवं आवरण पृष्ठ द्विभाषी रूप में प्रस्तुत करने के साथ–साथ परियोजना रिपोर्टों के आवरण पृष्ठ, आमुख, एवं सारांश द्विभाषी रूप में प्रस्तुत करने के साथ –साथ कुछ हिन्दी के व्याख्यान भी शामिल किए। संस्थान के वैज्ञानिकों द्वारा हिन्दी में वैज्ञानिक विषयों पर हिन्दी कार्यशालाओं का भी आयोजन किया गया। इसके अतिरिक्त, संस्थान में एम.एससी. तथा पीएच.डी के विद्यार्थियों ने अपने शोध–प्रबन्धों के सार द्विभाषी रूप में प्रस्तुत किए। वैज्ञानिकों एवं तकनीकी कर्मियों द्वारा कुछ शोध–पत्र भी हिन्दी में प्रकाशित किए गए।

प्रतिवेदनाधीन अवधि के दौरान संस्थान में राजभाषा कार्यान्वयन समिति की 04 बैठकें क्रमशः मार्च 21, 2022य जून 25, 2022य सितम्बर 26, 2022 एवं दिसम्बर 27, 2022 को आयोजित की गई । इन बैठकों में राजभाषा नियम एवं अधिनियम को कारगर ढंग से लागू करने तथा इसमें दिए गए प्रावधानों के अनुसार वार्षिक कार्यक्रम में निर्धारित लक्ष्यों की प्राप्ति हेतु चर्चा की गई तथा आवश्यक कदम उठाए गए।

संस्थान के समस्त कर्मियों को 02 वर्ष की अवधि में कम से कम एक बार हिन्दी कार्यशाला में सहभागिता करने का अवसर मिले, इस अनिवार्यता के संबंध में भारत सरकार, गृह मंत्रालय, राजभाषा विभाग द्वारा समय – समय पर जारी कार्यालय ज्ञापन द्वारा निर्धारित लक्ष्य की प्राप्ति के लिए, संस्थान द्वारा अक्तूबर 10, 2020 से अक्तूबर 09, 2022 के दौरान राजभाषा हिन्दी के साथ–साथ संस्थान से संबंधित विभिन्न विषयों पर हिन्दी कार्यशाला का आयोजन कर संस्थान के समस्त कर्मियों को कम से कम एक बार हिन्दी कार्यशाला में प्रशिक्षित किया गया। इस प्रकार संस्थान ने राजभाषा विभाग द्वारा निर्धारित लक्ष्य को उक्त अवधि में पूरा किया।

प्रतिवेदनाधीन अवधि के दौरान संस्थान के विभिन्न वर्गों के कर्मियों एवं राष्ट्रीय कृषि अनुसंधान प्रणाली के अन्य संस्थानों के वैज्ञानिकों के लिए छः हिन्दी कार्यशालाएं आयोजित की गई। पहली कार्यशाला संस्थान के कृषि जैव सूचना विज्ञान प्रभाग के वैज्ञानिकों, डॉ. सुधीर श्रीवास्तव, डॉ.यू.बी. अंगडि एवं सुश्री स्नेहा मुर्मू द्वारा जनवरी 27–29, 2022 के दौरान ''कृषि मैं जैविक डेटा विश्लेषण के लिए सांख्यिकीय और कम्प्यूटेशनल विधियां'' विषय पर ऑन–लाइन आयोजित की गई, जिसमें 14 वक्ताओं द्वारा विषय से संबंधित 14 उप–विषयों पर व्याख्यान दिए गए। इस कार्यशाला में कुल 15 प्रतिभागियों (संस्थान के 06 वैज्ञानिक, 03 तकनीकी अधिकारी एवं 02 तकनीकी सहायक के अतिरिक्त भारतीय कृषि अनुसंधान परिषद के अधीनस्थ अन्य संस्थानों से 02 वैज्ञानिक एवं 02 तकनीकी अधिकारी) ने सहभागिता की।

दूसरी कार्यशाला संस्थान के सभी वर्ग के कर्मियों के लिए संगणक अनुप्रयोग प्रभाग के वैज्ञानिकों, डॉ. शशि दहिया एवं श्री समर्थ गोदारा, द्वारा मार्च 26, 2022 को ''कृषि शिक्षण एवं प्रशिक्षण मैं संगणक अनुप्रयोग'' विषय पर आयोजित की गई, जिसमें 04 वक्ताओं द्वारा विषय से संबंधित 04 उप–विषयों पर व्याख्यान दिए गए। इस कार्यशाला में कुल 19 प्रतिभागियों (संस्थान के 12 वैज्ञानिक, 06 तकनीकी अधिकारी एवं 01

प्रशासनिक कर्मी) ने सहभागिता की। तीसरी कार्यशाला जून 14–16, 2022 को संस्थान के परीक्षण अभिकल्पना प्रभाग के वैज्ञानिकों, डॉ. अनिंदिता दत्ता, डॉ. मोहम्मद हारून एवं डॉ. सुकान्त दाश द्वारा ''परीक्षणात्मक अभिकल्पनाएँ एवं विश्लेषण'' विषय पर ऑन लाइन आयोजित की गयी जिसमें 11 वक्ताओं द्वारा विषय से संबंधित 12 उप–विषयों पर व्याख्यान दिए गए। इस कार्यशाला में कुल 19 प्रतिभागियों (संस्थान के 04 वैज्ञानिक, 03 तकनीकी एवं अन्य संस्थानों से 05 वैज्ञानिक तथा 07 तकनीकी वर्ग के कर्मियों) ने सहभागिता की।

चौथी कार्यशाला अगस्त 03–05, 2022 के दौरान संस्थान के सांख्यिकी आनुवंशिकी प्रभाग के वैज्ञानिकों, डॉ. रंजीत कुमार पॉल, डॉ. प्रकाश कुमार एवं डॉ. मोहम्मद यासीन द्वारा ''बुनियादी सांख्यिकीय तकनीकें और आनुवंशिकी में इसका अनुप्रयोग'' विषय पर ऑन–लाइन आयोजित की गई। जिसमें 10 वक्ताओं द्वारा विषय से संबंधित 11 उप–विषयों पर व्याख्यान दिए गए। इस कार्यशाला में कुल 19 प्रतिभागियों (संस्थान से 06 वैज्ञानिक, 02 तकनीकी अधिकारी एवं अन्य संस्थानों से 16 वैज्ञानिक तथा 01 तकनीकी कर्मी) ने सहभागिता की।

पाँचवी कार्यशाला संस्थान के सभी वर्ग के कर्मियों के लिए अक्टूबर 06, 2022 को संस्थान के सूचना प्रौद्योगिकी एकक के सहायक मुख्य तकनीकी अधिकारी, श्री सुभाष चंद एवं श्री जय भगवान द्वारा ''साइबर जागरूकता'' विषय पर आयोजित की गयी जिसमें 03 वक्ताओं द्वारा विषय से संबंधित 03 उप–विषयों पर व्याख्यान दिए गए। इस कार्यशाला में कुल 47 अधिकारियोंध्कर्मियों (16 वैज्ञानिक, 8 तकनीकी अधिकारी तथा 23 प्रशासनिक वर्ग के कर्मियों) ने सहभागिता की।

