Annual Report
2019

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Advisors / Directors

Dr. P.V. Sukhatme	September 1940 – July 1951
Dr. V.G. Panse	August 1951 – March 1966
Dr. G.R. Seth	April 1966 – October 1969
Dr. Daroga Singh	November 1969 – May 1971
Dr. M.N. Das (A)	June 1971 – October 1973
Dr. Daroga Singh	November 1973 – September 1981
Dr. Prem Narain	October 1981 – February 1992
Dr. S.K. Raheja (A)	February 1992 – November 1992
Dr. R.K. Pandey (A)	December 1992 – May 1994
Dr. P.N. Bhat (A)	June 1994 – July 1994
Dr. O.P. Kathuria	August 1994 – May 1995
Dr. R.K. Pandey (A)	June 1995 – January 1996
Dr. Bal B.P.S. Goel	January 1996 – October 1997
Dr. S.D. Sharma	October 1997 – August 2008
Dr. V.K. Bhatia	August 2008 – February 2013
Dr. U.C. Sud	March 2013 – 31 July 2017
Dr. A.K. Choubey (A).....	01 August 2017 – 21 January 2018
Dr. L.M. Bhar (A).....	22 January 2018 – 27 October 2019
Dr. Tauqueer Ahmad (A)...	28 October 2019 onwards

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 2019 (January-December) of ICAR-Indian Agricultural Statistics Research Institute (ICAR-IASRI), an ISO 9001:2008 certified Institute with proven track record and science based commitment of carrying out research, teaching and training in the area of Agricultural Statistics (Sample Surveys, Design of Experiments, Statistical Modeling & Forecasting and Statistical Genetics) and Informatics (Computer Applications and Bioinformatics). This report highlights the research achievements that came to fruition in the year 2019, new methodologies developed, consultancy services provided, significant methodological and computational support, dissemination of knowledge acquired and human resource development, particularly post graduate and doctoral level teaching and research guidance. The esteemed scientists, technical personnel, administrative, finance and other staff have rose to the occasion and put in their best efforts in fulfilling the mandate of the Institute.

A mammoth event namely, Eighth International Conference on Agricultural Statistics (ICAS-VIII) was successfully organized during 18-21, November 2019 at New Delhi by the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers' Welfare (MoA&FW), Government of India, the task of organizing of which was entrusted to our institute by DARE under the able leadership of Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR. The theme of ICAS-VIII was 'Statistics for Transformation of Agriculture to Achieve the Sustainable Development Goals (SDGs)'. The Conference was inaugurated by Shri Bill Gates, Co-Chair, Bill & Melinda Gates Foundation in the presence of Shri Narendra Singh Tomar, Union Minister of Agricuture and Farmers' Welfare, Rural Development and Panchayati Raj who presided over the inaugural function of the Conference and Guest of Honour was Shri Kailash Choudhary, Union Minister of State for Agriculture and Farmers' Welfare. This Conference was attended by more than 500 delegates from around 100 countries across the globe. ICAS-VIII was also annexed with three side events as post-conference events on the use of methods and standards for the collection and analysis of agricultural statistics.

During the year, research was carried out under 91 research projects (37 Institute funded, 50 externally funded, one project under National Fellow Scheme and 03 Consultancy Projects) in various thrust areas.

An efficient small area estimation method that incorporates the sampling information when estimating small area proportions has been delineated and applied to estimate the incidence of food insecurity in different districts of rural areas of the State of Uttar Pradesh. A sampling methodology including sample size, allocation of sample in different strata and sub-strata, selection of sample in different stages and listing exercise as well as schedules and instruction manual has been developed and implemented by 16 different cooperating centres in the Energy Audit Survey under Energy Management in Agriculture component of the ICAR-AICRP on EAAI.

Towards providing Integrated Sample Survey (ISS) Solutions for major livestock products, a web portal has been developed for four commodities (Milk, Meat, Egg and Wool) with three modules viz., sample selection module, data entry & analysis module and GIS map module. An integrated methodology using remote sensing techniques, GIS, sample surveys, weather parameters and spatial interpolation techniques for crop insurance was developed and field tested for cotton, wheat and mustard crops. The results revealed that number of Crop Cutting Experiments (CCEs) can be reduced to great extent using a portion of large number of actual CCEs under the present Pradhan Mantri Fasal Bima Yojana (PMFBY) Scheme. A suitable sampling methodology for producing state level estimates of crop area and yield on the basis of sample sizes recommended by Professor Vaidyanathan Committee report has been developed and it was found that, the methodology for obtaining yield estimates from reduced sample sizes (reduced number of Crop Cutting Experiments i.e. CCEs with respect to General Crop Estimation Surveys i.e. GCES), produced reliable estimates with acceptable level of precision for major food grain crops at State level. Pilot survey was implemented in five states namely Assam, Odisha, Uttar Pradesh, Karnataka and Gujarat. Mobile Assisted Personal Interview (MAPI) software was also developed for collection of survey data using android smart phones in addition to traditional Paper Assisted Personal Interviewing (PAPI). The results show that MAPI is more efficient than PAPI both in terms of time and accuracy. Calibration estimators under Adaptive Cluster Sampling (ACS) have been proposed that produce reliable estimates of population parameters from the ACS survey data obtained from a situation when the members bearing a characteristic of interest are sparsely scattered in a geographically distributed population concerned in unknown manners.

Modelling and forecasting of drought index using machine learning techniques viz., multiple kernel extreme learning machine (MK-ELM) and wavelet based MK-ELM (W-MK-ELM) algorithms have been proposed for forecasting of effective drought index (EDI) considering Sagar and Chattarpur districts of Bundelkhand region. In another study, Simpson Index of diversification (SID) is used to estimate the extent of crop diversification towards high value crops by considering food crops, non-food crops and the crop sector in major states of India. It has been found that Kerala, Andhra Pradesh and Karnataka recorded a higher degree of crop diversification among food crops based on SID. The prospects of irrigation in India with respect to its trends, determinants and impact on agricultural productivity, time series data on area under different sources of irrigation, and public irrigation expenditure in 20 major agricultural states have been investigated. It has been revealed that the relative share of surface irrigation has declined across the regions. On the other hand, the intensive use of groundwater due to its reliability and efficiency has resulted in groundwater emerging as the dominating source of irrigation. An effort has been made to examine the temporal variations and spatial differences in public expenditure on agricultural research and development in India. Results revealed that irrigation has highest share followed by rural development in total public agricultural expenditure. Institutional source of credit for agriculture in India comes from both Scheduled Commercial Banks (SCBs) and co-operatives of which SCBs (87.26 %) are the major financer. Triennium (TE 2015-18) average district-wise outstanding agricultural credit of SCBs was subjected to cluster analysis. One third of the advances to agriculture in the country are found to concentrate in just 50 districts and top ten districts are from southern region only, of which five are from Andhra Pradesh itself.

Scope of future perspectives of *Bacillus thuringiensis* (Bt) technology in Indian agricultural scenario using technology forecasting tools suggested that government policy, Bt seed sector and technological interventions are the main three factors. Using bibliometrics analysis, the constructed Activity Index (AI) revealed that India's research effort is higher only in Bt Cotton and Bt Mustard than other crops. Development of Bayesian estimation technique for ARIMAX and ARIMAX-GARCH model carried out using price series (Garlic and Potato of Ahmedabad and Agra markets respectively) and arrival quantity as external variable for each series revealed that superior results for Bayesian ARIMAX-GARCH and ARIMAX-Bayesian GARCH models over the traditional models like ARIMAX. Both conventional classification tree (of Classification And Regression Tree i.e. CART) model as well as Bayesian CART have been fitted with study variable as presence or absence of discomfort for farm labourers during agricultural field operation along with associated variables and the results revealed that Bayesian CART model as more promising for classification.

For finding ways of aiding doubling of farmers' income in India by 2021-22, farm income was estimated in terms of price changes considering monthly Wholesale Price Index (WPI) of onion of India. The instability in onion price index has become much more pronounced particularly after 2005. The length of price stability phases has reduced overtime and shorter phases with greater instability are becoming pronounced. Studies on severity of sterility mosaic disease (SMD) in pigeon pea carried out for six consecutive kharif seasons (2011-16) in various locations showed the commencement of infestation from second week of August with peak incidence between third week of October and November.

Methodology of analysis of incomplete split plot designs which are incomplete both at whole plot level and at subplot level has been developed. The methodology has also been included as part of a web application by implementing the methods of construction and analysis of such designs so that it can be used by researchers and experimenters. A method of constructing Partial Triallel Crosses (PTC) using a class of Generalized Row-Column (GRC) designs was obtained. An online software web generation of GRC Designs (WebGRC) has been developed. As plant and animal hybrids are increasingly gaining popularity among the breeders as well as the industrial sector, a method of constructing augmented partial four-way cross plans has been developed. These plans are suitable for situations wherein some lines are of primary importance in comparison to others and resources do not permit all possible four-way crosses.

The Indian NARS Statistical Computing Portal is being extensively used throughout NARES and helped the researchers in analyzing their data in an effective manner. Design Resources Server has been strengthened by adding the links of online generation of A-efficient and D-efficient Incomplete block designs, orthogonal latin hypercube designs and nested orthogonal hypercube designs. ICAR Research Data Repository for Knowledge Management as (KRISHI-Knowledge Based Resources Information Systems Hub for Innovations in Agriculture) portal is serving as a gateway to online resources available at different ICAR Institutes to enhance visibility and easy access of digital outputs of ICAR to stakeholders. Under this programme, Information System on (i) AICRP on Pearlmillet and (ii) AICRP on Castor, Safflower and Sunflower have been developed.

Implementation of ICAR-ERP, Unified Communication and Web Hosting Solution has been a continuous activity performed by our institute for supporting ICAR. It is being used by all ICAR-Institutes and all ICAR-Employees for ERP-Services, MIS/FMS services. IVRI-Waste Management Guide App has been designed and developed in collaboration with ICAR-Indian Veterinary Research Institute, Izatnagar to impart information and knowledge to graduating veterinarians, field vets, general public, farmers and other stakeholders about management of waste originating from agriculture, livestock and household activities. Artificial Insemination App, Dairy Manager App, IVRI-Vaccination Guide App, Pig Ration App have been developed in Hindi. All newly developed and modified apps have been uploaded to Google play store. Farmer FIRST Programme (FFP) Portal, which is a knowledge management and dissemination system in the field of agricultural extension, is providing detailed information of all projects under FFP. This portal acts as a single hub of collection of information related to events, trainings, activities and interventions of the projects under FFP. 'Krishi Vigyan Kendra Knowledge Network' or KVK Portal and KVK Mobile App have been developed to disseminate knowledge and information from KVKs to farmers. Direct Benefit Transfer Portal for DARE Schemes has been updated. Training Management Information System for ICAR (TMIS) is catering to the needs of training requirements of ICAR personnel. A national level image base for collecting and analyzing the images of pests and diseases for different agricultural crops and extracting the hidden insight of the image using sophisticated AI techniques is being developed. For using these images for pest and disease diagnosis, a mobile app has been developed. An online system which enables automation and streamlining of all the academic activities of a university has been developed at ICAR-IASRI. The system has been designed in a modular approach with in-built work flows. It allows all ICAR Deemed Universities to follow the best standards and builds a repository of the academic records and e-learning resources.

Denovo transcriptome sequencing assisted identification of terpene synthases from black pepper (*Piper nigrum*) berry was done. This study provides the first of its kind information on the terpene synthase family profile in *Piper nigrum*, which is potentially an important step for further characterizing the functional terpene synthase genes in black pepper. Genomic data analysis was done to elucidate the regulatory network and candidate genes underlying cytoplasmic male sterility in pigeonpea. Computational approach for genomic resource improvement and precision phenotyping of less explored yield traits in wheat has been attempted. For effective future use of findings, web genomic resource, Wheat drought root transcriptome database (WDRoTDb) was developed. Proteome and transcript-level changes in the rice plants inoculated with individual or combined application of microbial species and grown under different stresses (drought and salinity) has been explored. Identification of differentially methylated regions under heat stress, their pathway and gene ontology analysis in wheat has been carried out in wheat. Identification of differentially expressed genes under drought stress and normal conditions, their pathway and gene ontology analysis in rice has also been carried out. Study on genes associated in nitrogen metabolism to improve nitrogen use efficiency (NUE) of plants has been done in potato to discover N-responsive genes and regulatory elements to improve NUE of plants. Metagenomic profiling for assessing microbial biodiversity in River Ganga for ecosystem health monitoring has been done. Platform or Integrated Genomics Warehouse has been developed with the aim of developing a subject-oriented, integrated, time-variant and non-volatile data warehouse for omics data in agriculture domain. Gene selection for classification of crop gene expression data has been done. Attempts have been made to develop some gene selection techniques to identify the informative genes from large microarray data, which may help in gene class discovery.

During the year, 42 training programmes (Seven under Centre of Advanced Faculty Training, Two Winter Schools, Three training programmes under HRM, Four national/ international training programmes and 26 other training programmes) were organized in which 985 participants were imparted training. During the year, a total of 18 students {3 Ph.D. (Agricultural Statistics), 7 M.Sc. (Agricultural Statistics), 4 M.Sc. (Computer Application), 1 Ph.D. (Bioinformatics) and 3 M.Sc. (Bioinformatics)} got their respective degrees.

The Institute has published 109 research papers in National and International refereed Journals along with more than 100 other publications. I am happy to share that scientists of the Institute have received 16 copyrights during this year.

Our scientists have brought laurels to the institute by way of bagging a number of prestigious awards ranging from Best Teacher Award in Agricultural Higher Education 2018-19 from ICAR-IARI, New Delhi; Fellow of Indian Society of Agricultural Statistics – 2018 & Recognition Award for outstanding contributions in the field of Social Sciences for the Biennium 2017-2018 from the National Academy of Agricultural Sciences (NAAS), New Delhi; NAAS Associate Award; Jawaharlal Nehru Award for P.G. Outstanding Doctoral Thesis Research in Agricultural and Allied Sciences 2018 – Social Sciences by ICAR (Conferred in 2019); many Young

Scientist awards; many best paper awards etc.

I would like to express my gratitude to Dr. Trilochan Mohapatra, Secretary (DARE) & Director General (ICAR) for his invaluable guidance, encouragement and support. I am grateful to Dr. R.C. Agrawal, DDG (Agricultural Education), ICAR; Dr. P.S. Pandey, ADG (EP&HS), ICAR and Dr. G. Venkateshwarlu, ADG (EQA&R), ICAR for their constant direction, inspiration and support. My sincere appreciation are 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 PME Cell in compiling and timely publication of the Annual Report are highly appreciated. I wish to express my sincere thanks to all my colleagues in PME Cell, in particular, Dr. Ajit, PME In-charge for all the efforts and coordinating various activities. The sincere efforts of all members of Editorial Committee for Annual Report preparation are praiseworthy.

I am hopeful that the scientists in NARES/NASS will find this publication quite informative and useful and will be immensely benefitted from the information contained in it. I look forward to any suggestions and comments for its improvement.

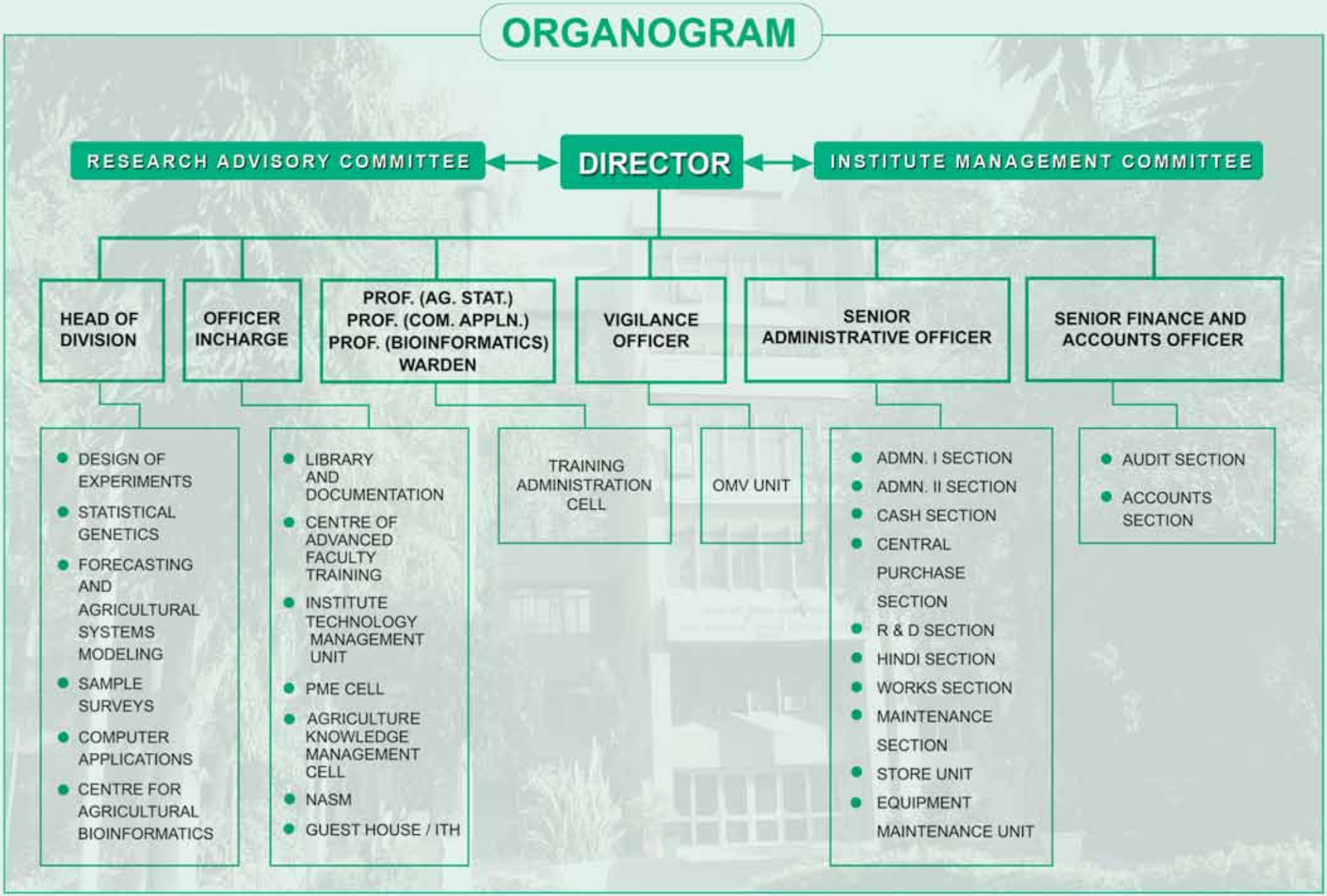
(Tauqueer Ahmad)
Director (A)

Milestones

1930	• Statistical Section created under ICAR
1940	• Activities of the Section increased with appointment of Dr. PV Sukhatme
1945	• Re-organisation of Statistical Section into Statistical Branch as a centre for research and training in the field of Agricultural Statistics
1949	• Re-named 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
1956	• Collaboration with AICRP initiated
1959	• Re-designated as Institute of Agricultural Research Statistics (IARS)
1964	• Installation of IBM 1620 Model-II Electronic Computer
	• Signing of MOU with IARI, New Delhi to start new courses for M.Sc. and Ph.D. degree in Agricultural Statistics
1970	• Status of a full fledged Institute in the ICAR system, headed by Director
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	• New Course leading to M.Sc. degree in Computer Application in Agriculture 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	• M.Sc. degree in Computer Application in Agriculture changed to M.Sc. in Computer Application
1995	• Centre of Advanced Studies in Agricultural Statistics & Computer Application established by Education Division, ICAR
1996	• Establishment of Remote Sensing & GIS lab with latest software facilities
	• 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
	• Revolving Fund Scheme on Short Term Training Programme in Information Technology initiated
	• Training programmes in Statistics for non-statisticians in National Agricultural Research System initiated
1999	• Strengthening of LAN & Intranet with Fibre optics & UTP cabling
	• Substantial growth in outside funded projects and training programmes
2000	• Two Divisions re-named as Division of Forecasting Techniques and Division of Econometrics
2001	• Data Warehousing activities (INARIS project under NATP) initiated
2002	• Development of PIMSNET (Project Information Management System on Internet) for NATP
2003	• Establishment of National Information System on Long-term Fertilizer Experiments funded by AP Cess Fund
	• 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 NARS initiated
2006	• Organisation of International Conference on Statistics and Informatics in Agricultural Research
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 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
	• A new centre namely Centre for Agricultural Bioinformatics [CABin] created
2011	• Maize AgriDaksh and Expert System on Seed Spices launched
	• 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 Modeling
	• 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	• High Performance Computing (HPC) System for Biological Computing established
	• Ph.D. degree in Computer Application initiated
	• Certified as ISO 9001:2008 (Quality Management System) Institute
2014	• Advanced Supercomputing Hub for OMICS Knowledge in Agriculture (ASHOKA) inaugurated
	• ICAR-ERP system implemented
	• Ph.D. degree in Bioinformatics initiated
	• IASRI Campus Wi-Fi enabled
	• ICAR Data Centre, Unified Communication and Web Hosting Services for ICAR started
	• FAO Sponsored Study under the Global Strategy for Improvement of Agricultural Statistics initiated
2015	• KRISHI (http://krishi.icar.gov.in/) Knowledge based Resources Information Systems Hub for Innovations in agriculture portal has been launched as a centralized data repository system of ICAR.
	• ICAR-IASRI has been declared as National Level Agency (NLA) under MIDH (Mission for Integrated Development of Horticulture).
	• ICAR Data Centre established at IASRI acquired the certification for ISO/IEC 20000 and ISO/IEC 27001 for IT-service management and information security legislation respectively.
2016	• KVK-Portal (Krishi Vigyan Kendra Knowledge Network) and Mobile Application (http://kvk.icar.gov.in/) developed and launched
	• MAPI (http://sample.iasri.res.in/ssrs/android.html/) Mobile Assisted Personal Interview- An android application developed
	• Sampling methodologies for estimation of crop area and yield under mixed and continuous cropping for different situations prevailing in different countries and field tested in the three identified countries by the FAO, one each in Asia-Pacific, Africa and Latin America/Caribbean region, i.e. Indonesia, Rwanda and Jamaica respectively developed.
	• Methodology for estimation of area and production of Horticultural crops developed, tested and validated in four states. The methodology will be implemented at national level.
	• Personnel Management System developed, for managing the cadre strength and transfer of the scientific staff and implemented in ICAR.
2017	• Suitable sampling methodology (aligned with existing Input Survey of Agriculture Census) for estimation of private foodgrain stock and post-harvest losses at farm level has been developed.
	• Guidelines for estimating post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries)/fish products have been developed and will be tested in the two countries (Namibia and Mexico).
	• Poverty map of spatial inequality in distribution of poverty incidence in different districts of Bihar State produced.
2018	• Education Portal-ICAR (https://education.icar.gov.in) developed and launched.
	• Mobile Apps: Pashu Prajanan (Animal Reproduction) and Sukar Palan (Pig Farming) developed in collaboration with ICAR-IVRI.
2019	• Webserver and Mobile App, VIS*Ta* (Variety Identification System of *Triticum aestivum*): World's first of its kind; Training Management Information System (TMIS) for ICAR; Three sampling methodologies for estimating post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries) developed and accepted by FAO of the United Nations.
	• Organised Eighth International Conference on Agricultural Statistics (ICAS-VIII) during November 18-21, 2019 (as one of the partners) .

ORGANOGRAM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SAMPLE SURVEYS
COMPUTER APPLICATIONS
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LIBRARY AND DOCUMENTATION
CENTRE OF ADVANCED FACULTY TRAINING
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PME CELL
AGRICULTURE KNOWLEDGE MANAGEMENT CELL
NASM
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TRAINING ADMINISTRATION CELL
OMV UNIT
ADMN. I SECTION
ADMN. II SECTION
CASH SECTION
CENTRAL PURCHASE SECTION
R & D SECTION
HINDI SECTION
WORKS SECTION
MAINTENANCE SECTION
STORE UNIT
EQUIPMENT MAINTENANCE UNIT
AUDIT SECTION
ACCOUNTS SECTION

Executive Summary

Small area estimation methods for agricultural and socio-economic surveys and their application in Indo-Gangetic plain was carried out to estimate the incidence of food insecurity in different districts of rural areas of the state of Uttar Pradesh. Towards providing integrated sample survey (ISS) solutions for major livestock products, a web portal has been developed for four commodities (Milk, Meat, Egg and Wool) with three modules viz., sample selection module, data entry and analysis module and GIS map module. Integrated sampling methodology for crop yield estimation using remote sensing, field surveys and weather parameters for crop insurance has been developed. Using the developed integrated methodology, crop yield estimation was done for cotton, wheat and mustard crops. The results revealed that number of Crop Cutting Experiments (CCE) can be reduced to great extent using a portion of large number of actual CCEs under present Pradhan Mantri Fasal Bima Yojana (PMFBY) scheme. A suitable sampling methodology for producing state level estimates of crop area and yield on the basis of sample sizes recommended by Professor Vaidyanathan Committee report to generate quick estimate of crop area and yield has been developed and also the feasibility of using electronic device has been explored. Pilot survey was conducted in five states namely Assam, Odisha, Uttar Pradesh, Karnataka and Gujarat. Mobile Assisted Personal Interview (MAPI) software was also developed for collection of survey data using android smart phones in addition to traditional Paper Assisted Personal Interviewing (PAPI). The results show that MAPI is more efficient than PAPI both in terms of time and accuracy. Calibration estimators under Adaptive Cluster Sampling (ACS) have been proposed that produce reliable estimates of population parameters from the ACS survey data obtained from a situation when the members bearing a characteristic of interest are sparsely scattered in a geographically distributed population concerned in unknown manners. Modelling and forecasting of drought index using machine learning techniques viz., multiple kernel extreme learning machine (MK-ELM) and wavelet based MK-ELM (W-MK-ELM) algorithms have been proposed for forecasting of effective drought index (EDI) considering Sagar and Chattarpur districts of Bundelkhand region. Simpson Index of diversification (SID) is used to estimate the extent of crop diversification towards high value crops by considering food crops, non-food crops and the crop sector in major states of India. It has been found that Kerala, Andhra Pradesh and Karnataka recorded a higher degree of crop diversification among food crops based on SID. Also a significant negative correlation between district-wise area under high value crops and extent of under-nutrition was found.

To investigate the prospects of irrigation in India with respect to its trends, determinants and impact on agricultural productivity, time series data on area under different sources of irrigation, and public irrigation expenditure in 20 major agricultural states have been considered. The states were categorised into four geographical regions for inter-regional analysis. Available data on district-wise ground water extraction shows that there has been a remarkable change in the groundwater scenario in the country during 2004-2017. It has been revealed that the relative share of surface irrigation has declined across the regions. On the other hand, the intensive use of groundwater due to its reliability and efficiency has resulted in groundwater emerging as the dominating source of irrigation. The results

of public expenditure analysis showed that, during 2005-16, the share of capital investment in total public expenditure was highest (68%) in Southern region and was lowest (37%) in northern region. Results also show that cultivation of pulses and millets will reduce the extraction of ground water.

An effort has been made to examine the temporal variations and spatial differences in public expenditure on agricultural research and development in India. Results revealed that irrigation has highest share followed by rural development in total public agricultural expenditure.

For scoping the future perspectives of *Bacillus thuringiensis* (Bt) technology in Indian agricultural scenario, case studies of four quantitative/ quasi-quantitative techniques of technology forecasting tools viz., Trend Impact Analysis (TIA), Scientometric analysis, Grey modeling and Cross impact analysis (CIA) techniques for Bt technology in agricultural sector have been employed. The analysis suggested that government policy, Bt seed sector and technological interventions are the main three factors for future perspective of Bt technology in India. Using bibliometrics analysis, the Activity Index (AI) constructed for seven domains viz. Bt Cotton, Bt Maize, Bt Mustard, Bt Brinjal, Bt Soyabean, Bt Sunflower, Bt Rice and 'Bt related but not crop specific' under these four regions viz., India vis-à-vis three other competing country regions - China, USA cum Canada and European countries revealed that India's research effort is higher only in Bt Cotton and Bt Mustard than other regions considered.

Institutional source of credit for agriculture in India comes from both Scheduled Commercial Banks (SCBs) and co-operatives of which SCBs (87.26 %) are the major financer. Triennium (TE 2015-18) average district-wise outstanding agricultural credit of SCBs was subjected to cluster analysis. One third of the advances to agriculture in the country are found to be concentrated in just 50 districts and top ten districts are from southern region only, of which five are from Andhra Pradesh itself.

Development of Bayesian estimation technique for ARIMAX and ARIMAX-GARCH model has been carried out. Using price series (Garlic and Potato of Ahmedabad and Agra markets respectively) and arrival quantity as external variable for each series, superior results for Bayesian ARIMAX-GARCH and ARIMAX-Bayesian GARCH models over the traditional models like ARIMAX have been obtained.

Both conventional classification tree (of Classification And Regression Tree i.e. CART) model as well as Bayesian CART have been fitted with application in agricultural ergonomics with study variable as presence or absence of discomfort for farm labourers during agricultural field operation along with associated variables. Bayesian CART has been used to grow a tree by stochastic search algorithm based on prior specifications of parameters like probability of splitting node, probability of assignment of splitting rule, control parameters of size and shape of tree, distribution of study variable etc. The results revealed Bayesian CART model as more promising for classification when compared to conventional classification trees.

For finding ways of aiding doubling of farmers' income in India by 2021-22, farm income was estimated in terms of price changes of agricultural commodities. For this, monthly Wholesale Price Index (WPI) of onion of India was considered. The instability in onion price index has become much more pronounced particularly after 2005. The length of price stability phases has reduced overtime and shorter phases with greater instability are becoming pronounced. The instability is largely driven by the changes on production front.

Studies on severity of sterility mosaic disease (SMD) in pigeon pea carried out for six consecutive *kharif* seasons (2011-16) in three locations namely Gulbarga (Karnataka), Rahuri (Maharashtra), and Vamban (Tamil Nadu) showed the commencement of infestation from second week of August with peak incidence between third week of October and November. Statistical model of autoregressive integrated moving average model with exogenous variable (ARIMAX) along with machine learning techniques *viz.,* support vector regression (SVR) and artificial neural network (ANN) were applied for predicting the mean severity of SMD at all three locations. Comparative performance of different models assessed in terms of root mean square error (RMSE) indicated that ANN and SVR models predicted the mean incidence of SMD on pigeon pea better than ARIMAX model across all three-study locations. In addition, such studies were conducted for thrips also.

Methodology of analysis of incomplete split plot designs which are incomplete both at whole plot level and at subplot level has been developed. The methodology has also been included as part of a web application developed by implementing the methods of construction and analysis of such designs so that it can be used by researchers and experimenters.

A method of constructing Partial Triallel Crosses (PTC) using a classes of Generalized Row-Column

(GRC) designs with parameter v (prime), p = 2, q = 2v and k (3 ≤ k ≤ v-1) was obtained. The parameters of the developed PTC plan will be n (no of lines/ genotypes) = v, N (no of crosses) = 6v and f (degree of fractionation) = 12/ (v-1)(v-2). An online software, web generation of GRC Designs (WebGRC) has been developed.

Plant and animal hybrids are increasingly gaining popularity among the breeders as well as the industrial sector. A method of constructing augmented partial four-way cross plans has been developed. These plans are suitable for situations wherein some lines are of primary importance in comparison to others and resources do not permit all possible four-way crosses.

The Indian NARS Statistical Computing Portal is being extensively used throughout NARES and helped the researchers in analyzing their data in an effective manner. The total number of logged in users from Indian NARES during the year 2019 are 88,654 which is on an average 240+ logged in per day.

Design Resources Server has been strengthened by adding the links of online generation of A- efficient and D-efficient Incomplete block designs, orthogonal latin hypercube designs and nested orthogonal hypercube designs. During the year 2019, Google Analytics gave 8,403 page views across 310 cities of 78 countries. Average time taken on page is 3.26 minutes.

ICAR Research Data Repository for Knowledge Management as (KRISHI-Knowledge Based Resources Information Systems Hub for Innovations in Agriculture) portal is serving as a gateway to online resources available at different ICAR Institutes to enhance visibility and easy access of digital outputs of ICAR to stakeholders. Under this programme, Information System on (i) AICRP on Pearlmillet and (ii) AICRP on Castor, Safflower and Sunflower have been developed. Also the following are the highlights of the KRISHI portal during the year 2019:

- Interportal Harvester: Unified search is ready for 26 repositories for 4,92,914 records (earlier 4,57,312 records) at http://krishi.icar.gov.in/ohs-2.3.1/index.php/browse.
- ICAR publication and data inventory repository has been enriched through populating data by Nodal Officers and other researchers. 27530+ publications and 690+ dataset have been submitted from 107 Institutes. 1440 researchers other than Nodal officers have registered themselves as submitters.
- Technology Repository: Developed a mobile app on ICAR Technologies. Using webservices, the information on ICAR Technologies is also made available on Open Government Data Platform.
- ICAR Geo-Portal: Developed workflow based applications for (i) Spatial Meta Data Repository and (ii) Satellite Monitored India Crop Residue Burn Events have also been developed.
- Visibility: KRISHI Portal has attracted more than 2,20,000 page views since May 2015 across more than 620 cities of 110 countries. There are more than 52,,800 page views across 250 cities of 55 countries on ICAR Publication and Data Inventory Repository. It provides enhanced visibility to the publications. Since May 2017, there are more than 4,50,000 downloads (3,00,000 reported earlier) that includes documents fetched through computer programme by other sites. KRISHI Publication and Data Inventory is now being indexed by Google Scholar, Base: Bielefeld Academic Search Engine and OpenDOAR: Directory of Open Access Repositories. Other agencies such as Open Government Data Platform (data.gov.in) and the Global Forum for Agricultural Research (GFAR) have taken note of this initiative and listed as important resource in Agricultural Research in India.

Implementation of ICAR-ERP, Unified Communication and Web Hosting Solution has been continuous activity performed by our institute for supporting ICAR. It is being used by all ICAR-Institutes and all ICAR-Employees for ERP-Services, MIS/FMS services, Unified messaging (ICAR-Email solutions), Hosting of ICAR-Institutes websites and more recently for ICAR-e-Office solutions to all ICAR-Institutes/Directorates/NRCs etc. With a Data Centre at our institute, the institute is facilitating ICAR mailing solution. Beside that, three email ids have been given to each KVK.

IVRI-Waste Management Guide App has been designed and developed in collaboration with ICAR-Indian Veterinary Research Institute, Izatnagar to impart information and knowledge to graduating veterinarians, field vets, general public, farmers and other stakeholders about management of waste originating from agriculture, livestock and household activities. The App covers information related to composting and its various methods viz., aerobic, anaerobic, rapid, large scale, in vessel and miscellaneous methods. It also provides

information on various compost related products, vermicomposting, its various methods and procedure, nutrient profile and use of the vermicomposting for crops.

Artificial Insemination App, Dairy Manager App, IVRI-Vaccination Guide App, Pig Ration App have been developed in Hindi. All newly developed and modified apps have been uploaded to Google play store. Farmer FIRST Programme (FFP) Portal, which is a knowledge management and dissemination system in the field of agricultural extension, is providing detailed information of all projects under FFP. This portal acts as a single hub of collection of information related to events, trainings, activities and interventions of the projects under FFP. At present, 613 interventions, 541 events, 2040 images, 84 videos and 288 publications related to FFP have been uploaded on the portal of different projects running under FFP. FFP Android Mobile Application consisting of two modules viz. (i) Capturing of Data and (ii) Knowledge Dissemination has been developed. The App captures and disseminates data of Events, Farmer Innovations, Farmer Practices and Interventions. Web APIs have been developed for interaction between database and the mobile App.

'KrishiVigyan Kendra Knowledge Network' or KVK Portal and KVK Mobile App have been developed to disseminate knowledge and information from KVKs to farmers. As of now, total 693 KVKs have been registered into this portal. Information on 136983 KVK event (past and future) details have been uploaded into the portal. 598 KVKs have uploaded their facility details in the portal. 519 KVKs have uploaded Package of Practices into the portal. 20690 Farmers are registered into KVK Portal. 53134 farmer details have been uploaded by different KVKs in the KVK portal. Functionality was developed to upload data of different activities under Crop Residue Management (CRM) initiative in the KVK portal. A consolidated report of different activities (State Wise/District Wise/ Activities Wise) under CRM was developed. Image and video gallery were created for CRM. KVK Mobile App has been enriched with new functionalities and dashboard for different categories of users.

Direct Benefit Transfer Portal for DARE Schemes has been updated. Training Management Information System for ICAR (TMIS) is catering to the needs of training requirements of ICAR personnel.

A national level image base for collecting and analyzing the images of pests and diseases for different agricultural crops and extracting the hidden insight of the image using sophisticated AI techniques is being developed. For using these images for pest and disease diagnosis, a mobile app has been developed. The extracted insights collected from analysis using AI techniques, are then embedded into mobile App in the form of model. This will help millions of farmers for diagnose the pest and diseases and get the advisory.

An online system which enables automation and streamlining of all the academic activities of a university has been developed at ICAR-IASRI. The system has been designed in a modular approach with in-built work flows. It allows all ICAR Deemed Universities to follow the best standards and builds a repository of the academic records and e-learning resources. Presently the system is operational at IARI New Delhi, CIFE Mumbai, IVRI Izatnagar, NDRI Karnal and CAU Imphal.

Denovo transcriptome sequencing assisted identification of terpene synthases from black pepper (*Piper nigrum*) berry was done. This study provides the first of its kind information on the terpene synthase family profile in *Piper nigrum,* which is potentially an important step for further characterizing the functional terpene synthase genes in black pepper.

Genomic data analysis was done to elucidate the regulatory network and candidate genes underlying cytoplasmic male sterility in pigeonpea. The miRNAs identified from the small RNA libraries of isogenic lines (UPAS 120 A and UPAS 120B) were further used to predict mRNA targets.

Computational approach for genomic resource improvement and precision phenotyping of less explored yield traits in wheat has been attempted. Two contrasting genotypes, namely, NI5439 41 (drought tolerant) and WL711 (drought susceptible) were used to generate ~78.2 GB data for the responses of wheat roots to drought. Gene regulatory networks showed 69 hub-genes integrating ABA dependent and independent pathways controlling sensing of drought, root growth, uptake regulation, purine metabolism, thiamine metabolism and antibiotics pathways, stomatal closure and senescence. For effective future use of findings, web genomic resource, Wheat drought root transcriptome database (WDRoTDb) was developed. For studying genetic diversity and population structure in wheat using array based SNP markers, an array based SNP genotyping to expand the utility of SNP markers for genomic analysis was performed.

For identification and characterization of wheat germplasm for stripe rust, 391 wheat germplasm lines including landraces have been evaluated for

seedling stage resistance against four stripe rust pathotypes viz., 46S119, 110S119, 238S119 & T at IIWBR Regional Station, Flowerdale, Shimla and promising accessions were obtained based on two years evaluation. Genome Wide Association Studies (GWAS) for stripe rust resistant pathotypes in wheat using Breeders' 35K Axiom® array was performed. The aforesaid same set of lines were genotyped using 35K SNP Axiom® Arrays for performing GWAS. A total of 51 significant marker trait associations (MTAs) were identified for disease resistance against four different pathotypes.

Proteome and transcript-level changes in the rice plants inoculated with individual or combined application of microbial species and grown under different stresses (drought and salinity) has been explored. Proteome level changes led to reveal identification and characterization of various proteins unique in plants due to the stress conditions or due to microbial inoculation. Comparative analysis of proteome showed circumstantial presence or absence of specific proteins under stresses or microbe-mediated conditions, suggesting their critical role.

Identification of differentially methylated regions under heat stress, their pathway and gene ontology analysis in wheat has been carried out in Raj3765 and HD2329 cultivars of wheat. After identification of DMR's, their pathway analysis has also been carried out. Moreover, their ontology has also been done. These results may provide postulates for experimenters involved in the development of new heat stress resistant cultivars to mitigate the ill effects of global warming.

Identification of differentially expressed genes under drought stress and normal conditions, their pathway and gene ontology analysis in rice has also been carried out. The results obtained may provide postulates for experimenters involved in the development of new drought stress resistant cultivars to mitigate the ill effects of water scarcity.

Study on genes associated in nitrogen metabolism to improve nitrogen use efficiency (NUE) of plants has been done in potato to discover N-responsive genes and regulatory elements to improve NUE of plants. Potential differentially expressed genes (DEGs) responsive to N metabolism in potato like superoxide dismutase, GDSL esterase lipase, probable phosphatase 2C, protease inhibitors, high affinity nitrate transporters, sugar transporter, ferric reduction oxidase, glycine/proline rich proteins, glutaredoxin, transcription factors (VQ motif, SPX domain, bHLH), GA, ethylene, terpenoids, and cell wall modifying genes so on were identified. This suggests that the above genes play key roles in adaptation to low N stress and sufficient N conditions in potato. These genes could be manipulated in future to develop N-use efficient potatoes.

Metagenomic profiling for assessing microbial biodiversity in River Ganga for ecosystem health monitoring has been done. Nine sediment metagenome samples in the context of polluted versus non-polluted sites of river Ganga and Yamuna were analysed using NGS technique. The functional metagenomics analysis revealed the presence of Heavy metal-associated domain (HMA) and HMA-conserved sites in the identified bacteria. Several protein domains including urea ABC transporter, UrtA, UrtD, UrtE and zinc/ cadmium/ mercury/ lead-transporting ATPase, which play pivotal role in bioremediation were identified from the identified bacteria of the riverine polluted environments.

Platform or Integrated Genomics Warehouse has been developed with the aim of developing a subject-oriented, integrated, time-variant and non-volatile data warehouse for omics data in agriculture domain. The system architecture for genomic data warehouse has been developed using open source software tools. The existing repository related to genetic variants were integrated through Pentaho data integration (PDI) by creating ETL process and workflow using core data integration (ETL). OLAP cubes have been developed by Pentaho Schema Workbench (PSW) with creation of hierarchies, dimensions and useful facts. The metadata of developed cubes are stored in XML format and exported to the Pentaho Business Intelligence (BI) Server for reports/ dashboards development. Further, Hadoop cluster has also been configured to address the genomic data in big data environment. This cluster will be useful for analysis and exploration of genomic data through big data environment. A web based module for exploration of genetic variants has been developed in this platform. The web based aces for SNP, SSRs and CNVs for Rice genomes have been uploaded and accessible to end users. Currently, this module is accessible in our LAN environment. A significant improvement of access time has been observed with the use of big data and Hadoop framework in accessing and querying genetic variants of Rice. Integrated platform for genomic data warehouse will provide a source of easy to browse centralized repository with mostly useful genetic markers through analytical capabilities. The developed system/ tool can be used to develop the integrated solution for the development of any crops/ species provided their genetic variants are available

in public domain.

Gene selection for classification of crop gene expression data has been done. Attempts have been made to develop some gene selection techniques to identify the informative genes from large microarray data, which may help in gene class discovery. First, a technique called GSAQ for gene set analysis with trait specific QTLs, which can be considered as a valuable tool for performing gene(s) enrichment analysis in plant breeding context has been developed. The GSAQ approach will also provide a valuable platform for integrating the GE data with genetically rich QTL data to identify potential QTL enriched gene sets or set of QTL candidate genes, which may act as valuable input or hypothesis for the plant breeders for designing breeding experiments. The credibility of the proposed method (GSAQ) by comparing its performance with the only existing approach (GSVQ) through a statistically strong criterion, i.e. FDR, in five different stress scenarios in rice has been done.

2

Introduction

ICAR-Indian Agricultural Statistics Research Institute (IASRI) is a pioneer and premier Institute of Indian Council of Agricultural Research (ICAR) undertaking research, teaching and training in Agricultural Statistics, Computer Application and Bioinformatics. Ever since its inception way back in 1930, as small Statistical Section of the then Imperial Council of Agricultural Research, the Institute has grown in stature and made its presence felt both nationally and internationally. ICAR-IASRI has been mainly responsible for conducting research in Agricultural Statistics and Informatics to bridge the gaps in the existing knowledge. It has also been providing education/ training in Agricultural Statistics and Informatics to develop trained manpower in the country. The research and education is used in improving the quality and meeting the challenges of agricultural research in newer emerging areas. The Institute has been awarded an ISO 9001:2015 certificate in the year 2018. ICAR Data Centre established at ICAR-IASRI acquired the certification for ISO/IEC 20000 & ISO/IEC 27001 in October, 2015. ISO 20000:2011 & ISO 27001:2013 External Surveillance Audit was successfully completed at ICAR Data Centre on September 19, 2016 and it was recommended for continuation of the ISO 20000-1:2011 & ISO 27001:2013 standard by the BSI.

- ICAR Data Centre has been continuously providing the Unified Communication (Email, Audio, Video, Web conference etc.) and Webhosting service to ICAR and its Institutes.
- The Institute has used the power of Statistics, as a science, blended judiciously with Informatics and has contributed significantly in improving the quality of Agricultural Research. To convert this vision into a reality, the Institute has set for itself a mission to undertake research, teaching and training in Agricultural Statistics and Informatics so that these efforts culminate into improved quality of agricultural research and also meet the challenges of agricultural research in newer emerging areas. 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.
- The Institute has made its presence felt in the National Agricultural Research and Education System (NARES). The Institute feels proud to have established the first supercomputing hub for Indian Agriculture, ASHOKA (Advanced Super-computing Hub for OMICS Knowledge in Agriculture). Linkages have been established with all National Agricultural Research organizations for strengthening statistical computing. For providing service oriented computing for the users, Indian NARS Statistical Computing portal has been developed. Appropriate statistical techniques have been developed and recommended to researchers through advisory services. The Institute is also becoming progressively a repository of information on agricultural research data with the establishment of a Data Centre. The Institute also occupies a place of pride in the National Agricultural Statistics System (NASS) and has made several important contributions in strengthening NASS, which has a direct impact on the national policies. The

Institute has contributed significantly by providing excellent human resource to NARES in the country in the disciplines of Agricultural Statistics and Informatics for meeting the challenges of Agricultural Research in the newer emerging areas. Conducting post graduate teaching and in-service courses in Agricultural Statistics, Computer Application and Bioinformatics for human resource development is an important activity.

- The Institute has made some outstanding & useful contributions to research in Agricultural Statistics and Informatics in the fields like Design of Experiments, Statistical Genetics, Forecasting Techniques, Statistical Modelling, Sample Surveys, Econometrics, Computer Applications in Agriculture, Software Development, Agricultural Bioinformatics etc. 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. It has also been very actively pursuing advisory services that have enabled to enrich the quality of agricultural research in the NARES. Besides, many projects funded by Government and Public Sector agencies like Department of Science and Technology, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Planning Commission, Ministry of Statistics and Programme Implementation (MoS&PI), Ministry of Fisheries, Animal Husbandry & Dairying, Coconut Development Board have been undertaken. Some of these projects were taken on request from several Government agencies and others were awarded through competitive bidding. This has helped the Institute in resource generation as well. The Institute works in close collaboration with NARES organizations and` many projects are being run in collaboration with All India Co-ordinated Research Projects and ICAR Institutes. Further linkages with the CGIAR organizations such as CIMMYT, IRRI and ICARDA have been developed. The institute has been awarded many studies since 2014 by Food and Agriculture Organization of the United Nations (FAO).

Significant Research Achievements

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. Some of the areas are:

- Designs for single factor experiments which include variance balanced, efficiency balanced, and partially efficiency balanced designs; designs for tests versus control(s) comparisons; designs for multi-response experiments; crossover designs; designs with nested structures; neighbour balanced designs; optimality and robustness aspects of designs.
- Designs for multi-factor experiments which include confounded designs for symmetrical and asymmetrical factorials; block designs with factorial structure; response surface designs, mixture experiments for single and multifactor experiments; orthogonal main effect plans; orthogonal arrays; supersaturated designs.
- Designs for bioassays; designs for microarray experiments and designs for agroforestry experiments.
- Diagnostics in designed field experiments.
- Computer aided construction of efficient designs for various experimental settings; etc.
- For dissemination and e-advisory on designed experiments, developed a Design Resources Server (www.iasri.res.in/design) which is being viewed throughout the globe and used extensively in NARES.
- Web solutions for generation of experimental designs and online analysis of experimental data for different experimental settings.
- The scientists of the Institute participate actively in planning and designing of experiments in the NARES and have also involved themselves in the analysis of experimental data.
- Basic research work carried out on balanced incomplete block designs, partially balanced incomplete block designs, group divisible designs, α-designs, reinforced α-designs,

square and rectangular designs, nested designs, augmented designs, extended group divisible designs, factorial experiments, response surface designs, experiments with mixtures etc. have been adopted widely by the experimenters in NARES.

- Designs for factorial experiments such as response surface designs and experiments with
- mixtures have been used for food processing and value addition experiments; soil test crop response correlation experiments; experiments with fixed quantity of inputs and ready to serve fruit beverage experiments; etc.
- Analytical techniques based on mixed effects models and 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.
- Analytical techniques for the analysis of data from the experiments conducted to study the post harvest storage behaviour of the perishable commodities like fruits and vegetables are being widely used in NARES.
- Planning, designing and analysis of data relating to experiments under AICRPs on (i) Integrated Farming System (IFS); (ii) Long Term Fertilizer Experiments (LTFE); (iii) Soil Test Crop Response Correlation (STCR); (iv) Rapeseed and Mustard; (v) Sorghum; (vi) Wheat and Barley and (vii) Vegetable Crops.

Sample Surveys

The subject of sampling techniques helps in providing the methodology for obtaining precise estimators 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 have been made in theoretical aspects of sample surveys like successive sampling, systematic sampling, cluster sampling, sampling on successive occasions, sampling with varying probabilities, controlled selection, balanced sampling plans, ranked set sampling, nonsampling errors, analysis of complex surveys, various methods of estimation such as ratio, regression and product methods of estimation, use of combinatorics in sample surveys and of late small area estimation as well as use of calibration approach in developing improved estimators.
- The methodology for General Crop Estimation Surveys (GCES), cost of cultivation studies for principal food crops, cash crops and horticultural crops, Integrated Sample Surveys (ISS) for livestock products estimation, fruits and vegetable survey are being adopted throughout the country and many Asian and African countries.
- Methodology based on small area estimation technique for National Agricultural Insurance Scheme, also called Rashtriya Krishi Bima Yojana, suggested by the Institute has been pilot tested in the country.
- The sample survey methodology for imported fertilizer quality assessment, estimation of fish catch from marine and inland resources, flower production estimation, area and production of horticultural crops estimation, etc. has been developed and passed on to the user agencies.
- Integrated methodology for estimation of multiple crop area of different crops in North Eastern Hilly Regions using Remote Sensing data has been developed.
- Sampling methodology for estimation of post-harvest losses has been successfully adopted in AICRP on Post-Harvest Technology for Assessment of Post-Harvest Losses of Crops/ Commodities.
- Reappraisal of sampling methodologies, evaluation and impact assessment studies like studies to make an assessment of Integrated Area Development programmes, High Yielding Varieties programmes, 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.
- 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.
- For providing e-advisory and e-learning in sample surveys, initiated a Sample Survey Resources

- Server (http://js.iasri.res.in/ssrs/) which also provides calculator for sample size determination for population mean and population proportion among other material.
- MAPI (http://sample.iasri.res.in/ssrs/android. html/) Mobile Assisted Personal Interview- An android application namely MAPI has been developed for survey data collection
- Sampling methodologies for estimation of crop area and yield under mixed and continuous cropping have been developed for different situations prevailing in different countries. The developed methodology has been field tested in the three identified countries by the FAO, one each in Asia-Pacific, Africa and Latin America/ Caribbean region, i.e. Indonesia, Rwanda and Jamaica respectively.
- Methodology for estimation of area a n d production of Horticultural crops has been developed, tested and validated in four states of the Country.
- Suitable sampling methodology (aligned with existing Input Survey of Agriculture Census) for estimation of private food grain stock and post-harvest losses at farm level has been developed.
- Samplng methodologies for estimating post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries) have been developed and field tested in the two countries identified by FAO namely Mexico and Zambia.

Statistical Genetics

- The Institute has made significant contributions in statistical genetics/ genomics for improved and precise estimation of genetic parameters, classificatory analysis and genetic divergence etc.
- Developed procedures for estimation of genetic parameters; construction of selection indices; studying G × E interactions; progeny testing and sire evaluations; detection of QTLs, classification of genotypes using molecular marker data, etc.
- The modification in the procedure of estimation of genetic parameters has been suggested for incorporating the effect of unbalancedness, presence of outliers, aberrant observations and non-normality of data sets.
- Procedures for studying genotype environment and QTL environments interactions have been used for the analysis of data generated from crop improvement programmes.
- The research work on construction of selection indices, progeny testing and sire evaluation have been used for animal improvement programmes

Agricultural Bioinformatics

- 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. The establishment of a National Agricultural Bioinformatics Grid (NABG) is a landmark in this direction.
- A number of databases and web services have been developed which include pigeonpea microsatellite database, buffalo microsatellite database, genome sequence submission portal, biocomputing portal, livestock EST database, insect barcode database, tomato microsatellite database, goat microsatellite database.
- Supercomputing facility (High Performance Computing System) has been established for biological computing and bioinformatics

Statistical Modelling and Forecasting for Biological Phenomena

- Statistical modelling of biological phenomena is carried out by using linear and non-linear models, non-parametric regression, structural time series, fuzzy regression, neural network and machine learning approaches.
- Developed models for pre-harvest forecasting of crop yields using data on weather parameters; agricultural inputs; plant characters and farmers' appraisal.
- Models have been developed using weather and growth indices based regression models, discriminant function approach, markov chain approach, bayesian approach, within year growth models and artificial neural network approach.
- Methodologies for forewarning important pests and diseases of different crops have been developed which enable the farmers to use plant protection measures judiciously and save cost on unnecessary sprays.

- Methodology developed for forecasting based on weather variables and agricultural inputs was used by Space Application Centre, Ahmedabad to obtain the forecast of wheat yield at national level with only 3% deviation from the observed one.
- Models developed for forewarning of aphids in mustard crop were used by Directorate of Rapeseed and Mustard Research, Bharatpur to provide forewarning to farmers which enabled them to optimize plant protection measures. and save resources on unnecessary sprays consecutively for three years.
- Forecasting of volatile data has been attempted through non-linear time series models. Such models were developed for forecasting onion price, marine products export, lac export, etc.
- Non-linear statistical models were developed for aphid population growth and plant diseases. Modelling and forecasting of India's marine fish production was carried out using wavelet methodology. The models developed have potential applications in long term projections of food grain production, aphid population, marine fish production, etc.
- The 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.
- Created a web solution for estimation of compound growth rate and several other resources.

The Institute has 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 agro-climatic 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 a study on the dietary pattern of rural households.

Information & Communication Technology

ICAR-IASRI is pioneer 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 and Expert Systems. These systems are helpful in taking the technologies developed to the doorsteps of the farmers.

- The Institute has developed information system for designed experiments which includes agricultural field experiments, animal experiments and long term fertilizer experiments conducted in NARES as research data repositories.
- A comprehensive Personnel Management Information System Network (PERMISnet) has been implemented for the ICAR for manpower planning, administrative decision making, and monitoring. A Project Information and Management System Network (PIMSnet) was developed and implemented for concurrent monitoring and evaluation of projects. This is developed as a Project Information and Management System for all ICAR projects. A National Information System on Agricultural Education Network in India (NISAGENET) has been designed, developed and implemented so as to maintain and update the data regularly on parameters related to agricultural education in India.
- Online Management System for Post Graduate Education has been developed and implemented for PG School, IARI, New Delhi. The Institute has taken a lead in the development of Expert Systems on wheat crop, maize crop and seed spices. AgriDaksh has been developed for facilitating the development of expert systems for other crops.
- Web based software for Half Yearly Progress Monitoring (HYPM) of scientists in ICAR (http://hypm.iasri.res.in) has been developed and implemented for online submission of data regarding the proposed targets and the achievements for the half yearly period. It enables to monitor online progress of the scientists, manpower status, research projects, prioritized activities and salient research achievements at institute/SMD/ICAR level.
- Strengthened Statistical Computing facilities in NARS, helped in capacity building in the usage of high end statistical computing and developed

Indian NARS Statistical Computing Portal for providing service oriented computing to the researchers of NARES, which has paved the way for publishing agricultural research in high impact factor journals.

- A number of software and web solutions have been developed for the agricultural research workers: Statistical Package for Agricultural Research (SPAR) 2.0, Statistical Package for Block Designs (SPBD) 1.0, Statistical Package for Factorial Experiments (SPFE) 1.0, Statistical Package for Augmented Designs (SPAD) 1.0, Software for Survey Data Analysis (SSDA) 1.0, Statistical Package for Animal Breeding (SPAB) 2.1, Online Analysis of Block Designs, Web Generation and Analysis of Partial Diallel Crosses, Web Generation of Designs Balanced for Indirect Effects of Treatments etc.
- A Vortal has been designed and developed to facilitate 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.
- For providing transparency in day to day work of the ICAR/Institute, ICAR-ERP system has been implemented with the Financial Management, Project Management, Material Management, Human Resource Management and Payroll System modules. The system is hosted on IASRI website and can be accessed through URL http://icarerp.iasri.res.in. It can also be visited through http://www.iasri.res.in/misfms/.

Human Resource Development

- One of the thrust areas of the Institute is to develop trained manpower in the country in the disciplines of Agricultural Statistics and Informatics for meeting the challenges of agricultural research in the newer emerging areas
- The Institute conducts degree courses leading to M.Sc. and Ph.D. in Agricultural Statistics, Computer Application and Bioinformatics in collaboration with Indian Agricultural Research Institute (IARI), New Delhi.
- The Institute is functioning as a Centre of Advanced Studies in Agricultural Statistics and Computer Application (CAS) re-named as Centre of Advanced Faculty Training (CAFT). Under this programme, the Institute organizes training programmes on various topics of interest for the benefit of scientists of NARES. These training programmes cover specialized topics of agricultural sciences.
- The Institute conducts the Senior Certificate Course in Agricultural Statistics and Computing. This course is of six months 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 months duration each.
- There is another form of training course, 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. The Institute has conducted such programmes for Indian Council of Forestry Research, Indian Statistical Service probationers, State Department of Agriculture and senior officers of Central Statistical Office and many other organizations.
- The Institute has also conducted several international training programmes on request from FAO, particularly for African, Asian and Latin American countries.
- The Institute has broadened the horizon of capacity building by opening its doors to he international organizations and agro-based private sector. The Institute has conducted training programmes for the scientists/research personnel of CGIAR organizations such as ICARDA, AARDO, Rice-Wheat Consortium for Indo-Gangetic plains, Government Officials from Afghanistan etc..

Infrastructural Development

As the activities of the Institute have expanded in all directions, the infrastructure facilities are also expanding. An important landmark in the development of the Institute was the installation of an IBM 1620 Model-II Electronic Computer in 1964. A third generation computer Burroughs B-4700 system was installed in March 1977 and then replaced in 1991 by a Super Mini COSMOS-486 LAN Server with more than hundred nodes consisting of PC/ AT's, PC/XT's and dumb terminals all in a LAN environment. Later, COSMOS-486 LAN Server was replaced by a PENTIUM-90 LAN Server having

state-of-art technology with UNIX operating system. Computer laboratories equipped with PCs, terminals and printers, etc. had been set up in each of the six Scientific Divisions as well as in the Administrative Wing of the Institute.

Keeping pace with the emerging technologies in the area of Information Technology (IT), the computing infrastructure have been constantly upgraded/ replaced with newer platforms and versions. The computing environment in the Institute has latest computing and audio visual equipments i.e. High Performance Computing having 144 cores Intel HPC cluster, rack mount & redundant SMPS servers, workstations, desktops, laptops, netbooks, documents printing & scanning, DVD duplicator, visualiser and wireless multimedia projectors etc.

The Institute is also well equipped with 100 MBps bandwidth fiber optics backbone wired and wireless networking campus. The first supercomputing hub for Indian Agriculture ASHOKA (Advanced Super-computing Hub for OMICS Knowledge in Agriculture) established at IASRI, was dedicated to the Nation on 15 January 2014. In order to provide access to this advanced computing facility to researchers, a National Bio-Computing Portal has been launched through which authenticated users will be able to perform their biological data analysis. This portal consists of number of computational biology and agricultural bioinformatics software/workflow/ pipelines which will be able to automate routine biological analytics in seamless manner. This super-computing hub consists of hybrid architecture with high performance computing having (i) 256 nodes Linux cluster with two masters, 3072 cores and 38 Tera Flops computing, (ii) 16 nodes windows cluster with one master, (iii) 16 nodes GPU cluster with one master with 192 CPUs + 8192 GPUs and (iv) SMP based machine with 1.5 TB RAM. Also, this hub has approximately 1.5 Peta Byte storage divided into three different types of storage architecture i.e. Network Attached Storage (NAS), Parallel File System (PFS) and Archival. This hub also consists of super-computing systems (16 node Linux cluster with one master and 40 TB storage) at National Bureaux of Plant Genetic Resources (NBPGR), New Delhi, National Bureaux of Animal Genetic Resources (NBAGR), Karnal, National Bureaux of Fish Genetic Resources (NBFGR), Lucknow, National Bureaux of Agriculturally Important Microbes (NBAIM) Mau and National Bureaux of Agriculturally Important Insects (NBAII), Bangalore which forms a National Agricultural Bioinformatics Grid in the country.

There are various labs in the Institute for dedicated services like ARIS lab for training, Statistical computing lab, Student lab and Centre of Advanced Study lab. An Agricultural Bioinformatics Lab (ABL) fully equipped with software and hardware to study crop and animal biology with the latest statistical and computational tools was also established. 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 is equipped with latest state-of-art technologies like computer hardware and peripherals, Global Positioning System (GPS), software like ERMapper, PCARC/INFO, Microstation 95, Geomedia Professional, ARC/INFO Workstation and ERDAS Imagine with the funds received through two AP Cess Fund projects. This computing facility has further been strengthened with the procurement of ARC-GIS software. Some of the important available software are SAS 9.2, 9.3, 9.4 JMP 8.0, 9.0, 10.0 JMP Genomics 4.0, 5.1, 6.0, SAS BI Server 4.2, SPSS, SYSTAT, GENSTAT, Data warehouse software – Cognos, SPSS clementine, MS Office 2007, Linux OS, MS Visual Studio.net, MS-SQL Server, Microsoft SQL DBMS, Microsoft Exchange 2013, Microsoft Lync 2013, Unix based AIX Operating System, Oracle, Oracle Fusion Middleware 12C, Oracle ERP Release 12.1.3, Macro-Media, E-views, STATISTICA Neural Networks, Gauss Software, Minitab 14, Maple 9.5, Matlab, Web Statistica, Lingo Super, Discovery Studio, CLC Bio, SAS Modules of Text Mining and Data Management & Integration, ArcGIS among others.

A laboratory has been created in the Computer Division to facilitate training. The laboratory is equipped with 25 desktop computers with digital board. It has centralized AC facility. Another video-conferencing lab has been setup to facilitate video-conferencing. Network Operating Centers (NOC) have been created in the ground and second floor of the computer center building to manage the computing infrastructure and services. Auditorium of the institute has been renovated with latest infrastructure.

Local Area Network of IASRI has been strengthened with state of art Ethernet Passive Optical Network (EPON) with 344 nodes. The technology has triple play service Data, Video and Voice with modular planning. The networking services at IASRI have been further strengthened. The entire IASRI campus is Wi-Fi enabled with a high speed internet connection

to allow the staff and students to access the internet no-matter wherever they are. The coverage of Wi-Fi is not only restricted to labs but also extends to all the areas including library, auditorium and hostels.

The Institute's domain service like Primary and Secondary DNS, Domain (iasri.res.in) Website (http://www.iasri.res.in), Live E-mail services, more than 462 network nodes and number of various Online Information Systems are being developed and maintained by the Institute.

ICAR Data Centre was inaugurated by Union Minister of Agriculture and Farmers' Welfare at IASRI on 21st December, 2016. About 80 website have been launched in Data Centre.

Krishi Vigyan Kendra Knowledge Network Portal and KVK Mobile APP (http://kvk.icar.gov.in) have been developed to disseminate knowledge and information from KVKs to farmers. KVK Portal was launched on 8th July 2016 and KVK Mobile APP was launched on 21st December, 2016 by the Union Minister of Agriculture and Farmers Welfare.

Honourable Union Minister of Agriculture and Farmers' Welfare released the Education portal of ICAR along with two Mobile Apps namely Pashu Prajanan (Animal Reproduction) and Shukar Palan (Pig Farming) in the Conference of Vice Chancellor of Agricultural Universities and Directors of ICAR Institutes on 8th March, 2018 at NAAS Complex, Pusa, New Delhi. Mobile Apps Pashu Prajanan and Shukar Palan have been developed in collaboration with ICAR-IVRI and is available on Google Play Store. Four copyrights have been obtained for Animal Reproduction and Pig Farming mobile apps for different languages.

The Library of ICAR-IASRI is considered as a well known and specialized library 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 with best IT agricultural library under ICAR system. 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. All housekeeping activities of the library have been computerized and bar-coded and all bonafide library users have been issued electronic membership cards and all Ph.D. and M.Sc. Thesis have been digitized and given access to users through LAN. Library of the Institute got associated with CERA in terms of electronic document delivery services. The library reading room has been renovated with 5 split air conditioners to provide congenial environment for readers. All library users were given training to access on-line services available in the library.

ICT Infrastructure and Unified Messaging and Web Hosting facilities have been created. The facilities provide email solution for all employees of ICAR with features of unified messaging at desktop of users. Web hosting environment facilitates use of website/ applications developed by ICAR institutes.

There are three well-furnished hostels, viz. Panse Hostel-cum-Guest House, 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, one Unit and three Cells to undertake research, training, consultancy, documentation and dissemination of scientific output.

Divisions

- Design of Experiments
- Sample Surveys
- Statistical Genetics
- Forecasting and Agricultural Systems Modeling
- Computer Applications
- Centre for Agricultural Bioinformatics [CABin]

Unit

- Institute Technology Management Unit (ITMU)

Cells

- Prioritization, Monitoring and Evaluation (PME) Cell
- Training Administration Cell (TAC)
- Consultancy Processing Cell (CPC)

Financial Statement

The Institute was able to ensure optimal utilization of funds available in the budget. The actual utilization of the budget is furnished below:

Expenditure Statement (detailed) (Rs. In Lakhs) **(April, 2019 - March, 2020)**

S. No.	Head	Allocation Govt. Grant 2019-20	Allocation Internal Resource + Additional amount provided by HQ out of Council's share (2019-20)	TOTAL ALLOCATION 2019-20	Expenditure (Govt. Grant) 2019-20				Expenditure (Revenue Generation) 2019-20	TOTAL EXPENDITURE 2019-20
1	2	3	4	5 (3 + 4)	6				7	8
					NEH	TSP	SCSP	Other than NEH & TSP		
1	Works									
	A. Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B. Building	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	i. Office building	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ii. Residential building	44.10	0.00	44.10	0.00	0.00	0.00	0.00	0.00	0.00
	iii. Minor Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Equipment	13.47	0.00	13.47	0.00	0.00	0.00	7.84	0.00	7.84
3	Information Technology	7.18	0.00	7.18	0.00	0.00	0.00	6.46	0.00	6.46
4	Library Books and Journals	42.73	0.00	42.73	0.00	0.00	0.00	42.71	0.00	42.71
5	Vehicles & Vessels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Livestock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Furniture & fixtures	4.00	0.00	4.00	0.00	0.00	0.00	1.83	0.00	1.83
8	Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total – CAPITAL (Grants for creation of Capital Assets)	111.48	0.00	111.48	0.00	0.00	0.00	58.83	0.00	58.83
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	Establishment Expenses(Salaries)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	i. Establishment Charges	2740.00	0.00	2740.00	0.00	0.00	0.00	2733.46	0.00	2733.46
	ii. Wages	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

S. No.	Head	Allocation Govt. Grant 2019-20	Allocation Internal Resource + Additional amount provided by HQ out of Council's share (2019-20)	TOTAL ALLOCATION 2019-20	Expenditure (Govt. Grant) 2019-20				Expenditure (Revenue Generation) 2019-20	TOTAL EXPENDITURE 2019-20
1	2	3	4	5 (3 + 4)				6	7	8
	iii. Overtime Allowance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total – Establishment Expenses (Grant in Aid - Salaries)	2740.00	0.00	2740.00	0.00	0.00	0.00	2733.46	0.00	2733.46
1	Pension & Other Retirement Benefits	977.00	0.00	977.00	0.00	0.00	0.00	953.62	0.00	953.62
2	T.A.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A. Domestic TA / Transfer TA	19.00	0.00	19.00	0.00	0.00	0.00	16.01	0.00	16.01
	B. Foreign TA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total – Traveling Allowance	19.00	0.00	19.00	0.00	0.00	0.00	16.01	0.00	16.01
3	Research & Operatinal Expenses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A. Research Expenses	152.00	0.00	152.00	0.00	0.00	0.00	149.92	0.00	149.92
	B. Operational Expenses	280.00	0.00	280.00	0.00	0.00	0.00	279.21	0.00	279.21
	Total - Research & Operational Expenses	432.00	0.00	432.00	0.00	0.00	0.00	429.13	0.00	429.13
4	Administrative Expenses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A. Infrastructure	483.00	0.00	483.00	0.00	0.00	28.19	450.76	0.00	478.94
	B. Communication	3.00	0.00	3.00	0.00	0.00	0.00	2.51	0.00	2.51
	C.Repair & Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	i. Equipments,Vehicles & Others	370.00	0.00	370.00	0.00	0.00	0.00	361.62	0.00	361.62
	ii. Office building	50.00	0.00	50.00	0.00	0.00	12.04	32.41	0.00	44.46
	iii.Residential building	48.02	0.00	48.02	0.00	0.00	0.00	41.45	0.00	41.45
	iv. Minor Works	6.98	0.00	6.98	0.00	0.00	0.00	6.96	0.00	6.96

S. No.	Head	Allocation Govt. Grant 2019-20	Allocation Internal Resource + Additional amount provided by HQ out of Council's share (2019-20)	TOTAL ALLOCATION 2019-20	Expenditure (Govt. Grant) 2019-20				Expenditure (Revenue Generation) 2019-20	TOTAL EXPENDITURE 2019-20
1	2	3	4	5 (3 + 4)				6	7	8
	D. Others (excluding TA)	230.00	0.00	230.00	0.00	0.00	39.98	189.53	0.00	229.52
	Total - Administrative Expenses	1191.00	0.00	1191.00	0.00	0.00	80.21	1085.24	0.00	1165.45
5	Miscellaneous Expenses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	A. HRD	23.00	0.00	23.00	0.00	0.00	0.00	16.45	0.00	16.45
	B. Other Items (Fellowships, Scholarships etc.)	175.00	0.00	175.00	0.00	0.00	71.88	100.00	0.00	171.88
	C. Publicity & Exhibitions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	D. Guest House – Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	E. Other Miscellaneous	470.00	0.00	470.00	0.00	0.00	20.00	449.95	0.00	469.95
	Total - Miscellaneous Expenses	668.00	0.00	668.00	0.00	0.00	91.88	566.40	0.00	658.28
	Total --Grants in Aid - General	3287.00	0.00	3287.00	0.00	0.00	172.10	3050.40	0.00	3222.50
	Grand Total (Capital + Establishment + General)	6138.48	0.00	6138.48	0.00	0.00	172.10	5842.69	0.00	6014.79
6	Loans and Advances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
										(Rs. In Lakhs)
	Swachh Bharat Mission									8.42

Research Achievements

Programme 1: Development and Analysis of Experimental Designs for Agricultural Systems Research

Incomplete split-plot designs: construction and analysis

Split-plot designs are widely used in agricultural experiments where whole plot treatments are applied to larger plots and within each whole plot, all the subplot treatments are applied. Certain experimental situationscan arise when one cannot apply each of the subplot treatments within each wholeplot. In such situations, number of subplot treatments to be applied in each whole plot is less than the total number of subplot treatments. Such types of experimental designs are called as incomplete split-plot designs. In split-plot designs, whole plot treatments are generally applied in randomized complete block designs. Sometimes we may apply whole plot treatments in incomplete block design set up. In some situations, subplot treatments may be combinations of two factors. The analysis methods of incomplete split-plot designs are not readily available in standard statistical packages. The purpose of this project is to address the problem of constructing incomplete split-plot designs for the three situations viz. (i) when the sub-plots are incomplete, (ii) when the main-plots are incomplete and (iii) when both the whole plots and sub-plots are incomplete along with analyzing data and implementing the analysis method in a software module.

During 2019, methodology of analysis of incomplete split plot designs which are incomplete both at whole plot level and at subplot level has been developed. The method has been implemented using R programming language. The methodology has also been included as part of a web application so that it can be used by researchers and experimenters. Two methods of construction of incomplete split-plot designs which are complete at whole plot level and incomplete at subplot level with two factors at subplot level have been developed. Two lists of such incomplete split-plot designs have been prepared in a restricted parametric range. An R package named

ispd has been developed by implementing all the proposed methods of construction and analysis of incomplete split-plot designs and is available at https://cran.r-project.org/web/packages/ispd/index.html.

Further, a web application has also been developed by implementing the methods of construction and analysis of incomplete split-plot designs. Users can easily create incomplete split-plot designs and analyze data from such experiments using the web application. The web application can be accessed on http://drsr.icar.gov.in/ISPD/.

Planning, designing and analysis of data relating to experiments for AICRP on Long Term Fertilizer experiments

Long term fertilizer experiments are conducted on every year at 17 cooperative centres during Kharif and Rabi seasons for specific crops at specific centres. The experimenters record grain yield, macro and micro nutrients uptake by the crops and soil parameters.

During 2019, data analysis of Raipur centre for Kharif and Rabi season of 2013-14, 2014-15, 2015-16, 2016-17 has been done and analysis results have been sent to centre in-charge in specified format. Data of Coimbatore centre for 104th and 105th crop have been analyzed and the reports have been sent to centre in-charge. Data of Jabalpur centre for 2015-16 and 2016-17 for Kharif and Rabi season has been analyzed and analysis results have been sent to centre in-charge. Pantnagar centre for 2015-16 and 2016-17 for Kharif and Rabi season have been completed and analysis results have been sent to centre in-charge in specified format.

Analytical procedure for factorial experiments with Logistic and Gompertz error distributions

Analysis of variance procedure in the framework of experimental designs has traditionally been based on assumptions of normality. In practice, however, non-normal distributions are more prevalent. So, it is of great interest to study the effect of non-normality on the *F* statistics used for testing main and interaction effects in ANOVA. In this study two non-normal distributions have been considered (i) generalized logistic distribution and (ii) Gompertz distribution. When the data do not follow normal distribution, the equations obtained of MLE are not linear and so these equations are difficult to solve. One can use Taylor's series to solve these equations by making it linear.

Suppose, there are three factors (say A, B and C), in which factor A has 2 levels, factors B and C have 3 levels (2×3^2 factorial experiments) in unblocked situation. The statistical model for such experiments is

$$y_{ijul} = \mu + \tau_i + \beta_j + \lambda_u + (\tau\beta)_{ij} + (\tau\lambda)_{iu} + (\beta\lambda)_{ju} + (\tau\beta\lambda)_{iju} + e_{ijul}$$
$$(i = 1,\ 2;\ j = 1,\ 2,\ 3\ ;\ u = 1,\ 2,\ 3\ ;\ l = 1, 2, \ldots,\ n)$$

$$f(e_{ijul}) \propto \frac{\theta}{\sigma}\left[\frac{\exp\left[-\left(\frac{y_{ijul} - \tau^*_{iju}}{\sigma}\right)\right]}{\left[1+\exp\left[-\left(\frac{y_{ijul} - \tau^*_{iju}}{\sigma}\right)\right]\right]^{\theta+1}}\right]$$

where, θ and σ are the parameters of the logistic distribution, and

$$\tau^* = \mu + \tau_i + \beta_j + \lambda_u + (\tau\beta)_{ij} + (\tau\lambda)_{iu} + (\beta\lambda)_{ju} + (\tau\beta\lambda)_{iju}$$

Log likelihood function when error follows generalized logistic distribution.

Solving likelihood equation and using Taylor's series expansion, modified maximum likelihood estimates have been obtained for the parameters of the 2×3^2 factorial experiment, when error follows generalized logistic distribution.

$$\log L = \text{Constant} - N\log\sigma + \sum_{i=1}^{2}\sum_{j=1}^{3}\sum_{u=1}^{3}\sum_{l=1}^{n}\left(-\left(\frac{y_{ijul} - \tau^*_{iju}}{\sigma}\right)\right)$$
$$-(\theta+1)\sum_{i=1}^{2}\sum_{j=1}^{3}\sum_{u=1}^{3}\sum_{l=1}^{n}\log\left[1+exp\left(-\left(\frac{y_{ijul} - \tau^*_{iju}}{\sigma}\right)\right)\right]$$

The expressions for the estimates of model parameters, contrast of the main effects, interaction effects, sum of squares and *F* statistics based on weighted treatment totals for 2×3^2 factorial experiments have been developed. This is helpful in obtaining the ANOVA for this particular experimental situation. SAS code has been developed for sum of squares and *F* statistics for the analysis of the 2×3^2 factorial experiments when error follows generalized logistic distribution.

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

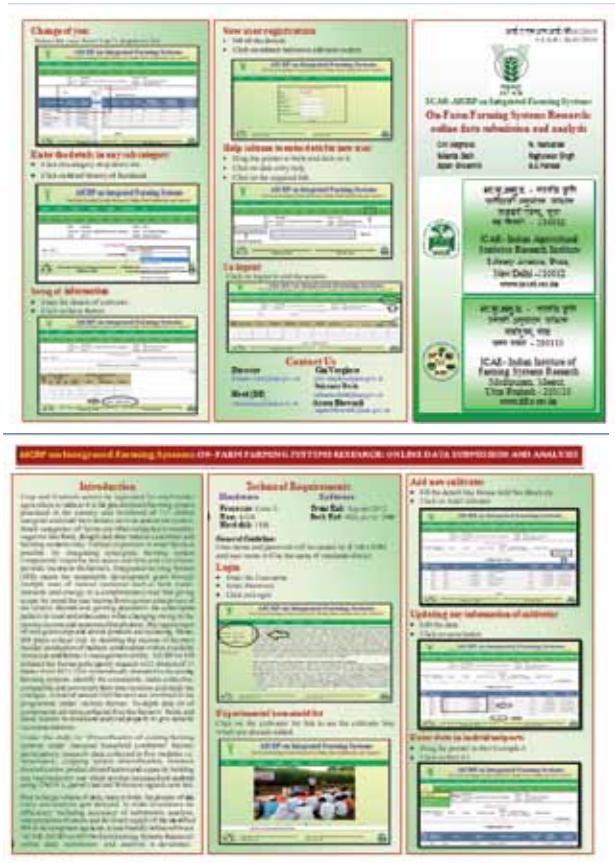
Crop and livestock cannot be separated for small holder agriculture in India as it is the predominant farming system practiced in the country and livelihood of 117 million marginal and small farm holders revolves around this system. Small categories of farms are often subjected to weather vagaries like flood, drought and other natural calamities and farming remains risky. Vertical expansion in small farms is possible by integrating synergistic farming system components requiring less space and time and can ensure periodic income to the farmers. Integrated Farming System (IFS) meets the sustainable development goals through multiple uses of natural resources such as land, water, nutrients and energy in a complimentary way thus giving scope for round the year income from various enterprises of the system. Besides ever growing population, the consumption pattern in rural and urban areas is fast changing owing to the raising income and economic liberalization. The requirement of non-grain crops and animal products are increasing. Hence, IFS plays critical role in doubling the income of farmers besides production of multiple commodities within available resources and farmer's management ability. 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. A total of around 1920 farmers are involved in the programme under various themes. 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.

Under the study on "Diversification of existing farming systems under marginal household conditions", farmer participatory research data in five modules viz. benchmark, cropping system diversification, livestock diversification, product diversification and capacity building are received every year which are then processed and analyzed using ANOVA, paired t test and Wilcoxon signed-rank test.

Due to large volume of data, many a times, the process of data entry and analysis gets delayed. In order to enhance the efficiency including accuracy of submission, analysis, interpretation of results and for timely supply of the identified IFS to development agencies, a user-friendly online software "ICAR-AICRP on IFS On-Farm Farming Systems Research: online data submission and analysis" is developed.

A training programme on "On-line submission and analysis of on-farmfarming systems research data and Preparation of promising farming systems for scaling up" was organized in collaboration with ICAR-IIFSR during 27-29 August, 2019. A pamphlet developed on the software AICRP on Integrated Farming Systems On-farm Farming Systems Research: Online data submission and analysis was released in the inaugural function. The details are as given below:

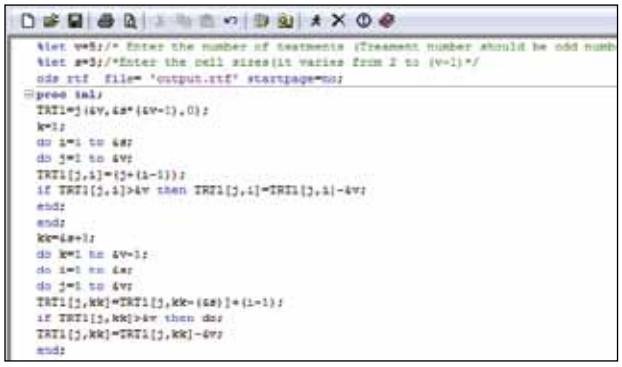
Cini Varghese, Sukanta Dash, Arpan Bhowmik, N. Ravisankar, Raghuveer Singh and A.S. Panwar (2019). AICRP on Integrated Farming Systems On-farm Farming Systems Research: Online data submission and analysis. IASRI/B-01/2019.



Generalized Row-Column Designs for Crop and Animal Experiments

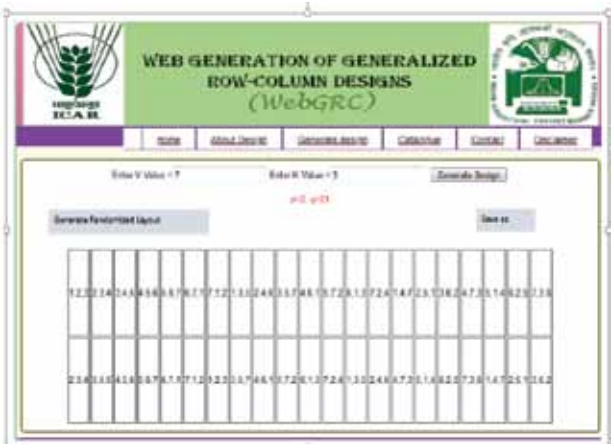
In case of a generalized row-column design there is more number of units in a cell and the treatment applied to one experimental unit in a cell may affect the response on neighbouring unit in the same cell. A GRC design with v treatments in p rows and q columns is said to be balanced for spatial effects from neighbouring units if within a cell every treatment

has every other treatment appearing as neighbour a constant number of times (say l times). These designs are called here as Neighbour Balanced GRC (NBGRC) designs. Obtained the canonical efficiency of the developed NBGRC designs with parameters *v* (prime), *p* = *v*, *q* = *v*-1, *k* = s (3 ≤ s ≤ *v*-1), r = s (*v*-1) and l=2(s-1) for direct treatment effects and neighbour treatment effects. SAS macro for generating this class of NBGRC designs has been developed.



A method of constructing Partial Triallel Crosses (PTC) using a classes of GRC designs with parameter *v* (prime), p=2, *q* = *2v* and *k (3 ≤ k ≤ v-1)* was obtained. The parameters of the developed PTC plan will be *n* (no of lines/genotypes) = *v*, *N* (no of crosses)= *6v* and *f* (degree of fractionation) = *12/(v-1)(v-2)*.

An online software Web generation of Generalized Row-Column Designs *(WebGRC)* has been developed. In addition, computer modules for generating a class of GRC designs with parameter *v* (prime), *p = 2, q = 2v* and cell of size *k (2 ≤ k ≤ v-1)* along with randomized layout have been developed.



Designs involving Three-way and Four-way Genetic Crosses for Crop and Animal Breeding Programmes

Plant and animal hybrids are increasingly gaining popularity among the breeders as well as the industrial sector. The increased performance of hybrids over the parents in terms of vigour and yield potential is the basic reason for this gain in performance. Now, among various types of hybrids two-way (diallel) cross hybrids are the simplest and easily manageable. However, three-way (triallel) cross hybrids and four-way (tetra-allele) cross hybrids are genetically more viable, stable and consistent in performance than two-way cross hybrids. A method of constructing augmented partial four-way cross plans has been developed. These plans are suitable for situations wherein some lines are of primary importance in comparison to others and resources do not permit all possible four-way crosses. Information matrix and inverse of information matrix has been derived for the developed class of augmented partial four-way cross plans. These plans are suitable for situations wherein some lines are of primary importance in comparison to others and resources do not permit all possible four-way crosses.Expressions for variance estimates of contrasts pertaining to gca effects of primary Vs. primary, primary Vs. secondary and secondary Vs. secondary lines have been derived for the class of augmented partial four-way cross plans obtained. These plans are suitable for situations wherein some lines are of primary importance in comparison to others and resources do not permit all possible four-way crosses. A list of augmented partial four-way cross plans has been prepared consisting of no. of primary lines (p), no. of secondary lines (q), total number of lines (n), no. crosses among primary lines (N_{pp}), no. crosses involving primary Vs. secondary lines (N_{ps}), no. crosses among secondary Vs. secondary lines (N_{ss}), total no. of crosses (N_{APDC}), degree of fractionation,

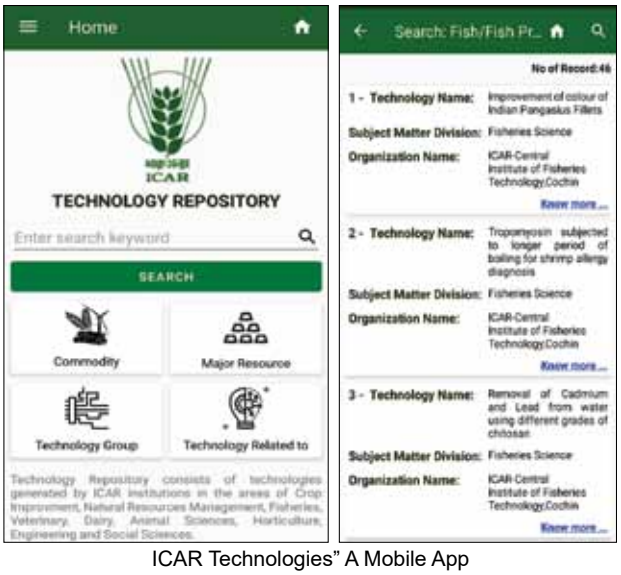
and variance estimates of contrasts pertaining to gca effects of primary Vs. primary, primary Vs. secondary and secondary Vs. secondary lines. These plans are suitable for situations wherein some lines are of primary importance in comparison to others and resources do not permit all possible four-way crosses. SAS code has been written for computing variance estimates of contrasts pertaining to gca effects of primary Vs. primary, primary Vs. secondary and secondary Vs. secondary lines for augmented partial four-way cross plans. The user has to enter the number of primary lines, number of secondary lines and the crosses to obtain the estimates.

ICAR Research Data Repository for Knowledge Management as (KRISHI-Knowledge Based Resources Information Systems Hub for Innovations in Agriculture)

This portal is serving as a gateway to online resources available at different ICAR Institutes to enhance visibility and easy access of digital outputs of ICAR to stakeholders. The salient achievements are given in the sequel:

- **Inter Portal Harvester:** In order to bring various agricultural research publications collected by various organizations within as well as outside of ICAR, strengthened Inter Portal Harvester (http://krishi.icar.gov.in/ohs-2.3.1/index.php/browse) by adding one more resource. At present more than **4,92,914** (**4,57,321** reported earlier**)** records from 26 repositories (2 repositories added during the period) are available for unified search.
- **Publication and Data Inventory Repository:** The repository has been enriched through populating data by Nodal officers and other researchers. **27530+** publications and **690+** dataset have been submitted from **107** Institutes (106 Reported earlier). **1440** researchers other than Nodal officers have registered themselves as submitters. Added following new collections of publications (i) AICRP on Pearlmillet was also added under the community Others (DKMA, ICAR-HQ), (ii) AICRP on UAE under ICAR-CIAE, Bhopal and (iii) AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture under ICAR-CSSRI, Karnal; Added discovery index on language and updated default display of 8 items (5 items earlier) under Author name and date Range.
- ICAR **Mobile Apps:** Workflow based application for submission and search of links of Mobile Apps was maintained and updated. At present links of a total of **246** (215 reported earlier) **mobile Apps** (ICAR: 158; SAU/CAU: 37; KVK: 30 and Other Govt. Agencies: 21) are available through single window access. Also uploaded the apk of around 80 mobile apps on this portal. Partner Centre, ICAR - Directorate of Knowledge Management in Agriculture has developed a mobile app KISAAN (Krishi Integrated Solution for Agri Apps Navigation) that integrates more than 100 Agriculture related apps developed by ICAR Institutes in a single mobile app which can be accessed through Android smart phones.
- **Video/Audio Gallery:** This application provides single window access to **1630** videos (1337 reported earlier) and 54 Audios (52 earlier) for unified search.