छठी कार्यशाला दिसम्बर 20–22, 2022 के दौरान संस्थान के पूर्वानुमान एवं कृषि प्रणाली मॉडलिंग प्रभाग के वैज्ञानिकों, डॉ. बिशाल गुरुंग, डॉ. कंचन सिन्हा एवं डॉ. अचल लामा द्वारा ''कृषि ऑकड़ों के लिए समय श्रृंखला पूर्वानुमान और मशीन लर्निंग मॉडल का अवलोकन'' विषय पर ऑन लाइन आयोजित की गई, जिसमें 09 वक्ताओं द्वारा विषय से संबन्धित 12 उप–विषयों पर व्याख्यान दिए गए। इस कार्यशाला में कुल 18 प्रतिभागियों (संस्थान से 06 वैज्ञानिक, 06 तकनीकी एवं अन्य संस्थानों से 04 वैज्ञानिक तथा 02 तकनीकी अधिकारी) ने सहभागिता की।

राजभाषा विभाग द्वारा जारी वार्षिक कार्यक्रम में निहित लक्ष्यों को पूरा करते हुए संस्थान के अधिकारियों/कर्मचारियों द्वारा समस्त पत्राचार हिन्दी में अथवा द्विभाषी रूप में किया गया। संस्थान के विभिन्न वैज्ञानिक प्रभागों तथा प्रशासनिक अनुभागों द्वारा आयोजित बैठकों की कार्यसूची तथा कार्यवृत्त हिन्दी अथवा द्विभाषी रूप में जारी किए गए। संस्थान में अपना कार्य शत–प्रतिशत हिन्दी में करने के लिए 12 अनुभागों को विनिर्दिष्ट किया गया है। गृह मंत्रालय, राजभाषा विभाग द्वारा जारी विभिन्न नकद पुरस्कार योजनाएँ संस्थान में लागू हैं तथा संस्थान के कर्मियों ने इन योजनाओं में बढ़–चढ़कर भाग लिया।

संस्थान में कार्यरत सभी हिन्दीतर अधिकारियों/कर्मचारियों द्वारा हिन्दी ज्ञान संबंधी प्रशिक्षण पूरा किया जा चुका है। आज तक की स्थिति के अनुसार, संस्थान में अब कोई ऐसा हिन्दीतर अधिकारी/कर्मचारी शेष नहीं रह गया है जिसे हिन्दी ज्ञान संबंधी प्रशिक्षण दिया जाना शेष हो।

संस्थान की वेबसाइट पर 'हिन्दी सेवा लिंक' उपलब्ध है। जिसमें सांख्यिकीय एवं प्रशासनिक शब्दावली के वर्ण क्रमानुसार कुछ शब्द, कुछ द्विभाषी प्रपत्र, दैनिक काम–काज के प्रयोग में आने वाली कुछ टिप्पणियाँ, द्विभाषी पदनाम, वाक्यांश इत्यादि उपलब्ध हैं। संस्थान के कर्मियों द्वारा अपना दैनिक कार्य हिन्दी में सरलता से करने के लिए इस सेवा का उपयोग किया जाता है।

संस्थान द्वारा प्रकाशित वार्षिक हिन्दी पत्रिका: 'सांख्यिकी–विमर्श' का नियमित प्रकाशन किया जा रहा है तथा 17वें अंक का प्रकाशन प्रतिवेदनाधीन अवधि के दौरान किया गया।

संस्थान में 14 से 30 सितम्बर 2022 के दौरान हिन्दी पखवाड़े का आयोजन किया गया। हिन्दी पखवाड़े का शुभारंभ अर्थात उदघाटन हिन्दी दिवस एवं दूसरे आखिल भारतीय राजभाषा सम्मेलन के अवसर पर सितम्बर 14, 2022 को सूरत, गुजरात मैं श्री अमित शाह, माननीय केंद्रीय गृह एवं सहकारिता मंत्री, भारत सरकार द्वारा किया गया था। हिन्दी पखवाड़े से संबन्धित प्रतियोगिताएं दिनांक सितम्बर 17–29, 2022 के दौरान संस्थान मैं आयोजित की गई। सितम्बर 17, 2022 को काव्य पाठ का आयोजन किया गया। इसके अलावा अलग–अलग तिथियों में हिन्दी में सर्वाधिक वैज्ञानिक कार्य करने के लिए प्रभागीय चल–शील्ड, डिजिटल हिन्दी शोध–पोस्टर प्रस्तुति प्रतियोगिता, डिजिटल हिन्दी पोस्टर प्रस्तुति प्रतियोगिता, हिन्दी श्रुतलेख तथा हिंदीतर कर्मियों के लिए शब्दार्थ लेखन प्रतियोगिताएं आयोजित की गई। इन सभी प्रतियोगिताओं में संस्थान के विभिन्न वर्ग के कर्मियों ने बड़े उत्साह के साथ तथा बढ़–चढ़कर हिस्सा लिया। संस्थान में प्रत्येक वर्ष हिन्दी दिवस के अवसर पर डॉ. दरोगा सिंह स्मृति व्याख्यान का आयोजन किया जाता है। इस कड़ी का इकत्तीसवाँ व्याख्यान सिम्मबायोसिस यूनिवर्सिटी ऑफ एप्लाईड साइंसिज, इंदौर के कुलपति डॉ० पृथ्वी यादव जी द्वारा दिया गया और इस कार्यक्रम की अध्यक्षता संस्थान के निदेशक महोदय द्वारा की गई। दिनांक सितम्बर 30, 2022 को हिन्दी पखवाड़ा के समापन समारोह के अवसर पर इन प्रतियोगिताओं के सफल प्रतियोगियों के साथ–साथ वर्ष 2021–22 के लिए सरकारी काम–काज मूल रूप से हिन्दी में करने के लिए संस्थान के पाँच कर्मियों को पुरस्कृत किया गया।

Annexure-I

LIST OF RESEARCH PROJECTS

01 January to 31 December, 2022

DEVELOPMENT AND ANALYSIS OF EXPERIMENTAL DESIGNS FOR AGRICULTURAL SYSTEMS RESEARCH

On-going

Institute Funded

1. Efficient designs for order-of-addition experiments. (AGEDIASRISIL202100800179)

   BN Mandal (till 22.08.2022), Sukanta Dash (PI since 23.08.2022 & Co-PI upto 22.08.2022), Rajender Parsad: 09.09.2021-08.06.2024

2. Efficient designs for double cross experiments under fixed/mixed effects model (AGEDIASRICIL202101300184)

   ICAR-IASRI: Harun, Cini Varghese; ICAR-DPR: L. Leslie Leo; ICAR- IARI: Mallikarjuna M.G: 11.11.2021-10.11.2024