- **Technology Repository:** Developed a Mobile App on **ICAR Technologies** with search facility. The mobile app was launched by Honourable



ICAR Technologies" A Mobile App

Secretary DARE and Director, General ICAR on December 10, 2019 and is available at GooglePlay Store. **61**(28 reported earlier) Institutes have been initiated uploading the Technologies /proven technologies. At present **984** (427 reported earlier) technologies are available in public domain and **80** are in the workflow process. The information on Technologies has also been made available on Open Government Data Platform using webservices.

- **ICAR IPR Repository:** Developed work flow based ICAR IPR Repository consisting of three inbuilt applications on Copyrights, Patents and Registered varieties. This was launched by Honourable Secretary DARE and Director, General ICAR on December 10, 2019.

Screen shot of ICAR-IPR Repository

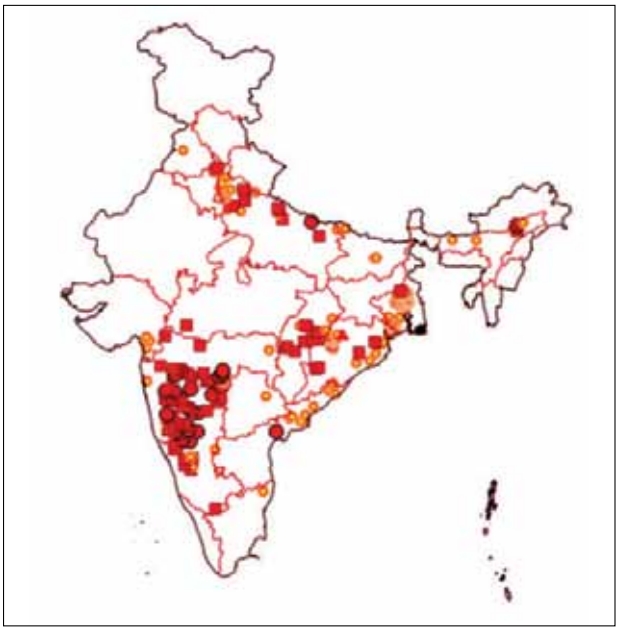
- **Unit Level Data Repository**
  - **Content Management System AICRP Websites:** Based on information received from stakeholders developed and strengthened Websites for **21** AICRPs with uniform formatting and contents using Content Management System and different level user authentications. Among these 21, **07** are developed for new AICRPs: (i) AICRP on Pearlmillet; (ii) AICRP on Castor, Safflower and Sunflower; (iii) AICRP on Groundnut; (iv) AICRP on National Seed Project; (v) AICRP on Pig; (vi) AICRP on Utilization of Animal Energy with Enhanced System Efficiency; (vii) AICRP on Tobacco.
  - **Experimental Data Repository:** The AICRP information system allows trial creation, layout preparation, data submission, analysis and reporting of AICRP trials. Role based access and random coding of entries being tested allows to maintain quality of data. Uniform reporting based on appropriate statistical analysis ensures easiness in drawing inferences and uniform reporting of experiments. These proytotypes

can be customized for other AICRPs as per requirements. The Coordinating Unit has to play active role for customisation followed by implementation. Following information systems have been developed and launched by Secretary DARE and Director General, ICAR on December 10, 2019: (i) Information System for AICRP on Pearlimmilet:

(ii) Information Systems on Castor, Sunflower and Safflower. Beta version of Information System on AICRP on Weed Management has been developed and is being tested by the Project Coordinator. Information System on AICRP on LTFE; Integrated water management; Management of salt affected soils and use of saline water agriculture; Pig and Poultry are being customized.

- **Observational Data Repository:** Strengthened the application for harvesting/ scrapping of daily weather data from eight Institutes and developed one new for harvesting data from (x) ICAR-CSWRI, Avikanagar (June 2019). Past weather data collected by AICRP on AM during 2007-2018 (24 Centres) in Daily, Weekly and Yearly format for 28 stations made available on Obsewrvational repository.

- **ICAR Geo-Portal:** Developed workflow based applications for (i) Spatial Meta Data Repository and (ii) Satellite Monitored India Crop Residue Burn Events have also been developed. Strengthened ICAR geo-portal by adding new layers of (i) Crop residue burning points (i) Wheat: April 15-May 31, 2019 and (ii) All India crops: June 01, 2019 onwards; (iii) thematic layers of livestock disease outbreaks 2016, 2017 and 2018 as per data received from ICAR-NIVEDI, Bengaluru. The Interoperable Geoportal platform has been developed by synchronizing soils of India and crop suitability for rice and wheat at national and state level from Bhoomi Geoportal (http://www.bhoomigeoportal-nbsslup.in/) with 36 themes of India of Rice



All India Crop Residue burning points as on December 31, 2019

Spatial Meta Data Repository

(18 themes) and wheat (18 themes) regarding Area, Production and Yield of KRISHI Geoportal (http://geoportal.icar.gov.in:8080/geoexplorer/composer/). This interoperable platform enable the users to visualize the interoperable services on crop suitability of rice and wheat at national and state level vis-a-vis the actual area, production and yield details pertaining to 2008-09 to 2013-14.

- **Dashboard for Monitoring:** Dashboard created to monitor the progress of submissions to various repositories by ICAR institutes has been strengthened by (i) adding new graphs of Mobile Apps SMD wise and Organization Type Wise and (ii) Table display data with Expand-Collapse Button.

- **Visibility**: KRISHI Portal has attracted more than **2,20,000** page views since May 2015 across more than **620** cities of **110** countries. There are more than **52,800** page views across **250** cities of **55** countries on ICAR Publication and Data Inventory Repository. It provides enhanced visibility to the publications. Since May 2017, there are more than **4,50,000** downloads (3,00,000 reported earlier) that includes documents fetched through computer programme by other sites. KRISHI Publication and Data Inventory is now being indexed by Google Scholar, Base: Bielefeld Academic Search Engine and OpenDOAR: Directory of Open Access Repositories. Other agencies such as Open Government Data Platform (data.gov.in) and the Global Forum for Agricultural Research (GFAR) have taken note of this initiative and listed as important resource in Agricultural Research in India.A question was asked on KRISHI Portal in IAS preliminary paper test series by Vision IAS Academy which shows wide reach of KRISHI Portal to public.

Planning, designing and analysis of experiments planned on stations under All India Coordinated Research Project on Integrated Farming Systems

On stations research experiments under All India Coordinated Research Project on Integrated Farming Systems are planned and conducted under four types of research programmes viz. (i) development of new cropping systems; (ii) nutrient management in cropping systems; (iii) development of system based management practices and (iv) maximum yield research. These experiments are conducted using Randomized Complete Block (RCB) design, Factorial RCB design, split plot design, strip plot design, 3^2 x 2 balanced confounded factorial experiments and split-split plot design.

Data of 120 experiments (1a, 2a and OF) for the year 2017-18 have been received and analysis of all 120 experiments have been completed and sent to Program Facilitator of coordination unit of ICAR-IIFSR, Modipuram.

Results have been tabulated in the form of summary tables and sent to the respective scientist- in-charge of the cooperating centres and Program Fecilitator of coordinating unit, ICAR-IIFSR, Modipuram.

Online data entry and analysis module has been developed for Experiment 2(a) {Permanent plot experiment on integrated nutrient management in rice-wheat cropping sequence}. The developed module deals from data entry to final report preparation. Corresponding centres can get the final report immediately after entering the data in the website.

Data of the experiment entitled “Permanent plot experiment on integrated nutrient supply system in a cereal based crop sequence” on four years (2014-15 to 2017-18) of four centers (Hissar, Karjat, Varanasi and Sabour) for both Kharif and Rabi yield have been analyzed separately. Then, we have performed the combined analysis and was found that effect of treatment is significant for both Kharif and Rabi yield for all three centres but year*trt effect is significant for both Kharif and Rabi yield only for the Hissar and Karjat centre.

At Hisar centre, it was found that T6 (50% Rec. NPK dose through fertilizers + 50% N through FYM), T5(100% Rec. NPK dose through fertilizers) and T10 (50% Rec. NPK dose through fertilizers + 50% N through GM) have same effects over the year and found T6 as the best treatment irrespective of years. Similarly for karjat centre, it was found that all the treatments show different effects in different years but still found T6 as the best treatment. But for Sabour centre, it was found that all the treatments shows same effects irrespective of years and found T6 as the best treatment. It may be concluded that treatment T6 is the best treatment over years and locations.The progress of the project has been presented in the annual group meeting of AICRP on IFS organized at Junagadh Agricultural University, Junagadh during 27-29 November, 2019.

Plant source based environmentally safe crop protection and production technologies: Development and capacity building

A web application named as “Web enabled phytochemical knowledge based system for crop protection” using Python programing language with Django framework and Pycharm IDE as the backend has been developed and information based of phytochemical is regularly updated in the database. This application is developed to create a Centralized Information Source about phytochemicals. It is further enabled to carry out appropriate Statistical Analysis and Automate Uniform Reporting Process. It also provides Secure Access of Data for authorized users and allow different users at different location to provide inputs in database.In this application two different accesses have been provided in this software (Information System): Restricted access and Open access. Restricted access is for the Authorized users and they can input and modify the data into the

database. Open access is for Guest users who can only view the data. 4-tier user authentication have been provided for different type of users. The seven (7) different modules have been developed under the application. Screenshots of the web application with all different modules are shown below (Fig.).

Home Page

Login Page

Page after Login

Data entry by user

Page after Login

Final upload

Fig.: Screenshots of the web application with all different modules

Application of Next-Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic Gain in Indian Staple Crops

Fig.: Launching workshop of the project

The ICAR in collaboration with Bill Melinda Gates Foundation launched a Mega Project on “Application of Next-Generation Breeding, Genotyping and Digitalization Approaches for Improving the Genetic Gain in Indian Staple Crops” on January 25, 2019.

The knowledge partners include State Agricultural Universities and Government, Excellence in Breeding Platform, CIMMYT, Mexico and ICRISAT. The project aims to optimize conventional breeding pipelines towards development of consumer-oriented products while improving crop productivity and profitability of Indian farmers. In the first phase, Breeding Management System (BMS) implementation in all AICRP/ Institutes concerned i.e. ICAR-IARI (Lead Institute), ICAR-NRRI (Rice), ICAR-IIRR (Rice), ICAR-IIWBR (Wheat), ICAR-PC (Pearl millet), ICAR-PC (Chickpea), ICAR-IIMR (Millets), ICAR-IIPR (Pulses), ICAR-CPRI (Potato) is being carried out. To achieve better implementation, a training programme on Digitalization of Breeding Programme & Data Management was organised at ICRISAT, Hyderabad during July 09-12, 2019 in which training expertise in various workshops was provided by our institute.

Programme-2: Forecasting, Modelling and Simulation Techniques in Biologicaland Economic Phenomena

Modelling and forecasting of drought index using machine learning techniques

In this study, multiple kernel extreme learning machine (MK-ELM) and wavelet based MK-ELM (W-MK-ELM) algorithms have been proposedfor forecasting of effective drought index (EDI). For the development of W-MK-ELM, the input data were firstscreened through the wavelet pre-processing. Determined by the autocorrelation function (ACF) and partial ACFs, the lagged EDI signals for the current and past months were used as significant inputs for one month lead-time EDI forecasting. For drought model development, 52 years (1951-2002) of data of Sagar and Chattarpur districts of Bundelkhand region were used. The discrete wavelet transformation (DWT) is applied to the predictor datasets to decompose inputs into their time–frequency components that capture important information onperiodicities. DWT sub-series have been used to develop new EDI sub-series as inputs for the W-MK-ELM model. The forecasting capability of MK-ELM and W-MK-ELM is benchmarked with Extreme Learning Machine (ELM), artificial neural network (ANN), least squares support vector regression (LSSVR) models. Statistical metrics based on agreement between the forecasted and observed EDI, including coefficient of determination, root-means quare error and mean absolute error have been used to assess the effectiveness of the models.

Forecasting Agricultural output using Space Agro meteorology and Land based observation (FASAL)

During the period under report, the developed Bayesian based weather indices model have been applied for yield forecasting of different crops (rice and wheat) for different regions (Rajasthan, West Bengal and Delhi). The developed model was compared with other base models such as stepwise regression, least absolute shrinkage and selection operator (LASSO) regression and ARIMA with explanatory variables (ARIMAX). Superior results for Bayesian approach as compared to the others in terms of root mean square error (RMSE) and mean absolute percentage error (MAPE) have been obtained. For ease of using the models we have developed an automated system for modelling and forecasting using weather indices based models. This system is currently under testing phase using different datasets for crops and locations.

ICT based extension strategies for nutrition sensitive agriculture in the states of U.P. and Odisha

Multistage Stratified Random Sampling with first-stage sampling units- District, second-stage sampling units- Block/ Village and third-stage sampling units-Farmer/ Respondent has been proposed for data collection. The collected data has been summarized in Excel sheet. There were three forms (Form A, Form B and Form C) in the data. To identify the best form Confirmatory Factor Analysis (CFA) has been employed. The three models viz. Form A, Form B and Form C were evaluated using several fit indices: normed chi-square statistics, Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). Based on the fit indices, it has been inferred that Form A model has higher accuracy as compared to Form B and Form C. Hence are retained the questions belonging to Form A and discard the questions belonging to Form B and Form C discarded. Genetic algorithm based Mokken's Scaling Analysis (MSA) has been used for the selection of statements of a schedule for farmers which will be used for understating a farmer's perspective on nutritional health, anaemia and motivational factors influencing their beliefs. Modified Analytic Hierarchy Process (AHP) approach has been proposed where pairwise comparison matrices can be obtained at the analysis stage. The proposed modified AHP has been employed for ranking of several factors.

Crop diversification: Pattern, Determinants and its Impact on Nutritional Security in India

Diversification towards high value crops is regarded as a major source of growth in farmers' income operating within agricultural sector. Time series data on crop area statistics was collected from the Land Use Statistics, Department of Agriculture and Co-operation Network (DACNET), Government of India. Simpson Index of diversification (SID) is used to estimate the extent of crop diversification. The index ranges between 0 and 1, wherein the value closer to 1 indicates high diversification and the value closer to 0, indicates no diversification. The SID has been measured for food crops, non-food crops and the crop sector in major states of India for the period 2000 to 2017. To identify change in the diversification indices, the values are estimated for five year periods with triennium ending average. Food crop groups included food grains, sugarcane & sugar, condiments & spices and fruits & vegetables; while non-food crop group was comprised of oilseeds, fibers, drugs& narcotics and plantation crops. Region wise as well as state wise diversification indices were estimated for food crops and non-food crops. The extent of crop diversification has been further classified into three groups namely: Lower SID (Range: 0.00-0.30), Moderate SID (Range: 0.31-0.60) and Higher SID (Range 0.61-1.00). Under the food crops, Punjab and Haryana did not experience crop diversification at a significant scale, hence, recorded a lower SID. The states of Uttar Pradesh, Odisha, Bihar, West Bengal, Assam, Madhya Pradesh, Rajasthan, Maharashtra, Gujarat, Telangana, Tamil Nadu and Chhattisgarh registered a moderate degree of crop diversification and hence were under the category of moderate SID. Kerala, Andhra Pradesh and Karnataka recorded a higher degree of crop diversification among food crops, hence higher SID. Region-wise shares as well as trends of various crop groups in gross cropped area was also estimated. District-wise diversification indices and area under high value crops are estimated for the period 2014-15 to 2016-17. A significant negative correlation between district-wise area under high value crops and extent of under-nutrition is observed.

Prospects of Irrigation in India: Trends, Determinants and Impact on Agricultural Productivity

Time series data on area under different sources of irrigation (from 1990 to 2015), and public irrigation expenditure (2005 and 2016) in 20 major agricultural states was collected from the Comptroller and Auditor General of India reports of land use statistics and state finance accounts respectively. Subsequently, the states were categorised into four geographical regions for inter-regional analysis. They are Northern region (Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Uttar Pradesh and Uttarakhand), Western region (Gujarat, Madhya Pradesh, Maharashtra and Rajasthan), Eastern region (Bihar, Chhattisgarh, Jharkhand, Odisha, West Bengal and Assam) and Southern region (composite Andhra Pradesh, Karnataka, Kerala and Tamil Nadu). The expenditure data collected under different subheads was clubbed separately under revenue expenditure and capital expenditure categories. The expenditure data was then deflated using GFCF deflator for the base year 2011. In order to study the dynamics of groundwater extraction for agriculture, district-wise panel was prepared for three periods viz., 2004, 2009 and 2013. Available data on district-wise ground water extraction shows that there has been a remarkable change in the groundwater scenario in the country during 2004-2017. On the basis of their stage of groundwater development, districts are classified as "Safe" and "unsafe" (which includes semi-critical, critical and over-exploited categories). There has been a structural shift in the irrigation sector in terms of its relative contribution of different irrigation sources. The relative share of surface irrigation has declined across the regions. On the other hand, the intensive use of groundwater due to its reliability and efficiency has resulted in groundwater emerging as the dominating source of irrigation. During 2010-14, the share of surface irrigation was highest (42%) in the eastern region followed by southern region (41%), and was lowest (23%) in western region. The share of groundwater irrigation was highest (74%) in the northern region followed by western region (71%) and was lowest in eastern region (49%). The results of public expenditure analysis showed that, during 2005-16, the share of capital investment in total public expenditure was highest (68%) in Southern region and was lowest (37%) in northern region. Per hectare cost of creation of irrigation potential was also highest (₹ 21 Lakh/ha) in the southern region followed by eastern region (₹ 5.57 Lakh/ha) whereas it was lowest in the northern region (₹ 3 Lakh/ha). In order to study the status and factors influencing ground water extraction in India, data on district wise groundwater extraction was collected from the reports of groundwater statistics of Central Groundwater Board for the years 2004, 2009, 2013 and 2017. Proportion of unsafe districts has grown from 49% in 2004 to 58% in 2017. Panel data analysis showed that ground water extraction was higher during low rainfall years. There was a

positive and significant association between ground water extraction for irrigation and cultivation of water intensive crops such as rice, wheat and sugarcane. Results also show that cultivation of pulses and millets will reduce the extraction of ground water.

Role of Research and Development in Indian Agriculture: An Economic Analysis

Many findings reiterated that the desirable way for increasing farm profitability is by achieving agricultural growth induced by sufficient investments in the sector in form of infrastructure and research and development. Achieving these goals will not only require a significant increase in agricultural spending but also requires setting right priorities and improving efficiency in spending. Hence, in this study, an effort has been made to examine the temporal variations and spatial differences in public expenditure on agricultural research and development in the context of India. State wise time series data on quantum and composition of central and state agricultural expenditure in different schemes was extracted from finance accounts of 27 states for a period of 11 years i.e. from 2006-07 to 2016-17. The time series data on various heads of public agricultural expenditure includes revenue and capital expenditures on different sectors like irrigation, agricultural inputs and services, rural infrastructure, rural development, and agricultural research and development. The real expenditure and investment series was prepared by deflating at 2011-12 prices by implicit price index of agricultural capital formation. Results revealed that irrigation has highest share followed by rural development in total public agricultural expenditure. Around 13 percent of total public agricultural expenditure in India was made on agricultural R&D. In case of public agricultural R&D expenditure, Maharashtra has the highest share followed by Bihar and Tamil Nadu. Sectoral analysis found that Northern region (28%) has the major share followed by Southern region (27%). Knowledge on existing allocation pattern of agricultural research and development expenditure, both sector wise and region wise will be used to suggest appropriate distribution form of public fund. Also, the results on sector wise and region wise public expenditure pattern will be the input for policy makers in bridging the gaps.

Future perspective of Bt technology in Indian agriculture.

The future of Indian agriculture is very much affected by the emerging scenario in the field of science and technology effected by thrust areas of research. Use of what is called, Technology Forecasting (TF), can aid in understanding the underlying trends in the key factors of technologies so that they can be influenced to achieve the required needs. Technology refers to the collection of production possibilities, techniques, methods, machinery and processes by which resources are actually transformed by humans to meet their wants. Forecasting is the scientific and systematic process of computation/ prediction or giving a statement of what is expected to happen in the future in relation to a particular event or situation. TF is thus distinct from the usual forecasting where technology plays a role but not the central issue. It enables us with qualitative and/or quantitative prediction of technologies at stated level of confidence with a specific time frame and specified level of support such as policy, capital, human resource and infrastructural needs. Modern TF involves a systemic, quantitative and comprehensive analysis of future technologies. It tries to determine what technologies should be developed at different times in the future to meet the specific needs of our population and also as to what technologies are likely to be available at different times in the future in view of the present rate of growth of scientific innovation. For scoping the future perspectives of *Bacillus thuringiensis* (Bt) technology in Indian agricultural scenario, case studies of four quantitative/ quasi-quantitative techniques of TF technology forecasting tools viz., Trend Impact Analysis (TIA), Scientometric analysis, Grey modeling and Cross impact analysis (CIA) techniques for Bt technology in agricultural sector have been employed. In TIA, a modified Delphi approach has been proposed based on GOS tree approach which has the ability to combine the expert opinions after first round survey. Next based on the collected data time series intervention model has been employed for envisioning crop yield scenarios of maize, potato, rice, tomato, okra, cabbage, mustard at All-India level considering the impact of Bt technology. while employing CIA technique to study the direct as well as indirect cross impacts of Bt technology, the following factors were considered: increased productivity, contribution to national income, efficient overall agricultural sector, reduced input costs, improved quality of produce, increased farmer's income, reduced product costs to consumers, government policy, ethical and legal concerns, health issues, environmental implications, societal impacts, technological interventions, Bt seed sector. Three types of CIA techniques viz., direct classification, Cross-Impact Matrix Multiplication Applied to Classification (MICMAC) and CIA with Time consideration (CIAT) have been attempted. The ranking of the factors obtained by three methods were

combined using Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) approach. The analysis suggested that Govt. policy, Bt seed sector and technological interventions are the main three factors for future perspective of Bt technology in India. For bibliometrics analysis specific information relating to abstract, key words, authors, affiliation etc. relevant to research publication on applications of Bt technology in India vis-à-vis three other competing country regions - China, USA cum Canada and European countries were collected from ScienceDirect database for the period 1997-2017. Activity Index (AI) has been constructed for seven domains viz. Bt Cotton, Bt Maize, Bt Mustard, Bt Brinjal, BtSoyabean, Bt Sunflower, Bt Rice and 'Bt related but not crop specific' under these four regions. From the values of AI, it has been found that India's research effort is higher only in Bt Cotton and Bt Mustard than other regions considered. Conventional version of Grey model as well as Grey model improved by genetic algorithm were fitted using yearly Bt cotton yield of India (2002-03 to 2016-17) obtained from Cotton Advisory Board of India. Only the first 11 years were utilized for model fitting and the rest utilized for validation purposes. The results revealed that Grey model improved by genetic algorithm performed better. In addition to this an improved version of intervention model based on genetic algorithm has been proposed. The proposed model was employed for quantifying the impact of cotton yield due to introduction of Bt cotton.

Modelling dynamics of institutional credit to agriculture in India

Institutional source of credit for agriculture in India comes from both Scheduled Commercial Banks (SCBs) and co-operatives of which SCBs (87.26 %) are the major financer. Triennium (TE 2015-18) average district-wise outstanding agricultural credit of SCBs was subjected to cluster analysis. One third of the advances to agriculture in the country are found to concentrate in just 50 districts and top ten districts are from southern region only, of which five are from Andhra Pradesh itself. Based on Euclidean distance, cluster analysis has grouped the districts of the states into three distinct clusters representing High, Medium and Low concentration of agricultural advances. Database of 47 years outstanding agricultural credit of SCBs in 3 districts from every state representing three scenarios is created by extracting data from basic statistical returns of Reserve Bank of India. Bai-Perron test was applied to the time series data (1972-2018) of selected districts to know the structural breaks. In most of the districts the major breaks are identified in 2004 and 2011 which are attributed to policies like doubling volume of credit to agriculture over a period of three years (2004), interest subvention and prompt repayment incentive schemes introduced in 2006 and 2009.

Parameter estimation of time series models using Bayesian technique

ARIMAX and ARIMAX-GARCH models are very useful and efficient at present context of time series modelling and forecasting, where the series are volatile in nature and are influenced by other series as well. Agriculture domains being no exception, the use of these two models have immense potential. Hence, proper estimation of these model parameters is very crucial. The classical estimation technique underlines many assumptions which sometimes at practical situations do not hold, leading to inconsistent parameter estimates. Under such circumstances the Bayesian parameter estimation technique can be applied successfully to obtain the estimates of the model parameters. Hence, in this project the aim is to develop Bayesian estimation technique for ARIMAX and ARIMAX-GARCH model. In this respect, implementation of Bayesian framework to basic ARIMAX and different combinations of ARIMAX-GARCH models has been started and the forecasting performance with that of the classical estimates of ARIMAX and ARIMAX-GARCH models using price series (Garlic and Potato of Ahmedabad and Agra markets respectively) and arrival quantity as external variable for each series have been compared. Superior results for Bayesian ARIMAX-GARCH and ARIMAX-Bayesian GARCH models have been obtained and for implementation appropriate R codes were written. The Bayesian combination of ARIMAX-GARCH model outperformed the classical ARIMAX and ARIMAX-GARCH model in terms of in-sample performance and parameter estimates. The parameters where estimated precisely with lower standard error in the Bayesian framework as compared to the classical one. To test the stability and consistency of the estimates from Bayesian technique tests such as Heidelberger and Welch, 1983 and Gelman and Rubin, 1992 were applied. Both the tests yielded positive results indicating appropriate estimates. Superiority of the developed methodology over the existing one, i.e., Bayesian estimation over the classical one was documented. Further, Bayesian estimation technique for ARIMAX model under first objective has been developed and had implemented to daily time-series data of spot and future prices of Soy Bean in Indore market from

01st Jan, 2017 to 31st July, 2018 (https://www.ncdex.com). Thus for the ease of implementation of the proposed model a R package named BayesARIMAX has been developed and submitted to CRAN for its publication.

Bayesian framework has been developed and applied to basic ARIMAX and different combinations of ARIMAX-GARCH models and the forecasting performance with that of the classical estimates of ARIMAX and ARIMAX-GARCH models has been compared using price series (Garlic and Potato of Ahmedabad and Agra markets respectively for the period January, 2012 to June, 2019) and arrival quantity as external variable for each price series.

Tractorization in Semi Arid Tropic (SAT) India: Determinants and Implications

Tractor is one of the most versatile farm machines that supplies traction power to several farm implements. In Semi-Arid Tropic (SAT) India, tractors are widely used for farming operation, rural transportation and for various non-farm activities in urban areas, as well. After liberalization of Indian economy, *i.e.,* after mid of 1990s, the tractors use in India has spurred up dramatically. During the 1990s and early 2000/10, the tractor uses have been growing in India over 10 % per annum over these 20 years. In 2000s, the post reform period in India, especially after 2004/05, there has been a rapid pace of migration of labour forces from rural to urban sectors and from farm to non-farm activities, leading to absolute decline in number labour force engaged in agriculture in recent past. During this period, the rural wage rate has also increased dramatically. Tractors use is limited scale still in dry region and in SAT region of India. There are many farmers in SAT region who still are depended upon animal drawn ploughing and animal drawn implements. As, there is virtually no recent study on factors determinants on tractor uses, and specially in dry region and in SAT region of India. In this context, to bridge the gap on factors affecting the tractors uses, as well as consequence of tractors on farm profitability, crop productivity, and on cropping intensity, this study carried out economic modelling of farm household decision making towards extent of tractors uses in SAT India. Utilizing six years of panel household data series of 860 households compiled from the Village Dynamics in South Asia (VDSA) spread over five states (Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra) of India collected by ICRISAT, this investigation addresses critical policy questions on tractorization in SAT India.

To begin, the factors associated with tractor uses by means of panel tobit model have been identified. On assessment of factors affecting tractor use by using household level data it is found that the level of tractor use in SAT India is determined by high amount of institutional credit, higher cropping intensity, education level of HH head. Despite the relatively low rural wage economy, the use of tractor in SAT India is increasing. It is found that area under food grain crop is not a binding factor for tractor use in SAT India. The results imply that education and wage rate (in terms of hired labor) are factors which promotes the tractor uses. Although a formal analysis is precluded due to the changes in costs between tractor use and animal traction use rather than changes in labor wages and institutional innovations in hiring service. The results revealed that both tractor use in term of rupees per acre and hour per acre almost remain consistent.

After analyzing the various factors affecting use of tractor we turned our focus on identifying various factors determining the uses of bullock farm implements. It is only after careful investigation of factors affecting use of tractorand bullock drawn implements, it is concluded that tractor is good substitute of bullock, as it is found that almost all factor determinants of both are opposite to each other. It is also found that, those farmers use more bullock drawn farm implements who are younger, less educated, higher number of family members, lower cropping intensity, small and fragmented land holding, less availability of irrigation and more dependency on informal credit system. Labor wage rate play an important role for both tractor and bullock use because it is positively associated. Importantly, it is also found that bullock use in term of hour per acre is decreasing over the time. The results of study revealed that both bullock use in term of rupees per acre and hour per acre almost remain consistent except operational land holding.

Finally, after identifying the factor determinants of tractor and bullock uses in SAT India, it was further quantified that the impact of tractorization on intensification of agriculture and crop productivity. To achieve this goal, panel modelling approaches were used to study the impact of tractorization. Panel modelling in the data of tractor use for SAT India used first time. Panel modeling allow us to control the household heterogeneity and separate out impact of tractorization from other associated factors like irrigation and input uses. Based on our findings, it can be safely concluded that the tractor use in term of rupees per acre has positive

and significant impact on both cropping intensity and farm productivity (rupees per acre). Hence, findings revealed that, higher uses of tractor in SAT India will help in increasing farm productivity and cropping intensity. It was assumed that increase in cropping intensity causes positive increment in farm productivity, but in the case of SAT India, it is not valid. As, it was found that cropping intensity is negatively associated with farm productivity albeit insignificant. This study concludes that factors affecting cropping intensity and farm productivity are differing to each other but tractor uses in term of rupee per acre is a common factor which influences both cropping pattern and farm productivity by same pattern. This study also supports to "Attracting and Retaining of Youth in Agriculture (ARYA)" as farmers of younger age have higher farm productivity in SAT India. In this project, panel modelling approach (Panel tobit model and fixed effect panel model) have been used first time in tractor use for semi-arid tropic India. For Impact assessment, random effect and fixed effect panel model was applied then Hausman's test was applied and found that fixed effect model is performing better. Therefore, fixed effect panel model for analysis was used. This type of analysis is done first time particularly for tractor use in SAT India.

Efficiency of Micro-Irrigation in economizing water use in India-learning from potential and under explored States

In this study, the experiences in spread and adoption of micro irrigation have been explored in selected four states namely, Punjab (Unexploited region), Maharashtra, Gujarat and Andhra Pradesh. This study departure from the usual supply side perspective, which is often presented, and provides a demand side perspective. It seeks to overcome the limitation of irrigation an engineering oriented research which does not take into account the need, aspiration and experience of the users. It combines and compare the observations across four states of India with varied cropping pattern. The study shows that farmers are motivated to adopt drip irrigation primarily to cope with the scarcity in at least one of three factors of production, namely water, power and labour. They also adopt the technology in pursuit of a rapid growth in incomes, which can be achieved through it. Micro irrigation appears to give very good results on each of these counts, and therefore the farmers see it as very useful technology. Micro irrigation reduces the water need per unit of land resulting in and gives a significant saving of water. The survey results show that farmers use the saved water for variety of purposes including cultivation of new crops, giving more irrigation to other existing crops. Expanding the areas under cultivation/ irrigation and non-agricultural use. Though rare, some farmer also does sharing and selling water informally. The study clearly establishes the benefit of the technology for conservation of water and extending its use. The study explores the adoption process beyond technology use to mastering the management of micro irrigation agriculture and roles of stakeholders. We proposed a PPP approach to maximum utilization and benefit of MIS to different stakeholder of MIS. In Gujarat, GGRC (Gujarat Green Revolution Company Ltd.) has been designated as nodal agency for all administrative and operational decisions for implementing the micro-irrigation scheme. The field level evidences revealed that operational model being followed for implementing the scheme is effective. All the steps followed from request application by the beneficiary to installation of micro-irrigation system are online. Even the installation of micro-irrigation system at the farmers' field is monitored through satellite. The standard prerequisites such as testing of water quality at farmers' field have been found to follow during installation and in case of any deficiency, suitable remedies are suggested. Andhra Pradesh has a dedicated separate department for implementing and monitoring MI schemes. The state is following good practices in terms of operational and administrative procedures in promoting MI system. The discussion with APMIP (Andhra Pradesh Micro Irrigation Project) staff and field visits revealed that all administrative and operational process in implementing the scheme are digitally followed. However, feedback mechanism from beneficiary and other stakeholders can be strengthened further in the state. In Maharashtra, micro-irrigation system is adopted on relatively larger scale in both annual and perennial crops such as sugarcane, grapes, cotton, pulses, lime, etc. Horticulture department of the state government is a nodal agency which coordinates with other line departments for implementation of micro-irrigation schemes. The consultation with officials of line departments revealed strong coordination among them. In Punjab, Department of soil and water conservation department is responsible for implementation of micro-irrigation scheme. The field-level observations suggest a great scope to improve coordination among different line departments for scaling up of micro-irrigation coverage in the state. The operational procedures adopted by APMIP or GGRC can be successfully replicated in the state while implementing the schemes. For instance, the can be a dedicated separate department for micro-

irrigation schemes which can coordinate with all other related departments. Presently, operational procedures in implementing scheme are not digitized which takes lot of time while moving from files from tehsils to state headquarter for taking necessary permissions. An online portal for the micro-irrigation schemes can be developed for executing administrative procedures. Public and private investment in MIS has been calculated in the selected states. Different constraints have been identified for adoption of the MIS in various state. Level of awareness and sources of information for MIS has been evaluated. Cost of cultivation of major crops in selected states had been calculated and compared with adopters and non-adopters by using CACP concept. Location coefficient has been constructed across states on different point of time. Penetration of micro irrigation has been estimated. Irrigation Index for estimation of potential area under micro irrigation has been constructed.

Enhanced Classification And Regression Tree (CART) models for forecasting in agriculture

During the reporting period, both conventional classification tree model as well as Bayesian CART have been fitted and its application in agricultural ergonomics has been demonstrated. The variable considered as the study variable was dichotomous i.e. presence/ absence of discomfort (Y) for farm labourers during agricultural field operation. The set of qualitative explanatory variables were modes of operation (X_1) with broadly two levels viz., predominantly foot operated and others and percent aerobic capacity (X_2) of the farm labourers each having two levels viz., low (35%) and high (> 35%) and load given to farm machinery (X_3) with five levels. The quantitative explanatory variables were difference between working and resting heart rates (X_4) and percent oxygen consumption (X_5) at time of farm operation.

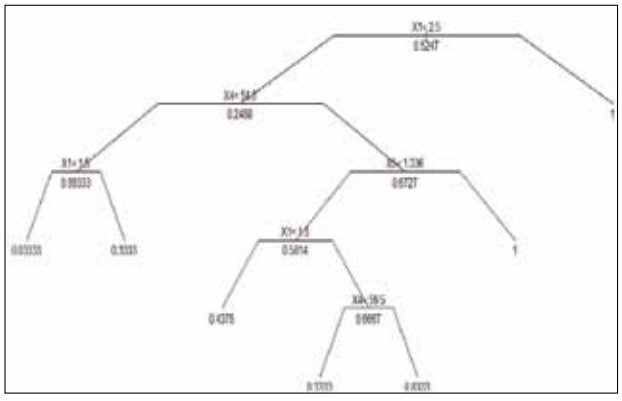


Fig. 1 Conventional CART model as a classification tree

A total of 405 observations were available for the study. The model was fitted on a training dataset of 80% of the observations selected randomly, while the remaining were kept as test dataset. As the response variable was categorical, CART model has been used as a classification tree (Fig. 1) with proportion (less than or equal to one) of 'presence' of discomfort written at each node. Due to utilization of greedy search algorithm for growing a tree, the conventional CART approach sometimes gets stuck in the local minima. To overcome this problem, Bayesian CART has been used to grow a tree by stochastic search algorithm based on prior specifications of parameters like probability of splitting node, probability of assignment of splitting rule, control parameters of size and shape of tree, distribution of study variable etc. Relevant computer program codes were written in R language for fitting conventional as well as Bayesian CART on available data. The results revealed that Bayesian CART model seems to be more promising for classification as compared to conventional CART.

Doubling Farmers' Income in India by 2021-22: Estimating Farm Income and Facilitating the Implementation of Strategic Framework

Vector error correction model (VECM) and Granger causality testing are being used on monthly Wholesale Price Index (WPI) of pulses namely Arhar, Gram, Moong, Masur and Urad for the period January, 2005 to March, 2017 collected from Office of The Economic Adviser, Government of India. The abrupt price changes detection from a statistical point of view corresponds to estimating the points which exhibit significant change in the statistical properties of a sequence of observations. In order to find out multiple change points in the variance of wholesale price index of onion, the Pruned Exact Linear Time (PELT) method has been used. Total 9 breaks have been noted in the data. Onion WPI touched the highest value of 619 in January 2011. In 2013, highest ever onion WPI was recorded in September 2013. Year 2015 also led the WPI to jump to an index of 758, which was, of course, lower than the previous shocks. Even the price spikes were observed during October to December, 2017 and are linked to production and market arrival pattern. Prices started increasing from late September and have continuously increased till December 2017. The instability in onion price index has become much more pronounced particularly after 2005. The dissection of breaks reveals that the length of price stability phases has reduced overtime and shorter phases with greater instability are becoming

pronounced. The instability is largely driven by the changes on production front.

Modelling insect pests and diseases under climate change and development of digital tools for pest management

Studies on severity of sterility mosaic disease (SMD) in pigeon pea carried out for six consecutive *kharif* seasons (2011-16) in three locations namely Gulbarga (Karnataka), Rahuri (Maharashtra), and Vamban (Tamil Nadu) showed the commencement of infestation from second week of August with peak incidence between third week of October and November. Statistical model of autoregressive integrated moving average model with exogenous variable (ARIMAX) along with machine learning techniques *viz.,* support vector regression (SVR) and artificial neural network (ANN) were applied for predicting the mean severity of SMD at all three locations. Comparative performance of different models assessed in terms of root mean square error (RMSE) indicated that ANN and SVR models predicted the mean incidence of SMD on pigeon pea better than ARIMAX model across all three-study locations. The study is being carried out to assess impact of changing present and past scenario of meteorological variables on thrips variability in conjunction of location specificity. Location specific thrips abundance varies between 7 to 94% across locations, being highest at Jalgaon (MH) and least at Junagadh (GJ). Jalgaon (MH) revealed maximum thrips density in 2014-15. Vridhachalam (TN) and Junagadh (GJ) were least thrips abundant eco-regions of India. Quantified variables significantly contributed at all locations except Jalgaon (MH) and Junagadh (GJ). Weather fluctuations on the other hand had highest A-MaxT at Vridhachalam (TN) while lowest at Dharwad (KA). Kendall's correlation ascertained maximum contribution of weather and climatic variables at Jalgaon (MH), illustrating maximum thrips density and minimum contribution at Junagadh (GJ) inferring minimum thrips density. The study is being carried out to assess impact of changing present and past scenario of meteorological variables on thrips variability in conjunction of location specificity. The study is being carried out to assess impact of changing present and past scenario of meteorological variables on thrips variability in conjunction of location specificity. Machine learning technique is also being applied for prediction of incidence of SMD in pigeonpea in four locations in India. Modelling of mean incidence of Sterility mosaic disease (SMD) on pigeonpea is carried out for four locations namely SK Nagar (GJ), Gulbarga (KA), Rahuri (MH) and Vamban (TN) during the kharif seasons 2011-16. Machine learning techniques e.g. Support vector regression (SVR), Artificial neural network (ANN) and their combination with stochastic model e.g. Autoregressive integrated moving average (ARIMA) model have been applied for predicting the mean severity of SMD. Modelling incidence of sterility mosaic disease (SMD) on pigeon pea for four locations [SK Nagar (Gujarat), Gulbarga (Karnataka), Rahuri (Maharashtra) and Vamban (Tamil Nadu)] was carried out based on field data sets generated during six*kharif* seasons [2011-16]. Mean seasonal incidence amongst all locations was on the decline during recent periods (0.5-5.3%) over past decades (9.8-12.8%). Correlation analyses of SMD incidence with weather parameters lagged one and two weeks indicated spatial differences for the variables besides their significance. While MaxT(ºC) lagged by one week alone was significantly positive with SMD at Gulbarga (KA), Vamban (TN) had negative significance of rainfall (mm/week) and rainy days. S.K. Nagar (GJ) and Rahuri (MH) had shown opposite effects of both morning and evening RH (%) of both one and two lagged weeks. Support vector regression (SVR), artificial neural network (ANN) models and their combination with autoregressive integrated moving average (ARIMA) models are being applied for prediction of SMD incidence across locations.

Studying Dynamics of market integration and price transmission of agricultural commodities

The cointegration analysis for major wheat markets of India has been carried out. There are some markets where asymmetric cointegration exist. Threshold VECM model has been applied for accommodating the threshold cointegration. Volatility Impulse Response Function (VIRF) has been computed for potato price in five different markets. The relevant R–code has been developed. Volatility Impulse Response Function (VIRF) has been computed for potato price in five different markets. The relevant R –code has been developed. Threshold autoregressive (TAR) model and Momentum TAR (MTAR) model have been applied for asymmetric cointegration of wheat price in major markets of India. Volatility Impulse Response Function (VIRF) has been computed for Potato in major markets of India.

Leveraging Institutional Innovations for Inclusive and Market led Agricultural Growth in Eastern India

ARIMA model has been applied for forecasting of

Brinjal prices for the markets of Delhi, Varanasi, Kolkata, Gorakhpur and Kanpur. The best model has been selected based on minimum information criterion values. It is seen that highest price of Brinjal is likely to prevail in Kolkata market. The other models including machine learning techniques are also being applied for forecasting of agricultural commodity prices in different parts of country in order to increase the accuracy of forecasting.

Study of Long Memory and Periodicities in Climate Variables in Different Meteorological Subdivisions of India

Testing periodicities in annual rainfall in different subdivisions of India is being carried out using the algorithm proposed by Araghi *et al.* (2014) as follows: Each dataset was decomposed through DWT using the Daubechies (db) wavelet family as the mother wavelet. This split each series into A and D components. The Mann-Kendall test was applied to the original time series, to the decomposed components (i.e. A and D components), and also to combinations of A plus one or two D components. The MK test was performed on the original time series, the decomposed components, and the combinations of A and D components. The dominant component(s) that had the greatest impact on the rainfall time series were determined by matching the MK Z-values for the original series as well as with the combination of the decomposed series. Out-of-sample forecasting by ARFIMA-GARCH model is carried out**.** Formulae for multi-step ahead out-of-sample forecast and forecast error variance for ARFIMA-GARCH model has been developed by recursive use of conditional expectation in the same line of Ghosh *et al*. (2011) and Paul *et al*. (2014). Let, follows an ARFIMA process with error, $\{e_t\}$ follows GARCH model, can be expressed as,

$$(1-\rho_1 L)y_t = (1-\theta_1 L)(1-L)^{-d}e_t \quad (1)$$

$$e_t = h_t^{1/2}\zeta_t \text{ where } h_t = \alpha_0 + \alpha_1 e_{t-1}^2 + \beta_1 h_{t-1}$$

ζ_t is a i.i.d. random variable with zero mean and constant variance σ^2. After expanding the term $(1-L)^{-d}$ with Taylor series expansion and by ignoring the higher order terms, equation (1) can be written as,

$$\Rightarrow y_t - \rho_1 y_{t-1} = (e_t - \theta_1 e_{t-1})\left(1 + dL + \frac{d(d-1)}{2}L^2\right)$$

$$\Rightarrow y_t = \rho_1 y_{t-1} + e_t + (d-\theta_1)e_{t-1}$$

$$+\left[\frac{d(d-1)}{2} - \theta_1\right]e_{t-2} - \frac{d(d-1)}{2}e_{t-3}$$

Let, t data points are utilized for modelling and the parameter estimation purpose and k data points are conserved for model validation purpose. The i-step ahead out-of-sample forecast and forecast conditional error variance are denoted by $\hat{y}_{t+i|1,2,..,t}$ and $\hat{h}_{t+i|1,2,...,t}$, $i = 1,2,3$, respectively. So, One-step ahead prediction, i.e.

$$\hat{y}_{t+1|1,2,...,t} = \hat{\rho}_1 y_t + (\hat{d} - \hat{\theta}_1)\hat{e}_t$$

$$+\left[\frac{\hat{d}(\hat{d}-1)}{2} - \hat{\theta}\right]\hat{e}_{t-1} - \frac{\hat{d}(\hat{d}-1)}{2}\hat{e}_{t-2}$$

where is the residual in the fitted ARFIMA - GARCH model at time . And the corresponding one-step ahead prediction of error variance is calculated as,

$$\hat{h}_{t+1} = E[\{e_{t+1} - \hat{e}_{t+1|1,2,...,t}\}^2 | e_1, \dots, e_t]$$
$$= \hat{\alpha}_0 + \hat{\alpha}_1 \hat{e}_t{}^2 + \hat{\beta}_1 \hat{h}_t$$

Wavelet-ARIMA model along with Wavelet-ANN methodology is being applied for modelling and forecasting of sub divisional rainfall in India. Total 30 sub-divisions have been considered. The trend in the rainfall is also being investigated using linear regression as well as by using M-K test.

Development of count time series models for predicting pest dynamics using weather variables

Agriculture being highly cost intensive and full of uncertainties have great impact on the livelihood of farmers, if timely measures are not taken to minimize the risk from incidence of pest attacks, they may fall in the trap of vicious cycle. Incidence of pest and diseases in crops have made agriculture very risky venture and about 15-25 per cent of crops yields is lost each year due to this. To mitigate these problems, reliable and timely forecast provides an important and extremely useful input in formulation of policies. An attempt has been made using count time series of pests using advanced models viz. generalized linear (GLM), integer autoregressive (INAR) and integer artificial neural network (IANN) models. This study has been conducted to develop count time series models for modelling and forecasting pest dynamic prediction.The developed models viz GLM, INAR and IANN were applied in aphids and Jassids of cotton pests at different centres of India. Pest count time series data (2008-2013) for Bt. cotton along with standard meteorological weekly data on weather parameters viz., maximum temperature (MAXT), minimum temperature (MINT), rainfall (RF), maximum relative humidity (MAX_RH) and minimum relative humidity (MIN_RH) were used to

build the model. Developed models are compared using MAE, MSE and RMSE and based on these reported values, it was observed that integer based artificial neural network (IANNX) models performed better compared to other models for Aphid of Akola centre. For Jassids of Akola, Banswara, Faridkot, Guntur and Perambalur centres integer based neural network model with exogenous variables performed better compared to other models. For Aphid of Vadodra centre INAR model outperformed over all the models. Based on the results obtained in this study it was concluded that whenever data set is nonlinear and complex in nature integer based neural network model performed better. On the other hand if data set is linear in nature, INAR model performed better compared to other models.Better performance of integer based neural network can be due to its ability to model the complex relationship existing in the data set.

Programme 3: Development of Techniques for Planning and Execution of Surveys and Statistical Applications of GIS and Remote Sensing in Agricultural Systems

Robust and Efficient Small Area Estimation Methods for Agricultural and Socio-Economic Surveys and Their Application in Indo-Gangetic Plain

The food security is one of the highest priority of the Government of India to achieve the Sustainable Development Goal 2. In India, the Household Consumer Expenditure Survey (HCES) data collected by National Sample Survey Office (NSSO), Ministry of Statistics and Program Implementation, Government of India is used to generate the estimates of food insecurity indicators at state and national level for both rural and urban sectors separately. In spite of high importance, the estimates of food insecurity indicators are not available at local area or lower administrative unit (e.g. district) level in the country. Policy planners, researchers, government and public agencies are more and more interested in obtaining statistical summaries for smaller domains called small areas, created by cross classifying demographic and geographic variables such as small geographic areas (e.g. districts) or small demographic groups (e.g. age-sex groups, land category, social groups) or a cross classification of both. However, the sample sizes for such small areas in the existing large scale survey data (e.g. HCES in India) may be very small or even zero. The small area estimation (SAE) methodology provides

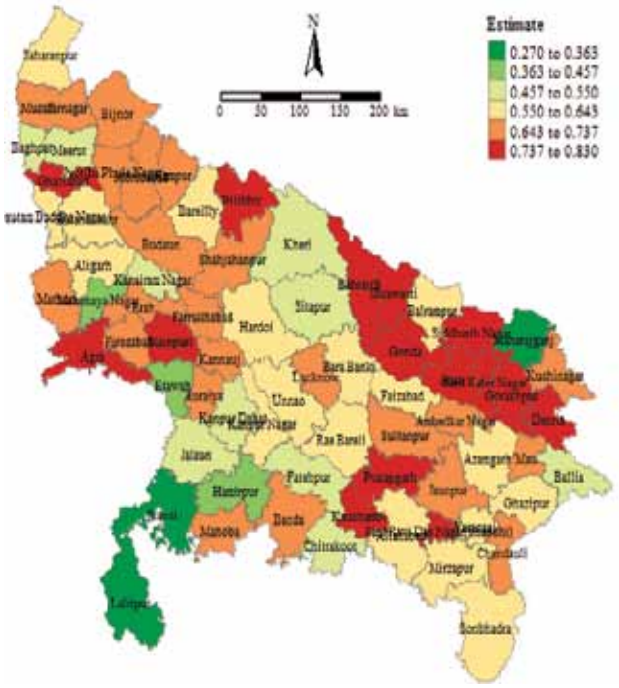


Fig. 1. Spatial distribution of incidence of food insecurity by District in rural area of Uttar Pradesh

a viable and cost effective solution this problem of small sample sizes. Standard SAE methods based on linear mixed models for continuous data can produce inefficient and sometime invalid estimates when the variable of interest is binary. If the variable of interest is binary and the target of inference is a small area proportion (e.g. for estimating food insecurity proportions), then the logistic linear mixed model (LLMM) is fitted. An empirical plug-in predictor (EPP) under a LLMM is commonly used method for the estimation of small area proportions. This approach implicitly assumes simple random sampling with replacement within each area and ignores the survey weights. Unfortunately, this has the potential to seriously bias the estimates if the small area samples are seriously unbalanced with respect to key population characteristics, and consequently use of the survey weights appears to be inevitable for if one wishes to generate representative small area estimates. We deliberated SAE method that incorporates the sampling information when estimating small area proportions. The method is applied to estimate the incidence of food insecurity in different districts of rural areas of the state of Uttar Pradesh by linking data from the 2011-12 Household Consumer Expenditure Survey collected by the National Sample Survey Office of India and the 2011 Population Census. A map (Fig. 1) showing district level inequalities in the distribution of food insecure households in Uttar Pradesh is also produced which provides an important

information for analysis of spatial distribution of food insecurity in the state.

The Sustainable Development Goal-1 of the United Nations is to end poverty in all its forms everywhere. The estimates of poverty related parameters obtained from large scale sample survey are often available at large domain (e.g. State) level. But, poverty rates are not uniformly distributed across the regions (e.g. district or local levels). The regional variations are masked in such large domain level estimates. However, for monitoring the progress of poverty alleviation programmes aimed at reduction of poverty often require micro or disaggregate level estimates. West Bengal is facing a poverty issue due to low development in agricultural and industrial sectors over time. For effective development in state in sense of poverty eradication, there is a crucial requirement to develop a focused scheme for poverty eradication. Timely and reliable local and disaggregate level statistics is therefore essential for effective planning, implementation and monitoring of various government strategy. The disaggregate level statistics is also must for identifying the districts more in need and for developing focused and target oriented intervention programs. We apply small area estimation technique to produce reliable district level estimates of poverty incidence in the rural areas of West Bengal. We use the 2011-12 household consumer expenditure survey data collected by NSSO and combine with the 2011 Population Census data to generate precise and representative district-level estimates of poverty incidence. A map (Fig. 2) showing how poverty incidence varies by district across the state is also produced. The estimates generated from this research are useful for meeting the data requirements for policy research and strategic planning by different organizations and by the Government Departments and Ministries.

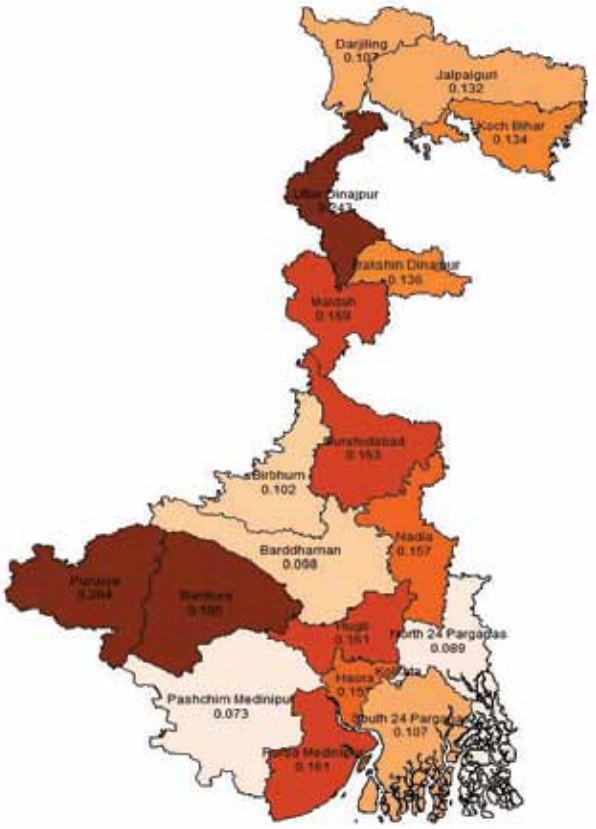


Fig. 2. Poverty mapping for the state of West Bengal

The worker population ratio is the number of persons employed per 1000 persons. The work force in the usual status includes the persons who worked for a relatively long part of the 365 days preceding the date of survey and the persons from among the remaining population who had worked at least for 30 days during the reference period of 365 days preceding the date of survey. Compared with other measures of labor force participation, the worker population ratio is not as affected by seasonal variations or short-term fluctuations in the labor market. Consequently, it is often deliberated to be a more reliable indicator of job shrinkage or growth than the unemployment rate. The estimates of worker population ratio from the Employment and Unemployment survey (EUS) of the National Sample Survey Office (NSSO) are produced separately for the rural and urban sectors of the country, for States and Union Territories, and for different socio-economic groups. However, worker population ratio is often distributed unevenly among the subsets of relatively small areas (e.g., districts). The state level estimates do not adequately capture the extent of geographical inequalities which restricts the scope for policy analysis locally within and between districts. Small area estimation approach to produce district level estimates of the working population ratio for rural and urban areas of Uttar Pradesh using latest round of the 2011-12 EUS of NSSO and the 2011 Population Census. The empirical results, evaluated through a set of internal and external diagnostics measures, indicate that the district-level estimates generated using small area estimation approach are more precise than the direct survey estimates. Spatial maps showing district level inequality in distribution of working population ratio rural and urban areas of Uttar Pradesh are also produced (Fig. 3). Darker areas of the maps correspond to the areas of high worker population ratio. These maps and districts level estimates are invaluable for target oriented effective policy planning, monitoring and decision-making.

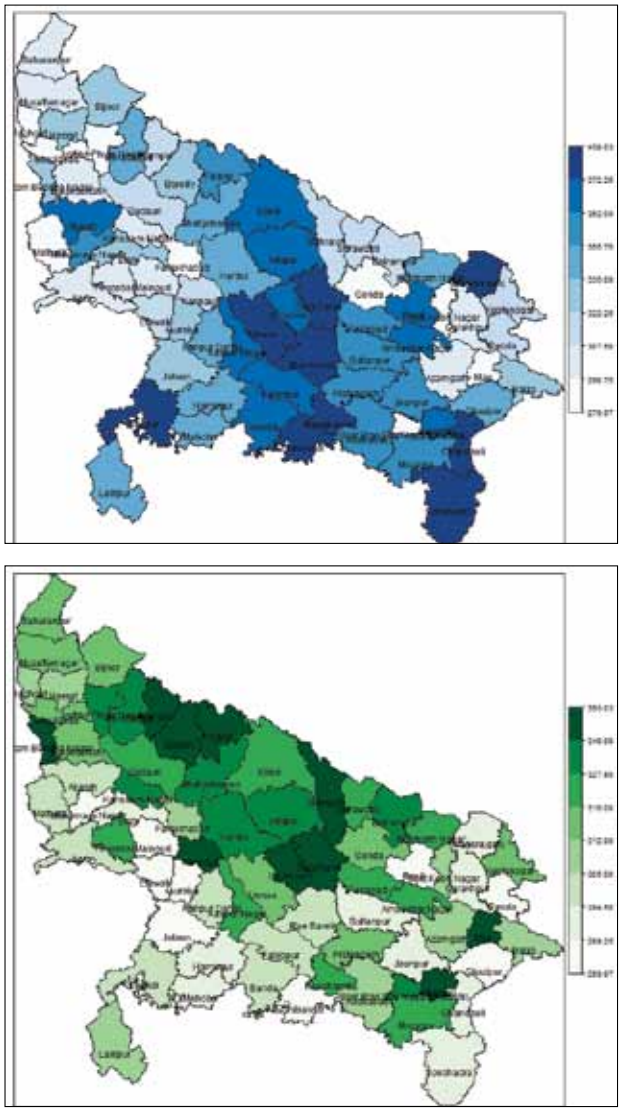


Figure 3. District-wise mapping of worker population ratio for rural (left) and urban (right) areas in the state of Uttar Pradesh generated by small area estimation method, 2011-12.

Energy Audit Survey of AICRP on Energy in Agriculture & Agro-based Industries: Sampling Design and Analysis

A new component on "Energy Management in Agriculture (EMA)" was added in the ICAR-AICRP on Energy in Agriculture & Agro-based Industries (EAAI) with effect from 12th Plan with basic motto of reducing energy intensity and increasing energy efficiency in Indian agricultural sector. The ICAR-AICRP on EAAI has therefore decided to conduct energy audit in agro-industrial sector for most prominent crop in the region by the cooperating centres of the project Energy Auditing in Production Agriculture and Agro-industries. To achieve this, energy audit survey has been planned on the selected crops. The crops that are significantly present in the state and having higher use of energy are included in the survey. The objective of the survey is to identify energy intensive operation for energy conservation and efficiency improvement. The ICAR-IASRI, New Delhi is one of the collaborating centre of ICAR-AICRP on EAAI to provide the statistical support. Sampling design, questionnaires and instruction manual for the energy audit survey of Sugarcane crop in Tamil Nadu and Onion in Karnataka have been developed. A sampling methodology (protocol) including sample size, allocation of sample sizes in different strata and sub-strata, selection of sample in different stages and listing exercise as well as schedules, instruction manual and estimation formula for Implementation of Energy Audit Survey has been developed. This protocol has been adopted and implemented by different 16 cooperating centres of the ICAR-AICRP on EAAI located in different states in India. A two days training programme was designed and developed on "Sampling Design and Schedules for Implementation of Energy Audit Survey" under EMA component of the ICAR-AICRP on EAAI. The training programme was organized during November 1-2, 2019 at ICAR-IASRI, New Delhi. The scientists involved in EMA activity of the ICAR-AICRP on EAAI at different co-operating centres has attended this training programme. The main aim of this training programme was to provide training as well as clarifications of doubts in finalization of sampling design and schedules for implementation of energy audit survey. A user manual on the "Sampling Design and Schedules for Implementation of Energy Audit Survey" under Energy Management in Agriculture component of the ICAR-AICRP on EAAI is being prepared for publication.

Study to Estimate the Sub-State Level Estimate of Socio-Economic Indicators of Uttar Pradesh by Using Small Area Estimation Techniques

The disparities among the households both rural and urban sector with their standard of living in the state of Uttar Pradesh for different household categories such as land holding size (i.e. marginal, small and others) and social group (i.e. SC, ST, OBC and Others) categories have been estimated and analysed. In particular, the estimates of average household monthly per capita consumer and expenditure (MPCE) and poverty incidence (defined as the proportion of households below the poverty line) as well as the measure of reliability of the estimates (defined by the percent coefficient of variation) have been produced. These estimates are generated with respect to land holding size and the social group category of the rural households

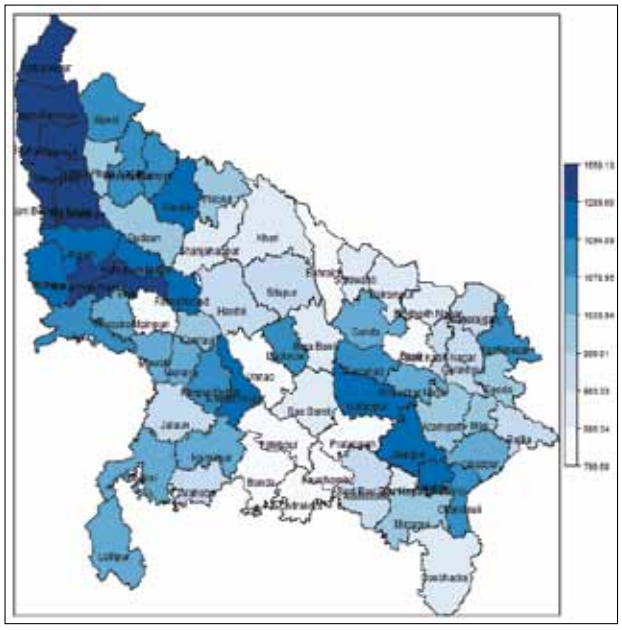


Figure 4. District-wise mapping of average household MPCE for rural areas of Uttar Pradesh

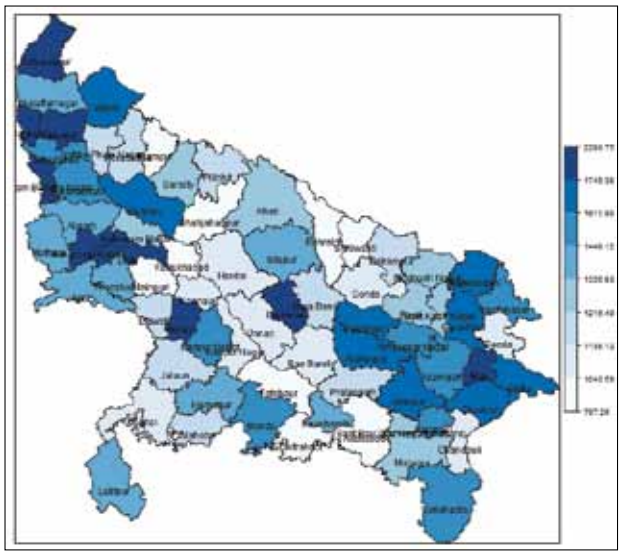


Figure 5. District-wise mapping of average household MPCE for urban areas of Uttar Pradesh

and for urban sector, only social group category is considered. The Household Consumer Expenditure Survey (HCES) of the NSSO conducted in 2011-12 for both rural and urban sectors of the State of Uttar Pradesh and auxiliary information from the Population Census 2011-12 have been used in this study. In the HCES 2011-12 a total of 5916 rural and 3102 urban households from the 71 districts of Uttar Pradesh were surveyed. The district sample sizes for rural areas ranged from 32 to 128 with average of 83. Similarly the district sample sizes for urban areas varied from 30 to 128 with average of 44. The district specific sample sizes reduce further in case of further disaggregation such as district by land categories etc. Therefore, it is difficult to generate reliable district level direct survey estimates with associated standard errors from this survey. This small sample size problem has been resolved by using small area estimation (SAE) approach. District-wise estimates of MPCE have also been obtained for both rural and urban sectors of Uttar Pradesh using SAE method. Table 1 provides percentage distribution of households, household size, average household MPCE and poverty incidence along with coefficient of variation by household category for rural and urban areas in Uttar Pradesh. District-wise maps of average household MPCE (living condition) for both rural and urban sector of Uttar Pradesh have also been produced and given in Figure 4 and 5. The results clearly indicate the disparities within the state with respect to different household categories. The results also identify the regions and household categories with low and high MPCE estimates.

Integrated Sample Survey Solutions for Major Livestock Products

This Study titled is funded by Animal Husbandry Statistics Division, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. Under this study, a web portal has been developed named as “ISS Web Portal” (Fig 1 & Fig 3). ISS Web Portal (https://iss.icar.gov.in) for four commodities (Milk, Meat, Egg and Wool). This portal has three modules; i. Sample Selection Module, ii. Data Entry and Analysis Module and iii. GIS Map Module. Sample Selection Module (Fig. 2) allows state operators to draw sample of villages for complete enumeration and detailed survey for all three seasons (summer, rainy and winter) in a year according to the ISS sampling design. Selected sample will be visible to all district users. They can down download the sample and start the survey. Using this portal state operator can also substitute the sample. This portal provides control to manage district users at state level and similarly mange state users at admin level. State operators have access to monitor the survey status can they can download the survey status report for any round of survey. Data Entry and Analysis Module provide state users and district users to enter/update the district level estimate for all four commodities which are also pooled automatically to produce state level and national level estimates according to the methodology. GIS Map Module generates thematic maps at State/district level in GIS environment for all commodities. Geographical coverage of this project encompasses all States/UTs of the Country.

Table 1. Percentage distribution of households (HH), household size (HHS), average household MPCE and poverty incidence along with coefficient of variation (CV) by household category for rural and urban areas in Uttar Pradesh

Category		HH	HHS	MPCE	CV	Poverty incidence	CV
Rural							
Land holding size	All	100.0	5.47	1073	1.11	25.8	3.56
	Marginal	83.0	5.28	1013	1.09	28.4	3.65
	Small	10.9	6.04	1245	3.50	13.9	15.68
	Others	6.0	7.06	1426	5.17	12.4	25.53
Social group	ST	1.3	5.46	1179	8.66	22.8	28.99
	SC	28.2	5.16	927	1.97	35.2	5.26
	OBC	54.2	5.60	1049	1.51	25.5	5.01
	OTHER	16.3	5.58	1377	2.53	11.0	13.76
Urban							
Social group	All	100.0	4.89	1942	3.03	19.2	5.11
	ST	1.0	3.39	2408	16.36	9.6	42.86
	SC	12.8	5.17	1345	5.37	32.6	10.05
	OBC	47.0	5.21	1430	3.16	24.4	6.36
	OTHER	39.1	4.45	2882	4.79	8.7	13.31

Login credentials for all State/UT operators have been created and distributed through which they have logged in and they have drawn sample for all their districts using the sample selection module. District operators are suggested to sign up using the portal, 338 users have signed up and approved by state operators using the portal. Implementation support was provided by sharing the tutorial video and Queries or state/district operators regarding Forgot/Reset password, Adding more Re-Draw chances for districts, Clarification of sample size and format of sample, Adding all users to Google group for FAQ Support, Updation of villages/wards, sharing the sample with district users, Sign up Issues for districts, Clarification of data entry fields have been resolved through mail and call. Some key features of the portal are as follows:

- State/UT users have been provided with login credentials created by development team through which they can login. On their first successful login every state/UT user has been prompted with a page where user has to change their password.
- District users are advised to sign up through the web portal. On successful signup district user will get a username dynamically created for that district. Once district has signed up then user need to check its status on home page by entering the username provided earlier. By default every signed up user will be blocked for logging in.
- State/UT user will be notified on every successful sign up of their respective districts.
- State/UT user has authority to Block/Activate or Delete the district user.
- If State/UT user finds the district user authentic by checking the signed up details filled by district user, then state/UT user can activate that particular user and if state/UT user finds district user fake then state/UT user can delete that particular district user.
- State/UT user has authority to block the district user for any reason.
- Once state/UT user has blocked or deleted the district user then that user won't be able to login and won't be able to make any changes.
- District user can check its status on home page and if district user finds out its status as blocked then user will be prompted with a block message along with an email id of its state on which user can contact state/UT operator.
- Similarly Admin has authority to block any state and its district operators by making any change.

- Using sample selection module states/UTs can draw first stage unit sample i.e. villages/ urban wards for complete enumeration and detailed survey according to the ISS sampling methodology.
- Only State/UT level users are allowed to draw sample for any of its district.
- Once State/UT has selected/drawn the sample, district users will be able to download that sample by logging in with their credentials.
- If State/UT user finds out that selected village in sample of any of its district have no livestock or that village is not suitable for sample, then state/ UT user can substitute the complete enumeration sample as well as detailed sample. On click of a button provided on 'Survey Status' page state/ UT operator can re-draw a village selected accordingly to the ISS sampling methodology.
- Using the data entry and analysis module states/ UTs and district users can enter the district level estimates for four commodities (Milk, Meat, Egg and Wool) and entered data can be analysed and pooled to produce state and national level estimates.
- GIS Map for all commodities at district and State level

Fig 1: ISS Web Portal – Home/Login

Fig 2: ISS Web Portal – Sample Selection Module

Fig 3: ISS Web Portal – State/UT Dashboard

Integrated sampling methodology for crop yield estimation using remote sensing, Field surveys and Weather Parameters for crop insurance

The Pradhan Mantri Fasal Bima Yojana (PMFBY) launched by the Prime Minister of India Shri Narendra Modi on 18 February 2016 is of great importance to Indian farmers. Therefore the methodology to be adopted under PMFBY ought to be very efficient. It envisages a uniform premium of only 2 percent to be paid by farmers for Kharif crops, and 1.5 per cent for Rabi crops. In the crop insurance sector, there is no robust and optimum result-oriented methodology for crop yield estimation. This provides the motivation to develop an integrated methodology using remote sensing techniques, sample surveys and weather parameters resulting in a minimum number of CCEs required and which will be robust and can be operational at the national level. This study funded by Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India mainly focused on optimizing the number of crop cutting experiments for crop insurance and to develop an integrated methodology for Crop Yield Estimation using Remote Sensing, Field Surveys and Geo spatial techniques in the context of crop insurance. The study was carried on for cotton crop in Buldana district of Maharashtra for Kharif season, wheat in Barabanki district of Uttar Pradesh and mustard in Morena district of Madhya Pradesh for Rabi season. The sentinel-2, cloud-free, single-date data of Kharif 2018-19, and multi-date data of Rabi 2018 -19 were downloaded from the European space agency's website. The image was classified and from the classified image, the crop mask of the study area was extracted. For stratification, various vegetation indices namely Normalised Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI) and Soil Adjusted Vegetation Index (SAVI) and the combination of all these indices were also generated. The districts were divided into 3, 4 and

5 classes/strata according to the score of these indices. The methodology based on stratification done by NDVI and Neighbouring GP's for estimating yield in context of crop insurance is very efficient. The selected Tehsil / Block and Districts were divided into 3 groups of adjacent Gram Panchayat based on the vigour of the vegetation. They've been named as High Vigour NDVI Gram Panchayats, Medium Vigour NDVI Gram Panchayats and Low Vigour NDVI Gram Panchayats. Interpolation techniques like Inverse Distance Weighting (IDW) and Kriging have been used for predicting the yield with limited number of CCEs. Results show that by using interpolation techniques, number of Crop Cutting Experiments (CCE) can be reduced to great extent using a portion of large number of actual CCEs under present PMFBY scheme.

Assessment of post-harvest losses in fruits and vegetables and strategies for their reduction in Andaman and Nicobar Islands

This is an Institute funded collaborative project with ICAR-Central Islands Agricultural Research Institute (ICAR-CIARI), Port Blair as the Lead Centre and ICAR-IASRI as collaborative Institute. The study is being conducted in three districts namely North and Middle Andaman, South Andaman and Nicobar. Designing of schedules for primary data collection was completed. Sample selection for primary data collection was carried out as per proposed sampling design. Selected list of villages was sent to ICAR-Central Islands Agricultural Research Institute, Port Blair, Lead Institute for survey to be carried out by them. Technical guidance especially for primary data collection by actual measurement for fruits and vegetables for different channels were provided. Complete enumeration work of the selected villages was made. Primary data collection with regard to detailed survey was also completed.

Pilot Study for Developing State Level Estimates of Crop Area and Production on the Basis of Sample Sizes Recommended by Professor Vaidyanathan Committee Report

This project is funded by Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare, Government of India with a total budget of Rs 929.89,160 lakh. The project initiated on 16 February 2015 and completed on June 30, 2019. The main aim of the project was to develop a suitable sampling methodology for producing state level estimates of crop area and yield on the basis of sample sizes recommended by Professor Vaidyanathan Committee report to generate quick estimate of crop area and yield and also to explore the feasibility of using electronic device. Accordingly, under this study, pilot survey has been implemented in five states namely Assam, Odisha, Uttar Pradesh, Karnataka and Gujarat. Out of 5 states covered in this project, 4 states, viz. UP, Karnataka, Odisha & Assam, were assigned to state agencies, whereas Gujarat state was assigned to AERC, a center under Sardar Vallavbhai Patel University, Anand, Gujarat. The survey was carried out during Kharif and Rabi seasons of AY 2015-16 in all the selected states, except in Gujarat state, where it was conducted during AY 2016-17. A data entry software has been developed under this project to digitize survey data collected under the study. This software was made available in the state headquarters of the five states. Mobile Assisted Personal Interview (MAPI) software was also developed for collection of survey data using android smart phones. This software was implemented successfully in two districts of Uttar Pradesh and one district of Gujarat in addition to traditional Paper Assisted Personal Interviewing (PAPI). A draft report of the project has been submitted and findings were presented before the funding agency. The results show that MAPI is more efficient than PAPI both in terms of time and accuracy and thus it emerged as an efficient alternative of PAPI. Although data entry software was provided to the states, several discrepancies were noticed in the data reporting and entry which leads to significantly delay in analysis and other follow up activities. It is therefore recommended to employ new technologies like MAPI to tackle this kind of issues in data collection and processing. One of the issue observed during the survey was identification of the major crops, because major crops found at district level may not be the same as those fixed at state level. The empirical results from the study further indicate that the methodology for obtaining yield estimates from reduced sample sizes, produced reliable estimates with acceptable level of precision for major food grain crops at State level. For crop area enumeration there is need for further research to achieve the desired precision.

A study on calibration estimators under Adaptive Cluster Sampling

Adaptive Cluster Sampling (ACS) proposed by Thompson (1990), is an efficient method for sampling geographically rare and hidden clustered population. Under this study, following the Calibration Approach (Deville and Särndal, 1992), sampling methodology for obtaining calibration estimators of

population mean and ratio under ACS design has been developed where the sampling units bearing a characteristic of interest are sparsely scattered in a geographically distributed population in unknown manners. New sets of calibration weights were obtained by minimizing the Chi-square distance between calibration weights and design weights of Horvitz-Thompson (1952) estimator under ACS design using the method of Lagrange multiplier subject to calibration constraints. The approximate variance and the form of estimate of variance of the proposed calibration estimator have been developed using Särndal *et al.* (1992). Project has been completed on 15th April 2019.

Let, $U=\{1,2,\ldots,N\}$ be the finite population under consideration. Y is a variable defined on the population U and taking real values as $y_1, y_2, \ldots, y_N$ and X be a linearly related auxiliary variable with real values $x_1, x_2, \ldots, x_N$ Let us assume, population total $X=\sum_{i=1}^{N} x_i = \sum_{i=1}^{K} x_i^*$ is known, where $x_i^* = \sum_{j\in A_i} x_j$ and K is the total number of distinct network in the population and Ai is defined as the ith network. Let, the study variable y_i was observed for all $i \in s$, where s is the set all sampling units in the sample obtained by adaptive cluster sampling. The parameter to estimate was the population mean of the character under study, $\bar{Y}=\frac{1}{N}\sum_{i=1}^{N} y_i$. Using the well-known Calibration Approach (Deville and Särndal, 1992), attempt was made to improve the Horvitz-Thompson (HT) estimator (Thompson, 1990) of the population mean under ACS design i.e. $\hat{\bar{Y}}_{HT(AC)} = \frac{1}{N}\sum_{i=1}^{k} d_i y_i^*$, where y_i^* is the sum of y values for ith network i.e. $y_i^* = \sum_{j\in A_i} y_j$, $d_i = 1/\pi_i'$ are the design weights and the inclusion probabilities

$$\pi_i' = 1-\left[\binom{N-m_i}{n_1}\Big/\binom{N}{n_1}\right]..$$

The proposed calibration estimator of population mean under ACS design is given by

$$\hat{\bar{Y}}_{CAL(AC)} = \frac{1}{N}\sum_{i=1}^{k} d_i y_i^* + \frac{1}{N}\frac{\sum_{i=1}^{k} d_i q_i x_i^* y_i^*}{\sum_{i=1}^{k} d_i q_i x_i^{*2}}\left(X-\sum_{i=1}^{k} d_i x_i^*\right).$$

where, population total of auxiliary variable, $X=\sum_{i=1}^{N} x_i = \sum_{i=1}^{K} x_i^*$ is assumed to be known.

Now, when we choose $q_i = 1$ the proposed calibration estimator simplifies to

$$\hat{\bar{Y}}_{CAL(AC)} = \frac{1}{N}\sum_{i=1}^{k} d_i y_i^* + \frac{1}{N}\frac{\sum_{i=1}^{k} d_i x_i^* y_i^*}{\sum_{i=1}^{k} d_i x_i^{*2}}\left(X-\sum_{i=1}^{k} d_i x_i^*\right)..$$

When we choose $q_i = \left(x_i^*\right)^{-1}$ the proposed calibration estimator simplifies to

$$\hat{\bar{Y}}_{CAL(AC)} = \frac{1}{N}\sum_{i=1}^{k} d_i y_i^* + \frac{1}{N}\frac{\sum_{i=1}^{k} d_i y_i^*}{\sum_{i=1}^{k} d_i x_i^*}\left(X-\sum_{i=1}^{k} d_i x_i^*\right) = \frac{\sum_{i=1}^{k} d_i y_i^*}{\sum_{i=1}^{k} d_i x_i^*}\bar{X}.$$

The proposed calibration estimator of population ratio under ACS design is given by

$$\hat{R}_{CAL(AC)} = \frac{\sum_{i=1}^{k} w_{1i} y_i^*}{\sum_{i=1}^{k} w_{2i} z_i^*} = \frac{\sum_{i=1}^{k} d_i y_i^* + \frac{\sum_{i=1}^{k} d_i q_i u_i^* y_i^*}{\sum_{i=1}^{k} d_i q_i u_i^{*2}}\left(U-\sum_{i=1}^{k} d_i u_i^*\right)}{\sum_{i=1}^{k} d_i z_i^* + \frac{\sum_{i=1}^{k} d_i q_i v_i^* z_i^*}{\sum_{i=1}^{k} d_i q_i v_i^{*2}}\left(V-\sum_{i=1}^{k} d_i v_i^*\right)}.$$

Further, a simulation study was carried out in order to study the statistical performance of the proposed calibration estimators with respect to usual HT estimator under ACS design. A real dataset on the blue-winged teal bird population given in the often cited Smith *et al.* (1995) has been utilized for the simulation study. In order to study the statistical performance of proposed calibration estimators using the above discussed real dataset, several auxiliary variables that are highly correlated with study variable Y are generated. From the study population, a total of 5000 independent ACS samples of different sample sizes were selected. From each of these samples, estimates of the proposed calibration estimators of population mean and ratio under ACS design as well as corresponding HT estimators were calculated. The proposed calibration estimators of the population mean as well as ratio under ACS design were found to be performing better than the HT estimator with respect to percent Relative Root Mean Square Error (%RRMSE). The proposed calibration estimator of the population mean considering $q_i = 1$ i.e. $q_i = 1$ i.e. $\hat{\bar{Y}}_{CAL(AC),2}$ was found to be most efficient in estimation of the population mean ($\bar{Y}$), since it gives least %RRMSE. Finally, it is concluded that the proposed calibration estimators will produce reliable estimates of population parameters from the ACS survey data obtained from a situation when the members bearing a characteristic of interest are sparsely scattered in a geographically distributed population concerned in unknown manners.

Two Step Calibration for Estimation of Finite Population Total under Two-Stage Sampling Design

For two-stage sampling design, efficient estimators of population total have been developed using two step calibration approach estimators for the different situations of availability of auxiliary information. In order to evaluate the empirical performance of the proposed calibration estimators a real data based simulation study has been conducted. A real dataset of 284 municipalities of Sweden, referred to as MU284 population was used for simulation. The result of the simulation study show that the value of percentage absolute relative bias is highest for π-estimator (Est- π) followed by Est-CAL1 (calibrated estimator under unavailability of auxiliary information at PSU level). The value of percentage absolute relative bias is least for Est-CAL2 (calibrated estimator under unavailability of auxiliary information at both PSU and SSU level). Therefore, it can be concluded that in terms of absolute relative bias Est-CAL2 shows best performance. In the case of percentage relative root mean square error (RRMSE), it is highest for π-estimator and least for the Est-CAL2. The percentage RRMSE of the estimator Est-CAL1 lies between Est- π and Est-CAL2. Therefore, also in terms of criterion of percentage RRMSE the calibrated estimator Est-CAL2 gives the best performance.

Construction of Composite Index under Complex Surveys

In general, an indicator is a quantitative or a subjective measure got from a series of watched actualities that can uncover relative positions in a given area. A composite indicator is framed when singular indicators are assembled into a single index on the premise of a basic model. Normally the indices are based on simple average/ weighted average method which does not consider the effect of multicollinearity among the indicator variables that are used for index construction. The drawback of the existing methods except PCA based method for index construction is that if there is multicollinearity among variables, then the weight of one variable is added to the weight of correlated variables. This yields poorly constructed composite index. However, principal component analysis (PCA) based index account for the effect of multicollinearity uses the unweighted estimator of population variance- covariance matrix. So far, the existing methodologies of PCA based index construction do not use the survey weight and auxiliary information for estimation of Eigen values and Eigen vectors. In general, indicator variables that are used for index construction are collected using some survey design. Thus, there is a need to develop a methodology of index construction using survey weights and auxiliary information along with catering the need of multicollinearity.

Under the project the index based on survey weighted estimators of Variance-Covariance matrix for index construction have been developed. The survey weighted PCA and bias corrected survey weighted PCA based index have been developed. The Agricultural Consumption Index based on survey weighted PCA based index and bias corrected PCA based index has been developed for all-India and major states of India using NSSO 68th round data.

Detection of outliers in presence of masking and imputation of data when auxiliary variables are available in sample surveys

Linear regression model is one of the most powerful methods in statistics for determining the relationships between variables. The presence of outlier in the data is the most serious illness to the linear statistical model. Survey data are usually the product of a complex survey design which makes use of the population structure, either through stratification, multi-stage sampling techniques or other explicit uses of auxiliary information about the population under study. Therefore, there is also a need of detection and treatment of outliers in the situations when weights are included in a regression model. Now, if the data set contains more than one outlier or influential observation, which is likely to be the case in most data sets, the problem of identifying such observations becomes more difficult. This is due to the masking and swamping effects.

Development of test statistics for detection of outlier(s) in presence of masking for Weighted Linear Regression Model in sample survey has been taken up. Suppose that the following model is a fixed effect model.

$$\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\xi},\ \boldsymbol{\xi} \sim N(\mathbf{0}, \sigma^2\mathbf{V})$$

where $\mathrm{Y} = \left(Y_1, Y_{2,}..., Y_n\right)^T$, $\mathrm{X} = \left(X_1, X_{2,}..., X_n\right)^T$ $\xi = \left(\xi_1, \xi_{2,}..., \xi_n\right)^T$ and $\mathrm{V} = diag(v_i)$ is an n X n diagonal matrix. Yi is a response variable for unit i, Xi is a p-vector of fixed covariates β is a fixed but unknown parameter, ξ_i are independently normally distributed with mean 0 and variance $\sigma^2 v_i$. Parameter estimators in linear regression using complex survey data are typically derived from the Pseudo Maximum Likelihood (PML) approach, outlined by Skinner

et al. (1989), following ideas of Binder (1983). Li and Valliant (2011) proposed an extended cook's distance for Unclustered Survey Data, a single case deletion method, which is an extension of cook's distance.

Extended cook's distance :(single stage samples)

$$ED_i = (\hat{\boldsymbol{\beta}} - \hat{\boldsymbol{\beta}}_{(i)})'[v(\hat{\boldsymbol{\beta}})^{-1}(\hat{\boldsymbol{\beta}} - \hat{\boldsymbol{\beta}}_{(i)})$$

$$= \frac{w_i^2 e_i^2}{(1-h_{ii})^2} \mathbf{X}_i' \mathbf{A}^{-1}[v(\hat{\boldsymbol{\beta}})]^{-1} \mathbf{A}^{-1} \mathbf{X}_i$$

where, $\mathbf{A} = \mathbf{X}'\mathbf{W}\mathbf{X}$, $h_{ii} = w_i \mathbf{X}_i' \mathbf{A}^{-1} \mathbf{X}_i$ is a survey weighted leverage and $v(\hat{\boldsymbol{\beta}}_{SW}) = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{W}^2\mathbf{X}(\mathbf{X}'\mathbf{X})^{-1}\sigma^2$ is the model based variance estimator.

Development of test statistics for detection of outlier(s) in presence of masking for Weighted Linear Regression Model in sample survey is under progress.

Programme 4: Development of Statistical Techniques for Genetics/ Computational Biology and Applications of Bioinformatics in Agricultural Research

CABin

CABin scheme - Network Project on Agricultural Bioinformatics and Computational Biology:

Sub-Projects under CABin Scheme:

Computational and experimental biology approaches for delineation of selected secondary metabolite pathways and antimicrobial peptides (AMPs) in major spices

Denovo transcriptome sequencing assisted identification of terpene synthases from black pepper (*Piper nigrum*) berry: In this study, using a combinatorial approach, the berry hybrid transcriptome assembly of illumina and nanopore sequencing, we profiled the entire terpene synthase family responsible for the biosynthesis of the flavor-imparting volatiles in black pepper berries. The profile shows 98 terpene synthases from various terpene synthesis pathways. We also validated the 3 important monoterpene synthases by targeted amplification, sequencing & homology modeling. This study provides the first of its kind information on the terpene synthase family profile in *Piper nigrum,* which is potentially aimportant step for further characterizing the functional terpene synthase genes in black pepper.

The discovery of peppery aroma compound 'rotundone' backbone genes from black pepper: We reported the identification of rotundone backbone genes viz., α-guaiene synthase and α-guaiene oxidase in black pepper. The precursor genes of rotundone using berry transcriptome profiling have been indentified. The metabolite profiling using head space mass spectrometry ensured the presence of the direct precursor compounds for rotundone biosynthesis in black pepper berries. The successful identification of the genes & compounds of the guaiene skeleton is expected to help in bioprospecting of black pepper varieties & also in recombinant production of the aroma compound.