Outside Funded

3. Planning, designing and analysis of experiments planned on stations under AICRP on IFS. Funded by AICRP on IFS as Voluntary Centre, ICAR-IIFSR, Modipuram. (AGEDIASRISOL 201701900105)

   Anil Kumar, Harun (till 11.09.2018 & rejoin 12.03.2020), Susheel Kumar Sarkar and Sunil Kumar Yadav (since 20.11.2021):01.04.2017- 31.03.2023

4. Designing and analysis of on farm research experiments planned under AICRP on IFS. Funded by AICRP on IFS as Voluntary Centre, ICAR-IIFSR, Modipuram. (AGEDIASRISOL201702000106)

   Cini Varghese, Sukanta Dash, Arpan Bhowmik (till 08.04.2022): 01.04.2017- 31.03.2023

5. Planning, designing and analysis of data relating to experiments for AICRP on Long Term Fertilizer Experiments. Funded by AICRP on Long Term Fertilizer Experiments as Voluntary Centre, ICAR-IISS, Bhopal (AGEDIASRISOL 201702100107)

   B.N. Mandal (till 22.08.2022), Aninditta Datta, Sunil Kumar Yadav: 01.04.2017-31.03.2023

6. ICAR research data repository for knowledge management as KRISHI: Knowledge based Resources Information System Hub for Innovations in Agriculture. (AGENIASRICOL201503100068)

   ICAR-IASRI: Rajender Parsad, A.K. Choubey (till 20.01.2018), Anil Kumar, Mukesh Kumar, Anshu Bharadwaj, Susheel Sarkar, and Sukanta Dash (since 03.04.2017); ICAR-NAARM: A. Dhandapani; ICAR-NBSS&LUP: G.P. Obi Reddy, Nirmal Kumar, Sudipto Chattaraj; ICAR-IARI: Vinay Kumar Sehgal, Joydeep Mukerjee, Rajkumar Dhakar (since 18.01.2019); ICAR-DKMA: S.K. Singh (07.08.2019-28.02.0222), H.K. Tripathi (since 07.08.2019), Mitali Ghosh Roy; ICAR-CMFRI: J. Jayasankar

   ICAR-CRIDA: N.S. Raju, P.Vijaya Kumar (Since 17.12.2017-31.03.2020), A.V.M. Subba Rao (Since 17.12.2017), Shantanu Kumar Bal (since 21.12.2018): 24.07.2015-31.03.2023

7. Application of next-generation breeding, genotyping, and digitalization approaches for improving the genetic gain in indian staple crops. (AGEDIASRICOP201900200148)

   ICAR-IARI: A.K. Singh, Ranjith Kumar Ellur, S. Gopala Krishnan, C. Bharadwaj, Shailesh Tripathi, Rajbir Yadav, Harikrishna, Neelu Jain, M. Ganapathi, Jyoti Kaul, R.S. Raje, G. Rama Prashat, Durgesh Kumar; ICAR-IIMR: T. Nepolean, Madusudhana, B. Aruna, Sanjana Reddy; ICAR-IIPR: Abhishek Bohra, B. Mondal; ICAR-CPRI: Vinay Bhardwaj, Vinod; ICAR-NRRI: J.N. Reddy, Anandan; ICAR-IIRR: L.V. Subbarao, Abdul Fiaz; ICAR-IIWBR: Satish Kumar, Ravish Chatrath; ICAR-Project Coordinating Unit (Pearl millet): Vikas

Khandelwal; ICAR-Project Coordinating Unit (Chickpea): A.K. Srivastava; ICAR-IASRI: Susheel Kumar Sarkar

ICRISAT/Excellence in Breeding Platform, CIMMYT: Abhishek Rathore: 22.01.2019-31.10.2023

8. Biomass and carbon mapping across altitudinal gradient of major Darjeeling and Sikkim himalayan land uses: implications for carbon sink management and mitigation. DST (AGEDIASRICOP202100400175)

   UBKV: Sumit Chakravarty, Gopal Shukla and Ganesh Banik; ICAR-IASRI: Arpan Bhowmik (till 08.04.2022), Ankur Biswas (since 09.04.2022): 10.02.2021-09.02.2024

9. Sustainable biochar production and use through Rice-Cotton based agro-forestry system in Odisha: A climate resilient soil management approach. (AGEDIASRICOP202100700178)

   ICRAF: Javed Rizvi, Shiv K. Dhyani, Aqeel Hasan Rizvi, Archna Singh; ICAR-IISS: Brij Lal Lakaria, Promod Jha, A K Biswas; ICAR-IASRI: BN Mandal (till 22.08.2022), Ajit (PI since 23.08.2022 & Co-PI upto 22.08.2022), Rajender Parsad: 25.08.2021-31.05.2023

10. Diversified farming through livestock and agriculture under farmer farm, innovations, resources, science and technology programme (ICAR-CIRB Farmer First) (AGEDIASRICOP202101500186)

    ICAR-CIRB: Sarita Yadav, Ashok K. Boora, P.C. Lailer, Sajjan Singh, Bharat Singh; ICAR-IARI: Manjeet Singh; ICAR-IASRI: Anil Kumar, Sukanta Dash: 25.11.2021-31.03.2023

FORECASTING, MODELLING AND SIMULATION TECHNIQUES IN BIOLOGICAL AND ECONOMIC PHENOMENA

On-going

Institute Funded

11. Forecasting onion prices using deep learning techniques. (AGEDIASRISIL202100300174)

    Kanchan Sinha, KN Singh, Mrinmoy Ray, Harish Kumar HV (till16.10.2022): 20.02.2021-20.11.2022

12. Development of spatio-temporal neural network models for forecasting space-time data (AGEDIASRISIL202101900191)

    Mrinmoy Ray, KN Singh, Kanchan Sinha, Rajeev Ranjan Kumar: 21.12.2021-20.06.2024

Outside Funded

13. Forecasting agricultural output using space Agrometeorology and land based observations (FASAL) (AGENIASRICOP201600700076)

    IMD: K.K. Singh; ICAR-IASRI: K.N. Singh, Achal Lama (since 31.10.2018): 13.04.2016-30.09.2022

14. Doubling farmers' income in India by 2021-22: Estimating farm income and facilitating the implementation of strategic framework. Funded by Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, and Farmers Welfare, Govt. of India. (AGENIASRICOP201700600092)

    ICAR-NIAP: Suresh Pal, Raka Saxena, Naveen P Singh, Usha R Ahuja; ICAR-IASRI: RK Paul: 31.03.2017-31.03.2023

Completed

Institute Funded

15. Enhanced Classification and Regression Tree (CART) models for forecasting in Agriculture. (AGEDIASRISIL201900700153)

    Ramasubramanian V., Mrinmoy Ray, Md. Wasi Alam: 31.03.2019-31.03.2022

16. Modeling insect pests and diseases under climate change and development of digital tools for pest management National Innovations in Climate Resilient Agriculture (NICRA). (AGEDIASRICOP201701500101)