Genomic data analysis to elucidate the regulatory network and candidate genes underlying cytoplasmic male sterility in pigeonpea

Under this project, the miRNAs identified from the small RNA libraries of isogenic lines (UPAS 120 A and UPAS 120B) were further used to predict mRNA targets. For the predicted known and novel miRNAs, corresponding mRNA targets were predicted using psRNATarget. Table 1 shows the number of miRNAs against which one or more targets were found. A total of 2282 and 445 gene targets were predicted for known miRNAs and novel miRNAs, respectively. Figure represents the prediction of corresponding known and novel miR-targets. Figure shows the

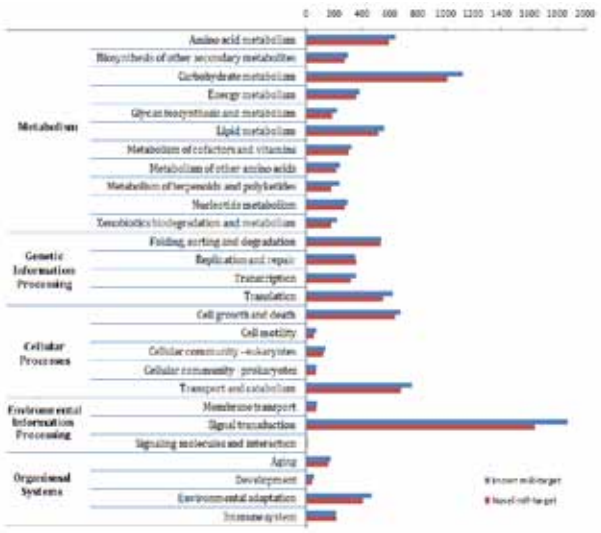


Figure . Prediction of corresponding known and novel miR-targets

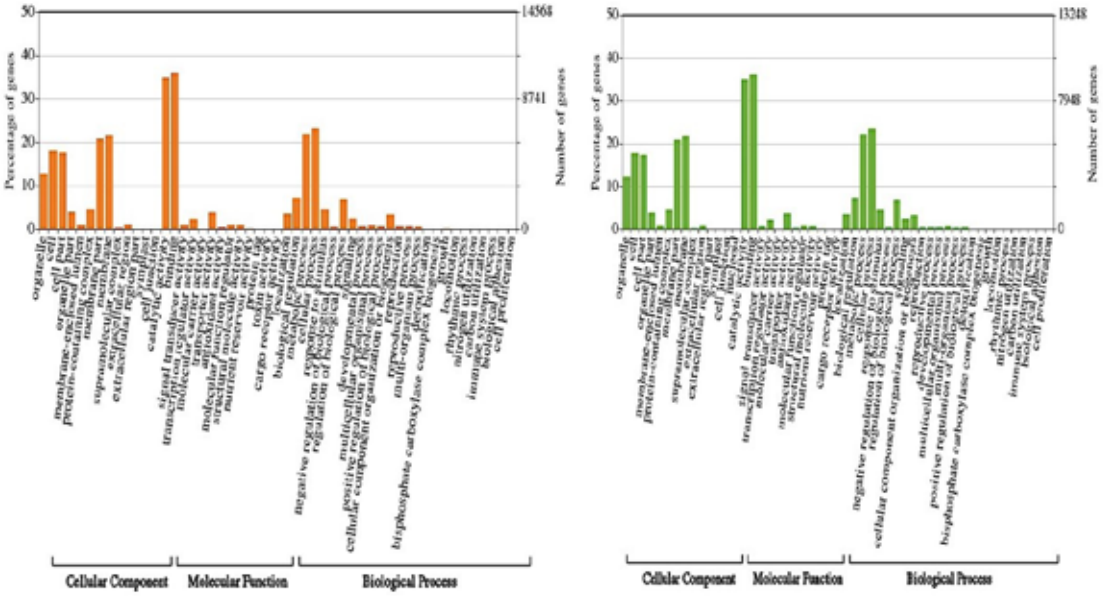


Figure. WEGO (Web Gene Ontology Annotation) plots showing the distribution of GO terms for target genes (known and novel)

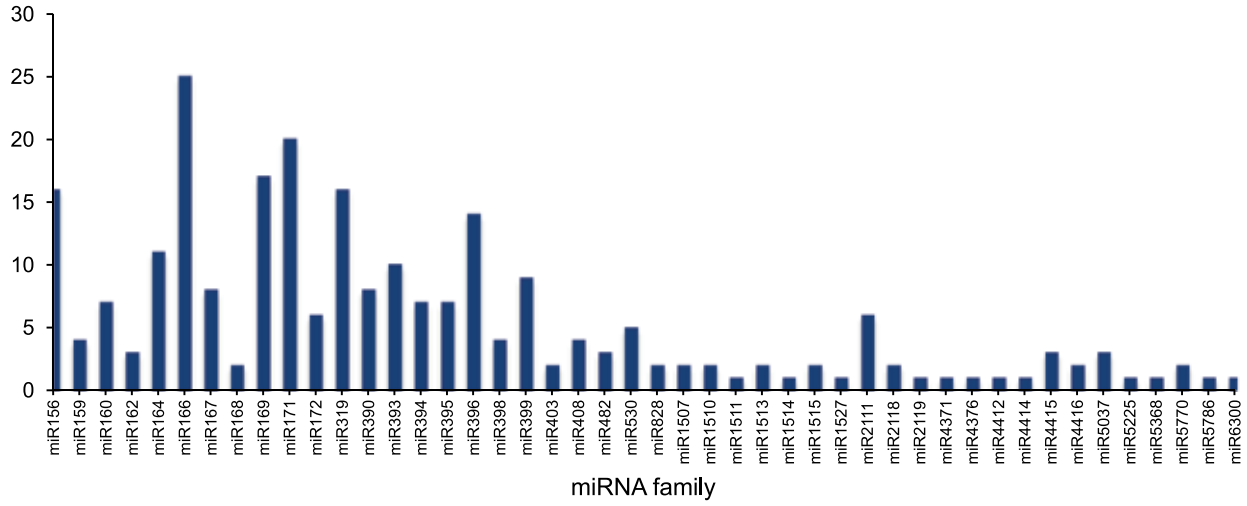


Figure. Distribution of identified miRNAs in known miRNA families

Web Gene Ontology Annotation distribution of GO terms (biological processes, molecular functions and cellular components) for these target genes. Figure represents the distribution of identified miRNAs in known miRNA families. This work was done in collaboration with ICAR-IIPR, Kanpur.

	Known miRNA	Novel miRNA
Number of transcripts identified as targets	14170	26496
Identified miRNAs	248	68
Number of miRNA against which at least one or more targets were identified	202	43
Table. Identified miRNAs' and their targets' statistics		

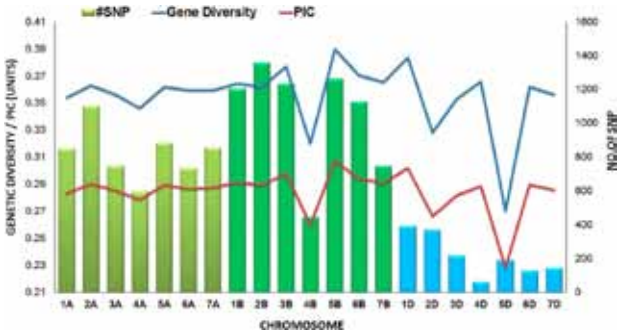
Computational approach for genomic resource improvement and precision phenotyping of less explored yield traits in wheat

Drought being one of the major stresses in wheat was targeted for the study. Drought is first sensed by root tissue but limited information is available about how roots respond to drought stress. In the study, two contrasting genotypes, namely, NI5439 41 (drought tolerant) and WL711 (drought susceptible) were used to generate ~78.2 GB data for the responses of wheat roots to drought. A total of 45139 DEGs, 13820 TF, 288 miRNAs, 640 pathways and 435829 putative markers were obtained. Study reveals use of such data in QTL to QTN refinement by analysis on two

model drought-responsive QTLs on chromosome 3B in wheat roots possessing 18 differentially regulated genes with 190 sequence variants (173 SNPs and 17 InDels). Gene regulatory networks showed 69 hub-genes integrating ABA dependent and independent pathways controlling sensing of drought, root growth, uptake regulation, purine metabolism, thiamine metabolism and antibiotics pathways, stomatal closure and senescence. Eleven SSR markers were validated in a panel of 18 diverse wheat varieties. For effective future use of findings, web genomic resource, Wheat drought root transcriptome database (WDRoTDb) was developed (http://webtom.cabgrid.res.in/wdrotdb/)(Figure). The study reports RNA-Seq based approach on wheat roots describing the drought response mechanisms under field drought conditions along with genomic resources, warranted in endeavour of wheat productivity.

Figure. Web interphase of Wheat drought root transcriptome database *(WDRoTDb)*

Genetic diversity and population structurein wheat using array based SNP markers: In this study, an array based SNP genotyping has been performed to expand the utility of SNP markers for genomic analysis. This study comprised a diverse panel of 483 genotypes. Of 35,143 SNPs, monomorphic markers(6041), markers failing minor allele frequency test[MAF < 0.05] (8123) and missingness test [GENO > 0.1](1412) were removed. Further, 5055 SNPs lacking informationin the consensus genetic map for genetic distanceand chromosomal location were also removed. No individualsfailed for having more than 10 percent missingSNP calls (MIND > 0.1). Therefore, after quality filtration,483 genotypes with 14,650 markers were used forfurther analysis.These markers covered a total geneticdistance of 4477.85 cM. The B genome was observedto have the maximum numbers of filtered SNP markers(7377, ~ 50%) followed by A genome (5771, ~ 39%) and Dgenome (1502, ~ 10%). Supporting this, marker density was1053.85, 824.42 and 214.57 per chromosome for the B, A,and D



genome, respectively. Chromosome 2B comprisedof a maximum number of genetically mapped SNP markers(1360). The lowest number of SNP markers were geneticallymapped to chromosome 4D (61) (Figure). Physical map positions of the SNP markers wereobtained from the Ensembl database. The Circos plot (Figure) indicates thatSNPs used in variability and structure analysis of all 483genotypes of wheat were covered by more than 450 SNPper chromosome. It also depicts the correlation between thegenetic and physical map based chromosomal locations ofSNP markers graphically.

Figure:Distribution of 14,650SNPs across genomes. Different genome has been represented with different colour. Gene diversityand PIC has been shownfor all chromosomes with linerepresentations

Figure: Schematic representation of relationship between chromosomallocation of any one marker based on genetic and physical maps. Gen-1A to Gen-7D represent the 21 wheat chromosomal genetic maps and Phy-1A to Phy-7D represent the 21 wheat chromosomal physicalmaps

Two subpopulations, SP1 and SP2(Figure), based on unlinked SNP markers, natural adaptation and

selection history for traits of interest have been identified. SP2 comprised genotypes that were mostly the result of selection. However, based on GD and PIC analysis, it was identified as genetically more diverse. As compared to SP1, it was identified exhibiting higher values for Shannon's information index (I), expected heterozygosity (He), and unbiased expected heterozygosity (uHe). This kind of genetic diversity can be utilized for developing biotic and abiotic stress tolerant varieties adaptive to diverse agro-climatic regions. Modern day wheat improvement program involves multi-parent crosses with diverse pedigree, wild germplasm or alien gene introgressed lines, developing a broad genetic based population from which selections are made. This study will be beneficial to the wheat breeders in taking decision about the parental lines to be selected for further genetic improvement.

Deciphering genetic variation in the carbohydrate

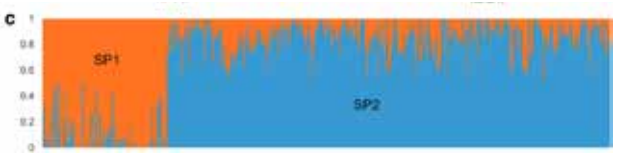


Figure: Structureplot for 483 genotypes at K = 2,where each colour represent onesubpopulation namely SP1 andSP2

metabolism of farmed rohu families: The role of microRNA in gene regulation during developmental biology has been well depicted in several organisms. Under this project, the role of miRNAs in liver tissue of rohu, Labeorohita when fed with different carbohydrate diets was investigated. A total of 22,612,316; 44,316,046 and 13,338,434 clean reads were obtained from three small-RNA libraries using Illumina-HiSeq platform. A total of 138 conserved and 161 novel miRNAs linked with carbohydrate metabolism were identified. MicroRNAs miR-22, miR-122, miR-365, miR-200, and miR-146 are involved in carbohydrate metabolism. Analysis of differentially expressed miRNAs depicted their role during metabolic gene regulation. Also, the network analysis between miRNA-mRNA (target genes) revealed that single miRNA controls many gene functions(Figure). Further analysis depicted mature miRNA and their predicted target sites in genes that were involved in developmental biology, cellular activities, transportation, etc(Figure). This is the first report of the presence of miRNAs in liver tissue of rohu and their comparative profile linked with metabolism serves as a vital resource as a biomarker.

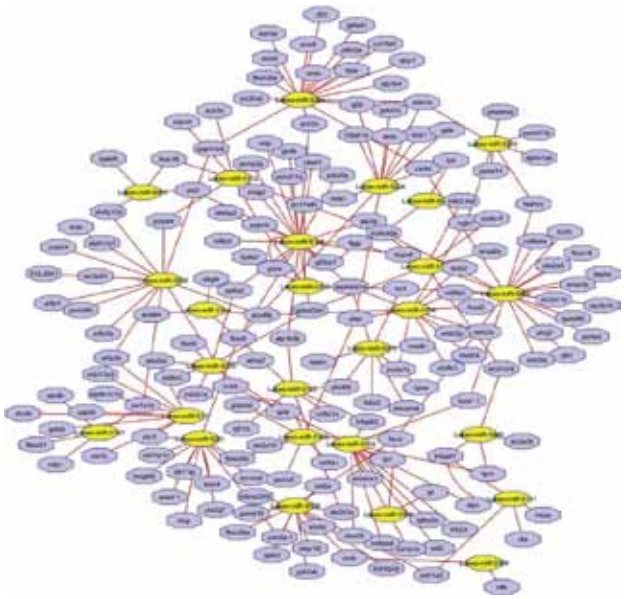


Figure. Network diagram of upregulated genes involved in carbohydrate metabolic pathway. Solid lines denote association between the miRNAs and the target genes. The nodes represent target genes; the circle nodes represent miRNAs.

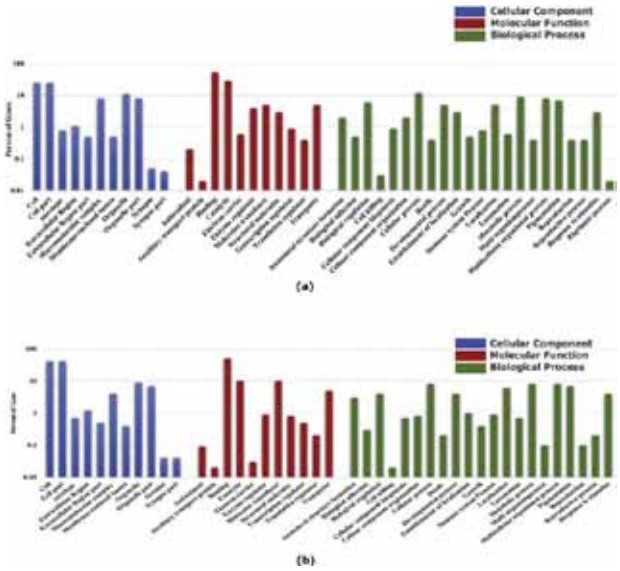


Figure. Functional enrichment of differentially expressed miRNA in different treatments: Conserved miRNAs, (b) Novel miRNAs.

Investigations on pathogenic microorganisms of shrimp aquaculture using metagenomic and other bioinformatic approaches:

Whole genome sequence of *Vibrio campbellii LB102 strain* was assembled. de novo Assembly was done using SPAdes. 90 scaffolds (107 contigs) of ≥200 bp, covering 5,588,138 bp, 5198 genes; 4920 protein coding, 15 rRNA, 121 tRNA, 4 other RNA and 138 pseudogenes were obtained. The data was submitted to NCBI (Bioproject PRJNA377806) (Figure)

Figure: Genome Similarity with Strain: 170502

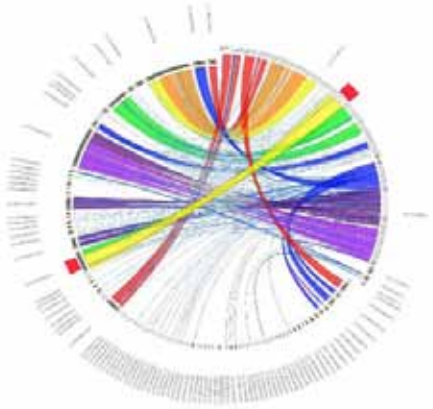


Figure: Genome Similarity with Strain: RIMD 2210633 O3:K6

Whole genome sequence of *Vibrio parahaemolyticus VP14 strain:* Whole genome sequence of bacterial strain VP14 of *Vibrio parahaemolyticus* has been submitted to NCBI. About 1,754,630 paired-end reads of size 250bp were used for denovo assembly in MaSuRCA. The assembly contained 94 scaffolds. VP14 has 5,224,046 bp with 45.3% GC content. The genome contained 5326 genes that include 4972 coding sequences, 10 5S rRNA, 15 16S rRNA, 12 23S rRNA, 161 tRNA, 4 ncRNA and 152 pseudogenes. (Figure)

Identification of defence genes/QTLs associated with rust resistance in wheat

For identification and characterization of wheat germplasm for stripe rust 391 wheat germplasm lines including landraces have been evaluated for seedling stage resistance against four stripe rust pathotypes viz., 46S119, 110S119, 238S119 & T at IIWBR Regional Station, Flowerdale, Shimla Seedling response was scored two weeks after inoculation based on the infection types expressed on each entry. Disease severity was recorded following 0-9 scale. The following promising accessions were obtained based on 2years evaluation (Table)

GWAS for stripe rust resistant pathotypes in wheat using Breeders' 35K Axiom® array was performed. An association panel of 391 wheat accessions was evaluated against four different pathotypes viz., 46S119, 110S119, 238S119 & T at IIWBR Regional Station, Flowerdale, Shimla while, same set of lines were genotyped using 35K SNP Axiom® Arrays for performing genome-wide association analysis. A total of 51 significant marker trait associations (MTAs) were identified for disease resistance against four different pathotypes. 58 Gene candidates including some R-genes were also found for four races with 35 markers from the Wheat genome. The significant marker-trait associations are given in Table.

Table: Promising accessions based on 2 years evaluation.

IC Number	Coll. No	District	State
335794	37289	-	Others
549396	NIAW-231	Karnal	Haryana
336645	22	Lahaul & Spiti	Himachal Pradesh
393943	FRL-434	Kargil	Jammu and Kashmir
406521	AKS/RRA/ BS-171	Rudraprayag	Uttarakhand
529399	VWFW-1192	Almora	Uttarakhand
530051	VWFW- 2366	Almora	Uttarakhand
539593	VW-0211	Karnal	Haryana
549409	NOO-13	Karnal	Haryana
553131	KCM-1028	Chamoli	Uttarakhand

Table: Significant marker-trait association (P value <0.001)

Races	SNP	Chr	Position (mbp)	Gene model/annotation
T	AX-94490490	2BL	759.82	TraesCS2B02G569300, Heavy metal-associated domain, HMA
T	AX-95175933	2BL	760.12	TraesCS2B02G569500, Heavy metal-associated domain superfamily
T	AX-95142963	2BL	760.89	TraesCS2B02G570000, Plant actin-related protein 8

Races	SNP	Chr	Position (mbp)	Gene model/annotation
T	AX-95238626	2BL	760.95	TraesCS2B02G570500, Phosphatidylinositol 3-/4-kinase, catalytic domain
T	AX-94497849	2BL	761.98	TraesCS2B02G571600, Exocyst subunit Exo70 family protein,Ubiquinol oxidase
T	AX-94868242	2BL	761.99	TraesCS2B02G571700, Ubiquinol oxidase
T	AX-95166280	2DL	621.02	TraesCS2D02G542500, Exocyst subunit Exo70 family protein
238S119	AX-94381637	1AL	542.87	TraesCS1A02G362200, F-box-like domain superfamily
238S119	AX-95243592	1BL	606.84	TraesCS1B02G376000, Serine-threonine/tyrosine-protein kinase, catalytic domain
238S119	AX-95229302	1BL	608.47	TraesCS1B02G376800, Phosphoribosylformylglycinamidine synthase PurL
238S119	AX-94850928	1BL	608.53	TraesCS1B02G377000, Nucleosome assembly protein (NAP)

Computational biology approach for deciphering transcriptome and proteomic changes in rice-microbial interaction system

Proteome and transcript-level changes in the rice plants inoculated with individual or combined application of microbial species and grown under different stresses (drought and salinity) has been explored under the project. Proteome level changes led to reveal identification and characterization of various proteins unique in plants due to the stress conditions or due to microbial inoculation. Overall, large number of proteins including *1107* in Control plants, 1063 in *Trichoderma* inoculated plants, 1185 in *Pseudomonas* inoculated plants, 1111 in plants with combined application, 1179 in drought grown plants, 1123 in plants inoculated with *Trichoderma* under drought, 1185 in *Pseudomonas* treatment under drought and 990 in plants with combined application following drought. Different functions assigned for various proteins include Defense responses, signaling, ROS scavenging, superoxide dismutation, energy metabolism, water deficit, photosynthesis & structural proteins, transport related proteins, host metabolism, DNA repair/ maintenance, antioxidant related proteins and proteins for oxidative phosphorylation. Differential presence of the proteins linked with these functions in different treatments was correlated with the growth and development of plants under stress or microbial inoculation. Proteomic profile of PB 1612, CO51, Swarna Sub-1 and BPT 5204 grown under drought (and salinity) has led to interpret specific functions of crucial proteins having prominent role in drought responses/tolerance or mitigation.Comparative analysis of proteome also showed circumstantial presence or absence of specific proteins under stresses or microbe-mediated conditions, suggesting their critical role (Figure).

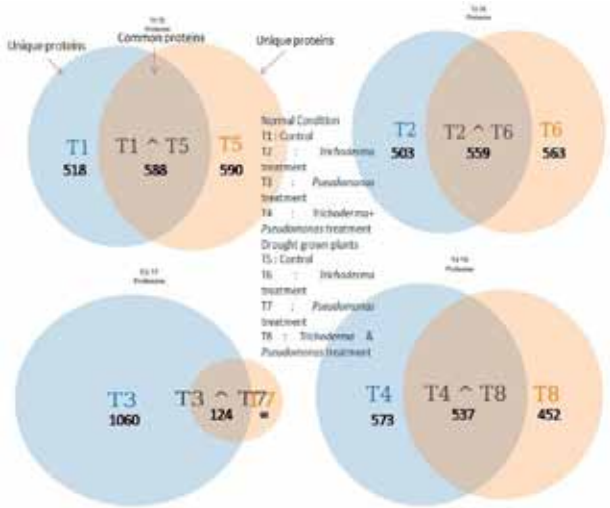
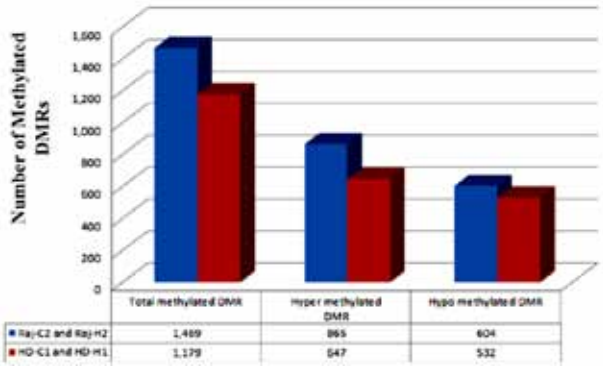


Figure. Commonality and distinction of the proteins in leaves of plants grown under stress or microbial inoculation or both

Exploring the Epigenetic Control of Heat Stress Responses in Wheat for Characterizing the Regulatory Networks Associated with Thermotolerance

Identification of Differentially Methylated Regions under Heat Stress, their pathway and Gene Ontology Analysis in Wheat: Recent studies indicate that heritable variations in traits may also be caused by changes in DNA without affecting its nucleotide sequence. Such genetic changes are now known as epigenetic variations. Epigenetic changes are caused by enzymatic modifications of DNA or histones that control transcriptional activity of genes, movement of transposable elements etc. Thus,

epigenetic changes are considered to be important regulators of genome integrity in higher eukaryotes. Many of the traits in plant, such as flowering time, yield, and abiotic stress tolerance etc., controlled by such epigenetic variations are being reported. Heat stress is one such stress and it is found to be one of the most alarming threats that global warming is bringing with time. A functional understanding of the epigenetic changes such as DNA methylation under heat stress is required with the ultimate aim to secure global food security. Therefore, in this study, identification of differentially methylated regions (DMR) under heat stress has been carried out in in Raj3765 and HD2329 cultivars of wheat (Figure). After identification of DMR's, their pathway analysis has also been carried out (Figure). Moreover, their ontology has also been done (Figure). These results may provide postulates for experimenters involved in the development of new heat stress resistant cultivars to mitigate the ill effects of global warming.



Genes Affected	Pathway-Associated
RuBisCo small subunit	Carbon Fixation
RuBisCo Activase	Carbon Assimilation
RuBisCo large subunit	Carbon Metabolism
PS-II reaction centre	Photosynthesis ET
OEEP	Photosynthesis ET
WRKY33	Signalling pathway
MAPK2	Signalling Pathway
CDPK	Signalling Pathway
HSP17	Protein Folding
HSP70	Protein Processing in ER
SOD	Defence Pathway

Figure: Differential Methylation Region Figure: Associated Pathways

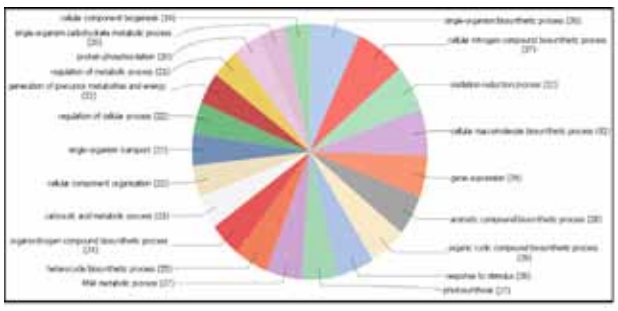
Figure: Gene Ontology Analysis under Heat Stress in Wheat

RiceMetaSys: Understanding of Rice Gene Network for Biotic and Abiotic Stress Management through System Biology Approach

Identification of Differentially Expressed Genes under Drought Stress, their pathway and Gene Ontology Analysis in Rice: Scarcity of water is an alarming threat world wide and it greatly affects the agricultural production. Rice is a very important crop and has significant contribution in total grain production. Since requirement of water is more in rice so it is severely affected by drought stress. In this study, genes which are differentially expressed under drought and normal conditions are identified in Rice (Table). These putative genes may be associated with drought stress and can play important role in mitigating the effects of drought stress. Moreover, identified genes were further explored by carrying out their pathways and gene ontology analysis (Figure). These results may provide postulates for experimenters involved in the development of new drought stress resistant cultivars to mitigate the ill effects of water scarcity.

Table: Number of Up and Down-regulated Genes in various comparisons with different tissues under drought stress in Rice

Comparisons	Up-regulated Genes	Down-regulated Genes
C2LEAF_S2_vs_D2LEAF_S4	365	275
C2ROOT_S1_vs_D2ROOT_S3	195	173
IC2LEAF_S7_vs_ID2LEAF_S8	54	172
IC2ROOT_S5_vs_ID2ROOT_S6	63	53



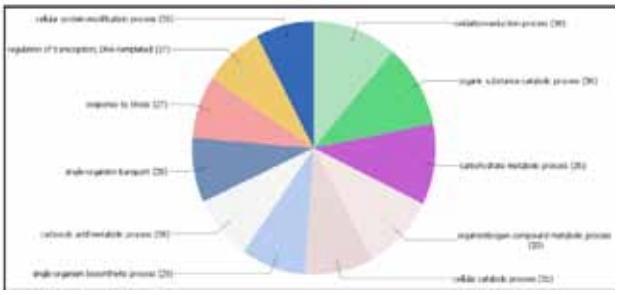


Figure: Biological Process of up and down regulated DEGs identified under drought stress in Rice

Structural and functional genomics of potato and its pest / pathogen using bioinformatics approaches

Knowledge about genes associated in nitrogen metabolism is very important to improve nitrogen use efficiency (NUE) of plants, and further to reduce the N dose as well as cost of production and save the environment. Aim of this study was to discover N-responsive genes and regulatory elements in potato to improve NUE of plants. An experiment was conducted in potato cv. Kufri Gaurav under aeroponics with low N (0.75 milli molar) and high N (7.5 milli molar) supply and transcriptomes of leaf, root and stolon tissues were sequenced. Quality data (≥ Q20) of 2.04 to 2.73 Gb per sample was obtained using Ion Proton™ System and over 80% alignment was obtained with the reference potato genome. A total of 176 significant up-regulated and 30 down-regulated differentially expressed genes (DEGs) were found in leaves; 39 up-regulated and 105 down-regulated in roots; 81 up-regulated and 694 down-regulated in stolons (Figure). Potential DEGs responsive to N metabolism in potato like superoxide dismutase, GDSL esterase lipase, probable phosphatase 2C, protease inhibitors, high affinity nitrate transporters, sugar transporter, ferric reduction oxidase, glycine/proline rich proteins, glutaredoxin, transcription factors (VQ motif, SPX domain, bHLH), GA, ethylene, terpenoids, and cell wall modifying genes so on were identified. This suggests that the above genes play key roles in adaptation to low N stress and sufficient N conditions in potato. These genes could be manipulated in future to develop N-use efficient potatoes.

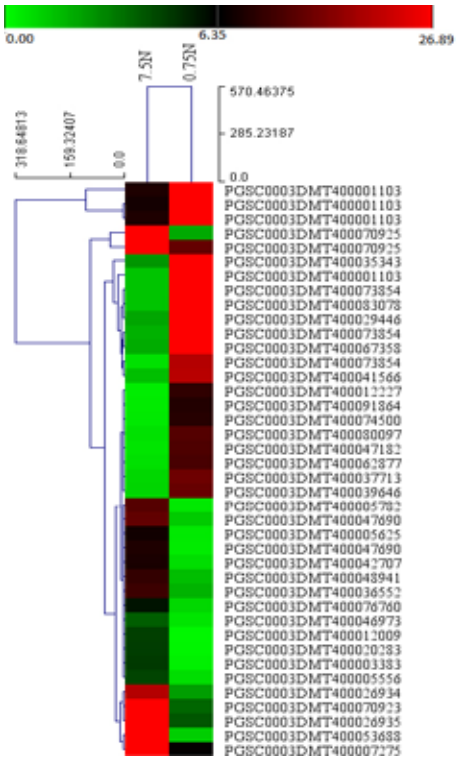


Figure Heat map showing DEGs in potato leaves under supply of low and high nitrogen.

Studying drought-responsive genes in subtropical maize germplasm and their utility in development of tolerant maize hybrids:

A total of 100 candidate genes were chosen from the combined whole genome bi-sulfite and RNA-sequencing assay for drought stress tolerance to undertake candidate gene validation through association analysis. Phenotyping of association panel (~200 maize inbred lines) for drought tolerance was completed at Delhi location during *kharif*-2019. Phenotyping for drought tolerance in Dharwad (*Summer*-2020) and Delhi (*Rabi*-2020) are in progress. Evolutionary and functional analysis of GPX gene family in maize revealed a total of seven GPX genes distributed on six chromosomes in maize genome. Besides, the evolutionary analysis

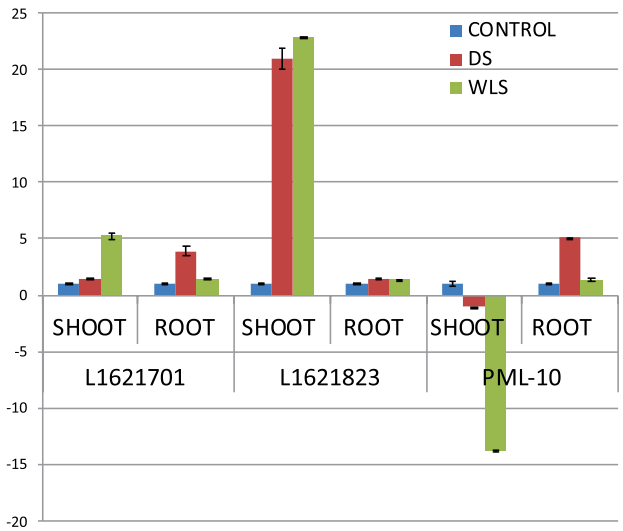


Figure: Functional response of maize GPX gene *ZmGPX7* to drought and waterlogging stresses in tolerant (L1621701and L1621823) and sensitive (PML10) genetic background.

revealed stress regulating conserved cis-acting elements and motifs. Functional characterization of maize GPX genes showed tissue specific and stress specific expression patterns in tolerant (L1621701and L1621823) and sensitive (PML10) genotypes (Figure).

Metagenomic profiling for assessing microbial biodiversity in River Ganga for ecosystem health monitoring

The metagenomic libraries could be used as a tool for the monitoring of aquatic microbial biodiversity by characterization and their genetic variation for adaptations. Therefore, aquatic pollution monitoring using metagenomics could be efficiently applied for the characterization of total microbes and their functional pathways. Comparative metagenomic study could be used between polluted and non-polluted aquatic sites to identify unique environmentally significant microbes present in the polluted sites. In the present study, nine sediment metagenome samples in the context of polluted versus non-polluted sites of river Ganga and Yamuna were analysed using NGS technique. Sediment metagenomics revealed the presence of 22 Bacteriophages in river Ganga. Similarly, a total of 92 species related to bioremediation bacteria and 242probiotic bacteria were identified from the sediment metagenome of river Ganga and Yamuna. A total of 139 antimicrobial resistance genes (ARGs) were identified from 39 microbial species. Moreover, the functional metagenomics analysis revealed the presence of Heavy metal-associated domain (HMA) and HMA-conserved sites in the identified bacteria. Several protein domains including urea ABC transporter, UrtA, UrtD, UrtE and zinc/ cadmium/ mercury/ lead-transporting ATPase, which play pivotal role in bioremediation were identified from the identified bacteria of the riverine polluted environments (Figure).

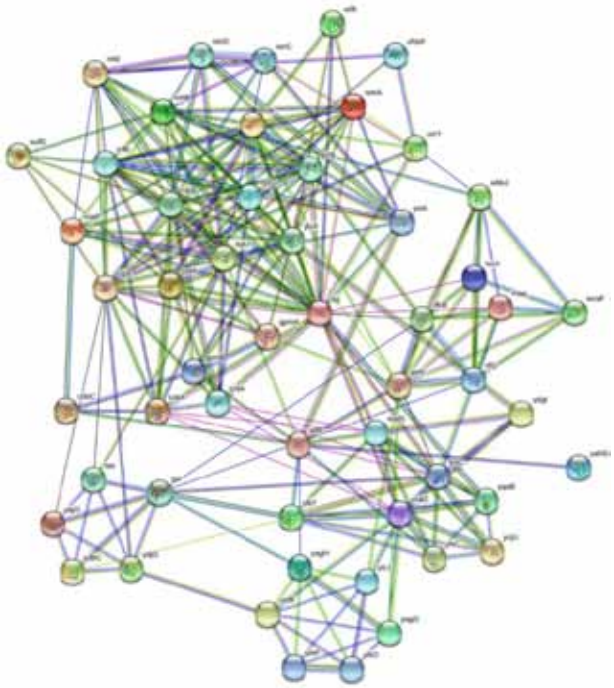


Figure. Functional metagenomics revealed the presence of Heavy metal-associated domain (HMA) and HMA-conserved site in the identified Probiotic bacteria

Deciphering health biomarkers and thermo-tolerant traits by computational genomics approach in goats

Toxin iELISA and peptide iELISA were developed for detection of ET serum antibodies for protected animals in the goat population. Sandwich ELISA for direct detection of the epsilon toxin in ET suspected animals has been standardized and presently being validated. Dot ELISA has been developed for quick (pen-side) identification of immuno-protection against ET, which can be applied as field test to differentiate vaccinated from non-vaccinated. Initially the study started with the identification of newer and unique isolates extensively involved in outbreak of enterotoxaemia. For this purpose, 23*Clostridium perfringens* isolates have been characterized for epsilon toxin *(etx*) gene, of which 5 isolates (4-goats; 1-sheep) were found to be unique based on the sequencing and phylogenetic analysis. Gene expression profile studies of ET affected goats showed upregulation all the inflammatory cytokine genes (IL-1β, IFN**γ**, IL6, IL8 and TNFα) except IL2 which was downregulated in PBMCs. In intestinal tissue, most pro-inflammatory markers, pattern recognition receptor genes and cell stress response genes like IFN**γ**, IL6, TNFα, TLR2, TLR4, GPx and CuZnSOD as well as an anti-inflammatory cytokine IL-10 showed higher fold changes in spontaneously ET affected field goats compared to the experimentally infected goats. Besides, fifteen samples from two contrast phenotypes, i.e., tolerant and resistant to heat stress under extreme climatic conditions were sequenced for RNA seq. Eight samples from goats under normal climatic condition (control) were sequenced for RNA seq and the sequence analysis is being carried out.

An integrative transciptomics and DNA methylomics approach to understand the dynamic features of biotic stress responses associated with mastitis in buffalos: Identification of Mastitis associated genes was done through literature mining. Approximately 159 genes known to be involved in mastitis in cattle and buffalo was

identified from literature search. The redundancy was removed leading to 153 genes which were further used for chromosome location mapping. To continue the mapping process, the entire set of buffalo genes, *Bubalusbubalis* was downloaded from NCBI retrieving 34,615 genes. These genes were manually curated based the organism specific term *Bubalusbubalis*to fetch 34,067 genes. Finally, these filtered genes were used for chromosome number and location mapping with mastitis associated genes. Mapping was done using the in-house perl script based on gene symbol and its alias. Mappping results for 94 genes were achieved including features like gene symbol, gene ID, description, chromosome number, chromosome start and end location, strand orientation and exon count (Table). The 59 unmapped genes retrieved to be involved in mastitis condition that did not map to buffalo genes which may be due to their exclusive presence in cattle only.

Table. Mapped mastitis associated genes over buffalo genome

Symbol	GeneID	Description	Chromo-some	Start position	End position	Orienta-tion	Exon count
NOD2	102390227	nucleotide binding oligomerization domain containing 2	18	18682925	18716169	plus	13
AHCY	102390596	adenosylhomocysteinase	14	19916831	19932656	plus	10
DCDC2	102391050	doublecortin domain containing 2	2	19028043	19183604	minus	11
LY75	102391290	lymphocyte antigen 75	2	88993242	89084297	plus	35
RELB	102392246	RELB proto-oncogene, NF-kB subunit	18	52712582	52741429	plus	13
CCL5	102392310	C-C motif chemokine ligand 5	3	48948779	48955564	minus	3
LY96	102392837	lymphocyte antigen 96	15	45045776	45079102	minus	5
ACLY	102393057	ATP citrate lyase	3	21270131	21314426	plus	29
FGF2	102393273	fibroblast growth factor 2	17	38184720	38239832	plus	3
FOS	102393791	Fos proto-oncogene, AP-1 transcription factor subunit	11	16812238	16815530	minus	4
BFSP1	102393801	beaded filament structural protein 1	14	45947181	45986083	plus	8
BIRC3	102394110	baculoviral IAP repeat containing 3	16	78623153	78641369	plus	11
ETS2	102394352	ETS proto-oncogene 2, transcription factor	1	195766624	195786350	plus	10
CXCL16	102394558	C-X-C motif chemokine ligand 16	3	36771027	36774569	minus	5
TACC3	102394600	transforming acidic coiled-coil containing protein 3	7	950764	961155	plus	18
RORA	102395227	RAR related orphan receptor A	11	53639029	54450465	minus	15
BCL2A1	102395403	BCL2 related protein A1	20	43458172	43470928	plus	3
PTGS1	102395640	prostaglandin-endoperoxide synthase 1	12	92804414	92829321	plus	12
RBMS1	102395707	RNA binding motif single stranded interacting protein 1	2	88371004	88617706	plus	18
GPD1	102395827	glycerol-3-phosphate dehydrogenase 1	4	90491307	90497688	plus	9
IL1B	102396262	interleukin 1 beta	12	46284574	46293003	minus	7
ETV6	102397175	ETS variant transcription factor 6	4	21927676	22217154	plus	9
UCP3	102397277	uncoupling protein 3	16	31360362	31371780	plus	7
HADHB	102397671	hydroxyacyl-CoA dehydrogenase trifunctional multienzyme complex subunit beta	12	72905983	72937636	minus	17
NFKBIZ	102397695	NFKB inhibitor zeta	1	90942949	90974380	plus	14
TLR2	102397791	toll like receptor 2	17	69069623	69091444	plus	7

Symbol	GeneID	Description	Chromo-some	Start position	End position	Orienta-tion	Exon count
SELP	102397837	selectin P	5	43841921	43884226	plus	17
RELA	102397938	RELA proto-oncogene, NF-kB subunit	5	120420240	120429172	minus	11
S100A8	102398240	S100 calcium binding protein A8	6	16790208	16791292	plus	3
PLAT	102398577	plasminogen activator, tissue type	1	8520535	8544648	plus	14
IRF1	102398631	interferon regulatory factor 1	9	89358528	89365523	minus	10
BTG1	102398846	BTG anti-proliferation factor 1	4	98236506	98239213	plus	2
CD14	102399257	CD14 molecule	9	59472581	59475345	plus	2
MAP3K8	102399287	mitogen-activated protein kinase kinasekinase 8	14	48499556	48526611	minus	9
BID	102399521	BH3 interacting domain death agonist	4	11044202	11062286	plus	8
LTF	102399523	lactotransferrin	21	53019196	53052145	plus	17
BRCA1	102399547	BRCA1 DNA repair associated	3	20209334	20286775	plus	26
BAX	102400076	BCL2 associated X, apoptosis regulator	18	55540482	55544744	plus	6
PLCE1	102400189	phospholipase C epsilon 1	23	15203933	15572597	plus	33
ALOX5	102400249	arachidonate 5-lipoxygenase	4	163691453	163738329	minus	14
VRK2	102400600	VRK serine/threonine kinase 2	12	40396255	40504741	plus	17
C5AR1	102400801	complement C5a receptor 1	18	54314694	54329591	plus	2
CEBPB	102401454	CCAAT enhancer binding protein beta	14	5292987	5295000	minus	1
TP53	102402069	tumor protein p53	3	36006734	36019283	plus	11
BCL2	102402077	BCL2 apoptosis regulator	22	590147	785693	plus	7
YES1	102402581	YES proto-oncogene 1, Src family tyrosine kinase	22	26520117	26584457	plus	14
PRKDC	102402820	protein kinase, DNA-activated, catalytic subunit	15	62849792	62976253	plus	87
SPP1	102403043	secreted phosphoprotein 1	7	80782654	80789613	plus	7
MCL1	102403565	MCL1 apoptosis regulator, BCL2 family member	6	19848966	19853726	plus	3
HP	102403575	haptoglobin	18	38758639	38764791	minus	7
CDKL5	102403791	cyclin dependent kinase like 5	X	12421285	12596766	plus	23
EHHADH	102404255	enoyl-CoA hydratase and 3-hydroxyacyl CoA dehydrogenase	1	126702951	126756081	plus	7
TIRAP	102404626	TIR domain containing adaptor protein	5	105522721	105532588	plus	7
CFB	102404663	complement factor B	2	25555077	25561115	plus	18
MAP2K7	102404881	mitogen-activated protein kinase kinase 7	9	94605470	94615280	minus	12
TAOK3	102406129	TAO kinase 3	17	15949245	16140836	minus	26
HGF	102406209	hepatocyte growth factor	8	38707241	38792681	plus	22
DNTT	102406379	DNA nucleotidylexotransferase	23	17436567	17469020	plus	11
CACNA2D1	102406537	calcium voltage-gated channel auxiliary subunit alpha2delta 1	8	37921326	38447975	plus	44
TLR4	102407022	toll like receptor 4	3	169689210	169700933	plus	5
C3	102407588	complement C3	9	93485444	93521626	minus	41

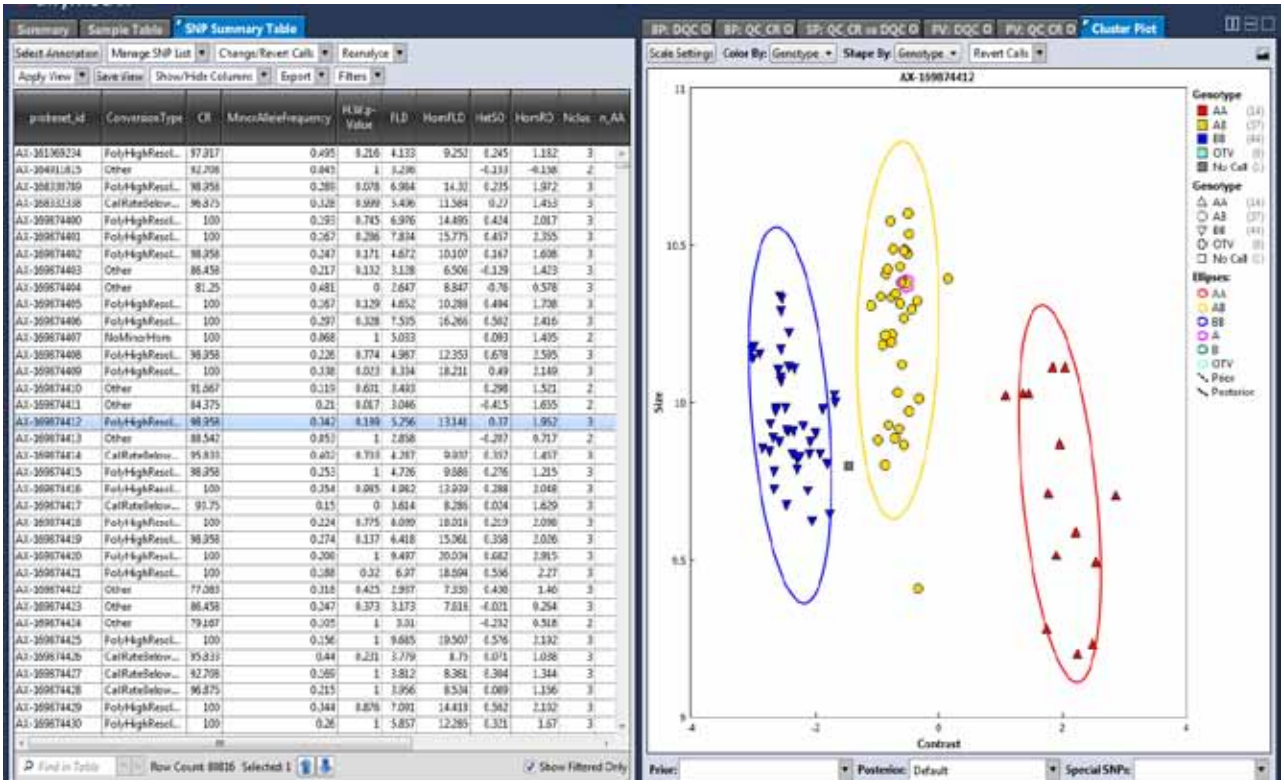
Symbol	GeneID	Description	Chromo-some	Start position	End position	Orienta-tion	Exon count
SLC18A2	102408717	solute carrier family 18 member A2	23	36989210	37030313	plus	16
IL12B	102409559	interleukin 12B	9	39936556	39955232	plus	11
MAFF	102409791	MAF bZIP transcription factor F	4	10229250	10238406	minus	3
OXCT1	102410048	3-oxoacid CoA-transferase 1	19	32391695	32559174	plus	17
GADD45B	102410115	growth arrest and DNA damage inducible beta	9	90203976	90206128	plus	4
CDK8	102410237	cyclin dependent kinase 8	13	57597995	57670492	plus	14
CALM2	102410813	calmodulin 2	12	29261756	29274718	minus	6
DUSP1	102410828	dual specificity phosphatase 1	19	4326581	4329684	minus	4
HSPA8	102411242	heat shock protein family A (Hsp70) member 8	16	51229014	51233506	plus	9
OSTF1	102411605	osteoclast stimulating factor 1	3	113965232	114025684	plus	11
CCL20	102412530	C-C motif chemokine ligand 20	2	168974704	168978216	plus	4
FEZF2	102412822	FEZ family zinc finger 2	21	38980959	38985831	plus	5
CSF2	102413568	colony stimulating factor 2	9	88897909	88899933	plus	4
ACTB	102413719	actin beta	24	3757940	3761410	minus	6
SSR1	102413832	signal sequence receptor subunit 1	2	4439705	4457888	minus	9
ACSL1	102414095	acyl-CoA synthetase long chain family member 1	1	30341810	30407173	plus	23
MMP9	102414528	matrix metallopeptidase 9	14	8765042	8772373	minus	13
STAT3	102414888	signal transducer and activator of transcription 3	3	20869046	20943851	plus	24
CCL3	102415065	C-C motif chemokine ligand 3	3	49105120	49106558	minus	3
IL6	102415101	interleukin 6	8	31215270	31219246	plus	5
LBP	102415422	lipopolysaccharide binding protein	14	16357503	16392221	minus	15
APP	102416140	amyloid beta precursor protein	1	54928393	55236109	plus	18
PTGS2	102416528	prostaglandin-endoperoxide synthase 2	5	13291950	13299493	plus	10
CCR5	102393452	C-C motif chemokine receptor 5	21	53090244	53114601	minus	5
CXCL8	102412933	C-X-C motif chemokine ligand 8	7	28769703	28772345	minus	4
LOC102402015	102402015	serotransferrin	1	180137689	180177417	minus	17
LOC102402713	102402713	complement C4	2	25590016	25604860	plus	41
LOC102408597	102408597	guanine nucleotide-binding protein G(s) subunit alpha isoforms short	14	26056556	26110548	plus	15
LOC102409564	102409564	acyl-coenzyme A thioesterase 1	11	18256506	18271647	minus	3
LOC102410151	102410151	serum amyloid A protein-like	5	102085523	102088779	minus	4
LOC112577794	112577794	serum amyloid A protein-like	5	102063403	102067260	minus	4
LOC112587745	112587745	beta-2-microglobulin	11	158245	164476	minus	4
LTF	102399523	lactotransferrin	21	53019196	53052145	plus	17

ICAR Network Project on Functional Genomics and Genetic Modification

Under this project, re-sequencing, SNPs discovery and level of heterozygosity in 25 mango varieties was carried out. A total of 8,362,720 SNPs and 2,197,722 InDels were discovered (Table). Figure shows the SNP Summary and Cluster Plot of validated SNP locus AX-169874412.

Linkage Group	Length (bp)	No. of SNPs	No. of InDels	SFP Density (bp)
LG1	1,52,32,102	2,96,893	82,937	40
LG2	1,37,96,269	2,85,649	75,374	38
LG3	1,64,90,533	3,65,965	90,476	36
LG4	2,11,68,693	4,15,337	1,19,965	40
LG5	1,17,81,399	2,55,264	72,487	36
LG6	1,15,60,298	2,37,208	67,574	38
LG7	1,15,74,172	2,54,354	72,195	35
LG8	1,13,30,313	2,22,043	65,291	39
LG9	1,83,93,972	3,81,308	1,01,482	38
LG10	1,00,58,126	2,18,774	54,533	37
LG11	1,42,75,844	2,65,443	70,460	42
LG12	1,22,02,370	2,56,656	69,183	37
LG13	1,56,40,443	3,25,776	84,840	38
LG14	95,16,842	2,03,871	53,086	37
LG15	1,02,44,494	1,86,084	53,646	43
LG16	1,82,52,290	3,15,426	85,678	46
LG17	1,02,84,815	2,26,240	54,276	37
LG18	1,50,09,555	3,22,189	80,992	37
LG19	2,33,18,555	4,86,824	1,36,261	37
LG20	1,36,40,176	3,01,403	72,853	36
Floating	11,95,34,726	25,40,013	6,34,133	38
Total	**40,33,05,987**	**83,62,720**	**21,97,722**	**38**

Table. Genome wide SNP haterozygocityusing 'Amrapali' genome as reference



Further, population structure and diversity analysis of 373 Mango Genotypes were run. A subset of 60 SNP markers covering whole genome and having Minor allele frequency of 0.5 was selected among 96. The maximum delta K (ad-hoc quantity) was reached at K = 2 suggesting presence of two subpopulations in the collection. In SNP-based structure analysis, population I consisted 39.5% of genotypes (38). Population II comprised of total 58 genotypes. Out of total genotypes, 62% of genotypes were pure and 38% were admixed (Figure). Diversity Analysis of 373 Mango Cultivars was also done (Figure). Genome-wide association mapping of traits like acidity, fruit length, pulp percentage was also done.

Figure: Population Structure of 373 Mango Genotypes

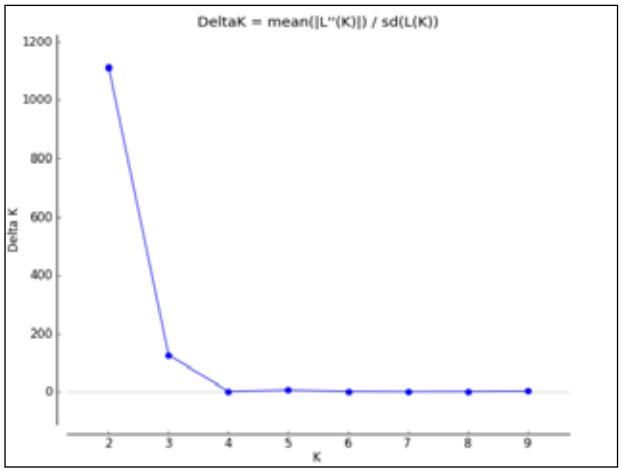


Figure. The true value of K determined by Evanno plot

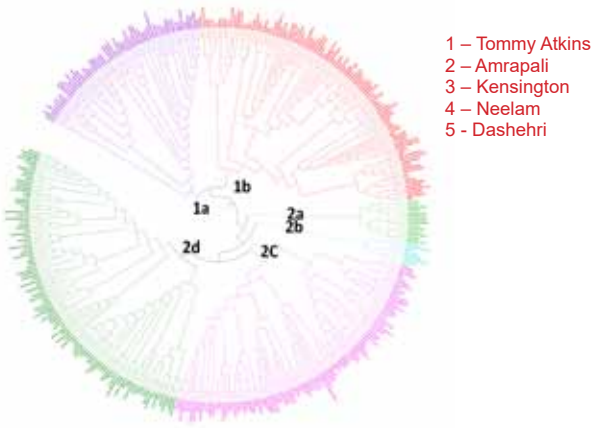


Figure. Haplotype based UPGMA phylogenetic tree of 384 mango varieties based on 60 SNPs with 100% genotypic call rates and MAF of > 0.3

ICAR Consortium Research Platform on Genomics project entitled Computational and Analytical Solutions for High-throughput Biological Data

With the advent of next generation sequencing (NGS) technologies, it has become easier to significantly enhance the analysis of SNPs and Insertions/Deletions (indels) for crop improvement. Thus, transcriptomes of three cultivars of *Cyamopsistetragonoloba*, namely, RGC-936, RGC-1066 and M-18 were analysed for the identification of SNPs and indels. Besides, a comparison among the identified SNPs and Indels of three cultivars was made to mine out the cultivar specific SNPs and indels as well as common markers among the cultivars. In addition, an online database, cbSIR, was developed based on the markers populated from the said cultivars of cluster bean.

Creating a fully characterized genetic resource pipeline for mustard improvement programme in India

Genotype-by-sequencing data of 289 *B.juncea* accessions, included in the diversity set, was processed and aligned to the reference genome. SNP calling was done by different tools like, SAM tools, FreeBayes and GATK. A total of 370629 SNPs were found but with missing values. Beagle was used to impute the missing values and subsequently, the accessions with SNPs were subjected to genome wide association studies (GWAS). Three models, namely, MLM, FarmCPU and SUPER (Settlement of MLM under Progressively Exclusive Relationship) were fitted for GWAS. Significantly associated SNPs were identified from the analysis of 11 traits and 5 locations. A very large number of associated SNPs were recognized, spreading over most chromosomes. Besides, a core set of 77 accessions was developed using GenoCore. This set was further augmented with 19 phenotypically diverse genotypes. Thus, a core with 96 genotypes was finalized and re-sequenced (8-10X). Phenotyping of the diversity set was completed for 22 phenological, morphological, quality traits at 5 locations over two years. Mixed Linear Model with germplasm effect as random was fitted and phynotypic responses were predicted. *Denovo* genome assembly of two wild species was also performed and further downstream analysis is being done.

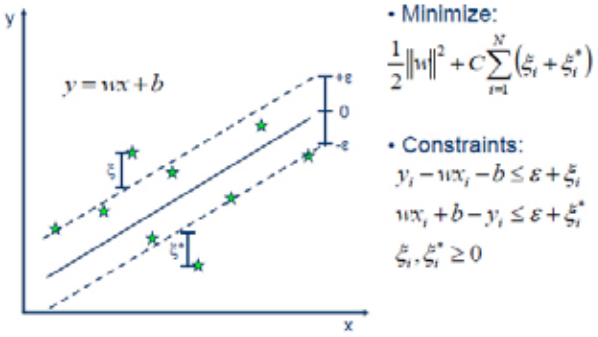
Phenomics of Moisture Deficit Stress Tolerance and Nitrogen Use Efficiency in Rice and Wheat – Phase II

Images of total 184 RILs of wheat (C306 x HD2697) and 8 parental lines with three replications under drought stress and control were received from Phenomics facility of IARI. Three types of Camera (image angles) *viz.* Visual (4 angles), NIR (2 angles) & IR (2 angles) used for collecting data at 18 phases covering growth period of wheat during January to March 2018. Analysis were carried out of these RILs wheat cultivars to classify the RIls into different groups with respect to drought stress: data cleaning and pre-processing, variable selection, SVM classification, K-mean clustering, hierarchical clustering, PCA and Estimation of heritability, repeatability and genetic correlation.

Data Description and steps of pre-processing: Following are the details of image data of RILs were used and steps of pre-processing and associated results:Total number of RILs 192 with 3 replications (drought & control) : (184+8) x 3 x 2 = 1152, Types of Camera (image angles) : Visual (4 angles), NIR (2 angles) & IR (2 angles), Time points : 18 phases, Expected number of data points = 165888 (1152 x 8 x 18), Observed number of data points = 161136, Data: 161136 x 124 (image traits observed), Remove columns with names (.Norm/.Row/Analysis): 161136 x 116, Remove columns having unique values up to two: 161136 x 87, Data Transformation : 20718 x 667, Again remove columns having unique values up to two : 20718 x 630, Remove duplicate columns : 20718 x 588, Split metadata column into Genotype, Replication and Treatment : 20718 x 590, Remove Phase 1 and 2: 18414 x 590, Imputation for missing cell values, Outlier Detection: 37256 Outliers, Remove columns having unique values up to two: 18414 x 589, Correlation analysis *(One trait from the highly correlated (> 0.95) image trait pairs were removed, one by one)* : 18414 x 373, Variance Inflation Factor (>5) : 18414 x 140, Added Interested Traits : 18414 x 148, Anova for further trait selection: 18414 x 115, Dimension of final data for further analysis (18414 x 115).

Statistical Analysis: Support vector machine was used to assess the accuracy between drought and control of RILs captured by image traits. The parameters of SMV and data with accuracy is given below (Table).

Table: Classification accuracy between drought vs control treatment based on selected image traits by using SVM



Total Data points : 8922
No of traits included : 130
Training data : 70 %
Validation data : 30 %

Normalization method : $\frac{(x - min(x))}{(\max(x) - \min(x))}$
Training parameter : *Kernal=radial, degree=3, cost=1*

Time Points	Accuracy (%)
3	0.52
4	0.50
5	0.48
6	0.49
7	0.46
8	0.68
9	0.69
10	0.78
11	0.86
12	0.87
13	0.94
14	0.94
15	0.96
16	0.92
17	0.90
18	0.81

Variance components and Estimates of Heritability of Image Traits: Restricted Maximum Likelihood Estimation method has been used for the estimation of component of variances viz. Phenotypic (Total), Genetic (G), Treatment (T), Interaction (GxT) and Error at every 18 growth stages were phenotyping has been done. Following the methods of Chen et al. 2014, and using the estimates of variance components, estimates of heritability were obtained of the image traits at every observed stages of growth (Table, Figure).

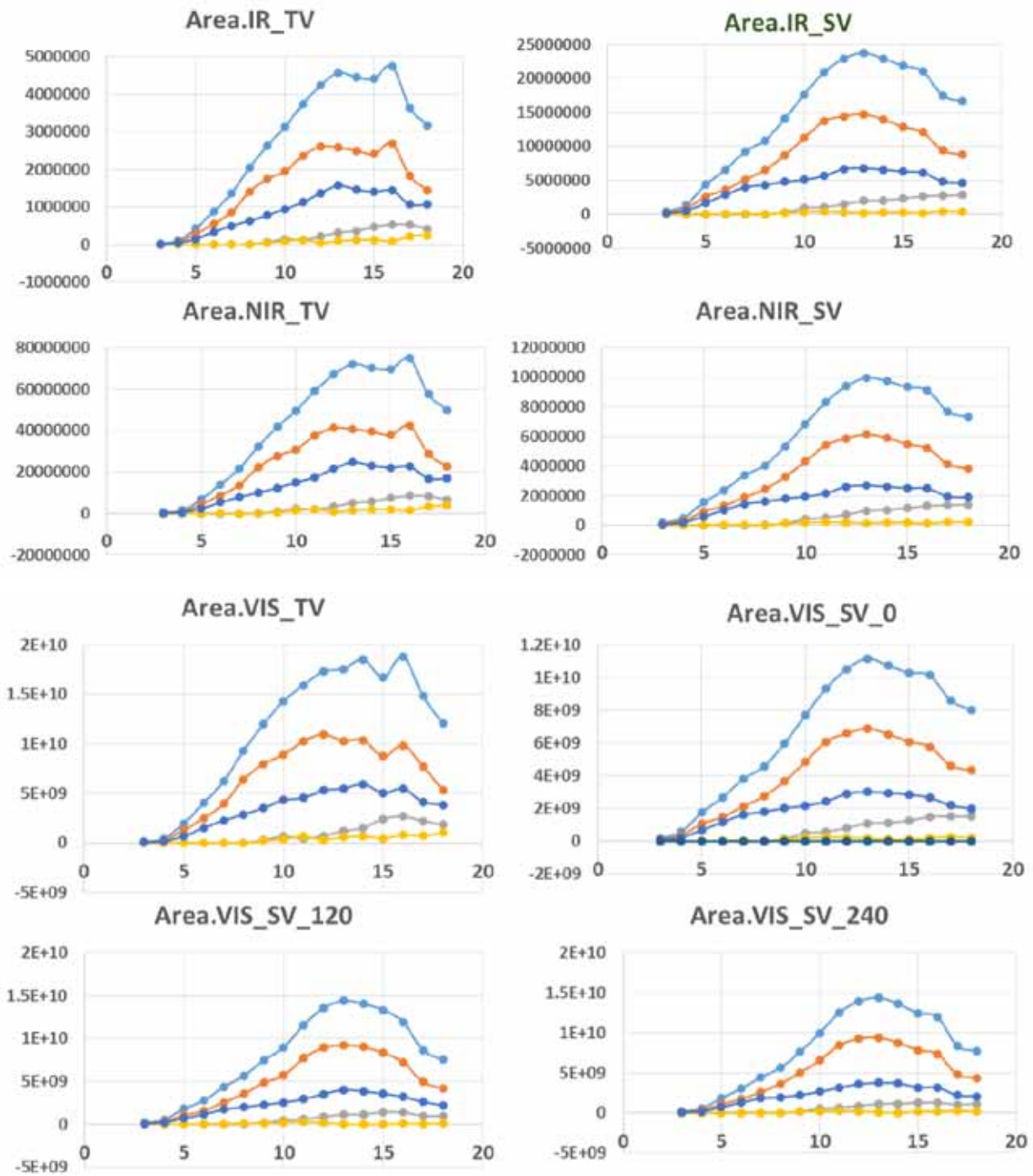
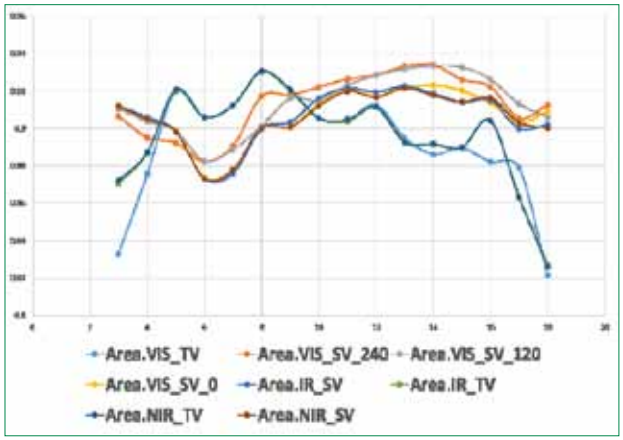
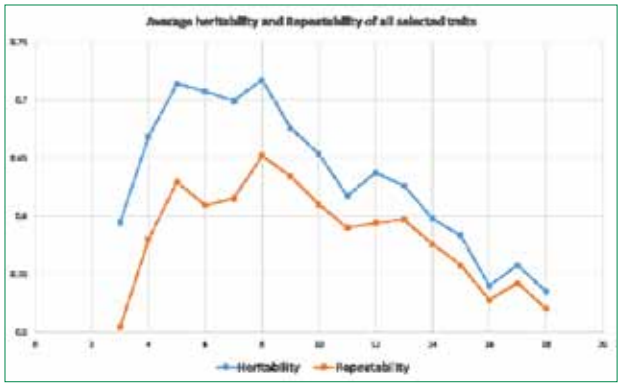


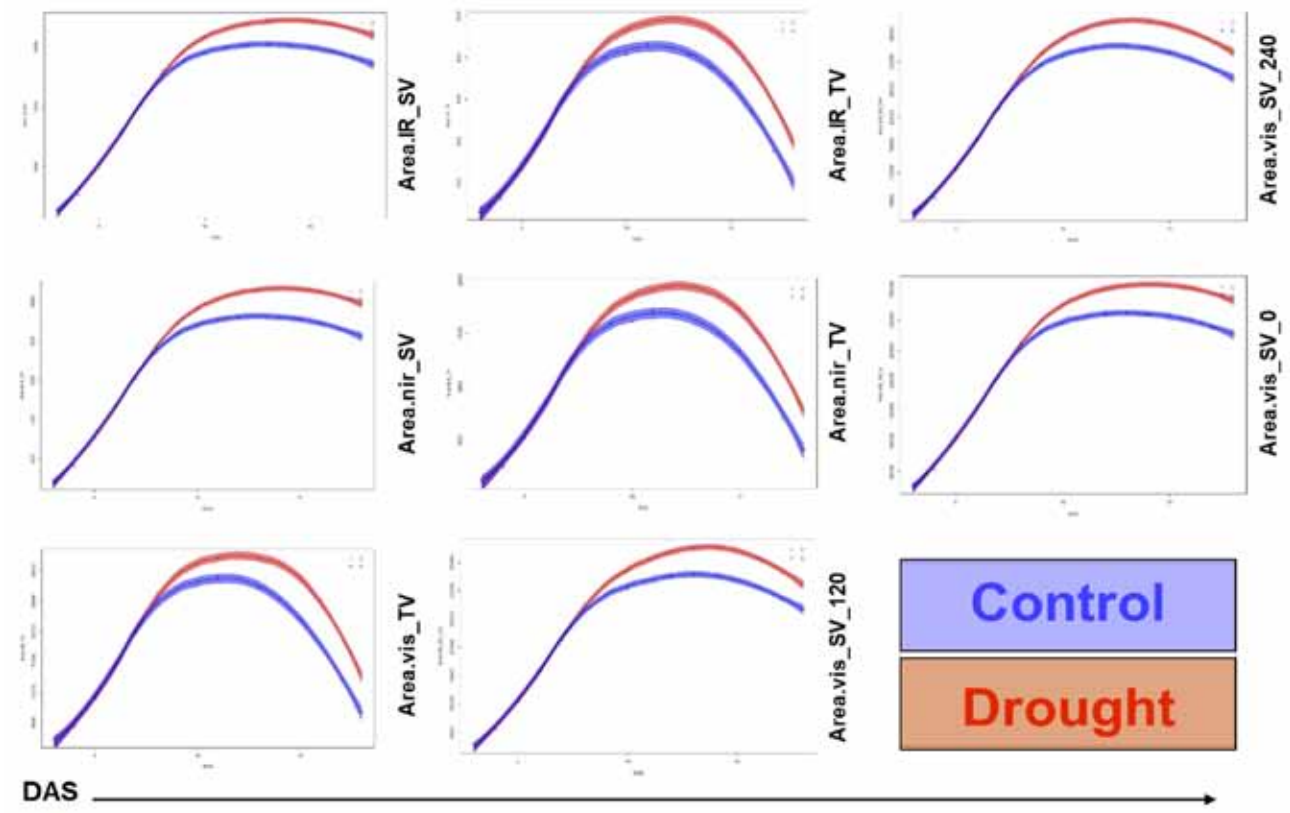
Figure: Plot of components of variances of important image traits associated with measurement of area using various camera type.

Table: Estimates of stage wise average heritability and repeatability of filtered image traits

Phase	Number of Filtered Traits	Average Heritability	Average Repeatability
3	140	0.62	0.52
4	116	0.68	0.58
5	107	0.71	0.62
6	106	0.71	0.61
7	102	0.68	0.60
8	89	0.70	0.63
9	90	0.65	0.60
10	88	0.65	0.59
11	91	0.64	0.59
12	90	0.62	0.56
13	86	0.62	0.57
14	89	0.61	0.57
15	94	0.57	0.54
16	94	0.51	0.49
17	103	0.53	0.49
18	110	0.48	0.44







High throughput Phenomics-Data Analysis Platform (HtP-DAP)

HtP-DAP isdesigned and developed to support the analysis of large-scale image data sets of crop plants captured by different camera systems. It aims to bridge the gaps by integrating different approaches to data analysis and data mining. Software has been designed in modular fashion and following module has been incorporated for post-processing/ analysis of image data: a) Project Management module: Creation and management of projects and management of large scale project specific data; b) Pre-processing module: All together six steps has been included in this module for cleaning and filtering of data. Following data operations has been integrated- Addition, Deletion, removal of null/blank values, Normalization, outliers detection and finally imputation of missing values; c) Statistical Analysis module: variable selection using variance inflation factors and other features selection methods, SVM, Clustering, ANOVA, Self-organizing map, Principal component analysis etc.; d) Genetic analysis module: Heritability analysis, linkage map construction, QTL mapping etc.; e) Visualization: Heatmap plot, Growth Modeling (linear, exponential, monomolecular, logistic, Gompertz) curves and f) Report generation Module (Figure).

Figure: Few Screen shots of the interface of the software HtP-DAP

Potential gene mining from salt tolerant grasses for improvement of salt tolerance in crops

The coverage efficiency of Control, Urochondra and Dicanthum salt treated and control transcriptome was assessed, in absence of reference genome, by relating the unique genes with the closest available transcriptome in de novo sequencing. The high-quality reads were used for the clustering of transcripts which resulted into ~123,715 clustered transcripts (in all treatments) with an average length of 1259 bp and N50 of 1819 bp. Since the shorter sequences may lack a characterized protein domain or may be too short to show sequence matches, resulting in false negative results, the contigs which were less than 300 bp in length were excluded. Approximately, a total of 48.39 million, 45.88 million, 45.02 million and 45.04 million raw reads were obtained from the control and salt treated transcriptome libraries of Urochondra, respectively. More than 94% high-quality reads (clean reads) were obtained for each group and used for downstream analyses.

Similarity search and GO annotation the clustered high-quality reads were blasted against the viridiplantae database in NCBI. Of the 123,715 clustered transcripts, 81,069 transcripts (65.52%) were annotated against uniport database and remaining 42,646 (34.46%) transcripts could not be annotated due to lack of information for Urochondra in the database. The E-value distribution of the transcripts showed that 58.03% of the aligned transcripts had similarity with an E-value range of 1e-05 to 1e-60, whereas the remaining homologous sequences ranged from 1e-5 to 0. The similarity distribution showed that 47.99% of the transcripts had a similarity higher than 80most of the transcripts had a significant level of sequence similarity to *Zea mays*, Oryza sativa, *Dichantheliumoligosanthes*, *Hordeum vulgare* subsp. *Vulgare*, *Arundo donax*, *Setaria italic*, *Sorghum bicolor*, *Cicer arietinum* and *Aegilops tauschii*. The annotated transcripts could be categorized into three ontologies i.e. Biological processes (BP), Cellular component (CC) and Molecular function (MF). Among these ontologies, BP (1931 terms) was the most abundant followed by MF (1505 terms) and CC (521 terms). The major GO terms identified for the biological processes were transcription, DNA-templated (GO:0006351), regulation of transcription, DNA-templated (GO:0006355), carbohydrate metabolic process (GO:0005975), metabolic process (GO:0008152), DNA repair (GO:0006281), DNA integration (GO:0015074), translation (GO:0006412), DNA recombination (GO:0006310), telomere maintenance (GO:0000723), transmembrane transport (GO:0055085), intracellular protein transport (GO:0006886), protein folding (GO:0006457),

signal transduction (GO:0007165), cell redox homeostasis (GO:0045454), lipid metabolic process (GO:0006629), ubiquitin-dependent protein catabolic process (GO:0006511), cell wall organization (GO:0071555), response to oxidative stress (GO:0006979) and protein transport (GO:0006979). Likewise, the major terms for molecular functions were ATP binding (GO:0005524), DNA binding (GO:0003677), metal ion binding (GO:0046872), zinc ion binding (GO:0008270), nucleic acid binding (GO:0003676), protein kinase activity (GO:0004672), RNA binding (GO:0003723), hydrolase activity (GO:0016787), protein serine/threonine kinase activity (GO:0004674), sequence-specific DNA binding transcription factor activity (GO:0003700), structural constituent of ribosome (GO:0003735), calcium ion binding (GO:0005509), oxidoreductase activity (GO:0016491), kinase activity (GO:0016301), GTP binding (GO:0005525), protein dimerization activity (GO:0046983), transmembrane transporter activity (GO:0022857), heme binding (GO:0020037) and catalytic activity (GO:0003824). The key terms for cellular components, under salinity, involved integral component of membrane (GO:0016021), nucleus (GO:0005634), cytoplasm (GO:0005737), plasma membrane (GO:0005886), intracellular (GO:0005622), chloroplast (GO:0009507), ribosome (GO:0005840), mitochondrion (GO:0005739), cytosol (GO:0005829), membrane (GO:0016020), endoplasmic reticulum membrane (GO:0005789), chloroplast stroma (GO:0009570), endoplasmic reticulum (GO:0005783), golgi membrane (GO:0000139), extracellular region (GO:0005576), chloroplast thylakoid membrane (GO:0009535), nucleolus (GO:0005730), golgi apparatus (GO:0005794) and microtubule (GO:0005874). Most abundant 10 terms from each ontology are represented as donut chart. GO enrichment analysis of both induced and repressed genes in tissue samples led to the recognition of many over-represented and under-represented GO terms in biological processes under high salt concentrations. Further, to identify the active biological pathways in Urochondra, 18,953 unique transcripts were annotated against the KAAS server. From the unique pathways identified, ribosome (981 transcripts), protein processing in the endoplasmic reticulum (900 transcripts) are the most abundant and anthocyanin biosynthesis (1 transcript) is the least in terms of the number of homologous transcripts.

Improving the usability of buffalo spermatozoa by sperm surface remodeling and immune acceptance in female reproductive tract

Under this project, attempt was made to standardize the protoocol for CNV (copy number variation) discovery. Since CNV as marker is three times more powerful in association studies of fertility traits, thus we have two groups, i.e., high fertility (HF) and low fertility (LF) group to discover. Four publicly available buffalo genomes, namely, Chinese, African, Egyptian and Mediterranean were used for discovery of CNVs. CNVnator (Vs 0.3.2), LUMPY (Vs 0.4.13) and cn.MOPS (Vs. 1.24.0) were employed for CNV discovery. Table shows the chromosome-wise CNV distribution across the genome.

Table. Chromosome-wise CNV distribution across the genome

Chromosome	Chromosome length (bp)	No. of CNVR on chromosome
Chr 1	274333569	1209
Chr 2	151974556	234
Chr 3	247349841	121
Chr 4	256333515	143
Chr 5	351974534	97
Chr 6	247347341	141
Chr 7	157349841	189
Chr 8	166334515	29
Chr 9	191974534	155
Chr 10	127347341	89
Chr 11	274209328	211
Chr 12	35274653	73
Chr 13	12368996	96
Chr 14	13253778	93
Chr 15	12576463	109
Chr 16	343096456	100
Chr 17	5645436	39
Chr 18	123654987	70
Chr 19	543764987	47
Chr 20	123409786	67
Chr 21	5367587	23
Chr 22	16538769	67
Chr 23	5479580	80
Chr 24	186524487	56

Genome and transcriptome sequencing of coriander (*Coriandrum sativum*) to reveal insight of its genomic architecture and breeding targets

Coriander (*Coriandrum sativum* L. $2n = 2x = 22$), a plant from the Apiaceae family, is a important crop used as vegetable, spice, fragrance and traditional medicine. Genome size estimation of coriander was carried out using flow cytometer that came to be 2171.4 Mbp. A total of 550 Gbp (approx.) of coriander DNA sequence data were generated produced with a depth of almost 250x. Then, a coriander genome sequence was *de novo* assembled, with cumulative scaffold length of 1982.19 Mbp (scaffolds: 8936 and contigs: 7386). For gene prediction, homologous prediction with Blast2Go and Gene wise software and *denovo* prediction using Augustus and GlimmerHMMsoftware. In total, 43128 genes were predicted in the coriander genome. Functional annotation using protein databases, NCBI nonredundant protein (NR), Swiss-Prot, KEGG and InterPro, provided function for more than 90% of genes. Also a database was developed on 3 tier architecture that catalogues the information of Cumin, Coriander, celery, fennel, Ajwain, Dil and fenugreek spices in it. The information of number of markers along with the BLAST analysis tool is available for easy user of spices breeders.

Molecular markers for improving reproduction of cattle and buffaloes

Epididymal coat of beta-defensin (like) proteins are emerging as the master regulator of fertilizing traits of spermatozoa in animals. During the period upon reported for this project, differential gene expression data were analysed for five MRT tissues (Rete testis, caput, corpus & cauda epididymis, and vas deferens) for four targeted genes. Primers were designed for qPCR using standard guidelines / HKG –GAPDH. Dose compensation curve drawn for each gene against serially diluted template and delta CT was calculated. BBD 126,129 were found to be highly expressed in terminal epididymis region of buffalo male reproductive tract of buffalo. BBD 125,126, 128, 129 & 132 were found to be expressed in non-reproductive tissues as well, hinting at the retention of their AMP role along with pleiotropic functions (reproduction). The BMGF Annual Review meet was held on February 22, 2020 at ICAR-NDRI, Karnal and evaluated as satisfactory by the committee.

Molecular characterization, development of molecular markers and metabolite analysis of Tree bean (*Parkia roxburghii*) landraces of North-East India:

Field survey, disease symptoms and fungal isolation: A survey was conducted during the month of 17th to 18th September 2019, at the tree bean growing areas of Mizoram, India. The trees and geographical details of six treewere recorded with GPS (Global Positioning Services, Model: GPSMAP 76CSx, Garmin, USA) data. The diseased and healthy trees were selected and strictly examined for confirmation of tree bean decline (TBD) disease by the presence of different syndrome (sign and symptoms) like excessive gummosis at trunk, half plant wilting and severe wilt of entire branches, excessive leaf shedding, rotting, trash, stem splitting, black streak on diseased trees (Figure).

Small bits of logs/chips from tree trunks both from healthy and diseased were collected and store in ice pack for isolation of pathogens. Big and small logs were also collected from the symptomatic and healthy plant. Number of already death trees in surveyed areas also recorded for maintaining history of disease.For RNA sequencing purpose also the same healthy and diseased plant samples were collected from leaf tissues and sent for data generation.

Figure: Different symptom of decline at Bilkhawthlir, Kolasib, Mizoram a)Wilting, b) Half portion of tree decline or whole tree death c) black streak of diseased tree in trunk and d) Dark yellow (healthy) crown cross section

Fungal isolation morphology and Identification: Six wood (H1, D1, H2, D2, H3 and D3) chips from healthy and decline trees were used for isolation of pure culture of pathogens. Isolated pathogen and Pure culture were cultured on antibacterial amended PDA medium showing cultural and conidial morphology on PDA plates of pathogen. *Fusarium* sp were frequently isolated from all diseased samples and identified based cultural and conidial morphology of pathogen. Further, *Lasiodiplodiatheobromae, Fusarium Euwallacea* and *Fusarium* sp was identified by PCR amplification of the ITS, and EF1-α, gene regions yielded amplicons of approximately 0.8 kb, and 0.35 kb, respectively.

Preliminary phytochemical parameters viz. Total phenolic content (µg Catechol/g dry tissue), Total Flavonoid Content (µg Catechin/g dry tissue), Total Protein Content (mg BSA/g dry tissue) and Total Proline Content (µ mole/g dry tissue) were estimated (Table). Preliminary antioxidant activity assay parameters DPPH scavenging activity (IC50), ABTS scavenging activity (IC50), TAC mg AAE/g, CUPRAC assay mM TE/g were also estimated from 4 tissues (leaf, pod, seed, bark). Table shows the mean values of the parameters. Further, estimation of HPLC Quantification of phenolics compounds parameters viz. retention time (RT) in minute, limit of detention (LOD) in ppm and limit of quantification (LOQ) in (ppm) were carried out (Table).

Genomics assisted crop improvement and management

A proposal on “Statistical model based prediction of discrete and continuous trait response in evolutionarily distant species using genome wide variants”, submitted by one student from Agricultural Statistics discipline, was evaluated and submitted to the PI for further consideration to send the student abroad (School of Plant, Environmental and Soil Sciences, Louisiana State university Agricultural Center, 104 Madison B Sturgis Hall, Baton Rouge, LA 708083) to carry out his research work / short term training. Besides, NAHEP-CAAST training programme on “High Dimensional Genome data

Table: Estimated preliminary phytochemical parameters

Plant Parts	Total phenolic content (µg Catechol/g dry tissue)	Total Flavonoid Content (µg Catechin/g dry tissue)	Total Protein Content (mg BSA/g dry tissue)	Total Proline Content (µ mole/g dry tissue)
Leaf	200.32	79.15	12.03	34.36
Pod	2600.97	620.76	17.28	31.27
Seed	55.38	20.32	19.65	44.07
Bark	332.64	104.08	18.03	32.65

Table: Estimated preliminary antioxidant activity assay parameters

Plant Parts	DPPH scavenging activity (IC_{50}) (Mean)	ABTS scavenging activity (IC_{50}) (Mean)	TAC mg AAE/g (Mean)	CUPRAC assay mM TE/g (Mean)
Leaf	209.17	176.09	9.46	0.68
Pod	121.04	118.34	13.46	0.49
Seed	145.26	107.32	14.49	0.42
Bark	140.67	126.23	7.23	0.46

Table: Preliminary HPLC Quantification of phenolics compounds

Name	RT (min)	LOD (ppm)	LOQ (ppm)
Gallic acid	3.466	0.5	0.75
Catechin	11.298	0.5	0.75
Caffeic Acid	12.187	0.125	0.187
Vanillic Acid	13.092	0.5	0.75
Syringic acid	14.875	0.012	0.031
t-Cinnamic acid	15.157	0.035	0.046

Name	RT (min)	LOD (ppm)	LOQ (ppm)
p-Coumaric acid	16.509	0.0156	0.0234
Sinapic acid	17.575	0.03125	0.0468
Ferrulic acid	18.376	0.03125	0.0468
Quercetin	19.140	0.042	0.062
Salicylic acid	20.58	0.125	0.187

Analysis by R and Open Source Tools" was organized during November 01-11, 2019, at Centre for Agricultural Bioinformatics (CABin), ICAR-Indian Agricultural Statistics Research Institute, New Delhi. The training was attended by twenty-seven students from 19 different State Agricultural Universities in India. Twenty-six students belong to 16 different Indian states of domicile whereas one is the citizen of Vietnam who is pursuing his Ph.D.(Plant Physiology) from ICAR-IARI have attended the training programme.

Development of web server for phenotype and genotype analysis for cattle breeding management

Systematic Information Resources for Dairy Animal Management (SIReDAM) - Web based system has been developed using PHP for server side scripting for database connectivity and database management operations. Java and HTML scripting language have been used for development of client side data entry forms and validation. Back-end MySQL database management system has been used. The web based system includes Registration, Growth, Service, Confirmation, Calving, Milking, Feeding, Health, semen collection, Disposal, Inbox, Help, Chatting, person to person communication modules. Dashboard has been made to view summery of the data available in database (Figure). One day training was conducted at ICAR-IASRI on data entry and two technical persons attended from ICAR-Central Institute for Research on Cattle, Meerut, UP on 15/10/2019. One day workshop on "Systematic Information Resources for Dairy Animal Management (SIReDAM)" was held at ICAR-Central Institute for Research on Cattle, Meerut, UP on November 05.

Platform or Integrated Genomics Warehouse

The present study aims to develop a subject-oriented, integrated, time-variant and non-volatile data warehouse for omics data in agriculture domain. The three steps Extract-Transform-Load (ETL) process will be used to extract the genetic variants data from different sources, transformed and finally loaded into the data warehouse. This high volume, variety and velocity of variants data will be stored in subject/species specific data-marts which are subsets of the data warehouse.

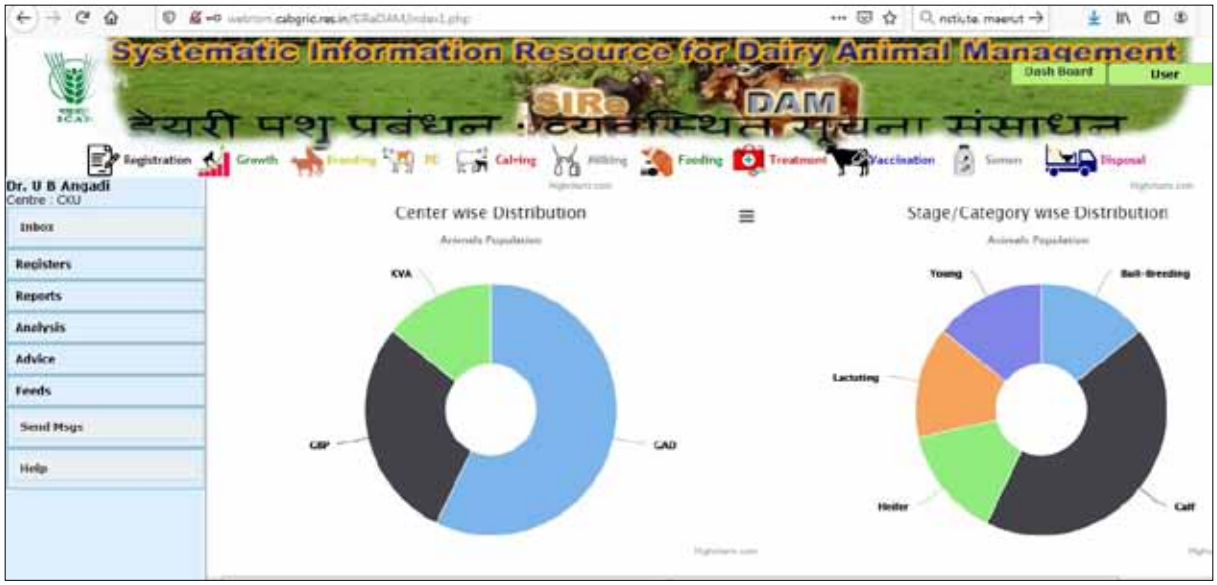


Figure: Screenshot of dashboard to view summery of the data available in database.

The system architecture for genomic data warehouse has been developed using open source software tools. The existing repository related to genetic variants were integrated through Pentaho data integration (PDI) by creating ETL process and workflow using core data integration (ETL). OLAP cubes have been developed by Pentaho Schema Workbench (PSW) with creation of hierarchies, dimensions and useful facts. The metadata of developed cubes are stored in XML format and exported to the Pentaho Business Intelligence (BI) Server for reports/ dashboards development. Further, Hadoop cluster has also been configured to address the genomic data in big data environment. This cluster will be useful for analysis and exploration of genomic data through big data environment. A web based module for exploration of genetic variants has been developed in this platform. The web based aces for SNP, SSRs and CNVs for Rice genomes have been uploaded and accessible to end users. Currently, this module is accessible in our LAN environment. A significant improvement of access time has been observed with the use of big data and Hadoop framework in accessing and querying genetic variants of Rice.

Integrated platform for genomic data warehouse will provide a source of easy to browse centralized repository with mostly useful genetic markers through analytical capabilities. The developed system/ tool can be used to develop the integrated solution for the development of any crops/species provided their genetic variants are available in public domain.