    ICAR-NCIPM: S. Vennila, M.N. Bhat, Niranjan Singh; ICAR-CRIDA: M. Prabhakar, M.S. Rao; ICAR-IASRI: Ranjit Kumar Paul: 20.06.2017-31.03.2023

17. Leveraging institutional innovations for inclusive and market led agricultural growth in eastern India. (NASF Funded). (AGEDIASRICOP201901300159)

    ICAR-IARI: Pramod Kumar; BHU, Varansi: PS Badal; ICAR-NRRI, Cuttack: Biswajit Mondal; CCS NIAM, Jaipur: Sathyendra Kumar; ICAR-IASRI: R.K. Paul: 01.12.2019-30.11.2022

New Initiated

Institute Funded

18. Modelling of proportional data for forewarning pest attacks in crops. (AGEDIASRISIL202200700200)

    Bishal Gurung, Achal Lama, KN Singh: 21.05.2022-20.11.2024

19. A novel approach for time series forecasting of demand and supply of food grains in India. (AGEDIASRISIL202201900212)

    Wasi Alam, Kanchan Sinha, Prawin Arya: 28.11.2022-27.05.2024

Outside Funded

20. Market information system. ICAR-NIAP (AGEDIASRICOP202200100194)

    ICAR-NIAP: Purushottam Sharma; ICAR-IASRI: Ranjit Kumar Paul, Md. Yeasin, A.K. Paul, Ajit: 22.01.2022-31.03.2026

DEVELOPMENT OF TECHNIQUES FOR PLANNING AND EXECUTION OF SURVEYS AND STATISTICAL APPLICATIONS OF GIS AND REMOTE SENSING IN AGRICULTURAL SYSTEMS

On-going

Institute Funded

21. A study on domain calibration estimators under two stage sampling design. (AGEDIASRISIL202100100172)

    Kaustava Aditaya, Vandita Kumari (till 16.10.2021), Hukum Chandra (till 26.04.2021), Pankaj Das, Raju Kumar (since 23.11.2021): 18.01.2021-17.07.2023

Outside Funded

22. Energy audit survey of AICRP on EAAI: sampling design and analysis. Funded by AICRP on EAAI as Voluntary Centre, ICAR-CIAE, Bhopal. (AGEDIASRICOP201802000129)

    ICAR-CIAE: K.C. Pandey (till 17.02.2022), M. Din (since 18.02.2022); ICAR-IASRI: Hukum Chandra (till 26.04.2021), Kaustav Aditya (since 27.04.2021) Susheel Kumar (till 05 07.2018), Pradeep Basak (till 30.11.2020), Ajit, Bharti (since 23.11.2021): 01.06.2018-31.05.2026

23. Integrated sample survey solution for major livestock products. Funded by Animal Husbandry Statistics Division, Department of Animal Husbandry, Dairying & Fisheries Ministry of Agriculture and Farmers Welfare, Govt. of India. (AGEDIASRISOL201900800154)

    Prachi Misra Sahoo, Tauqueer Ahmad, Ankur Biswas, Pradip Basak (till 30.11.2020), Anil Rai, S.B. Lal: 28.03.2019-31.03.2023

24. Planning of survey and analysis of AICRP data on Honey bees and Pollinators (AGEDIASRICOP202100600177)

    ICAR-IARI: Balraj Singh; Project Coordinator, AICRP on Honey Bees & Pollinators: Kumaranag, K.M; ICAR-IASRI: Deepak Singh: 30.03.2021- 31.03.2023

Completed

Institute Funded

25. Estimation of finite population proportion from geo-referenced survey data. (AGEDIASRISIL202000800167)

    Vandita Kumari (till 16.10.2021), Ankur Biswas (since 17.10. 2021), Pradip Basak (till 30.11.2020), Hukum Chandra (till 26.04.2021), Kaustava Aditya, Rahul Banerjee (since 23.11.2021), Deepak Singh (since 23.11. 2021): 02.10.2020-01.12.2022

26. Detection of outliers in presence of masking and imputation of data when auxiliary variables are available in sample surveys. (AGEDIASRISIL201901100157)

    Raju Kumar, Ankur Biswas, Lal Mohan Bhar (till 31.07.2021), Deepak Singh: 23.07.2019-22.01.2022

New Initiated

Institute Funded

27. A regression type estimator in dual frame surveys under two-stage sampling. (AGEDIASRISIL202200800201)
    Bharti, Kaustav Aditya, Deepak Singh, Rahul Banerjee: 01.08.2022-30.11.2024
28. Machine learning models in complex surveys for crop yield estimation. AGEDIASRISIL202200900202
    Pankaj Das, Ankur Biswas, Tauqueer Ahmad, Prachi Misra Sahoo: 02.09.2022-01.09.2025
29. Model-assisted estimators using survey weighted artificial neural networks in complex surveys. (AGEDIASRISIL202201500208)
    Deepak Singh, Raju Kumar, Samarth Godara, Bharti: 10.10.2022- 31.03.2024
30. Development of robust estimator by integrating data from different surveys. (AGEDIASRISIL202202000213)
    Rahul Banerjee, Pankaj Das, Raju Kumar, Ankur Biswas: 28.11.2022-27.11.2024

Outside Funded

31. Agri-drone in ICAR: ICAR-IASRI component. Funded by ICAR HQ through ATARI, Jodhpur. (AGEDIASRICOL202201200205)
    Tauqueer Ahmad, Prachi Mishra Sahoo, KK Chaturvedi, Ankur Biswas, Pankaj Das: 21.07.2022-31.03.2023
32. Planning and data analysis of FSSAI and NeTSCoFAN surveys. Funded by FSSAI. (AGEDIASRICOL202201300206)
    ICAR-IASRI: Deepak Singh, Raju Kumar, Ankur Biswas, Tauqueer Ahmad, Prachi Mishra Sahoo, Kaustava Aditya, Bharti, Pankaj Das, Rahul Banerjee; ICAR- IIHR: R. Venugopalan; ICAR- CARI: Sandeep Saran; ICAR- CIFT: Satyen Kumar Panda, Girish Patil, S; ICAR-NRCM: Yogesh Gadekar; ICAR-NRCG: Ahammed Shabeer T.P. : 22.07.2022-31.03.2024

DEVELOPMENT OF STATISTICAL TECHNIQUES FOR GENETICS/ COMPUTATIONAL BIOLOGY AND APPLICATIONS OF BIOINFORMATICS IN AGRICULTURAL RESEARCH

On-going

Institute Funded

33. An effective approach for combining time series and deep learning models (AGEDIASRISIL202101600187)
    Md. Yeasin, Ranjit Kumar Paul: 25.11.2021-24.04.2024
34. Modelling and forecasting for time-to-event analysis in Agriculture. (AGEDIASRISIL202000500164)
    Himadri Ghosh, AK Paul; ICAR- NBPGR: Sherry Jacob: 22.06.2020-21.03.2023
35. Development of artificial intelligence framework for prediction of protein 3D structure (AGEDIASRISIL202100500176)
    U.B. Angadi, KK Chaturvedi, Sudhir Srivastava: 16.03.2021-15.03.2024
36. Development of statistical and computational approach for preprocessing and analysis high-throughput proteomics data with missing values. (AGEDIASRISIL202000200161)
    Sudhir Srivastava, DC Mishra, UB Angadi, KK Chaturvedi: 13.03.2020- 12.03.2023
37. Development of machine learning models and Bayesian network for discovery of Nucleic acid-binding protein and their application in disease/pest surveillance. (AGEDIASRISIL202101700188)
    Upendra Kumar Pradhan, Samarendra Das (till 02.04.2022), Prabina Kumar Meher, Sanchita Naha (since 06.12.2022) : 25.11.2021-24.05.2024
38. Statistical approaches for analysis of zero-inflated and over-dispersed counts data and their in single cell studies. (AGEDIASRISIL202101800189)
    Samarendra Das (till 02.04.2022 as PI), Upendra Kumar Pradhan (since 03.04.2022 as PI), Upendra Kumar Pradhan (till 02.04.2022 as Co-PI), Sudhir Srivastava, Prakash Kumar, ICAR/DFMD: Samarendra Das (since 13.09.2022 as Co-PI): 25.11.2021-24.05.2024
39. Potential irrigated area mapping through remotely sensed high-resolution data (AGEDIASRICIP202102100192)
    CAR-IIWM: R.K. Jena, R.R. Sethi; ICAR-NBSS&LUP: Nirmal Kumar; Office of Climate Research and Services, IMD, Pune: S. Khedikar; ICAR-IASRI: U.K. Pradhan: 05.09.2021-04.09.2024

40. Forest cover trend and above ground biomass estimation using advanced statistical technique based on remote sensing data. (AGEDIASRISIL202201700210)

    ICAR-IASRI: Yeasin, Ranjit Kumar Paul, Ajit; IIRS, ISRO: Dipanwita Haldar: 22.10.2022-21.10.2025

41. Network project on agricultural bioinformatics and computational biology

    (AGEDIASRISOL202000900168)

    Anil Rai, Dinesh Kumar (till 02.12.2021), Monendra Grover, UB Angadi, Sunil Kumar, KK Chaturvedi, SB Lal, Anu Sharma, Sarika, MA Iquebal, Samir Farooqi, Sanjeev Kumar, DC Mishra, Sudhir Srivastava, Neeraj Budhlakoti, Ratna Prabha, Sarika Sahu: 12.07.2020-31.03.2025

Outside Funded

42. Computational and analytical solutions for high-throughput biological data. Funded by ICAR project on CRP Genomics. (AGENIASRISOL201502400061)

    ICAR-NBFGR: Vindhya Mohindra; ICAR-IASRI: Anil Rai, Anu Sharma, Dwijesh Chandra Mishra, Sudhir Srivastava, Neeraj Budhlakoti, Sarika Sahu: 04.09.2015-30.10.2022

43. Genomic prediction for micro-nutritional traits in bread wheat: a study on machine learning algorithm. ICAR-LBS young scientist award scheme (AGEDIASRISOL202200500198)

    P.K Meher: 0104.2022-31.03.2025

44. Genome wide association studies in giant freshwater prawn, M rosenbergii: Linkage mapping and QTL identification. NASF Funded. (AGEDIASRICOP202201100204)

    ICAR- CIFA: P. Das, B.R. Pillai, Lakshman Sahoo, Debabrata Panda; ICAR-IASRI: PK Meher: 01.09.2022-31.08.2025

45. Molecular markers for improving reproduction of cattle and buffaloes. Bill & Melinda Gates Foundation Funded, USA. (AGEDIASRICOP201803000139)

    ICAR-NDRI: TK Datta; ICAR-CIRB: Varij Nayan; ICAR-IASRI: Dinesh Kumar (deputation on 02.12.2021), MA Iquebal, Sarika, UB Angadi, Anil Rai: 19.09.2018-30.09.2023

46. Genomics assisted crop improvement and management. Funded by NAHEP (AGEDIASRICOP201803200141)

    ICAR-IARI: Viswanathan Chinnusamy; ICAR-IASRI: ICAR-IASRI: A.R. Rao (till 19.02.2020), Seema Jaggi (20.02.2020-27.04.2021), Sudeep (28.04.2021 to till date)-CC-PI Seema Jaggi (till 19.02.2020), Sudeep (till 27.04.2021), Sanjeev Kumar, Soumen Pal, Anindita Datta: 26.09.2018-31.03.2023

47. Characterization, evaluation, genetic enhancement and generation of genomic resources for accelerated utilization and improvement of minor pulses. Funded by DBT. (AGEDIASRICOP201803500144)

    ILS, Bhubaneshwar: Ajay Kumar Parida; ICAR-NBPGR: Kuldeep Singh, DP Wankhede;

    ICAR-IASRI: Sanjeev Kumar, Anu Sharma;

    UAS, Bangalore: Niranjana Murthy

    PAU, Ludhiana: Dharminder Bhatia CSKHPKVV, Palampur: Rajan Katoch

    VNMKV, Parbhani, Maharashtra: Deepak K Patil

    ICAR-CAZRI, Jodhpur: Rajwant Kaur Kalia

    World Vegetable Centre, South Asia, Hyderabad: RM Nair: 24.10.2018- 23.10.2022

48. Mainstreaming rice landraces diversity in varietal development through genome wide association studies: A model for large-scale utilization of gene bank collections of rice. (DBT) (AGEDIASRICOP202000300162)

    ICAR-IARI, Director: Ashok Kumar

    ICAR-IASRI: Sarika, Dinesh Kumar (deputation on 02.12.2021), MA Iquebal: 01.05.2020-30.04.2025

49. Germplasm characterization and trait discovery in Wheat using genomics approaches and its integration for improving climate resilience, productivity and nutritional quality. (DBT) (AGEDIASRICOP202000400163)

    ICAR-NBPGR, Director: Kuldeep Singh

    ICAR-IASRI: Dinesh Kumar (deputation on 02.12.2021), MA Iquebal, UB Angadi, DC Mishra, Neeraj Budhlakoti, Sarika,: 01.04.2020-31.03.2025

50. Minor oilseeds of Indian origin: Mainstreaming sesame germplasm for productivity enhancement and

sustainability through genomics assisted core development and trait discovery. Funded by Department of Biotechnology. (AGEDIASRICOP202100200171)

NBPGR: Kuldeep Singh, Rashmi Yadav & Ashok Kumar,

ICAR-IASRI: UB Angadi, Dinesh Kumar (deputation on 02.12.2021), D.C. Mishra: 29.02.2020- 28.02.2025

51. Assessing genetic variability in duck of eastern states (AGEDIASRICIP202100300173) ICAR-RCER: Shanker Dayal, Rajni Kumari P.K. Ray, Reena Kamal