Development of an improved hybrid *denovo* whole genome assembler

A Software for hybrid assembly of genome sequences has been developed that can be used on LAN for convenience of the users. The programming languages used for the development of web interface are Java Server Pages (JSP), Cascading Style Sheets (CSS) and Java. It has been developed on Intel Xeon based 64-bit computer with 3.20 GHz-clock speed, Microsoft Windows 7 Operating System and 16.0 GB RAM. NetBeans 8.0 Integrated Development Environment (IDE) with java development kit 1.8 has been used as a platform for development of the software.

This software has been developed using client-server architecture. Heavy computations are carried out over high-end Symmetric Multiprocessing (SMP) server or Advanced Supercomputing Hub for OMICS Knowledge in Agriculture (ASHOKA) cluster to get the computation faster and achieve the results in least possible amount of time. Data size of the input files are very big and they need to be uploaded separately to divide the process in separate activities.

Software Design: The design of the assembler software has been shown in the Figure that schematically shows the modules developed under the software. This software has four modules for file and user management, Pre-processing of input sequence data, alignment for error correction, assembly of corrected sequence and scaffolding generation. A separate library has been developed for connectivity to the ASHOKA supercomputing platform and the computations thereon. Reference of the library has been added in the main application for subsequent usage. These are developed as reusable components that can be utilized in other Java based applications of various types like windows, web application and web services.

Figure: Design of the Assembler Software

Methodology: The assembly process includes many steps to carry out as mentioned in Figure. In the first step, the sequence data received from any sequencing platform needs to be pre-processed. The long read pre-processed sequence data are aligned using short read sequences for correcting errors. These corrected long read sequences are then assembled using an assembly program. Finally, these assembled sequences are combined together to form scaffolds using another available program.

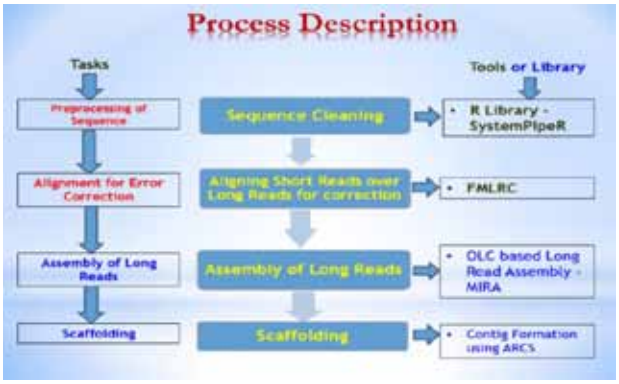


Figure: Workflow of the developed assembler

Pre-processing: Pre-processing of next generation sequencing data is carried out for quality checking. The following activities are carried out for quality checking.

- Import of data from BAM, SAM or FastQ files (any variant)
- Providing a quick overview to tell the areas where there may be problems
- Summary graphs and tables to quickly assessment data
- Export of results to an HTML based permanent report
- Offline operation to allow automated generation of reports without running the interactive application

It uses the **FastqStreamer** function from **ShortRead** package to stream through large FASTQ files in a memory efficient manner. It performs adapter trimming with the **trimLRPatterns** function from the **Biostrings** package of R. After the trimming step, a new targets file is generated (targets_trim.txt) containing the paths to the trimmed FASTQ files.

Assembling Corrected Long Reads: Long read sequencing is changing the landscape of genomic research, especially *de-novo* assembly. Despite the high error rate inherent to long read technologies, increased read lengths dramatically improve the continuity and accuracy of genome assemblies. However, the cost and throughput of these technologies limit their application to complex genomes. One solution is to decrease the cost and time to assemble novel genomes by leveraging “hybrid” assemblies that use long reads for scaffolding and short reads for accuracy. MIRA - a multi-pass DNA sequence data assembler/mapper for whole genome were used.

Scaffolding: ARCS is an application that utilizes the barcoding information contained in linked reads to further organize draft genomes into highly contiguous assemblies. It harnesses the barcoding information contained in linked read data for connecting high-quality sequences in genome assembly drafts. For layout building, ARCS’ gv file is converted to a tab-separated value (tsv) file listing all possible oriented sequence pairs, the number of supporting barcodes with gap sizes arbitrarily set at 10 bp. This is facilitated by the supplied python script (makeTSVfile.py). Since positional information of reads within the molecule of origin is not known, estimation of gap sizes is not a straightforward problem, and would require more sophisticated approaches. ARCS first pairs sequences within a draft assembly, then lays out the pairing information for scaffolding. Input alignments in BAM format are processed for sets of read pairs from the same barcode that align to different sequences. A link between the two sequences is formed. Each link represents evidence that one barcode/molecule connects the sequences.

Client interface: This web-based assembler software that is freely accessible for LAN users. User authentication is needed to ensure security. It is accessible only after entering valid user name and password. For getting user name and password, any user may sign up by clicking on appropriate link on home page. The home page (Figure) of the software presents the user with a brief welcome note on the software.

Figure: Home page of the assembly software

Data Management: It includes registration of user profile (data stored in MYSQL database), Email notification, folder management, file management, Input selection and output management.

The genome assembler developed under the project carries out the assembly process in the form of pipeline using fast available algorithms. The pipeline carries out the processes such as preprocessing of short and long read sequences, correcting the errors in the long reads, assembly of corrected long reads using a fast and parallelized assembler to form contigs and finally scaffolding these contigs using a parallelized scaffolding tool. The whole process of computation can be carried out using a web browser for convenience of the user. The results of every computational steps are downloaded to the client machine for viewing. The output the of the developed software was also tested for its quality using a web-based tool. It is known that new technologies in the computational and hardware resources are emerging very fast which is making heavy computational task easier. Therefore, the process of assembly may further be improved with availability of more high-end computational resources.

Discovery of novel genes and promoters responsible for salinity tolerance in *Haloarcula* spp.

Sequence motifs/Transcription factor binding sequences are found in upstream regions of genes. The genomic sequence of the microorganism under investigation is not available so the upstream regions from the genomic sequences closely matching with the transcript sequences from the microorganisms used in this study (found using blast with NCBI nr database) were analyzed for motif sequences. RSAT tool was used for this purpose. (https://rsat01.biologie.ens.fr/rsat/RSAT_home.cgi). The following motifs were found in these sequences (Table):

TATA Box	TTTATAATA
BRE	ATACTA
INR	(T/C)(A/G)TG or (T/C)(G/A)(A/T)(G/T)AAA
PPE	ATAAA

Table: Motif sequences found in upstream sequences of genes closely related to upregulated transcripts

Identification of promoters in each selected gene: Since the genomic sequence of microorganism investigated in the current study is not available, the transcript sequences of the selected genes were subjected to blast with NCBI nr database. A 1 kb upstream region of the matching genomic sequence was analysed for promoter analysis. The results are shown below in Table:

Table: Promoters identified in upstream sequences in closely related genes of upregulated transcripts

These transcript sequences were uploaded in Possum web server for prediction of sequence motifs. Score defines the log likelihood of presence of sequence at a particular position. A threshold score of 7 was selected to find probable sequence motifs. Transcribed sequences were translated into ORFs using Translate server of EXPASY. The largest ORF was selected and blasted against protein sequence database and if the annotation comes same to the transcript annotation that was selected as final ORF and converted to amino acid sequence. The amino acid sequence was further input into Phyre for prediction of 3D protein structure. This method employs homology modelling and incorporates new ab initio folding simulation called Poing to model regions of the proteins with no detectable homology with protein structure database

Development of methodology for trait specific gene identification

In order to develop methodology for selecting trait specific relevant genes from biological expression data using Support Vector Machine (SVM) and a Genetic Algorithm (GA) which will be used to control and optimize the subset of genes sent to the SVM for classification and evaluation, relevant gene expression data sets have been explored and downloaded from NCBI. R codes have been developed to obtain simulated gene expression dataset. Differentially expressed genes have been

S.No.	Gene	Position	Strand	Score	Sequence
1	XLOC_001655	430	+	4.510	TTGAACTTGTCGACCAGCCACTGCACGAT
2	XLOC_004533-	-	-	-	-
3	XLOC_004540	-	-	-	_
4	XLOC_005818	130	+	6.844	TCGACGTCGTCGAATACCTCGGTAAACT
5	XLOC_005903	389	+	4.856	ATGACGAACGAGGGCAGGTCGTCGAAAAT
6	XLOC 006089	-	-	-	-
7	XLOC 008875	696	+	12.729	TTGACAAGAACGAATGTTCGTATATAAT
8	>XLOC_010712	-	-	-	-
9	>XLOC_012148	-	-	-	-
10	>XLOC_005883	-	-	-	-
11	>XLOC_005211	-	-	-	-
12	>XLOC_004942	-	-	-	-
13	>XLOC_004593	-	-	-	-
14	>XLOC_004191	-	-	-	-
15	>XLOC_003610	-	-	-	-

obtained from these simulated and real datasets. R code has been written to implement genetic algorithm and test the fitness of an initial generation of selected individuals. Training of these genes on SVM and to determine the performance of the SVM on the test data has been done.

Development of algorithms and software for Informative Gene Selection:

Informative gene selection from high dimensional gene expression data has appeared as an important area of research in agri-genomics. Different gene selection techniques has been developed in recent time based on relevancy and redundancy of genes with class and among the genes. Most popular techniques for informative gene selection are Maximum Relevancy and Minimum Redundancy (MRMR) and Support Vector Machine Recursive Feature Elimination (SVM-RFE). However, these methodology have some drawbacks. One of the major drawback is that it ignores the spurious relations between genes and trait under study. In this study, an algorithm for informative gene selection has been developed which takes care of this spurious relation by implementing the bootstrap technique along with SVM-RFE and MRMR (Figure). In order to proper implementation and dissemination of the developed methodology, a user friendly web-based tool named “Informative Gene Selection Tool (IGST)” has been developed by using state of the art technology (Figure). This study will provide a practical guide to select informative genes from high dimensional expression data to enhance the molecular breeding program in the area of agriculture science.

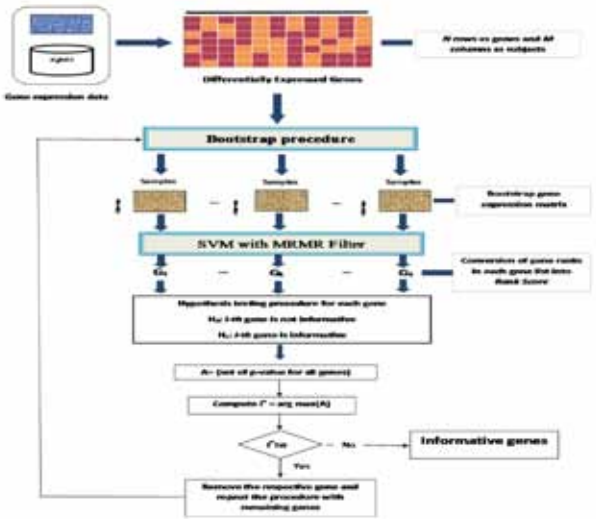


Figure: Schematic diagram of the methodology followed

Figure: Homepage of the developed tool

Machine learning approach for binning of metagenomics data

Machine learning techniques have been applied for the binning of metagenomics data in both supervised and unsupervised manner. There are several issues that needs attention of researchers in accurate and efficient binning of metagenomics data. Survey of literature revealed that uneven abundance of species in the metagenomics sample is a challenging task. Many techniques for representing the genomic fragment using genome signature methods have been explored. Some of the genomic signature methods are GC contents, tetra nucleotide frequency, di and tri nucleotide frequency patterns, amino acid count, synonymous codon usage count, mutual information profiles etc. But existing methods utilizes mostly one method. So, there is a scope of applying these methods in a composite way with the aim of improving binning.

Further, markerbased approaches are helpful in accurate clustering of metagenomics reads. Machine learning has been successfully applied in this domain but there exists a scope of combining these methods for better binning accuracy and efficiency. This study would aim at development of efficient and improved method for binning of metagenomics data considering these aspects. This is a new study that has been initiated and new proposal was submitted and approved. A study of existing genome signature methods have been explored and program are written to calculate the GC contents, tetramer frequencies and amino acid frequencies.

Genome wide association study in Indigenous poultry breeds/varieties

An investigation has been recently initiated in collaboration with CGIAR Intitute: International Livestock Research Institute and ICAR-Directorate

of Poultry Research with an aim to perform GWAS in indigenous poultry breeds / varieties. A total of 7 chicken breeds (Native chicken breeds- Aseel, Ghagus, Nicobari, Kadaknath, Hansli and tropically adapted chicken breeds- PB-1 (a broiler type line) and IWH White Leghorn layer chicken) were included in the study. From each breed, a total of 10 birds (5 males and 5 females) were randomly selected and their genomic DNA samples were given to M/s Nucleome, Hyderabad for whole genome sequencing with 10x coverage under Illumina NovaSeq platform. The raw reads of the samples varied from 7.3 to 262 million. The raw Q20 score was more than 95.8 while Q30 score was more than 91.2 indicating the good quality sequence data of the samples generated from the sequencing platform. The raw data is being analysed for detection of SNPs present in the genome.

Estimation of breeding value using generalized estimation equation and Bayesian Approach: Used different distribution of link function and different covariance structure using the mixed model. Review of literature is being studied and collected and work on to develop a suitable approach for estimation of variance component using generalized estimating equation (GEE) by considering the correlated structure of both random effects and errors is going on. Bayesian analysis was done and posterior for the heritability h^2 is calculated. Used different prior setting for obtaining estimated heritability. Different distribution of link function is assumed, work is going on using the link function is Logit i.e. Log(μ/(1- μ)) and also different covariance structure is assumed. Under the 1st objective, Bayesian analysis was done using INLA model and posterior for the heritability h^2 is calculated. Under objective 2: "To develop a Bayesian based approach for estimation of breeding value", different posterior densities are derived and first work to the objective is to check by empirical study by making R programming.Review of literature is being studied and collected and work on 1st objective is going on. Under 2nd object-**Bayesian linear mixed model (BLMM): Y = X ß+ ZU+,** where, **Y** is response vector of size nx1. ***β*** is a vector of size p x 1 fixed effects that follows a multivariate normal distribution with zero mean vector, and prior covariance matrix $\mathbf{B}\sigma^2_{\beta}$, where ***β*** is a non-singular un-scaled covariance matrix of size p x p and σ^2_{β} is the scale parameter. Here, $\mathbf{B}\sigma^2_{\beta}$ is treated as known. ***U*** is a vector of size n x 1 containing genetic effects that follow a multivariate normal distribution with zero mean vector, and covariance structure $\mathbf{A}_G\sigma^2_U$, where $\mathbf{A}_G$ is the genomic relationship matrix of size n x n and σ^2_U is the genetic variance component. Known incidence matrices ***X*** and ***Z*** are relating phenotypic records to respective parameters included in (1), and ***E*** is a vector containing independent residual errors that follow a multivariate normal distribution with zero mean vector, and covariance structure $\mathbf{I}\sigma^2_E$, where **I** is the identity matrix of order n. here, we will use the one genetic (random) effect case in all equations, but it is straight forward to generalize the model to handle multiple random effects.

A data set is collected which is described below:The dataset collected was studied by Liu *et al*.(2019). They studied cross between SYN-D × Weebill 1 and 276 entries of RIL population was derived. SYN-D has dark green broad leaves without wax which is synthetic derived hexaploid wheat. It was seen that segregation for Rht-B1, Rht-D1, Ppd-A1, Ppd-D1, Vrn-A1, Vrn-A1, Vrn-D1, and Eps-D1 genes is constrained in RILs. They also showed a narrow range of phenology, hence avoids the confounding effect of phenology to identify QTL that may otherwise be masked by crop development. Randomized lattice design was used to study the whole design with two replications under four environments. The four environments considered here is –(i) drought (2009-2010, D10) (ii) heat (2009-2010, H10) (iii) heat + drought (2011-2012 and (iv) heat + drought (2012-2013, HD12 and HD13). Drought stress (D) was applied by normal planting (late November) with significantly reduced irrigation (total water supply < 200 mm); heat stress (H) was applied by late sowing (late February) with supplementary irrigation (total water supply > 700 mm) to avoid the effect of drought; the combined stress (H+D) was applied by delayed planting date (late February) with reduced irrigation (total water supply < 200 mm). **Result:** In primary dataset, we have used SNP(50K) matrix with A-T-G-C format to compute the genotype matrix with 0(aa)-1(AA)-2(Aa) format. Next wen have used a imputation technique to replace the missing values. After the successful preliminary process we have used the differct phenotypic character to estimate the heritability and estimated breeding values. Initially RR-BLUP was used and following RR-BLUP, We have analyzed the dataset using Bayesian Mixed model. The estimated heritability of the 6 characters are calculated and presented in the Table.

Table: Different character along with heritability

Character	Heritability
Yield	0.52
TGW	0.62
GM2	0.64
DTA	0.48

Character	Heritability
DTM	0.60
PH	0.56

Considering Generalized Estimating Equation (GEE and using the correlated structure of both random effects and errors, estimation of variance component. Considering Generalized Estimating Equation, an attempt has been made to study breeding value in longitudinal data. From proposed structure, we are trying to use different correlated structure and incorporating the structure in the model. Using Generalized Estimating Equation, a work is in progress to use different covariance structure and estimate heritability from longitudinal model:

Structure	Description	{i,j}th element
AR (1)	Autoregressive(1)	$\sigma_{ij} = \sigma^2\rho^{\|i-j\|}$
VC	Variance Components	$\sigma_{ij} = \sigma_k^2 1(i = j)$ and i corresponds to k^{th} effect
ARH(1)	Heterogeneous AR(1)	$\sigma_{ij} = \sigma_i\sigma_j\rho^{\|i-j\|}$
CSH	Heterogeneous CS	$\sigma_{ij} = \sigma_i\sigma_j[\rho^{1\|i\neq j\|+1\|i=j\|}]$
TOEPH	Heterogeneous TOEP	$\sigma_{ij} = \sigma_i\sigma_j\rho_{\|i-j\|}$

A study on detection and interpretation of expression quantitative trait loci (eQTL) mapping: Work on development of Statistical Methodology for eQTL(s) mapping in presence of correlation and study and compare the performance of developed mapping procedure with various existing procedure is in progress. Work on 3rd objective i.e. "Study and compare the performance of developed mapping procedure with various existing procedures. Currently, analysis is going on assuming a regression equation of gene expression measurement and using Bayesian paradigm where Beta distribution as a prior distribution. In parallel with that study and reviewing of literature is going on to include epitasis interaction in the assumed model. Application of different model approach for EQTL mapping is in progress for Barley gene expression. Under 3rd analysis is going on assuming a regression equation of gene expression measurement and using Bayesian paradigm where Beta distribution as a prior distribution, where model gene expression measurements across individuals is given below-

$$y_{ig} = \mu_g + \sum_{j=1}^{s} x_{ij}\gamma_{jg}\beta_{jg} + \varepsilon_{ig}$$

In parallel with that study and reviewing of literature is going on to include epistasis interaction in the assumed model. Application of different model approach for eQTL mapping is in progress for Barley gene expression. Under this objective, a comparative study is going on to compare Bayesian model with linear Model by checking the number of detected eQTLs. The dataset is analyzed using R-qtl package which is based on t test statistic and hidden Markov model (HMM) technology to calculate eQTL genotype probabilities, to simulate from the joint genotype distribution and to calculate the most likely sequence of underlying genotypes (all conditional on the observed marker data). LOD is score is calculated and best on the LOD is score compared with the threshold value, eQTL is considered. Work on the first objective for the development of statistical methodology for eQTL(s) mapping in presence of correlation is going on in Bayesian prospective using different prior setting. An attempt has been made to use different prior settings in Bayesian paradigm and use random forest for detecting eQTL in presence of correlation.

Study on Robust Estimation of Heritability: SAS Code for simulation of data using t-distribution has been developed. Data has been generated with various parameters. Efficiencies of estimation of heritability in case of normal data and outlier data for normal distribution case are obtained. Outliers often pose problems in analyses of data in not only plant breeding, but also different field of study. Their influence on the performance of methods for estimating predictive accuracy in genomic prediction studies has not yet been evaluated. Here, the influence of outliers on the performance of methods for accuracy estimation in genomic prediction have been evaluated. 500 phenotypic observations were simulated with 7 replication generated by simulation to evaluate the influence of outliers on the performance of different methods for estimating accuracy. To mimic outliers, outlying observations were added which are 3% of total observations in each simulated dataset as 5 times the error SD used to simulate phenotypic dataset. The effect of outliers on accuracy estimation was evaluated by comparing deviations in the estimated and true accuracies for dataset with and without outliers. In this project then dataset were simulated and accuracy is estimated by different methods using different distributions also. Two distributions namely, Normal, student's-t distribution are assumed and using the simulated dataset, RR-BLUP method is applied and their accuracy is estimated. Here, the case of a trial conducted in a single location was considered. The

analysis is done using two stage approach. The model for the observed plot data can be written as

$$y = X_1\mu + f$$

where y is the vector of the observed phenotypic values, μ is a vector containing the adjusted genotype means to be estimated from a model in which genotype enters as a fixed effect and X1 is an associated design matrix and f combines all the fixed, random design and error effects.

The adjusted means from the first stage are used in the second stage to predict the true breeding values g. The second stage model is given by- $\hat{\mu}_i = \phi + g_i + e_i$ where, $\hat{\mu}_i$ is the adjusted mean of the i-th genotype (estimates of $\hat{\mu}_i = \phi + g_i$ from the first stage), φ is the general effect or mean, g_i is the random effect of the i-th genotype and e_i is the residual error; $e_i \sim N(0, R = I\sigma_e^2)$ and , where Z is the matrix of SNP marker covariates, $u \sim N(0, I_p\sigma_u^2)$ I_p is the p -dimensional identity matrix and σ_u^2 is the variance of marker effects. We simulated the random SNP marker effects as random draws from a normal distribution with zero mean and variance σ_u^2. We therefore simulated the field trial data according to an RCBD design. Now simulated dataset is applied and accuracy is estimated using three different models which are presented in the following Table& Table.

Table: Accuracy of the model using Normal distribution with and without outlier

	Without outlier	With outlier
Method 1	0.9764	0.8636
Method 2	0.7314	0.4715
Method 3	0.9994	0.9888

Table: Accuracy of the model using student's t distribution with and without outlier

	Without outlier	With outlier
Method 1	0.7509	0.7675
Method 2	0.9998	0.7854
Method 3	0.9088	0.8988

Statistical approach for genome-wide association studies and genomic selection for multiple traits in structured plant and Animal population

R-codes for genomic prediction using G-BLUP and EG-BLUP are being evaluated for single trait genomic prediction in different plant species. Kernel averaging techniques are employed for genomic prediction in a wheat dataset consisting of 599 genotypes and 1479 Dart markers. This technique is seen to be giving more accuracy than different Bayesian approaches such as BayesA, BayesB, BayesC, Bayesian LASSO and Bayesian ridge regression. This analysis is performed in a cross-validation mode. The methods BayesA, BayesB, BayesC, Bayesian LASSO (BL) and Bayesian Ridge Regression (BRR) were employed for genomic prediction in Wheat dataset that comprises 599 genotypes and 1479 DArT markers. The trait of interest is yield in four mega environment i.e., Env-1, Env-2, Env-3 and Env-4. Prediction was made following 10 fold cross validation techniques. Accuracies are given in the Table.

Table: Prediction accuracy of different genomic prediction methods

	Env-1	Env-2	Env-3	Env-4
BayesA	0.523	0.512	0.376	0.439
BayesB	0.518	0.514	0.371	0.435
BayesC	0.519	0.514	0.383	0.442
BL	0.522	0.513	0.386	0.434
BRR	0.526	0.514	0.381	0.443

It can be seen that BRR achieved highest accuracy in three environments, whereas BL performed better than the others in 3rd environment. Further, it is observed that genomic prediction accuracies are higher for the 1st environment and lower for the 3rd environment.We evaluated the performance of eight different genomic prediction methods i.e., BayesA, BayesB, BayesC, Bayesian LASSO (BL), Bayesian ridge regression (BRR), Ridge regression BLUP (rrBLUP), genomic BLUP (G-BLUP) and compressed BLUP (C-BLUP) on Barley dataset collected from the public domain. It consisted of 309 advanced spring barley lines that were tested at two locations each with three replicates and phenotyped (Nielsen et al., 2016). Each line was genotyped by 7865 SNP markers using Illumina iSelect 9Kbarley chip. Phenotypic measurements considered were seed size, protein content (PR), protein yield, test

Table: Trait wise accuracy of different genomic prediction methods in Barley dataset

Trait	BayesA	BayesB	BayesC	BL	BRR	C-BLUP	G-BLUP	rr-BLUP
ER	0.760±0.011	0.759±0.010	0.757±0.011	0.756±0.009	0.759±0.011	0.730±0.014	0.730±0.014	0.764±0.010
PR	0.574±0.019	0.579±0.017	0.570±0.017	0.565±0.016	0.567±0.017	0.566±0.023	0.566±0.023	0.568±0.016
TW	0.578±0.017	0.575±0.017	0.575±0.020	0.572±0.017	0.576±0.017	0.460±0.018	0.640±0.018	0.582±0.019

Table: Trait wise accuracy of different genomic prediction methods in maize dataset MAIZE

	BayesA	BayesB	BayesC	BL	BRR	C-BLUP	G-BLUP
SS	0.417±0.019	0.405±0.025	0.421±0.025	0.417±0.024	0.423±0.023	0.390±0.031	0.411±0.030
WW	0.557±0.022	0.552±0.019	0.558±0.020	0.557±0.022	0.559±0.018	0.502±0.019	0.502±0.019

weight (TW) and ergo sterol (ER) content. Here, only PR, TW and ER were considered, for which 307 genotyped lines were available. The accuracies are given in the Table. The rr-BLUP, G-BLUP and BayesB achieved highest accuracies for the traits ER, PR and TW respectively.

The performance of eight different genomic prediction methods i.e., BayesA, BayesB, BayesC, Bayesian LASSO (BL), Bayesian ridge regression (BRR), Ridge regression BLUP (rrBLUP), genomic BLUP (G-BLUP) and compressed BLUP (C-BLUP) on Maize (DSM) dataset were evaluated. The DSM consisted of 300 maize lines from Drought Tolerance Maize for Africa project of CIMMYT Global Maize Program genotyped with 1148 SNP markers (Crossa *et al*., 2010). Here, grain yield for well-watered (WW) and severe stress (SS) conditions, which was examined for 264 lines were considered. Performance of each method was measured following 10-fold cross validation, where the experiment was repeated 1000 times. R-program was developed for execution of each of the method in cross validation mode. Genomic prediction accuracy was measured by using the correlation between observed phenotypic value and predicted phenotypic value. The average correlation over five folds of the cross validation as well over 1000 experiments was used as the final accuracy of each method. The accuracy for each method is presented in the following Table.

One data set is collected. Work is going on Parameter estimation in a Multivariate Linear Mixed Model (MLMM) using Derivative approach and derivative free approach. Among derivative-free methods, we working on the (restricted) likelihood function and the derivative-based methods include the expectation maximization (EM) algorithm (Meyer *et al*., 2004) and its accelerated version using parameter expansion (PX-EM) (Meyer, 1991; Kang, 2010) and the Newton-Raphson (NR) algorithm (Lippert *et al*., 2011; Pirinen*et al*., 2013) and its variant, the average information (AI) algorithm(Yu, *et al.*, 2006), among derivative-free method,we are working on EM algorithm. Simulation study is being carried out to evaluate the performance of 10 different methods of genomic prediction. For genomic prediction study, different methodologies have been applied and compared for three datasets i.e. Wheat (Crossa *et al.*, 2010), Maize (Crossa *et al*, 2010) and Barley (Nielsen *et al.*, 2016). These datasets are collected from public domain. Performance of each method was measured following 10-fold cross validation, where the experiment was repeated 1000 times. R Program was developed for execution of each of the method in cross validation mode. Genomic prediction accuracy was estimated by using correlation between observed phenotypic values and predicated phenotypic values. The average correlation over five folds of the cross-validation as well over 1000 experiments was used as final accuracy of each methods. These are the following methodologies we have applied: Bayes A, Bayes B, Bayes C, BRR, C-BLUP, G-BLUP, rrBLUP. BLUP alphabets are observed to achieve higher accuracies than the Bayesian alphabets. Accuracy of G-BLUP and rr-BLUP are found to be almost same for all traits under study, which is in accordance with the theoretical establishment of both the methods. In most of the cases, performance of C-BLUP is observed not to be better than that of G-BLUP and rr-BLUP which is in contradiction with existing study, and hence need further validation. Genomic prediction of G-BLUP model using multiple kernel approach is being evaluated in three different datasets i.e., wheat, maize and barley.

Gene selection for classification of crop gene expression data

In this study, attempts have been made to develop some gene selection techniques to identify the informative genes from large microarray data, which may help in gene class discovery. First, a technique called GSAQ for gene set analysis with trait specific QTLs was proposed, which can be considered as a valuable tool for performing gene(s) enrichment analysis in plant breeding context. The GSAQ approach will also provide a valuable platform for integrating the GE data with genetically rich QTL data to identify potential QTL enriched gene sets or set of QTL candidate genes, which may act as valuable input or hypothesis for the plant breeders for designing breeding experiments. The credibility of the proposed method (GSAQ) was statistically

established by comparing its performance with the only existing approach (GSVQ) through a statistically strong criterion, i.e. FDR, in five different stress scenarios in rice.

Second, a statistical approach for informative gene selection from such GE data by considering gene relevance and redundancy was proposed simultaneously. Here, the informative genes were selected based on the statistical criterion, which is more convincing as compared to other competitive gene selection techniques. Further, the GSEQ analysis provided two innovative biologically relevant criteria for performance analysis of gene selection technique(s). Through this, it was observed the gene set obtained by Boot-MRMR are more enriched with the underlying QTLs and has more functional similarity as compared to other techniques. Further, the systematic MCDM-TOPSIS analysis of the gene selection techniques revealed that Boot-MRMR approach is better method over the available alternatives with respect to a broad spectrum of criteria.

Third, an R-package BootMRMR was developed for selection of informative features like genes, transcripts, RNAseq, etc. using Bootstrap Maximum Relevance and Minimum Redundancy technique from a given high dimensional genomic dataset. The package is freely available at https://cran.r-project.org/web/packages/BootMRMR/index.html. Another R-package GSAQ for gene set analysis with QTL was also established. This package can be useful for computation of QTL hits in the selected gene set, performing gene set validation with QTL information, performing gene set enrichment analysis with available QTL data and computation of statistical significance value from gene set analysis.

Programme 5: Development of Informatics in Agricultural Research

Implementation of ICAR-ERP, Unified Communication and Web Hosting Solution

Customization / Development of New Functionality and Reports:

- Major budget had been created for ICAR HQ to allocate budget institute wise. The budget had been entered on major heads and scheme wise.
- Financial Dashboard was developed as per revised format to view sanctioned/released budget and expenditure for all ICAR institutes. The dashboard has functionality to download the data in MS Excel format.
- New responsibility for ICAR Manager Self-Service has been created
  - Absence of All Direct Reportees
  - Apply Leave on DRs behalf
  - Salary structure and Service Record - View Mode only
- Emeritus Scientist scheme included in LOV of ICAR Project Details Report
- Personalized end employment date in system for restricts wrong entry of superannuation based on age calculation.
- Added the basic calendar for date wise expenditure tracking.
- Alert notifications for employee address change/update, joining report to institute admin sections.
- Functionality added for deduction of salary in case of Half Pay Leaves based on HPL month applied.
- Cleared the ICAR Pending Invoice Report and Global Bursting Report.
- Matched expenditure of 26 institutes and contacted 111 institutes for expenditure matching.
- Customized the ICAR Account analysis report with payment date.
- Customized ICAR payroll employee wise New Pay Register report. NPS for adding added employer NPS share in earnings and deductions.
- ICAR Employee Payroll Data New: merged same account head elements, PFMS ID, Bank Account No, Employer NPS Share in Earnings and Deductions.
- Customized ICAR Employee CCL element to limit the maximum restriction.
- Allowance were incorporated as per 7th CPC viz. Island Special Duty Allowance, care taking Rate change and DA.
- Created the functionality for updating the budget value up to the value of expenditure done till that date.
- Enablement of the Verified by DDO functionality along with report.
- Updated the ICAR Invoice Register - Budget Head Wise - user can get the details of beneficiary in case of any beneficiary added to the payment.
- Employer NPS Share in Earnings and Deductions

changes made in following reports:

- ICAR Payroll Employee Wise New Pay Register Report – NPS
- ICAR HQ Payroll Employee Wise Pay Register Report
- ICAR HR Pay Slip Report NPS
- ICAR_PAYSLIP_FORM_PRINT (Self-Service Pay Slips)
- ICAR Employee Payroll Data Report New

- Developed ICAR requisition indent approval alertto send a notification mail to requisition indenter that indent is approved successfully.
- GAR Report customized which is fetching complete financial year employees earnings and deductions data.
- Created the GPF Opening Balance functionality to capture the last financial year closing balance automatically for current financial year opening balance in GPF statement report.
- Customized ICAR TDS Detailed Report.
- Expenditure Mapping ICAR institutes and restriction personalization on Previous SGST & CGST Tax.
- Developed invoice cancellation API.
- Modified in invoice after verification by DDO. It displays the details on ICAR Bill report who have validated the bill.
- The functionality developed for automatically carry forward of EL, HPL, CCL and addition of 10 HPL and 15 EL.

Review Meeting:

- Three Technical committee meetings have been organized to find out the way forward for migrating the ERP on higher version or alternate solution.
- Organized various meetings to monitor the progress of ERP under the Chairmanship of Secretary, ICAR.
- Successfully organized four FMS Financial Workshops for Finance and administrative officer of ICAR institutes on September 16, October 15, October 21 and October 31, 2019. Dr. T. Mohapatra, DG ICAR & Secretary DARE inaugurated the workshops.

Monitoring & Coordination for Effective Implementation:

- MSR Meetings with IBM personnel for reviewing the progress and issues.
- Monitoring the day to day transactions in ICAR-ERP system and issues.
- Replies were given of the queries raised by the institutes and coordinated work among all the institutes.
- Follow up with institutes for expenditure and posting of Payroll GL entries
- Detailed Expenditure on Dashboard
- Support has been provided to ERP users and resolved the queries through helpdesk.
- The IBM Contract has been extended up to 31 July, 2020

End User Training & Support:

- One-day training on SCM module was organized at NCIPM, Delhi on 28 May 2019.
- Imparted the training to ICAR-IISS personnel for payroll module on 22 August and 27 August, 2019
- Numerous need based online sessions were organized for various ICAR institutes.

Instruction materials

- The instructions material has been prepared:
  - "How to update ICAR Employee Email ID?"
  - FAQ for **"ICAR Employees CCL Maximum Value Restriction"** has been prepared and made available on MISFMS site under **HRMS Section**.
  - Addition of FAQ for **"Verified by DDO Functionality"** under Finance section.
  - Prepared FAQ for **"How to add Liquidity Tax while receiving?"** and made available at FMS website
  - All above documents made available on MIS/FMS website. (http://misfms.icar.gov.in/FAQGeneral.aspx)

Status of ERP

- Presently the ICAR-ERP is being used the following modules
- Human Resources Management -109 institutes
- Finance Module- 112 institutes
- PAYROLL-106 institutes
- Supply Chain Module – 60 institutes
- Project Module – 112 institutes

ICAR-Data Centre (DC):

- All institutes have been onboard with ICAR mailing solution. Beside that three email id have been given to each KVK.
- ISO 20000-1:2011 & ISO 27001:2013 External Audit is successfully completed at ICAR DC (IASRI).
- Total number of 21098 AD users, 20468 Mailbox users and 11714 Lync users are created so far.
- 169 numbers of websites are hosted and running through ICAR-DC till January 2020.
- Credential Administrator tool has been launched for end users to change/reset password
- Enhanced the ICT infrastructure by including hardware and software.
- Support is being provided from central help desk for Unified Communication Services.
- Dell-Infra restructuring activity has been carried out and is completed successfully. All the servers have been renamed and new IP have been provided to them as per approval/defined policy for DELL infra. The Dell-infra as per DC policy have been streamlined.
- New HP service Manager tool (version 9.60) has been launched for end user. Tool is made user friendly for their use.
- Email service and SMS service has been enabled for end user through the tool.

Dell Chassis Network Switch Configured successfully (Switch Port configuration from bandwidth 1Gbps to 10Gbps). Now Services running from Dell Chassis (Maximum Website and Applications) are accessible at 10Gbps speed.

Development and assessment of educational mobile apps for improving livestock health and production

- IVRI-Waste Management Guide App is designed and developed in collaboration with ICAR-Indian Veterinary Research Institute, Izatnagar to impart information and knowledge to graduating veterinarians, field vets, general public, farmers and other stakeholders about management of waste originating from agriculture, livestock and household activities.
- The app covers information related to composting and its various methods viz., aerobic, anaerobic,

rapid, large scale, in vessel and miscellaneous methods. It also provides information on various compost related products, vermicomposting, its various methods and procedure, nutrient profile and use of the vermicomposting for crops.

- Updated Pig Farming App in English and Punjabi with extra diseases, weaning, etc.
- The Shookar Palan (Pig Farming) App provides scientific knowledge and skills to the graduating veterinarians, field veterinary officers, developmental organizations and entrepreneurs for promoting commercial pig farming.
- This is an educational app also providing information on breeds, housing, feeding, breeding, healthcare and general management of pigs.
- The app additionally supports for technical aspects, economic analysis and evaluation of commercial pig farming projects.
- Artificial Insemination App in Hindi
  - This App is targeted to impart knowledge and skills to Graduating Veterinarians, Field Veterinary Officers and Paravets about Artificial Insemination (AI) in cattle and buffaloes.

- The App covers information on various aspects related to AI viz., symptoms of heat, stages of estrus cycle, heat detection, AI kit, proper time of AI, common sanitary measures, thawing, loading of AI gun, semen deposition and post AI advise and follow-up.

- Dairy Manager App in Hindi
  - IVRI-Dairy Manager App provides the knowledge and skills to Graduating Veterinarians, Field Veterinary Officers, Developmental Organisations and Entrepreneurs for promoting dairy farming.
  - This is an educational app providing information on breeds and housing, feeding, calf and general management, clean milk production and identification and vices of dairy animals.

- The IVRI-Vaccination Guide App in Hindi
  - This app imparts the knowledge and skills to Graduating Veterinarians, Field Veterinary Officers, Paravets, Livestock, Poultry and Pet Owners about vaccination in domestic animals, poultry and pets.

  - The app provides basic information about vaccination in livestock and covers specific information about vaccination related to all the major bacterial and viral diseases. For each of the disease in various species, the information on the causative agents, types of vaccines available, serotype / strain used for the vaccines, vaccination schedule and commercially available vaccines are provided in the app.

Pig Ration App in Hindi

- This App can help the end users to formulate balanced ration for the various categories of pigs based on the locally available feed ingredients.
- This App can generate the pdf document of calculated diet.
- The app additionally provides for ready diets for different categories of pigs.
- The nutrient requirement for the selected animal

will be automatically displayed.

- This App can help to enhance the profitability of the piggery enterprise by balanced pig ration.
- **Four Mobile App have been released by Hon'ble Union Minister for Agriculture and Farmers Welfare on August 26 at NASC Complex, New Delhi viz.,** IVRI- Dairy Manager App, IVRI-Artificial Insemination App, IVRI-Pig Ration App, IVRI-Vaccination Guide App.
- All newly developed and modified apps have been uploaded to Google play store.

Management and Impact Assessment of Farmer FIRST Project

- Farmer FIRST Programme (FFP) Portal is a knowledge management and dissemination system in the field of agricultural extension. This portal provides detailed information of all projects under FFP programme. This portal acts as a single hub of collection of information related to events, trainings, activities and interventions of the projects under FFP. At present, 613 interventions, 541 events, 2040 images, 84 videos and 288 publications related to FFP have been uploaded on the portalof different projects running under FFP.
- Annual Progress Module: This module has been modified to capture the annual progress report from different centres. The system facilitates the user to print and save Project report in pdf format. Annual Report Dashboard has been made available for ATARI and ADG (Extension). Functionality has been given to view report of organizations ATARI wise. The higher officials can thus monitor the FFP related activities in the organizations under their supervision.

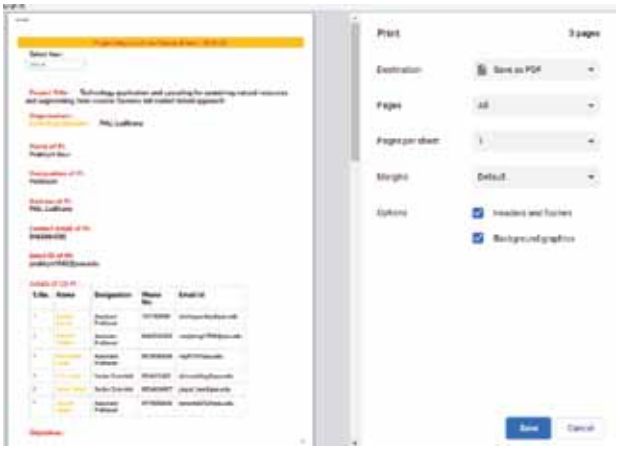


Fig. Project report in FFP Portal

- FFP Mobile Application: Android application which consistsof two modules viz. (i) Capturing of Data and (ii) Knowledge Disseminationhas been developed. The app captures data of Events, Farmer Innovations, Farmer Practices and Interventions. Valid users can add, update and delete information from these modules using the same credentials which is provided to login into FFP portal. This application facilitates the user to export the information in excel format. The app is disseminating the information about project, interventions, events, farmer innovations, farmer practices and publications of differentorganisations using the Dashboard functionality. Search and Advance Search functionality has also been incorporated along with dashboard. Web APIs have been developed for interaction between database and the mobile app.

Fig. FFP Mobile App – Data Capturing

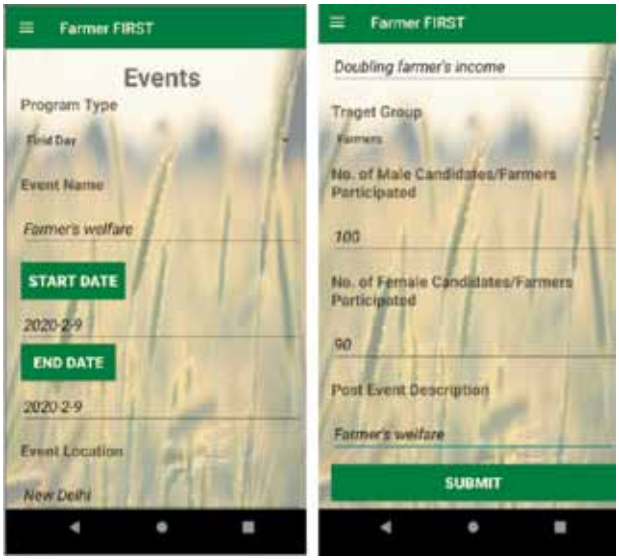


Fig. Data Capturing in FFP Mobile App

Fig. Knowledge Dissemination through FFP Mobile App

- A recommendation functionality has been developed in the portal for registered users to provide them information about trainings, events, farmer innovation and practices etc. which have been taken place in their respective area.
- Farmers are facilitated to send queries to respective scientist on basis of their area of expertise. The details of all answered queries are available in open access.
- A Chat Window has been created for the farmers who can chat with scientists to get the answer of their queries.

Fig. Query Window in FFP Portal

- News, media and publications related information have been uploaded in the portal.
- Regular updating and modification of the portal have been done based on the requirements of users of different levels.
- All PIs have been communicated for uploading the data in the portal on regular basis.
- A Hindi Article on FFP has been presented during Hindi Pakhwara 2019 at ICAR-IASRI.
- Support is being provided to PIs for uploading the information on the portal and technical issues have been resolved over email.

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

Education Portal-ICAR (https://education.icar.gov.in/) acts as a single window platform for providing vital education information/announcements/event schedules/e-learning resources from Agricultural Universities. System also helps in managing the financials (sanction/demand) of different schemes under Education Division, ICAR. Education Portal has been developed and maintained at ICAR-IASRI with the funding support from Education Division under **National Information System on Agricultural Education Network in India (NISAGENET**).

- Functionality to fill unspent balance, generation of Sanction letter for releasing of fund instalment wise have been customized.
- Scholarship/fellowship for student READY, NTS, JRF, SRF and MCM, Development Grant and Library strengthening has been released through Education Portal.
- Sanction letter for NTS and Student Ready, JRF/SRF, Development grant, Library Strengthening has been generated through the system for the release (Installment Four and Five), backlogs and arrears.
- Utilization certificate GFR 12A and GFR 12C forms have been developed for budget utilization and declaration of unspent balance.
- Changes have been done in generation of sanction letter for Niche Area of Excellence (NAE) and functionality to fill unspent balance has been developed for NAE. Functionality for summarized report to help in noting have been developed in the system.
- Sanctioned fund report under Experiential Learning (EL) sub component has been developed. This module now shows report of all previous sanctions, year-wise and project-title-wise of Experiential Learning.
- Enhancement done for Sanction Report for TSP, Library strengthening, NAE and Development Grant schemes.
- ICAR PGS, JRF/SRF module has been developed, to fill demand according to the different rates: - Revised rate, Re-revised rate and arrear.
- Supports is provided for creating USID and also in mapping of USID under current University/College for students whose USID already

existing in other University/College.

- Functionality has been developed to update/ delete student demand based on nodal officer feedback.
- Search module has been added in ADG profile to search students USID.
- Functionality has been modified for NAE,TSP grants in the form to “Fill unspent” balance to add multiple projects and generate grant accordingly.
- Consolidated reports have been developed to total grants under different schemes.
- Extended support is provided in filling “unspent” form i.e. current demand, AUC, UC and net release for Student READY. Support was also provided for Letter generation and authority generation for NTS, Student READY. Trainings were provided for generation of online noting of NTS and Student READY.
- Hands on training were provided to personnel from Sam Higginbottom University of Agricultural Technology, NDRI-Karnal, NAVSARI-Navsari, AAU-Jorhat, BAU-Ranchi, TNFAU-Nagapattinam, MPUAT and MPKV-Rahuri Universities.
- USID has been generated for Approx. 146326 students covering 74 universities.

Knowledge Management System for Agriculture Extension Services in Indian NARES

‘Krishi Vigyan Kendra Knowledge Network’ or KVK Portal (https://kvk.icar.gov.in/) and KVK Mobile App have been developed to disseminate knowledge and information from KVKs to farmers with the funding support from Extension Division, ICAR.

- As of now, total 693 KVKs have been registered into this portal. Information on 136983 KVK event (past and future) details have been uploaded into the portal.
- 598 KVKs have uploaded their facility details in the portal.
- 519 KVKs have uploaded Package of Practices into the portal.
- 20690 Farmers are registered into KVK Portal. 53134 farmer details have been uploaded by different KVKs in the KVK portal.
- Functionality was developed to upload data of different activities under Crop Residue Management (CRM) initiative in the KVK portal. A consolidated report of different activities (State Wise/District Wise/Activities Wise) under CRM was developed. Image and video gallery were created for CRM.
- Inspired by the Hon’ble Prime Minister’s impetus on Jal Sanchay, the Jal Shakti Abhiyan (JSA) was run in two Phases: Phase 1 from

1st July to 15th September 2019 for all States and Union Territories; and Phase 2 from 1st October to 30th November 2019 for States and UTs receiving the retreating monsoon (Andhra Pradesh, Karnataka, Puducherry and Tamil Nadu). Functionality was modified under 'Add Event' page to upload 'Jal Shakti Abhiyan' event data. All the blocks were mapped into database to facilitate entry of this event. Consolidated reports on 'Jal Shakti Abhiyan' were developed at different level (State, District and Block).

- An additional user level for Host Organisation has been created in the system. The access right for viewing has been given to Director of the organisation under which KVKs are running. Director of the Host Institute can monitor the activities performed by different KVKs under them. Host institute level is added in KVK database; accordingly, all ATARI level reports/ stored procedures have been modified for host institute level. New user ids are created for Directors of Extension Education of various State Agricultural Universitiesand Directors of ICAR Institutes at the database level to facilitate them in monitoring the KVK activities. Login credentials were communicated to them.
- Dashboard has been developed for KVK level user. Dashboard shows event details, facilities, packages and practice details, farmers' query report, market price, subject matter specialist details and status of MPR reports etc. at the KVK level.
- Functionality has been developed at KVK level to approve and disapprove Subject Matter Specialists as part of creating expert panel for solving farmers' queries asked through KVK Portal or KVK App.
- A report has been created to see vacancies of Subject Matter Specialist (SMS) and other staff in the various KVKs, State, District wise.
- Functionality has been developed to view latest market price of various commodities in particular district using API shared from NIC and a link has been provided under 'Market' menu in the KVK portal homepage, farmer level and KVK level.
- DBT functionality is modified at ATARI, Extension and Director (of Host Organization) level, added one section 'DBT report' to view KVK wise (No. of Training/OFT/FLD, Total Beneficiaries, Total Fund Transfer) report and drill down report has been developed to see further details of particular OFT/FLD and training in the particular KVKs.
- Crop-wise and farmer-wise information is modified under cluster demonstrations (Oilseeds and Pulses) page to add farmers' details.
- Farmer outreach page is modified by adding previous years (2017-18, 2018-19 etc.) to upload data of the same period.
- DBT report State wise is modified to show total no. beneficiaries and fund transfer. Stored procedure is created at database level to count total no. of beneficiaries and total fund transfer for particular financial year for Agri. Extension scheme.
- DBT report of KVK and ATARI was modified in the portal. Data is showcased month wise (the month, which is selected by KVKs at the time of uploading DBT data in the portal).
- DBT data (Monthly Progress Report (MPR)) entered by KVKs and consolidated/summarized at ATARI level is forwarded to DBT DARE MIS which is further linked with DBT BHARAT Portal for Agri. Extension Scheme every month.
- The functionality to broadcast message (text message/audio/image/video using the Firebase services provided by Google) to KVKs and farmers has been developed at Agri. Extension and ATARI level. Through this functionality, registered farmers of particular KVK get the future event details in English language as well in regional language.
- Recent news from KVKs and ATARIs has been uploaded in the portal under News Section.
- Power Point Presentations have been prepared on KVK Portal and KVK Mobile App for different categories of users (ATARI, KVK, Managers). The link of presentations has been given under 'Download' menu in the KVK Portal homepage.
- The videos in the KVK video gallery page have been uploaded in KVK Portal. YouTube channel and link is given in video gallery page.
- Information on new KVKs and their host organisations have been added in the database.
- Workshop was organised at ICAR-ATARI, Zone – VII, Umiam, Meghalaya on 1-2 March 2019, which was attended by personnel from 43 KVKs.

- Support has been provided for various issues related to data entry in the KVK portal.

Fig. Jal Shakti Abhiyan Image Gallery

Fig. KVK Dashboard

Fig. DBT Report

KVK Mobile App:

- KVK Mobile App has been enriched with new functionalities and dashboard for different categories of users. User Interface (UI) has been modified for Home gallery in KVK APP. UI for login of Subject Matter Specialist, KVK Head and DDG (Extension) have also been modified.
  - Functionality of sending image, video and audio along with the reply of the solution of farmer query was added for the KVK Head.
  - User interface (UI) was redesigned for different functionalities viz.Send query, video gallery, change language and feedback.
  - Dashboard created for showing summary information on total farmer registered and total visitors. Video gallery functionality was added.
  - Language translation feature of English to regional language (Marathi, Hindi, Guajarati, Kannada, Telugu, Urdu, Tamil, Bengali) functionality was added in “Facilities”, “Send Query”, “Past event” and “Upcoming event” Modules and Sign-up/Registration page.
  - In admin panel, functionality is developed for Role mapping for different users.
  - Feature of sorting report by Total Query and Unanswered Query of KVK is added in Query Detail Report at the ATARI level.
  - At farmer level- farmer can see the state and district details under which farmer is registered and can download Agro Metrological Advisory of any state and district in English/local Language.
  - At farmer level- search functionality has been provided by which famer can search

particular event (past, future, ongoing event) by entering event name or event date. Farmer can also search facility details by entering facility name and also download the images related to particular facility.

Fig. KVK mobile App at Head KVK level

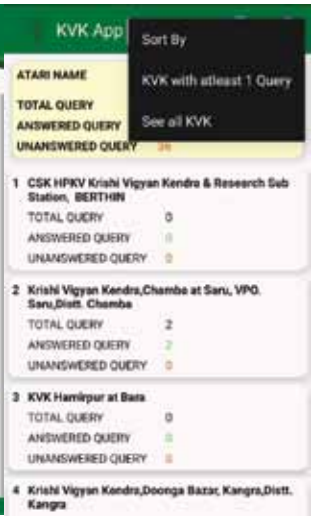


Fig. KVK mobile App at ATARIIevel

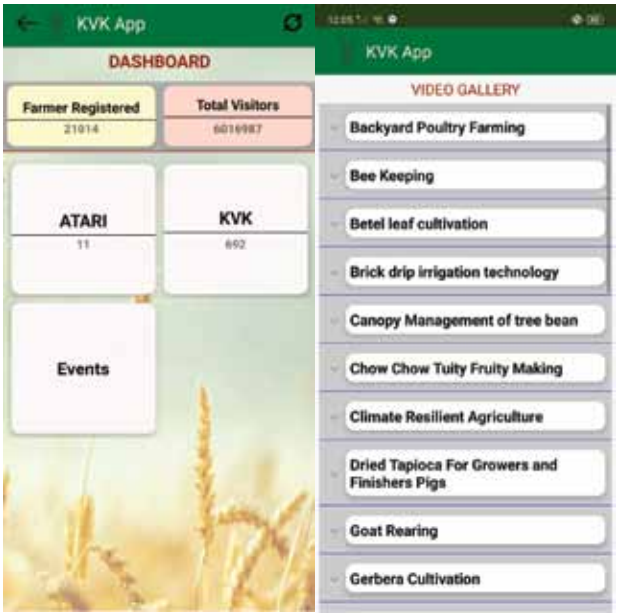


Fig. Dashboard and video gallery in KVK Mobile App

Development of Direct Benefit Transfer Portal for DARE Schemes

- Backlog data of FY 2018-19 for different DBT Schemes have been uploaded in DBT DARE MIS.
- The logic for cumulative number of beneficiaries for all the schemes has been implemented in DBT DARE MIS.
- DBT Schemes related data of January, 2019 till December, 2019 have been uploaded in DBT DARE MIS.
- DBT Schemes related data of January, 2019 till December, 2019 have been uploaded in DBT Bharat Portal through web service.
- Login credentials have been created in the DBT DARE MIS for the Scheme Managers. Reports have been developed for the Scheme Managers to monitor the data uploading status in the MIS for the respective schemes.
- Support has been provided to the Nodal Officers for issues in data uploading DBT DARE MIS.

Fig. Monthly data approval in DBT DARE MIS

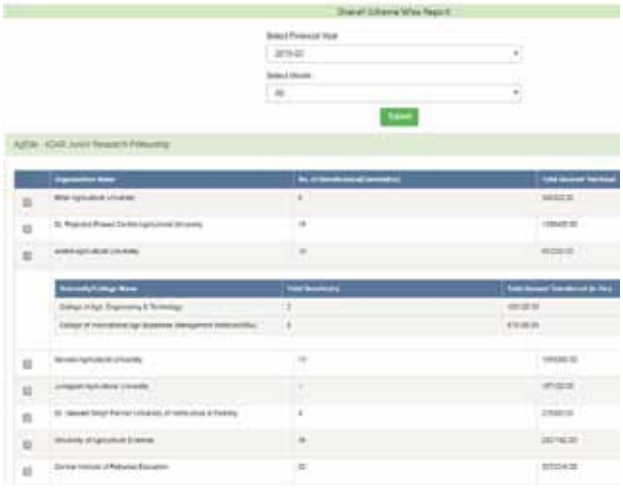


Fig. Monitoring of uploaded data in DBT DARE MIS

Training Management Information System for ICAR (TMIS)

- Development
  - Management Reports were developed that allows Training Manager of ICAR to keep track of institutes that have submitted the Annual Training Plan (ATP), keep track of the Cadre wise training requirements (Fig.1).
  - Web forms were developed for HRD Nodal Officer of Institutes to allocate yearly budget estimate for trainings to be undertaken by the employees of Institute, add new training areas, assign tentative expenditure to training needs by individuals and create

annual training plan (ATP), finalize the ATP and send it to the director of the institute for approval, modify ATP based on reviews from the director of the Institute, add more trainees even after submission of ATP to the director. Forms were also developed for preparing the Annual Training Plan of the institute, assign the trainings to the employees from a Cadre wise list, view the ATP finalized by the director and submitted to the training manager.

- Web forms were developed for the director to review ATP, where director can accept or reject individual training requests in the ATP, add comments and send back the individual training requests to the nodal officer for editing/updation.
- Web pages were developed for the employee to submit the feedback after coming back from the training (Fig.2), view the approval status (Fig.3)of the training application and of feedback submitted.
- Tested all the web forms, workflows of web forms and data flows with real data. Provided proper validations on the all web forms.

- Documentation
  - Detailed Help manual was documented for help and support of TMIS users.
- Hosting of Portal, Operationalization of TMIS in ICAR institutes
  - TMIS has been operationalized across all ICAR institutes. ICAR users have started using the portal for submitting training needs, applying annual trainings and getting them approved. Online support was provided and problems of users were resolved using the support mail-id support.hrms@icar.gov.in.
- Launching of TMIS
  - Honourable Minister of Agriculture and Farmers Welfare Shri Radha Mohan Singh launched online Training Management Information System (TMIS) during the VCs and Directors' Conference on 31st January 2019 and released its Brochure.

Fig. Training Manager Report to View Cadre Wise Training Requirements in ICAR

Fig. Training Feedback Submission by Employee after Training Completion

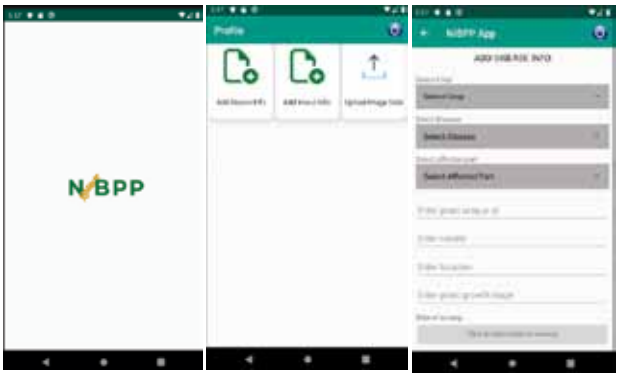
Fig. Approval Status of the Training Application

Artificial intelligence based mobile app for identification and advisory of maize diseases and insect pests (NASF Project)

A national level image base for collecting and analyzing the images of pests and diseases for different agricultural crops and extracting the hidden insight of the image using sophisticated AI techniques is being developed. For using these images for pest and disease diagnosis, a mobile app has been developed. The extracted insights collected from analysis using AI techniques, are then embedded into mobile app in the form of model. This will help millions of farmers for diagnose the pest and diseases and get the advisory.

5 Agricultural Universities signed the Agreement to collect different types of Crops images in the Respective Crops field in different locations and different Environmental Lighting Conditions. (NAU, Navsari; UAS, Banglore; SKRAU, Bikaner; JAU, Junagadh; MPUAT, Udaipur). Fund Rs. 600000 Allocated to each University and Rs.150000 already released for year 2019-20 for Skilled Manpower Recruitment by the respective participating Universities.

Google Play Store Link for Artificial Intelligence Mobile App Usage for Online Disease and Pest image database on various crops and live stocks:https://



play.google.com/store/apps/details?id=com.iasri.croping_image&hl=en_IN

Investments in ICAR for Leadership in Agricultural Higher Education

Background

- Concept Note presented to ND NAHEP and all NCs on 17th August 2018.
- Based on suggestions the concept note was presented in NSC of NAHEP on 23rd August 2018.
- Multiple deliberations took place between NCs , IASRI and NAARM to evolve the concept of the project as per PAD and NSC suggestions.
- Meeting with World Bank on 17th October 2018 was held and the concept note was discussed.
- Two days partner institutes meeting at ICAR-IASRI for finalizing draft project proposal on 1st and 2nd November 2018.
- One Day Brainstorming Workshop was organized on 3rd November 2018 on NAHEP Component -2A at NASC Complex, New Delhi with the aim:
- To discuss the objectives/activities of the NAHEP Component-2A project proposal.
- To sensitize the participating Universities for readiness.
- Vice Chancellors of Agricultural Universities and their representatives, NSC and PMC members and scientists from partner institutes attended the brainstorming workshop.
- Project Proposal was presented (objectives and their respective activities) and discussed at length at the Brainstorming Workshop.
- Proceedings of the workshop was circulated among the VCs of AUs for their comments and suggestions. 25 days' time was given.
- Review Committee constituted as per National Steering Committee recommendations. The constituted Review committee attended the workshop.
- Review Committee submitted their draft report on their observations on Project proposal. The same was incorporated.
- Meeting was held between partner institutes at NAARM Hyderabad on 24thNovember2018 and at IASRI on 29th November 2018 to finalize the project proposal.
- Draft proposal submitted to NC, NAHEP on 2nd Dec. 2018.
- Comments received on 3rd December 2108 from NC, NAHEP.
- After incorporating NC's Comments, project proposal was presented to the World Bank Review Mission on 6th and 7th Dec. 2018. The World Bank appreciated the progress made so far in formulating the project proposal and given the satisfactory status.
- World Bank in its report asked to send the project proposal through email to all the members of the mission for critical review. The same was sent and the comments of the World Bank were received on 21st January 2019.
- The comments were incorporated or given due to justification as per the case and the proposal was again sent on 24th January 2019.
- The World Bank has given its approval to the project proposal for further internal processing.
- The proposal was sent to approval on file February 04, 2019 and all the comments of the Internal Finance were duly incorporated and the funds have been approved on 27th February 2019.

Procurement

Procurement Plan for the entire project duration was prepared and uploaded in World Bank's software Systematic Tracking of Exchanges in Procurements (STEP).After the approval from the World Bank, the process of procurement was initiated.RFPs for procurement of various items were prepared and submitted to PIU for approval. Under this project, the major procurement that have been completed in 2019 are as under:

- Establishment of DR Center (ONE) at NAARM and synchronization with ICAR-DC at IASRI has already started and is in progress at ICAR-

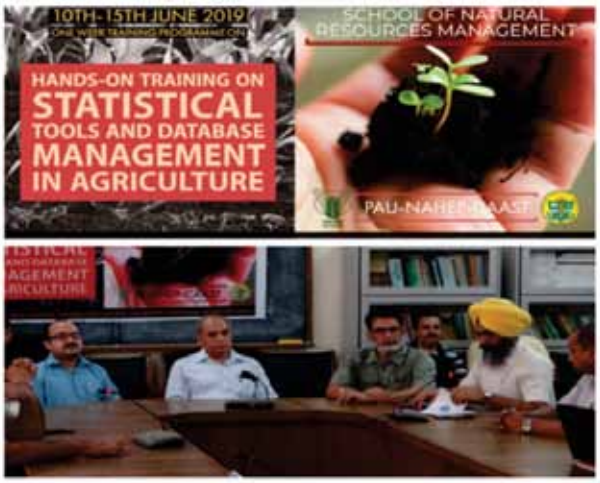
NAARM. The solution consists of 8 Racks with cooling units, 2 Blade chassis, 100TB storage, 1 generator, 12 HCI nodes, network & security devices (26), UPS, 1 BMS, Software.

- Storage (Hard Disk, enclosure, etc). (NL-SAS HDD-15 nos, SSD HDD-10 nos).
- Network Switch 40 GbE (02), SAN Switch (01) for existing Dell Blade Chassis.
- Web Application Firewall (02 nos).
- Blade Chassis (01) with blade servers (02) for ICAR-DC Strengthening at IASRI.
- Two Individual Consultants for projects planning, designing, development, co-ordination, implementation and maintenance at IASRI were appointed.

National and International Trainings & Workshop Organized

Training Organized

1. A Hands-on Training on Statistical Tools and Database Management In Agriculture was organised in Collaboration with ICAR-IASRI (Under NAHEP-CAAST-COMPONENT-2) at Department of Soil Science, PAU, Ludhiana during 10-15 June, 2019. The training modules include Database Management, Statistical tool: R, R Studio & SPSS, Data Mining & WEKA Software, Descriptive statistics, Inferential statistics, Correlation & Regression Analysis, Time Series Analysis, Logistic Regression, Classification and Regression Tree (CART), Multivariate Data Analysis, Non parametric testing, Artificial Neural Network (ANN), Artificial Intelligence & Knowledge base systems. Around 35 participants including faculty, research associate and students participated in this training programme.



2. A Hands-on Training on Tools and Techniques for Data Analysis and Management was organised in Collaboration with ICAR-IASRI (Under NAHEP-IG-COMPONENT-2) at Department of IABM, SKRAU, Bikaner during 20-25 Jan, 2020. The training modules include Database Management, Statistical tool: R, R Studio & SPSS, Data Mining & WEKA Software, Descriptive statistics, Inferential statistics, Correlation & Regression Analysis, Time Series Analysis, Logistic Regression, Classification and Regression Tree (CART), Multivariate Data Analysis, Non parametric testing, Artificial Neural Network (ANN), Artificial Intelligence & Knowledge base systems. Around 108 participants including faculty, research associate and students participated in this training programme.

3. A National Workshop on Academic Excellence through Building Partnerships and Resources Generation was organised by ICAR-NAARM during 30-04-2019 to 01-05-2019. Dr. Sudeep presented the overview of the project and also co-chaired the session. Dr. Anshu Bharadwaj also co-chaired a session.

4. International Workshop on Strengthening International Agribusiness Trade Stakeholder Dialogue and Partnership towards SDGs during 14-11-2019 to 15-11-2019
5. Three Thematic training workshops were organized by ICAR-NAARM as the partner institute:
   - Training of Trainers Workshop for organizing workshops on Development of soft skills for Entrepreneurship among Agri Graduates during 17-09-2019 to 18-09-2019.
   - Training Workshop on Education Management and Academic Leadership during 20-09-2019 to 25-09-2019.
   - Developing Winning Research Proposals on Digital Solutions in Agriculture during 19-11-2019 to 23-11-2019
6. Five Regional Workshops on Academia-Industry-Government linkages for Quality Agricultural Education were organised by ICAR-NAARM, the partner institute in the project. The workshops were organised at Meerut, Bhubaneshwar, Hyderabad, Rahuri and Banglore.

7. Under the University Student Awareness Programmes Workshop on "Soft Skills for Entrepreneurship Development" was organized during 30-12-2019 at SVVU, Tirupati.
8. 2 days Workshop for Sensitization of Nodal Officers of ICAR Institutes & Agricultural Universities was successfully organised during 18-19 September 2019 to finalise the implementation plan of the project.
9. The following Sensitization Workshops on NAHEP Component 2 Activities & Implementation of Academic Management System were planned and held, wherein Consultants and IT Professionals conducted the various sessions presenting the visiting University academicians, with the features and functionalities of AMS. Live Demonstration of the system was also provided. Sensitization Workshop on NAHEP Component – 2 Activities and Implementation of Academic Management System & Project Information Management System.

S.No.	University/Institute	Dates
1	AU, Jodhpur	Oct 4th - Oct 5th
2	JAU, Junagadh	Oct 14th - Oct 15th
3	SVVU, Tirupati	Oct 18th - Oct 19th
4	AAU, Jorhat	Oct 22nd - Oct 23rd
5	RLBCAU, Jhansi	Nov 6th - Nov 7th
6	CSAUAT, Kanpur	Nov 28th - Nov 29th
7	UAS, Dharwad	Dec 5th - Dec 6th
8	ANGRAU, Guntur	Dec 11th - Dec 12th
9	TANUVAS, Chennai	Dec 19th - Dec 20th

Conference/Workshops/Meetings organised /Attended

- The Project Team attended the World Bank Mission meeting during 28-29 March 2019 for the discussion on the project.
- NAHEP Review Workshop was held during 05-06 August 2019. All the NAHEP Comp-2 team

members attended the workshop. Document for the First online call for elearning courses, and Brochure for Academic Management System (AMS) were released in the Review Workshop. Grievance Redressal Mechanism System was developed and launched in the review workshop.

- Three Technical Committee Meetings were held for finalisation of the RFP of Disaster Recovery Center and Virtual Classroom.
- NAHEP National Director held a meeting in IASRI with the Project team to review the progress and to know about the issues regarding delay in meetingthe deadlines for procurement of items.
- One IT Professional-III, NAHEP Comp-2 Team attended a workshop on Applied Deep Learning at BITS Pilani, Rajasthan, on December 15-18, 2019.

Systems /Mobile App Developed

Systems Developed- Five (5)

1. E Learning

- eLearning Call 1: for Creating and Reviewing Agriculture Courses - The eLearning Portal was opened from October 15th, 2019 for filling up applications for Content Creators, Unit Reviewer and Course Reviewer. The portal was later opened from November 22nd, 2019 to November 28th, 2019 for the Nodal Officers of the University for Application Approval. The dates were further extended from Nov 28th to Dec 2nd, for Content Creator applications and for the approvals to be done by the Nodal Officers. The Portal was then opened from 6th November 2019 to 12th November 2019 for the Nodal Officers of the University for Application Approval.
- E-Learning Portal Link: https://education.icar.gov.in/eLearningHomepage.aspx
- The following was the count of people applied on the portal.

No. Of Users Registered on Portal	891
Total Applications Received	2501
Content Creator Unit Reviewer Course Reviewer	1387 797 314
Approved Applications	1983

- E-courses to be developed

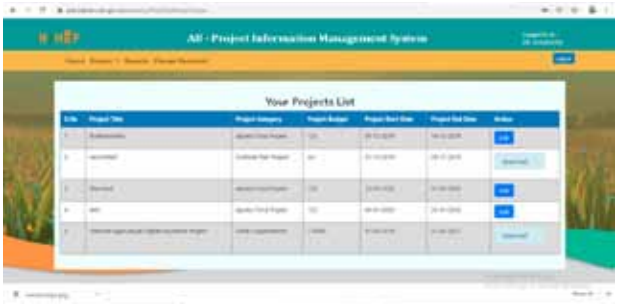
BSMA Groups	18
Disciplines	72
Courses	144
Units	810

- The following reports were created, for the usage by the Administrator: User-wise Report; Unit-wise Applications; Submitted Applications; Registered Users; Courses/Units with no Applications; Consolidated Report; Applications approved by Nodal Officer; Course-wise applications approved by Nodal officer; Users approved by Nodal Officer; Pre-Approval by Project Team

2. Project Information Management System (PIMS)

An online system which enables automation and streamlining of all the academic activities of a university has been developed at ICAR-IASRI. The system has been designed in a modular approach with in-built work flows. It allows all ICAR Deemed Universities to follow the best standards and builds a repository of the academic records and e-learning resources. Presently the system is operational at IARI New Delhi, CIFE Mumbai, IVRI Izatnagar, NDRI Karnal and CAU Imphal. It has been decided that under Eakikrit Krishi shiksha Takniki Ayaam (EKTA) initiative of Education Division, ICAR that this system will be extended to all the Central Universities by March 2018.

- UI and Basic Module has been developed for Project Information Management System. Requirement study for PIMS in 2 Universities has been carried out in the following Universities:
  - TANUVAS Chennai
  - RBLCAU, Jhansi



3. Academic Management System

Academic Management System(AMS) has been customized by the NAHEP Component 2 Project Team at ICAR-Indian Agricultural Statistics Research Institute (IASRI) for the implementation at various Agricultural Universities. It is a web enabled system for management of all the various 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 for performing their assigned tasks. A System has been designed in a modular approach with in-built work flows. System ensures that the individuals responsible for the next task are notified and receive the data they need to execute at their stage of process. At present five modules have been envisaged viz., Student Management, Faculty Management, Course Management, Administration Managementand E-Learning.

AMS facilitates in automation of various academic processes of the university and enhances the efficiency of the overall system by saving time and efforts involved in manual processes. It continues to be customized as per the respective needs of the various universities. For developing the network

platform containing the details of alumni of Indian AUs working abroad the Mapping of Alumni is was initiated.

4. Network of inspired teachers

Network of inspired teachers has been developed. Under this, database of Best Teacher awardees and popular teachers (600 no.s of 30 Universities)

5. Grievance Redressal Mechanism (GRM) System in NAHEP

A three tier Grievance Redress Mechanism (GRM) has been put in place for use by stakeholders, as per the Environmental and Social Standard (ESS 10), which from the part of the World Bank's 2016 Environmental and Social Framework. The objective of the Grievance Redress Mechanismis "To provide an access to stakeholders to complain and ensure grievance promptly registered, responded and redressed to, and problems and solutions are identified by working together". The online form is available at (https://nahep.icar.gov.in/CreateGRM.aspx). Grievances can be registered beside all the

IDP/IG/CAAST universities and their colleges under NAHEP. Grievance Categories are Procurement, Social, Environmental and Others

Key features of GRM are:

- Encourage people to raise concerns without fear of reprisal
- Provides a fair and speedy means of dealing with complaints
- Prevent minor disagreements developing into more serious disputes
- Taking appropriate actions and ensure resolution to the problem

4

Technology Assessed and Transferred

- An R package named *ispd* has been developed by Mandal, B.N., Dash, S. and Parsad, R. (2019). The package is a collection of several functions related to construction and analysis of incomplete split-plot designs. The package contains functions to obtain and analyze incomplete split-plot designs for three kinds of situations namely (i) when blocks are complete with respect to main plot treatments and main plots are incomplete with respect to subplot treatments, (ii) when blocks are incomplete with respect to main plot treatments and main plots are complete with respect to subplot treatments and (iii) when blocks are incomplete with respect to main plot treatments and main plots are incomplete with respect to subplot treatments. The package is available at CRAN: https://cran.r-project.org/web/packages/ispd/index.html.

- A web application for construction of balanced incomplete Latin square has been developed. A balanced incomplete Latin square design with parameters v and r is an incomplete Latin square of order v such that each row and each column has $r < v$ non-empty cells and $v - r$ empty cells and each of the v symbols appears exactly r times in the whole square. Here the term 'balanced' implies that each row and column has same number of non-empty cells and each

symbol has same number of replications in the whole square. This balance is neither related to pair-wise balance nor variance balance. Here, construction of BILS (v, r) is done by removing the $v - r$ disjoint transversals from a Latin square of order v via a pair of orthogonal Latin squares. Here, a transversal in a Latin Square of order v is a set of v cells such that only one cell is allowed in each row and in each column, and furthermore, each symbol can appear in each cell once. Balanced incomplete Latin square designs can be used in comparative experiments where two crossed blocking factors are present and each blocking factor has v levels but in each row and column has only r treatments are to be applied. The web application has been developed by Dash, S., Mandal, B.N., Parsad, R. and Gupta, V.K. and can be accessed at http://drsr.icar.gov.in/BILS/.

- A web application for construction of A-efficient and D-efficient incomplete block design has been developed. User can construct an A-efficient and D-efficient incomplete block design for given number of treatments, number of blocks and block size. Incomplete block designs can be

used in comparative experiments where one blocking factor is present and only a subset of treatments is to be applied in each block. The web application has be designed in such a manner that it enables construction of incomplete block design which permits comparison of treatments with high precision. The web application has been developed by Mandal, B.N., Parsad, R. and Dash, S. and can be accessed at http://drsr.icar.gov.in/IBD/.

- A web application for construction of orthogonal and nested orthogonal Latin hypercube designs has been developed. User can construct orthogonal Latin hypercube designs and nested orthogonal Latin hypercube designs for given number of runs, number of factors and number of layers in case of nested Latin hypercube designs. Latin hypercube designs can be used in computer experiments it is not feasible to conduct a real life experiment due to cost and other practical difficulties. The web application has been developed by Dash, S., Mandal, B.N., Parsad, R. and Sarkar, S. K. and can be accessed at http://drsr.icar.gov.in/OLH/

- A web application for construction and analysis of incomplete split-plot design has been developed. User can construct and analyze incomplete split-plot designs for three situations namely (i) when blocks are complete with respect to main plot treatments and main plots are incomplete with respect to subplot treatments, (ii) when blocks are incomplete with respect to main plot treatments and main plots are complete with respect to subplot treatments and (iii) when blocks are incomplete with respect to main plot treatments and main plots are incomplete with respect to subplot treatments. Incomplete split-plot designs are useful in comparative experiments when

it is not possible to accommodate all levels of subplot factor in each main plot and / or it is not possible to accommodate all levels of main plot factor in each block. The web application has been developed by Mandal Mandal, B.N., Dash, S. and Parsad, R. and can be accessed at http://drsr.icar.gov.in/ISPD/.

- A web resource on “Incomplete Split-plot Designs: Blocks are complete, main plots are incomplete” on Design Resources Server has been made available at http://drs.icar.gov.in/CMIS/CMIS.htm. The resource has been developed by Mandal, B.N., Parsad, R. and Dash, S. This web page gives a catalogue of incomplete split plot designs for the situation when blocks are complete with respect to whole plot treatments and whole plots are incomplete with respect to subplot treatments for up to 6 levels of main and subplot factors.

- A web resource on “Incomplete Split-plot Designs: Blocks are incomplete, main plots are complete” on Design Resources Server has been made available at http://drs.icar.gov.in/IMCS/IMCS.htm. The resource has been developed

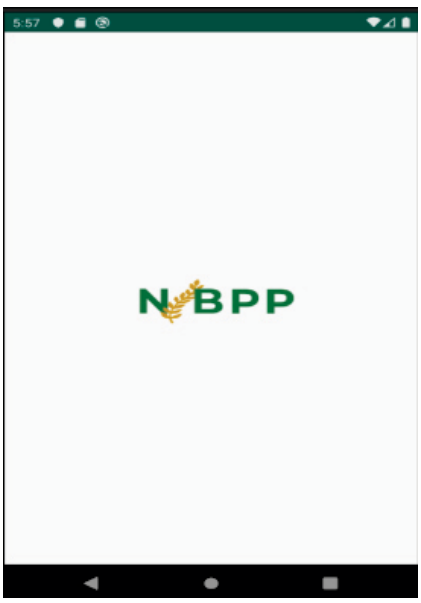
by Mandal, B.N., Parsad, R. and Dash, S. This web page gives a catalogue of incomplete split plot designs for the situation when blocks are incomplete with respect to whole plot treatments and whole plots are complete with respect to subplot treatments for up to 6 levels of main and subplot factors.

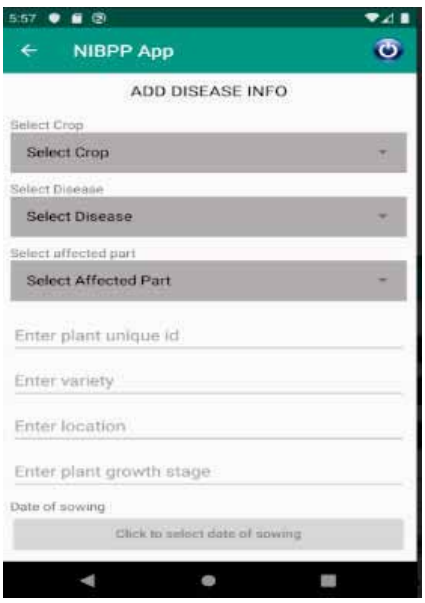
- A web resource on "Incomplete Split-plot Designs: blocks are inccomplete, main plots are incomplete" on Design Resources Server has been made available at http://drs.icar.gov.in/IMIS/IMIS.htm. The resource has been developed by Mandal, B.N., Parsad, R. and Dash, S. This web page gives a catalogue of incomplete split plot designs for the situation when blocks are incomplete with respect to whole plot treatments and whole plots are also incomplete with respect to subplot treatments for up to 6 levels of main and subplot factors.

- Following applications were **formally released /launched** by Secretary DARE and DG, ICAR during IV National workshop of Officer Incharge Data Management on December 10, 2019:
  i. ICAR IPR Repository available at https://krishi.icar.gov.in/icaripdb/
  ii. ICAR Technologies: A Mobile App and can be accessed at https://play.google.com/store/apps/details?id=gov.krishi.icar.technologyrepository&hl=en_IN
  iii. Information System for (i) AICRP on Pearl Millet; (iii) Information system for AICRP on Castor, Safflower and Sunflower
  iv. Information System for AICRP on PHET Information System for AICRP on PHET: The Information System was released by Dr. N. Kumar, Vice-Chancellor, TNAU, Coimbatore during 34th Annual Workshop of AICRP on PHET organized at Tamil Nadu Agricultural University, Coimbatore on March 12, 2019;
- A sampling methodology (protocol) delineating sample size, allocation of sample in different strata and sub-strata, selection of sample in different stages of sampling and listing for preparation of frame as well as schedules and instruction manual for collection of primary data has been developed under the project "Energy Audit Survey of AICRP on Energy in Agriculture & Agro-based Industries: Sampling Design and Analysis". The developed sampling methodology has been adopted and implemented by 16 different cooperating centres in the energy audit survey under Energy Management in Agriculture (EMA) component of the ICAR-AICRP on EAAI. A training programme on "Sampling Design and Schedules for Implementation of Energy Audit Survey" has been organized during November 1-2, 2019 at ICAR-IASRI, New Delhi for the scientists involved in EMA activity of the ICAR-AICRP on EAAI at different co-operating centres.
- Suitable small area estimation approach has been outlined for estimating the district level estimates of living condition and poverty incidence for rural and urban areas of the state of Uttar Pradesh under the project "Study to Estimate the Sub-State Level Estimate of Socio-Economic Indicators of Uttar Pradesh by Using Small Area Estimation Techniques". The codes and programs have also been developed in R software for implementing the method to generate disaggregate level estimates along with reliability measures and spatial maps. These have been used by Giri Institute of Development Studies, Lucknow for undertaking the small area analysis to produce sub-state level estimates of several socio-economic parameters under the project.
- The existing approach of Myanmar Census of Agricultural 2010 has been evaluated and appropriate changes have been suggested in Myanmar Census of Agricultural 2020 as per the FAO World Programme on Census of Agricultural 2020 by Dr. Hukum Chandra as expert of the Food and Agriculture Organization of the United Nations (FAO), Myanmar. Guidance on preliminary planning and associated technical issues including schedules and coverage for Myanmar Agricultural Census 2020 have been provided.
- Under the activities related to monitoring and analyzing food and agricultural policies programme, a comprehensive review on National Food Security Policy and National Agriculture Market in India has been undertaken by Dr. Hukum Chandra as expert of the Food and

Agriculture Organization of the United Nations (FAO), India. This assessment covers the PDS under the National Food Security Act including the changes in the functioning of the public distribution system. The electronic National Agriculture Market, its coverage and functioning.

- A sampling design has been suggested for Serosurveillance and Seromonitoring of Foot-and-mouth disease in India under FMDCP by Dr. Hukum Chandra as part of Internal Evaluation Committee for validation of sampling plan at ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, Bengaluru.
- R package "WaveletANN" for modelling by combining wavelet and ANN method is developed and published in CRAN.https://cran.r-project.org/package=WaveletANN.
- R package "VIRF" for Computation of volatility impulse response function for multivariate time series model using algorithm by Jin, Lin and Tamvakis (2012) is developed and published in CRAN.https://cran.r-project.org/package=VIRF.
- **Artificial Intelligence Mobile App:** A national level image base for collecting and analyzing the images of pests and diseases for different agricultural crops and extracting the hidden insight of the image using sophisticated AI techniques is being developed. For using these images for pest and diesaes diagnosis, a mobile app has been developed. The extracted insights collected from analysis using AI techniques, are then embedded into mobile app in the form of model. This will help million of farmers for diagnose the pest and diseases and get the advisory. 5 Agricultural Universities Signed the Agreement to collect different types of Crops images in the Respective Crops field in different locations and different Environmental Lighting Conditions. (NAU, Navsari; UAS, Banglore; SKRAU, Bikaner; JAU, Junagadh; MPUAT, Udaipur). Fund Rs. 600000/- Allocated to each University and Rs.150000 already released for year 2019-20 for Skilled Manpower Recruitment by the respective participating Universities. Google Play Store Link for Artificial Intelligence Mobile App Usage for Online Disease and Pest image database on various crops and live stocks: https://play.google.com/store/apps/details?id=com.iasri.croping_image&hl=en_IN
- Web based software for **Trait Associated Feature Selection from Genomic Data (TAGexp)** by Lovkush Patel, Mohammad Samir





Farooqi, S.B.Lal, K.K Chaturvedi, Anu Sharma, D. C. Mishra and Prawin Arya. TAGexp is user friendly web based software which provides the list of informative genes related to specific trait for any crop. TAGexp has been developed by integrating R package GSAQ to perform gene selection from expression data. User interface has been developed to allow the users to interact with the system for authentication and for displaying all the services provided by the software. The web interface allows users to upload data file in CSV format and obtain the required number of informative genes.

Mobile App Developed: An android based mobile app named as 'MandiInfo' (by Naik, Banoth Jagdish, Lal, S.B., Sharma, A., Chaturvedi, K.K., Farooqi, M. S. and Chandra, H.) has been developed for finding the nearby mandis and information about market prices in different states throughout the country. It also forecasts the prices of different commodities in different markets based on the previous years' data. MandiInfo is an android based application which allows users to access the nearby markets with commodity selection. The important features of MandiInfo are mentioned below:

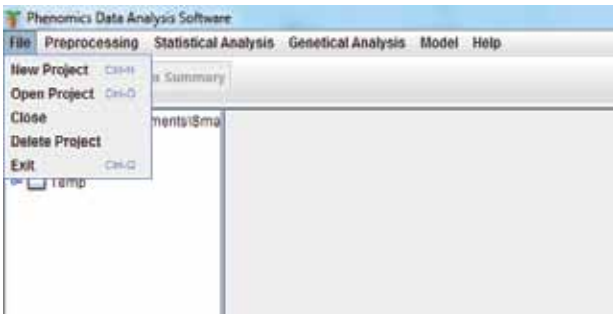
- Detection of user's location
- Information retrieval interface for markets and commodity prices
- Commodity selection from the available list
- Selection of state and district
- Price forecasting for selected commodities
- Viewing results: Output can be viewed in pdf format and also can be shared through email, whatsapp, google drive, bluetooth etc.

Figure shows the icon of 'MandiInfo' app and its splash screen. The splash screen shows the title of the app and a picture related to agricultural transport activity. Home screen of the 'MandiInfo' app has also been shown in Figure. It displays the location details and three other options for selection.

Figure: 'MandiInfo' app icon and its splash screen

Figure: Home page of the 'Mandi Info' app

High Throughput Phonemics Data Analysis Software (HtP-DAP): Data analysis and model development is a vital part of phenomics research. But it requires a high level of knowledge of data science and artificial Intelligence which again have a longer learning curve and is time consuming. So, it is required to automate these task for researchers. A windows based standalone application named *High Throughput Phonemics Data Analysis Software (HtP-DAP)* is developed using Java to provide a unique solution to manipulate, transform, clean, analyses and extract useful pattern using powerful artificial intelligence algorithm from phenomics data to reach any conclusion. *HtP-DAP* is designed and developed to support the analysis of large-scale image data sets of different camera systems. It aims in bridging different data domains and in integrating different approaches to data analysis and post-processing. This software is highly used for researcher working in the area of plant breeding, plant improvement and data analysis.



- **Biocomputing Portal:** National Agricultural Biocomputing Portal has been developed and upgraded to provide a single point of access to High Performance Computing (HPC) resources established under National Agricultural Innovation Project (NAIP), ICAR, New Delhi using JSP technology. Various bioinformatics applications/software/tools have been installed on these clusters. The portal is designed for seamless integration with grid computing resources and providing services such as application services, grid information services, user authentication services, data management services, e-mail notification services etc.

- **Website for Centre for Agricultural Bioinformatics:** A website for Centre for Agricultural Bioinformatics has been updated and developed with detailed information about the various academic courses, students, projects, trainings, staff and publications. This website is updated monthly with the latest information on regular basis.

- **Data Submitted:** Metaproteome data from maize rhizospheric soil. In total 697 proteins with different functions representing 244 genus and 393 species were identified. The proteome data provides direct evidence on the biological processes in soil ecosystem and is the first reported reference data from maize rhizosphere. The LC MS/MS proteomic data are available via ProteomeXchange with identifier PXD014519. (Renu, Sanjay Kumar Gupta, Ashutosh Kumar Rai, Khan Mohammad Sarim, Anu Sharma, Neeraj Budhlakoti, Devendra Arora, Dhiraj Kumar Verma, Dhananjaya P.Singh, 2019).

- **Computational Comparison on Metagenomic Assemblers:** Assembly of metagenome is computationally challenging and more complex than single genome assembly. Keeping in view the volume, diversity and varied abundance of different microbes in microbial communities, number of metgenome assemblers have been developed to address the specific computational issues by following mainly De Bruijn Graph (DBG) and Overlap Layout Consensus (OLC) approaches. It is very pertinent to understand different computational approaches and issues of metagenomic assembly to further improve them with respect to time and computational resource requirements. Therefore, in this study various metagenomic assemblers are assessed with respect to their characteristics in addressing major computational issues. Initially, the computational perspective of single genome assemblers based on OLC and DBG graph construction approaches were studied. This is followed by review of metagenomic assemblers with respect to the algorithms implemented for addressing issues in metagenome assembly. Further, the performance of some of the popular metagenome assemblers was empirically evaluated with respect to run time and memory requirements on diversified benchmark metagenomic data. It was found that performance of assemblers varied considerably on these datasets and there is need to further make efforts to develop new tools or to modify the existing ones using efficient algorithms and data structures. (Anu Sharma, Dwijesh Chandra Mishra, Neeraj Budhlakoti, Anil Rai, Shashi Bhushan Lal and Sanjeev Kumar)

- **R Package Developed:** Genomic Selection (GS) is a latest development in animal and plant breeding where whole genome markers information is used to predict genetic merit of an individuals in a practical breeding programme. GS is one of the promising tool for improving genetic gain in animal and plants in today's scenario. This package is basically developed for genomic predictions by estimating marker effects. These marker effects further used for calculation of genotypic merit of individual i.e. genome estimated breeding values (GEBVs). Genomic selection may be based on single trait or multi traits information. This package performs genomic selection only for single traits hence named as STGS i.e. single trait genomic selection. STGS is a comprehensive package which gives single step solution for genomic selection based on most commonly used statistical methods. Neeraj Budhlakoti, D C Mishra, Anil Rai and K K Chaturvedi (2019). STGS: Genomic Selection using Single Trait. R package version 0.1.0. https://CRAN.R project.org/package=STGS.

- Genomic selection (GS) is recent development in animal and plant breeding. In GS whole genome markers information is used to predict genetic merit of an individual. This package is basically developed for genomic predictions by estimating marker effects. These marker effects are then further used for calculation of genotypic merit of individual i.e. genome estimated breeding values (GEBVs). However, as genetic correlations between quantitative traits under breeding studies are obvious. These correlations indicate that one trait carry information over other traits. Current, single-trait genomic selection (STGS) methods could not able to utilize this information. Genomic selection based on multiple traits (MTGS) could be a better alternative to STGS. This package performs genomic selection using multi traits information hence named as MTGS i.e. multi trait genomic selection. MTGS is a comprehensive package which gives single step solution for genomic selection using various MTGS based methods. Neeraj Budhlakoti, D C Mishra and Anil Rai (2019). MTGS: Genomic Selection using Multiple Traits. R package version 0.1.0. https://CRAN.R-project.org/package=MTGS.

- Estimation of error variance in case of genomic selection is a necessary step to measure the accuracy of the genomic selection model. For genomic selection whole genome high density marker data is used where number of markers is always larger than the sample size. This makes it difficult to estimate the error variance because ordinary least square estimation technique cannot be used in case of datasets where number of parameters is greater than number of individuals (i.e., p > n). Generally, four error variance estimation methods (viz, RCV, kfold-RCV, Bootstrap-RCV, Ensemble method) are suggested for such cases. These methods were compared on twenty four simulated dataset of various genetic architecture. Furthermore, an R package **"varEst"** has been developed which contains four different functions to implement these error variance estimation methods in case of Least Absolute Shrinkage and Selection Operator (LASSO), Least Square Regression and Sparse Additive Models (SpAM). Sayanti Guha Majumdar, Anil Rai and Dwijesh Chandra Mishra (2019). varEst: Variance Estimation. R package version 0.1.0. https://CRAN.R-project.org/package=varEst.

- Genomic selection is a specialized form of marker assisted selection. The package "**GSelection**" contains functions to select important genetic markers and predict phenotype on the basis of fitted training data using integrated model framework (Guha Majumdar et. al. (2019) <doi:10.1089/cmb.2019.0223>) developed by combining one additive (sparse additive models by Ravikumar et. al. (2009) <doi:10.1111/j.1467-9868.2009.00718.x>) and one non-additive (hsic lasso by Yamada et. al. (2014) <doi:10.1162/NECO_a_00537>) model. Sayanti Guha Majumdar, Anil Rai and Dwijesh Chandra Mishra (2019). GSelection: Genomic Selection. R package version 0.1.0. https://CRAN.R-project.org/package=GSelection.

- **Wheat drought root transcriptome database (WDRoTDb):** An online relational database of wheat drought transcriptome named WDRoTDb was developed. From the two contrasting genotypes, namely, NI5439 41 (drought tolerant) and WL711 (drought susceptible), ~78.2 GB data was generated on Illumina HiSeq 2000 platform. The web-resource catalogues details of 45139 DEGs, 13820 TF, 288 miRNAs, 640 pathways and 435829 putative markers including SSRs, SNPs and InDels. The study also reports 67823 and 64721 contrasting variety specific variants

for drought tolerant and drought susceptible varieties, respectively which are relevant for future association studies. This web-resource is based on "three-tier architecture" having, client-, middle- and database tier. This genomic resource can be accessed freely for non-commercial use at http://webtom.cabgrid.res.in/wdrotdb/. MySQL in the database tier stores all the information related to DEGs, TFs, KEGG pathways and markers in tabular form. For database connectivity, execution and fetching of query, server side scripting was done in PHP in the middle tier. As a model work, it was demonstrate that QTL region can be further dissected by RNA Seq data to understand its role in terms of DEG of specific genes harbouring in QTL regions along with its structural variants in terms of SNPs and InDels. GRNs constructed revealed role of key candidate genes responding to drought. This database was developed under CABin Scheme project.

- **Brassica SSR database:** Under the CABin scheme, Brassica SSR database with "three-tier architecture" was developed using PHP and MYSQL. It uses *de novo Brassica* genome assembly of ensembl genome database and NCBI database as an invaluable resource to mine putative SSR markers and generate their primers. The web-resource catalogues SSR information of five Brassica cultivars, namely, *Brassica Olarecea*, *Brassica Rapa*, *Brassica Juncea* and *Brassica Nigra, all assembled* chromosome-wise while *Brassica Napus* is available scaffold-wise. The data was retrieved in FASTA format. Individually, *Brassica Olarecea* has 9 chromosome, Brassica *Rapa* has 10-chromosome, *Brassica Juncea* has 18-chromosome and *Brassica Nigra* has

8-chromosome. A total of SSR 202313, 135767, 142191 and 300096 SSR markers were mined using MISA tool in *Brassica olarecea, Brassica napa*, *Brassica nigra* and *Brassica junecea,* respectively. It is **available at** http://webtom.cabgrid.res.in/brassica_ssrdb/ **for scientific community.**

- **VigSatDb: *Vigna* sp. *Insilico* and validated microsatellite database (**http://webtom.cabgrid.res.in/vigna_ssr/): *VigSatDB* has been successfully developed using three-tier architecture. It contains a total of 876219 SSR loci mined from whole-genome sequence data of three *Vigna* species represented by six different varieties. It also contains 1976 published SSR loci, which are already validated. This database has seven tabs viz. Home, Microsatellite, Tools, Polymorphism, Statistics, Tutorial and Team. The `Microsatellite' tab provides two search options viz., *in silico* mined SSRs and experimentally validated SSRs. *In silico* mined SSR tab is used for mining of simple and compound SSRs of chromosome-wise or scaffold-wise genome assemblies along with motif type, motif kind,

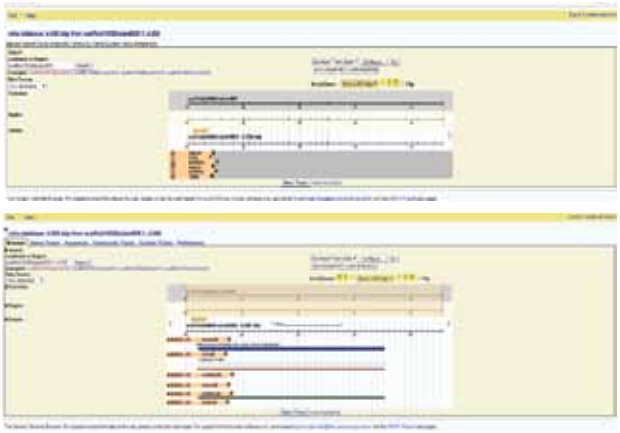
GC content, percentage, copy number and start position. Primer3core executable integrated at the backend can generate locus-specific primers of desired loci displaying their respective values of annealing temperature, product size and GC content. In order to use genic region SSRs as putative FDM, user has the choice to mine genic region SSRs selectively along with gene annotation. Using genome browser, user can get the details of gene name, accession number, descriptions, positions, strands, etc.

- **CastDB: Castor Transcriptome Database** (http://webtom.cabgrid.res.in/castdb/)**:** This database contains 71418 transcripts. The total DEGs between the pistillate and male line of the isogenic line M574 were 1453 while those in male and female buds of the monoecious line DCS-107 were 810. Further, the miRNA targets, SSRs and SNPs were mined which serve as a valuable genomic resources.

- **Seed spices web-resource:** An online web-resource of important seed spices was developed using 3 tier architecture. The seed spices included are Cumin, Coriander, celery, fennel, Ajwain, Dil and fenugreek spices. The information of number of markers along with the BLAST analysis tool is available for easy user of spices breeders (Figure).

- **Whole genome sequencing website hosted on NBFGR server:** A website, 'Rohu and Magur Genome Sequencing Consortium' has been developed under the project entitled and the has been hosted on ICAR-NBFGR server**.** This website contains information regarding the genome sequence data generation on multi sequencing platform along with statistics and progress of the project. The website also includes the information about the collaborating institutes along with the research personnel involved in the project. Further, an effort will be made to enrich the website with assembly information as well as the data obtained after downstream processing of the assembled genome. A snapshot of the website is depicted below.

- **Development of genome browser for rohu fish:** Rohu GBrowser has been developed using GBrowser. GBrowse is a web based tool combination of database and interactive web tool for manipulating and displaying annotations on genomes. All information has been stored in the MYSQL database and configuration has been done for accessing data from MYSQL server. It consists of 13494 scaffolds with 40,099 genes predicted using Augustus software.



- **Development of rohu (**http://webtom.cabgrid.res.in/romisatdb/) **and magur (**http://webtom.cabgrid.res.in/mamisatdb/) **microsatellite database**: A total of 5,57,193 SSRs were mined in Rohu while 702739 SSRs in Magur from final assembled whole genome. From this, di-nucleotide (72.28%) was the most common repeat unit followed by the tri- (16.20%), tetra- (10.10%), penta- (0.87%) and hexa- (0.03%) nucleotide in Magur. A database was developed using MySQL and PHP to facilitate the end user with these mined SSR for both the species. This database is linked to a user-friendly Web interface designed with the open-source scripting language PHP. The Primer3 standalone tool is integrated for designing forward and reverse primers for microsatellite sequences.

- **funbarRF**: DNA barcode based identification of fungal species (http://cabgrid.res.in:8080/funbarrf/): Identification of unknown fungal species aids to the conservation of fungal diversity. As many fungal species cannot be cultured, morphological identification of those species is almost impossible. But, DNA barcoding technique can be employed for identification of such species. For fungal taxonomy prediction, the ITS (internal transcribed spacer) region of rDNA (ribosomal DNA) is used as barcode. Though the computational prediction of fungal species has become feasible with the availability of huge volume of barcode sequences in public domain, prediction of fungal species is challenging due to high degree of variability among ITS regions within species. In funbarRF, a Random Forest (RF)-based predictor was built for identification of unknown fungal species.

5

Training Administration Cell

MATERIAL FOR ANNUAL REPORT (Jan 2019–Dec, 2019)

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 since 1964, M.Sc. in Computer Application since 1985-86, Ph.D. in Computer Application since 2013-14, M.Sc. in Bioinformatics since 2011-12 and Ph.D. in Bioinformatics since 2014-15. A brief description of human resource development during the year is given in the sequel.

1. DEGREE COURSES

The Institute continued to conduct the following degree courses in collaboration with the Post Graduate School of Indian Agricultural Research Institute (IARI), New Delhi which has the status of a Deemed University:

i) Ph.D. (Agricultural Statistics)

ii) M.Sc. (Agricultural Statistics)

iii) Ph.D. (Computer Application)

iv) M.Sc. (Computer Application)

v) Ph.D. (Bioinformatics)

vi) M.Sc. (Bioinformatics)

Both Ph.D. and M.Sc. students are required to study courses not only in Agricultural Statistics but also in Agricultural Sciences like Genetics, Agronomy, Agricultural Economics, etc. The Courses in Mathematics, Agricultural Statistics and Computer Application, are offered at this Institute while the courses in Agricultural Sciences are offered at IARI.

Number of students admitted / completed various courses during the period under report are:

S. No.	Course	No. of Students	
		Admitted	Passed Out
1	Ph.D. (Agricultural Statistics)	09	03
2	M.Sc. (Agricultural Statistics)	08	07
3	Ph.D. (Computer Application)	06	00
4	M.Sc. (Computer Application)	07	04
5	Ph.D. (Bioinformatics)	04	01
6	M.Sc. (Bioinformatics)	06	03

2. FACULTY MEMBERS OF P.G. SCHOOL, IARI IN AGRICULTURAL STATISTICS

S. No.	Name	Year of Induction
1.	Dr. L.M. Bhar, Principal Scientist & Director (A) till 27.10.2019	1998
2.	Dr. Tauqueer Ahmad, Principal Scientist & Director (A) from 28.10.2019 onwards	1998
3.	Dr. Seema Jaggi, Professor (Agricultural Statistics)	1995
4.	Dr. Anil Rai, Principal Scientist	1995
5.	Dr. K.N. Singh, Principal Scientist	2011
6.	Dr. Rajender Parsad, Principal Scientist	1995
7.	Dr. Amrit Kumar Paul, Principal Scientist	1998
8.	Dr. A.R. Rao, Principal Scientist	1998

S. No.	Name	Year of Induction
9.	Dr. Girish Kumar Jha, Principal Scientist (at IARI)	1999-2005; 2006
10.	Dr. Ramasubramanian, V., Principal Scientist	1999-2013; 2017
11.	Dr. Cini Varghese, Principal Scientist	2000
12.	Dr. Himadri Ghosh, Principal Scientist	2004
13.	Dr. Ajit, Principal Scientist	2015
14.	Dr. Anil Kumar, Principal Scientist	2010
15.	Dr. Prawin Arya, Principal Scientist	2003
16.	Dr. Hukum Chandra, National Fellow	2003
17.	Dr. Prachi Misra Sahoo, Principal Scientist	2002
18.	Dr. Amrender Kumar, Senior Scientist (at IARI)	2003
19.	Md. Wasi Alam, Scientist	2003
20.	Dr. Ranjit Kumar Paul, Scientist	2011
21.	Dr. Mir Asif Iqubal, Scientist	2011
22.	Dr. B.N. Mandal, Scientist	2011
23.	Dr. Susheel Kumar Sarkar, Scientist	2011
24.	Dr. Kaustav Aditya, Scientist	2012
25.	Dr. Sukanta Dash, Scientist	2013
26.	Dr. Arpan Bhowmik, Scientist	2014
27.	Dr. Ankur Biswas, Scientist	2015
28.	Dr. Anindita Datta, Scientist	2017
29.	Dr. Soumen Pal, Scientist Faculty Transferred to Computer Application on 13.12.2019	2017
30.	Dr. Sarika, Scientist	2018
31.	Mr. Deepak Singh, Scientist	2018
32.	Dr. Achal Lama, Scientist	2018
33.	Dr. Pradip Basak, Scientist	2018
34.	Dr. Mrinmoy Ray, Scientist	2018
35.	Dr. Raju Kumar, Scientist	2019
36.	Dr. Vandita Kumari, Scientist	2019
37.	Dr. Kanchan Sinha, Scientist	2019

3. FACULTY MEMBERS OF P.G. SCHOOL, IARI IN COMPUTER APPLICATION

S. No.	Name	Year of Induction
1.	Dr. Sudeep Marwaha, Head & Professor (Computer Application)	2002
2.	Dr. Rajni Jain, Principal Scientist (at NIAP)	2007
3.	Dr. Alka Arora, Principal Scientist	2001
4.	Dr. Anu Sharma, Senior Scientist	2004
5.	Dr. Shashi Dahiya, Senior Scientist	2001
6.	Md. Samir Farooqi, Scientist	2001
7.	Dr. K.K.Chaturvedi, Senior Scientist	2002
8.	Dr. S.B. Lal, Senior Scientist	2004
9.	Dr. Anshu Bhardwaj, Principal Scientist	2004
10.	Dr. Sangeeta Ahuja, Scientist	2002
11.	Sh. Pal Singh, Scientist	2010
12.	Dr. Mukesh Kumar, Principal Scientist	2014
13.	Dr. A.K. Mishra, Principal Scientist (at IARI)	2014
14.	Ms. Shaloo, Scientist (at WTC, IARI)	2016
15.	Sh. S,N. Islam, Scientist	2018
16.	Dr. Soumen Pal, Scientist Faculty Transferred to Computer Application on 13.12.2019	2019

4. FACULTY MEMBERS OF P.G. SCHOOL, IARI IN BIOINFORMATICS

S. No.	Name	Year of Induction
1.	Dr. A.R. Rao, Professor (Bioinformatics)	2010
2.	Dr. Anil Rai, Head (CABin) & ADG(ICT)	2010
3.	Dr. Seema Jaggi, Principal Scientist	2010
4.	Dr. Rajender Parsad, Principal Scientist	2010
5.	Dr. S.S. Marla, Principal Scientist	2010
6.	Dr. Sudeep Marwaha, Principal Scientist	2010
7.	Dr. Kishore Gaikwad, Principal Scientist (at NRCPB)	2010
8.	Dr. P.K. Singh, Principal Scientist (at IARI)	2010
9.	Dr. A.K. Mishra, Principal Scientist (at IARI)	2010
10.	Dr. U.B. Angandi, Senior Scientist	2014
11.	Dr. S.B. Lal, Senior Scientist	2010
12.	Mohd. Samir Farooqi, Scientist	2010
13.	Dr. Anu Sharma, Senior Scientist	2010

S. No.	Name	Year of Induction
14.	Dr. Sunil Archak, Senior Scientist	2010
15.	Dr. D.C. Mishra, Scientist	2010
16.	Dr. Sarika, Scientist	2010
17.	Sh. Sanjeev Kumar, Scientist	2010
18.	Dr. Mir Asif Iquebal, Scientist	2013
19.	Dr. Monendra Grover, Principal Scientist	2013
20.	Dr. K.K. Chaturvedi, Senior Scientist	2014
21.	Dr. M.G. Mallikarjuna, Scientist (at IARI)	2017
22.	Dr. Yasin Jeshma K., Scientist (at NBPGR)	2018
23.	Dr. Sudhir Shrivastava, Scientist	2019

5. DISSERTATIONS APPROVED

Ph.D. (Agricultural Statistics)

Name: Raju Kumar
Guide: Dr. L.M. Bhar
Roll No. 10093

Title of the Thesis: Outliers in Block Designs for Incomplete Multi-response Experiments

In any experiment, if data on a single response variable are measured from each experimental unit corresponding to the application of a treatment, is known as uni-response experiment and if data on several response variables are measured from an experimental unit corresponding to the application of a treatment, is known as multi-response experiment. In many multi-response experiments, due to constraints on resources and time, it may not be feasible to collect the observations on all the response variables from each experimental unit. As a consequence, the data on a subset of response variables is collected from one subset of units; the data on another subset of response variables is collected from another subset of units. Such experiments are called incomplete multi response experiments. If outlier(s) is/are present in the data set in case of designed experiment, the assumption like normality and homogeneity of error variances and additivity of the experimental effects gets violated. In the present study an attempt has been made to tackle the problem of outlier(s) in block designs for incomplete multi-response experiments. Cook-statistic and AP-statistics for identification of outlier(s) in block designs for incomplete multi-response experiments are developed. Observations from a particular experimental unit have been considered as outliers. Thus, we have taken vectors of outliers for developing the statistics. Developed statistics are illustrated with real experimental data. Tackling of multiple outliers is very difficult owing to the presence of masking. Following the techniques used in linear regression model two methods have been developed in the present study for detecting outliers in incomplete multi-response experiments in presence of masking. One method is based on the eigenvalues of a well defined influence matrix and the other is based conditional Cook-statistic. Both the methods are again illustrated with real experimental data. The problem of outliers in data set can also be tackled by adopting a design that is insensitive to the presence of outliers. In the present study, a robustness criterion has been proposed for block designs for incomplete multi-response experiments for one-way elimination heterogeneity and designs that are robust against the presence of a single outlier vector are identified.

Name: Saurav Guha
Guide: Dr. Hukum Chandra
Roll No. 10544

Title of the Thesis: Use of Calibration Approach in the Estimation of Domain Total in the Presence of Auxiliary Information

In many surveys, sample estimates are required not only for the population parameters but also for the various subgroups or subpopulations which are generally known as domains. For example in a household survey, main aim of the survey is to obtain separate estimates on the basis of income level, gender or may be the literacy rate of the household etc. The number of units corresponding to a particular domain is random in nature and sometimes very small. One can think of the domain as a stratum when there is availability of perfect sampling frame like in stratified sampling and may proceed to estimate the parameter of interest. But when the number of domains are large and problem of imperfect frame arises as well as high cost is associated with them, then it is practically impossible to single out the domain as a stratum. It is a common practice to incorporate auxiliary information at the estimation stage to improve the precision of the sample estimates. The present study investigates the situations where calibration approach can be used in estimation of domain parameter using two auxiliary variables. It is assumed that complete information is available for one auxiliary variable while information is not available for other auxiliary variable which is highly correlated with the study variable, and

the double sampling approach is proposed accordingly. Different conditions like known and unknown domain sizes, positive as well as negative correlation between study and auxiliary variable are considered. Different ratio and regression type estimators for domain as well as population total along with their variance and variance estimator have been developed. The expressions for all the proposed estimators and their variance estimations are derived under simple random sampling without replacement. It is shown, through empirical studies that the proposed estimators perform better than the existing estimators. Further, empirical studies reveal that higher the correlation between the study and the unknown auxiliary variable, greater the precision. It may be noteworthy that proposed estimators outperforms the existing estimators in both synthetic data as well as in the real datasets considered.

Name: Shyamsundar Parui
Chairman: Dr. Rajender Parsad
Roll No. 10582

Title of Thesis: Efficient Designs for Incomplete Factorial Treatment Structure

In many factorial experiments, certain treatment combination(s) need to be excluded from complete factorial treatment structure due to practical considerations. The remaining factorial treatment structure is incomplete. The literature on designing experiments with incomplete factorial treatment structure is limited and concentrated on placebo (no drug or no application of factor) controlled clinical trials for two factors where treatment combination associated with double placebois excluded. In the present investigation, a general procedure has been developed for obtaining A-optimal completely randomized designs for three factors considering all possible sets of treatment contrasts of interest after excluding triple placebo or both double and triple placebo. Catalogues of A-optimal completely randomized design shave been prepared for three factors up to 4 levels and maximum 10 choices of experimental units starting from minimum number required for existence. A-efficient proper block designs have been obtained for two factors with arbitrary number of levels having incomplete factorial treatment structure using replications of treatment combinations of A-optimal completely randomized designs and modifying strongest treatment interchange algorithm. Several new and more efficient designs have been obtained as compared with the designs available in literature. Catalogue with layout of A-efficient designs up to 4 levels and blocks and block size 10 has also been prepared. Lower bound to A-efficiency of non-proper block designs has been derived. A general method of construction of A-efficient non-proper block designs for two factors with one factor at 2 levels has been developed. SAS codes for obtaining designs for all the three situations have been developed.

M.Sc. (Agricultural Statistics)

Name: Sandipan Sarkar
Guide : Dr. Ranjit Kumar Paul
Roll No. 20781

Title of Thesis: Study of Wavelite and Long Memory Time Series Models for Forecasting

Now a day's time-series analysis and forecasting is a burning issue in the area of statistical modelling. In the field of agriculture, spot price forecasting is an important argument for both farming community as well as policy makers. Mainly the agricultural commodity prices are symbolize with a high degree of risk in terms of volatility. Therefore, more rigorous forecast of price volatility is highly essential for budgetary planning and monitoring. In the practical field, mainly for financial time-series data of agricultural commodity has long memory property. Usually Autoregressive fractionally integrated moving average (ARFIMA) model is used to capture the characteristic feature of the long memory time-series. But time-series data consist of signal parts and irregular parts. Due to this irregular part, the forecasting performance of ARFIMA model is reduced significantly. Keeping it in view, in our study wavelet transformation is used to extract the signal part for modelling the long memory process more precisely. The better performance of wavelet approach is demonstrated using the daily wholesale price data of wheat in Rewari market of Haryana, India. In many situation volatile series exhibits the long memory property in mean model. In this type of situation Generalized autoregressive conditional heteroscedastic (GARCH) model is not a good choice for specification of the time-series model. To capture the volatility and long memory, ARFIMA-GARCH model is fitted to the maximum and modal spot price of mustard in Bhopal market of Madhya Pradesh, India. The residuals of the fitted model have been investigated and no systemic pattern is found, confirming the adequacy of the model. The out-of-sample forecast formulae along with forecast error variance for fitted ARFIMA-GARCH model is derived theoretically by recursive use of conditional expectation. A comparative study between usual GARCH and ARFIMA-GARCH has been executed in this study. The predictive performance of the

ARFIMA-GARCH model is examined in terms of MAPE and RMSE values.

Name: Jitendra Kumar
Guide: Dr. Seema Jaggi
Roll No. 20782

Title of Thesis: Statistical Designs for Fitting Response Surfaces Incorporating Neighbour Effects

Response Surface Methodology (RSM) approximates the relationship between one or more response variables and a set of experimental variables or factors. In RSM, it is generally assumed that the observations are independent and there is no effect of neighbouring units. But under the situation when the units are placed linearly with no gaps there is high possibility of overlapping or neighbour effects from the adjacent units. So including these effects into the model is of great importance in deciding the precision of the experiment. Further, availability of resources and size of the experiment is important factor in conducting an experiment. As the size increases, cost involved in conducting the experiment increases, thereby decreasing the precision of the experiment. In this study, response surface designs incorporating neighbour effects have been considered. Method of constructing First order rotatable designs with differential neighbour effects (FORDDNE) and second order rotatable designs with differential neighbour effects (SORDDNE) have been developed in smaller number of runs. The methodology for response surface designs with neighbour effects at distance 2 has been developed and a method of constructing FORDDNE at distance 2 has been obtained. The designs developed ensure the constancy of the prediction variance. Relevant SAS macros/codes using PROC IML have been developed to generate the designs and the variance of the estimated response.

Name: Garima Singh
Guide: Dr. Baidya Nath Mandal
Roll No. 20783

Title of Thesis: On Block Desins for Comparing Test Treatments with Control(s)

There are many research investigations where the interest of the experimenter is in comparing a set of new treatments called test treatments with one or more established standard treatment(s) known as control treatment(s). Under the presence of one nuisance factor, two popular classes of block designs for comparing test treatments with control treatment(s) namely balanced treatment incomplete block (BTIB) designs and balanced bipartite block (BBPB) designs are used for such situations. In this investigation, two new classes of block designs namely nearly balanced treatment incomplete block (nearly BTIB) designs and nearly balanced bipartite block (nearly BBPB) designs are introduced for comparing test treatments with a single control treatment and with more than one control treatments, respectively. Necessary parametric conditions for existence of these two classes of block designs are obtained. Two algorithms are proposed to construct nearly BTIB and nearly BBPB designs for given parameters. The algorithms are implemented using R programming language. Nearly BTIB designs are obtained in a restricted parametric range using the first algorithm. In the restricted parametric range, a total of 635 nearly designs are possible and 595 of them are constructed. It was found that 182 nearly BTIB designs have higher A-efficiency compared to BTIB designs of Mandal *et al*. (2013). Using the second algorithm, nearly BBPB designs are also obtained in a restricted parametric range. In this parametric range, 886 nearly BBPB designs may exist out of which 874 designs are obtained.

Name: Mahalingraya Prakash Changond
Guide: Dr. Tauqueer Ahmad
Roll No. 20784

Title of Thesis: Estimation of Harvest and Post-harvest Losses of Major Crops using Double Sampling Approach

Increasing agricultural production is one aspect of fulfilling food demand and the efficient use of food materials produced and saving them as much as possible is another aspect. Delivering food to the consumers by saving produced commodities from loss in fields, transport, storage, retailing, processing etc. without straining, our fields, water and environment seems much better option. In this study, the methodology for estimation of quantitative harvest and post-harvest losses for major crops agro-climatic zone level and at district level has been provided under stratified two-stage sampling. The double sampling approach under stratified two stage sampling design framework for estimation of harvest and post-harvest losses for major crops has been developed. In the proposed study, samples were selected using stratified two-stage sampling design in two phases i.e., for enquiry and for actual observations from each districts. Here, at the first stage, districts are selected which are considered as PSU's and at the second stage i.e., at the farm household (SSU's) stage, two-phase sampling design is employed where a preliminary sample is

selected using SRSWOR to estimate the harvest and post-harvest losses of crops by enquiry and the second phase sample selected using SRSWOR from the already selected preliminary sample for actual observation. The estimates using developed double sampling approach and existing pooling technique approach were obtained through the simulation study. The real data obtained in the large scale National Survey conducted for estimation of quantitative harvest and post-harvest losses of major crops and commodities by ICAR-IASRI in collaboration with ICAR-CIPHET, Ludhiana in 2013-14 has been considered for simulation in this study. The efficiency of the estimator obtained using developed methodology was evaluated with help of simulation study. Estimate of the percentage loss at farm operations at district level and agro-climatic zone level has been obtained from the simulation study. The developed methodology provided estimates of percentage loss, variance and estimate of variance along with percentage bias of the estimates at district level and at agro-climatic zone level and these are compared with the same parameters estimated through existing methodology which are obtained an optimum pooling technique. The percent bias of estimates obtained using the proposed methodology were less than those obtained by existing pooling technique. The estimates obtained using the proposed methodology were found to be more reliable and almost at par with the estimates obtained through pooling technique.

Name: Kapil Choudhary
Guide: Dr. Girish Kumar Jha
Roll No. 20785

Title of Thesis: Study on Empirical Mode Decomposition based Neural Network for Agricultural Price Forecasting

Agricultural price forecasting is one of the challenging areas of time series analysis due to its strong dependence on biological processes. In this study, an ensemble empirical mode decomposition (EEMD) based neural network model is proposed for agricultural price forecasting. For this purpose, the original price series were first decomposed into several independent intrinsic mode functions (IMFs) and one residual component. Then a time-delay neural network (TDNN) with single hidden layer was constructed to forecast these IMFs and residual component individually. Finally, the prediction results of all IMFs including residual are aggregated to formulate an ensemble output for the original price series. Empirical results demonstrated that the proposed EEMD-TDNN model outperforms the TDNN model in terms of root mean square error and directional prediction statistics. Besides, efforts were made to propose an EEMD based hybrid model including TDNN and ARIMA for agricultural price prediction. For this, all IMFs were divided into high frequency, low frequency and trend components using the fine-to-coarse reconstruction method. Further, TDNN is suitable for forecasting the high frequency and trend components and ARIMA is appropriate for predicting the low-frequency components. The prediction results of all the components are aggregated to obtain the final forecasting values of the price series. Empirical results showed that EEMD-TDNN-ARIMA outperformed TDNN but under performed compared to EEMD-TDNN model, mainly due to nonlinear characteristics of low frequency component.

Name: Rohit Kundu
Guide: Dr. Rajender Parsad
Roll No. 20786

Title of Thesis: Response Surface Designs with Four and six Levels

Second order response surface is fitted to find the relationship between the response and the level combination(s) of experimental factors. Most of the designs available in literature for fitting second order response surfaces are for 3-level and 5-level factors. In agricultural sciences, several experiments are conducted with 4- or 6-equispaced level factorial experiments. In the literature, it has been shown that it may not be easy to construct second order rotatable response surface designs with 4- and 6-equispaced level factorial experiments. Therefore nearly rotatable second order response surface designs with 4-equispaced and 6-equispaced levels have been obtained. Methods of construction available in literature for obtaining second order rotatable designs in 4- and 6-level factorial experiments have been modified to get designs with equispaced levels. It has also been shown that it is possible to construct a 4-equispaced level second order rotatable response surface design in 16 factors. The methods given are general in nature and can be used for obtaining designs with any number of factors. In the present investigation, designs up to 6 factors are constructed. Rotatability measure of second order response surface designs with 4-equispaced and 6-equispaced level factorial experiments up to 6 factors have been computed. Catalogues of 4-equispaced and 6-equispaced level designs with minimum number of designs points and/or maximum value of rotatability measure up to 6 factors are also given. Value of rotatability

measures of the designs catalogued is more than 0.968, therefore, these designs can be used in practical experimental situations.

Name: Sayantani Karmakar
Guide: Dr. Prachi Misra Sahoo
Roll No.20787

Title of Thesis: Soil Health Assessment Using Spatial Statistics

Soil health is one of the key factors for efficient agricultural production system. In this study soil health assessment is done using spatial statistics. For this spatial variability of various soil parameters has been captured. Soil Health Index (SHI) has been developed and optimum sampling distance for sampling soils has been identified. The present study has been conducted using data of Bihar state. Soil samples at 12264 locations spread across 29 districts of Bihar with 11 soil parameters (i.e. pH, Electrical Conductivity, Organic Carbon, Phosphorus, Potassium, Sulphur, Copper, Iron, Manganese, Zinc, Boron) was used for the study. Initially, spatial variability of soil attributes was captured using Inverse Distance Weighing (IDW) and kriging techniques. Different variogram models applied for kriging were compared using Akaike Information Criterion score (AIC). The exponential model was found to be best. Based on Root Mean Square Error (RMSE), Ordinary Kriging was found to be better than IDW. Soil Health Index (SHI) was developed using Principal Component Analysis (PCA) approach for each of the 12264 sampled points. Classified SHI map has been generated based on three classes- low, medium and high indicating good soil health for high index values. The index values were also validated by comparing the yield of rice, wheat and maize, at district level, for which the data was obtained for the year 2016-17. SHI was found to be in accordance with the yield data. The contribution of each of the soil parameters to SHI has been obtained using variance based approach of sensitivity analysis. Potassium (K_2O) was found to be highly sensitive followed by pH, Boron, and Phosphorus (P_2O_5). An optimal sampling distance was identified using Global Moran's I statistic of spatial autocorrelation computed at different sampling interval of 2, 4, 6, 8 and 10 km, which resulted in identification of optimum distance of 6 km, beyond which next soil sample should be collected. Therefore, from this study it can be concluded that Kriging using exponential model performs best for capturing maximum spatial variability of various soil parameters. Soil health index could be efficiently used for assessing soil health and contribution of each parameter can be studied by sensitivity analysis. The optimum distance at which sampling should be done can be obtained by observing the pattern of spatial autocorrelation.

M.Sc. Computer Application

Name: Debdali Chowdhury
Chairperson: Dr. Anshu Bharadwaj
Roll No. 20802

Title: GIS Approach for Mappint the Mega-Environment for Maize in India.

Greater emphasis on future constraints to agricultural production are motivated by the projections of environmental change. The speed of population, change in climate and environmental has pressurized the crop community to understand the importance of those stresses which may result in the significant declines in yield. Advances in data availability, advance information technology, and new and improved methods to target genotypes to environments have benefited the crop improvement practices. No methodology is found in literature which integrates factors like climate, soil, land cover etc., and can predict the most suitable environment (Area) for growing maize based on its genetic variability for India. Therefore, a methodology is needed which considers the integration of factors like climate, soil, land cover etc., to map the most suitable Mega- Environment for growing maize based on their genetic variability. Mega-environment can be defined as a part, which may not necessarily be contiguous, of growing region of any species of a particular crop, with homogeneous environment which encourages similar genotypes to perform best. The MEs (homogeneous environments of production delineated on the basis of an agro-climatic) are helpful to the crop breeders in managing the genotype-by-environment interactions and then extrapolate the same within similar agro climatic areas. MEs are known to be broad and may not necessarily be contiguous growing areas, which are international and frequently transcontinental, They have similar cropping system requirements, biotic and abiotic stresses, consumer preferences and production volume of the relevant crop, enough to justify attention," for example, "tropical lowland, late-maturing, white dent" corn with relevant disease resistances, which occupies 3.8 million hectares across 18 countries (CIMMYT1, 1989a). Sites suitable as testing sites for the selection of new varieties to be sown with specific and wide adaptability to different environmental conditions can be identified. Over the period of time, the concept of

global maize mega-environments (MEs) has been developed a defined by the International Maize and Wheat Improvement Centre (CIMMYT) and its partners. The MEs (homogeneous production environments defined on the basis of agro-climate) help the crop breeders to manage genotype-by-environment interactions and to extrapolate them within similar agro climatic zones (Hartkamp *et al*., 2000). In this research study, an effort has been made to using GIS to map/ identify mega environment for breeding of maize crop for all over the India.

Name: Vivek Kumar
Guide: Dr. Anu Sharma
Roll No. 20804

Title of Thesis: Development of Web based Tool for Visualization of Genetic Variants

India is an agricultural country. Agricultural plays a significant role in our Indian economy. Agriculture is the main source of livelihood of many people in India and world. Increasing human population requires more land for living as well as for growing food, but one major problem is that land is fixed. Hence, there is a requirement of more food from less land, which is the basic need. To fulfil this need, we have to apply modern methods on crop production. In modern agricultural practices, genetics and plant breeding plays a significant role in increasing the agricultural products. Genetic variations are used to describe the variations present in a DNA sequence of an individual's genome. Individuals belonging to specific species have similar characteristics but they are rarely identical, the difference between them is called variation. Single Nucleotide Polymorphisms (SNPs) pronounced as 'snips', is the most common type of genetic variation amongst individuals genome. Each SNP represents a difference in a single DNA base namely Adenine (A), Thymine (T), Cytosine (C) or Guanine (G) in a person's DNA. On average, they occur once in every 300 bases and are often found between genes in the DNA. Similarly there are many other genetic variants namely Simple Sequence Repeat (SSR), Copy Number Variations (CNV), InDels etc. The identified genetic variants are scattered at different locations in a genome and are also explored in isolation. There is a need to integrate these genetic variants to bring at common platform where they can be easily explored and compared to identify the causes of such variations.

Therefore, there is a need to make an attempt to integrate and provide these genetic variants and its associated information to the end users with easy accessibility in the form of a Web based Tool for Genetic Variants. This tool will help users to access and study genetic variants and its associated information through single window. Hence, a web based tool has been developed for visualization of genetic variants.

Name: Vaijnath Shivlingappa
Chairman: Dr. S.B. Lal
Roll No.: 20805

Title of Thesis: Development of Software Prototype for In-Solico copy Number Variation Identification

The biggest challenge facing Indian agriculture is to develop high yielding varieties to feed the vast increasing population of the country. Seed is critical and basic input for attaining high crop yields and sustainable growth in agricultural production. The advances in genome sequencing technologies are helpful in identification of different types of markers which can help in development of high yielding varieties. Single reference genome is not able to provide the representation of genetic diversity in a given species. The diversity can be identified and discovered using the study of structural variation in the form of copy number variants (CNVs) by studying the sequences of different accessions. The CNV will account for complete value of genetic information that is present in individual species. Copy number variation (CNV) plays an important role in identifying the genetic and phenotypic variation in the breeding population. Web based software for identification of CNV has been developed to and will help to perform CNV identification. Development work has been carried out using some technologies like Java Server Pages (JSP), Hyper Text Markup Langauge (HTML), Java script, Cascading Style Sheets (CSS) for front end interface, SQL for backend database and R has been used for integration with JSP to display the results in developed web based interface for CNV identification. The developed interface shows information about Chromosome name, starting position, ending position, size, position of the CNV, depth of the normal sample , depth of the targeted sample and shows the relative Copy Number Ratios (CNRs) between the normal and targeted sample. This CNV information can further be used by researchers for retrieval of CNV information to identify disorder and helpful in developing diagnostic kits and treatments, varietal development and improvement by genome wide association of different cultivars.

Name: Lakshmi Sonkusale

Chairman: Dr. Sangeeta Ahuja
Roll No. 20807

Title of Thesis: Design and Development of Mobile App for Ergonomics Assessment of Drudgery Prone Activities in Agriculture

Agriculture is one of the significant contributors to the Indian economy. For enterprise based agriculture, it is important to utilize the available resources in best possible way. Most of agricultural activities performed by different workers/farmers are done in inappropriate way which can lead to the physical stress of worker's body and many potentially serious problems/harmful. Different researchers and other many scientists have conducted studies to reduce all these problems of workers related to agricultural activities. Manual evaluation involves more efforts, time and sometimes can affect the quality of decisions. Hence, android based mobile app named "Ergon" for Evaluating Agricultural Activities on Ergonomics Protocol is designed and developed to overcome the these limitations that can be faced by some of the evaluators. It helps to evaluate workers, store data, display various reports (based on search criteria of district wise, activity wise, mode of activity wise and gender wise), export data to excel for further analysis, provide authentication to different users that include administrator, internal user (under ICAR-Institutions) and external user. The 'Ergon' app can be installed on user's mobile or shared on a network. It is developed, tested and validated to insure its functionality as well as reliability. Its interface that is used for the interaction with users was developed by using Java language. The mobile app named 'Ergon' has been developed on Android Studio 3.0.1 and the minimum requirement for the app is a device running on API 16: Android 4.1 (Jelly Bean). Java and XML programming languages are used. Tools used to develop the 'Ergon'app are Android Studio IDE, SQLite, Android Device Monitor, and Firebase Cloud Firestore Beta as a database. The 'Ergon' app has been tested for the various agricultural activities in field and provided the best result form of mean and standard deviation. The developed android app 'Ergon' would be of great use to the farmers/user for reducing drudgery during farm activity. In future, more information can be easily added in the 'Ergon' app like farm equipments, ergonomics protocol that are involved in agricultural activities etc.

Ph.D. (Bioinformatics)

Name: Tanmaya Kumar Sahu
Chairman: Dr. A.R. Rao
Roll No: 10433

Title of Thesis: Computational approaches to understand host pathogen interactions in foot-and-mouth disease (FMD) of cattle

Foot-and-mouth disease (FMD), being an extremely infectious viral disease in wild and domestic cloven-hoofed animals, endangers several livestock populations nurtured in India. FMD adversely affects the socioeconomic status of millions of farmers. Though considerable amount of genomic information related to FMD is available, it has remained as a major threat to the livestock industry world-wide. The high genetic variability in the FMDV genome limits the effectiveness of vaccination. Moreover, traditional vaccine and drug development methods are time consuming. Hence, an intervention of bioinformatics approaches is required to supplement the rapid therapeutics development for FMD infected animals. Among these animals, cattle are highly affected by FMD that contribute substantially to the survival of mankind since several years. Therefore, the present study has been designed to explore the *in silico* aspects of therapeutics development against FMD in cattle. Specifically, the study includes development of a flexible length B-Cell epitope prediction method to supplement FMD therapeutics, computational designing of an effective therapeutic antibody that can address the problem of genetic variability in FMDV, unraveling the role of RNA interference in host-pathogen interaction and development of an information system on FMD of cattle that can assist related research community in controlling FMD in cattle. The performance of machine learning models like, Random Forest(RF) and Support Vector Machine (SVM) were assessed using the flexible length linear B-Cell epitope datasets encoded with nineteen different amino acid encoding schemes (feature vectors) including a proposed scheme. Out of these nineteen encoding schemes, Amino acid Composition(AC; 20 dimensional feature vector), Distribution component of Composition Transition Distribution(CTDD; 105 dimensional feature vector), Amino acid anchoring Pair Composition(APC; 1200 dimensional feature vector), Codon Degeneracy based Encoding(CDE; 16 dimensional feature vector), Di-Peptide Composition (DC; 400 dimensional feature vector)

were combined based on their performance as well as length of the corresponding feature vectors. The combinations namely, AC+CTDD, CDE+CTDD and APC+AC+CTDD with RF model have exhibited high prediction accuracy while using specialized FMDV dataset. Whereas, the combination APC+DC with RF model showed high accuracy while using generalized homogeneous flexible length B-Cell epitope dataset. A similar trend was also observed while APC+DC with RF was compared with existing state-of-art methods for prediction of flexible length B-Cell epitopes while using an independent test set. As far as, the computational antibody design is concerned, six variants of the monoclonal antibody (mAb) 4C4 were identified with better binding potential than the native one. Amongst the 4C4 variants, the model with mutations at 2096 (N®C), 2098(D®I), 2599(A®G) and 2602(S®Q) positions was found most favorable for interacting with the antigen. Another 4C4 variant having mutations at 2034(N®L), 2096(N®C) 2098(D®Y), 2532(T®K) and 2599(A®G) positions confirmed better binding potential with two genetically variable GH loops of FMDV-VP1 protein than the native ones. In the context of RNAi mechanism in host pathogen interaction, nine mature host miRNAs were identified to have a total of 284 targets in 98 distinct FMDV genomic sequences. Futher, 14 miRBase miRNAs were found with better target accessibility in FMDV than that of *Bos taurus*. Besides, eight putative targetable regions having sense strand properties of siRNAs were identified on FMDV genes that are highly dissimilar from the host genome. In addition, 21 simulated nucleotide sequences having >90% identity with mature miRNAs were identified to have targets in FMDV accessions. The **"**Foot and Mouth Disease Information System for Cattle (FMDISC)" has been developed based on the information generated on antibodies, ncRNAs and epitopes related to FMD with user-friendly retrieval system. FMDISC also incorporates a flexible length linear B-Cell epitope prediction server (FlexiBcF), which is especially trained with the experimentally validated B-Cell epitopes related to FMD. The FMDISC is freely accessible at http://bioinformatics.iasri.res.in/fmdisc.

M.Sc. (Bioinformatics)

Name: Ankita Negi
Guide: Dr. Sarika
Roll No. 20797

Title of Thesis: Development of transcriptome based web-genomic resources for drought responsiveness in block pepper

Black pepper (*Piper nigrum* L.) (2n= 52) is a perennial, trailing woody flowering vine belonging to the family *Piperaceae*, also commonly known as white pepper, green pepper, peppercorn, Madagascar pepper. It is known as the "*King of spices*" due to its global trade and widespread dietary, medicinal, and preservative uses. It is cultivated for its fruit, which is dried and used as spice, seasoning food as well as traditional medicine. The pungency of black pepper is due to the chemical *piperine*, an alkaloid present in the fruits and roots of the plant. It is cultivated as a major cash crop in more than 30 tropical countries of the world. Black pepper germplasm is costly and economically important. The crop production in black pepper is affected by both biotic as well as abiotic factors. Drought or water deficit stress is one of the major environmental stresses affecting plants, resulting in reduced productivity and crop losses. The present study is based on the paired-end reads of control and drought affected leaf transcriptome of black pepper, generated by Illumina Hiseq 2000 technology. The study aims at identification of candidate genes in leaf tissues of black pepper for drought tolerance by its transcriptional profiling, mining of putative molecular markers (SSRs, SNPs and InDel markers) with their primers, transcription factors, pathways etc and cataloguing of these information in the form of web genomic resource, which is otherwise lacking. *De novo* transcriptome assembly was performed using *trinity* assembler. A total of 114598 transcripts, 4914 differential expressed genes, 2110 transcriptional factors, 786 domains and 1137 families, 20124 putative SSR markers and 259236 variants (246458 SNPs and 12778 and Indels) were identified from *de novo* assembly. Leucine-rich repeats (LRR) and ubiquitin-like domain-containing At2g30105, serine threonine protein kinase, Mitogen-activated protein kinase (MAPKKK), NBS-LRR, Myeloblastosis related proteins (MYB), Basic helix-loop-helix (bHLHs) found in this study are reported to be associated with plant tolerance against drought condition. All the information have been catalogued in Black Pepper Drought Transcriptome Database (BPDRTDb) accessible freely for academic use at http://webtom.cabgrid.res.in/bpdrtdb/. All these information can be further be utilized in the implementation of genetic improvement, breeding programmes, mapping population and validation for development of new improved cultivars. The molecular markers can also be valuable genomic resource in endeavour of drought tolerant variety development for higher productivity of black pepper.

Name: Mohan Babu H.S.
Guide: Dr. Sunil Archak
Roll No. 20800

Title of Thesis: Development of Non-B, DNA Database for Rice and Maize

Amongst nucleic acids it has been found that apart from normal canonical form of B-DNA there are many other forms which are biologically functional. Keeping this in mind a database of non-B DNA was created for Rice and Maize. The Chromosome sequences and the gene information was collected from NCBI Database for Rice (*Oryza sativa Japonica Group*) and Maize (*Zea mays*) crops. The seven major non-B forms of DNA i.e., A-DNA, Z-DNA, G-Quadruplex motifs, Inverted Repeats, Direct Repeats, Mirror Repeats and Short Tandem Repeats were predicted in Rice and Maize chromosomes using the non-B DNA motif search tool which is freely available over the internet. The results were used to create the database, using the WAMP framework for Windows operating system. The database Architecture includes three tiers with the clients at the top, web server at the middle and MySQL database at the bottom. Bioperl script with the SeqIO module was used to divide the chromosomal sequences into subsequences while predicting the motifs from the chromosomes of Maize since their size is more than the analysis limit of the motif search algorithm. Window analysis was done to obtain the motifs that might have been missed, at the flanking regions of the subsequences. The interface was created using the client side programming languages HTML (Hypertext markup Language), CSS (Cascading style sheets), and JavaScript. PHP (Hypertext Preprocessor) was used as server side scripting language. MySQL was used as the structured query language to create the General search option to retrieve the motif data and the advanced search option in which user can search by Gene ID, accession number and description of the protein product coded by the gene. With these search options the interface also includes the menu for crop wise and chromosome wise statistics of non-B DNA motifs. The glossary menu includes the definitions for technical terms used in the project. Link is provided to NCBI Genome Data view to visualize the motif location on the genome. Links are also provided to the User manual, index files of Rice and Maize, tools and resources used in the research project. Since these motifs are involved in critical functions in the cell their study may be important for understanding economically important physiological phenomenons in other crops and animals of agricultural importance so the database can be further extended to meet this objective.

Name: Dipro Sinha
Guide: Md. Samir Farooqui
Roll No. 20887

Title of Thesis: An Ensemble Based Clustering Approach for Metagenomics Data

Metagenomics is the study of microorganisms and a major part of it to reconstructing the genome of different organisms because it is difficult to isolate and clone some organism in *in-vitro*. It is also known as environmental genomics, eco-genomics or community genomics. In order to reassemble the reads obtained from shotgun sequencing, genome assembly plays an important role in this process. The main problem appears in separating and assembling the genomes obtained from different organisms as they are very large in number and also all the genomics reads are jumbled up. The shotgun sequencing resulting genomic reads which contain fragments from different genomes of several microorganisms. So in order to reconstruct them, these reads are needed to be clustered in different bin according to the different microorganism separately. For this, classification of the jumbled genomes from various organism's different clustering techniques are evolved like binning, boosting, bagging, stacking. Among them, nowadays, binning is the most widely used algorithm. In other words genomes are grouped into operational taxonomic units (OTUs) for further taxonomic profiling and down-streaming functional analysis. This OTU clustering is considered as binning. For clustering binning uses several clustering techniques like k-means, k-medoids, Hidden Markov Model (HMM), hierarchical clustering *etc*. But each of these clustering techniques has their own drawbacks. In past, a very few efforts had been seen to apply ensemble based clustering on the metagenomic data for clustering. Here in this research an ensemble based clustering approachP has taken to cluster the metagenome. Different clustering technique like k-means, hierarchical, PAM and DBSCAN is applied on the metagenome. For this R-packages namely Consensus ClusterPlus (for k-means, hierarchical and PAM) and dbscan (for DBSCAN) is used. K-means clustering outperforms other clustering technique, having a rand index 0.7831 by cluster the metagenome in seven bins where hierarchical clustering can only able to generate two bins and DBSCAN and PAM unable to cluster the metagenome. In a population where diversity can be observed by means of abundance, k-means can give a satisfactory result.

6. AWARDS TO STUDENTS

- Sh. Kapil Choudhary (Agricultural Statistics)
  - Received Nehru Memorial Gold Medal 2019 of IASRI for being Best M.Sc. (Agricultural Statistics) Student during the Annual Day of the Institute
- Ms. Debdali Chowdhury (Computer Application)
  - Received Nehru Memorial Gold Medal 2019 of IASRI for being Best M.Sc. (Computer Application) Student during the Annual Day of the Institute
- Ms. Ankita Negi (Bioinformatics)
  - Received Nehru Memorial Gold Medal 2019 of IASRI for being Best M.Sc. (Bioinformatics) Student during the Annual Day of the Institute
- Sh. Kapil Choudhary (Agricultural Statistics)
  - Received IARI Medal for M.Sc. (Agricultural Statistics) student during 57th Convocation 2019.

7. ANNUAL DAY CELEBRATIONS

The Annual Day of the Institute was celebrated on July 2, 2019. Professor Ramesh Chand, Member Niti Aayog delivered the Nehru Memorial Lecture entitled. Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR presided over the function and Dr. NS Rathore, DDG (Edn.), ICAR was the Guest of Honour.

8. TEACHER'S DAY CELEBRATIONS

The Teacher's Day was celebrated on September 05, 2019 in which Dr. R.C. Jain, Former Head Division of Forecasting Techniques, IASRI was honoured.

9. RESEARCH FELLOWSHIPS

During 2019-20, 57 Ph.D. and 38 M.Sc. students received research fellowship. 46 Ph.D. 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. 02 Ph.D. student received Rajeev Gandhi National Fellowship @ Rs. 31,000/, 01 Ph.D. student received DBT Scholarship @ Rs. 31,000/- per month, 01 student received ICMR fellowship @ Rs. 31,000/- in addition to Rs. 20,000/- per annum as contingency Grant. 03 Ph.D. students received UGC fellowship @ 31,000/- per month and Contingency Rs. 10,000/-, 04 students received Maulana Azad National Fellowship @ Rs. 31,000/- per month and Rs. 10,000 per annum as contingency grant. 13 M.Sc. students received ICAR Junior Research Fellowship @ Rs. 12,640/- per month in addition to Rs. 6,000/- per annum as contingency grant and 25 M.Sc. students received IASRI fellowship @ Rs. 7,560/- per month and Rs. 6,000/- per annum as contingency grant.

Courses Offered in the academic session 2019 (Agricultural Statistics)

Code	Course Title	Credits		Course Instructors
		L	P	
Trimester – II (2018-19)				
PGS 504	Basic Statistical Methods in Agriculture	2	1	Arpan Bhowmik, Kaustav Aditya, Himadri Shekhar Roy
AS 502	Basic Design of Experiments	2	1	Susheel Kr. Sarkar, Sukanta Dash
AS 551	Mathematical Methods in Statistics	4	0	Cini Varghese, Himadri Ghosh Sukanta Dash,
AS 562	Advanced Statistical Methods	2	1	Seema Jaggi, Ranjit Kumar Paul, Arpan Bhowmik
AS 565	Sampling Techniques	3	1	Anil Rai, Tauqueer Ahmad, Ankur Biswas
AS 570	Statistical Modeling	2	1	Ranjit Kumar Paul, Achal Lama, Mrinmoy Roy
AS 573	Demography	2	0	Prawin Arya, Wasi Alam
AS 574	Advanced Data Analysis Using Statistical Software	1	2	B.N. Mandal, Rajender Parsad, Hukum Chandra, Ankur Biswas

Code	Course Title	Credits		Course Instructors
		L	P	
AS 605	Advanced Statistical Inference	1	1	K.N. Singh, L.M. Bhar
AS 661	Advanced Designs for Single Factor Experiments	2	1	Cini Varghese, B.N. Mandal, Seema Jaggi
AS 663	Advanced Theory of Sample Surveys	2	1	Tauqueer Ahmad, Hukum Chandra, Ankur Biswas
AS 665	Advanced Statistical Methods for Population Genetics	2	1	A.K. Paul, L.M. Bhar
AS 691	Seminar	1	0	V. Ramasubramanian
Trimester - III (2018-19)				
PGS 504	Basic Statistical Methods in Agriculture	2	1	Sarika, Ajit, Anil Kumar
AS 503	Basic Sampling and Non-parametric Methods	2	1	Kaustav Aditya, Ankur Biswas
AS 563	Statistical Inference	4	1	K.N. Singh, Arpan Bhowmik, Pradip Basak
AS 564	Design of Experiments	3	1	Seema Jaggi, B.N. Mandal
AS 566	Statistical Genetics	3	1	L.M. Bhar, A.K. Paul, Himadri Shekhar Roy
AS 662	Advanced Designs for Multi-factor Experiments	2	1	Rajender Parsad, Sukanta Dash
AS 667	Forecasting Techniques	1	1	Amrender Kumar, Achal Lama
AS 668	Bayesian Inference in Survey Sampling	1	1	Hukum Chandra, Pradip Basak
AS 691	Seminar	1	0	Prawin Arya
Trimester - I (2019-20)				
PGS 504	Basic Statistical Methods in Agriculture	2	1	Susheel Kr. Sarkar, Wasi Alam, Raju Kumar
AS 501	Basic Statistical Methods	2	1	Mir Asif Iquebal Mrinmoy Ray, Vandita Kumari, Pradip Basak
AS 550	Mathematical Methods	4	0	Cini Varghese Susheel Kr. Sarkar Himadri Ghosh
AS 560	Probability Theory	2	0	K.N. Singh, Prabina Kumar Meher
AS 561	Statistical Methods	2	1	Seema Jaggi V. Ramasubramanian Ranjit Kumar Paul
AS 567	Applied Multivariate Analysis	2	1	A.R. Rao, Prabina Kumar Meher

Code	Course Title	Credits		Course Instructors
		L	P	
AS 568	Econometrics	2	1	G.K. Jha, Achal Lama R.S. Shekhawat
AS 569	Planning of Surveys/ Experiments	2	1	Tauqueer Ahmad, Prachi Misra Sahoo, Ajit
AS 572	Statistical Quality Control	2	0	Prawin Arya, Wasi Alam
AS 600	Advanced Design of Experiments	1	1	Rajender Parsad, Cini Varghese
AS 601	Advanced Sampling Techniques	1	1	Hukum Chandra Prachi Misra Sahoo Pradip Basak
AS 602	Advanced Statistical Genetics	1	1	A.K. Paul, Himadri Shekhar Roy
AS 603	Regression Analysis	1	1	L.M. Bhar, Ranjit Kumar Paul
AS 604	Linear Models	2	0	Rajender Parsad, B.N. Mandal
AS 606	Optimization Techniques	1	1	B.N. Mandal, Harish Kumar H.V., Rajesh
AS 691	Seminar	1	0	Kaustav Aditya

Course allotment for the academic session 2019 (Computer Application)

Code	Course Title (L + P)	Credits		Instructors
		L	P	
Trimester II (2018-19)				
CA 501	Computer Fundamentals and Programming	3	2	Ajit, Pal Singh
CA 562	Object Oriented Analysis and Design	2	1	Sudeep Marwaha, Sangeeta Ahuja
CA 564	Data Structures and Algorithms	2	1	A.R. Rao, Shashi Dahiya
CA 566/ BI 507	Data Base Management System	2	2	S.B. Lal, Soumen Pal
CA 568	Software Engineering	2	0	A.K. Choubey
CA 572	GIS and Remote Sensing Techniques	2	1	Anshu Bhardwaj, Prachi Misra Sahoo
CA 573	Data Warehousing	2	1	A.K. Choubey, K.K. Chaturvedi
CA 574	Multimedia and Applications	1	1	Sangeeta Ahuja
CA 577	Data Mining and Soft Computing	2	1	Anshu Bhardwaj, Shashi Dahiya
CA 578	Information Security	2	1	Mukesh Kumar, Samir Farooqi
CA 580	Mobile Application Development	1	1	S.B. Lal, Soumen Pal
CA 612	Fuzzy Sets and Rough Sets	2	1	Rajni Jain, Alka Arora
CA 617	Natural Language Processing	1	1	Anu Sharma
CA 691	Seminar	1	0	S.N. Islam
Trimester III (2018-19)				
CA 503	Statistical Computing in Agriculture	1	2	Rajender Parsad, V. Ramasubramanian, Wasi Alam Ranjit Kumar Paul
CA 563	Operating System	2	1	Soumen Pal, A.K. Mishra
CA 567	Computer Networks	2	1	Mukesh Kumar, S.N. Islam

Code	Course Title (L + P)	Credits L	Credits P	Instructors
CA 571	Modeling and Simulation	2	1	Wasi Alam, Achal Lama
CA 576	Theory of Computation	2	0	A.K. Choubey, Mukesh Kumar
CA 613	Artificial Neural Networks	2	1	Anshu Bhardwaj, V. Ramasubramanian, Mrinmoy Ray
CA 614	Knowledgebase Systems for Semantic Web	2	1	Sudeep Marwaha
CA 616	Big Data analysis	2	0	Anshu Bhardwaj, Shashi Dahiya, A.K. Choubey
CA 691	Seminar	1	0	Sangeeta Ahuja
Trimester I (2019-20)				
CA 551	Mathematical Foundations in Computer Application	4	0	Sukanta Dash, Sunil Kumar Yadav, Raju Kumar
CA 552	Computer Oriented Numerical Methods	2	1	A.K. Choubey, Sangeeta Ahuja
CA 560	Computer Organization and Architecture	3	0	Shashi Dahiya, Mukesh Kumar
CA 561/ BI 505	Principles of Computer Programming	2	1	K.K. Chaturvedi, S.B. Lal
CA 565	Compiler Construction	2	1	Soumen Pal, A.K. Choubey
CA 569	Web Technologies and Applications (2+1)	2	1	Alka Arora, S.B. Lal
CA 570	Computer Graphics	2	1	Pal Singh, S.N. Islam
CA 575	Artificial Intelligence	2	1	Rajni Jain, Sudeep Marwaha
CA 579	Graph Theory and Application	2	0	Anu Sharma, K.K. Chaturvedi
CA 611	Design and Analysis of Algorithms	2	1	Mukesh Kumar, A.K. Choubey
CA 621	Advances in Data Mining	2	1	Anshu Bhardwaj, Rajni Jain
CA 691	Seminar	1	0	Shashi Dahiya

Course allotment for the academic session 2019 (Bioinformatics)

Code	Course Title (L + P)	Credits L	Credits P	Instructors
Trimester II (2018-19)				
BI 506	Computational Genomics	3	1	Mir Asif Iquebal, DC Mishra, Sarika, Yasin
BI 507 / CA 566	Database Management System	2	2	S.B. Lal
BI 508	Computer Applications in Bioinformatics	2	1	KK Chaturvedi, S.B. Lal, Anu Sharma, A.K. Mishra
BI 603	Machine Learning Techniques in Bioinformatics	2	1	Sanjeev Kumar, DC Mishra, V. Ramasubramanian
BI 604	Computational Techniques of Transcriptomics and Metabolomics	1	1	MS Farooqi, Monendra Grover
BI 632	Peptide Design, Synthesis and Applications	2	1	UB Angadi, Monendra Grover
BI 623	Optimization Techniques in Bioinformatics	2	1	UB Angadi, Himadri Ghosh
BI 624	Genome Wide Association Study	2	1	Sunil Archak, Mallikarjuna M.G., Anil Rai,

Code	Course Title (L + P)	Credits L	Credits P	Instructors
BI 651	Recent Advances in Bioinformatics	1	0	
BI 691	Seminar	1	0	M.S. Farooqi
Trimester III (2018-19)				
BI 502	Protein Structure Analysis	2	1	Anil Rai, Sarika, Yasin
BI 503	Computational Biology	2	1	DC Mishra, Sanjeev Kumar A.R. Rao
BI 504	Evolutionary Biology	2	1	Sunil Archak, Mallikarjuna M.G., A.K. Mishra.
BI 612	Quantum Theory and Applications in Biology	2	1	Monendra Grover
BI 633	Biological Data Integration and Quality Control	2	1	K.K. Chaturvedi S.S. Marla
BI 643	Graphics and Visualization of Biological Data	2	1	Sudeep Marwah UB Angadi
BI 691	Seminar	1	0	KK Chaturvedi

Course	Course Title	Credits L	Credits P	Instructors 2019-20
Trimester - I (2019-20)				
BI 501/ MBB 509	Introduction to Bioinformatics	2	1	A.R. Rao, Mallikarjuna M.G., Anshul Watts
BI 505/ CA 561	Principles of Computer Programming	2	1	K.K. Chaturvedi, S.B. Lal
BI509/ BIO601	Nucleic Acids	2	1	
BI 510/ MBB 501	Principles of Biotechnology	4	0	
BI 511 / BIO 501	Basic Biochemistry	4	1	
BI 512	Advanced Programming in Bioinformatics	2	2	Anu Sharma, UB Angadi, Sudhir Srivastava
BI 601	Genome Assembly and Annotation	1	2	Sanjeev Kumar, DC Mishra
BI 602	Biomolecular Modelling and Simulation	2	1	Anil Rai, Monendra Grover, UB Angadi,
BI 611	Metagenomics Data Analysis	2	1	MS Farooqi, Anu Sharma
BI 622	Molecular Dynamics	2	1	Monendra Grover, Sarika
BI 614	Biological Network Modelling and Analysis(2+1)	2	1	Sanjeev Kumar, Prabina Kumar Meher
BI 691	Seminar	1	0	MS Farooqi

Board of Studies for Academic Year 2019

Agricultural Statistics

1.	Dr. Seema Jaggi, Professor (Agricultural Statistics)	Chairperson
2.	Dr. L.M Bhar, Director till 27.10.2019	Member (Ex-officio)
3.	Dr. Tauqueer Ahmad, Director from 28.10.2019 onwards	Member (Ex-officio)
4.	Dr. Cini Varghese, Principal Scientist	Member
5.	Dr. Wasi Alam, Senior Scientist	Member
6.	Dr. Ankur Biswas, Scientist	Member Secretary
7.	Sh. Ashis Ranjan Udgata, Student	Students' Representative

Computer Application

1.	Dr. Sudeep Marwaha, Professor (CA)	Chairman
2.	Dr. L.M Bhar, Director till 27.10.2019	Member (Ex-officio)
3.	Dr. Tauqueer Ahmad, Director from 28.10.2019 onwards	Member (Ex-officio)
4.	Dr. Mukesh Kumar, Principal Scientist	Member
5.	Dr. S.B Lal, Senior Scientist	Member Secretary
6.	Sh. Pal singh, Scientist	Member
7.	Md. Arpan Kumar Maji	Students' Representative

Bioinformatics

1.	Dr. A.R. Rao Professor (Bioinformatics)	Chairman
2.	Dr. L.M Bhar, Director till 27.10.2019	Member (Ex-officio)
3.	Dr. Tauqueer Ahmad, Director from 28.10.2019 onwards	Member (Ex-officio)
4.	Dr. U.B. Angadi, Principal Scientist	Member
5.	Dr. S.B. Lal, Senior Scientist	Member
6.	Dr. S.K. Mallikarjuna, Scientist	Member Secretary
7.	Ms. Ritwika Das	Students' Representative

Central Examination Committee for Academic Year 2019

Agricultural Statistics

1. Dr. L.M Bhar, Director till 27.10.2019
2. Dr. Tauqueer Ahmad, Director from 28.10.2019 onwards
3. Dr. Seema Jaggi, Professor (Agricultural Statistics)
4. Dr. Anil Rai, Head, CABin
5. Dr. K.N. Singh, Head, Statistical Genetics
6. Dr. Rajender Parsad, Principal Scientist
7. Dr. Hukum Chandra, National Fellow

Computer Application

1. Dr. L.M Bhar, Director till 27.10.2019
2. Dr. Tauqueer Ahmad, Director from 28.10.2019 onwards
3. Dr. Sudeep Marwaha, Professor (Computer Application)
4. Dr. Alka Arora, Principal Scientist
5. Dr. Mukesh Kumar, Principal Scientist
6. Dr. Anshu Bhardwaj, Principal Scientist
7. Sh. S.N. Islam, Scientist

Bioinformatics

1. Dr. L.M. Bhar, Director till 27.10.2019
2. Dr. Tauqueer Ahmad, Director from 28.10.2019 onwards
3. Dr. A.R. Rao, Professor (Bioinformatics)
4. Dr. Anil Rai, Head, CABin
5. Dr. K.K. Chartuvedi, Senior Scientist
6. Dr. D.C. Mishra, Scientist

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, etc. & foreign countries including SAARC countries

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 June 10, 2019 to Nov. 23, 2019. The Course comprise of two independent modules of three months duration each. Two officer participated in both the modules. Module – I was organized during June 10, 2019 to August 27, 2019. Module-II was organized during September 06, 2019 to November 23, 2019. Two officers participated in Module – I and two officers 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 Seema Jaggi was the course coordinator of the course.

Topic	Instructor
Module-I	
Statistical Methods	Dr. Raju Kumar, Md. Wasi Alam & Dr. Achal Lama
Official Agricultural Statistics	Sh. Deepak Singh, Dr. Ankur Biswas & Dr. Kaustav Aditya
Use of Computers in Agricultural Research	Sh. Pal Singh, Sh. Deepak Singh & Dr. Vandita Kumari
Module-II	
Sampling Techniques	Sh. Deepak Singh, Dr. Raju Kumar & Dr. Vandita Kumari
Statistical Genetics	Dr. Amrit Kumar Paul & Dr. Himadri Shekhar Roy
Design of Experiments	Dr. Arpan Bhowmik, Dr. Susheel Kumar Sarkar & Sh. Sunil Kumar Yadav

Programmes under Centre of Advanced Faculty Training (CAFT)

S. No	Title	Course Coordinators	Period	No. of Participants
1	Modern Statistical Techniques in Genetics Under the aegis of Agricultural Education Division, ICAR	Dr. Himadri Shekhar Roy Dr. Ranjit Kumar Paul Dr. Amrit Kumar Paul	01.02.19 to 21.02.19	21
2	Recent Advances in Statistical Modeling and Forecasting for Agricultural Data Analysis	Dr. K.N. Singh Dr. Achal Lama Dr. R.S. Shekhawat	23.02.19 to 15.03.19	21
3	Statistical Advances in Designing Agricultural Experiments and Data Analysis	Dr. Cini Varghese Dr. Susheel Kumar Sarkar Dr. Arpan Bhowmik	19.07.19 to 08.08.19	25

S. No	Title	Course Coordinators	Period	No. of Participants
4	Advances Statistical Analysis of Breeding Data	Dr. Amrit Kumar Paul Dr. Ranjit Kumar Paul Dr. Himadri Shekhar Ray	27.08.19 to 16.09.19	22
5	Advances in Data Science using R	Dr. Soumen Pal Sh. Pal Singh Dr. Sudeep	21.09.19 to11.10.19	22
6	Recent Advances in Sample Survey and Data Analysis using Statistical Software	Dr. Hukum Chandra Dr. Kaustav Aditya Dr. Pradip Basak	28.11.19 to18.12.19	20
7	Statistical and Machine Learning Techniques for Modeling and Forecasting Agricultural Data	Dr. Mrinmoy Ray Dr. Shivaswamy GP Dr. Harish Kumar H.V	20.12.19 to 09.01.20	21

Winter School

S. No.	Title	Course Director/ Co-Director	Period	No. of Participants
1	Recent Advances in Statistical Techniques for Data Analysis and Agriculture	Dr. Lal Mohan Bhar Dr. Ranjit Kumar Paul Dr. Amrit Kumar Paul	10.01.19 to 30.01.19	25
2	Advances in designing and Analysis of Field Crop Experiments	Dr. Anil Kumar Dr. Susheel Kumar Sarkar Dr. Sukanta Dash	14.10.19 to 03.11.19	13

Training Programmes under HRM

S. No	Title	Course Coordinator	Period	No. of Participants
1	Experimental Designs and Statistical Data analysis for the Scientific Personnel of NARES	Dr. Seema Jaggi Dr. Arpan Bhowmik Dr. Anindita Datta	03.01.19 to 16.01.19	16
2	ICAR-ERP Finance Module	Dr. Mukesh Kumar Dr. Sudeep Marwaha Dr. Shashi Dahiya	11.03.19 to 16.03.19	14
3	Recent Advances of Bioinformatics in Agricultural Research : A Practical Perspective for the Scientific Personnel of NARES	Md. Samir Farooqui Dr. K. K. Chaturvedi Dr. D. C. Mishra	12.12.19 to 21.12.19	08

Resource Generation National/International Trainings

S. No	Title	Course Coordinators	Period	No. of Participants
1	Recent Advances in Agricultural Surveys Remote Sensing and GIS Application (International) (AARDO)	Dr. Prachi Mishra Sahoo Dr. Tauqueer Ahmad Dr. Ankur Biswas	11.03.19 to 31.03.19	08
2	Data Analysis and Interpretation for ISS Probationers funded by National Statistical System Training Academy	Dr. Hukum Chandra Dr. Kaustav Aditya Dr. Pradip Basak	13.05.19 to 24.05.19 Rs. 1,57,933/-	28

S. No	Title	Course Coordinators	Period	No. of Participants
3	Sampling Design and Schedules for Implementation of Energy Audit Survey	Dr. Hukum Chandra Dr. Pradip Basak	01.11.19 to 02.11.19	16
4	Field Survey, Data Collection, Compilation and Analysis (for Officials of Indian Council of Forestry Research and Education (ICFRE)	Dr. Tauqueer Ahmad Dr. Prachi Misra Sahoo Dr. Raju Kumar	04.11.19 to 08.11.19 Rs. 65,588/-	13

Other Training Programmes

S. No	Title	Course Coordinators	Period	No. of Participants
1	कृषि सर्वेक्षणों के लिए प्रतिदर्श तकनीके एवं प्रतिदर्श ऑकड़ों का सांख्यिकीय विश्लेषण	डॉ राजू कुमार डॉ दीपक सिंह डॉ अंकुर विशवास	22.02.19 to 27.02.19	09
2	Training programme on e-Office at ICAR-Indian Agricultural Statistics Research Institute, New Delhi (9 Training Programmes)	Dr Sudeep, Sh. Rakesh Kr Saini	22 Feb., 2019	05
			28 Feb., 2019	18
			02 March, 2019	06
			09 April, 2019	06
			12 April, 2019	05
			18 April, 2019	06
			21 April, 2019	09
			24 April, 2019	19
			26 April, 2019	10
3	Training programme on “Hands-on training on Molecular biology and computational tools” jointly organized at ICAR-CIFA, Bhubaneswar	ICAR-CIFA: Dr. S. Nadi, Dr. L. Sahoo, Mr. K.D. Rasal ICAR-IASRI: Dr. Mir Asif Iquebal, Dr. Sarika	April 16-25, 2019	25
3	HPC Administration at ICAR-IASRI, New Delhi	Dr K K Chaturvedi	29th April 2019.	10
4	Training programme on e-Office	Dr. Mukesh Kumar, Sh. Rakesh Kr Saini	03.05.19 to 04.05.19	08
5	HPC Storage Administration at ICAR-IASRI, New Delhi	Dr K K Chaturvedi	8th May 2019	10
6	Hands-on Training on “Statistical Tools and Database Management In Agriculture” jointly with PAU, Ludhiana under NAHEP Component 2	Dr. Sudeep Dr. Soumen Pal	10.06.19 to 10.06.19	35
7	Training programme on e-Office at ICAR-Indian Institute of Horticultural Research, Bengaluru	Dr. Sudeep, Sh. Rakesh Kr Saini	16-18 July, 2019	08
8	Job Submission and management using PBS scripting training at ICAR-IASRI, New Delhi	Dr. K K Chaturvedi	24th July 2019	36
9	Training programme on e-Office at ICAR-DCFR, Bhimtal, Nainital	Dr. Sudeep, Sh. Rakesh Kr Saini	25 July, 2019	04
10	Training programme on e-Office at ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora	Dr. Sudeep, Sh. Rakesh Kr Saini	26-27 July, 2019	78

S. No	Title	Course Coordinators	Period	No. of Participants
11	Organized Two days training on e-Office at ICAR- CPRI, in which ICAR- CPRI and its all regional stations, ICAR- DMR, Solan and other institute's regional stations personnel located in Shimla participated.	Dr. Mukesh Kumar	11.09.19 to 12.09.19	106
12	Training programme on e-Office at ICAR-Indian Institute of Sugarcane Research, Lucknow ICAR-National Bureau of Fish Genetic Resources, Lucknow ICAR-Central Institute of Sub Tropical Horticulture, Lucknow	Dr. Sudeep, Sh. Rakesh Kr Saini	23-25 Oct., 2019	81
13	High Dimensional Genome Data Analysis by R and Open Source Tools (World Bank) CAAST	Dr. A.R. Rao Sh. Sanjeev Kumar Dr. Soumen Pal Dr. P.K. Meher	01.11.19 to 11.11.19	27
14	Training programme on e-Office, ICAR-National Academy of Agricultural Research & Management, Hyderabad	Dr. Sudeep, Sh. Rakesh Kr Saini	05-07 Dec., 2019	102
15	Training programme on e-Office at ICAR-Indian Agricultural Statistics Research Institute, New Delhi	Dr. Sudeep, Sh. Rakesh Kr Saini	13 Dec., 2019	13
16	Training programme on e-Office	Dr. Sudeep, Sh. Rakesh Kr Saini	16-17 Dec., 2019	34
17	Training programme on e-Office at ICAR-Indian Agricultural Statistics Research Institute, New Delhi ICAR-Indian Veterinary Research Institute, Izatnagar	Dr. Sudeep	16-17 Dec., 2019	22

6

Awards and Recognitions

(a) AWARDS

A.R. Rao

- Received Best Teacher Award in Agricultural Higher Education 2018-19 from ICAR-IARI. Received the award from the Union Minister of Agriculture & Farmers Welfare, Govt. of India on February 8, 2019.

Hukum Chandra

- Recognition Award of the National Academy of Agricultural Sciences (NAAS), India for the Biennium 2017-2018 for outstanding contributions in the field of Social Sciences. The award was conferred by Shri Radha Mohan Singh, Honorable Union Minister of Agriculture & Farmers' Welfare, and Shri Gajendra Singh Shekhawat, Honorable Union Minister of State for Agriculture & Farmers' Welfare, Govt. of India, on February 20, 2019, New Delhi.

Rajender Parsad and B N Mandal

- Coauthored a paper presented by student Mr Shyamsundar Parui who received Dr. M.N. Das Memorial Young Scientist Award 2019 for the paper "Efficient Designs for Designs for Incomplete Factorial Experiments for Two Factors with Unequal Block Sizes" in the National Conference on Challenges and Opportunities in Statistics and Informatics for Futuristic Humanosphere especially in Agriculture and 21st Annual Conference of Society of Statistics, Computer and Applications held at S.V. Agricultural College, Tirupati during January 29-31, 2019

Sarika

- Conferred NAAS Associate, National Academy of Agricultural Sciences on June 5, 2019 during the Foundation Day and Annual General Body Meeting at NASC Complex, New Delhi.

Mrinmoy Ray

- Received Jawaharlal Nehru Award for P.G. Outstanding Doctoral Thesis Research in Agricultural and Allied Sciences 2018 – Social Sciences by ICAR on 16 July, 2019 on ICAR Foundation day at NASC Complex, New Delhi.

Kanchan Sinha

- Received Young Scientist Award for contribution in the field of forecasting and agricultural systems modelling on the occasion of International Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2019) during 20-22 October, 2019 organized at ICAR-National Academy of Agricultural Research Management, Rajendranagar, Hyderabad, Telengana, India from the Society for Scientific Development in Agriculture and Technology.

Achal Lama

- CWSS YOUNG SCIENTIST AWARD 2020 during "International Seminar on agriskills for Convergence in Research, Industry and Livelihood (ACRIL)" held during 28-11-19 to 01-12-19 at BCKV, Kalyani, West Bengal, India.

Arpan Bhowmik

- Received Young Scientist Award-2018 of Coochbehar Association for Cultivation of Agricultural Science (COBACAS) for contribution in agricultural sciences during the COBACAS 4th National Conference organized jointly by COBACAS and UBKV at College of Agriculture, UBKV, West Bengal during 17-18 January, 2019

Best paper awards

Vandita Kumari, Hukum Chandra, L.M. Bhar and Kaustav Aditya

- Best paper award for the paper Calibration Approach Based Estimation of Regression Coefficient using Auxiliary Data by Vandita Kumari, Hukum Chandra, L.M. Bhar and Kaustav Aditya presented at 72nd Annual National Conference of Indian Society of Agricultural Statistics.

Prachi M Sahoo, Tauqueer Ahmad and S.B. Lal

- Best Research Paper 2018 for the paper entitled "Acreage estimation of mango orchards using hyperspectral satellite data" authored by Nobin C Paul, Prachi M Sahoo, Tauqueer Ahmad, R.N. Sahoo, Gopal Krishna and S.B. Lal published in Indian Journal of Horticulture Vol. 75 (1), March 2018 / PP 27-33. The award was presented during the Foundation Day Celebration of Indian Academy of Horticultural Sciences (IAHS) organized by the Academy on 29th November, 2019 at NAAS Lecture Hall, NASC Complex, Pusa, New Delhi.

Arpan Bhowmik

- Best Paper Award 2018 for the paper Pandirwar, A., Kumar, A., Mani, I., Gaikwad, B. B., Sawant, C. P. and Bhowmik, A. (2018). Soil Bin Studies on Plug and Finger-type Onion Seedling Transplanting Mechanisms. Journal of Agricultural Engineering. 55 (1), 1-14 conferred by the Executive council of the Indian Society of Agricultural Engineers, New Delhi during 53rd ISAE Annual Convention to be held during 28-30 January,2019 at BHU, Varanasi.

Mukesh Kumar, Shashi Dahiya, Alka Arora, Soumen Pal

- Awarded second position in oral presentation to paper entitled" Development and Validation of Mobile Based Decision Support System for Postural Assessment of Agricultural Activities Using Rapid Upper Limb Assessment (RULA) Technique" presented by Abhishekh M.P., Mukesh Kumar, Pratibha Joshi, Shashi Dahiya, Alka Arora, Soumen Pal in International Conference On Global Research Initiatives For Sustainable Agriculture & Allied Sciences (GRISAAS-2019) during 20–22 October 2019 at ICAR-NAARM, Hyderabad, Telangana.

A. R. Rao

- Received **best poster award** in XIV Agricultural Science Congress organized by NAAS and ICAR-IARI at NASC Complex, New Delhi during 20-23 February, 2019 for the research paper entitled "Development of bioinformatics tool for analysis

of crop DNA fingerprints" by Kumari, S., Bhat, K.V., Rao, A.R., Mishra, D.C. and Paul, R.K.

Mir Asif Iquebal, Sarika Jaiswal and Dinesh Kumar

- Received Best Poster Award for the paper Ali, Abid, Kumar, Rakesh, Iquebal, Mir Asif, Jaiswal, Sarika, Kumar, Dinesh and Khan, Asad (2019). Role of N193, S217, G219 and T262 conserved residues in catalytic activity of NDM-1: an computational and molecular approach. In International Conference Interdisciplinary Science Conference on Big Data and Computational Biology during October 21-22, 2019 at Jamia Milia Islamia University, New Delhi 110025.

Achal Lama

- Best oral presentation in Theme 6 for the paper entitled "Monthly rainfall forecasting of Sub-Himalayan West Bengal and Sikkim: An application of SARIMA, TDNN and EXPAR models" during "International Seminar on agriskills for Convergence in Research, Industry and Livelihood (ACRIL)" held during 28-11-19 to 01-12-19 at BCKV, Kalyani, West Bengal, India.

कृषि विज्ञान गौरव

- अखिलेश झा, सिनी वर्गीस, सीमा जग्गी, मो. हारून एवंदेवेन्द्र कुमार **(2018)**। तीन प्रतिकृतियों वाली असमान खण्ड आकारों में समाधेय आंशिक संतुलित अपूर्ण खण्ड (2) अभिकल्पनाओं की एक नई श्रृंखला। *भारतीय कृषि अनुसंधान पत्रिका,* **33***(3)*: **161.164,**
- सुमित सौरव, सिनी वर्गीस, मो. हारून,सीमा जग्गीएवंदेवेन्द्र कुमार **(2018)**। संवेदी परीक्षण ों में दोनियंत्रण वाले परीक्षण उत्पादों की तुलना हेतु संतुलित अभिकल्पनाएं। *भारतीय कृषि अनुसंधान पत्रिका,* 33**(3): 218–220,**
- बी एन मंडल, सुकांत दाश, अनिल कुमार एवं देवेन्द्र कुमार (2018). अनुवांशिक अध्ययन के लिए परिक्षण अभिकल्पना का उपयोग. भारतीय कृषि अनुसन्धान पत्रिका, 33(2), 177–180.
- सुकांत दाश, अनिल कुमार, बी एन मंडल, कृष्ण लाल एवं देवेन्द्र कुमार(2018). मिश्रनों का द्वारा परीक्षण। भारतीय कृषि अनुसन्धान पत्रिका, 33(2), 181–184.
- अपर्ण भौमिक, सीमा जग्गी, एल्दो वर्गीस, सुनील कुमार यादव, मो. हारून, सिनी वर्गीस, अनिंदिता दत्ता एवं उदयवीर सिंह (2018) विविधता के स्त्रोतों के अंतर्गत पशु परीक्षणों के लिए प्रवृति मुक्त अभिकल्पनाएं
- The Design of Experiments division received the Chal Shield for doing work in Hindi during the Hindi Pakhwada celebration from 3-16 September, 2019 at ICAR-IASRI, New Delhi.

Digital Hindi Research Paper Presentation competition during Hindi Pakhwada celebration during 3-16 September, 2019 at ICAR-IASRI, New Delhi

Scientist Category:

- सारिका, मीर आसिफ़ इकबाल, उमा, यू बी अंगडी, अनिल राय और दिनेश कुमार'. कृत्रिम मेधा (आर्टिफिशियल इंटेलिजेंस) आधारित जीवाणु नाशक पेप्टाइड खोज़ की विधि एवं सॉफ्टवेयर का विकासद्य डिजिटल शोध – पत्र प्रस्तुति में प्रथम पुरस्कार
- सुदीप मारवाह, मुकेश कुमार, सौमेन पाल, रूपसी तिवारी, त्रिवेणी दत्त, अवनक्ष सिंह संबबयाल और हरीश कुमार (2019) "पशुधन मालिकों के लिए आई वी आर आई–मोबाइल पशु चिकित्सा संबंधित ऐपस"। द्वितीय पुरस्कार
- Vandita Kumari, Hukum Chandra, Kaustav Aditya and U. C. Bandooni. ''लघु क्षेत्र आकलन तकनीक के अनुप्रयोग द्वारा उत्तर प्रदेश के ग्रामीण परिवारों में ऋणग्रस्तता की स्थिति का आकलन''। संयुक्त रूप से तृतीय पुरस्कार
- सुकान्त दाश, सिनी वर्गीस, अर्पण भौमिक एवं देवेंद्र कुमार (2019) ऑन –फार्म परीक्षणों के अंतर्गत फसल प्रणाली में विविधीकरण के प्रभाव। संयुक्त रूप से तृतीय पुरस्कार

Student Category

- राहुल कुमार गुप्ता', अर्पण भौमिक, सीमा जग्गी, मो. हारून, सिनी वर्गीस अनिंदिता दत्ता एंव देवेन्द्र कुमार। किसी भी उपचार संख्या के लिए रैखिक प्रचलन–मुक्त आंशिक रूप से संतुलित खंड अभिकल्पनायें। प्रथम पुरस्कार
- मो. हारून', सिनी वर्गीसएसीमा जग्गी, एंव अर्पण भौमिक। लैटिसअभिकल्पनाओं का प्रयोग करते हुए छोटे खण्डों में आंभिक त्रि–पथ क्रॉस।द्वितीय पुरस्कार
- अंकिता वर्मा', सीमा जग्गी, सिनी वर्गीस, अर्पण भौमिक, एल्दो वर्गीस एंव शशी दहिया। प्रतिवेशी प्रभावों की उपस्थिति में विषम रिस्पॉन्स सरफेस अभिकल्पनाएँ। संयुक्त रूप में तृतीय पुरस्कार

Vandita Kumari Choudhary

- Received Second prize for "Antakshari" organized on 07 September, 2019 during Hindi Pakhwara at ICAR-IASRI, New Delhi.