    ICAR-IASRI: Ratna Prabha: 08.02.2021-31.07.2023

52. Identification and functional characterization of the key resistance/susceptible determinants for Sclerotinia stem rot disease in oilseed Brassica. (DST). (AGEDIASRICOP202001100170)

    ICAR-NIPB: Navin Chandra Gupta, Mahesh Rao, Ramcharan Bhattacharya, ICAR-IASRI: Dwijesh Chandra Mishra: 30.12.2020-31.12.2023

53. Establishment of centre for bioinformatics and computational biology in agriculture-BIC at ICAR-IASRI. Funded by Department of Biotechnology. (AGEDIASRISOL202102200193)

    Anil Rai, Sunil Kumar, KK Chaturvedi, Sanjeev Kumar, MA Iquebal, Sarika, Anu Sharma, Dinesh Kumar (deputation on 02.12.2021), Monendra Grover, DC Mishra, Samir Farooqi. UB Angadi, Sudhir Srivastava, Neeraj Budhlakoti: 16.12.2021-14.11.2026

54. Development of artificial intelligent based computational tools for genomic data analysis in domestic animal species (AGEDIASRISOL202101400185)

    M.A. Iquebal: 12.11.2021-11.11.2024

55. KISAN SARATHI (Powered by IIDS): System of agri-information resources auto-transmission and technology hub interface: ICT and ICAR Data Repository. (AGEDIASRICOL202100900180)

    Sanjeev Kumar, K.K. Chaturvedi, S. B. Lal, Mukesh Kumar: 09.08.2021-31.03.2026

56. Network program on Precision Agriculture (NePPA) (AGEDIASRICOP202101100182)

    ICAR- IARI: Rabi N. Sahoo; ICAR-IASRI: K.K. Chaturvedi, Sanjeev Kumar, S.B. Lal, Mukesh Kumar, Ankur Biswas, Rajeev Ranjan Kumar, Samarth Godara: 04.09.2021-31.03.2026

Completed

Institute Funded

57. Machine learning approach for binning of metagenomics data. (AGEDIASRISIL201901200158)

    Anu Sharma, SB Lal, Sanjeev Kumar, DC Mishra: 24.7.2019-13.05.2022

Outside Funded

58. Molecular characterization, development of molecular markers and metabolite analysis of tree bean (Parkia roxburghii) landraces of North-East India. Funded by DBT. (AGEDIASRICIP201803100140)

    ICAR Research Complex for NEH Region (Gangtok Sikkim Centre): Sudip Kumar Dutta, Ratankumar Akoijam, Vishambhar Dayal; UBKB, West Bengal: Somnath Mandal, Nandita Sahana; ICAR-IASRI: MA Iquebal, Sarika: 15.03.2019-14.03.2022

59. Explicating genomic insights of Indigenous equines breed population through Computational Genomics and Artificial Intelligence based approaches. (AGEDIASRICIP202000600165)

    ICAR-NRCE, Hissar: Anuradha Bhardwaj, Yash Pal; ICAR-IASRI: Sarika, MA Iquebal, Dinesh Kumar (on deputation since 02.12.2021): 17.08.2020-30.11.2022

60. Genome wide association study in indigenous poultry breeds/varieties. (AGEDIASRICOP202001000169)

    ILRI: Hanotte Olivier, Dessie Tadelle; ICAR-Directorate of Poultry Research:TK Bhattacharya

    ICAR-DPR: RN Chatterjee, SP Yadav, Chandan Paswan; ICAR-IASRI: Anil Rai, DC Mishra: 21.05.2020-31.12.2022

New Initiated

Institute Funded

61. Development of artificial intelligence and big data analytics-based framework for predicting protein-ligand interaction. (AGEDIASRISIL202200600199)

Sneha Murmu, Soumya Sharma, Bharati Pandey (till 29.12.2022), Md Samir Farooqi, Ritwika Das (since 06.02.2023): 11.05.2022-11.02.2025

62. Meta-analysis of crop rhizosphere microbiome for identification of abiotic stress responsive microbial signatures and development of integrated information system. (AGEDIASRISIL202201000203)

    Ratna Prabha, Sudhir Srivastava, Sarika Sahu: 02.09.2022-01.03.2025

63. Mining agricultural microbiome datasets for Antibiotic Resistance Genes (ARG) diversity and prediction of microbial resistome. (AGEDIASRICIP202201400207)

    ICAR-NBAIM: Kumar M, Harsh Vardhan Singh, Abhijeet Shankar Kashyap, Jyoti Prakash Singh; ICAR-IASRI: Ratna Prabha, Sunil Kumar: 03.10.2022- 02.04.2025

64. Development of computational pipeline(s) for identification, characterization and functional analysis of ncRNAs in agriculturally important species.(AGEDIASRISIL202201600209)

    Sarika Sahu, Ratna Prabha, Soumya Sharma: 18.10.2022-17.10.2024

65. Development of an integrated framework for the analysis of biogeochemical cycles from metagenomic data. (AGEDIASRISIL202201800211)

    Ritwika Das, Sneha Murmu, Anu Sharma: 28.11.2022- 28.05.2025

66. Improving seed health and storage system (AGEDIASRICIP202200200195)

    ICAR-IISS: Arvind Nath Singh; ICAR-IASRI: Sunil Kumar: 25.01.2022-31.03.2026

DEVELOPMENT OF INFORMATICS IN AGRICULTURAL RESEARCH

On-going

Outside Funded

67. Management and impact assessment of farmer FIRST project. Funded by ICAR farmer FIRST programme under KVK scheme (ATARI-I). (AGENIASRICOP201700200088)

    ICAR-NIAP: Shiv Kumar, Rajni Jain, Vinayak R Nikam, Kinsly IT, Abhimanyu Jhajhria; ICAR-NAARM: P Venkatesan, Bharat S Sontakki, N Sivaramane; ICAR-IASRI: Mukesh Kumar, Anshu Bharadwaj, Soumen Pal; ICAR-DKMA: Aruna T Kumar, Mitali Ghosh Rai: 14.02.2017-31.03.2023

68. Knowledge management system for agriculture extension services in indian NARES. Funded by ICAR Extramural Research Projects-Agricultural Extension Division. (AGENIASRICOL201600500074)

    ICAR-IASRI: Alka Arora, AK Choubey (till 20.01.2018), NS Rao (till 24.09.2016), SN Islam, Soumen Pal, Sudeep, Ajit (since 29.08.2018), RK Paul (since 29.08.2018); ICAR: P Adiguru: 04.03.2016-31.03.2026

69. Investments in Indian Council of Agricultural Research leadership on agricultural higher Education (NAHEP Component-2 Funded). (AGEDIASRISOL201900500151)

    ICAR-IASRI: Sudeep, Alka Arora, Anshu Bharadwaj, Mukesh Kumar, Shashi Dahiya, Pal Singh (till 30.06.2021), SN Islam, Soumen Pal, Ajit, Ramasubramanian V, Mrinmoy Ray, Achal Lama, Arpan Bhowmik (since 13.12.2019); ICAR-NAARM: SK Soam, D Thammi Raju, N Srinivasa Rao, Alok Kumar, VV Sumanthkumar, Sanjiv Kumar, Surya Rathore; ICAR-NIAP: Rajni Jain: 28.02.2019-31.03.2024