Susheel Kumar Sarkar

- हिंदी पखवाड़ा के अंतर्गत श्रुतलेख में प्रथम पुरस्कार
- गाँधी जी की 150वीं जयंती के उपलक्ष्य में मनाये गए साप्ताहिक कार्यक्रम प्रश्न मंच में प्रथम पुरस्कार
- गाँधी जी कि 150वीं जयंती के उपलक्ष्य में मनाये गए

साप्ताहिक कार्यक्रम eropmetxe में प्रथम पुरस्कार

(b) RECOGNITIONS

Tauqueer Ahmad

- Recognized as Sampling Expert by Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific (FAO-RAP), Bangkok, Thailand for providing technical guidance on sampling strategy and development of suitable sampling methodologies for the Asian Countries starting with Laos and Nepal.
- All the three guidelines prepared under the "Study on developing Guidelines for estimating post-harvest losses of horticultural crops, livestock products and fish and fish products" as PI funded by FAO, Rome, under Institutional Consultancy Project mode have been accepted (technically cleared) by FAO and will be published shortly by FAO on FAO-website. Appreciation email has been received from FAO, Rome for successful conduct of the study and on-time (as per Letter of Agreement) completion of the study during a short span of time.
- Co-opted Member, Board of Studies (BOS), Department of Statistics and Operations Research, Aligarh Muslim University (AMU), Aligarh for four years with effect from 01 June, 2016.
- Co-opted Member, Faculty of Science, Statute 20(3)(viii) of the Statutes of Aligarh Muslim University (AMU), Aligarh for a period of two years with effect from 03 January, 2018.
- Course Coordinator, for Organizing a three weeks International Training Programme on "Applications of Remote Sensing and GIS in Agricultural Surveys" at ICAR-IASRI during 11-31 March, 2019 for participants from African-Asian Rural Development Organization (AARDO) member countries.
- Awarded a study entitled "Integrated Sampling Methodology for Crop Yield Estimation using Remote Sensing, Field Surveys and Weather Parameters for Crop Insurance" by Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Govt. of India for optimizing the number of Crop Cutting Experiments being conducted under Pradhan Mantri Fasal Bima Yojna (PMFBY).
- Expert for the Panel discussion and concluding session of the Conference on Crop Cutting Experiment (CCE) on 30 September, 2019 held at NASC Complex, New Delhi which was organized by Credit Division, DACFW, MoAFW, Govt. of India.

Anil Rai

- Scheme Coordinator of "Network Project for Agricultural Bioinformatics and Computational Biology" under Centre for Agricultural Bioinformatics Scheme at IASRI, New Delhi.
- Member of Examination Committee of P.G. School, IARI New Delhi in Bioinformatics in the institute.
- Member of Examination Committee of P.G. School, IARI New Delhi in Agricultural Statistics in the institute.
- Member of Expert Advisory Committee (EAC) of "Proof of concept proposal for Digital Agricultural Mission in India" from ICPS Programme of DST.
- Member of committee related to conducting online UG and PG examination by Education Division of ICAR.
- Member of three member committee for Ph.D. Confirmation of students, JNU New Delhi. Attended the meeting on January 14, 2019 at School of Computer Science, JNU, New Delhi
- Membership of committees of other Institutes – IMC, IMTU, etc.
- Member of interview board for selection of scientist in Dessert Medicine Research Centre (ICMR), Jodhpur.
- Member of the tender committee related to conducting All India Examinations for admission in UG and PG in ICAR.
- Member of Institute Management Committee of "ICAR-National Institute of Agricultural Economics and Policy Research" New Delhi
- Member of DPC of Scientists in ICAR Headquarter.
- Member of the Institute Management Committee of ICAR-Indian Institute of Agricultural Biotechnology, Ranchi.
- Nodal officer of institute RFD.

A.R. Rao

- Acted as Chairman, Presentations and Projection

Systems Committee, XIVth Agricultural Science Congress, jointly organized by NAAS and ICAR-IARI at NASC Complex, New Delhi during 20-23 February, 2019

- Acted as Member, Broad Subject Matter Area (BSMA) for Biotechnology and Bioinformatics, Education Division, ICAR
- Acted as Professor (Bioinformatics), Post Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi
- Acted as an Examiner for evaluating Ph.D. Thesis in Bioinformatics, Mangalore University
- External Expert, M.Sc. (Bioinformatics) Course Committee, TNAU, Coimbatore
- External Examiner for Evaluation of Ph.D. thesis, Guru Jambheshwar University of Science & Technology, Hisar, Haryana
- Member, Academic Council, PG School, ICAR-IARI, New Delhi
- Special Invitee, Fifth Meeting of Working Group (WG)-2016 on Industrial Application
- Special Invitee, Sixth Meeting of Working Group (WG)-2016 on Industrial Application
- Member, Interview Panel for selection of RA, SRF, YPII and Skilled Labor under CESCRA project, ICAR-IARI, New Delhi
- Member, Institute Management Committee (IMC) of ICAR-Central Institute for Cotton Research, Nagpur
- Member, Institute Management Committee (IMC) of ICAR-Cotton Research Institute of Jute and Allied Fibres, Barrackpore, Kolkata
- Member, Standing Committee on Faculty & Discipline, PG School, ICAR-IARI.
- Member, Standing Committee on Course Curricula and Academic Affairs, PG School, ICAR-IARI.
- Chairman, Specification Committee constituted by ICAR-NBAGR, Karnal.
- Member, Working Group for defining the data requirement for agronomy part for GE crops during confined field trials, Biosafety Support Unit, DBT since July 2016.
- Leading a team of 3-members, constituted by the Council to assist the ADG, National Agricultural Science Fund (NASF), ICAR in augmentation and analysis of resources generated under National Agricultural Science Fund project, ICAR
- Member, Evaluation Committee to evaluate the proposals received on “ICT Roadmap, ICAR”.

Rajender Parsad

- Member, QRT of ICAR-CRIDA, Hyderabad
- Member, Executive Council, National Academy of Agricultural Sciences till December 2019.
- Co-Chair, Technical Session on e-Governance in Agricultural Research and Restructuring and Development of New Models of Research in NARS during National Consultation on ICT in Agriculture organized at NASC Complex, New Delhi on March 06, 2019.
- Panelist for a Panel discussion on Ethics in Scientific Research and Publications organized to mark Foundation day celebrations of Indian Society of Seed Technology on April 23, 2019 at Virology Auditorium, ICAR-IARI, New Delhi.
- Expert/Resource Person in the Workshop on Curriculum updation of Masters in Statistics, Department of Statistics, University of Jammu, Jammu on July 26, 2019.
- Co-Organizing Secretary, Eighth International Conference on Agricultural Statistics during November 18-21, 2019 at New Delhi.
- Session Chair, Spatial Sampling Designs and Spatial Data Analysis held on November 21, 2019 during Eighth International Conference on Agricultural Statistics during November 18-21, 2019 at New Delhi.
- Nominated to teach part of a course on Basic Statistics to the postgraduate students of Advanced Centre for Agricultural Research and Education (ACARE), Yezin Agricultural University Campus, Yezin, Nay Pyi Taw, Myanmar during September 11-21, 2019.

Hukum Chandra

- Academic Visitor, The Australian National University, Australia, December 2019.
- Adjunct Faculty, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal, India.
- Chaired Invited Paper Session on “Recent Developments in Analysis of Complex Survey Data”, International Conference of International

Indian Statistical Association 2019 (IISA 2019), Mumbai, 26-30, December 2019.

- Chaired Invited Paper Session, National Conference on "Recent Developments in Statistics and their -Applications to the Society", Ahmednagar, January17-18, 2019.
- Chaired Technical Session on "Sampling Methodology-1", Eighth International Conference on Agricultural Statistics, New Delhi, India, 18-21 November 2019.
- Chaired Technical Session, National Conference on "Emerging Trends in Statistics and Data Sciences 2019" (ETSDS-2019) New Delhi, September 06-07, 2019.
- Convener, Invited Technical Session on "Recent Developments in Analysis of Complex Survey Data", International Conference of International Indian Statistical Association 2019 (IISA 2019), Mumbai, 26-30, December 2019.
- Convener, Technical Session on "Sampling Methodology-1", Eighth International Conference on Agricultural Statistics, New Delhi, India, 18-21 November 2019.
- Convener, Technical Session on "Sampling Methodology-2", Eighth International Conference on Agricultural Statistics, New Delhi, India, 18-21 November 2019.
- Elected Member, International Statistical Institute, The Netherland.
- Expert and Reviewer, SERB, Department of Science and Technology, Govt of India, 2019.
- Expert Member, Core Group of Experts on Normalization, constituted by the Chairman, National Testing Agency and Secretary, Department of Higher Education, Ministry of Human Resource Development, Government of India, 2018-2019.
- Expert Member, Corporate Outcome Assessment Survey, Food and Agricultural Organization of the United Nations, India, 2019.
- Expert Member, Departmental Promotion Committee constituted by ASRB for the assessments of the Scientists in the discipline of Agricultural Statistics, ICAR-CIFRI, Barrackpore, West Bengal, 2019.
- Expert Member, GIRI Institute of Development Studies, Lucknow, 2019-2020.
- Expert Member, Monitoring and Analyzing Food and Agricultural Policies Programme (in collaboration with NITI Aayog), Food and Agricultural Organization of the United Nations, India, 2019.
- Expert Member, Myanmar Agricultural Census 2020, Food and Agricultural Organization of the United Nations, Myanmar, 2019.
- Expert Member, Panel Sample Survey of Households in the State of Tamil Nadu (collaboration with Govt of Tamil Nadu), Madras Institute of Development Studies, Chennai, India, 2017-2020.
- Expert Member, Selection Committee of Assistant Professor (Agricultural Statistics). Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, 2019.
- Expert, Assessment of the Candidate for Promotion to the Position of an Associate Professor, Indian Statistical Institute, Govt of India, Kolkata, 2019.
- Expert, Experts Group Panel for Planning Future Strategy on Standardization of Data Quality, Bureau of Indian Standards, New Delhi, 2019.
- Expert, Internal Evaluation Committee for validation of Sampling Plan, ICAR- National Institute of Veterinary Epidemiology and Disease Informatics, Bengaluru, 2019.
- Expert, Rajasthan Public Service Commission, Government of Rajasthan, 2019.
- Fellow, Commonwealth Association, United Kingdom.
- Fellow, Indian Society of Agricultural Statistics, India.
- Fellow, National Academy of Agricultural Sciences, India.
- Guest of Honour, National Workshop on "Big Data Analysis with R", Rabindranath Tagore University, Bhopal, March 15, 2019.
- Member Advisory Committee, All India Rural Financial Inclusion Survey 2.0, NABARD, Mumbai, 2019-20.
- Member Group of Experts, Pooling data from DLHS-4 and AHS, Ministry of Health & Family Welfare, Government of India, 2019.
- Member Secretary, Quinquennial Review Team (QRT) of ICAR-IASRI for the period 2011-2018.
- Member, Advisory Committee National

conference on "Emerging Trends in Statistics and Data Sciences 2019", New Delhi.

- Member, Committee to resolve various issues related to Bt. Cotton/HT Cotton, Ministry of Agriculture and Farmers Welfare, Govt of India, 2018-2019.
- Member, Governing Body of the Institute of Applied Statistics and Development Studies, Lucknow, 2018-2021.
- Member, Sectional Committee on "Statistical Methods for Quality and Reliability" (MSD 3), Bureau of Indian Standards, New Delhi, 2018-2019.
- Member, Subcommittee for "Sampling Methods" (MSD 3:6), Bureau of Indian Standards, New Delhi, 2018-2019.
- Member, sub-group on "Development of Common Curriculum for Training on Agricultural and Rural Statistics in Asia and the Pacific", United Nations Statistical Institute for Asia and the Pacific, Chiba, Japan.
- Member, sub-group on "Skills Framework and Training Needs Assessment Tools for Agricultural and Rural Statistics in Asia and the Pacific", United Nations Statistical Institute for Asia and the Pacific, Chiba, Japan.
- Member, Technical Advisory Committee (TAC) for the Coverage Evaluation Survey, Ministry of Health and Family Welfare, Govt of India, New Delhi, 2019.
- Participated as Member, Training Programme Approval Committee under the chairmanship of Director General (Social Statistics), CSO, Ministry of Statistics and Programme Implementation, Govt. of India, New Delhi, 2019.
- Resource Person, National workshop on "Big Data Analysis with R", Rabindranath Tagore University, Bhopal, March 15, 2019.
- Resource Person, National workshop on "Data Analysis using Software", Department of Statistics, M.D. University, Rohtak, India, October 17-18, 2019.
- Resource Person, training programme on "Statistical Analysis of Disaggregated SDG Indicators for Inclusive Development Policies", United Nations-Statistical Institute for Asia and the Pacific, Chiba, Japan, June 07 to July 12, 2019.
- Resource Person, workshop on "Applications of Spatio-Temporal models", University of Hyderabad, Hyderabad, January 31 to February 01, 2019.
- Resource Person, workshop on "Statistical Computing Using R", at Department of Statistics, Punjab University, Chandigarh, February 28 to March 01, 2019.
- Reviewer, Engineering and Physical Sciences Research Council, United Kingdom, 2019.

Ramasubramanian V.

- Nodal Officer for DKMA e-krishi-Manch
- Question paper setter on Statistical Methods (Course No. FES11) for Birsa Agricultural University (BAU), Ranchi

Alka Arora

- Session organizer and chair for the session on "Frontier and Innovative Technologies" in the Eighth International Conference on Agricultural Statistics (ICAS VIII) organised from 18-21 November 2019 at New Delhi.
- Moderator for the session "Sectoral Group Discussion" in the workshop "National Consultation on ICT in Agriculture" workshop for all Computer Scientists of ICAR, jointly organized by DKMA & ADG (ICT), ICAR on March 06, 2019 at NASC Complex, New Delhi.
- Member of interview board for assessment of Computer scientist at ICAR-CRIDA Hyderabad.

Anil Kumar

- Chairman, Editorial Board, Sankhyiki Vimarsh
- Member, "Course Co-ordination Committee" for smooth conducting of CAFT program on "Modern Statistical Techniques in Genetics" during 01.02.2019 to 21.02.2019 at ICAR-IASRI, New Delhi
- Chairman, "Boarding and Lodging Committee" for smooth conducting of CAFT program on "Modern Statistical Techniques in Genetics" during 01.02.2019 to 21.02.2019. at ICAR-IASRI, New Delhi
- Member, Advisory Committee conducted viva-voce of Ph.D. student of PG School, ICAR-IARI, on 19.01.2019.
- Chairman of "Boarding and Lodging Committee"

for smooth conducting of International Training program on "Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications" during 11.03.2018 to 31.03.2019 at ICAR-IASRI, New Delhi

- Panellist in the interview committee for the selection of Consultant at ZTM & BPD Unit at ICAR-IARI on 18.03.2019.
- Participated in the XIV Agricultural Science Congress organized by NAAS in collaboration with the ICAR and Indian Agricultural Research Institute at New Delhi from February 20-23, 2019 on the theme "Innovations for Agricultural Transformation". and acted as a Rapporteur in Statistical Science Session.
- External examiner for conducting B.Sc. (3rd) statistics practical exam- 2019 N.R.E.C College, CCS University, Meerut on 06.03.2019.

Prachi Misra Sahoo

- Programme Director of an International training programme on "Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications" organized at the Institute during 11-31 March, 2018 for the participants from African-Asian Rural Development Organization (AARDO) member countries.
- Awarded a study entitled "Integrated Sample Survey Solution for major Livestock Products" by Animal Husbandry Statistics Division, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Fisheries Animal Husbandry and Dairying, Government of India
- Invited Speaker, in the research methodology workshop on Geography and Environment with SPSS training held at Department of Geography, Jamia Millia Islamia, New Delhi.

K K Chaturvedi

- Received appreciation letter for significant contribution as a resource person in the training "Next Generation Sequence Data Analysis" held at AAU, Assam during 14-16, March, 2019.
- Mentor and Jury Member for Institution's Innovation Council (IIC), Rajkiya Engineering College Banda (U.P.) in organizing a TEQIP-III sponsored 24 hour Hackathon event "HackTech" from 6-7th Sept. 2019.
- Received Reviewer Certificate from Journal of Software: Practice and Experience (May 2019).
- Reviewer, International Journal of Computer and Information Technology (IJCIT, http://www.ijcit.com/index.php). ISSN 2279-0764.
- Expert Member, Selection committee for selection of Research Associate in the project at NCIPM, New Delhi.
- Centre Coordinator, for smooth functioning and reporting of the ICAR-NBAIM, Mau.
- External examiner, Thesis viva voce examination and evaluation of two M.Tech. (Computational Biology) students of IIIT New Delhi on 15th July 2019.

Anshu Bharadwaj

- Member of interview board for selection of Ph.D. candidates for Ph.D. (Computer Application, Agricultural Statistics and Bioinformatics) in PG School, IARI, New Delhi.
- Rapporteur in the session "E-learning" in the 2 Days Workshop for Nodal Officers of Agricultural Universities under the NAHEP, Component 2A Subproject - "Investments in ICAR Leadership in Agricultural Higher Education" held during 18th - 19th, September' 2019 at NASC Complex, New Delhi.
- Rapporteur in a session in the NAHEP Review Workshop held during 5-6 August 2019.

Anu Sharma

- Chaired a session on National Conference on "Challenges and opportunities in Statistics and Informatics for Futuristic Humanosphere especially in Agriculture (COSIFHA-2019) from 29-31 January, 2019 held at Department of Statistics & Computer Application at Acharya NG Ranga Agricultural University, Tirupati, and Andhra Pradesh.
- Worked as Reviewer in International Journal of Fog Computing (IJFC), International Journal of Big Data Intelligence and Bioinformation

S B Lal

- Appointed as Member of selection committee for interview of JRFs for DBT supported project at CCUBGA, Division of Microbiology, ICAR-IARI, New Delhi.

- Appointed as Member of selection committee for selection of YP-II in Division of Agricultural Economics, ICAR-IARI, New Delhi.
- Guest of Honor and Resource Person in National Workshop on "Big Data Analytics with R" during 15-16 March, 2019 held at Dept. of CSE & IT, Rabindranath Tagore University, Bhopal.

Shashi Dahiya

- Acted as Chairman of a contributory paper session on Statistics and Informatics held on 31st January 2019, in the National Conference on "Challenges and Opportunities in Statistics and Informatics for Futuristic Humanosphere Especially in Agriculture" (COSIFHA – 2019), held during 29 – 31 January 2019 at S.V. Agricultural College, Tirupati.
- Conducted a session on "Designing Databases and Online Applications with Case Studies" on April 3, 2019 in the "Faculty Development Programme On Data Analytics" held during April 3-5, 2019 at Lady Irwin College, University of Delhi, New Delhi.
- Acted as Co-Chairman of the Session on "Online Pest Management".
- Acted as Rapporteur of the Session on "Virtual Classroom and Virtual Reality".

Sarika

- Worked as the committee member for evaluation of quality attributes of the non-IF Journals for NAAS, New Delhi.
- Worked as Reviewer in Scientific Reports.

Mir Asif Iquebal

- Worked as the committee member for evaluation of quality attributes of the non-IF Journals for NAAS, New Delhi.
- Worked as Reviewer in Plant Molecular Biology Reporter, Legume Research.

Md. Samir Farooqi

- Appointed reviewer of the journal Annals of Data Science and Biologia *Planatorium*.
- Appointed paper setter for a course by NDUAT, Ayodhya, UP.

B N Mandal

- Session Co-chair, Spatial Sampling Designs and Spatial Data Analysis held on November 21, 2019 during Eighth International Conference on Agricultural Statistics during November 18-21, 2019 at New Delhi.
- Reviewer of the Behaviour Research Methods journal published by Springer; The Statistics and Applications journal published by Society of Statistics and Computer Applications and Journal of Indian Society of Agricultural Statistics published by Indian Society of Agricultural Statistics.

D.C. Mishra

- Received appreciation letter for significant contribution as a resource person in the training "Next Generation Sequence Data Analysis" held at AAU, Assam during 14-16, March, 2019.

Sukanta Dash

- Expert member of an Interview board for selecting Six SRFs under a project "Plant source based environmentally safe crop protection and production technologies: Development and capacity building" under Niche Area of excellence scheme of ICAR on 30th March, 2019.
- **Honoured with recognition award in** Sixth Group Discussion of ICAR-AICRP on Fruits held at Assam Agricultural University, Jorhat, during February 14-16, 2019 as an expert member.
- Awarded Third prize in Hindi pakhwada during 03-16 September, 2019 for सुकान्त दाश, सिनी वर्गीस, अर्पण भौमिक एवं देवेन्द्र कुमार (2019) ऑन–फार्म परीक्षणों के अंतर्गत फसल प्रणाली में विविधीकरण के प्रभाव, डिजिटल हिंदी शोध पत्र प्रस्तुति, भा.कृ.अनु.प. –भारतीय कृषि सांख्यिकी अनुसंधान संस्थान ।
- Acted as a Rapporteur in Technical Session III on "Unit Level Data Repository: Part I" of 4th National Workshop of Officer In-charge, Data Management (ICAR Research Data Repository for Knowledge Management)" on December 11, 2019 at NASC, New Delhi.
- Visited IIWBR, Karnal as a resource person and delivered training on KRISHI on February 04, 2020.

Prabina Meher

- Acted as question setter for the course BI-505 for the Bioinformatics students of OUAT, Bhubaneswar.

- Acted as reviewer for the journals IEEE Access, published by IEEE society; Scientific Reports, published by Nature Springer group; IEEE/ ACM Transaction in Computational Biology and Bioinformatics, published by IEEE society, PeerJ, published by O'Reilly and SAGE group; Theoritical Biology and Medical Modelling, published by Nature Springer group and Neurocomputing, published by Elsevier.

Ankur Biswas

- Resource person in the Training Programme on "Agriculture and Allied Statistics" for 41st batch of ISS probationers organized by National Statistical Systems Training Academy (NSSTA), MoSPI, Greater Noida during 18 February-01 March, 2019.
- Resource person of a one-day Training Programme on Crop Cutting Experiments on fruits and vegetables (class room training as well as field training) for the field investigators at Horticulture Training Institute (HTI), Uchani, Karnal on 08 August, 2019 and provided technical guidance in implementation of the developed methodology by ICAR-IASRI under CHAMAN project in the Haryana State.
- Acted as a co-opted member of the advisory committee, attended and evaluated students of Agricultural Engineering Division, ICAR-IARI in the Qualifying Viva Examination.

Arpan Bhowmik

- Co-Chairman for Technical Session 2 on Conservation, Sustainable Development, Crop Improvement and Management for Doubling Farmers' Income in the COBACAS 4th National Conference on Diversified Farming Systems: Sustainable Livelihood and Doubling Farmers' Income organized jointly by Coochbehar Association for Cultivation of Agricultural Science (COBACAS) and Uttar Banga Krishi Viswa Vidyalaya (UBKV) at College of Agriculture, UBKV, Majhian, Dakshin Dinajpur, West Bengal during 17-18 January, 2019.
- Acted as an Expert Member of an Interview board for selecting one SRF under one NASF project in division of Agricultural Extension on 30 January, 2019.
- **Interview Board member** for the appointment of one SRF in the project titled "AICRP on Ergonomics and Safety in Agriculture" [a Centre had been in operation in IARI] on 29th March 2019 in the Division of Agricultural Engineering.

Harish Kumar H V

- Acted as question setter for final external examination of the course "Agricultural Finance and Co-Operation" AEC 201-3 (2+1) for Rai Technology University, Bangalore.

Raju Kumar

- Resource Person, National Workshop, "Improvement of Agriculture Statistics", Department of Agriculture & Farmers Welfare, Panchkula, Haryana during 05-06 February, 2019
- Resource Person, training programme "Statistical Tools and Database Management in Agriculture", PAU, Ludhiana during 10-15 June, 2019.
- Programme coordinator, training programme "Field Survey, data collection, compilation and analysis" during 04-08 November, 2019 for technical staff of Indian Council of Forestry Research and Education (ICFRE), Dehradun funded by Indian Council of Forestry Research and Education (ICFRE), Dehradun.
- Executive Magistrate, Flying Squad Team, Lok Sabha election 2019 at Ac-01, Narela, Distt-North West, Delhi during 11-26 March, 2019.
- Exhibitor, Krishi Unnati Mela during 05-07 March, 2019 at ICAR-IARI, New Delhi.

Ravindra Singh Shekhawat

- External examiner and question paper setter of Agricultural university, Kota for course NRM 313 (Principles of forest economics, project planning and evaluation).
- External examiner and question paper setter of Agricultural university, Kota for course AGECON-221 (Agricultural Marketing, Trade and Prices).
- Worked as a paper setter of Pre-PG entrance test-2019 for Agriculture in SAUs (Rajasthan only) for Agricultural Economics + Agricultural Statistics.
- Worked as a paper setter of PhD entrance examination-2019 of NDRI, Karnal.
- Worked as a reviewer, Indian Journal of Agricultural Sciences.

Sudhir Srivastava

- Received Financial Aid (Tuition) award from the National Institutes of Health (NIH) R01 project of Dr. J. Christopher States, University of Louisville, Kentucky, USA for Spring 2019 and Summer 2019.

(c) Membership of Scientific Societies

Indian Society of Agricultural Statistics	Ajit Alka Arora Amrit Kumar Paul Anil Kumar Anil Rai Anindita Datta Ankur Biswas Anshu Bharadwaj Anu Sharma AR Rao Arpan Bhowmik Bishal Gurung BN Mandal Cini Varghese Deepak Singh Dwijesh C Mishra Himadri Ghosh Himadri Shekhar Roy Hukum Chandra Kaustav Aditya KK Chaturvedi KN Singh Lal Mohan Bhar Md. Harun Md. Samir Farooqi Mir Asif Iquebal Mrinmoy Ray Mukesh Kumar Neeraj Budhlakoti Pal Singh PK Meher Prachi Misra Sahoo Prakash Kumar Prawin Arya Rajeev R. Kumar Rajender Parsad Raju Kumar Ramasubramanian V Ranjit Kumar Paul Sangeeta Ahuja Sarika SB Lal Seema Jaggi Shashi Dahiya
	SN Islam Soumen Pal Sudeep Marwaha Sudhir Srivastava Sukanta Dash Sunil K. Yadav Susheel K Sarkar Tauqueer Ahmad UB Angadi Vandita Kumari Wasi Alam
Society of Statistics and Computer Application	Ajit Alka Arora Amrit Kumar Paul Anil Kumar Anshu Bharadwaj Anu Sharma B.N Mandal Cini Varghese Dwijesh Chandra Mishra Himadri Ghosh Hukum Chandra Lal Mohan Bhar Mukesh Kumar Pal Singh Prawin Arya Rajender Parsad Ramasubramanian V. Ranjit Kumar Paul S.B Lal Sangeeta Ahuja Seema Jaggi Shashi Dahiya Soumen Pal Sukanta Dash Sunil Kumar Susheel Kumar Sarkar
Indian Science Congress Association	A R Rao Anil Rai Arpan Bhowmik Prachi Misra Sahoo Rajender Parsad Ramasubramanian V. Ranjit Kumar Paul SN Islam
Inland Fisheries Society of India	Ranjit Kumar Paul
Agricultural Economics Research Association	A R Anuja Ranjit Kumar Paul
Calcutta Statistical Association	Himadri Ghosh Hukum Chandra
Society for Application of Statistics in Agriculture and Allied Sciences	L. M. Bhar Ranjit Kumar Paul
Computer Society of India	Alka Arora Anil Rai Shashi Dahiya

Indian Society of Agricultural Sciences	Anil Rai Sangeeta Ahuja SN Islam
Society of Farming Systems Research and Development Association	Anil Kumar Anshu Bharadwaj Rajender Parsad Shashi Dahiya
Crop and Weed Science Society (CWSS)	Soumen Pal
Society for Application of Statistics in Agriculture and Allied Sciences (SASAA)	M.A. Iquebal Soumen Pal
Association of Agrometeorologists society	Kaustav Aditya Soumen Pal Vandita Kumari Choudhary
Society of Extension Education	Anil Kumar Shashi Dahiya K.K. Chaturvedi
Indian Society of Remote Sensing	Anil Rai Prachi Misra Sahoo
Society of Applied Biotechnology	Dinesh Kumar
Indian Society of Genetics & Plant Breeding	A R Rao
International Association of Engineers	S B Lal
Indian Society of Agricultural Engineers	S B Lal
Society for Farming System Research and development	K K Chaturvedi Md. Samir Farooqi
Society for Recent Development in Agriculture	K K Chaturvedi
Society for Advancement of Science and Rural Development	K K Chaturvedi
Society for Bioinformatics and Biological Sciences	M.A. Iquebal Sarika
Bioinformatics and Drug Discovery Society (BIDDS)	M.A. Iquebal Sarika
Indian Society of Pulses Research and Development	M.A. Iquebal

Elected Member, International Statistical Institute, The Netherlands.	Hukum Chandra
International Indian Statistical Association	Rajender Parsad Hukum Chandra
Forum for Interdisciplinary Mathematics.	Rajender Parsad Hukum Chandra
International Association of Survey Statisticians.	Hukum Chandra
Indian Statistical Association	Hukum Chandra
Indian Society for Probability and Statistics	Hukum Chandra
Indian Society for Medical Statistics, India	Hukum Chandra
Indian Science Association	Hukum Chandra
Agricultural Economics Research Association	Hukum Chandra
Indian Association for the Study of Population	Hukum Chandra
Indian Association for Reliability & Statistics	Hukum Chandra
Society for Integrated Development of Agriculture, Veterinary & Ecological Sciences	Hukum Chandra
The Horticultural Society of India	Prachi Misra Sahoo Tauqueer Ahmad
International Statistical Institute, Netherlands	Hukum Chandra Rajender Parsad
Indian Society of Ornamental Horticulture	Anil Kumar
Society for Community Mobilization for Sustainable Development	Anil Kumar
Society for Progressive Research	Anil Kumar
Indian Society of Agronomy	Anil Kumar
Indian Society of Geo-informatics	Prachi Misra Sahoo

Society of Economics and Development	A R Anuja Rajesh T. Ravindra Singh Shekhawat
Indian Society of Agricultural Marketing	Ravindra Singh Shekhawat
Society of Biotechnology and Bioinformatics	Prabina Meher
Bhartiya Krishi Anusandhan Samiti	Arpan Bhowmik
Coochbehar Association for Cultivation of Agricultural Science	Arpan Bhowmik

(d) Offices in Professional Societies

Tauqueer Ahmad

- Honorary Secretary of Journal of the Indian Society of Agricultural Statistics, New Delhi.
- Coordinating editor of Journal of the Indian Society of Agricultural Statistics, New Delhi.
- Editor of Agricultural Research Data Book, 2019.

Anil Rai

- Associate Editor of Journal of Indian Society of Agricultural Statistics, New Delhi

A.R. Rao

- Member, Editorial Board for the Indian Journal of Genetics and Plant Breeding
- Senior Editorial Board Member, Scientific Reports, Nature Publishing Group
- Member, Journal Score Committee of National Academy of Agricultural Sciences, (NAAS), New Delhi

Rajender Parsad

- Executive Editor, Statistics and Applications, the Journal of Society of Statistics, Computers and Applications.
- Associate Editor, Journal of Statistical Theory and Practice, published by Taylor and Francis
- Associate Editor, Agricultural Research, Journal of the National Academy of Agricultural Sciences published by Springer.
- Member, Editorial Board, Journal of Wheat Research, the Journal of Society for Advancement of Wheat Research.
- Executive President, Society of Statistics, Computers and Applications.
- Member, Governing Body, Institute of Applied Statistics and Development Studies, Lucknow.
- Executive Council Member, National Academy of Agricultural Sciences

L.M. Bhar

- Joint Secretary of Society of Statistics, Computer and Applications

Hukum Chandra

- Associate Editor, Journal of Statistical Theory and Practice (Springer).
- Associate Editor, Journal of Model Assisted Statistics and Applications, IOS Press.
- Associate Editor, Statistics and Applications.
- Member, Board of Editors, Advancements and Developments in Statistical Science - An International Journal.
- Member Editorial Board, Journal of Safe Agriculture.
- Guest Editor, Special issue, Statistics and Applications (Journal of Society of Statistics, Computer and Applications), India, 2019.
- Council Member, International Association of Survey Statisticians, 2015-2019.
- Joint Secretary, Society of Statistics, Computer and Applications.
- Member Editorial Board, Journal of Safe Agriculture.
- Member, Board of Editors, Advancements and Developments in Statistical Science.
- Guest Editor, Statistics and Applications (Journal of Society of Statistics, Computer and Applications), India, special issue, 2019.

Ramasubramanian V.

- Associate Editor, Statistics and Applications journal
- Associate Editor, Journal of Fisheries and Life Sciences

A.K. Paul

- Joint Secretary of Indian Society of Agricultural Statistics

Alka Arora

- Member of Executive Council, Society of Statistics and Computer Applications
- Nomination Committee (NC) Chairman, Computer Society of India, Delhi Chapter.

Anil Kumar

- Associate Editor, Indian Research Journal of Extension Education, Society of Extension Education.
- Member, Editorial Board, International Journal of Agricultural and Statistical Sciences.
- Member, Editorial Board, Society for Community Mobilization for Sustainable Development.
- Member, Editorial Board, International Journal of Essential Sciences.
- Member, Editorial Board, Progressive Research.

K K Chaturvedi

- Member, Reviewer's Board, Amity International Conference of Artificial Intelligence AICAI'19 during 4-6 Feb 2019 at Amity University, Dubai.
- Member, Editorial Board, International Journal of Current Trends in Engineering & Technology (IJCTET).
- Member, Editorial Board, International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE, http://www.ijarcce.com). ISSN 2278-1021.
- Member, Editorial Board, Journal of Computer Science and Engineering (JCSE, www.journalcse.co.uk). ISSN 2043-9091.
- Member, Editorial Board, International Journal of Emerging Technology & Advanced Engineering (IJETAE, www.ijetae.com). ISSN 2250-2459.
- Member, Editorial Board, Current Trends in Technology & Sciences (CTTS, http://ctts.in/). ISSN: 2279-0535.
- Member, Reviewers Board, Aloy Journal of Soft Computing and Applications (AJCSA, http://www.ajsca.org).

Anshu Bharadwaj

- Member of Executive Council, Society of Statistics and Computer Applications
- Member, Executive Council, Indian Society of Agricultural Statistics
- Member of Editorial Board, American Research Journal of Computer Science and Information Technology

Md. Samir Farooqi

- Member Executive Committee of the Indian Society of Agricultural Statistics

Sarika

- Worked as Executive Member, Indian Society of Agricultural Statistics
- Worked as Member Editorial Board of Computational Biology and Bioinformatics.

M. A. Iquebal

- Worked as Executive Member, Indian Society of Agricultural Statistics
- Worked as Member, Scientific Board, Online Journal of Bioinformatics.
- Worked as Member, Editorial Board, International Journal of Genetics and Genomics
- Appointed as Editorial board member Journal of Plant Sciences (http://www.jplantsciences.org/editorialboard)
- Worked as Member, Editorial Board of Computational Biology and Bioinformatics
- Worked as Editor, Current Agriculture (ISSN : 0254-1092)
- Worked as Review Editor in Frontiers in Genetics: Bioinformatics and Computational Biology Section.

S.N. Islam

- Member, Editorial Board, Annals of Agricultural Research

Shashi Dahiya

- Member of Editorial Board, International Journal of Advanced Computer Science and Applications (IJACSA).

D.C. Mishra

- Member, Editorial Board, Journal Proteomics & Bioinformatics: Current Research (PBCR).
- Member, Editorial Board, Journal Annals of Genetics and Molecular Biology.

Kaustav Aditya

- Executive Council Member, Indian Society of Agricultural Statistics (ISAS), New Delhi

Ankur Biswas

- Executive Council Member, Indian Society of Agricultural Statistics (ISAS), New Delhi

Ranjit Kumar Paul

- Executive Member of Indian Society of Agricultural Statistics
- Executive Memberof Society of Statistics, Computer and Applications

Soumen Pal

- Member, Editorial Board, RASHI

Prabina Meher

- Member Editorial Board for the journal "Computational Biology and Bioinformatics" from 2017-2019.

Sukanta Dash

- Member of the Editorial Board of the Journal Progressive Research: An International Journal.
- Member of Executive Council of Indian Society of Agricultural Statistics.

Arpan Bhowmik

- Editorial Board Member of Journal of Agriculture and Technology

(e) Membership/Offices in Committees/ Panels/Working Groups

Tauqueer Ahmad

- Chairman, Purchase Advisory Committee (PAC) of the Institute.
- Chairman, Screening Committee for conducting screening for the post of MTS, Office Assistant and Driver etc. on contract basis through third party for different Divisions, Sections and Units of the Institute.
- Chairman, Invitation Committee and member, Management Committee for organization of Annual Day of the Institute.
- Chairman, Hindi Translation Outsourcing Committee for technical translation of News Letter and Annual Report in Hindi.
- Incharge of NATP Computer Lab., Division of Sample Survey, IASRI, New Delhi.
- Chairman, Selection Committee by the Director of the Institute for conducting Walk-in interview for the post of RAs/SRFs, IT Professional-II and YP-IIs under Livestock project held on 14 May 2019 at ICAR-IASRI, New Delhi.
- Chief Guest of CAFT training programme organized by the Division of Statistical Genetics of the Institute on 06 September, 2019.

Anil Rai

- To act as Head of Division for Centre for Agricultural Bioinformatics in the institute.
- Officer In-charge of the institute Library.
- Chairman of review committee of SSS staff in the institute
- Member of IDC, ITMC, IPC of IASRI, New Delhi.
- Member of prequalifying viva of Computer Application.
- Chairman of prequalifying viva of Bioinformatics.
- Member of board for selection of Ph.D. (Bioinformatics, Agricultural Statistics and Computer Applications.
- Member of interview for selection of students for Ph.D. admissions in Agricultural Statistics, Computer Applications and Bioinformatics, in P.G. School IARI, New Delhi.
- Member of the tender committee related to conducting All India Examinations for admission in UG and PG in Agricultural Education, ICAR New Delhi.
- Chairman of the committee for procurement of CCTV camera in the institute.
- Chairman of the committee related to issues of recovery from the scientists doing Ph.D. after availing study leave.

- Chairman of the committee to prepare the document related to Role of ICAR-IASRI for the council.
- Chairman of the interview Board for the appointments of RA and SRF.
- Chairman of the committee related to implementation of e-Office in ICAR.

A R Rao

- Chairman, Management & Operation of ASHOKA HPC at CABin, ICAR-IASRI.
- Chairman, Canteen Committee, ICAR-IASRI, New Delhi
- Chairman, Technical Bids opening committee for Lekhan Samagri, ICAR-IASRI
- Chairman, Price Bids opening committee for Equipment Purchase other than Computers, ICAR-IASRI
- Member, Course Coordination Committee, CAFT on Modern Statistical Techniques in Genetics (01-21st February 2019)
- Member, Coordination Committee, Institute Annual Day Function, ICAR-IASRI, New Delhi
- Chairman, NAHEP "Investiments in Indian Council of Agricultural Research Leadership in Agricultural Higher Education" – Procurement Committee
- Chairman, ASHOKA-High Performance Computing Facility Maintenance and Management Committee
- Member, Interview Board for selection of candidates for Ph.D. programme in the disciplines of Agril. Statistics, Computer Application and Bioinformatics for the academic Session 2019-20.
- Member, Journal Rationalization Committee (JRC) of the Institute
- Member, Core Faculty, Centre For Advanced Faculty Training On "Advances Statistical Analysis Of Breeding Data" held during 27 August – 16 September 2019
- Chairman, Sub-Committee for organizing Dr. Daroga Singh Memorial Lecture and Valedictory function of Hindi Pakhwara organized during 03-16 September 2019
- Coordinator, Students Session, 150th Birth Anniversary of Mahatma Gandhi – 2019
- Chairman, Digital Board Specification Committee, ICAR-IASRI

Seema Jaggi

- Nodal Officer, Mahatma Gandhi's 150th Birth Anniversary Celebration Programme during September 26 – October 2, 2019. Organized Quiz, Painting/Sketching Competition, Students Session with street play, skit, songs, Extempore Contest, Session on Sahaja Yoga for Stress Management and Overall Well Being.

Rajender Parsad

- Member, Committee constituted to Review the Draft Report on ICT Roadmap of ICAR {File No. 1(8)/2019-ICT dated February 20, 2019).
- Chief Data Officer, DARE/ICAR for Open Data Initiative of Government of India to function as per National Data Sharing and Accessibility Policy (Vide D.O. No. Secy., DARE & DG, ICAR/2018/1379-1380 dated December 24, 2018)
- Chairman, Works Committee vide Officer Order No. 39/15/2016-17/Works dated 29.11.2016.
- Member, Committee constituted for examining the family details and fixing a criteria for service on the basis of compassionate grounds vide officer order No. 20(11)/2017-Admin II dated 07.12.2017.
- Chairman, Committee to oversee the quality of the services and food provided by the Vendor in International Training Hostel vide F..No. 20(24)/2015-Admn. I dated 20.03.2018.

Hukum Chandra

- Member, Coordination Committee, Centre of Advanced Faculty Training on "Recent Advances in Sample Survey and Data Analysis using Statistical Software", at ICAR-IASRI, New Delhi, November 28-December 18, 2019.
- Member, Core Committee, refresher training programme on "Field Survey, data collection, compilation and analysis" for the participants from ICFRI, Dehradun, at ICAR-IASRI, New Delhi, November 04-08 2019.
- Chairman, Purchase Accounts Committee, refresher training programme on "Field Survey,

data collection, compilation and analysis" for the participants from ICFRI, Dehradun, at ICAR-IASRI, New Delhi, November 04-08 2019.

- Member, Coordination Committee, training programme on "Data Analysis and Interpretation" for the probationers of ISS, at ICAR-IASRI, New Delhi, May 13-24, 2019.
- Member, Core Committee, International Training Programme on "Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications" for participants from African-Asian Rural Development Organization member countries, ICAR-IASRI, New Delhi, March 11-31, 2019.
- Chairman, Purchase and Account Committee, International training programme on "Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications" for the participants from African-Asian Rural Development Organization member countries, at ICAR-IASRI, New Delhi during March 11-31, 2019.
- Co-Chairman, committee constituted by Director ICAR-IASRI, New Delhi for compilation, editing of the material related to Quinquennial Review Team 2011-12 to 2015-16.

Ramasubramanian V.

- Chairman, Bid evaluation meeting for creation of Data Recovery Centre at our institute
- Chairman, Quarter Allotment Committee for institute staff
- Core Faculty & Chairman, Programme Coordination Committee, associated in organizing CAFT programme on "Recent advances in statistical modeling and forecasting for agricultural data analysis" conducted during 25.02.2019 to 15.03.2019 at ICAR-IASRI, New Delhi
- Member, Selection Board, conducted interview on 06.02.2019 for recruitment of 01 RA/ 01 SRF in the externally funded project entitled "Artificial intelligence based mobile app for identification and advisory of maize diseases and insect pests" being carried out at our institute
- Faculty coordinator, College students' visit (College of Agriculture, Ahmednagar) and gave presentation to them on institute's activities on 06.02.2019 (along with Dr. Susheel Kumar Sarkar)
- Member, Interview Board for selection of candidates for admission to Ph.D. degree course in the disciplines of Agricultural Statistics, Bioinformatics and Computer Application on 08.07.2019 at ICAR-IASRI, New Delhi.
- Member, Jury for Extempore Contest organized at our institute on the occasion of 150th Birth Anniversary of Mahatma Gandhi on 30.09.2019.
- Member, Interview Board for selection of 02 RA and 04 SRF in ongoing projects of our institute on 21.12.2019 at CABIn

A.K. Paul

- External member of SRF Interview board at IARI.
- Chairman of the Committee for the preparation of tender of Civil Engineering work of IASRI and Krishi Niketan.
- Chairman of research work committee to review 2 year time period of JRF for the SERB funded project Stochastic differential equation model and their application to agriculture on 1st June, 2018.
- Member of research work committee to review 2 year time period of JRF for the SERB funded project Stochastic differential equation model and their application to agriculture.
- Chairman of DPC for Scientist Probationer Clearance and also for promotion of AAO and Assistant.

Dinesh Kumar

- Worked as Chairman, Selection Committee for RA and SRFs at ICAR-IASRI, New Delhi on Dec 21, 2019.

Alka Arora

- Acted as member of Abstracts and Poster Management Committee under Agricultural Engineering & IT team of XIV Agricultural Science Congress and evaluated the papers under IT Theme.
- Chairman, Website Contents updating and management Committee
- Member, Data Centre Management Committee.
- Co-chairmen, ICAS 2019 Website development committee.
- Technical committee member in the Project 'Investments in ICAR Leadership in Agricultural Higher Education' under NAHEP Component 2.

- Involved in development of ICAS website and providing support for the queries.
- Acted as chairman in the interview board committee for the interview held for the position of SRF at NAHEP on 24th Oct. 2019.
- A member of interview board for assessment of Computer scientist at ICAR-CRIDA Hyderabad.

Cini Varghese

- Chairperson, Sapling Committee formulated on the occasion of 150th birth anniversary celebrations of Mahatma Gandhi.

Anil Kumar

- Coordinator of ITH and Panse Hostel.
- Member Coordination Committee for conducting 90th Foundation day of ICAR and Award ceremony.

Anshu Bhardwaj

- Member of interview board for selectionof Ph.D. candidates for Ph.D. (CA, Statistics and Bioinformatics) in PG School, IARI, New Delhi.
- Worked as Chairman of the Institute House Allotment Committee.
- Member, Data Centre Management Committee.
- Member of technical committee in the Project 'Investments in ICAR Leadership in Agricultural Higher Education' under NAHEP Component 2.
- Member, Committee formed for exploring the possibility of establishing a Crèche in the Institute.
- Worked as member of the Committee for Hindi Digital Shodh Patra Prastuti Pratiyogita during the Hindi Pakhwada.
- Worked as the member of the Ph.D. Candidate selection Committee for Ph.D. (CA) and Ph.D. (Statistics) PG, School IARI, New Delhi

Mukesh Kumar

- Worked as Chairman for Technical Evaluation Committee of equipments.
- Worked as Transparency Officer and RTI Nodal Officer
- Worked as Co-Chairman in PAC committee.

Himadri Ghosh

- Member in interview board for selection of candidates for admission to Ph. D. course in the discipline of Agricultural Statistics, Computer Application in Agriculture and Bioinformatics.

Prachi Misra Sahoo

- Secretary, Divisional Research Committee for the Division of Sample Surveys.
- Incharge of Geo-informatics Lab., Division of Sample Survey, IASRI, New Delhi.

K K Chaturvedi

- Invigilator, Conduct Comprehensive Examination of Ph.D. students of Bioinformatics for Paper-II on 27th Nov. 2019.
- Member, Selection Committee for YP-II at IARI, New Delhi on 23rd May 2019.
- Chairman, MACP of Supporting staff of the institute on 20th March 2019
- Expert Member, Enquiry Committee to examine the lapses in performing duty by administrative personnel in the institute.
- Expert Member (Examiner), Recruitment of Adhoc Personnel for ICAR institute.
- Member, Operational management and Maintenance of IT and Non-IT resources under NABG Committee.
- Member, Committee for specifying spare of Services and Equipment on Portal for its wider usage.
- Incharge, Managing and coordinating IT and Non-IT resources of the division.
- Incharge, Video conferencing facility of the division
- Incharge, Labs of the CABin division.
- Member, Photography and Audio Video Recording Committee to celebrate 150th Anniversary of Mahatma Gandhi during 26th Sept to 2nd Oct 2019 as
- Member, Technical Committee to decide the services and equipment on Knowledge Management Portal

Shashi Dahiya

- Member Website Content Updating and Management Committee,
- Member of technical committee in the Project 'Investments in ICAR Leadership in Agricultural Higher Education' under NAHEP Component 2.

M.A. Iquebal

- Working as Member, QRT Document Preparation Committee.
- Worked as Member, Selection Committee for RA and SRFs at ICAR-IASRI, New Delhi on Dec 21, 2019.
- Worked as Co-Chairperson of ONE Ph.D. (Bioinformatics) Student, Mr. Rahul Singh Jasrotia (PID: 15PHBIN104) registered at Sam Higginbottom Institute of Agriculture, Technology and Sciences (Formerly Allahabad Agriculture Institute) (Deemed-to-be-University), Allahabad, India.

Sarika

- Worked as Member Secretary, DRC, CABin (January 15, 2018-31 Dec2019)
- Coordination and operational management of Accelyrs Discovery studio complete software and related services
- Worked as Member Secretary, Crèche committee of ICAR-IASRI, New Delhi

S N Islam

- Co-ordinated Smart India Hackathon 2019 from ICAR side for Software Problem during March 2019 and Hardware problem during July 2019
- DRC Secretary for the Division of Computer Applications.

Anu Sharma

- Worked as Chairman of painting competition organized during 150th birth anniversary of Shri. Mahatama Gandhi.

Md. Samir Farooqi

- Worked as member of Institute committee for valuation of services provided to ITH and Panse Hostel by M/S Professional services.
- Worked as member of Institute committee for valuation of services provided to NASC Museum by M/S Professional services.

Susheel Kumar Sarkar

- हिंदी पखवाड़ा के अंतर्गत मुख्य आयोजन समिति का सदस्य
- हिंदी पखवाड़ा के अंतर्गत काव्यपाठ के संचालक
- हिंदी पखवाड़ा के अंतर्गत छायांकन समिति का अध्यक्ष
- गाँधी जी कि 150वीं जयंती के उपलक्ष्य में मनाये गए साप्ताहिक कार्यक्रम के अंतर्गत खरीद समिति का अध्यक्ष

B.N. Mandal

- Member Secretary, Divisional Research Committee, Division of Design of Experiments
- Member, Institute Website Content Updating and Management Committee

D.C. Mishra

- Worked as Chairman of Quiz competition organized during 150th birth anniversary of Shri. Mahatma Gandhi.
- Working as a member secretary of Evaluation Committee for publication of "ICAR-IASRI Annual Report" in Hindi
- Working as a member of Editorial Board for Hindi Magazine "सांख्यिकी विमर्श"
- Working as a center coordinator of National Research Centre on Plant Biotechnology, New Delhi for network projects under the CABin Scheme.
- Working as a member of Institutional Work Committee
- Worked as Executive Magistrate in Lok-Sabha Election 2019.
- Working as a member of major work committee constituted for carrying out major work at Krishi Niketan, Paschim Vihar.

Ranjit Kumar Paul

- Worked as question setter and evaluator for Qualifying Examinations of M.Sc. Statistics in TNAU
- Worked as Secretary DRC, Division of Statistical Genetics

- Worked as member of DPC for promotion of SSS and skilled staff
- Worked as exhibitor in the Kishan Mela at IARI, New Delhi during 05-07 March, 2019

Soumen Pal

- Worked as a member of Institute Technical Expert Committee.
- Worked as a member of Data Centre Management Committee.
- Worked as a member of e-Office specification committee.
- Worked as a member of technical committee in the Project 'Investments in ICAR Leadership in Agricultural Higher Education' under NAHEP Component 2.
- Worked as an External Examiner to set question paper of the course Agri-informatics & Computer Applications (For Agriculture and Horticulture Faculty) in Uttar Banga Krishi Viswavidyalaya, West Bengal.
- Appraised the visiting students and faculties of Tamil Nadu Agricultural University, Agricultural College and Research Institute, Coimbatore about training and research activities of the institute on December 19, 2019.

Prabina Meher

- Member Secretary, Divisional Research Committee, Division of Statistical Genetics.
- Member, Institute Website Content Updating and Management Committee.

Kaustav Aditya

- Member, Committee for maintenance and check of quality of services of ITH of ICAR-IASRI, New Delhi-12.

Pal Singh

- Committee member framed for allotment of IASRI Staff Quarters
- Worked as a member secretary to interview panel for the post IT professionals in different projects held on 15-5-2019
- Member, committee framed for bid evaluation committee in NAHEP project.
- Working in development online software for inviting application for grant financial assistance for organizing seminar/symposium /conference to scientific societies and academic institutions
- Worked as member of food committee in one day workshop on FMS organized on October 31.2019.

Ankur Biswas

- Member, Institute Housing Quarter Allotment Committee
- Member of Standing Committee to inspect office quarters at Krishi Niketan.
- Acted as invigilator of the Ph.D. (Agricultural Statistics) Written Comprehensive Examination of 2019-20 at ICAR-IASRI, New Delhi.
- Acted as Chairman of a committee for Spot Quotations for Hotel booking for a training.
- Acted as Chairman of a committee for Spot Quotations for furniture for office.
- Nominated as the Chairman of "Course Conduct Committee" and "Travel Committee" in organization of the Training Programme on "Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications" held during 11-31 March, 2019 at ICAR-IASRI, New Delhi.
- Nominated as the Chairman of "Registration Committee" in organization of the Training Programme on "Data Analysis and Interpretation" held during 13-24 May, 2019 at ICAR-IASRI, New Dedhi.
- Nominated as Chairman of "Travel Committee" and a member of the "Core Committee" and "Course Conduct Committee" in organization of the Training Programme on "Field Survey, data collection, compilation and analysis" during 04-08 November, 2019 at ICAR-IASRI, New Delhi.
- Nominated as Co-Chairman of the "Purchase, Accounts and TA Bill Committee" in organization of the CAFT Training Programme on "Recent Advances in Sample Survey and data analysis using Statistical Software" during 28 November - 18 December, 2019 at ICAR-IASRI, New Delhi.
- Nominated as member of the "Purchase, and Accounts Committee" in organization of the Training-cum-Interaction Programme on "Sampling Design and Schedules for Implementation of Energy Audit Survey" during

01-02 November, 2019 at ICAR-IASRI, New Delhi.

Mrinmoy Ray

- Secretary, DRC for Division of Forecasting and Agricultural Systems modelling.
- Acted as Rapporteur on the Technical Session - V: Online Pest Management in Workshop for Nodal Officers of Agricultural Universities under NAHEP-Component 2A SubProject - Investments in ICAR Leadership in Agricultural Higher Education organized by ICAR-IASRI at NASC Complex, New Delhi during 18th and 19th September, 2019.

Vandita Kumari Choudhary

- Chairman of the Registration committee for the training cum interaction programme on "Sampling Design and Schedules for the Implementation of Energy Audit Survey" at ICAR-IASRI during 01-02 November, 2019.
- Member of the Editorial Committee and Travel Committee for the training programme on "Field Survey, Data collection, Compilation and Analysis" conducted during 04-08 November, 2019.
- Member of the Editorial Committee and Candidate Selection Committee for the training programme on "Recent Advances in Sample Survey and Data Analysis using Statistical Software" organized during 28 November-18 December, 2019.
- Chairman of the Registration committee for the for the training programme on "Recent Advances in Sample Survey and Data Analysis using Statistical Software" organized during 28 November-18 December, 2019.

Deepak Singh

- Executive Magistrate, Flying Squad Team, Lok Sabha election 2019 at AC-13, Kanjhawala, Distt-North West, Delhi State during 11 March -10 April, 2019.
- Exhibitor, Krishi Unnati Mela during 05-07 March, 2019 at ICAR-IARI, New Delhi

Ravindra Singh Shekhawat

- Deputed as Sector Officer for the General Election i.e. Lok Sabha 2019 in West Delhi, Parliamentary Constituency (PC-06) from 15/03/2019 to 28/05/2019.
- Deputed as sector officer from 5th December, 2019 to 15th February, 2020 during Delhi Legislative Assemble election at Rajouri Garden (AC-27).

Achal Lama

- Acted as Rapporteur on the Technical Session - IV: AMS and Web Hosting in Workshop for Nodal Officers of Agricultural Universities under NAHEP-Component 2A SubProject - Investments in ICAR Leadership in Agricultural Higher Education organized by ICAR-IASRI at NASC Complex, New Delhi during 18th and 19th September, 2019.

A R Anuja

- Acted as exhibitor of ICAR-IASRI stall in PusaKrishiVigyan Mela-2019 organized by ICAR-IARI between March 5th to 7th, 2019 in New Delhi.
- Acted as core faculty member and member of Registration committee, Lecture notes preparation committee and Purchase and Accounts Committee for a training on "Recent Advances in Statistical Modelling and Forecasting for Agricultural Data Analysis" held during Feb 23rd to March 15th, 2019 at ICAR-IASRI, New Delhi.
- Acted as invigilator of examination for limited departmental examination for the post of assistant administrative officer conducted by IASRI, New Delhi.

Rajesh T.

- Sector Officer for the General Election i.e. Lok Sabha 2019 in West Delhi, Parliamentary Constituency (PC-06) from 15/03/2019 to 28/05/2019.
- Member, Committee for preparation of lecture notes and Course conduct Committee, ICAR Sponsored winter school on "Recent Advances in Statistical Modeling and Forecasting for Agricultural Data Analysis" (23th February 2019 to 15th March 2019), ICAR-IASRI, New Delhi.
- Member, Course conduct Committee, ICAR Sponsored CAFT training on "Statistical and

Machine Learning Techniques for Modeling and Forecasting Agricultural Data" (20th December 2019 to 09th January 2020), ICAR-IASRI, New Delhi.

Harish Kumar H V

- Worked as Sector Officer for the Lok Sabha 2019 Election in North West Delhi, Parliamentary Constituency (PC-05) from 13/03/2019 to 11/04/2019.

(f) Visit Abroad

Tauqueer Ahmad

- Was invited as Expert by Food and Agriculture Organization of the United Nations Regional office for Asia and the Pacific (FAO-RAP), Bangkok, Thailand for sharing knowledge and imparting classroom and field training to the Govt. of Nepal officials for field testing of guidelines on measurement of harvest and post-harvest losses of milk & meat and fruits & vegetables during 13-17 August 2019.
- Was invited as Expert by Food and Agriculture Organization of the United Nations Regional office for Asia and the Pacific (FAO-RAP), Bangkok, Thailand for sharing knowledge and imparting classroom and field training to the Govt. of Thailand officials for field testing of guidelines on measurement of harvest and post-harvest losses of cereals & pulses and fruits & vegetables during 17-23 August 2019.

Seema Jaggi

- Deputed to Yezin Agricultural University (YAU), NayPyiTaw, Myanmar to teach a Course on Basic Statistics to post graduate students of three newly introduced disciplines of Agricultural Extension, Food Engineering & Technology and Molecular Biology & Biotechnology at Advanced Centre for Agricultural Research and Education (ACARE), Myanmar under IM-ACARE Programme and visited Myanmar during August 30- September 13, 2019.

Rajender Parsad

- Nominated to teach part of a course on Basic Statistics to the postgraduate students of Advanced Centre for Agricultural Research and Education (ACARE), Yezin Agricultural University Campus, Yezin, Nay Pyi Taw, Myanmar during September 11-21, 2019.

Various committees were constituted for smooth conduct of ICAS-VIII i.e. Eighth International Conference on Agricultural Statistics 2019 during 18-21 November, 2019 as our institute was one of the Co-Organizers (while many other persons of repute and many other national and international organisations were involved in the following committees, only personnel working in our institute are mentioned)

Organizing Committee

1.	Lal Mohan Bhar	Organizing Secretary
2.	Rajender Parsad	Co-Organizing Secretary
3.	Hukum Chandra	Member
4.	Anil Rai	Member
5.	Seema Jaggi	Member
6.	Sudeep	Member
7.	Susheel Kumar Sarkar	Member
8.	K.N. Singh	Member
9.	Tauqueer Ahmad	Member
10.	A.R. Rao	Member
11.	Anil Kumar	Member
12.	A.K. Paul	Member

Event Management Committee

1.	Lal Mohan Bhar	Member
2.	A.R. Rao	Member

Scientific Programme Committee

1.	Rajender Parsad	Member
2.	Hukum Chandra	Member

Finance Committee

1.	Hukum Chandra	Member
2.	Ramasubramanian V.	Member Secretary

Special Events Committee

1.	Hukum Chandra	Chairperson
2.	S.B. Lal	Co-Chairperson
3.	Deepak Singh	Member Secretary
4.	Kaustav Aditya	Member
5.	Vandita K. Choudhary	Member

6.	Pradip Basak	Member
7.	B.N. Mandal	Member
8.	Ravindra Singh Shekhawat	Member
9.	Ankur Biswas	Member
10.	Raju Kumar	Member

Registration Committee

1.	Seema Jaggi	Chairperson
2.	Cini Varghese	Co-Chairperson
3.	Arpan Bhowmik	Member Secretary
4.	Sarika	Member
5.	Ranjit Kumar Paul	Member
6.	Himadri Shekhar Roy	Member
7.	Anindita Dutta	Member
8.	Anuja A.R.	Member

Hall Management Committee

1.	Tauqueer Ahmad	Chairperson
2.	Prachi Misra Sahoo	Co-Chairperson
3.	Ankur Biswas	Member Secretary
4.	Kaustav Aditya	Member
5.	Pradip Basak	Member
6.	Raju Kumar	Member

Accommodation Committee

1.	K.N. Singh	Chairperson
2.	Prawin Arya	Co-Chairperson
3.	Ravindra Singh Shekhawat	Member Secretary
4.	Mukesh Kumar	Member
5.	Rajesh T.	Member
6.	Anuja A.R.	Member
7.	Sunil Kumar Yadav	Member

Transport Committee

1.	Anil Rai	Chairperson
2.	U.B. Angadi	Co-Chairperson
3.	Mir Asif Iquebal	Member Secretary
4.	K.K. Chaturvedi	Member
5.	S.B. Lal	Member
6.	Sanjeev Kumar	Member
7.	Sudhir Srivastava	Member

Website Committee

1.	Sudeep	Chairperson
2.	Alka Arora	Co-Chairperson
3.	K.K. Chaturvedi	Member Secretary
4.	Anshu Bharadwaj	Member
5.	Mukesh Kumar	Member
6.	S.B. Lal	Member
7.	Kaustav Aditya	Member
8.	Soumen Pal	Member

Food Committee

1.	A.R. Rao	Chairperson
2.	Monendra Grover	Co-Chairperson
3.	P.K. Meher	Member Secretary
4.	Shah Nawazul Islam	Member
5.	D.C. Mishra	Member
6.	Deepak Singh	Member

Publication Committee

1.	Ajit	Co-Chairperson
2.	Achal Lama	Member Secretary
3.	Ramasubramanian V.	Member
4.	Shashi Dahiya	Member
5.	Ranjit Kumar Paul	Member
6.	B.N. Mandal	Member
7.	Ankur Biswas	Member
8.	Shivaswamy G.P.	Member

Cultural Committee

1.	Ajit	Chairperson
2.	Anuja A. R.	Member Secretary
3.	Md. Samir Farooqi	Member
4.	Sangeeta Ahuja	Member
5.	Anu Sharma	Member
6.	D.C. Mishra	Member
7.	H.V. Harish Kumar	Member

Media and Publicity Committee

1.	Shashi Dahiya	Member Secretary
2.	Dinesh Kumar	Member
3.	Ramasubramanian V.	Member
4.	Arpan Bhowmik	Member

Invitation Committee

1.	Ramasubramanian V.	Chairperson
2.	Himadri Ghosh	Co-Chairperson
3.	Shivaswamy G.P.	Member Secretary
4.	Shah Nawazul Islam	Member
5.	Mrinmoy Ray	Member
6.	Sunil Kumar Yadav	Member
7.	Achal Lama	Member
8.	Kanchan Sinha	Member

Exhibition Committee

1.	Hukum Chandra	Chairperson
2.	Anshu Bharadwaj	Co-Chairperson
3.	Pradip Basak	Member Secretary
4.	Deepak Singh	Member
5.	Vandita K. Choudhary	Member
6.	Raju Kumar	Member
7.	Ravindra Singh Shekhawat	Member
8.	Pal Singh	Member

Excursion Programme Committee

1.	Anil Kumar	Chairperson
2.	Md. Samir Farooqi	Co-Chairperson
3.	Sukanta Dash	Member Secretary
4.	Prawin Arya	Member
5.	Susheel Kumar Sarkar	Member
6.	Md. Wasi Alam	Member

Purchase Committee

1.	Amrit Kumar Paul	Chairperson
2.	Mukesh Kumar	Co-Chairperson
3.	Himadri Shekhar Roy	Member Secretary
4.	Susheel Kumar Sarkar	Member
5.	Mir Asif Iquebal	Member
6.	Sukanta Dash	Member

Security Committee

1.	Anil Kumar	Chairperson
2.	Sanjeev Kumar	Member Secretary
3.	Md. Samir Farooqi	Member
4.	R.K. Saini	Member
5.	Davendra Kumar	Member
6.	R.S. Tomar	Member
7.	Subhash Chand	Member

Young Statisticians Conference Committee

1.	Rajender Parsad	Member
2.	Hukum Chandra	Member Secretary
3.	BN Mandal	Member

7

Linkages and Collaborations

Linkages and Collaborations in India and abroad including externally funded projects (Jan- Dec, 2019)

Sr. No.	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	01.04.2017	31.03.2020
2	Designing and analysis of ON FARM research experiments planned under AICRP on IFS	ICAR-IIFSR	01.04.2017	31.03.2020
3	Planning, designing and analysis of data relating to experiments for AICRP on Long Term Fertilizer experiments	AICRP LTFE	01.04.2017	31.03.2020
4	ICAR Research Data Repository for Knowledge Management as KRISHI: Knowledge based Resource Information System Hub for Innovations in Agriculture:	ICAR Headquarters EFC Scheme: NAARM, NBSSLUP, IARI, CRIDA, CMFRI, DKMA as partners and all other ICAR Institutes as Nodal Centers	24.07.2015	31.03.2020
5	Incomplete split-plot designs: construction and analysis	Science and Engineering Research Board, DST	16.08.2016	11.08.2019
6	Creating a fully characterized genetic resource pipeline for mustard improvement	PAU, Ludhiana. National Agricultural Science Fund (NASF)	01.01.2017	31.12.2019
7	Genomics assisted crop improvement and management	ICAR-IARI, New Delhi	26.09.2018	31.03.2021
8	Application of Next-Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic Gain in Indian Staple Crops	IARI, New Delhi	22.01.2019	21.01.2023
9	Plant source based environmentally safe crop protection and production technologies: Development and capacity building	IARI, New Delhi	27.03.2019	06.02.2022
10	Statistical approach for genome-wide association studies and genomic selection for multiple traits in Structured plant and Animal population.	Funded by Science and Engineering Research Board, DST Government of India	20.06.2017	31.03.2020
11	Doubling Farmers' Income in India by 2021-22: Estimating Farm Income and Facilitating the Implementation of Strategic Framework	Ministry of Agriculture and Farmers Welfare	31.03.2017	31.03.2022

Sr. No.	Title	Collaborative /Funding agency	Date of Start	Date of completion
12	Modelling insect pests and diseases under climate change and development of digital tools for pest management	NICRA project funded by CRIDA(DBT funded)	20.06.2017	31.03.2020
13	Studying Dynamics of market integration and price transmission of agricultural commodities	ICAR Funded	02.04.2018	31.03.2021
14	Energy Audit Survey of AICRP on Energy in Agriculture & Agro-based Industries: Sampling Design and Analysis	ICAR-All India Coordinated Research Project on "Energy in Agriculture & Agro-based Industries	01.06.2018	31.05.2021
15	Pilot Study for Developing State Level Estimates of Crop Area and Production on the Basis of Sample Sizes Recommended by Professor Vaidyanathan Committee Report.	Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare, Govt of India	16.02.2015	30.06.2019
16	Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production	DES, MoA&FW, Govt. of India West Bengal State Govt. Assam State Govt. Bihar State Govt. Jute Advisory Board	01.09.2015	30.06.2019
17	Assessment of post harvest losses in fruits and vegetables and strategies for their reduction in Andaman and Nicobar Islands	Collaboration with ICAR-CIARI, Port Blair Inter-Institutional Project	03.10.2016	31.07.2019
18	Integrated Sampling Methodology for Crop Yield Estimation using Remote Sensing, Field Surveys and Weather Parameters for Crop Insurance	DACFW, MoAFW, Govt. of India MNCFC, New Delhi Maharashtra State Govt. U.P. State Govt. M.P. State Govt.	28.09.2018	30.09.2019
19	Integrated Sample survey Solution for major Livestock products	DAHDF, MoAFW, Govt. of India	27.03.2019	31.01.2021
20	Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications	African-Asian Rural Development Organization (AARDO), New Delhi	11.03.2019	31.03. 2019
21	Training program on "Data Analysis and Interpretation"	Ministry of Statistics & Programme Implementation, Govt. of India.	13.05.2019	24.05.2019
22	Training programme on "Field Survey, data collection, compilation and analysis"	Indian Council of Forestry Research and Education (ICFRE), Dehradun	04.11.2019	08.11.2019
23	Centre of Advanced Faculty Training (CAFT) on "Recent Advances in Sample Survey and Data Analysis using Statistical Software" under the aegis of Education Division, ICAR, New Delhi	ICAR Institutes and State Agricultural Universities	28.11.2019	18.12. 2019
24	Development and assessment of educational mobile apps for improving livestock health and production	Collaborative with ICAR-IVRI Inter-Institute Project	28.06.2017	31.03.2019
25	Knowledge Management System for Agriculture Extension Services in Indian NARES:	ICAR-Extramural Research Project funded by Agricultural Extension Division	04.03.2016	31.03.2020
26	Management and Impact Assessment of Farmer FIRST Project	Collaborative with ICAR-NIAP and Funded by ICAR	01.02.2017	31.03. 2020
27	Knowledge Management System for DUS Characteristic of Crops	Protection of Plant Varieties & Farmers' Rights Authority	03.01.2019	31.03. 2021

Sr. No.	Title	Collaborative /Funding agency	Date of Start	Date of completion
28	ICT based Extension Strategies for Nutrition Sensitive Agriculture in the States of UP and Odisha	NASF	01.11.18	October, 2021
29	Computational biology approach for deciphering stress induced transcriptomic and proteomic changes in rice-microbial system	NBAIM, Mau Funded by CABin, ICAR-IASRI	06.03. 2018	31.03. 2020
30	Potential Gene Mining from Salt Tolerant Grasses for Improvement of Stress Tolerance in Crops	National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA), Indian Council of Agricultural Research, New Delhi	April 2017	March 2020
31	Microbial Research Projects under CABin Scheme	NBAIM, Mau	July 2017	March 2020
32	Gene Regulatory Networks Modeling For Heat Stress Responses of Source and Sink for Development of Climate Smart Wheat	ICAR-IARI, New Delhi	July 2017	March 2020
33	RiceMetaSys: Understanding rice gene network for blast resistance and drought tolerance through system biology approach	ICAR-NRCPB, New Delhi	July 2017	March 2020
34	Computational and Analytical Solutions for High-throughput Biological Data	All Bureaux /ICAR Consortium Research Platform on Genomics	Sep 2015	March 2020 (II Phase)
35	Computational and experimental biology approaches for delineation of selected secondary metabolite pathways and antimicrobial peptides (AMPs) in major spices	(In collaboration with ICAR-IISR, Kozhikode)	05.03.2018	March 2020
36	Genomic data analysis to elucidate the regulatory network and candidate genes underlying cytoplasmic male sterility in pigeonpea	(In collaboration with ICAR-IIPR, Kanpur)	05.03.2018	March 2020
37	Computational approach for genomic resource improvement and precision phenotyping of less explored yield traits in wheat	(In collaboration with ICAR-IIWBR, Karnal)	05.03.2018	March 2020
38	Deciphering genetic variation in the carbohydrate metabolism of farmed rohu families.	(In collaboration with ICAR-CIFA, Bhubaneshwar)	05.03.2018	March 2020
39	An integrative transciptomics and DNA methylomics approach to understand the dynamic features of biotic stress responses associated with mastitis in buffalos	(In collaboration with ICAR-CIRB, Hisar) (Project Code: AGEDIASRICOP 201900100147)	16.01.2019	March 2020
40	ICAR Network Project on Functional Genomics and Genetic Modification (Earlier ICAR Network Project on Transgenic in Crops	NRCPB, New Delhi	27.01.2015	31.03.2020
41	Improving the usability of buffalo spermatozoa by sperm surface remodeling and immune acceptance in female reproductive tract (NASF).	ICAR-NDRI	31.08.2018	31.07.2021
42	Molecular markers for improving reproduction of cattle and buffaloes - Funded by Bill and Melinda Gates Foundation (BMGF)	ICAR-NDRI, ICAR-CIRB	19.09.2018	30.09.2023
43	Molecular characterization, development of molecular markers and metabolite analysis of Tree bean (*Parkia roxburghii*) landraces of North-East India (DBT Funded)	ICAR Research Complex for NEH Region (Gangtok, Sikkim Centre) and UBKV, West Bengal	15.03.2019	14.03.2021
44	Development of web server for phenotype and genotype analysis for cattle breeding management	ICAR-CIRC, Meerut	12.03.2018	31.03.2021

Sr. No.	Title	Collaborative /Funding agency	Date of Start	Date of completion
45	Genome and transcriptome sequencing of coriander (*Coriandrum sativum*) to reveal insight of its genomic architecture and breeding targets	JAU, Junagarh	14.03.2018	31.03.2021
46	Genomics assisted crop improvement and management - Centre for Advanced Agricultural Science and Technology (CAAST) project funded by National Agricultural Higher Education Project (NAHEP).	ICAR-IARI, ICAR-NBPGR and ICAR-NIPB	26.09.2018	31.03.2021
47	Gene Regulatory Networks Modeling For Heat Stress Responses of Source and Sink for Development of Climate Smart Wheat	ICAR-IARI, New Delhi	July 2017	March 2020
48	RiceMetaSys: Understanding rice gene network for blast resistance and drought tolerance through system biology approach	ICAR-NRCPB, New Delhi	July 2017	March 2020
49	Computational and Analytical Solutions for High-throughput Biological Data	All Bureaux /ICAR Consortium Research Platform on Genomics	April 2017	March 2020
50	Potential Gene Mining from Salt Tolerant Grasses for Improvement of Stress Tolerance in Crops	NFBSFARA, ICAR, New Delhi	April 2017	March 2020
51	Creating a fully characterized genetic resource pipeline for mustard improvement programme in India	PAU, Ludhiana; ICAR-IARI, New Delhi; Directorate of rapeseed-mustard research, Bharatpur; GBPUAT, Pantnagar	01.01.2017	31.12.2019
53	Robust and Efficient Small Area Estimation Methods for Agricultural and Socio-Economic Surveys and Their Application in Indo-Gangetic Plain	ICAR-National Fellow Scheme, ICAR	25.11.2014	24.11.2024
55	Study to estimate the sub-state level estimate of socio-economic indicators of Uttar Pradesh by using Small Area Estimation Techniques	Giri Institute of Development Studies, Lucknow, Uttar Pradesh and Directorate of Economics & Statistics, Government of Uttar Pradesh	01.06.2019	31.05.2020
57	Myanmar Agricultural Census 2020, Myanmar	FAO of United Nations	15.12.2019	21.12.2019
58	Academic Visitor, Research collaboration on Building a shared understanding for the application of the small area estimation approach	The Australian National University, Australia	02.12.2019	07.12.2019
59	Monitoring and Analyzing Food and Agricultural Policies Programme in India	FAO of United Nations and NITI Aayog, India	November 2019	December 2019
60	Corporate Outcome Assessment Survey, India	FAO of United Nations, India	November 2019	December 2019
61	Elected Member & Council Member (IASS)	International Association of Survey Statisticians (IASS), International Statistical Institute, The Netherlands	2015	2019
62	Feasibility Study for Developing Renewable Energy Systems for Tea Plantations in Assam	Indian Institute Technology, Delhi	31.07.2019	January 2022
63	Statistical Analysis of Disaggregated SDG Indicators for Inclusive Development Policies	United Nations Statistical Institute for Asia and the Pacific, Chiba, Japan	07.06.2019	12.07.2019
64	Panel Sample Survey of Households in the State of Tamil Nadu	Madras Institute of Development Studies, Chennai and Directorate of Economics & Statistics, Government of Tamil Nadu	2017	2019

8

Publications

Research Papers:

1. Aditya, K., Chandra, H., Kumar, S. and Das, S. (2019). Higher order calibration estimator of finite population total under two stage sampling design when population level auxiliary information is available at unit level. *Journal of the Indian Society of Agricultural Statistics*, **73(2)**, 99–103. http://krishi.icar.gov.in/jspui/handle/123456789/35365
2. Ali, A., Kumar, R., Iquebal, M.A., Jaiswal, S., Kumar, D., and khan, A. (2019). Role of conserved residues in catalytic activity of NDM-1: an approach of site directed mutagenesis and molecular dynamics. *Physical Chemistry Chemical Physics-a Journal of Royal Society of Chemistry*, **21(32),** 17821-17835.
3. Angadi, U.B., Chaturvedi, K.K., Srivastava, S. and Rai, A. (2019). A novel way of comparing protein 3d structure using graph partitioning approach. *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, DOI: 10.1109/TCBB.2019.2938948
4. Anjoy, P., Chandra, H. and Basak, P. (2019). Estimation of spatially disaggregated distribution of poverty incidence in Odisha by combining survey and census data. Social Indicators Research. *Social Indicators Research*, **144(1),** 251-273. http://krishi.icar.gov.in/jspui/handle/123456789/35350
5. Arora, S., Sehgal, M., Srivastava, D. S., Arora, S. and Sarkar, S. K. (2019). Rice pest management with reduced risk pesticides in India. *Environmental Monitoring and Assessment*, **191**,241.https://doi.org/10.1007/s10661-019-7384-5 http://krishi.icar.gov.in/jspui/handle/123456789/17706
6. Joshi, A., Kumar, U., Mishra, V.K., Chand, R., Chatrath, R., Naik, R., Biradar, S.S., Singh, R., Budhlakoti, N., Ravi, D. and Blummel, M. (2019). Variations in straw fodder quality and grain–straw relationships in a mapping population of 287 diverse spring wheat lines. *Field Crops Research*, **243(2019)**, 107627.
7. Awasthi, S., Sharma, A., Saxena, P., Yadav, J., Pandiyan, K., Kumar, M., Singh, A., Chakdar, H., Bhowmik, A., Kashyap, P.L., Srivastava, A.K. and Saxena, A.K. (2019). Molecular detection and in silico characterization of cold shock protein coding gene (cspA) from cold adaptive Pseudomonas koreensis. *Journal of Plant Biochemistry and Biotechnology*, **28**, 405-413. http://krishi.icar.gov.in/jspui/handle/123456789/36248
8. Baffour, B., Chandra, H. and Martinez, A. (2019). Localised estimates of dynamics of multidimensional disadvantage: an application of the small area estimation technique using Australian survey and census data. *International Statistical Review*, **87(1)**, 1-23. http://krishi.icar.gov.in/jspui/handle/123456789/35347
9. Bhat, B., Singh, A., Iqbal, Z., Kaushik, J. K., Rao, A. R., Ahmad, S. M., Bhat, H., Ayaz, A., Sheikh, F.D., Kalra, S., Shanaz, S., Mir, M.S., Agarwal, P.K., Mohapatra, T. and Shanaz, S. (2019). Comparative transcriptome analysis reveals the genetic basis of coat color variation in Pashmina goat. *Scientific Reports*, **9(1)**, 6361.
10. Bhowmik, A., Jaggi, S., Varghese, E. and

Varghese, C. (2019). A note on optimal directional neighbour designs with random block effect. Communications in Statistics - Simulation and Computation. DOI:10.1080/03610918.2019.1568475. http://krishi.icar.gov.in/jspui/handle/123456789/35359

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Copyrights received during 1st January 2019 to 31st December 2019:

Copyrights received/registered =16

S.No.	Diary Number	Name of Technology(Software)/ Literary Work	Application Registered	Applied on	Copyright Registration Number	Copyright Granted on (Rcvd. at IASRI)
1	3320/2019-CO/SW	DIRProt: Discriminating the insecticide resistance proteins from non-resistance proteins	Registered	28/02/2019	SW-12353/2019	03/06/2019 (04/06/2019)
2	3308/2019-CO/SW	Ir-HSP: Online software for improved recognition of Heat Shock Proteins (HSP) and their families	Registered	28/02/2019	SW-12349/2019	07/06/2019 (10/06/2019)
3	3319/2019-CO/SW	Cluster bean long Non-Coding RNA Database (CbLncRNAdb)	Registered	28/02/2019	SW-12348/2019	29/04/2019 (18/06/2019)
4	3297/2019-CO/SW	HRG Pred : Software For prediction of herbicide resistant genes	Registered	28/02/2019	SW-12347/2019	29/04/2019 (18/06/2019)
5	5462/2019-CO/SW	GoSatDb: Goat Microsatellite Database	Registered	10.04.2019	SW-12452/2019	23/05/2019 (18/06/2019)
6	3313/2019-CO/SW	PreDoss : Prediction of donor splice sites in eukaryotic genes with improved accuracy	Registered	28/02/2019	SW-12358/2019	29/04/2019 (19/06/2019)
7	3318/2019-CO/SW	HSplice: A hybrid approach for predicting 5' splicing junctions	Registered	28/02/2019	SW-12357/2019	29/04/2019 (19/06/2019)
8	3310/2019-CO/SW	MalDoss: A web server for Donor Splice site prediction using machine learning approaches	Registered	28/02/2019	SW-12345/2019	29/04/2019 (21/06/2019)
9	5460/2019-CO/SW	Coconut Transcriptome Database (CnTDB)	Registered	10.04.2019	SW-12454/2019	23/05/2019 (25/06/2019)
10	3301/2019-CO/SW	iAMPpred: Online software for improved prediction of antimicrobial peptides	Registered	28.02.2019	SW-12549/2019	19.06.2019 (08/08/2019)
11	3312/2019-CO/SW	dssPred: A web server for eukaryotic donor splice site prediction	Registered	28.02.2019	SW-12552/2019	20.06.2019 (08/08/2019)
12	3309/2019-CO/SW	nifPred: A webserver for prediction of nitrogen fixation genes	Registered	28.02.2019	SW-12548/2019	19.06.2019 (16/08/2019)
13	3316/2019-CO/SW	funBarRF: DNA barcode based fungal species identification	Registered	28.02.2019	SW-12551/2019	19.06.2019 (16/08/2019)
14	5458/2019-CO/SW	Banana Microsatellite Database with primer generation tool (BanSatDB)	Registered	10.04.2019	SW-12639/2019	22.07.2019 (16/08/2019)
15	5461/2019-CO/SW	OGR: The Onion Genomic Resource	Registered	10.04.2019	SW-12641/2019	22.07.2019 (17/08/2019)
16	3311/2019-CO/SW	DCDNC:Discrimination of coding sequence (CDS) from non-coding sequence (Intron)	Registered	28.02.2019	SW-12550/2019	19.06.2019 (20/08/2019)

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Consultancy, Methodological & Computational Support and Research Advisory Services

- **Agricultural Research Data Book (ARDB) 2019**

The Agricultural Research Data Book 2019 was released on 02 July, 2019 on the eve of Annual Day Function of the Institute and was released by Honorable Director General ICAR and Secretary DARE, Dr. Trilochan Mohapatra. This ARDB 2019 is twenty second 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 and human resources. It has 173 tables on different aspects of agriculture. The ARDB 2019 contains the latest information/data as available by the end of June 2019 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 2019 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.

Significant methodological support and computational activities

Strengthening Statistical Computing for NARS

- SAS licenses for the year 2019-20 have been received. SAS Licenses files have been uploaded on Resources Page of the Indian NARS Statistical Computing Portal (http://stat.iasri.res.in/sscnarsportal/public) under the link SAS License 2019-20. E-mail has already been sent on 28.06.2019 to all ICAR- Institutes.
- Technical support was provided to : (i) Dr. Shamsudheen Mangalassery, Senior Scientist (Soil Science), ICAR- Directorate of Cashew Research, Puttur was advised on the analysis of Response Surface Designs using Indian NARS Statistical Computing Portal; (ii) ICAR-DGR, Junagarh and (iii) ICAR-NAARM, Hyderabad for access of URL of Statistical Computing Portal; (iv) Dr. Sukhpreet Singh, Assistant Agronomist, Department of Agronomy, Punjab Agricultural University, Ludhiana for the analysis of data generated from Split Plot Design with two factors (factorial combination of two factors viz. date of sowing and sowing methods) in main plot and one factor in sub-plots; (v) M. Djanaguiraman, Assistant Professor, Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore how to update SAS license files.

Indian NARS Statistical Computing Portal

- For accessibility of Indian NARS Statistical Computing Portal and downloading of license files, updated IP addresses of following 14 NARES Organizations IP Addresses were updated for (i) ICAR-IIOR, Hyderabad; (ii) ICAR-CIPHET, Ludhiana and (iii) ICAR-DGR, Junagarh; (iv) ICAR-NRC for Banana, Trichy; (v)

ICAR-Directorate of Weed Research, Jabalpur; (vi) ICAR-Central Sheep and wool Research Institute, Avikanagar; (vii) ICAR-Directorate of Onion and Garlic Research, Pune; (viii) ICAR-National Bureau of Animal Genetic Resources, Karnal; (ix) ICAR-National Research Centre on Grapes, Pune; (x) Bihar Agricultural University, Sabour; (xi) ICAR-CIRCOT, Mumbai; (xii) VNMKV, Prabhani; (xiii) CHES Vejalpur Godhra (ICAR-CIAH, Bikaner); (xiv) Banda University of Agriculture and Technology, Banda.

- The portal is being extensively used throughout NARES and helped the researchers in analyzing their data in an effective manner. Based on the user logged information, the total number of logged in users from Indian NARES during January 01, 2019- December 31, 2019, there are **88,654** which is on an average **240**+logged in per day.