70. Resilient Agricultural Education System (RAES). (AGEDIASRISOL202101000181)

    Sudeep, Alka Arora, Anshu Bharadwaj, Ajit, V. Ramasubramanian, Shashi Dahiya, S. N. Islam, Soumen Pal Sanchita Naha, Madhu, Samarth Godra: 29.07.2021-31.03.2024

71. Development of artificial intelligence integrated big-data based system for automatic query-response generation and analysis of Indian farmers' queries. (AGEDIASRICIL202101900190)

    ICAR-IASRI: Samarth Godara, Madhu, Sanchita Naha; ICAR-IARI: JPS Dabas: 09.12.2021-08.12.2024

72. Cereal Systems Initiative for South Asia (CSISA) integration with KVK portal. Funded by International Maize and Wheat Improvement Center (CIMMYT) through Extension Division,ICAR. (AGEDIASRICOP202000700166)

    Soumen Pal, Alka Arora, Sudeep, SN Islam, Ajit, RK Paul: 01.04.2020-31.03.2025

Completed

Outside Funded

73. Artificial intelligence based mobile app for identification and advisory of maize diseases and insect pests. Funded by NASF. (AGEDIASRISOL201901000156)
    ICAR-IASRI: Sudeep, Alka Arora, Mukesh Kumar, SN Islam, Chandan Kumar Deb (since 10.04.2021), Ashraful Haque (since 10.04.2021); ICAR-IIMR Ludhiana: KS Hooda; IIT, Delhi: Brejesh Lall: 31.12.2018-30.09.2022

New Initiated

Institute Funded

74. AI and machine learning for supply forecasts (AGEDIASRICIP202200300196)
    ICAR-NIAP: Rajni Jain, Dilip Kumar, Abimanyu Jhajhria; ICAR-IASRI: Anshu Bharadwaj, Sapna Nigam: 03.03.2022-31.03.2026
75. Development of an intelligent system for determining pig live weight. AGEDIASRICIP202200400197)
    ICAR-IVRI: Ayon Tarafdar, Triveni Dutt, Gyanendra K. Gaur, Rupasi Tiwari, Anuj Chauhan, Mukesh Singh; ICAR-IASRI: Chandan K. Deb, Ashraful Haque, Samarth Godara: 02.06.2022- 18.10.2023
76. Development and assessment of conversational virtual agents 'Chatbots' for improving livestock, pet and poultry health and production. (AGEDIASRICIP202202100214)
    ICAR-IVRI: Rupasi Tiwari; ICAR-IASRI: Sanchita Naha, Chandan Kumar Deb: 10.10.2022-31.08.2025

Consultancy/Contract Projects Across Programmes

77. Study on reviewing the food loss index estimates for India and preparing assessment report for inclusion of the SDG indicator12.3.1 in the National Indicator Framework. Consultancy from FAO, India.
    Tauqueer Ahmad, Anil Rai, Rajender Parsad, Prachi Misra Sahoo, Ankur Biswas: 11.11.2022-10.05.2023
78. Development of e-voting system for Indian Dairy Association (IDA). Contract research from Indian Dairy Association.
    Sudeep: 21.02.2022-20.03.2022
79. Knowledge Management System for DUS characteristics of crops. Contract research from PPVFRA, Ministry of Agriculture and Farmers Welfare, Govt. of India.
    Sudeep, Alka Arora, Soumen Paul, L.M. Bhar (till 31.07.2021): 05.01.2019- 31.03.2022

Annexure-II

DISTINGUISHED VISITORS

Following dignitaries visited the Institute in person during 2022

Dr. G.P. Samanta Chief Statistician of India & Secretary, Ministry of Statistics and Programme Implementation, Govt. of India	**Dr. Bikas Sinha,** Former Member, National Statistical Commission, Govt. of India & Former Professor of Statistics, Indian Statistical Institute, Kolkata
Ms Alka Nangia Arora Additional Secretary(DARE) & Financial Advisor(ICAR) ICAR, New Delhi	**Dr. Padam Singh** Former Member, National Statistical Commission, Govt. of India & Former Additional Director General, ICMR, New Delhi
Dr. S.K. Chaudhary DDG (Natural Resource Management), ICAR, New Delhi	**Dr. R.C. Agrawal** DDG (Agricultural Education) and National Director, NAHEP, ICAR, New Delhi
Dr. V.K. Gupta Former ICAR-National Professor ICAR-IASRI, New Delhi	**Dr. Ranjana Nagpal** Deputy Director General, National Informatics Center, New Delhi
Dr Dalip Singh Deputy Director-General -Cum- Agriculture Census Commissioner, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare Shastri Bhawan, New Delhi	**Dr. Prabhat Kumar** Horticulture Commissioner, Ministry of Agriculture and Farmers' Welfare, Government of India
Dr. P.S. Pandey ADG (Education Planning & Home Science) ICAR, New Delhi	**Dr. Seema Jaggi** ADG (Human Resource Development) ICAR, New Delhi
Dr. Abhijit Kar Director, ICAR-National Institute of Secondary Agriculture, Ranchi	**Dr. A.S. Panwar** Director, ICAR-IIFSR, Modipuram
Dr. P.S. Birthal Director, ICAR-NIAP, New Delhi	**Dr. Prajneshu** Former Head of Division, Biometrics and Statistical Modelling, ICAR-IASRI, New Delhi
Dr. Indrarnil Mukhopadhyay Professor, Human Genetics Unit, Indian Statistical Institute, 203, BT Road, Kolkata	**Dr. Punam Bedi** Professor and Former Head of Department of Computer Science, University of Delhi, Delhi
Dr. Mausam Professor, Jai Gupta Chair Department of Computer Science and Engineering, Indian Institute of Technology (IIT), New Delhi	**Dr. K. Muralidharan** Professor, Department of Statistics, The Maharaja Sayajirao University of Baroda. Vadodara, Gujarat
Dr. Murari Singh Former Senior Biometrician International Center for Agricultural Research in the Dry Areas (ICARDA), Amman, Jordan	

Annexure-III

ICAR-NATIONAL AGRICULTURAL SCIENCE MUSEUM

ICAR-National Agricultural Science Museum (NASM) was conceived by the ICAR and executed by the National Council of Science Museum (NCSM), Ministry of Culture, Government of India during 2004. This museum is the only one of its kind in the country and is located in a sprawling two-storey building spread over 2000 sq. m. In this museum, the development of civilizations and Indian Agriculture since pre-historic age to the present time is displayed in a vibrant and vivid detail. Global issues pertaining to agriculture have also been presented. All this knowledge has been made available using computers, posters, models, audios as well as visuals. NASM is situated at NASC Complex, New Delhi. The major sections of the museum are:

1. Six Pillars of Agriculture
2. Agriculture in Pre-historic Period
3. Agriculture during Indus-valley Civilization
4. Agriculture during Vedic and Post Vedic Period
5. Agriculture during Sultanate and Mogul Period
6. Agriculture during British Period
7. Agricultural Science in Independent India
8. Global Issues Related to Agriculture
9. Golden Future of Indian Agriculture
10. Children Section

Following Committee looks after Management, Strengthening and Modernization of NASM

1.	Dr. R.C. Agrawal, DDG (Agricultural Education) ICAR	: Chairman
2.	Dr. Rajender Parsad, Director, ICAR-IASRI	: Nodal Officer and Member
3.	Assistant Director General (Farm Engineering)	: Member
4.	Dr. D.K. Yadav, ADG (Seeds), ICAR	: Member
5.	Director (Finance), ICAR	: Member
6.	Director (Works), ICAR	: Member
7.	Deputy Secretary (GAC), ICAR	: Member
8.	Dr. Seema Jaggi, ADG (HRD), ICAR	: Member
9.	Sh. V.R. Senthilkumar, ACTO (Civil), ICAR-IASRI	: Member Secretary

The responsibility of upkeep and maintenance of NASM rests with the Institute. Sh. RA Joshi, Chief Technical Officer, ICAR-IASRI is the In-Charge, NASM. Under the guidance of the management committee of museum, the activities of the museum relating to up-keep and maintenance are looked after. The fully air-conditioned Museum remains open to visitors on all days from 10:30 hrs to 16:30 hrs except Monday (weekly holiday). There is a nominal fee of Rs. 10/- per head, but the groups of farmers, children from school/ college are exempted from entry fee. During COVID 19, the museum was closed for some time for general public.

Attractive posters of NASM exhibits were presented during Pusa Unnati Krishi Mela, 2022 held at IARI mela ground, New Delhi during March 09-11, 2022 to the general visitors, researchers, students and farmers to give them adequate knowledge about NASM also distributed NASM Booklets & Pamphlets to the visitors.

During 2022, a total of 4649 visitors (2753 students, 1260 NARES and Government Officials, 514 farmers, 8 foreign delegates, 97 trainees from different training programmes conducted by ICAR Institutes and other Government Departments, 04 Media personnel and 13 senior functionaries) visited NASM.

Annexure-IV

ACRONYMS

AICRP: All India Coordinated Research Project
ADG: Assistant Director General
ASRB: Agricultural Scientists Recruitment Board
ATIC: Agricultural Technology Information Centre
BASU; Bihar Animal Sciences University
BAU: Bihar Agricultural University
BHU: Banaras Hindu University
CAFT: Centre for Advanced Faculty Training
CAU: Central Agricultural University
CAZRI: Central Arid Zone Research Institute
CBSE: Central Board of Secondary Education
CCS NIAM: Chaudhary Charan Singh National Institute of Agricultural Marketing
C-DAC: Centre for Development of Advanced Computing
CIAE: Central Institute of Agricultural Engineering
CICR: Central Institute of Cotton Research
CIFA: Central Institute of Freshwater Aquaculture
CIFE: Central Institute of Fisheries Education
CIFRI: Central Inland Fisheries Research Institute
CIRB: Central Institute for Research on Buffaloes
CMFRI: Central Marine Fisheries Research Institute
CIMMYT: International Maize and Wheat Improvement Center
CIPHET: Central Institute of Post Harvest Engineering & Technology
CPRI: Central Potato Research Institute
CRIDA: Central Research Institute on Dryland in Agriculture
CSKHPKV: Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya
DAHD: Department of Animal Husbandry and Dairying
DARE: Department of Agricultural Research and Education
DBT: Department of Biotechnology
DG: Director General
DDG: Deputy Director General
DKMA: Directorate of Knowledge Mangement in Agriculture
DPR: Directorate of Poultry Research
DST: Department of Science and Technology
EAAI: Energy for Agriculture and Agro-based Industries
FAO: Food and Agriculture Organization of the United Nations
FSSAI: Food Safety and Standards Authority of India
GKVK: Gandhi Krishi Vigyan Kendra
IARI: Indian Agricultural Research Institute
ICAR-RCER: ICAR Research Complex for Eastern Region

ICARDA: International Center for Agriculture Research in the Dry Areas
ICRAF: International Center for Research in Agroforestry
ICRISAT: International Crops Research Institute for the Semi-Arid Tropics
ICT: Information and Communications Technology
IFS: Integrated Farming Systems
IIFSR: Integrated Farming Systems
IGFRI: Indian Grassland and Fodder Research Institute
IMD: India Meteorological Department
IIMilletsR: Indian Institute of Millets Research
IPR: Intellectual property rights
IIPR: Indian Institute of Pulses Research
IIRR: Indian Institute of Rice Research
ISO: International Organization for Standardization
IISS: Indian Institute of Soil Sciences
IIWBR: Indian Institute of Wheat and Barley Research
IIWM: Indian Institute of Water Management
IIVR: Indian Institute of Vegetable Research
IVRI: Indian Veterinary Research Institute
KCC: Kisan Call Center
KVK: Krishi Vigyan Kendra
LTFE: Long Term Fertilizer Experiments
MeitY: Ministry of Electronics and Information Technology
NAARM: National Academy of Agricultural Research and Management
NAAS:National Academy of Agricultural Sciences
NADCL: National Agriculture Development Co-operative Ltd
NASC: National Agricultural Science Complex
NAHEP:National Agricultural Higher Education Project
NARES: Indian National Agricultural Research & Education System
NBAIM: National Bureau of Agriculturally Important Microorganisms
NBFGR: National Bureau of Fish Genetic Resources
NBPGR: National Bureau of Plant Genetic Resources
NBSSLUP: National Bureau of Soil Survey and Land Use Planning
NCERT: National Council of Educational Research and Training
NCIPM: National Research Centre for Integrated Pest management
NDRI: National Diary Research Institute
NIAP: National Institute of Agricultural Economics and Policy Research
NIC: National Informatics Centre
NICRA: National Innovations on Climate Resilient Agriculture
NIPB: National Institute For Plant Biotechnology
NRCB: National Research Centre for Banana
NRCE: National Research Centre on Equines
NRRI: National Rice Research Institute
OFR: On Farm Research

PAU: Punjab Agricultural University
PPVFRA: Protection of Plant Varieties and Farmers' Rights Authority
RC NEHR: Regional Complex for North Eastern Hilly Region
RLBCAU: Rani Lakshmi Bai Central Agricultural University
SAARC: South Asian Association for Regional Cooperation
SAUs: State Agricultural Universities
SDGs: Sustainable Development Goals
SKNAU: Sri Karan Narendra Agriculture University
SMD: Subject Matter Division
UBKV: Uttar Banga Krishi Viswavidyalaya
VNMKV: Vasantrao Naik Marathwada Krishi Vidyapeeth
WTC: Water Technology Centre

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