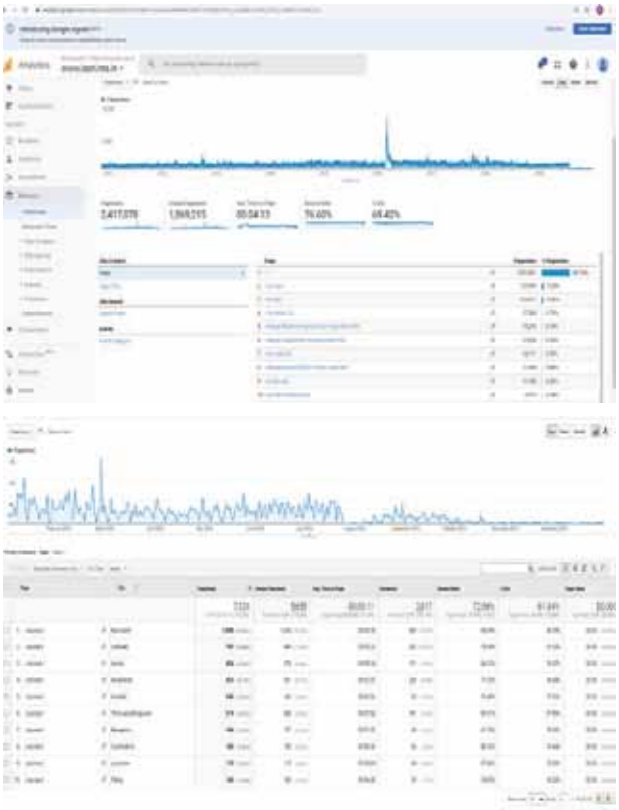
Usage of Statistical Computing Lab

- The statistical Computing Lab was used for the training programmes on (i) Experimental Designs and Statistical Data Analysis during January 03-09, 2019 and , 2018; (ii) Winter School on Recent Advances in Statistical Techniques for Data Analysis in Agriculture during January 10-30, 2019; (iii) Modular Course on Basic Statistical Methods in Agriculture for the Participants of 3rd Batch of Afghanistan National Agricultural Sciences and Technology University Students under International M.Sc. Programme for Afghan Nationals on Teaching of Post-Graduate courses in Agronomy" from February 03-23, 2019 at ICAR-IASRI, New Delhi ; (iv) Workshop on Unit Level Data Repository for AICRPs during February 03-23, 2019; (v) Half a day session on 27.02.2019 for the participants of CAFT Programme on Recent Advances in Modelling and Forecasting for Agricultural Data Analysis held at ICAR-IASRI, New Delhi during February 23-March 15, 2019; (vi) Recent Advances in Agricultural Surveys: Remote Sensing and GIS Applications sponsored by AARDO organized at ICAR-IASRI, New Delhi during March 11-31, 2019 (except March 18-19, 2019); (vii) Workshop on ICAR KRISHI Portal: A Central Research Data Repository during March 18-19, 2019; (viii) Training Programme on Data Analysis and Interpretation for ISS Probationers sponsored by MoSPI, New Delhi and organized at ICAR-IASRI, New Delhi during May 13-24, 2019 (Lab was used during May 15-24, 2019); (ix) Statistical Advances in Designing Agricultural Experiments and Data Analysis during July 19-August 08, 2019; (x) Advances in Statistical Analysis for Breeding Data organized under the aegis of CAFT at ICAR-IASRI, New Delhi during August 27-September 16, 2019; (xi) Winter School on Advances in Designing and Analysis of Field Crop Experiments organized at ICAR-IASRI, New Delhi during October 14-November 03, 2019; (xii) Field Survey, data collection, compilation and analysis organized for the technical officers of Indian Council of Forestry Research, Dehradun at ICAR-IASRI, New Delhi during November 04-08, 2019; (xiii) Recent Advances in Sample Surveys and Data Analysis Using Statistical Software organized under CAFT at ICAR-IASRI, New Delhi during November 28-December 21, 2019; (xiv) Statistics and Machine Learning Techniques for Modelling and Forecasting Agricultural Data organized under CAFT at ICAR-IASRI, New Delhi during December 20, 2019-January 9, 2020 (lab was provided from December 22 onwards);

- Sensitization of Researchers and Feedback: Dr. Javid Iquebal, Nodal Officer, ICAR-CITH, Srinagar informed that there are a total of 10 users of Statistical Computing Environment created and 25 publications have been brought out during 2017-18 and 2018-19 through data analysis using SAS. Some of these publications are : (i) Uzma Noor Shah, Javid Iqbal Mir, Nazeer Ahmed, Sumira Jan and Khalid Majid Fazili(2018). Bioefficacy potential of different genotypes of walnut Juglans regia L. *J Food Sci Technol*, 55(2),605–618. https://doi.org/10.1007/s13197-017-2970-4 (NAAS Score 2019: J241:7.80); (ii) Wajida Shafi, Sheikh Mansoor, Sumira Jan, Desh Beer Singh, Mohsin Kazi, Mohammad Raish, Majed Alwadei, Javid Iqbal Mir and Parvaiz Ahmad (2019). Variability in Catechin and Rutin Contents and their Antioxidant Potential in Diverse Apple Genotypes. *Molecules*, 24, 943(1-12); doi:10.3390/molecules24050943 (NAAS Score 2019: M084:9.10); (iii) Sumira Jan, Javid Iqbal Mir, Desh Beer Singh, Shafia Zaffar Faktoo, Anil Sharma, Mohammad Nassar Alyemeni and Parvaiz Ahmad (2018). Effect of environmental variables on phytonutrients of Origanum vulgare L. in the sub-humid region of the northwestern Himalayas. *Environ Monit Assess*, 190, 571(1-15). https://doi.org/10.1007/s10661-018-6951-5 (NAAS Score 2019: E085:7.80) and (iv)

Sumira Jana, Javid Iqbal Mir, Wajida Shafi, Shafia Zaffer Faktoo, Desh Beer Singh, Leonard Wijaya, M.N. Alyemeni and Parvaiz Ahmad (2018). Divergence in tissue-specific expression patterns of genes associated with the terpeniod biosynthesis in two oregano species Origanum vulgare L., and Origanum majorana. *Industrial Crops & Products*, 123 546–555 https://doi.org/10.1016/j.indcrop.2018.07.006 (NAAS Score 2019: I109:9.85);

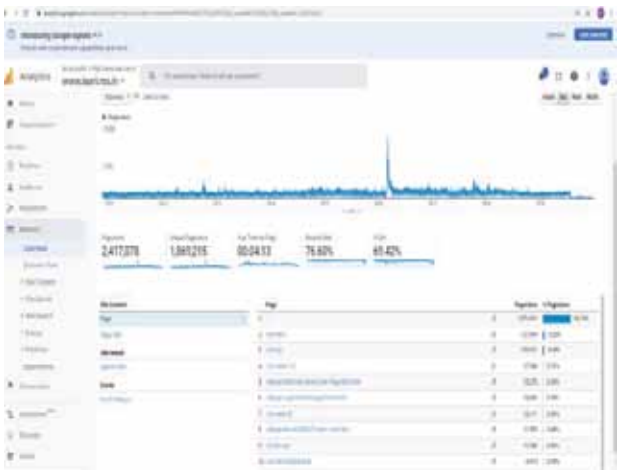
- ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand, Gujarat informed that they have has 05 users and published 03 research papers
- Website of the project is being maintained and updated regularly. The website has been shifted to http://sscnars.icar.gov.in/. The website has been updated by including updated list of new Nodal Officers nominated from ICAR-CIAH, Bikaner nominated a new Nodal Officer for Statistical Computing for NARS
- Website is registered under google analytics on November 15, 2010. Till December 31, 2019, there were **127699** page views. During January 01, 2019 to December 31, 2019, there were **7,324** page views across **215** cities of **45** countries and average time on each page was 3.11 minutes.



Strengthened Design Resources Server

For dissemination of research in Design of Experiments, Design Resources Server (http://drs.icar.gov.in/ earlier www.iasri.res.in/design) was further strengthened by adding the links of online generation of following designs (i) A- efficient and D-efficient Incomplete block designs for *v (number of treatments)* £30 and *k (block size)* £10using R at http://drsr.icar.gov.in/IBD/; (ii) First and Second order Orthogonal Lain Hypercube designs of upto 6 factors; Latin hypercube designs with good space filling properties upto 6 factors and upto 20 runs and nested orthogonal Latin hypercube designs upto 6 factors and at http://drsr.icar.gov.in/OLH/; (iii) incomplete split-plot designs for three kinds of situations namely (i) when blocks are complete with respect to main plot treatments and main plots are incomplete with respect to subplot treatments, (ii) when blocks are incomplete with respect to main plot treatments and main plots are complete with respect to subplot treatments and (iii) when blocks are incomplete with respect to main plot treatments and main plots are incomplete with respect to subplot treatments. at http://drsr.icar.gov.in/ISPD/. The catalogue of the above incomplete split plot designs for above three situations were also prepared for *b* (number of blocks) £10 and v_1 (levels of main plot factor), v_2(levels of sub plot factor) £ 6 and are made available at http://drs.icar.gov.in/CMIS/CMIS.htm; http://drs.icar.gov.in/IMCS/IMCS.htm and http://drs.icar.gov.in/IMIS/IMIS.htm respectively. The module of online generation of balanced incomplete latin squares have been converted using R and is made available at http://drsr.icar.gov.in/BILS/

Usage of the Server: The server has a facility of "Ask a Question" through which a lot of questions are being received and answered. More than 15 questions asked during this period, were answered for providing e-advisory services. Till December



31, 2019, there were **1,61,00+** page views and 996 cities of 123 countries. During January 01, 2019 to December 31, 2019, Google Analytics gave **8,403** page views across **310** cities of **78**countries. Average time taken on page is 3.26 minutes

ASHOKA (Advanced Supercomputing Hub for Omics Knowledge in Agriculture)

The High Performance Computing (HPC) facility has been created to help the biologists in performing the bioinformatics data analysis. The computing jobs are being submitted through GUI based National Agricultural Biocomputing portal as well as Command Line Interface (CLI). This system is also equipped with modern age open source software tools, pipelines, workflows as well as CLC Genomics Workbench and other proprietary software. The computer intensive analytical support is also being continuously provided to NARES institutions. Large numbers of databases, web servers and software pipelines have been developed by the centre. These software tools are being widely used by various stakeholders.

Videoconferencing facility

The videoconferencing facility is useful in providing the interactive virtual platform for interaction among various researchers and personnel. This facility has been used to conduct online meetings and interactions among scientists and researchers to discuss various issues pertaining to project proposals, monitoring of progress as well as other day to day official matters of mutual interest.

Research Advisory services

Tauqueer Ahmad

- Provided research advisory services i.e. shared knowledge and imparted classroom and field training to the Govt. of Nepal officials for field testing of guidelines on measurement of harvest and post-harvest losses of milk & meat and fruits & vegetables during 13-17 August 2019 as Expert, invited by Food and Agriculture Organization of the United Nations Regional office for Asia and the Pacific (FAO-RAP), Bangkok, Thailand.
- Provided research advisory services i.e. shared knowledge and imparted classroom and field training to the Govt. of Thailand officials for field testing of guidelines on measurement of harvest and post-harvest losses of cereals & pulses and fruits & vegetables during 17-23 August 2019 as Expert, invited by Food and Agriculture Organization of the United Nations Regional office for Asia and the Pacific (FAO-RAP), Bangkok, Thailand.

Hukum Chandra

- Expert Member, Myanmar Agricultural Census 2020, Food and Agricultural Organization of the United Nations, Myanmar, December 15-21, 2019.
- Expert Member, Food and Agricultural Organization of the United Nations in the activities related to Monitoring and Analyzing Food and Agricultural Policies Programme in collaboration with NITI Aayog India, October-December 2019.
- Expert Member, Food and Agricultural Organization of the United Nations in the activities related to Corporate Outcome Assessment Survey, India, October-December 2019.
- Expert Member, Core Group of Experts on Normalization, constituted by the Chairman, National Testing Agency and Secretary(HE), Department of Higher Education, Ministry of Human Resource Development, Government of India, 2018-19 .
- Expert Member, Giri Institute of Development Studies (GIDS), Lucknow, Uttar Pradesh 2019-20 (Advisory).
- Expert, Internal Evaluation Committee for validation of Sampling Plan at ICAR- National Institute of Veterinary Epidemiology and Disease Informatics, Bengaluru, 2019

Rajender Parsad

- Advised Dr. Sabina Islam, Senior Scientist, Division of Vegetable Science, ICAR-IARI, New Delhi on the use of Fisher's Protected LSD for Multiple Comparisons in the analysis of data

pertaining to a trial conducted to evaluate 26 germplasms of garlic in RCB design with 3 replications.

- Ms Ayushi Srivastava, Research Scholar, Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi was advised on the analysis of data generated from an line x tester experiment (9 lines and 3 testers). The advisory was provided along with Dr Sukanta Dash.

Ramasubramanian V.

- Fish species over markets data analysis using Friedman Rank test for Ms. Pooja Saklani, Ph.D. (Aquaculture) student of ICAR-CIFE, Mumbai on 18.01.2019
- Correlation and regression analysis between fish catch and fish seed stocking over seven reservoirs of Tamilnadu for Dr. Lloyd Chrispin, Assistant Professor, TNFU on 29.01.2019
- Factorial RBD ANOVA analysis on interaction effect between levels of storage periods & levels of different concentrations of chitosan gel on pH value of the refrigerated emulsion sausages for Ms. Kasturi Chattopadhyay, M.F.Sc. (PHT) student of ICAR-CIFE, Mumbai on 09.02.2019
- Fitting of weather indices based regression modeling of pest incidence for Chickpea varieties for Dr. Manish Bhan, JNKVV, Jabalpur on 13.02.2019
- Chisquare test analysis on fisheries related data for Mr. Nirmal, PhD student of ICAR-CIFE, Mumbai on 26.08.2019

K.K. Chaturvedi

- Five B.Tech. (Bioinformatics) students from SRM University, Sonipat, HR have been guided on their project work. They were mainly involved in the searching the genetic variants related to stress in wheat from the literature and compile the collected material in the form of database.

M.A. Iquebal

- Advised Dr. Prachi Shripatrao Yadav, Scientist, IARI, New Delhi regarding experimental designing for whole genome data generation.
- Advised Dr. Ram Asrey, Principal Scientist, IARI, New Delhi regarding analysis of response surface data.
- Advised Dr. HK Dixit, Principal Scientist and Dr. Murali A, Scientist, IARI, New Delhi regarding experimental designing for whole genome data generation.
- Advised Dr. SS Dey, Scientist, Horticulture-Vegetable Science, IARI, New Delhi regarding experimental designing for transcriptome experiment and data analysis.
- Advised Dr Shrawan Singh, Scientist, Horticulture-Vegetable Science, IARI, New Delhi regarding GBS data analysis of cowliflower.
- Advised Dr. K. Swarnalakshmi, Principal Scientist, Division of Microbiology regarding metagenome data analysis of chickpea under different soil condition.
- Advised Dr Amalendu Ghosh, Scientist (Senior Scale), Division of Plant Pathology, IARI, New Delhi regarding experimental designing of transcriptome experiment.
- Advised Dr. Norottam De, Assistant Professor, Visva Bharti University, West Bengal regarding genome-wide SNP mining of unique rice genotype.
- Advised Dr. A. Mukharjee, Principapal Scientist, ICAR-NRRI, Cuttack, regarding transcriptome analysis for sheath blight disease response in tolerant and susceptible rice genotypes.
- Advised Dr. Naveen Singh, Principal Scientist, Division of Genetics, IARI, New Delhi regarding SNP mining and association analysis using GBS data.

Sarika

- Advised Dr. Chiranjit Kaur, Principal Scientist, IARI, New Delhi regarding response surface design analysis.
- Advised Dr. Partha Saha, Scientist, Horticulture-Vegetable Science, IARI, New Delhi regading generation mean analysis of two location data.
- Advised Dr. Reeta Bhatia, Senior Scientist, Division of Floriculture and Landscaping, IARI, New Delhi regarding phylogenetic analysis.
- Advised Dr. K. Swarnalakshmi, Principal Scientist, Division of Microbiology regarding metagenome data analysis of chickpea under different soil condition.
- Advised Dr. Amrita Das, Scientist (Senior Scale), Division of Plant Pathology, IARI, New Delhi

regarding phylogenetic analysis.

- Advised Dr. V.K. Baranwal, Principal Scientist, Division of Plant Pathology regarding virome profiling and whole genome reconstruction of viruses and viroids in Grapevine (*Vitis vinifera* L.)

B.N. Mandal

- Provided advisory to Dr Harisankar Singha, Scientist, National Research Centre on Equines, Hisar on computation of seroprevalence of Glanders disease in equines. Tests of hypothesis of equality of seroprevalence across states, years and zones were suggested. Odds ratio computation methodology was also described.
- Advisory was provided to Dr Hari Shankar Singha from NRC Equines, Hisar to analyze glanders seroprevalence data in horse and for testing for equality of seroprevalence across states, months and for computation of odds ratio.
- Provided advisory for cluster analysis and principal component analysis on 25 genotypes based on 17 characters to Sh Desh Raj, M.Sc. student from CSKHPKV, Palampur.
- Provided advisory to perform analysis of variance and comparison of treatment means for two experiments conducted using completely randomized design for wheat and soybean crops, respectively. The advisory was provided to Sh. Mohan, M.Sc. student of ICAR-Indian Agricultural Research Institute, New Delhi
- Provided advisory to Shri Madan Kumar, Scientist, ICAR-Indian Institute of Agricultural Biotechnology (IIAB), Ranchi for performing Duncan's Multiple Range Test for more than 150 genotypes.

Arpan Bhowmik

- Genetic component analysis was performed based on the data from the experiment of Ms. Nehi, a student from the division of vegetable science, IARI, New Delhi. Phenotypic correlation and variance, genotypic correlation and variance, environmental correlation and variance along with heritability were obtained.
- Mr. Sunil Kumar, a Ph.D. Research Scholar from division of Agricultural Extension was advised on the use of logistic regression to determine the influence of different socio-economic factors on stakeholders in term of use of Rice Knowledge Management Portal (RKMP).
- Mr. Gaurav Singh, SRF at Water Technology Centre, IARI and a Ph.D. Scholar in Amity University was advised on the use of Principal Component Analysis (PCA) with respect to different physiochemical variables affecting different sites in terms of pollution alongside Hindon river water, Uttar Pradesh. The data pertaining to summer and winter season respectively and the analysis were carried out for both the seasons separately. Important determinants were identified in terms of pollution alongside Hindon River water. Further, different polluting sites were grouped based on their similarity w.r.t. pollution. The groupings of different polluting sites were also verified using Hierarchical Cluster Analysis (HCA). Both PCA and HCA yields similar results.
- Dr. Hillol Chakdar, Scientist, ICAR-NBAIM was advised on the use of Principal Component Analysis (PCA) to identify the contribution of different amino acids on the composition of four different Pseudomonas species viz. *P. koreensis*, *P. synergiae*, *P. aeruginosa* and *P. stutzeri*. The four species of Pseudomonas were also grouped in three different clusters using Hierarchical Cluster Analysis (HCA).
- Mr. Dinesh Saini, a Ph.D. Scholar in the division of Microbiology at PG School, IARI was advised on the use of Central Composite Designs with three factors viz. FAC, NaCl and K2HPO4 each at five levels.
- Dr. Niveta Jain, Principal Scientist, IARI was advised on the use of principal component analysis to study the variations among different treatments using environmental and soil parameters. Further, similarity analysis was also carried out between treatments using hierarchical clustering techniques.
- Ms. Sneha, a M.Sc. student from division of Microbiology, IARI was advised on the use of combined analysis for different chemical and biological soil parameters and also for plant parameters where the experiments were laid out in 9 different locations. For each locations, test vs control contrast were also analyzed. Correlation analysis were carried out between chemical and biological soil parameters and also between chemical soil parameters and plant parameters. Further, principal component analysis were also carried out to study the variations in the data over the locations. Further, PAM clustering was

also carried out to study the similarity of different locations in terms of microbial content based on the different characters.

- Dr. Shrila Das, Scientist, ICAR-IARI, New Delhi was advised on the use of Combined Analysis of variance w.r.t. different soil properties over different location. The treatments of interests are different soil depth.
- Miss Swarajya Laxmi Nayak, Ph. D Scholar, Division of Food Science and Postharvest Technology, ICAR-IARI, New Delhi was advised on the use of Repeated Measure Anova for studying the significance difference of variety when observations are collected based on various bio-physical properties over four different crop growth stages. There are 9 varieties of citrus crop. Further, similarity analysis among the varieties was also performed based on bio-physical properties for final growth stage using k-means clustering technique.
- Dr. Amrita Daripa, Scientist, ICAR-NBSS&LUP was advised on the use of k-means clustering techniques to study the similarity pattern of different land use systems w.r.t. heavy metal decomposition.
- Dr. Shruti Sethi, Principal Scientist, Division of Food Science & Post Harvest Technology, ICAR-IARI, New Delhi was advised on the use of principal component analysis and ggbi-plot technique to study antioxidant determinants in peel and cortex region of apple cultivars. K-means cluster analysis was also performed to cluster the similar apple cultivars. Further, Relative Antioxidant Capacity Index (RACI) was calculated based on different antioxidant capacity to study the impact of significant antioxidant capacity on peel and cortex region of apple cultivars.
- Dr. Arti Bhatia, Principal Scientist, Centre for Environment Science and Climate Resilient Agriculture was advised on the use of combined analysis under block design setup to study the impact of biological interventions on decrease of greenhouse gas emissions in paddy rice fields. The experiments involved 9 treatments.
- Dr. Alka Joshi, Senior Scientist, Division of Food Science & Post Harvest Technology, ICAR-IARI, New Delhi was advised on the use of combined analysis under block design setup to study the impact of 48 cultivars of potato on Phytate, Ascorbate and Phytate to ascorbate ratio. Further, 48 cultivars of potato was grouped on the basis of similarity using K-means clustering.
- Dr. Supradip Saha, Principal Scientist, Division of Agricultural Chemicals, ICAR-IARI, New Delhi was advised on the use of Box-Behken Design with tree factors as Strength, Time and Solute to Solvent Ratio each at three levels. The analysis was carried out and optimal points were obtained for getting maximum response in the context of Insulin Cont. (%). Further, a non linear second order response surface model was also fitted and based on the fitted non linear model, optimal soultion was also obtained using genetic algorithm approach.
- Dr. Aditi Chakrabarty (Kundu), Scientist, Division of Agricultural Chemicals was advised on the use of two way ANOVA for Deciphering potential bioactive metabolites from *Chaetomium globosum* 5157 for biocontrol of Sclerotinia rot disease and plant growth promotion. There were five treatments involved in the study.

Ranjit Kumar Paul

- Advised Mr. SubratKeshori Behera, Assistant Professor, Bihar Agricultural University in developing forecast model for forecasting of crop yield.
- Analyzed the SPI series for detection of trend and periodicity for Dr. Saurav Saha, Scientist, ICAR Research Complex for NEH Region, Mizoram Centre,Kolasib, Mizoram 796 081, India

P.K. Meher

- Provided advisory service to Sudhir PN, a Ph.D. student at BHU, Varanasi, with regard to linear mixed model analysis to study the effect of genotypes and isolates on disease severity in wheat crop. The analysis was performed using *lme4* package of R-software.
- Provided advisory service to Dr. Vijay Gehlot, a Post-doc student at Delhi University, with regard to genome-wide association studies based on multivariate linear mixed model approach using R-software.
- Provided advisory service to Jitendra Kumar, a Ph.D. student of CCS University, Meerut. The Genotype×Environment interaction analysis which was carried out for 230 genotypes in two different environments with 2 replications in

each location. The analysis was performed for 8 different nutritional traits of wheat crop. The analysis was conducted using AMMI model with the packages of R-software.

- Providing guidance to three M.Sc. Bioinformatics students of OUAT, Bhubaneswar for a period of 4 months (March-June, 2019) for their dissertation work. These students have been assigned three different problems and are working on the problem at ICAR-IASRI.

Himadri Shekher Roy

- Analysis was done by of stability analysis of Atar Singh, Assistant Professor, Department Of Genetics and Plant Breeding, SardarVallabhbhai Patel University of Agriculture and Technology.
- Analysis for M.C. Gupta Sr. Breeder-Mustard(R&D), Rasi Seeds (P) Lt.d. for calculating ANOVA, GCV, PCV, Heritability, Combined analysis of Variance and Divergence analysis, path analysis, Genotypic correlation, phenotypic correlation, Divergence analysis etc.
- Gave some suggestion to Dr. Harendra Verma, Scientist, Regional Station, ICAR Complex For NEH(Jharnapani) (ICARNEH,RS), Khanakhuru .
- Carried out contrast analysis of RBD data of Dr. Kirti Sourav, scientist, ICAR Research Complex for Eastern Region, Patna.
- PCA & Biplot was done using the data provided by Dr. Kirti Sourav, scientist, ICAR Research Complex for Eastern Region, Patna.

Neeraj Budhlakoti

- Ms. Sweetee Kumari, Ph.D. scholar from BHU Varanasi, was advised for Intra guilt predation (IGP) Analysis of Different stages of coccinellid beetles as a predator and cotton mealybug as prey.
- Deepali, Ph.D. scholar, NBPGR New Delhi, was advised on the procedure of analysis of an experiment conducted for Drought tolerance in Wheat genotype in association with enhanced antioxidative protection and decline lipid peroxidation.
- Ajeet Pandey, Ph.D. scholar, BHU Varanasi, was advised on the procedure of analysis of an experiment conducted for 285Wheat genotype under heat and draught stress with 35 K wheat SNP markers observed for various traits. Population structure has been identified and association study has been done to mine important marker related to underlying traits.
- Dr Roopa Swojanya, Scientist, ICAR - NRCP, Solapur was advised on the procedure of diallel analysis of Maize using R.

10

RAC, IMC, IRC 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. During the period 2019-20, 13 new research projects were approved and progress of 73 on-going research projects were reviewed.

In the 90th meeting, 13 new research projects (04 Institute funded, 09 outside funded) were approved and progress of 73 on-going research projects (28 Institute funded, 03 in collaboration with other Institute and 42 outside funded) were reviewed and 06 research projects were declared as complete.

Research Advisory Committee (RAC)

The 20th meeting of the Research Advisory Committee (RAC) of ICAR-IASRI was held on 17th September, 2019 under the Chairmanship of Professor R.B. Singh. The following were present:

1.	Prof. R.B. Singh, Chancellor, CAU, Imphal Former-Chairman, ASRB and Former-Director, IARI	Chairman
2.	Dr. A.K. Nigam Consultant Advisor, IASDS, Bengaluru	Member
3.	Dr. Sangeeta Verma Principal Advisor Department of Consumer Affairs, Krishi-Bhavan, New Delhi	Member
4.	Dr. S.D. Sharma Former-Vice Chancellor, DSVV, Haridwar and Former-Director, IASRI	Member
5.	Dr. V.K. Gupta Former ICAR-National Professor, New Delhi	Member
6.	Dr. P.S. Pandey Assistant Director General (EP&HS), ICAR, New Delhi	Member
7.	Dr. L.M. Bhar, Director (A), ICAR-IASRI	Member
8.	Dr. Ajit, Principal Scientist & In-Charge-PME Cell, ICAR-IASRI	Member Secretary
9.	Dr. Sudeep Marwaha, Head(A), Division of Computer Applications, ICAR-IASRI	By invitation
10.	Dr. Anil Rai, Head(A), CABin, ICAR-IASRI	By invitation
11.	Dr. K.N. Singh, Head(A), Division of F&ASM, ICAR-IASRI	By invitation
12.	Dr. Seema Jaggi, Head(A), Division of Design of Experiments and Incharge, TAC, ICAR-IASRI	By invitation
13.	Dr. Tauqueer Ahmad, Head, Division of Sample Surveys, ICAR-IASRI	By invitation
14.	Dr. Rajender Parsad, Principal Scientist, ICAR-IASRI	By invitation

15.	Dr. A.R. Rao, Principal Scientist and Professor (Bioinformatics)	By invitation
16.	Dr. Hukum Chandra, National Fellow (ICAR)	By invitation
17.	Dr. A.K. Paul, Principal Scientist, ICAR-IASRI	By invitation

Steps have been taken to get approval of RAC proceedings.

Institute Management Committee (IMC)

The 67th Meeting of the Institute Management Committee (IMC) was held on 19 February, 2019. The following members were present:

1	Dr. L.M. Bhar, Director (A), ICAR-IASRI	Chairman
2	Mr Rajya Kumar Agrawal, Non-Governmental Member	Member
3	Dr. Sunil Archak, Principal Scientist, ICAR-NBPGR, New Delhi	Member
4	Dr. Rajni Jain, Principal Scientist, ICAR-NIAP, New Delhi	Member
5	Dr. Amit Kar, Principal Scientist & Head (A), Division of Agricultural Economics, ICAR-IARI, New Delhi	Member
6	Dr. P.S. Pandey, Assistant Director General (EP&HS), ICAR, New Delhi	Member
7	Mrs Sanjeevan Prakash, DDF (II), ICAR, New Delhi	Member
8	Mr. Vijay Kumar, Head of Office, ICAR-IASRI	Member Secretary
9	Dr. Tauqueer Ahmad, Head, Division of Sample Surveys, ICAR-IASRI	By invitation
10	Dr. K.N. Singh, Head (A), Division of F&ASM, ICAR-IASRI	By invitation
11	Dr. Anil Rai, Head (A), CABin, ICAR-IASRI	By invitation
12	Dr. Seema Jaggi, Head (A), Division of Design of Experiments & Incharge, TAC, ICAR-IASRI	By invitation
13	Dr. Ajit, Principal Scientist & In-Charge, PME Cell, ICAR-IASRI	By invitation
14	Dr. Hukum Chandra, National Fellow (ICAR)	By invitation
15	Dr. A.R. Rao, Principal Scientist and Professor (Bioinformatics)	By invitation
16	Dr. Sudeep, Head(A), Division of Computer Applications, ICAR-IASRI	By invitation
17	Mr. Subhash Chand, ACTO, ICAR-IASRI	By invitation
18	Mr. Yogesh Kadian, Administrative Officer, ICAR-IASRI	By invitation
19	Mrs. Usha Jain, STO, ICAR-IASRI	By invitation
20	Mr. Amit Kumar Marwari, AF&AO, ICAR-IASRI	By invitation

The important issues discussed are as below:

At the outset, Dr. L.M. Bhar, Director (A), ICAR-IASRI, welcomed all the members of the IMC. The Proceedings of 66th IMC meeting were confirmed. In the meeting, Dr. P.S. Pandey, ADG (EP&HS), ICAR suggested that the staff quarters of our institute at Krishi Niketan, Paschim Vihar be maintained and repair be done so that the quarters is in good condition. He opined that necessary action be taken towards its intense repairing and renovation. Having discussed the agenda in meeting thoroughly, committee members recommended that the Institute may process this issue with ICAR for necessary decision/ action on the matter. He also suggested sending a proposal for including the names of our staff in the central pool of government quarters located at Delhi. The members appreciated the action taken of the minutes of the previous meeting. Dr. Ajit, Incharge, PME Cell, made a presentation on Institute's Research activities, including completed research projects and ongoing projects. The members appreciated the research activities especially technologies developed and copyrights received. Dr. Seema Jaggi, Principal Scientist and Training & Administration Incharge gave a presentation on the training and teaching activities of the institute. The house was satisfied with the teaching and training activities going on at IASRI. The IMC members suggested that a Mobile App may be developed on Mera Gaon Mera Gaurav in order to be helpful for the farmers for them getting relevant information directly in their mobiles in a handy and convenient manner. Also the members suggested that a training program on Artificial Intelligence be imparted by the institute, as this is the need of the hour. The list of equipment to be procured for the financial year 2018-19 of EFC with tentative cost and justification was discussed and considered for approval of the members. The Committee agreed to the agenda item as proposed. Budget Estimate for the year 2018-19 and actual expenditure incurred up to 31.01.2019 was presented before the members. While going through the expenditure, the members took a note on the amount spent. The members were assured for full utilization of funds in time. The Grievance committee was re-constituted. The progress of the work done in Hindi at the institute was appraised to the IMC team and it was appreciated by the team.

The 68th Meeting of the Institute Management Committee (IMC) was held on 27th December, 2019. The following members were present:

1	Dr. Tauqueer Ahmad, Director (A), ICAR-IASRI	Chairman
2	Mr Rajya Kumar Agrawal, Non-Governmental Member	Member
3	Dr. Sunil Archak, Principal Scientist, ICAR-NBPGR, New Delhi	Member
4	Dr. Amit Kar, Principal Scientist & Head(A), Division of Agricultural Economics, ICAR-IARI, New Delhi	Member
5	Dr. P.S. Pandey, Assistant Director General (EP&HS), ICAR, New Delhi	Member
6	Mrs Sanjeevan Prakash, DDF (II), ICAR, New Delhi	Member
7	Dr. Firouz Hussain, Principal Scientist, Division of Genetics, ICAR-IARI, New Delhi	
8	Mr. Piyush Shukla, Head of Office, ICAR-IASRI	Member Secretary
9	Dr. Seema Jaggi, Head (A), Division of Design of Experiments & Incharge, TAC, ICAR-IASRI	By invitation
10	Dr. Sudeep, Head, Division of Computer Applications, ICAR-IASRI	By invitation
11	Dr. Prachi Mishra Sahoo, Principal Scientist/Deputed Head, Division of Sample Surveys, ICAR-IASRI	By invitation
12	Dr. Prawin Arya, Principal Scientist/ Deputed Head, Division of F&ASM, ICAR-IASRI	By invitation
13	Dr. Dinesh Kumar, Principal Scientist/ Deputed Head, CABin, ICAR-IASRI, ICAR-IASRI	By invitation
14	Dr. Himadri Ghosh, Principal Scientist/ Deputed Head, Statistical Genetics	By invitation
15	Dr. Ajit, Principal Scientist & In-Charge-PME Cell, ICAR-IASRI	By invitation
16	Dr. A.R. Rao, Principal Scientist and Professor (Bioinformatics)	By invitation
17	Mr. K.K. Sharma, Sr. F&AO, ICAR-IASRI	By invitation
18	Mrs. Usha Jain, CTO, ICAR-IASRI	By invitation
19	Mr. Yogesh Kadian, Administrative Officer, ICAR-IASRI	By invitation
20	Mr. Amit Kumar Marwari, AF&AO, ICAR-IASRI	By invitation
21	Mr. B R Senthil Kumar, ACTO, ICAR-IASRI	By invitation

The important issues discussed are as below:

At the outset, Dr. Tauqueer Ahmad, Director (A), ICAR-IASRI, welcomed all the members of the IMC. The Proceedings of 67th IMC meeting were confirmed. In the meeting, Dr. P.S. Pandey, ADG (EP&HS), ICAR suggested that the staff quarters (G-type) of our institute at ICAR-IASRI and at Paschim Vihar be maintained and repair be done so that the quarters will be in good condition. Dr. Ajit, Incharge, PME Cell, made a presentation on Institute's Research activities, including completed research projects and ongoing projects. The members appreciated the research activities especially technologies developed and copyrights received. Dr. Seema Jaggi, Principal Scientist and Training & Administration Incharge, gave a presentation on the training and teaching activities of the institute. The house was satisfied with the teaching and training activities going on at ICAR-IASRI. She also emphasized displaying the awards received by the scientists at the main corridor of the TAC building. The list of equipment to be procured for the financial year 2019-20 of EFC with tentative cost and justification was discussed and considered for approval of the members. The Committee agreed to the agenda item as proposed. Budget Estimate for the year 2019-20 and actual expenditure incurred up to 31.11.2019 was presented before the members. While going through the expenditure, the members took a note on the amount spent. The members took the matter with seriousness that a very less amount of fund is utilized with respect to the proposed fund. There was a discussion about the Bus (DL1V A 4206) and the Bolero car (DL9CQ7662) needed to be condemned. Accordingly, the process was initiated. The matter of timely reimbursement of the Medical, LTC and Tour bills produced by the superannuated employees/working employees was also discussed and it was recommended that bills needed to be settled timely.

Quinquennial Review Team (QRT)

The Quinquennial Review Team (QRT) for the period of 2011-12 to 2017-18 at ICAR-IASRI, New Delhi is in place for reviewing the activities of our institute. The QRT consists of the following members:

1.	Dr.G.C. Manna Former Director General, Central Statistics Office, Ministry of Statistics and Programme Implementation, Govt. of India, New Delhi.	Chairman
2.	Prof. Rita Saha Ray Professor, Indian Statistical Institute, Kolkata, West Bengal	Member
3.	Dr. Ashish Kumar Former Senior Economic Advisor, Ministry of Road Transport, Highways & Shipping, Govt. of India, New Delhi	Member
4.	Dr. N. Balakrishna Professor, Department of Statistics, Cochin University of Science & Technology, Cochin, Kerela	Member
5.	Dr. BVS Sisodia Former Professor & Head, Department of Agricultural Statistics, N.D. University of Agriculture and Technology, Narendra Nagar, Ayodhya, Uttar Pradesh	Member
6.	Dr. Sridhar Sivasubbu Principal Scientist, CSIR-IGIB, Sukhdev Vihar, Mathura Road, New Delhi	Member
7.	Dr. Hukum Chandra National Fellow & Principal Scientist, ICAR-IASRI, New Delhi	Member Secretary

The QRT conducted several meetings and interacted with the Head of Divisions, In-charge PME, In-charge TAC, Scientists, Technical and Administrative staff and students of the institute. Finalization of recommendations has been initiated by the team.

11

Paper Presentations and Participation in Conferences/Workshops & other Events

Paper presented and participation of scientists in conferences, meetings, workshops, symposia in India and abroad (Jan, 2019- Dec, 2019)

Papers presented

- National Conference on Challenges and Opportunities in Statistics and Informatics for Futuristic Humanosphere especially in Agriculture and 21st Annual Conference of Society of Statistics, Computer and Applications held at Department of Statistics and Computer Applications, S.V. Agricultural College, Tirupati during January 29-31, 2019
  - Shyamsundar Parui, Rajender Parsad and B.N. Mandal. Efficient Designs for Designs for Incomplete Factorial Experiments for Two Factors with Unequal Block Sizes.
  - Chandra, H. Small Area Prediction of Counts Under a Spatial Non-Stationary Generalized Linear Mixed Model. (Invited Talk)
  - B.N. Mandal, Sukanta Dash and Rajender Parsad. Construction of Second Order Orthogonal Latin Hypercube Designs with Four Factors (Invited Talk)
  - Sukanta Dash, B.N. Mandal and Rajender Parsad. On the Construction of Nested Orthogonal Latin Hypercube Designs (Invited talk)
  - Susheel Kumar Sarkar and Sanjeev Panwar. Repeated Measurements analysis with missing observations (invited talk)
  - Eldho Varghese, Arpan Bhowmik, Seema Jaggi, Cini Varghese and T.V. Sathianandan. Experimentation Order in Multi-Factor Experiments.(Invited Talk)
  - Chandra, H., Salvati, N. and Chambers, R. Small Area Prediction of Counts Under a Spatial Non-Stationary Generalized Linear Mixed Model. .(Invited Talk). D. C. Mishra, Samarendra Das, Md. Samir Farooqi, Neeraj Budhlakoti, K.K. Chaturvedi, S.B. Lal, Sanjeev Kumar, S.N. Rai, Anil Rai. Informative Gene Selection : Algorithms and Techniques.
  - Alka Arora. Analysis and Evaluation of Training Effectiveness under Capacity Building Program of ICAR: A Case Study (invited paper).
  - Dahiya, S., Bharadwaj, A., Decision Tree based Online Classification and Visualization (invited paper).
  - Meher ,PK. Secondary structure information coupled with the sequence-derived features improves splice site recognition in A. thaliana: A machine learning-based approach.
  - Paul, R.K. Statistical Modelling of Climatic Variables using Wavelet Technique (Invited Talk).
  - Anu Sharma, D.C. Mishra, M.S. Farooqi, S.B. Lal, K.K. Chaturvedi and Sanjeev Kumar. Machine Learning for Binning of Metagenomics Data.
- COBACAS 4th National Conference on Diversified Farming Systems: Sustainable Livelihood and Doubling Farmers' Income organized jointly by Coochbehar Association for Cultivation of Agricultural Science (COBACAS) and Uttar Banga Krishi Viswa Vidyalaya (UBKV) at College of Agriculture, UBKV, Majhian, Dakshin Dinajpur, West Bengal during 17-18

January, 2019

- Rahul Kumar Gupta, Arpan Bhowmik, Seema Jaggi, Anindita Datta, Kaustav Aditya and Souvik Paul. Modeling of Occurrence of Neonatal Diarrhea in Young Goats through Distribution Approach. (Invited talk)

- Satellite Symposium on Big Data in Dryland Agriculture delivered on February 12, 2019 in 13th International Conference on Dryland Development: Converting Dryland Areas from Grey into Green organized by International Dryland Development Commission (IDDC) and Arid Zone Research Association of India (AZRAI) and hosted by ICAR-CAZRI at Jodhpur during February 11-14, 2019
  - Rajender Parsad and A. Dhandapani. Big Data in Indian Agricultural Research and Development (Invited talk)
- Sixth Group Discussion of ICAR-AICRP on Fruits held at Assam Agricultural University, Jorhat, during February 14-16, 2019
  - Rajender Parsad and Sukanta Dash. Information System for AICRP on Fruits (Invited talk)
- 34th Annual Workshop of AICRP on PHET at Tamil Nadu Agricultural University, Coimbatore during March 12-15, 2019
  - Rajender Parsad*, Piyush Kothyari, Arpan Bhowmik, Chandra Sekar and S.K. Tyagi. Information System for AICRP on PHET.
- Technical Workshop of ICAR-BMGF collaborative project on Application of Next Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic gain in Indian Staple Crops organized by ICAR-IARI, New Delhi during April 24-25, 2019
  - Rajender Parsad and A. Dhandapani. Framework for AICRP Information System in ICAR
- X Annual Group Meeting of All India Network Research Project on Onion & Garlic held at ICAR-IARI, New Delhi during May 31-June 01, 2019
  - Rajender Parsad. Designing, analysis and data management in AICRP Trials (Invited Talk)
- National Workshop on Agricultural Sustainability: Methods and Weight Determination organized jointly by Amity University, Amity Institute of Organic Agriculture and ICAR-NIAP, New Delhi at Amity University, Noida on August 31, 2019
  - Rajender Parsad and BMK Raju. Methodology for Constructing Index for Sustainable Agriculture. (Invited Talk)
- Workshop and Annual Review Meeting of ZTMcs/ ITMUs/ABIs in Animal Sciences and Fisheries Sciences Divisions organized by IPTM Unit and National Dairy Research Institute, Karnal at NASC Complex during October 04-05, 2019
  - Rajender Parsad. ICAR Research Data Repository for Knowledge Management with Emphasis on ICAR IP Database.
- Eighth International Conference on Agricultural Statistics during November 18-21, 2019 at New Delhi.
  - Rajender Parsad. Research data management in Indian agricultural research system and its accessibility.
  - B.N. Mandal and Rajender Parsad. Distance balanced sampling plans useful for sampling from naturally ordered populations.
  - Priyanka anjoy, Hukum Chandra, Rajender Parsad and Kaustav Aditya. Disaggregate level crop yield estimation under spatial non-stationary hierarchical bayes small area estimation approach.
  - Neeraj Budhlakoti, D.C. Mishra, Anil Rai. Kernelized Multi Response LASSO for Multi-trait Genomic Selection.
  - Chandra, H., Gupta, S., Verma, B. and Guha, S. (2019). Disaggregate Level Estimation of Food Insecurity Incidence for the State of Uttar Pradesh in India by Combining Survey and Census Data. Technical Session on “Small Area Estimation: Relevant Cost-Effective Method for Producing Disaggregated Data for SDG Monitoring”.
  - Kaustav Aditya, Hukum Chandra, Pradip Basak and Niranjan Nayak. Mobile Assisted Personal Interview Software-Filed Experiences from Implementation in Crop Estimation Survey in India.
  - Tauqueer Ahmad, Prachi Misra Sahoo, U.C. Sud and Ankur Biswas. Modified sampling methodology for estimation of area and production of horticultural crops.
  - Prachi Misra Sahoo, Anil Rai and Tauqueer Ahmad. GIS based spatial sampling designs for regular and irregular spatial units. Technical Session on “Spatial Sampling Designs and Spatial Data Analysis”. (Invited talk)
- XIV Agricultural Science Congress: Innovation for Agricultural Transformation (International Conference), held at NAAS complex, New Delhi

during 20th to 23rd February, 2019.

- Anuja AR.Crop diversification towards high value crops: Status, determinants and its impact on farmers' welfare in eastern India.

- Annual conference on "Changing Landscape of Rural India" organized by the Agricultural Economics Research Association during 17-19th December 2019.
  - Anuja AR (2019). The impact of crop diversification on the economic welfare of agricultural households in eastern India.
  - Shivaswamy G.P.(2019). Seed replacement in Pulses and its Impact on Productivity in India.
  - Ravindra Singh Shekhawat (2019). Econometric analysis of price dynamics of high valued seed spices in India.
- 27th Annual Conference of the Agricultural Economics Research Association (India) on "Changing Landscapes of Rural India" being held during 16-18 December, 2019 at Punjab Agricultural University, Ludhiana, Punjab.
  - Harish Kumar H V. "Land use dynamics across rural-urban transition of Bengaluru.
- International Seminar on agriskills for Convergence in Research, Industry and Livelihood (ACRIL) held during 28-11-19 to 01-12-19 at BCKV, Kalyani, West Bengal, India
  - Achal Lama. Monthly rainfall forecasting of Sub-Himalayan West Bengal and Sikkim: An application of SARIMA, TDNN and EXPAR models
- 13th International conference on Development of Drylands: Converting dryland areas from grey into green held on February 11-14, 2019 at ICAR-CAZRI, Jodhpur
  - Ravindra Singh Shekhawat. Tractorization in semi-arid tropic India: A Panel Data Analysis.
- International Conference on "Computer Age Statistics in the Era of Big and High Dimensional Data" at Pune during 03-05 January, 2019
  - Anjoy, P. and Chandra, H. Analysis of District and Social Group-Wise Disparity in Poverty in Chhattisgarh using Small Area Estimation Approach.
  - Chandra, H. Small Area Prediction of Counts Under a Spatial Non-Stationary Generalized Linear Mixed Model.
  - Guha, S. and Chandra, H. Finite Population Mean Estimation using Two Auxiliary Variables in Double Sampling in the Presence of Nonresponse
- National Conference on "Recent Developments in Statistics and their -Applications to the Society" at Ahmednagar during 17-18 January, 2019.
  - Chandra, H. Small Area Estimation of Proportions under a Spatial Dependent Aggregated Level Generalized Linear Mixed Model.(Invited talk)
- Workshop on "Applications of Spatio-Temporal Models" at University of Hyderabad, Hyderabad during 31 January - 01 February, 2019.
  - Chandra, H. Small Area Estimation under Spatial Models. (Invited Talk)
- Conference on "Estimation of Crop yield/Crop Cutting Experiments and Sampling Methodology for Crop Yield" on 30 September, 2019 at NASC Complex organised by Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, Govt. of India.
  - Tauqueer Ahmad. Designing and Sampling for Crop Yield Estimation.
- National Workshop on improvement of Agriculture Statistics organized by the Department of Agriculture & Farmers Welfare, Panchkula, Haryana during 05-06 February, 2019.
  - Kumar, Raju. Various activities covered by ICAR-IASRI and latest techniques of agricultural statistics.
- International Symposium on "Advances in Agrometeorology for Managing Climatic Risks of Farmers (INAGMET-2019)" at JNU, New Delhi during 11-13 February, 2019.
  - Deepak Singh, Rohini Yadav and Hukum Chandra. An efficient class of ratio-product-ratio type estimators of finite population mean in sample surveys.
  - Kumari, V., Kumar, A. and Chandra, H. Neural Network based Crop Forecast Model through Simulated Weather Data.
  - Paul, R K, Trends and Magnitude of Climatic Variability across Locations from Different Agro Climatic Zones of India.
- National Conference on "Emerging Trends in Statistics and Data Sciences" at Department of statistics, Ramanujan college, University of Delhi, New Delhi during 06-07 September, 2019.
  - Singh, D., Yadav, R. and Chandra, H. An improved family of estimators of finite population mean in sample surveys.
  - Chandra. H. Small Area Prediction of Counts

under a Spatial Non-Stationary Generalized Linear Mixed Model.(Invited Talk)

- Verma, B., Chandra. H and Gupta, S. "Inequalities in Living Conditions in Rural Eastern Indo-Gangetic Plain.(Invited Talk)

- The 2019 IISA Conference on Innovations in Data and Statistical Sciences organized at IIT Bombay, Mumbai, during December 26-30, 2019.
  - Chandra, H. Small area prediction of survey weighted counts using georeferenced data
- Indian Statistical Service probationers of the Ministry of Statistics & Programme Implementation, ICAR- IASRI, New Delhi, 13-24, May, 2019
  - S.B. Lal. MS Excel: Statistical Procedures" in a training programme on "Data Analysis and Interpretation
- Altair's Annual Altair Technology Conference (ATC): High Performance Computing (HPC) Track Le Meridian Windsor Place, New Delhi, 14th June 2019
  - KK Chaturvedi. Maintaining and Managing Supercomputing Resources in Agriculture
- 5th International Conference on Plant Genetics and Genomics: Germplasm to Genome Engineering, NASC Complex PUSA, New Delhi, October 17-18, 2019
  - Sarika. Computational perspective of identification of microsatellite DNA markers.
  - MA Iquebal. An insight into machine learning based computational approach for prediction of putative miRNA in polyploid genome.
- National Conference on Climate Change and Agriculture: Impacts, Resilience & Adaptations for Sustainable Food Security, India International Centre, Annexe , New Delhi, 20-21 December 2019
  - Shashi Dahiya. Machine Learning Techniques for Combating Climate Change in Agriculture (oral presentation).
- International Conference On Global Research Initiatives For Sustainable Agriculture & Allied Sciences (GRISAAS-2019) during 20–22 October 2019 at ICAR-NAARM, Hyderabad, Telangana.
  - Mukesh Kumar, Shashi Dahiya, Alka Arora, Soumen Pal. Development and Validation of Mobile Based Decision Support System for Postural Assessment of Agricultural Activities Using Rapid Upper Limb Assessment (RULA) Technique
- International conference on Plant Protection in Horticulture: Advances and Challenges (ICPPH-2019), ICAR-IIHR, Bengaluru, 24-27 July, 2019
  - Richa Varshney, Neeraj Budhlakoti and Chandish R Ballal. Biology and functional response of Dortus primaries Distant (Hemiptera: Miridae) to common member thrips Frankliniella schulzei (Trybom) (Thysanoptera): Thripidae
- 4th International Group Meeting(IGM), CSKHPKV, Palampur, 14-16 February 2019
  - Sundeep Kumar, Amit Kumar Singh, Divya Chauhan, Neeraj Budhlakoti, D.C. Mishra, S.C. Bhardwaj, O.P. Gangwar, Subodh Kumar, Anjan Kumar Pradhan and Monendra Grover. Transcriptome analysis to identify gene and pathways associated with yellow rust resistance in wheat
- Workshop on "Building Evidence in Agriculture: Reviewing Data Systems and the Way Forward" by International Growth Centre (IGC) at Hotel Maurya, Patna on 15.02.2019
  - Ramasubramanian V. Statistical methodologies for agricultural data analysis and decision making
- Asia-Pacific Aquaculture 2019 Conference and Exposition held during June 19-21, 2019 at Chennai
  - C. Lloyd Chrispin, P.S. Ananthan, Ramasubramanian V. and Agnes Daney Angela. Fisheries and management status of Vidur reservoir in Tamil Nadu, India
  - Gomathy V., Ananthan P. S., Achal Lama, Mrinmoy Ray and Ramasubramanian V. Shrimp price trends and forecast in wholesale fish market of Gazipur, Delhi
  - Tripathy, P., Ramasubramanian, V., Krishnan, M. and Ananthan, P. S. Determinants of household income and choice of alternative livelihoods: case study of Rushikulya fishers, Odisha
- 12th Asian Fisheries and Aquaculture Forum held at Iloilo, Philippines during 8-12 April 2019
  - Velumani, T., Ananthan, P.S., Ramasubramanian V. and Rama Krishna. Social hierarchy and human development: A case study of reservoir fishers in Karnataka, India

PARTICIPATION IN TRAINING, WORKSHOP, SEMINAR, CONFERENCES, MEETINGS ETC.

Participation

- Eighth International Conference on Agricultural Statistics 2019 (ICAS-VIII) during 18-21 November, 2019
  - Lal Mohan Bhar, Tauqueer Ahmad, K.N.Singh, Anil Rai, Rajender Parsad, Seema Jaggi, Ajit, Dinesh Kumar, Amrit Kumar Paul, A.R. Rao, Himadri Ghosh, Cini Varghese , Hukum Chandra, Anil Kumar, Prawin Arya , Sudeep, Alka Arora, Prachi Misra Sahoo, Monendra Grover, Anshu Bharadwaj, Mukesh Kumar, Ulavappa B. Angadi, Krishna Kumar Chaturvedi, S.B. Lal, Shashi Dahiya, Mohd. Samir Farooqui, Pal Singh, Anu Sharma, Shah Nawazul Islam, Sanjeev Kumar, Md. Wasi Alam, Mir Asif Iquebal, Sarika, Sangeeta Ahuja, Susheel Kumar Sarkar, B.N. Mandal, Ranjit Kumar Paul, Dwijesh Chandra Mishra, Soumen Paul, Kaustav Aditiya, Sukanta Dash, Ankur Biswas, Arpan Bhoumik, P.K. Meher, Sudhir Srivastava, Deepak Singh, Kanchan Sinha, Mrinmoy Ray, Raju Kumar, Vandita Kumari Choudhary, Sunil Kumar Yadav, Ravinder Singh Shekhawat , Md. Harun, Anindita Dutta, Achal Lama, Himadri Shekhar Roy, Pradip Basak, Rajesh T., Anuja A.R., Shivaswamy G.P., Harish Kumar H.V. and Manish Kumar
- The Young Statistician Seminar as an organizer, sponsored by USDA and hosted by ICAR-IASRI, New Delhi during 22-23 November, 2019 as a side event of ICAS-VIII 2019.
  - Kaustav Aditya, Vandita Kumari and Pradip Basak.
- 13th International Conference on Dryland Development: Converting Dryland Areas from Grey into Green organized by International Dryland Development Commission (IDDC) and Arid Zone Research Association of India (AZRAI) and hosted by ICAR-CAZRI at Jodhpur during February 11-14, 2019.
  - Rajender Parsad
- 34th Annual Workshop of AICRP on PHET organized at Tamil Nadu Agricultural University, Coimbatore during March 12-15, 2019.
  - Rajender Parsad, Mukesh Kumar
- National Consultation on ICT in Agriculture organized at Lecture Hall, Second Floor, NASC Complex, DP Shastri Marg, New Delhi on March 06, 2019.
  - Rajender Parsad
- Workshop for Chief Data Officers of OGD Platform India organized by National Informatics Centre at India Habitat Centre on April 11, 2019. Also shared OGD experiences and experiences gained for implementing KRISHI Portal.
  - Rajender Parsad
- Technical Workshop of ICAR-BMGF collaborative project on Application of Next Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic gain in Indian Staple Crops organized by ICAR-IARI, New Delhi during April 24-25, 2019.
  - Rajender Parsad
- National Workshop on Sustainability of Indian Agriculture: Methodology and Indicators organized by ICAR-NIAP, New Delhi during 18-19 June, 2019 at ICAR-NIAP, New Delhi
  - Rajender Parsad
- Brainstorming session on Enhancing Science Culture in Agricultural Research Institutions organized by National Academy of Agricultural Sciences on June 25, 2019 at NASC Complex, New Delhi
  - Rajender Parsad
- National Workshop on Agricultural Sustainability: Methods and Weight Determination organized jointly by Amity University, Amity Institute of Organic Agriculture and ICAR-NIAP, New Delhi at Amity University, Noida on August 31, 2019.
  - Rajender Parsad
- Special Event on Closing the Agricultural Data Gap through Agricultural Integrated Surveys sponsored by FAO, Rome organized at NASC Complex, New Delhi on November 22, 2019.
  - Rajender Parsad, Ankur Biswas, Raju Kumar
- Brain Storming Session on Big Data Analytics in Agriculture **o**rganized by National Academy of Agricultural Sciences on December 18, 2019.
  - Rajender Parsad, Susheel Kumar Sarkar
- The 2019 IISA Conference on Innovations in Data and Statistical Sciences organized at IIT Bombay, Mumbai, during December 26-30, 2019
  - Rajender Parsad, B N Mandal, Sukanta Dash, Vandita Kumari Choudhary, Hukum Chandra

- Special Event on "Using Administrative Data for Agricultural Statistics" in Young Statisticians' Conference sponsored by Eurostat organized at NASC Complex, New Delhi on November 22, 2019.
  - B N Mandal, Ravindra Singh Shekhawat
- Workshop on ICAR KRISHI Portal - A Central Research Data Repository during March 18-19, 2019 at ICAR-IASRI, New Delhi
  - B N Mandal, Sunil Kumar Yadav
- Sixth Group Discussion of ICAR-AICRP on Fruits held at Assam Agricultural University, Jorhat, during February 14-16, 2019.
  - Sukanta Dash
- National Conference on Challenges and Opportunities in Statistics and Informatics for Futuristic Humanosphere especially in Agriculture and 21st Annual Conference of Society of Statistics, Computer and Applications held at Department of Statistics and Computer Applications, S.V. Agricultural College, Tirupati during January 29-31, 2019.
  - Rajender Parsad, Susheel Kumar Sarkar, B.N. Mandal, Sukanta Dash, R.K. Paul, D.C. Mishra, Mukesh Kumar, Shashi Dahiya, Alka Arora, Anshu Bharadwaj.
- XIV Agricultural Science Congress organized by NAAS in collaboration with the ICAR and Indian Agricultural Research Institute at New Delhi from February 20-23, 2019 on the theme "Innovations for Agricultural Transformation".
  - Anil Kumar, Anindita Datta
- Workshop on "ICAR KRISHI Geoportal: A Digital Platform for Sustainable Agriculture' on March 07-08, 2019 at ICAR-NBSS&LUP, Nagpur.
  - Susheel Kumar Sarkar and Sukanta Dash
- "Academic Writing with LATEX" on March 25, 2019. organized at ICAR-IASRI by Division of Design of Experiments.
  - Seema Jaggi, Cini Varghese, Susheel Kumar Sarkar, Sukanta Dash, Sunil Kumar Yadav, Kaustav Aditya, Shivaswamy G.P., Mrinmoy Ray, Pal Singh, Soumen Pal, P.K. Meher.
- National Workshop on IV National Workshop of Officer Incharge, Data Management during December 10-11, 2019 at NASC, New Delhi.
  - Seema Jaggi, Rajender Parsad, Anil Kumar, Susheel Kumar Sarkar, BN Mandal, Sukanta Dash Arpan Bhowmik, Sunil Kumar Yadav and Anindita Datta
- COBACAS 4th National Conference on Diversified Farming Systems: Sustainable Livelihood and Doubling Farmers' Income organized jointly by Coochbehar Association for Cultivation of Agricultural Science (COBACAS) and Uttar Banga Krishi Viswa Vidyalaya (UBKV) at College of Agriculture, UBKV, Majhian, Dakshin Dinajpur, West Bengal during 17-18 January, 2019
  - Arpan Bhowmik
- Training-Cum-Workshop for Officer Incharge, Data Management, ICAR-IASRI, New Delhi, February 15-16, 2019
  - Arpan Bhowmik
- Training programme on "On-line submission and analysis of ON-FARM farming systems research data and preparation of promising farming systems for scaling up", ICAR-IIFSR, Modipuram, 27-28 August, 2019.
  - Arpan Bhowmik
- 21 days CAFT training programme on "Analytical Approaches on Doubling Farmers' Income", Division of Agricultural Economics, ICAR-IARI, New Delhi, 01-21 October, 2019.
  - Arpan Bhowmik
- One day conclave "Innovating Indian Agriculture -Towards a new Green Revolution" held at Leela Palace, Chanakyapuri, New Delhi on 01.02.2019
  - Prawin Arya
- Summer School organized by ICAR- National Institute on Agricultural Economics and Policy Research, New Delhi on "Quantitative Methods for Social Sciences" during 21st September to 11th October 2019.
  - Anuja AR, Rajesh T, R.S. Shekhawat
  - Training workshop on IFPRI International Model for Policy Analysis of Agricultural Commodities and Trade (IFPRI- IMPACT) organized by IFPRI and ICAR-NIAP at ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi-12 during 4th to 8th November 2019.
  - Anuja A R
- Annual conference on "Changing Landscape of Rural India" organized by the Agricultural Economics Research Association during 17-19th December 2019.
  - Anuja AR, Shivaswamy G.P.
- 27th Annual Conference of Agricultural Economics Research Association held during

17-19 December 2019 at Punjab Agricultural University, Ludhiana.

➢ Rajesh T, Harish kumar H V

- Indo-German conference on rural-urban transition (International conference) held at University of Agricultural Sciences, GKVK, Bangalore during 20-22, February, 2019 and delivered scientific talk on “Capital Formation across Rural-Urban Gradient of Bangalore North-An Economic Analysis”.

➢ Harish Kumar H V

- Hindi workshop entitled ”जैव सूचना विज्ञानः टूल्स एवं तकनीकियाँ” during Dec 09-11, 2019 at ICAR-IASRI, Pusa, New Delhi-12

➢ Wasi Alam

- 13th International conference on Development of Drylands: Converting dryland areas from grey into green held on February 11-14, 2019 at ICAR-CAZRI, Jodhpur

➢ Ravindra Singh Shekhawat

- Training programme on ”Statistical Analysis of Disaggregated SDG Indicators for Inclusive Development Policies”, United Nations-Statistical Institute for Asia and the Pacific (UN-SIAP), Chiba, Japan, June 07, 2019- July 12, 2019.

➢ Hukum Chandra

- Young Statisticians Training on Methodology for Agricultural Censuses and Surveys organized by the United States Department of Agriculture (USDA), New Delhi, November 22 and 23, 2019.

➢ Hukum Chandra

- International Conference on ”Computer Age Statistics in the Era of Big and High Dimensional Data” at Pune during 03-05 January, 2019

➢ Hukum Chandra

- Workshop on ”SDG Indicators Related to Food and Agriculture” organized by Ministry of Statistics and Programme Implementation, Govt. of India and FAO of the United Nations at New Delhi during 06-10 May, 2019

➢ Tauqueer Ahmad

- Conference on “Estimation of Crop yield/Crop Cutting Experiments and Sampling Methodology for Crop Yield” on 30 September, 2019 at NASC Complex organised by Department of Agriculture, Cooperation & Farmers’ Welfare, Ministry of Agriculture & Farmers’ Welfare, Govt. of India

➢ Tauqueer Ahmad, Ankur Biswas

- Final presentation of the project entitled “Pilot study for developing State level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee report” at Krishi Bhawan, New Delhi on 08 January 2019.

➢ Kaustav Aditya

- International Symposium on “Advances in Agrometeorology for Managing Climatic Risks of Farmers (INAGMET-2019)” at JNU, New Delhi during 11-13February, 2019.

➢ Vandita Kumari Choudhary

- Attended 21 days’ winter school on ”Advances in designing and analysis of field crop experiments” during 14 October – 03 November, 2019 held at ICAR-IASRI, New Delhi

➢ Deeepak Singh

- National Workshop on improvement of Agriculture Statistics organized by the Department of Agriculture & Farmers Welfare, Panchkula, Haryana during 05-06 February, 2019

➢ Raju Kumar

- Young Statisticians Seminar on Methodology for Agricultural Censuses and Surveys sponsored by USDA held at NASC Complex, New Delhi during November 22-23, 2019.

➢ Hukum Chandra, Kaustav Aditya, Pradip Basak, Vandita Kumari

- National Conference on ”Recent Developments in Statistics and their -Applications to the Society”, Ahmednagar, January17-18, 2019.

➢ Hukum Chandra

- Workshop on ”Applications of Spatio-Temporal Models”, University of Hyderabad, Hyderabad, January 31 to February 01, 2019.

➢ Hukum Chandra

- The “14th Agricultural Science Congress” on the topic ”Innovations for Agricultural Transformation”, at ICAR-IARI, New Delhi, February 20-23, 2019

➢ Hukum Chandra, Pravin Arya

- Workshop on ”Statistical Computing Using R”, Department of Statistics, Punjab University, Chandigarh, February 28 to March 01, 2019.

➢ Hukum Chandra

- National workshop on ”Big Data Analysis with R”, Rabindranath Tagore University, Bhopal, March 15, 2019.

➢ Hukum Chandra

- Workshop on "Social Transfers to Revitalize Rural India" and Launch of IFPRI Global Food Policy Report 2019, NASC Complex, Pusa, New Delhi, April 26, 2019.

  ➢ Hukum Chandra

- Workshop on "SDG Indicators Related to Food and Agriculture". Organized by Ministry of Statistics and Prgramme Implementation, Govt of India and FAO of the United Nations, New Delhi, May 06-10, 2019.

  ➢ Hukum Chandra

- Inception Workshop of the project entitled "Study to estimate the sub-state level estimate of socio-economic indicators of Uttar Pradesh by using Small Area Estimation Techniques", Giri Institute of Development Studies, Lucknow, Uttar Pradesh, August 01-03, 2019.

  ➢ Hukum Chandra

- National Conference on "Emerging Trends in Statistics and Data Sciences (ETSDS-2019)", Ramanujan College, University of Delhi, New Delhi on September 06-07, 2019.

  ➢ Hukum Chandra

- National Seminar on "Data Analysis using Software", Department of Statistics, M.D. University, Rohtak, October 17-18, 2019.

  ➢ Hukum Chandra

- Research collaboration workshop on Building a shared understanding for the application of the small area estimation approach, Australian National University, Canberra, Australia, December 02-07, 2019.

  ➢ Hukum Chandra

- National Conference on "Fisheries and Aquaculture" with the theme "Harnessing the Untapped Potential of Fisheries & Aquaculture", New Delhi, December 13, 2019.

  ➢ Hukum Chandra

- Methodology Seminar, Australian Bureau of Statistics, Canberra, Australia, December 04, 2019.

  ➢ Hukum Chandra

- Research School of Population Health and School of Demography Seminar, Australian National University, Canberra, Australia, December 03, 2019.

  ➢ Hukum Chandra

- "International workshop on genomic selection in Aquaculture", which was organised at ICAR-CIFE Mumbai, during 16-18 January, 2019.

  ➢ P.K. Meher, Himadri Shekhar Roy

- 3rd India Agricultural Outlook Forum, 2019 during September 26-27, 2019 in New Delhi organized by the Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW), Ministry of Agriculture & Farmers Welfare. Also worked as a panelist in the Session on "Robust Price Forecasting in Agriculture".

  ➢ R.K. Paul.

- Attended "International Seminar on Agriskills for Convergence in Research, Industry & Livelihood (ACRIL)" organized by Crop and Weed Science Society (CWSS) under the umbrella of Bidhan Chandra Krishi Viswavidyalaya (BCKV) at Farmers' Academy & Convention Centre (FACC), BCKV, Kalyani, Nadia, West Bengal, India during November 28 – December 01, 2019.

  ➢ R.K. Paul, Achal Lama

- Participated in the National Conference on Climate Change and Agriculture: Impacts, Resilience& Adaptations for Sustainable Foods Security organized during 20-21 December, 2019 at India International Centre, New Delhi.

  ➢ Soumen Pal, Shashi Dahiya, Sudeep, S.N Islam, Anshu Bharadwaj

- Participated in "National Consultation on ICT in Agriculture" workshop for all Computer Scientists of ICAR, jointly organized by DKMA & ADG (ICT), ICAR on March 06, 2019 at NASC Complex, New Delhi.

  ➢ Alka Arora, Sudeep Marwaha, Anshu Bharadwaj, Mukesh Kumar, Shashi Dahiya, S.N Islam, Pal Singh

- Participated in workshop on All India Survey on Higher Education (AISHE) for the year 2018-19 on 8th February, 2019 at Scope Complex, CGO, Lodhi Road New Delhi organized by Deptt. of Higher Education, Ministry of Human Resource Development.

  ➢ Alka Arora

- Hindi Workshop "Sampling techniques for Agricultural surveys and Statistical analysis of survey data" during 22-27 February,2019.

  ➢ Pal Singh

- Annual Zonal Action Plan Workshop of KVKs, Zone-VII at ICAR-ATARI, Zone – VII, Umiam, Meghalaya during 1-2 March, 2019.

- Soumen Pal

- Workshop Cum Training for KVKs of Punjab, Haryana and UP on Production Practices Survey at Krishi Vigyan Kendra, ICAR-National Dairy Research Institute, Karnal during 27-28 March, 201
  - Soumen Pal
- National Workshop on Academic Excellence through Building Partnerships and Resources Generation was organized by ICAR-NAARM during 30-04-2019 to 01-05-2019.
  - Anshu Bharadwaj
- Workshop for Chief Data Officers of Open Government Data Platform organized by NIC at India Habitat Center on 11th April 2019.
  - Anshu Bharadwaj
- Half day Workshop on Digital Technology in Agriculture" at KAB –II on 3rd May 2019.
  - Anshu Bharadwaj
- NAHEP Review Workshop during 5-6 August 2019.
  - Anshu Bharadwaj
- 52nd Annual Maize Conference at AAU, Jorhat during 5-7 April, 2019
  - Mr. SN Islam
- Digital Technology in Agriculture at Education Division, KAB-II, ICAR on May 03, 2019
  - Mukesh Kumar, Shashi Dahiya
- Annual Zonal Workshop of KVKs of Zone IV and V and given talk on Uploading of KVK activities in KVK Portal at Uttar Banga Krishi Viswavidyalaya (UBKV), Cooch Behar, West Bengal during June 8-10, 2019.
  - Alka Arora
- Workshop on Statistics Day at Vigyan Bhawan on 29th June, 2019.
  - Pal Singh
- 5 days Workshop on Applied Deep Learning at IIT Mandi during 01-05 July, 2019.
  - Mukesh Kumar, Pal Singh
- NAHEP first Annual Review Workshop at NASC Complex, New Delhi during 5-6 August, 2019.
  - Mukesh Kumar, Alka Arora, Anshu Bharadwaj, Shashi Dahiya. Soumen Pal
- User Conference organized by Esri India during 28-29 August, 2019 at Gurugram.
  - Mukesh Kumar, Anshu Bharadwaj
- Three days training Effective Development Programme (EDP) on Development Effective Organizational Leadership for Senior Officers of ICAR during 09-11 August, 2019 at ASCI, Hyderabad.
  - Mukesh Kumar
- One days Hindi Workshop on "File Management System in e-office" at ICAR-IASRI on 30th September, 2019.
  - Shashi Dahiya
- Workshop for Nodal Officers of Agricultural Universities under NAHEP-Component 2A at NASC Complex, New Delhi during 18-19 September, 2019.
  - Sudeep Marwaha, Alka Arora, Mukesh Kumar, Anshu Bharadwaj, Soumen Pal, Shashi Dahiya, S.N. Islam, Pal Singh, Ramasubramanian V., Mrinmoy Ray, Achal Lama
  - Workshop on Project Monitoring and Tracking System(PMTS) organised by NAHEP at IARI, New Delhi on 20 September 2019.
  - Alka Arora
- CSISA-KVK Annual workshop at A.P. Shinde Symposium Hall, NASC Complex, New Delhi during 24-25 September 2019.
  - Alka Arora
- Workshop on "Building Evidence in Agriculture: Reviewing Data Systems and the Way Forward" organized by International Growth Centre (IGC) at Hotel Maurya, Patna on 15.02.2019
  - Ramasubramanian V., Kaustav Aditya, Lal Mohan Bhar
- "Review meeting of BSMA committees" held during at NASC, New Delhi on 23-24, April, 2019
  - Ramasubramanian V., Shashi Dahiya
- Training Workshop on Applied Deep Learning (01-05, July, 2019) at IIT, Mandi, Himachal Pradesh during 03-05, July, 2019
  - Alka Arora, Mrinmoy Ray, Mukesh Kumar, Ramasubramanian V., SN Islam.
- 4th National Workshop of Officer Incharge Data Management for ICAR Research Data Repository for Knowledge Management Initiative (KRISHI) (10-11 Dec. 2019) on 10.12.2019
  - Ramasubramanian V.
- Teaching Seminar (for syllabus discussion on introduction of PhD Agricultural Statistics course)

at TNAU, Coimbatore on 16.12.2019

- Ramasubramanian V.

Poster Presentations

- Eighth International Conference on Agricultural Statistics 2019 (ICAS-VIII) during 18-21 November, 2019
  - Priyanka anjoy, Hukum Chandra, Rajender Parsad and Kaustav Aditya (2019). Disaggregate level crop yield estimation under spatial nonstationary hierarchical Bayes small area estimation approach.
  - Vandita Kumari, Hukum Chandra and Kaustav Aditya(2019). Estimation of regression coefficient for survey data using calibration approach and additional auxiliary variables.
  - Pradip Basak, Hukum Chandra and Kaustav Aditya (2019).Two-step calibration for estimation of finite population total under two-stage sampling design.
  - Deepak Singh, Rohini Yadav and Hukum Chandra. (2019). An efficient class of ratio-product-ratio type estimators of finite population mean in sample surveys.
  - Samir Barman, Hukum Chandra and Kaustav Aditya (2019). Estimation of finite population total using geo-referenced data.
  - Samir Barman, Hukum Chandra and Kaustav Aditya (2019). Estimation of finite population total using geo-referenced data.
  - Tauqueer Ahmad, Prachi Misra Sahoo, Ankur Biswas and Anil Rai (2019). Integrated sampling methodology using field surveys, remote sensing and GIS for yield based crop insurance.
  - Tauqueer Ahmad, Anil Rai, Prachi Misra Sahoo, Ankur Biswas and Man Singh (2019). Sampling methodologies for estimation of harvest and post-harvest losses of horticultural crops, livestock and fisheries.
  - Tauqueer Ahmad, U.C. Sud, Ankur Biswas and Man Singh (2019). Sampling methodology for estimation of private food grains stock at farm level aligned with input survey of agriculture Census in India.
  - Prachi Misra Sahoo, Anil Rai, Tauqueer Ahmad and B.K. Handique (2019). A systematic approach for Generation of Agricultural Statistics integrating Remote Sensing, GIS and Survey in Hilly regions.
  - Prachi Misra Sahoo, Tauqueer Ahmad and Anil Rai. (2019). Food security and Livelihood security in rural India.
  - Nobin Chandra Paul, Prachi Misra Sahoo, R. N. Sahoo, Bappa Das, Ankur Biswas, Gopal Krishna, Anil Rai and Tauqueer Ahmad (2019). Statistical Techniques for Discrimination of Fruit Crops using Hyperspectral Satellite Data.
  - Vinaykumar L.N., Tauqueer Ahmad, Ankur Biswas, Anil Rai and Prachi Misra Sahoo (2019). Rescaling Bootstrap variance estimation for Level-0 Ranked Set Sampling under finite population framework.
  - Pramod Kumar Moury, Tauqueer Ahmad, Anil Rai, Prachi Misra Sahoo and Ankur Biswas (2019). Outlier Robust Finite Population Estimation under Spatial Non-stationarity.
  - Shivaswamy G.P., Seed replacement in Pulses and its Impact on Productivity in India.
  - Harish Kumar H V. “Credit to Agriculture by Scheduled Commercial Banks (SCBs) in India-A Micro Level Overview.
  - Ravindra Singh Shekhawat. Impact of tractorization on farm productivity in SAT India
  - Neeraj Budhlakoti. Kernelized Multi Response LASSO for Multi-trait Genomic Selection.
  - Shashi Dahiya. Mobile based decision support system for crop selection.
  - Rohit Singh, Shashi Dahiya, Rajni Jain, Anshu Bharadwaj, Mukesh Kumar and Ramasubramanian V. Mobile based decision support system for crop selection.
  - Himadri Ghosh. Survival Analysis of Seed Germination using Cox Proportional Hazard Modelling and other Approaches.
  - Debopam Rakshit, B.N. Mandal, Rajender Parsad and Sukanta Dash. Augmentation of Standard Simplex-Lattice Designs
  - Rahul Kumar Gupta, Arpan Bhowmik, Seema Jaggi, Cini Varghese, Md. Harun, Eldho Varghese. Trend Free Partially Balanced Incomplete Block (TF-PBIB) Designs Useful in Agricultural Experiments
  - Jitendra Kumar, Seema Jaggi, Eldho Varghese, Arpan Bhowmik and Cini Varghese. Statistical Designs for Fitting Response Surfaces Incorporating Neighbour Effects Arfa Anjum, Seema Jaggi, Eldho Varghese, Anil Rai, Arpan Bhowmik and D.C. Mishra. Regression based Algorithm for Change-Point Detection (RAChPoD) in Genomic Sequence
  - Ankita Verma, Seema Jaggi, Cini Varghese,

Arpan Bhowmik, Eldho Varghese and Anindita Datta. Input-Response Relationship in the Presence of Spatial Effects.

- Peter T. Birteeb*, Cini Varghese, Seema Jaggi, Mohd Harun and Eldho Varghese. Network designs in agroforestry systems for sustainable livelihood.
- Sumeet Saurav*, Cini Varghese and Seema Jaggi. Methodology for bioequivalence assessment of veterinary medicinal products.
- Mohd Harun, Cini Varghese, Seema Jaggi and Eldho Varghese. Randomized designs for higher order mating experiments including specific combining abilities.

- International Symposium on "Advances in Agrometeorology for Managing Climatic Risks of Farmers (INAGMET-2019)" at JNU, New Delhi during 11-13 February, 2019.
  - Pradip Basak, Hukum Chandra and Kaustav Aditya (2019). "Two-step Calibration for Estimation of Finite Population Total under Two-stage Sampling Design".
- International Indian Statistical Association Conference (Innovation in Data and Statistical Sciences (INDSTATS-2019) at Indian Institute of Technology Bombay, Mumbai, during 26-30 December, 2019.
  - Vandita Kumari, Hukum Chandra and Kaustav Aditya (2019) "Calibration Estimation of Regression Coefficient from sample survey data with Additional Auxiliary Variables."
- International Conference on Global Environmental Challenges, Human Health and Sustainable Development held during 11 to 13 January, 2019 at The Convention Centre, JNU, New Delhi
  - Gaurav Singh, Neelam Patel, Tanu Jindal, Sumit Pal and Arpan Bhowmik. Assessment of water quality using pollution index of River Hindon, Uttar Pradesh, India
- XIV Agricultural Science Congress "Innovations for Agricultural Transformation" held during 20-23 February, 2019 at NASC Complex and IARI campus organized by National Academy of Agricultural Sciences, New Delhi and ICAR-Indian Agricultural Research Institute, New Delhi
  - Bisworanjita Biswal, Subhas Babu, S.L. Meena, B.N. Mandal, Kirttiranjan Baral (2019). Changes *in soil microbial health in upland rice under diverse nutrient management condition in NEH region*.
  - Anindita Datta, Seema Jaggi, Cini Varghese, Eldho Varghese, Arpan Bhowmik, and Md. Harun. *Generalized row-column designs for comparing test treatments with a control in agricultural experiments*.
  - Arya, P., Alam, W. and Paul, R. (2019) Modeling and forecasting of pest dynamics using Generalized linear models: A case of Jassidds in cotton.
  - R.K Paul. Machine Learning Techniques for Prediction of Sterility Mosaic Disease Incidence in Pigeonpea.

Lectures Delivered

Outside the Institute

Anil Rai

- Prepared lecture notes and delivered lecture on "Bioinformatics Techniques is Biological Data Mining" at National Workshop-cum-training program on "Bioinformatics Techniques is Biological Data Mining from March 25-27, 2019. AKMU, IARI New Delhi.

Harish Kumar H V

- Delivered lecture titled "Linear programming: concept and its application in agriculture" on 4th October-2019, in the 21 days Summer School training on "Quantitative Methods for Social Sciences" held during 21st September to 11th October 2019 at ICAR-NIAP, New Delhi.
- Delivered lecture titled "Reducing input cost by using linear programming - A strategy for doubling farmer's income" on 7th October-2019, in the 21 days CAFT training on "Analytical Approaches on Doubling Farmers' Income" held during 1-21st October 2019 at ICAR-IARI, New Delhi.

Hukum Chandra

- Delivered a talk on "Spatial Nonstationary Fay-Herriot Model for Small Area Estimation – An Application to Crop Yield Estimation", Methodology Seminar, Australian Bureau of Statistics, Canberra, Australia, December 04, 2019.
- Delivered a talk on "Small Area Estimation of Prevalence of Diarrhoea Among under-five Children in Bangladesh by Combining Health Survey and Census Data", a joint seminar with the Research School of Population Health and School of Demography, Australian National

University, Canberra, Australia, December 03, 2019.

- Delivered 04 lectures on different topics (R Overview, Descriptive Statistics using R, Import/Export Data in R, and Graphics in R) in the National workshop on "Data Analysis using Software", Department of Statistics, M.D. University, Rohtak, October 17-18, 2019.
- Delivered 15 lectures on different topics in the training programme on "Statistical Analysis of Disaggregated SDG Indicators for Inclusive Development Policies", United Nations-Statistical Institute for Asia and the Pacific (UN-SIAP), Chiba, Japan, June 07 to July 12, 2019. Delivered following 15 lectures: R Software: An Overview ;Various Elementary Concepts of Sample Surveys; Survey Data Analysis using R ;Practical tools for data analytics using R; Advanced small area estimation computing.
- Delivered a lecture in the UGC-Sponsored National Conference on "Emerging Trends in Statistics and Data Sciences", Ramanujan College, University of Delhi, New Delhi during September 06-07, 2019.
- Delivered 04 lectures related to topics "Spatial Models in Small Area Estimation and Applications" in the workshop on "Applications of Spatio-Temporal models", University of Hyderabad, Hyderabad, January 31 to February 01, 2019.
- Delivered 05 lectures on different topics related to "Statistical Software R and Data Analytics using R" in the workshop on "Statistical Computing Using R", Department of Statistics, Punjab University, Chandigarh, February 28 to March 01, 2019.
- Delivered 04 lectures on different topics (Overview of R, Graphics and Statistical Modeling) in the National workshop on "Big Data Analysis with R", Rabindranath Tagore University, Bhopal, March 15, 2019.

Kaustav Aditya

- Attended one day Workshop entitled "Building Evidence in Agriculture-Reviewing data systems and the way forward" Jointly organized by International Growth Centre (IGC), Asian Development Research Institute (ADRI) and ICAR-IASRI, New Delhi at Hotel Maurya, Patna, Bihar as an Expert on Agricultural Statistics and delivered a talk on Agricultural Statistics Systems in India-An Overview on 15 February, 2019. The work was highlighted with lot of media coverage.
- Delivered an invited lecture on A training program on Analysis using Statistical Package organized at Jagganath International Management School, Vasant Kunj, New Delhi on 28 May, 2019 on the following topics, i) Exploratory Data Analysis using R, ii) Tests of Significance Based on Z, t, chi-square and F Distributions, and iii) Analysis of survey data using R.
- Delivered two lectures on "Basic Sampling Design and Application in large Scale Surveys" at a workshop on "Sampling Design for M&E of Rainfed Agriculture Development Projects" of National Rainfed Area Authority at NASC Complex, New Delhi-110012 on 28 August, 2019.

Ankur Biswas

- Invited lecture delivered on "Horticulture Statistics" on 28 February, 2019 in the Training Programme on "Agriculture and Allied Statistics" for 41st batch of ISS probationers organized by National Statistical Systems Training Academy (NSSTA), MoSPI, Greater Noida during 18 February to 01 March, 2019.

Raju Kumar

- Delivered lectures on the topics "Introduction to statistical tool: SPSS", "Descriptive statistics using SPSS" and "Tests of Significance Based on Z, t, chi-square and F Distributions" on 11th June, 2019 at PAU, Ludhiana in training programme entitled "Statistical Tools and Database Management in Agriculture" organized by Department of Soil Science, PAU, Ludhiana during 10-15 June, 2019 at PAU, Ludhiana.

Ranjit Kumar Paul

- Delivered a lecture on 23rd September, 2019 on the topic "Linear and Nonlinear Regression" in the training programme on "Quantitative Methods for Social Sciences" 21st September to 11th October 2019 at ICAR-NIAP, New Delhi
- Delivered full day lecture on 29th May, 2019 on "Data Analysis using R" in the Faculty Development Programme at JIMS, Vasantkunj.


MORNING INDIA
City
IGC in collaboration with IASRI, ADRI organises agriculture data workshop


सन्मार्ग
आंकड़ों के संग्रहण में हो रहा सुधार : सुधीर


हिन्दुस्तान
डाटा एनालिसिस नहीं होने से पिछड़ रही खेती-बाड़ी

Himadri Shekher Roy

- Delivered a lecture on "Correspondence analysis" on 24st September 2019 at 12.00-13.00 Hrs at ICAR-National Institute of Agricultural Economics and Policy Research (NIAP) is organizing a ICAR- Summer School Training on "Quantitative Methods for Social Sciences" during 21st September to 11th October 2019

Shashi Dahiya

- Delivered two lectures on "Designing Databases and Online Applications with Case Studies" on 3rd of April'2019 in the "FACULTY DEVELOPMENT PROGRAMME ON DATA ANALYTICS" held during 3rd-5th April'2019 at Lady Irwin College, University of Delhi, New Delhi.
- Conducted a full day session on "Data Mining" and delivered 4 lectures on 14th June'2019 in a 5 days NAHEP training workshop entitled "Hands-On Training on Statistical Tools and Database Management in Agriculture" organized by Soil Science Division, PAU Ludhiana during 10-15 June'2019 at PAU Ludhiana.
- Delivered an invited talk on "Information Management and Mobile based Application Development" on 28th of August'2019 in a 21 days CAFT programme on "ICT based strategies for Nutritional Security" organized in the Division of Agriculture Extension, IARI, New Delhi during 16th August - 5 September'2019.
- Delivered an invited talk on "Designing Databases and Online Applications with Case Studies" on 3rd of April'2019 in the "FACULTY DEVELOPMENT PROGRAMME ON DATA ANALYTICS" held during 3rd-5th April'2019 at Lady Irwin College, University of Delhi, New Delhi.
- Delivered 4 lectures on 14th June'2019 in a 5 days NAHEP training workshop entitled "Hands-On Training on Statistical Tools and Database Management in Agriculture" organized by Soil Science Division, PAU Ludhiana in collaboration with ICAR-IASRI, New Delhi during 10-15 June'2019 at PAU Ludhiana

Soumen Pal

- Delivered one invited lecture on "Data Analytics with case studies through R" on 5th April, 2019 in the Faculty Development Program on Data Analytics held at Lady Erwin College, University of Delhi during 3-5 April, 2019
- Delivered 4 invited lectures on 27th May, 2019 in the Faculty Development Programme (FDP) on Data Analysis using Statistical Package held at Jagannath International Management School, Vast Kunj, New Delhi during 27 May – 1 June, 2019:
  - Introduction to R and R Studio and installations,
  - Data Types and their uses in R,
  - Data import/export, Packages and Functions in R,
  - Descriptive Statistics using R.
- Delivered invited lectures on i) 'Introduction to statistical tool: R, R Studio' and ii) 'Descriptive statistics using R' on 10th June, 2019 in Hands-on Training on "Statistical Tools and Database Management in Agriculture" held at PAU, Ludhiana during 10-15 June, 2019..
- Delivered the following 2 presentations in the "eLearning Session" of the 2 Days Workshop for the Nodal Officers of collaborating ICAR institutes and State Agricultural Universities under the NAHEP, Component 2A Subproject - "Investments in ICAR Leadership in Agricultural Higher Education" held during 18th - 19th, September' 2019 at NASC Complex, New Delhi.
  - About e-Learning Programme Activity.
  - Creation of e-Learning Content

SN Islam

- Delivered lecture on TMIS organized for the HRD nodal officers of ICAR institutes at ICAR-NAARM on 16th March, 2019.

Anshu Bharadwaj

- Delivered one lecture on “Introduction to Data Mining” and one lecture on “Association Rule Mining” on 4th April 2019 at Lady Irwin College, University of Delhi.

Ramasubramanian V.

- Delivered lectures on “Continuous distributions, time series & related topics; regression” in capsule course “Data analytical and statistical techniques” conducted during 14-18 Jan., 2019 for Border Security Force (BSF) personnel at BSF, Delhi on 16.01.2019.
- Delivered lectures on “Hierarchical classification, Components of variance and other related topics” (Theory & Practicals) in Ph.D. Course entitled ‘Research Methodology in Fish Genetics’ (FGB 604) (1+1) at ICAR-CIFE, Mumbai during 09-10, May, 2019
- Delivered lectures on “Correlation and Regression Analysis; Time series analysis; Logistic Regression; Classification And Regression Trees (CART)” in the CAAST training program on “Statistical tools and data management in agriculture” (10-15 June, 2019) at PAU, Ludhiana on 12.06.2019
- Delivered a lecture on “Multidimensional scaling” in ICAR-Summer School Training on “Quantitative Methods for Social Sciences” during 21st September to 11th October 201 at ICAR-NIAP, New Delhi on 26.09.2019
- Delivered lectures on “Time Series Analysis: Decomposition and Exponential Smoothing Methods” and “Technology Forecasting in the Fisheries Sector” in the CAFT Programme on Analytical Approaches on Doubling Farmers’ Income organized during 01-21 October, 2019 at Division of Agricultural Economics, ICAR-IARI, New Delhi on 19.10.2019

Arpan Bhowmik and Sukanta Dash

- Delivered an invited lecture on SAS, SPSS and R software: Basics during a training programme on "On-line submission and analysis of ON-FARM farming systems research data and preparation of promising farming systems for scaling up" jointly organized by ICAR-IASRI. New Delhi and ICAR-IIFSR, Modhipuram at ICAR-IIFSR, Modipuram during 27-28 August, 2019

Cini Varghese, Sukanta Dash, Arpan Bhowmik, Devendra Kumar and Rachit Verma

- Organized three different hands on session on OFR data submission and analysis process during a training programme on "On-line submission and analysis of ON-FARM farming systems research data and preparation of promising farming systems for scaling up" jointly organized by ICAR-IASRI. New Delhi and ICAR-IIFSR, Modhipuram at ICAR-IIFSR, Modipuram during 27-28 August, 2019

Cini Varghese

- Delivered a lecture on “online submission and analysis methodology of OFR data” in a training programme on “On-line submission and analysis of on-farm farming systems research data and Preparation of promising farming systems for scaling up in collaboration with ICAR-IIFSR during 27-29 August, 2019.

Susheel Kumar Sarkar

- Delivered 02 lectures to the participants of the 7th Refresher Course in Research Methodology (Interdisciplinary) at Jamia Milia Islamia, New Delhi during November 04 - 16, 2019 (Lecture was delivered on November 06, 2019).

Arpan Bhowmik

- Delivered an invited lecture on Cluster Analysis in ICAR Winter School on Quantitative Methods for Social Sciences from September 21 to October 11, 2019 at ICAR-NIAP, New Delhi.
- Delivered a lecture during a training programme on “On-line submission and analysis of ON-FARM farming systems research data and preparation of promising farming systems for scaling up” jointly organized by ICAR-IASRI. New Delhi and ICAR-IIFSR, Modhipuram at ICAR-IIFSR, Modipuram during 27-28 August, 2019 [Dr. Arpan Bhowmik and Dr. Sukanta Dash].
- Delivered a lecture n ICAR winter Schools on Quantitative Methods for Social Sciences” from September 21 to October 11, 2019 at ICAR-NIAP, New Delhi.

Himadri Shekher Roy

- Delivered a lecture on "Correspondence analysis" on 24st September 2019 at 12.00-13.00 Hrs at ICAR-National Institute of Agricultural Economics and Policy Research (NIAP) is organizing a ICAR- Summer School Training on "Quantitative Methods for Social Sciences" during 21st September to 11th October 2019.

Dinesh Kumar

- Delivered invited lecture as resource person in DBT sponsored training on "Genetics and Genomic Data analysis in Aquaculture" during September 19-28, 2019, at ICAR-CIFA, Bhubaneswar, Odisha. The following topics with hands on session were covered. Bioinformatics and its application in agriculture, Genome annotation, Metagenome analysis.
- Delivered invited lecture as resource person in ICAR sponsored winter school on "Livestock production and Climate Change: Impact, Adaptation and Mitigation" during September 24 to October 14, 2019 on Metagenome studies in Ruminants in NIANP, Bangaluru.

A.R. Rao

- Delivered invited lecture on "Bioinformatics in crop improvement" in NAHEP-CAAST Training programme on "Genomics assisted breeding for crop improvement" on 09-10-2019 at ICAR-IARI, New Delhi
- Delivered invited lecture on "Computational tools for gene annotation" in NAHEP-CAAST training programme on "Genomics of Agriculturally Important Insects" on 25-10-2019 at ICAR-IARI, New Delhi
- Delivered invited lecture on "Bioinformatics" in NAHEP-CAAST training programme on 'Genomics-Assisted Molecular Systematics of Fungi" during 09-17 September 2019 at ICAR-IARI, New Delhi.
- Delivered a lecture on "Statistical Genomics" in Centre for Advanced Faculty Training (CAFT) training on, "Next Generation Sequencing and its Applications in Plant Sciences" September 9, 2019 in ICAR-NIPB, New Delhi
- Delivered a lecture on "Bioinformatics applications in Agriculture" in a seminar organized for post graduate students at TNAU, Coimbatore on 10-12-2019.

K.K. Chaturvedi

- Delivered a talk on "Working with Linux for NGS data analysis" in Workshop cum training at AAU Jorhat during 13-15 March 2019. [Invited Talk]
- Delivered a talk on "Identification of Genetic Variants" in Workshop cum training at AAU Jorhat during 13-15 March 2019.
- Delivered two lectures "Linux for Bioinformaticians" and "Sequence Alignment" as resource person in NGS data analysis workshop cum Training sponsored by CAAST-NAHEP at ICAR-IVRI, Bareilly during 24-25 April 2019.
- Delivered a talk "Maintaining and Managing Supercomputing Resources in Agriculture" in Altair's Annual Altair Technology Conference (ATC): High Performance Computing (HPC) Track held at Le Meridian Windsor Place, New Delhi on 14th June 2019.
- Delivered a lecture entitled "ASHOKA and Bioinformatics" in the CAFT training program "Next generation sequencing and its applicationto crop science" to be held from 03-23 September 2019 at ICAR-NIPB New Delhi on 17th Sept 2019.

S.B. Lal

- Developed resource material on "Big Data in R and R Hadoop" for a National Workshop on "Big Data Analytics with R" during 15-16 March, 2019 held at Dept. of CSE & IT, Rabindranath Tagore University, Bhopal as a Guest of Honor and Resource Person.

Sanjeev Kumar

- Conducted theory and practical sessions on Sequence analysis, Genome annotation in the "Workshop-cum-training on NGS data analysis" at Assam Agricultural University, Jorhat during 14-16 March 2019.

M.A. Iquebal

- Delivered invited lecture as resource person in DBT sponsored training on "Genetics and Genomic Data analysis in Aquaculture" during September 19-28, 2019, at ICAR-CIFA, Bhubaneswar, Odisha. The following topics with hands on session were covered. Pre-processing of NGS data, Genome assembly, Transcriptome analysis and Molecular marker discovery.
- Delivered invited lecture on "NGS data analysis:

genome assembly and antimicrobial prediction" during ICMR sponsored training National workshop on Clinical and translational research on bacteriophages as promising antimicrobial alternatives for therapeutics, prophylaxis and food safety" organized at ICAR-National Research Centre on Equine, Hisar on July 30, 2019.

U.B. Angadi

- Delivered lecture on Web based tool and mobile apps for wheat variety identification using throughput SNP genotyping data, in proceedings of national conference "Advanced Research Methodologies in social Science" during Feb 26th to 28th 2019 at University of Agricultural Sciences, Dharwad.
- Delivered lecture on Ferns Based Naive Bayesian Novel Method for Qualitative and Quantitative Data Analysis,, in proceedings of national conference "Advanced Research Methodologies in social Science" during Feb 26th to 28th 2019 at University of Agricultural Sciences, Dharwad.

Anu Sharma

- Delivered an invited talk on "Machine Learning for Binning of Metagenomics Data" in National Conference on "Challenges and opportunities in Statistics and Informatics for Futuristic Humanosphere especially in Agriculture(COSIFHA-2019) from 29-31 January, 2019 held at Department of Statistics & Computer Application at Acharya NG Ranga Agricultural University, Tirupati, Andhra Pradesh.

D.C. Mishra

- Delivered various lectures in the training entitled "Next Generation Sequence Data Analysis" during 14-16, March, 2019 at Department of Agricultural Biotechnology, Assam Agricultural University, Jorhat (Assam).

Shashi Dahiya

- Delivered two lectures on "Designing Databases and Online Applications with Case Studies" on 3rd of April'2019 in the "FACULTY DEVELOPMENT PROGRAMME ON DATA ANALYTICS" held during 3rd-5th April'2019 at Lady Irwin College, University of Delhi, New Delhi.
- Conducted a full day session on "Data Mining" and delivered 4 lectures on 14th June'2019 in a 5 days NAHEP training workshop entitled "Hands-On Training on Statistical Tools and Database Management in Agriculture" organized by Soil Science Division, PAU Ludhiana during 10-15 June'2019 at PAU Ludhiana.
- Delivered an invited talk on "Information Management and Mobile based Application Development" on 28th of August'2019 in a 21 days CAFT programme on "ICT based strategies for Nutritional Security" organized in the Division of Agriculture Extension, IARI, New Delhi during 16th August - 5 September'2019.

R.K. Paul

- Delivered full day lecture on 29th May, 2019 on "Data Analysis using R" in the Faculty Development Programme at JIMS, Delhi.
- Delivered a lecture on 20th August, 2019 on the topic "Forecasting prices of agricultural commodities" in the training programme on "Agricultural policy analysis and communication" for African Nationals during 16-25 August, 2019 organized by ICAR-NIAP, New Delhi
- Delivered a lecture on 23rd September, 2019 on the topic "Linear and Nonlinear Regression" in the training programme on "Quantitative Methods for Social Sciences" 21st September to 11th October 2019 at ICAR-NIAP, New Delhi.

Rajender Parsad

- Delivered an Invited Lecture on Constructing Composite Index: Methodological Perspective to the participants of the Training Programme on Agricultural Policy Analysis and Communication for African Nationals organized at ICAR-NIAP, New Delhi during August 16-25, 2019 (lecture was delivered on August 19, 2019).
- Delivered an Invited Lecture on Information System for AICRP on Fruits to the participants of the Training-cum-Interface Meeting on Project Appraisal and Research Data Management of ICAR-AICRP on Fruits organized by AICRP on Fruits at ICAR-IIHR, Bengaluru during August 19-21, 2019 (lecture was delivered on August 19, 2019 through Google Hangout)
- Delivered 03 invited lectures on 1. Principal Component Analysis, 2. Logistic Regression and 3. Web Resources on Statistical Sciences and KRISHI Portal to the participants of the

Training Programme on Different Statistical Tools organized by Directorate of Economics and Statistics, Dehradun, Uttarakhand at Financial Training and management Institute, Suddhowala, Dehradun during August 19-22, 2019 (Lectures were delivered on August 20, 2019).

- Delivered a lecture on Web Resources on Design of Experiments at Department of Statistics and Mathematics, CCS, HAU, Hisar on December 19, 2019.
- Nominated to teach part of a course on Basic Statistics to the postgraduate students of Advanced Centre for Agricultural Research and Education (ACARE), Yezin Agricultural University Campus, Yezin, Nay Pyi Taw, Myanmar during September 11-21, 2019. Delivered 24 lectures and practical on the topics (i) Statistics: Introduction and Concepts (2); (ii) MS-EXCEL: Analysis of Experimental Data (2); (iii) Planning of Experiments (1); (iv) Basic Principles of Experimental Designs (1); Designs for Single Factor Experiments such as Completely randomized designs (2); Randomized complete block designs (2); Latin square designs (2), Augmented Designs (1); Resolvable block designs (2), Youden square designs (2); Designs for Multi-Factor Experiments without and with confounding and Fractional factorial plans (3), Response surface designs (2) and Experiments with mixtures (2). I have also conducted quiz, theory and practical examinations. The final result was submitted on September 21, 2019.
- Delivered an invited lecture on Introduction of Design of Experiments to the participants of the Training Programme on Modeling, Simulation and Systems Analysis Techniques organized at Institute for Systems Studies and Analysis, Defence Research and Development, Delhi during October 14-18, 2019 (Lecture was delivered on October 17, 2019).
- Delivered an invited lecture on Principles of Field Experimental Designs to the participants of the Training Programme on Layout and maintenance of field experiments and recording observation organized for capacity building of the technical Officers of ICAR Institutes at the Division of Agronomy, ICAR-IARI, New Delhi during October 29-November 11, 2019 (Lecture was delivered on October 30, 2019).

Susheel Kumar Sarkar

- Delivered 02 lecture on Hypothesis Testing to the participants of the 2nd Refresher Course in Research Methodology (Interdisciplinary at JNU, New Delhi during October 14 - 26, 2019 (Lecture was delivered on October 17, 2019).

B N Mandal

- Delivered one invited lecture on "Overview of R software" in a summer school training programme on "Quantitative Methods for Social Sciences" from 21st September – 11th October, 2019 at NIAP, New Delhi. The lecture was delivered on 21/09/2019.

Sukanta Dash

- Delivered 2 lectures on (i) Conjoint analysis (ii) Hands on conjoint analysis in a ICAR- Summer School on "Quantitative Methods for Social Sciences" during 21st September to 11th October 2019 at ICAR-NIAP.

Meetings Attended

Seema Jaggi

- Attended the Foundation Day and Annual General Body Meeting of National Academy of Agricultural Sciences (NAAS) at NASC Complex during June 4-5, 2019.
- Participated in the 68th Institute Management Committee Meeting held on December 27, 2019 and made a presentation on Teaching and Training Activities of IASRI.

Rajender Parsad

- 13th International Conference on Dryland Development: Converting Dryland Areas from Grey into Green organized by International Dryland Development Commission (IDDC) and Arid Zone Research Association of India (AZRAI) and hosted by ICAR-CAZRI at Jodhpur during February 11-14, 2019.
- 34th Annual Workshop of AICRP on PHET organized at Tamil Nadu Agricultural University, Coimbatore during March 12-15, 2019.
- National Consultation on ICT in Agriculture organized at Lecture Hall, Second Floor, NASC Complex, DP Shastri Marg, New Delhi on March 06, 2019.

- Workshop for Chief Data Officers of OGD Platform India organized by National Informatics Centre at India Habitat Centre on April 11, 2019. Also shared OGD experiences and experiences gained for implementing KRISHI Portal.
- Technical Workshop of ICAR-BMGF collaborative project on Application of Next Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic gain in Indian Staple Crops organized by ICAR-IARI, New Delhi during April 24-25, 2019.
- National Workshop on Sustainability of Indian Agriculture: Methodology and Indicators organized by ICAR-NIAP, New Delhi during 18-19 June, 2019 at ICAR-NIAP, New Delhi
- Brainstorming session on Enhancing Science Culture in Agricultural Research Institutions organized by National Academy of Agricultural Sciences on June 25, 2019 at NASC Complex, New Delhi
- National Workshop on Agricultural Sustainability: Methods and Weight Determination organized jointly by Amity University, Amity Institute of Organic Agriculture and ICAR-NIAP, New Delhi at Amity University, Noida on August 31, 2019.
- Special Event on Closing the Agricultural Data Gap through Agricultural Integrated Surveys sponsored by FAO, Rome organized at NASC Complex, New Delhi on November 22, 2019.
- Attended Brain Storming Session on Big Data Analytics in Agriculture organized by National Academy of Agricultural Sciences on December 18, 2019.
- The 2019 IISA Conference on Innovations in Data and Statistical Sciences organized at IIT Bombay, Mumbai, during December 26-30, 2019

Susheel Kumar Sarkar

- Attended a two days technical workshop of the project was held on April 24-25, 2019 at NASC and IARI. Breeding programmes of various crops and AICRPs were discussed at length
- Attended Brain Storming Session on Big Data Analytics in Agriculture organized by National Academy of Agricultural Sciences on December 18, 2019

B N Mandal

- Special Event on “Using Administrative Data for Agricultural Statistics” in Young Statisticians’ Conference sponsored by Eurostat organized at NASC Complex, New Delhi on November 22, 2019.
- The 2019 IISA Conference on Innovations in Data and Statistical Sciences organized at IIT Bombay, Mumbai, during December 26-30, 2019
- Participated in a two days’ Workshop on ICAR KRISHI Portal - A Central Research Data Repository during March 18-19, 2019 at ICAR-IASRI, New Delhi

Sukanta Dash

- Participated a Sixth Group Discussion of ICAR-AICRP on Fruits held at Assam Agricultural University, Jorhat, during February 14-16, 2019.
- Attended The 2019 IISA Conference on Innovations in Data and Statistical Sciences organized at IIT Bombay, Mumbai, during December 26-30, 2019

Rajesh T.

- Deputed as Sector Officer for the General Election i.e. LokSabha 2019 in West Delhi, Parliamentary Constituency (PC-06) from 15/03/2019 to 28/05/2019 and attended a series of meetings with AERO, Presiding Officers, Polling Officers, Sector Officers and SDM (Rajouri Garden) to have a discussion regarding smooth conducting of LokSabha General Election 2019 in West Delhi.

Ravindra Singh Shekhawat

- Deputed as Sector Officer for the General Election i.e. Lok Sabha 2019 in West Delhi, Parliamentary Constituency (PC-06) from 15/03/2019 to 28/05/2019 and attended a series of meetings with AERO, Presiding Officers, Polling Officers, Sector Officers and SDM (Rajouri Garden) to have a discussion regarding smooth conducting of Lok Sabha General Election 2019 in West Delhi.
- Deputed as Sector Officer for the Delhi Assembly election 2020 in AC-27 and have training and meeting with Sector Officers, AERO, ARO and SDM (Rajouri Garden) to have a discussion regarding smooth conducting of election.

Tauqueer Ahmad

- Attended Technical Advisory Committee (TAC) meeting for Crop Insurance held on 22 January, 2019 at Krishi Bhawan, New Delhi as member, TAC.
- As Officiating Director, attended a meeting under the Chairmanship of DG, ICAR and Secretary, DARE in DG's Committee Room at Krishi Bhawan, New Delhi on 30 January, 2019 in which progress of ERP project was reviewed and possibility of launching ERP-II project was discussed in detail.
- Attended a meeting on 31 January, 2019 at Agriculture Department, Bhopal, Madhya Pradesh (M.P.) under the Chairmanship of Additional Director, Agriculture Department, Bhopal to discuss the plan for carrying out the on-going Crop Insurance study during Rabi season 2018-19 and mainly to take M.P. State on-board for the smooth conduct of the study.
- Attended Directors' Conference in the forenoon of 01 February, 2019 held at NASC Complex, New Delhi as Officiating Director.
- Attended a meeting on 06.02.2019 at Agriculture Department, Lucknow, Uttar Pradesh (U.P.) under the Chairmanship of Director, Agricultural Statistics and Crop Insurance, Lucknow to discuss the plan for carrying out the Crop Insurance on-going study during Rabi season 2018-19 and mainly to take U.P. State on-board for the smooth conduct of the study.
- Attended Assessment Board meeting of T-II on 07 February, 2019 at ICAR-IASRI as member of the Committee.
- Attended a meeting held on 11 February, 2019 at Agriculture Department, Murena, M.P. under my Chairmanship in which details of the Crop Insurance study was shared and training for Crop Cutting Experiments was imparted to the primary workers, supervisors and other higher officers of the district.
- Attended Technical Advisory Committee (TAC) meeting for Crop Insurance issues relating to Jammu and Kashmir held on 19 March, 2019 at Krishi Bhawan, New Delhi as member, TAC.
- Attended a meeting organized by DES, MoAFW, Govt. India to discuss the methodology for obtaining Minimum Support Price (MSP) for minor millets 20 March, 2019 held on 20 March, 2019 at Krishi Bhawan, New Delhi as nominee of Director, ICAR-IASRI.
- Attended a meeting under the Chairmanship of Additional Secretary, MoFPI, Govt. India to discuss the proposal for carrying out the third national level study on assessment of post harvest losses of crops and commodities in India and a new study for assessing percentage of processing to be funded by MoFPI held on 05 April, 2019 at Panchsheel Bhawan, New Delhi.
- Attended meeting on exploring area of collaborations on SDGs data related matters under the Chairmanship of Chief Statistician of India and Secretary, MoSPI at Sardar Patel Bhawan, Sansad Marg, New Delhi on 29 May, 2019.
- Attended the meeting for presentation of the project proposal 'Integrated Sampling Methodology for Crop Yield Estimation at Gram Panchayat Level using Advanced Technologies for Crop Insurance' at MNCFC, New Delhi and made the presentation on 12 July, 2019.
- Attended the meeting for presentation of the project proposal 'Integrated Sampling Methodology for Crop Yield Estimation using Remote Sensing, Field Surveys and Weather Parameters for Crop Insurance under the Chairmanship of Additional Secretary, Credit at Krishi Bhavan New Delhi and Amade the presentation on 09 July, 2019.
- Attended IDC meeting on 11 July 2019.
- Attended a meeting with Dr. J.S. Samra, Former DDG (NRM), ICAR on 04 July, 2019 regarding a study on crop residue burning.
- Attended RAC meeting on 17 September, 2019 under the Chairmanship of Dr. R.B. Singh, former Chairman ASRB and former Director, IARI and presented the activities and achievements of the division for the last one year and three months.
- Attended a meeting with Sh. Sunil Kumar, Assistant Director and his team, Credit Division, DACFW, MoAFW, Govt. India at Krishi Bhawan, New Delhi to discuss the organizational aspects of one day Conference on CCE to be held on 30 September, 2019.

Hukum Chandra

- Attended Project presentation meeting on "Pilot Study for "Developing State Level Estimates of

Crop Area and Production on the Basis of Sample Sizes Recommended by Professor Vaidyanathan Committee Report" under the chairmanship of Sr, Economic & Statistical Adviser, DES, Krishi Bhawan, New Delhi, January 08, 2019.

- Attended meeting of Training Programme Approval Committee under the chairmanship of Director General (Social Statistics), CSO, Ministry of Statistics and Programme Implementation, Govt. of India, New Delhi, February 19, 2019.
- Attended meeting with Dr. K.C. Pandey, Project Coordinator, AICRP on EAAI at ICAR-IASRI, New Delhi, January 25, 2019.
- Attended meeting of the Core Group on normalization at National Testing Agency, Gautam Budh Nagar, Noida Uttar Pradesh, February 16, 2019 and May 18, 2019.
- Attended, as Expert Member, Advisory meeting of the experts for the project "Tamil Nadu Household Panel Survey (TNHPS)", Madras Institute of Development Studies and Department of Economics and Statistics, Govt. of Tamil Nadu, Chennai, March 11, 2019.
- Attended, as Member, 22nd meeting of Management and Systems Division Council at Bureau of Indian Standards, Bahadur Shah Zafar Marg, New Delhi, March 13, 2019.
- Attended, as Expert Member, Departmental Promotion Committee meeting at ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata, March 26, 2019.
- Attended 28th meeting of Sectional Committee on "Statistical Methods for Quality and Reliability" (MSD 3), Bureau of Indian Standards, New Delhi, April 16, 2019.
- Attended meeting of subcommittee for "Sampling Methods" (MSD 3:6), Bureau of Indian Standards, New Delhi, April 16, 2019.
- Attended meeting on exploring area of collaborations on SDGs data related matters under the chairmanship of Chief Statistician of India and Secretary, MoSPI at Sardar Patel Bhawan, Sansad Marg, New Delhi, May 29, 2019.
- Attended National Academy of Agricultural Science, New Year Programme at NASC Complex, New Delhi, January 01, 2019.
- Attended 1st meeting of panel for Planning Future Strategy for MSD 3, MSD 3/P-8, Bureau of Indian Standards, New Delhi, August 06, 2019
- As Expert member, attended Advisory Committee meeting to discuss the next steps on TNHPS Data Analysis with Madras Institute of Development Studies and Department of Economics and Statistics, Govt. of Tamil Nadu, Chennai, August 09-10, 2019.
- As Expert member, attended selection committee meeting of Assistant Professor in Agricultural Statistics, Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut, UP, August 13, 2019.
- Attended RAC meeting and presented progress of National Fellow Project at ICAR-IASRI, New Delhi, September 17, 2019
- Attended Internal Evaluation Committee meeting for validation of Sampling Plan at ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Bengaluru, India, October 11, 2019.
- Attended the review meeting and presented the progress of ICAR National Fellow project entitled "Robust and Efficient Small Area Estimation Methods for Agricultural and Socio-economic Surveys and Their Application in Indo-Gangetic Plain", ICAR, New Delhi, November 20, 2019.
- Attended Experts meeting of the Myanmar Census Agriculture 2020, Nay Pyi Taw, Myanmar during December 16-20, 2019.

Kaustav Aditya

- Attended the duty as flying squad executive magistrate for the general election to the Lok Sabha 2019 in 26 East Delhi constituency from 11 March to 15 March, 2019.

Ankur Biswas

- Attended Technical Advisory Committee meeting on the issues of prevented sowing in Jalore and Barmer districts of Rajasthan under PMFBY on 08 April, 2019 at Krishi Bhawan, New Delhi.
- Attended a meeting of High-Power Committee for Discussion and Finalization of the Protocol of Smart Sampling Technology and Optimization of CCEs on 11 September, 2019 at Krishi Bhawan, New Delhi.
- Attended a meeting of Sectoral Committee on "Poverty, Agriculture & Food Security" for Goal-1

& 2 to discuss the SDG retated matters on 12 September, 2019 at MoSPI, New Delhi.

- Attended First Technical Advisory Committee (TAC) meeting for resolution of yield dispute relating to the AY of Paddy in 3 blocks of Sambalpur District of Odisha raised by insurance company under PMFBY under the chairmanship of AS (Credit), MoA&FW on 18 October, 2019 at Krishi Bhawan, New Delhi.
- Attended First meeting of Technical Advisory Group (TAG) Agriculture Statistics and related issues under the chairmanship of Director General, NSS on 05 November, 2019 at Sankhyiki Bhawan, New Delhi.
- Attended final review meeting for the Pilot Studies for CCE optimization on 9th November, 2019 at MNCFC, New Delhi and made presentation on the project entitled "Integrated Sampling Methodology for Crop Yield Estimation using Remote Sensing, Field Surveys and Weather Parameters for Crop Insurance".
- Attended Second Technical Advisory Committee (TAC) meeting for resolution of yield dispute relating to the AY of Paddy in 3 blocks of Sambalpur District of Odisha of Kharif 2018 raised by insurance company under PMFBY under the chairmanship of AS (Credit), MoA&FW at Krishi Bhawan on 29 November, 2019 at Krishi Bhawan, New Delhi.
- Attended Third Technical Advisory Committee (TAC) meeting for resolution of yield dispute relating to the AY of Paddy in 3 blocks of Sambalpur District of Odisha of Kharif 2018 raised by insurance company under PMFBY under the chairmanship of AS (Credit), MoA&FW at Krishi Bhawan on 06 December, 2019 at Krishi Bhawan, New Delhi.
- Attended third meeting of Sectoral Committee on "Poverty, Agriculture &Food Security" for Goal-1 & 2 to discuss the SDG retated matters under the Chairmanship of ADG(SSD), MoSPI on 10 December, 2019 at East Block-10, RK Puram, Sector-1, New Delhi.
- Attended Second Technical Advisory Committee (TAC) meeting for resolution of Yield Variation disputes in Ahmednagar, Satara, Pune and Sangli districts of Maharahstra during Rabi 2018-19 season raised by insurance company under PMFBY under the chairmanship of AS (Credit), MoA&FW at Krishi Bhawan on 13 December, 2019 at Krishi Bhawan, New Delhi.

Raju Kumar

- Meeting of technical advisory committee (TAC) for reviewing the order dated 30 April, 2019 passed by the TAC on the issue of pending claims of Jalore and Barmer districts of Rajasthan under Pradhan Mantri Fasal Bima Yojana for Kharif 2018.
- Meeting of technical advisory committee (TAC) on the report submitted by the MNCFC on the prevented sowing matter of Jalore and Barmer district of Rajasthan under Pradhan Mantri Fasal Bima Yojana for Kharif 2018 on 22 August, 2019.

Pradip Basak

- Attended the duty as flying squad executive magistrate for the general election to the Lok Sabha 2019 in 07 South Delhi parliamentary constituency from 11 March to 26th March, 2019.

Ranjit Kumar Paul

- Attended the Annual Action plan (2019-20) meeting for the KVKs under ICAR-ATARI, Umiam during March 1-2, 2019 at Umiam.
- Attended one meeting at Krishi Bhawan on 20th March, 2019 chaired by Joint Secretary, DMI, Ministry of Agriculture regarding the procedure of collecting the data for Agmarknet.
- Attended one meeting at Krishi Bhavan on 29th April, 2019. Presented the technical part for modelling and forecasting of price of agricultural commodities under the chairmanship of Secretary DAC.

Anil Rai

- Attended Consultative meeting on "Development of Roadmap on Genomic Selection on Cattle and Buffaloes and Modalities for National Genetic Evaluation System (NGES)" at NASC, Complex New Delhi-110012 during January 18-19, 2019
- Attended interaction meeting of ICAR Experts with AI team of IBM under the Chairmanship of D.G. ICAR at ICAR, New Delhi on March 11, 2019
- Attended IMC of ICAR-NIAP, New Delhi on March 16, 2019

- Organized and attended review meeting and brainstorming meeting on "Metagenomics in Brackish Water Fisheries" on March 8, 2019 at ICAR-CIBA, Chennai.
- Attended the meeting on January 14, 2019 at School of Computer Science, JNU, New Delhi

A.R. Rao

- 409th Academic Council meeting of PG School, IARI held at IARI, New Delhi on 7th February 2019
- Attended 410 meeting of Academic Council on 25-07-2019
- Attended 411 meeting of Academic Council on 14-11-2019
- 54th Institute Management Committee Meeting held at ICAR-Central Institute for Cotton Research, Nagpur on 26-02-2019
- Attended 91st Foundation Day of the ICAR on 16-07-2019
- Attended 132nd Professors Meeting on 02-09-2019 at IARI, New Delhi
- Attended 55th IMC meeting of ICAR-CICR, Nagpur on 01-10-2019
- Attended 5th Meeting of Working Group on Industrial Applications on 12-09-2019 at Ministry of Electronics & Information Technology, New Delhi
- Attended 6th Meeting of Working Group on Industrial Applications on 30-10-2019 at Ministry of Electronics & Information Technology, New Delhi
- Attended Journal Score Committee, National Academy of Agricultral Scences (NAAS), New Delhi on 5-6 December 2019.
- National Consultation on "Genomics and Bioinformatics in Agriculture: The way Forward" at NASC complex, New Delhi on 27the Nov 2019.
- Project review meeting of Network Project of Agricultural Bioinformatics and Computational Biology during held at IASRI, New Delhi held during 16-17, January, 2019.
- Steering committee meeting of Network Project on Agricultural Bioinformatics and Computational Biology held at ICAR-IASRI, New Delhi held on 05, March, 2019.
- Attended review meeting of Network Project on Computational Biology and Agricultural Bioinformatics on 03/08/2019 and 07/08/2019 held at ICAR-IASRI, New Delhi.
- Project review meeting of Network Project of Agricultural Bioinformatics and Computational Biology during held at IASRI, New Delhi held on 02, November, 2019 under the chairmanship of Director General, ICAR, New Delhi

U.B.Angadi

- Attended National conference "Advanced Research Methodologies in Social Science" at University of Agricultural Sciences, Dharwad on Feb 26th to 28th 2019
- National Consultation on "ICT in Agriculture" at NASC complex, New Delhi on 6th March 2019.
- National Conference on "PBS-Pro Altair ATXc 2019 at New Delhi on 14th June 2019.
- Workshop on "SIReDAM- Systematic Information Resources Dairy Animal Management" at ICAR-Central Institute for Research on Cattle, Meerut, UP on 5th Nov 2019.
- National Consultation on "Genomics and Bioinformatics in Agriculture: The way Forward" at NASC complex, New Delhi on 27the Nov 2019.

M.A. Iquebal

- Attended 5th International Conference on Plant Genetics and Genomics: Germplasm to Genome Engineering at NASC Complex PUSA, New Delhi during October 17-18, 2019
- Attended International Conference on Recent Trends in Bioinformatics and Big Data analysis at National Institute of Plant Genome Research, New Delhi.

Sarika

- Attended 5th International Conference on Plant Genetics and Genomics: Germplasm to Genome Engineering at NASC Complex PUSA, New Delhi during October 17-18, 2019
- Attended International Conference on Recent Trends in Bioinformatics and Big Data analysis at National Institute of Plant Genome Research, New Delhi.
- Attended the Foundation Day and Annual

General Body Meeting at NASC Complex, New Delhi

- Working as the committee member for evaluation of quality attributes of the non-IF Journals for NAAS.

D.C. Mishra

- Attended an International Symposium on"Recent trends in Bioinformatics and Big data analysis" held at NIPGR, New Delhi on 08 November, 2019.
- Attended a brainstorming meeting on "National Consultation on Genomics and Bioinformatics in Agriculture : The Way Forward" held at NASC, New Delhi on 27/11/2019 under the chairmanship of DG, ICAR, New Delhi
- Attended fifth annual review meeting of National Agriculture Science Fund (NASF) on **"Abiotic and biotic stresses, and quality traits in plants"** held at NASC, New Delhi on 06, March, 2019.

Sudhir Srivastava

- Attended seminar titled "Tracking Recognition Elements in RNA-based and Classic Immune Surveillance" on May 9, 2019 at Health Sciences Center, University of Louisville.
- Attended seminar titled "Opportunistic RNAs and Acquisitive Genomes" on May 10, 2019 at CTRB, University of Louisville.
- Attended the 28th Annual E. Leonard Arnoff/ Milton J. Schloss Memorial Lecture on the Practice of Business Analytics hosted by the Lindner College of Business on April 17, 2019. The lecture "The Future of Statistical Bioinformatics and Genomics in the Automated World of Agriculture" was presented by Rebecca W. Doerge, Professor of statistics and biology at Carnegie Mellon University, and Glen de Vries, Dean of the Mellon College of Science at Carnegie Mellon.
- Attended the 10x Genomics Seminar "Single Cell" on June 5, 2019 at the Clinical Translational Research Building (CTRB), University of Louisville.

12

Conferences, Workshops, Meetings and Seminars organized

Eighth International Conference on Agricultural Statistics 2019 (ICAS-VIII) during 18-21 November, 2019

The Eighth International Conference on Agricultural Statistics 2019 (ICAS-VIII) was held during 18-21 November 2019 at New Delhi, India. ICAS-VIII was organized by the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers' Welfare (MoA&FW), Government of India with active participation from Department of Agriculture Cooperation & Farmers Welfare (DAC&FW) under MoA&FW and in close collaboration with the Food and Agriculture Organization of the United Nations (FAO), the US Department of Agriculture (USDA), ISI-CAS, EUROSTAT, Ministry of Statistics and Programme Implementation (MoSPI) and many other international and national organizations. It is emphasized here that, the DARE, under its valuable guidance, entrusted the task of organizing this mammoth event to ICAR-Indian Agricultural Statistics Research Institute (IASRI), New Delhi which is a constituent institute of ICAR that jointly worked with Indian Society of Agricultural Statistics (ISAS), New Delhi and National Academy of Agricultural Sciences (NAAS), New Delhi for smooth conduct of the event.

It was indeed a unique and important opportunity for India that it hosted this academically enduring conference for the first time. The Conference provided an opportunity to the young statisticians, agricultural workers and policy planners to learn the use of modern approaches in agriculture, such as, big data analysis, wide use of Artificial Intelligence in agriculture, precision farming and remote sensing, etc., for achieving the Sustainable Development Goals. Several younger statisticians, who participated in one of the earlier ICAS events, have now moved on to high-level positions in their country or in international organizations.

The theme of ICAS-VIII was "Statistics for Transformation of Agriculture to Achieve the Sustainable Development Goals (SDGs)". Other thematic sets for concurrent sessions were: Data Analysis / Data Integration; Data Sources / Data Collection/ Data Quality; Data Dissemination & Communication; Use of Statistics for Policy Making and Research; Food Security, Poverty, Rural Development and Social Dimensions of Agriculture; Sustainable Agricultural Production and Consumption; Natural Resource Use in Agriculture; Climate Change and Environmental Issues; Capacity building in Agricultural Statistics and Monitoring the SDGs. ICAS-VIII was also annexed with three side events as post-conference events on the use of methods and standards for the collection and analysis of agricultural statistics. On the website https://icas2019.icar.gov.in/ detailed information about the Conference are available.

The inaugural function was held on November 18, 2019 at National Agricultural Science Complex, New Delhi and other thematic sessions were held during 19-21 November 2019 at The Ashok Hotel, New Delhi. The inaugural function was attended by more than 1200 participants consisting of conference delegates, officials from various Ministries, volunteers and students. The Conference was inaugurated by the Chief Guest Dr. William Henry Gates III popularly known as Shri Bill Gates, Co-Chair, Bill & Melinda Gates Foundation in presence of Shri Narendra Singh Tomar, Union Minister of Agricuture & Farmers'

Welfare, Rural Development and Panchayati Raj who presided over the inaugural function of the conference and Guest of Honour, Shri Kailash Choudhary, Union Minister of State for Agriculture & Farmers' Welfare at the National Agricultural Science Centre Complex, New Delhi on 18th November, 2019. Shri Pietro Gennari, Chief Statistician, FAO, Rome, Italy; Ms. Mariana Kotzeva, Director General, EUROSTAT and Prof. Ramesh Chand, Member, NITI Aayog, India where some of the Keynote Speakers during the Conference. Earlier, while speaking during a curtain raiser organized prior to ICAS event, Dr. Purvi Mehta, Senior Advisor and Head of Agriculture for Asia, Bill & Melinda Gates Foundation (BMGF) highlighted about the huge potential in agricultural statistics in India.

A two-day "Training Session on Methodology for Agricultural Censuses and Surveys" during 22-23 November, 2019 was also conducted as a post conference event to ICAS.

A.R. Rao

- Organized NAHEP-CAAST 10 days training programme on "High Dimensional Genome data Analysis by R and Open Source Tools" as Course Director during November 01-11, 2019.

Alka Arora and Anshu Bharadwaj

- Organised two one day workshops on Financial Management System for Administrative and Finance Officers of ICAR institutes on October 15 and October 21, 2019.

Ankur Biswas

- Conducted a one-day Training for the field investigators on Crop Cutting Experiments on fruits and vegetables (class room training as well as field training) at Horticulture Training Institute (HTI), Uchani, Karnal on August 08, 2019 and provided technical guidance in implementation of the developed methodology by ICAR-IASRI under CHAMAN project in the Haryana State.

Anshu Bharadwaj and Mukesh Kumar

- Organised a Training cum Workshop at ICAR-IASRI, New Delhi for the Officer Incharge, Data Management, KRISHI (under KRISHI Project) during February 15-16, 2019.

Anshu Bharadwaj, Susheel Sarkar and Sukanta Dash

- Organized Sensitization Training cum Workshop for the Nodal Officers of KRISHI (Under KRISHI Project) during March 18-19, 2019.

Anuja A R, Ravindra Singh Shekhawat and Prawin Arya

- Organizer cum exhibitor of ICAR-IASRI stall in Krishi Unnati Mela organized by ICAR-IARI, New Delhi during March 05-07, 2019.

B. N. Mandal

- Organized Hindi workshop on "Academic writing with LaTeX" by the Division of Design of Experiments with the cooperation of Hindi Unit of the institute on March 25, 2019 in the institute.

D.C. Mishra

- Organized a three days training entitled "Next Generation Sequence Data Analysis" as a Coordinator during March 14-16, 2019.
- Organized a three days workshop entitled "*Jaiv Soochna Vigyaan*: *Tools evam Taknikiyan*" as a Coordinator during December 09-11, 2019.
- Organized a 10 days training entitled "Recent Advances of Bioinformatics in Agricultural

Research: A Practical Perspective" as a Course Co-Coordinator December 12-21, 2019.

Hukum Chandra

- As Course Director, organized a training cum interaction programme on "Sampling Design and Schedules for Implementation of Energy Audit Survey" was organized at ICAR-IASRI, New Delhi during November 01-02, 2019 under EMA component of the ICAR-AICRP on Energy in Agriculture and Agro based Industries.
- As Convener, Invited Technical Session on "Recent Developments in Analysis of Complex Survey Data", International Conference of International Indian Statistical Association 2019 (IISA 2019), Mumbai during December 26-30, 2019.
- As Convener, organized Technical Session on "Sampling Methodology-1", Eighth International Conference on Agricultural Statistics (ICAS-VIII), New Delhi, India during November 18-21, 2019.
- As Convener, organized Technical Session on "Sampling Methodology-2", Eighth International Conference on Agricultural Statistics (ICAS-VIII), New Delhi, India, during November 18-21, 2019.

Hukum Chandra, Rajender Parsad, B. N. Mandal, Kaustav Aditya, Pradip Basak and Vandita Kumari

- As Member, Organizing Committee, organized Young Statisticians Seminar on Methodology for Agricultural Censuses and Surveys sponsored by USDA at NASC Complex, New Delhi during November 22-23, 2019.

K.K. Chaturvedi

- Organized HPC Administration Training on April 29, 2019.
- Organized HPC Management Training for Upgraded Cluster on May 03, 2019.
- Organized one day training on Job submission, administration and Analytics of HPC on July 24, 2019.
- Organized a meeting under the chairmanship of ADG (ICT) with Computer Scientists of the institute to discuss AI applications in Agriculture on July 19, 2019.
- Organized various programmes to celebrate 150th Anniversary of Mahatma Gandhi as Member, Photography and Audio Video Recording Committee during September 26 to October 02, 2019.
- Organized HPC Storage Training for Upgraded Cluster on May 08, 2019.

Mukesh Kumar

- Organized a Training programme on e-Office during May 03-04, 2019.
- Organized two days training on e-Office at ICAR- CPRI, in which ICAR- CPRI and its all regional stations, ICAR- DMR, Solan and personnel of regional stations of other institutes located at Shimla have participated during June 10-15, 2019.

Mukesh Kumar, Sudeep, Rakesh Saini and Vijay Kumar

- Organised a Sensitization training cum workshop on "Implementation of e-Office in ICAR Institutes during January 23`-24, 2019.

Mukesh Kumar, Sudeep and Shashi Dahiya

- Organized training Programme on ICAR-ERP for Finance Officers of ICAR during March 11-16, 2019.

Mukesh Kumar and Sudeep

- Organized One day workshop on Financial Management System for Administrative and Finance Officer of 26 ICAR institutes on September 16, 2019.

Mukesh Kumar and S.N. Islam

- Organised one day workshop on Financial Management System was organized for Administrative and Finance Officer of ICAR institutes on October 31, 2019.

Pal Singh

- Organised and attended "Sensitization workshop on NAHEP component -2A Activities & Implementation of Academic Management System(AMS)" under National Agricultural higher Education Project at C.S. Azad University of Agriculture & Technology Kanpur U.P. during November 28-29, 2019.

P.K. Meher

- Organised a training programme "High

dimensional genome data analysis by R and open source tools" under NAHEP-CAAST project during, November 01-11, 2019 at our institute.

Rajender Parsad, Sukanta Dash and Arpan Bhowmik

- Organized Modular Course on Basic Statistical Methods in Agriculture for the Participants of 3rd Batch of Afghanistan National Agricultural Sciences and Technology University Students under International M.Sc. Programme for Afghan Nationals on Teaching of Post-Graduate courses in Agronomy" from February 04-23, 2019 at ICAR-IASRI, New Delhi
- Organized a Training-Cum-Workshop on Unit Level Data Repository for AICRPs during February 25-26, 2019 under KRISHI project

Rajender Parsad, Anil Kumar, Anshu Bharadwaj, Susheel Kumar Sarkar and Sukanta Dash

- Organized two days Workshop on ICAR KRISHI Portal - A Central Research Data Repository during **March 18-19, 2019** at ICAR-IASRI, New Delhi.

Rajender Parsad and B. N. Mandal

- Organized a session on Spatial Sampling Designs and Spatial Data Analytics during Eighth International Conference on Agricultural Statistics during November 18-21, 2019 at New Delhi (Session was held on November 21, 2019).

Rajender Parsad and Mukesh Kumar

- Organized one day workshop on KRISHI Portal-ICAR Research Data Repository at NRC, Banana, Tiruchirappalli on 25 March, 2019.

Sangeeta Ahuja, S.N Islam and Sudeep

- Organised a training programme on "E-governance Applications in ICAR" during December 16-20, 2019.

Shashi Dahiya

- Organised two days workshop for the Nodal Officers of collaborating ICAR institutes and State Agricultural Universities under the NAHEP, Component 2A Subproject - "Investments in ICAR Leadership in Agricultural Higher Education" at NASC Complex, New Delhi during September 18 - 19, 2019.

Shashi Dahiya, Mukesh Kumar and Pal Singh

- Organized a One days Hindi Workshop on "File Management System in e-office" on September 30, 2019 as Workshop Co-coordinator.

Seema Jaggi, Rajender Parsad and Anindita Datta

- Coordinated three months Professional Attachment Training for ARS Probationers of the discipline of Agronomy on Design of Experiments and Data Analysis at our institute during November 12, 2018 - February 11, 2019.

Soumen Pal

- Organised a NAHEP sponsored Training programme on High Dimensional Genome Data Analysis by R and Open Source Tools during November 01-11, 2019.

Sudeep, Shashi Dahiya and Soumen Pal

- Organized Hands-on Training on "Statistical Tools and Database Management in Agriculture" jointly with PAU, Ludhiana under NAHEP Component 2 during September 11-12, 2019.

Sudeep and S.N. Islam

- Organized the Smart India Hackathon SIH 2019 as Nodal officer and Co-ordinator from ICAR side at Shiva Nadar College of Engineering, Chennai during March 02-03, 2019.

Tauqueer Ahmad

- Organized Eighth International Conference on Agricultural Statistics (ICAS VIII) during November 18-21, 2019 as Director of the Institute organizing the Conference.
- Organized a training programme on "Field Survey, data collection, compilation and analysis" at ICAR-IASRI for the participants from Indian Council of Forestry Research and Education (ICFRE), Dehradun during November 04-08, 2019 as Program Director.

Distinguished Visitors

1. **Shri Narendra Singh Tomar**
   Union Minister of Agricuture & Farmers' Welfare & Rural Development and Panchayati Raj
   Krishi Bhavan, New Delhi

2. **Shri Kailash Choudhary**
   Union Minister of State for Agriculture & Farmers' Welfare,
   Krishi Bhavan, New Delhi

3. **Prof. Ramesh Chand**
   Member, NITI Aayog,
   New Delhi

4. **Dr. Trilochan Mohapatra**
   Secretary (DARE) & Director General (ICAR),
   Krishi Bhavan, New Delhi

5. **Dr. N.S. Rathore**
   Deputy Director General (Education),
   Indian Council of Agricultural Research,
   New Delhi

6. **Dr. R.C. Agrawal**
   Deputy Director General (Education),
   Indian Council of Agricultural Research,
   New Delhi

7. **Dr. K. Alagusundaram**
   Deputy Director General (Agricultural Engineering),
   Indian Council of Agricultural Research,
   New Delhi

8. **Dr. Joykrushna Jena**
   Deputy Director General (Fisheries Science),
   Indian Council of Agricultural Research,
   Krishi Bhawan, New Delhi

9. **Dr. Pravin Srivastava**
   Secretary (MoSPI) and Chief statistician of India (CSI),
   Sardar Patel Bhawan,
   Parliament Street, New Delhi

10. **Dr. Michael Steiner**
    World Bank representative,
    International Statistical Institute-CAS chair

11. **Shri Pietro Gennari**
    Chief Statistician,
    FAO, Rome

12. **Ms. Mariana Kotzeva**
    Director General,
    EUROSTAT, Luxembourg

13. **Dr. Sarah Hoffman**
    USDA,
    Washington, USA

14. **Dr. Purvi Mehta**
    Senior Advisor and Head of Agriculture for Asia
    Bill & Melinda Gates Foundation,
    New Delhi

15. **Dr. Srivalli Krishnan**
    Senior Program Officer,
    Agriculture Development - Asia India Country Office,
    Bill & Melinda Gates Foundation,
    New Delhi

16. **Dr. Mukesh Kumar Srivastava**
Senior Statistician,
FAO Regional Office for Asia and the Pacific,
Bangkok

17. **Shri Yugo Astuto**
Ambassador,
European Union of India,
New Delhi

18. **Shri Jose Rosero Moncayo**
Director, Statistics Division,
FAO, Rome

19. **Shri Gero Carletto**
Lead Economist, World Bank,
Washington, USA

20. **H.E. Eng. Wassfi Hassan Sreihin,**
Secretary General, AARDO,
New Delhi

21. **Dr. Manoj Nardeo Singh**
Assistant Secretary General, AARDO,
New Delhi

22. **Dr. P.S. Pandey**
Assistant Director General (EP&HS),
Indian Council of Agricultural Research,
New Delhi

23. **Dr. M.K. Agnihotri**
Assistant Director General (HRD),
Indian Council of Agricultural Research,
New Delhi

24. **Dr. G. Venkateshwarlu**
Assistant Director General (EQA&R),
ICAR Krishi Anusandhan Bhawan-II,
New Delhi

25. **Dr. V.K. Bhatia**
Ex-Director,
ICAR-Indian Agricultural Statistics Research Institute, New Delhi

26. **Dr. U.C. Sud**
Ex-Director
ICAR-Indian Agricultural Statistics Research Institute
New Delhi

27. **Dr. A.K. Srivastava**
Ex- Joint Director,
ICAR-Indian Agricultural Statistics Research Institute, New Delhi

28. **Dr. V.K. Gupta**
Ex- National Professor,
ICAR-Indian Agricultural Statistics Research Institute, New Delhi

29. **Dr. Ch. Srinivasa Rao**
Director,
ICAR-National Academy of Agricultural Research Management, Rajendranagar,
Hyderabad, Telangana

30. **Dr. Prakash Chauhan**
Director, Indian Institute of Remote Sensing,
Dehradun

31. **Dr. S.S. Ray**
Director, Mahalanobis National Crop Forecast Centre, New Delhi

32. **Dr. Bimal K. Bhattacharya**
Head, Space Applications Centre,
ISRO, Ahmedabad

33. **Dr. C. Patnaik,**
Space Applications Centre,
ISRO, Ahmedabad

34. **Dr. V.M. Chowdary**
Regional Remote Sensing Centre (RRSC)
-North, Indian Space Research Organisation,
New Delhi

35. **Dr. Padam Singh**
Ex-Additional DG, ICMR,
New Delhi

36. **Dr. K.K. Tyagi**
Ex- Principal Scientist
ICAR-Indian Agricultural Statistics Research Institute, New Delhi

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भा.कृ.अनु.प.-भारतीय कृषि सांख्यिकी अनुसंधान संस्थान में हिन्दी के प्रगामी प्रयोग की रिपोर्ट

भा.कृ.अनु.प.–भारतीय कृषि सांख्यिकी अनुसंधान संस्थान में राजभाषा हिन्दी के प्रगामी प्रयोग में सतत् अभिवृद्धि हो रही है। संस्थान के अधिकारियों/कर्मचारियों द्वारा समस्त प्रशासनिक कार्य शत–प्रतिशत हिन्दी में और यथाआवश्यक द्विभाषी किया जा रहा 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 निहित लक्ष्यों को संस्थान में लगभग पूरा कर लिया गया है।

भारतीय कृषि अनुसंधान परिषद् के संस्थानों में हिन्दी के प्रयोग को बढ़ावा देने के लिए चलायी जा रही ''राजर्षि टण्डन राजभाषा पुरस्कार योजना'' के अन्तर्गत वर्ष 2017–18 के लिए संस्थान को बड़े संस्थानों के वर्ग में द्वितीय पुरस्कार प्रदान किया गया। यह पुरस्कार संस्थान को 16 जुलाई 2019 को परिषद के स्थापना दिवस के अवसर पर प्रदान किया गया।

भारत सरकार, राजभाषा विभाग की नगर राजभाषा कार्यान्वयन समिति (उत्तरी दिल्ली) द्वारा वर्ष 2018–19 के दौरान राजभाषा कार्यान्वयन कार्य में उत्कृष्ट निष्पादन हेतु मध्यम वर्ग के कार्यालयों में संस्थान को प्रोत्साहन पुरस्कार प्रदान किया गया।

संस्थान में राजभाषा हिन्दी की प्रगति का जायजा लेने तथा संस्थान द्वारा ''राजर्षि टंडन राजभाषा पुरस्कार'' के लिए भेजी गयी प्रविष्टि में दर्शाये गए आँकड़ों के दस्तावेजी साक्ष्यों का निरीक्षण करने के लिए परिषद् मुख्यालय के उप–निदेशक (राजभाषा) द्वारा 29 अप्रैल 2019 को संस्थान का राजभाषा सम्बन्धी निरीक्षण एवं उक्त साक्ष्यों की जाँच की गयी। निरीक्षण एवं जाँच कार्य सफलतापूर्वक सम्पन्न हुआ।

प्रतिवेदनाधीन अवधि के दौरान संस्थान के विभिन्न वर्गों के कर्मियों के लिए पाँच हिन्दी कार्यशालाएँ आयोजित की गयीं । **पहली** कार्यशाला 22 से 27 फरवरी 2019 के दौरान प्रतिदर्श सर्वेक्षण प्रभाग के वैज्ञानिक, डॉ. राजू कुमार, श्री दीपक सिंह एवं डॉ. अंकुर विश्वास द्वारा **''कृषि सर्वेक्षण के लिए प्रतिदर्श तकनीकें एवं प्रतिदर्श आँकड़ों का सांख्यिकीय विश्लेषण''** विषय पर आयोजित की गयी। इस कार्यशाला में 04 अधिकारियों एवं 05 कर्मचारियों द्वारा सहभागिता की गयी। **दूसरी** कार्यशाला परीक्षण अभिकल्पना प्रभाग के वैज्ञानिक डॉ. बी.एन. मंडल द्वारा 25 मार्च 2019 को **''लाटेक के साथ शैक्षणिक लेखन''** विषय पर आयोजित की गयी। इस कार्यशाला में 18 अधिकारियों एवं 01 कर्मचारी द्वारा सहभागिता की गयी। **तीसरी** कार्यशाला 03 जून 2019 को **''राजभाषा नियम एवं हिन्दी यूनिकोड का उपयोग''** विषय पर आयोजित की गयी जिसमें संस्थान के विभिन्न वर्ग के कर्मियों ने सहभागिता की। इस कार्यशाला में 04 अधिकारियों एवं 23 कर्मचारियों द्वारा सहभागिता की गयी। **चौथी** कार्यशाला संगणक अनुप्रयोग प्रभाग द्वारा 30 सि. तम्बर 2019 को **''ई–ऑफिस में फाइल प्रबन्धन प्रणाली''** विषय पर आयोजित की गयी जिसमें संस्थान के विभिन्न वर्ग के कर्मियों ने सहभागिता की। इस कार्यशाला में 25 अधिकारियों एवं 22 कर्मचारियों द्वारा सहभागिता की गयी । **छठी** कार्यशाला 09 से 11 दिसम्बर 2019 के दौरान कृषि जैव सूचना केन्द्र के वैज्ञानिक, डॉ. द्विजेश चन्द्र मिश्र, डॉ. अनु शर्मा एवं डॉ. सुधीर श्रीवास्तव द्वारा **''जैव सूचना विज्ञानः टूल्स एवं तकनीकियाँ''** विषय पर आयोजित की गयी। इस कार्यशाला में 06 अधिकारियों एवं 06 कर्मचारियों द्वारा सहभागिता की गयी ।

संस्थान में प्रशासनिक कार्य के साथ–साथ वैज्ञानिक **प्रकृति के कार्यों में भी हिन्दी का** उपयोग हो रहा है। संस्थान के वैज्ञानिक प्रभागों द्वारा आयोजित प्रशिक्षण कार्यक्रमों की संदर्भ पुस्तिकाओं में कवर पेज, आमुख एवं प्राक्कथन द्विभाषी रूप में प्रस्तुत करने के साथ–साथ कुछ हिन्दी के व्याख्यान भी शमिल किये गये। वैज्ञानिकों द्वारा अपनी परियोजना रिपोर्टों में कवर पेज, आमुख, प्राक्कथन एवं सारांश द्विभाषी रूप में प्रस्तुत किये गये। संस्थान के वैज्ञानिकों द्वारा हिन्दी में वैज्ञानिक विषयों पर हिन्दी कार्यशालाओं का आयोजन किया गया तथा कार्यशालाओं के मैनुअल/प्रशिक्षण सामग्री हिन्दी में तैयार की गयी। इसके अतिरिक्त, संस्थान में एम.एससी. तथा पीएच.डी. के विद्यार्थियों द्वारा अपने शोध–प्रबन्धों में सार द्विभाषी रूप में प्रस्तुत किये गये। वैज्ञानिकों एवं तकनीकी कर्मियों द्वारा शोध–पत्र हिन्दी में प्रकाशित किये गये।

प्रतिवेदनाधीन अवधि में संस्थान में राजभाषा कार्यान्वयन समिति की बैठकें नियमित रूप से आयोजित की गयीं। इन बैठकों में राजभाषा अधिनियम, 1963 की धारा 3(3) के अनुपालन को सुनिश्चित करने, राजभाषा विभाग द्वारा जारी वार्षिक कार्यक्रम की विभिन्न मदों, राजभाषा विभाग एवं परिषद् मुख्यालय से समय–समय पर प्राप्त निदेशों का अनुपालन सुनिश्चित करने, कार्यशालाओं के नियमित आयोजन, हिन्दी पत्रिका के प्रकाशन, हिन्दी पखवाड़े के आयोजन इत्यादि पर विस्तार से चर्चा हुई।

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 शत–प्रतिशत हिन्दी में अथवा द्विभाषी रूप में जारी किये गये। 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।

संस्थान में कार्यरत सभी हिन्दीतर अधिकारियों/कर्मचारियों द्वारा हिन्दी ज्ञान सम्बन्धी 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 सम्बन्धी प्रशिक्षण दिया जाना शेष हो।

इसके अतिरिक्त, 'हिन्दी शिक्षण योजना' के अन्तर्गत संस्थान में 'हिन्दी आशुलिपि' के प्रशिक्षण का लक्ष्य पूरा है। अभी तक 'हिन्दी टंकण' के प्रशिक्षण का लक्ष्य भी पूरा था परन्तु दि. सम्बर 2018 से संस्थान में नव–नियुक्त 07 कनिष्ठ लिपिकों में से 02 कनिष्ठ लिपिकों को अगस्त 2019 से आरम्भ सत्र में हिन्दी टंकण के प्रशिक्षण हेतु भेजा गया है, 01 कनिष्ठ लिपिक का नाम फरवरी 2020 से आरम्भ होने वाले सत्र के लिये भेजा गया है, प्रवेश देने संबंधी पुष्टि प्राप्त होनी शेष है तथा 04 नव–नियुक्त कनिष्ठ लिपिक हिन्दी टंकण के प्रशिक्षण के लिये शेष हैं। **उक्त के अतिरिक्त**, राजभाषा विभाग से प्राप्त दिशा–निर्देशों के अनुसरण में वर्ग 'घ' से वर्ग 'x' में गये कर्मियों में से वर्ग 'x' श्रेणी के लिए निर्धारित शैक्षिक योग्यता रखने वाले 07 कर्मियों के नाम रोस्टरबद्ध कर उन्हें केन्द्रीय हिन्दी प्रशिक्षण संस्थान से हिन्दी टंकण का प्रशिक्षण दिलवाया जा चुका है। 06 कर्मियों द्वारा उक्त परीक्षा उत्तीर्ण की जा चुकी है तथा शेष बचे 01 कर्मी द्वारा जुलाई, 2019 में दी गयी टंकण परीक्षा का परिणाम अनुत्तीर्ण रहा है। उनके द्वारा अगामी टंकण परीक्षा पुनः दी जानी है।

संस्थान की वेबसाइट पर 'हिन्दी सेवा लिंक' उपलब्ध है। जिसमें सांख्यिकी 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 सामग्री उपलब्ध है। संस्थान के कर्मियों द्वारा अपना दैनिक कार्य हिन्दी में सरलता से करने के लिए इस सेवा का उपयोग किया जाता है।

संस्थान द्वारा प्रकाशित हिन्दी पत्रिका, 'सांख्यिकी–विमर्श' के चौदहवें अंक का प्रकाशन मार्च 2019 में किया गया। इस पत्रिका में संस्थान में सम्बन्धित वर्ष में किये गये अनुसंधानों व अन्य कार्यों के संक्षिप्त विवरण, राजभाषा से सम्बन्धित कार्यों आदि की जानकारी के साथ–साथ कृषि सांख्यिकी, संगणक अनुप्रयोग एवं कृषि जैव सूचना से सम्बन्धित विभिन्न लेखों एवं शोध–पत्रों को भी प्रस्तुत किया गया है। पाठकों के हिन्दी ज्ञानवर्धन के लिए दैनिक स्मरणीय शब्द–शतक हिन्दी व अँग्रेजी में दिया गया है।

संस्थान में 03 से 16 सितम्बर 2019 के दौरान हिन्दी पखवाड़े का आयोजन किया गया। दिनांक 03 सितम्बर 2019 को हिन्दी पखवाड़े का उद्घाटन संस्थान के तत्कालीन निदेशक द्वारा किया गया। हिन्दी पखवाड़े के उद्घाटन के तत्पश्चात काव्य–पाठ का आयोजन किया गया जिसमें संस्थान के कर्मियों द्वारा स्वरचित एवं प्रतिष्ठित कवियों की रचनाओं का पाठ किया गया। हिन्दी पखवाड़े के दौरान 'डॉ. दरोगा सिंह स्मृति व्याख्यान' के साथ–साथ वैज्ञानिक प्रभागों में

हिन्दी में सर्वाधिक वैज्ञानिक कार्य करने के लिए **प्रभागीय चल–शील्ड तथा काव्य–पाठ, काव्य गोष्ठी, प्रश्न–मंच, अन्ताक्षरी, डिजिटल हिन्दी शोध–पत्र प्रस्तुति, हिन्दी श्रुतलेख तथा** हिन्दीतर कर्मियों के लिए शब्दार्थ लेखन प्रतियोगिताएँ आयोजित की गयीं। प्रश्न–मंच एवं अन्ताक्षरी प्रतियोगिता के संचालकों द्वारा इन प्रतियोगिताओं को ऑडियो विजुअल रूप में प्रस्तुत किया गया जिससे ये प्रतियोगिताएँ अत्यन्त ही रोचक रहीं। सभी प्रतियोगिताओं में छात्रों सहित संस्थान के विभिन्न वर्ग के कर्मियों ने बढ़–चढ़कर हिस्सा लिया। दिनांक 16 सितम्बर 2019 को हिन्दी पखवाड़े का समापन हुआ।

संस्थान में वैज्ञानिक, तकनीकीगण एवं छात्रों के लिए 11 सि. तम्बर, 2019 को हिन्दी भाषा में ''डिजिटल हिन्दी शोध–पत्र प्रस्तुति'' प्रतियोगिता आयोजित की गयी। इस प्रतियोगिता में वैज्ञानिक, तकनीकीगण एवं छात्रों द्वारा अपने मूल शोध पर हिन्दी भाषा में डिजिटल प्रस्तुतियां की गयीं। जिसमें श्रेष्ठ प्रस्तुतियों को पुरस्कृत किया गया।

संस्थान में प्रत्येक वर्ष हिन्दी दिवस के अवसर पर डॉ. दरोगा सिंह स्मृति व्याख्यान का आयोजन किया जाता है। इस वर्ष इस कड़ी का अट्ठाइसवाँ व्याख्यान संस्थान के पूर्व प्रोफेसर (कृषि सांख्यिकी) एवं निदेशक, आई.ए.एस.डी.एस., डॉ. अरुण कुमार निगम जी द्वारा **''अक्षुण्ण विकास के लक्ष्य''** दिया गया और इस कार्यक्रम की अध्यक्षता आई.सी.एम.आर. के पूर्व अपर महानिदेशक एवं राष्ट्रीय सांख्यिकीय आयोग के सदस्य, डॉ. पदम सिंह जी द्वारा की गयी। दिनांक 16 सितम्बर, 2019 को हिन्दी पखवाड़े के समापन समारोह के अवसर पर इस दौरान आयोजित प्रतियोगिताओं के सफल प्रतियोगियों को पुरस्कृत करने के साथ–साथ वर्ष 2018–19 के दौरान ''सरकारी कामकाज मूल रूप से हिन्दी में करने के लिए प्रोत्साहन योजना'' के अन्तर्गत भी नकद पुरस्कार प्रदान किये गये। इसके अतिरिक्त, इस अवसर पर अगस्त 2018 से जून 2019 तक की अवधि के दौरान संस्थान में आयोजित हिन्दी कार्यशालाओं के वक्ताओं को प्रशस्ति–पत्र प्रदान किये गये।

Annexure-I

LIST OF RESEARCH PROJECTS

1st January to 31st December, 2019

DEVELOPMENT AND ANALYSIS OF EXPERIMENTAL DESIGNS FOR AGRICULTURAL SYSTEMS RESEARCH

On-going

Institute Funded

1. Design involving multi-way genetic crosses for agricultural and animal breeding programmes. (AGENIASRISIL201700300089)
   Harun (till 11.09.2018), Anindita Datta (since 12.09.2018), Cini Varghese, Seema Jaggi: 09.03.2017-08.03.2020
2. Generalized row-column designs for cop and animal experiments. (AGENIASRISIL201700400090)
   Anindita Datta, Harun (till 11.09.2018), Seema Jaggi, Cini Varghese: and Arpan Bhowmik (w.e.f. 12.09.2018) 31.03.2017-30.03.2020
3. Analytical procedure for factorial experiments with Logistic and Gompertz error distributions. (AGEDIASRISIL201701300099)
   Sunil Kumar Yadav: 25.05.2017-24.05.2019

Outside Funded

4. ICAR Research Data Repository for Knowledge Management as KRISHI: Knowledge based Resources Information System Hub for Innovations in Agriculture. Under ICAR Headquarter Plan Scheme (2015-2020). (AGENIASRICOL201503100068)
   ICAR-IASRI: Rajender Parsad, AK Choubey (till 20.01.2018), Anil Kumar, Mukesh Kumar, Anshu Bharadwaj, Susheel Kumar Sarkar, Arpan Bhowmik, Raju Kumar (till 04.06.2017), Vandita Kumari Choudhary (till August 2016) and Sukanta Dash (since 03.04.2017)
   ICAR-NAARM: A Dhandapani
   ICAR-NBSS&LUP: GP Obi Reddy, Nirmal Kumar and Sudipto Chattaraj
   ICAR-IARI: Vinay Kumar Seghal and Joydeep Mukerjee
   ICAR-DKMA: Mitali Ghosh Roy
   ICAR-CMFRI: J Jayasankar
   ICAR-CRIDA: NS Raju, P Vijaya Kumar (Since 17.12.2017), AVM Subba Rao (Since 17.12.2017): 24.07.2015-31.03.2020
5. Incomplete split-plot designs: construction and analysis. Funded by SERB. (AGENIASRISOL201601000079)
   BN Mandal, Sukanta Dash, Rajender Parsad, VK Gupta (till March 16, 2016): 16.08.2016-15.08.2019)
6. Planning, designing and analysis of experiments planned on stations under All India Coordinated Research Project on Integrated Farming Systems. Funded by AICRP on IFS, IIFSR, Modipuram. (AGEDIASRISOL201701900105)
   Anil Kumar, Md. Harun, Susheel Kumar Sarkar and Eldho Varghese (upto 22.07. 2017): 01.04.2017-31.03.2020
7. Designing and Analysis of ON FARM Research Experiments Planned under AICRP on IFS. Funded by AICRP on IFS, ICAR-IIFSR. (AGEDIASRISOL201702000106)
   Cini Varghese, Sukanta Dash, Arpan Bhowmik: 01.04.2017- 31.03.2020
8. Planning, designing and analysis of data relating to experiments for AICRP on Long Term Fertilizer Experiments. Funded by AICRP on Long Term Fertilizer Experiments, ICAR-IISS, Bhopal. (AGEDIASRISOL201702100107)
   BN Mandal, Anindita Datta, Sunil Kumar Yadav: 01.04.2017-31.03.2020

Completed

Institute Funded

9. On construction of orthogonal and nested orthogonal Latin hypercube designs. (AGENIASRISIL201503200069)
   Sukanta Dash, Rajender Parsad, BN Mandal and Susheel Kumar Sarkar: 16.11.2015-18.01.2019

New Initiated

Outside Funded

10. Plant source based environmentally safe crop protection and production technologies: Development and capacity building under the Niche Area of Excellence (NAE) Programme of ICAR at IARI. (AGEDIASRICOP201900600152)
    ICAR-IARI: Anupama Singh, Rajesh Kumar, Supradip Saha
    ICAR-IASRI: Sukanta Dash, Anil Kumar: 27.03.2019-26.03.2022
11. Application of Next-Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic Gain in Indian Staple Crops. Funded by ICAR and Bill and Melinda Gates Foundation (BMGF). (AGEDIASRICOP201900200148)
    ICAR-IARI: AK Singh, Ranjith Kumar Ellur, S Gopala Krishnan, C Bharadwaj, Shailesh Tripathi, Rajbir Yadav, Harikrishna, Neelu Jain, M Ganapathi, Jyoti Kaul, RS 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: JN Reddy, Anandan
    ICAR-IIRR: LV Subbarao, Abdul Fiaz
    ICAR-IIWBR: Satish Kumar, Ravish Chatrath
    ICAR-Project Coordinating Unit (Pearl millet): Vikas Khandelwal
    ICAR-Project Coordinating Unit (Chickpea): AK Srivastava
    ICAR-IASRI: Susheel Kumar Sarkar
    ICRISAT: Abhishek Rathore: 22.01.2019-21.01.2023

FORECASTING, MODELLING AND SIMULATION TECHNIQUES IN BIOLOGICAL AND ECONOMIC PHENOMENA

On-going

Institute Funded

12. Parameter estimation of time series models using Bayesian technique. (AGEDIASRISIL201702200108)
    Achal Lama, Bishal Gurung (till 19.07.2018), Santosha Rathod (till 13.06.2018): 01.11.2017- 31.10.2020
13. Crop diversification: Pattern, determinants and its impact on nutritional security in India. (AGEDIASRISIL201802800137)
    Anuja AR, Rajesh T, Harish HV, Mrinmoy Ray: 05.09.2018-04.09.2021
14. Role of research and development in Indian agriculture: An economic analysis. (AGEDIASRISIL201802500134)
    Rajesh T, Shivaswamy GP, Anuja AR, Ravindra Singh: 03.07.2018-02.07.2021
15. Prospects of irrigation in India: Trends, determinants and impact on agricultural productivity. (AGEDIASRISIL201802600135)
    Shivaswamy GP, Rajesh T, Anuja AR, Harish Kumar HV and Achal Lama: 19.07.2018-18.07.2021

Outside Funded

16. Forecasting Agricultural output using Space Agrometeorology and Land based observations (FASAL). Funded by IMD, New Delhi. (AGENIASRICOP201600700076)
    IMD: KK Singh, ICAR-IASRI: KN Singh, Bishal Gurung (till 19.07.2018) and Achal Lama (since 31.10.2018): 13.04.2016-31.03.2020

17. 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: 31.03.2017-31.03.2022
18. Modeling insect pests and diseases under climate change and development of digital tools for pest management National Innovations in Climate Resilient Agriculture (NICRA). Funded by ICAR. (AGEDIASRICOP201701500101)
    ICAR-NCIPM: S Vennila, MN Bhat, Niranjan Singh
    ICAR-CRIDA: M Prabhakar, MS Rao
    ICAR-IASRI: RK Paul: 20.06.2017-31.03.2020
19. Studying dynamics of markets integration and price transmission of agricultural commodities under ICAR's Lal Bahadur Shastri Young Scientist Award 2016. (AGEDIASRISOL201801600125)
    RK Paul: 02.04.2018- 31.03.2021
20. ICT based extension strategies for nutrition sensitive agriculture in the states of UP and Odisha. Funded by NASF. (AGEDIASRICOP201803600145)
    ICAR-IARI: Premlata
    ICAR-ATARI Zone-IV, Kanpur: Shantanu Dubey
    Directorate of Extension Education OUAT, Bhubaneswar: PJ Mishra
    ICAR-IASRI: KN Singh, Shashi Dahiya, Mrinmoy Ray: 01.11.2018-31.03.2020

Completed

Institute Funded

21. Developments of count time-series models for predicting pest dynamics using weather variables. (AGEDIASRISIL201700900095)
    Prawin Arya, Bishal Gurung (till 19.07.2018) and Md. Wasi Alam (since 20.07.2018): 19.04.2017-18.10.2019
22. Modelling and forecasting of drought index using machine learning techniques. (AGEDIASRISIL201701200098)
    Rajeev Ranjan Kumar (till 11.09.2018), KN Singh (since 12.09.2018), Ravindra Singh Shekhawat, Sanjeev Panwar: 22.05.2017-21.11.2019
23. Tractorization in Semi Arid Tropic (SAT) India: Determinants and implications. (AGEDIASRISIL201701100097)
    Ravindra Singh Shekhawat, Rajeev Ranjan Kumar (till 11.09.2018): 01.05.2017-01.11.2019
24. Future perspective of Bt technology in Indian agriculture. (AGENIASRISIL201601700086)
    Mrinmoy Ray, KN Singh, Santosha Rathod (till 13.06.2018), Bishal Gurung (till 19.07.2018), Ravindra Shekhawat (since 15.12.2016) and Ramasubramanian V (since 17.07.2017): 01.12.2016-18.04.2019

Outside Funded

25. Efficiency of micro irrigation in economizing water use in India-learning from potential and unexplored states. Funded by NITI Ayog. (AGEDIASRICOP201702300109)
    ICAR- NIAP: Subhash Chand, Shivendra Kumar Srivastava
    BACA, Anand, Gujrat: RS Pundir
    ICAR-IASRI: Ravindra Singh Shekhawat: 20.12.2017(02.08.2018 funds received)-31.05.2019

New Initiated

Institute Funded

26. Modelling dynamics of institutional credit to agriculture in India. (AGEDIASRISIL201900400150)
    Harish Kumar HV, Shivaswamy GP, Anuja AR, Achal Lama: 02.02.2019-01.08.2021
27. Enhanced Classification and Regression Tree (CART) models for forecasting in Agriculture. (AGEDIASRISIL201900700153)
    Ramasubramanian V, Mrinmoy Ray, Md. Wasi Alam: 31.03.2019-30.09.2021

Outside Funded

28. Leveraging Institutional Innovations for Inclusive and Market led Agricultural Growth in Eastern India. Funded By NASF. (AGEDIASRICOP201901300159)
    ICAR-IARI: Pramod Kumar
    BHU, Varansi: PS Badal
    ICAR-NRRI, Cuttack: Biswajit Mondal
    CCS NIAM, Jaipur: Sathyendra Kumar
    ICAR-IASRI: RK Paul: 01.12.2019-30.11.2022

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

On-going

Institute Funded

29. Two step calibration for estimation of finite population total under two-stage sampling design. (AGEDIASRISIL201701600102)
    Pradip Basak, Kaustav Aditya, Hukum Chandra, Ajit: 29.07.2017-28.01.2020
30. Construction of composite index under complex surveys. (AGEDIASRISIL201801800127)
    Deepak Singh, Pradip Basak and Raju Kumar (since 05.12.2018): 26.04.2018- 25.04.2020

Outside Funded

31 Energy Audit Survey of AICRP on Energy in Agriculture & Agro-based Industries: Sampling design and analysis. Funded by ICAR-All India Coordinated Research Project on Energy in Agriculture & Agro-based Industries (ICAR-AICRP on EAAI). (AGEDIASRICOP201802000129)
    ICAR-CIAE: KC Pandey
    ICAR-IASRI: Hukum Chandra, Susheel Kumar (till 05.07.2018), Pradip Basak (since 11.07.2018), Ajit: 01.06.2018-31.05.2021

Completed

Institute Funded

32. Assessment of post harvest losses in fruits and vegetables and strategies for their reduction in Andaman and Nicobar Islands. (AGENIASRICIP201601400083)
    ICAR-CIARI: Sachidananda Swain, SK Zamir Ahmad, LB Singh, Chandrika Ram, Manoj Kumar
    ICAR-IASRI: Prachi Misra Sahoo, Tauqueer Ahmad: 03.10.2016-31.07.2019 (Association of ICAR-IASRI w.e.f. 03.10.2016)
33. A study on calibration estimators under adaptive cluster sampling. (AGENIASRISIL201601500084)
    Raju Kumar (till 03.06.2017), Ankur Biswas (since 04.06.2017-PI & Associate till 03.06.2017), Pradeep Basak (since 26.09.2017), Deepak Singh: 25.10.2016- 15.04.2019

Outside Funded

34. Integrated sampling methodology for crop yield estimation using Remote Sensing, Field surveys and Weather parameters for crop insurance. Funded by Ministry of Agriculture & Farmers Welfare, Govt. of India. (AGEDIASRISOL201803300142)
    Tauqueer Ahmad, Prachi Misra Sahoo, Anil Rai, Hukum Chandra, Ankur Biswas: 28.09.2018-30.09.2019
35. Pilot study for developing state level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee Report. Funded by Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi. (AGENIASRISOL201500300040)

Kaustava Aditya, UC Sud (till 31.07.2017), Hukum Chandra, AK Gupta (till 31.07.2016), Ankur Biswas, Vandita Kumari (till 04.10.2017), Raju Kumar (till 03.06.2017), Anshu Bhardwaj, Anil Kumar, Ajit and Pradip Basak (since 13.09.2017): 16.02.2015-30.06.2019

36. Investigation of causes of divergence between official and trade estimates of jute production. Funded by Directorate of Economics & Statistics (DES), Department of Agriculture and Cooperation (DAC), Ministry of Agriculture (MoA), Govt. of India. (AGENIASRISOL201502800065).
    Prachi Misra Sahoo, Tauqueer Ahmed, Kaustav Aditya, Ankur Biswas, Ajit: 01.09.2015-30.06.2019

New Initiated

Institute Funded

37. Detection of outliers in presence of masking and imputation of data when auxiliary variable are available in sample surveys. (AGEDIASRISIL201901100157)
    Raju Kumar, Ankur Biswas, Lal Mohan Bhar, Deepak Singh: 23.07.2019-22.12.2021

Outside Funded

38. 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, Anil Rai, SB Lal: 28.03.2019-31.01.2019
39. Study to estimate the sub-state level estimate of socio-economic indicators of Uttar Pradesh by using Small Area Estimation Techniques" in Collaboration with GIDS, Lucknow and funded by Directorate of Economics and Statistics Government of Uttar Pradesh, Lucknow. (AGEDIASRICOP201900900155)
    GIDS: K. Srinivasa Rao
    IASRI: Hukum Chandra, Pradip Basak, Kaustav Aditya : 01.06.2019-31.05.2020

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

On-going

Institute Funded

40. Study of long memory and periodicities in climate variables in different Meteorological Subdivisions of India. (AGEDIASRISIL201701000096)
    RK Paul, LM Bhar, AK Paul: 19.04.2017-18.04.2020
41. Estimation of breeding value using generalized estimating equation and Bayesian approach. (AGEDIASRISIL201800100110)
    Himadri Shekhar Roy, LM Bhar, AK Paul: 07.02.2018-06.02.2021
42. A study on detection and interpretation of expression Quantitative Trait Loci (eQTL) mapping. (AGEDIASRISIL201800200111)
    Himadri Shekhar Roy, LM Bhar. RK Paul, AK Paul: 03.02.2018-02.02.2021
43. Development of web server for phenotype analysis for cattle breeding management. (AGEDIASRICIP201801100120)
    ICAR-CIRC: Umesh Singh, Susheel Kumar, AK Das, TV Raja, Rani Alex
    ICAR-IASRI: UB Angadi, MA Iquebal, Sarika, Dinesh Kumar: 12.03.2018-31.03.2021
44. Study of robust estimation of heritability. (AGEDIASRISIL201801300122)
    AK Paul, Himadri Sekhar Roy, LM Bhar, RK Paul: 22.03.2018-21.03.2021
45. Discovery of novel genes and promoters responsible for salinity tolerance in Haloarcula spp. (AGEDIASRISIL201803400143)
    Monendra Grover, DC Mishra, Rajeev Kaushik: 01.11.2018-31.10.2019

Outside Funded

46. ICAR-Network project on functional genomics and genetic modification (Earlier: ICAR Network Project on Transgenics in Crops (NPTC)). Funded by ICAR-NRCPB-Sub-Scheme. (AGENIASRICOP201500400041)
    ICAR-NRCPB: NK Singh (till 11.05.2015 and then from 10.01.2017), TR Sharma (from 12.05.2015-09-01-2017)
    ICAR-IASRI: MA Iquebal, Sarika, Dinesh Kumar, Anil Rai: 27.01.2015-31.03.2020
47. Computational and analytical solutions for high-throughput biological data. Funded by CABin. (AGENIASRISOL201502400061)
    Anil Rai, Dinesh Kumar, AR Rao, Monendra Grover, KK Chaturvedi, Sanjeev Kumar, DC Mishra:04.09.2015-31.03.2020
48. Creating a fully characterized genetic resource pipeline for mustard improvement programme in India. Funded by National Agricultural Science Fund (NASF). (AGENIASRICOP201700800094)
    PAU: SS Banga, National Professor (ICAR)
    ICAR-IARI: DK Yadav
    Directorate of rapeseed-mustard research, Bharatpur: KH Singh
    GBPUAT: Ram Bhajan
    ICAR-IASRI: AR Rao, Cini Varghese, PK Meher: 01.01.2017-31.12.2019
49. Phenomics of moisture deficit stress tolerance and nitrogen use efficiency in Rice and Wheat– Phase II. Funded by National Agricultural Science Fund (NASF). (AGENIASRICOP201700700093)
    ICAR-IARI: Viswanathan Chinnusamy
    ICAR-IASRI: Anil Rai, AR Rao, Sudeep, Sanjeev Kumar
    IIT, New Delhi: Brejesh Lall
    ICAR-NRRI: Padmini Swain: 01.01.2017-31.12.2019
50. Potential gene mining from salt tolerant grasses for improvement of salt tolerance in crops. Funded by NASF (AGEDIASRICOP201701400100)
    ICAR-CSSRI: Anita Mann, Ashwani Kumar, Arvind Kumar, BL Meena
    ICAR-IASRI: Monendra Grover, DC Mishra: 01.06.2017-31.03.2020
51. Rice-metasys: understanding rice gene network for blast resistance and drought tolerance through system biology approach. Funded by CABin Scheme. (AGEDIASRICOP201800300112)
    ICAR-NRCPB: Amol Kumar U Solanke, SV Amitha Charu Rama Mithra
    ICAR-IASRI: DC Mishra, KK Chaturvedi: 01.03.2018- 31.03.2020
52. Computational and experimental biology approaches for delineation of selected secondary metabolite pathways and antimicrobial peptides (AMPs) in major spices. Funded by CABin Scheme (AGEDIASRICOP201800400113)
    ICAR-IISR: Johnson George K, TE Sheeja, R Praveena, P Umadevi, R Sivaranjani
    ICAR-IASRI: UB Angadi, Dinesh Kumar, MA Iquebal, Sarika: 05.03.2018-31.03.2020
53. Deciphering genetic variation in the carbohydrate metabolism of farmed rohu families. Funded by CABin Scheme (AGEDIASRICOP201800500114)
    ICAR-CIFA: JK Sundaray, S Nandi, PK Meher, L Sahoo, Kiran D, Khuntia Murmu, UK Udit, AR Rasal
    ICAR-IASRI: Sarika, Dinesh Kumar, MA Iquebal, UB Angadi: 05.03.2018-31.03.2020
54. Genomic data analysis to elucidate the regulatory network and candidate genes underlying cytoplasmic male sterility in pigeonpea. Funded by CABin Scheme (AGEDIASRICOP201800600115)
    ICAR-IIPR: A Bohra
    ICAR-IASRI: MA Iquebal, Dinesh Kumar, Sarika, UB Angadi: 05.03.2018-31.03.2020
55. Computational approach for genomic resource improvement and precision phenotyping of less explored yield traits in Wheat. Funded by CABin Scheme (AGEDIASRICOP201800700116)
    ICAR-IIWBR: Ratan Tiwari, Pradeep Sharma, Sonia Sheoran
    ICAR-IASRI: Dinesh Kumar, MA Iquebal, Sarika, UB Angadi: 05.03.2018-31.03.2020

56. Computational biology approach for deciphering stress induced transcriptomic and proteomic changes rice-microbial interaction system. Funded by CABin Scheme. (AGEDIASRICOP201800800117)
    ICAR-NBAIM: DP Singh, Renu, Sunil Kumar, Pramod Sahu
    ICAR-IASRI: Sanjeev Kumar, KK Chaturvedi, MS Farooqi: 06.03.2018-31.03.2020
57. Investigations on stipe rust-defence response, identification of defence genes/QTLs associated with rust resistance in Wheat. Funded by CABin Scheme. (AGEDIASRICOP201800900118)
    ICAR-NBPGR: Sundeep Kumar, Amit K Singh
    ICAR-IASRI: Monendra Grover, DC Mishra, Neeraj Budhlakoti (till 11.09.2018): 09.03.2018-31.03.2020
58. Investigations on pathogenic microorganisms of shrimp aquaculture using metagenomic and other bioinformatic approaches. Funded by CABin Scheme. (AGEDIASRICOP201801000119)
    ICAR-CIBA: Ashok Kumar Jangam, SV Alavandi, K Vinaya Kumar, R Mary Lini, Satheesha Avunje
    ICAR-IASRI: Monendra Grover: 09.03.2018-31.03.2020
59. Genomic and transcriptome sequencing of coriander (Coriandrum sativum) to reveal insight of its genomic architecture and breeding targets. (Collaboration with Junagadh Agricultural University, Junagadh). (AGEDIASRICOP201801200121)
    JAU: Rukam Singh Tomar, MV Parakhia, Shradda B Bhatt
    ICAR-IASRI: MA Iquebal, Sarika: 14.03.2018-31.03.2021
60. Statistical approaches for genome-wide association studies and genomic selection for multiple traits in structured plant and animal population. Funded by DST. (AGEDIASRISOL201801400123)
    LM Bhar, Himadri Shekhar Roy (since 04.05.2018), PK Meher (since 04.05.2018): 16.03.2018-15.03.2021
    RK Paul: 02.04.2018-31.03.2021
61. Molecular Markers for Improving Reproduction of Cattle and Buffaloes. Funded by Bill & Melinda Gates Foundation. USA. (AGEDIASRICOP201803000139)
    ICAR-NDRI: TK Datta, ICAR-CIRB: Varij Nayan
    ICAR-IASRI: Dinesh Kumar, MA Iquebal, Sarika, UB Angadi, Anil Rai: 19.09.2018-30.09.2023
62. Genomics assisted crop improvement and management. Funded by NAHEP (AGEDIASRICOP201803200141)
    ICAR-IARI: Viswanathan Chinnusamy
    ICAR-IASRI: AR Rao, Sudeep, Seema Jaggi, Anindita Datta, Soumen Pal, Sanjeev Kumar: 26.09.2018-31.03.2021
63. Transcriptome analysis to decipher mechanism related to distinctive morphological phenotypes in indigenous poultry. Funded by CABin. (AGEDIASRICOP201802900138)
    ICAR-NBAGR, Karnal: Ramesh Kumar Vijh
    ICAR-IASRI: Anil Rai, AR Rao: 19.09.2018- 31.03.2020
64. Structural and functional genomics of potato and its pest/pathogen using bioinformatics approaches. Funded by CABin. (AGEDIASRICOP201802400133)
    ICAR-CPRI: SK Chakrabarti, Shashi Rawat, Som Dutt, Jagesh Tiwari, Aarti Bairwa, Tanuja Buckseth
    ICAR-IASRI: Anil Rai, AR Rao, Sanjeev Kumar, DC Mishra, Neeraj Budhlakoti (till 11.09.2018): 08.06.2018-31.03.2020
65. Network project on computational biology and agricultural bioinformatics under two subprojects: Funded by CABin. (AGEDIASRICOP201802300132): 08.06.2018-31.03.2020
    Sub-project-1: Exploring the epigenetic control of heat stress response in wheat for characterizing the regulatory networks associated with thermo tolerance.
    ICAR-IARI: C Viswasnathan, RR Kumar, Suneha Goswami
    ICAR-IASRI: DC Mishra, Monendra Grover, Sanjeev Kumar, KK Chaturvedi
    Sub-Project-2: Studying drought-responsive genes in subtropical maize germplasm and their utility in development of tolerant maize hybrids.
    ICAR-IARI: Viswanathan Chinnusamy, Mallikarjuna, MG
    ICAR-IASRI: Anil Rai, AR Rao, PK Meher
66. Metagenomic profiling for assessing microbial biodiversity in river Ganga for ecosystem health monitoring. Funded by CABin. (AGEDIASRICOP2018022000131)
    ICAR-CIFR: BK Behera, BK Das, PK Parida, Dhruba Jyoti Sarkar, RK Raman

ICAR-IASRI: Anil Rai, AR Rao, PK Meher: 08.06.2018-31.03.2020

67. Deciphering health biomarkers and thermo-tolerant traits by computational genomics approach in goats. Funded by CABin. (AGEDIASRICOP2018021000130)
    ICAR-CIRG: Rajveer Singh Pawaiya, K Gururaj, Mahesh Dige, PK Rout
    ICAR-IASRI: Anil Rai, AR Rao: 08.06.2018-31.03.2020
    Component 1: Host transcriptome analysis for identification of biomarkers and epitope mapping assisted diagnostics development for enterotoxaemia in goats.
    Component 2: Identification of heat stress/tolerance genes through transcriptomics approach in goats.
68. Characterization, evaluation, genetic enhancement and generation of genomic resources for accelerated utilization and improvement of minor pulses. Funded by DBT. (AGEDIASRICOP201803500144)
    ILS, Bhubneshwar: 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: 24.10.2018-23.10.2021
69. Improving the usability of buffalo spermatozoa by sperm surface remodelling and immune acceptance in female reproductive tract. Funded by NASF. (AGEDIASRICOP201802700136)
    ICAR-NDRI: TK Datta, Rakesh Kumar, SM Deb, TK Mohanty, JK Kaushik
    ICAR-IASRI: Sarika, Dinesh Kumar, MA Iquebal: 12.07.2018-11.07.2021

Completed

Institute Funded

70. Gene Selection for Classification of Crop Gene Expression Data. (AGENIASRISIL201503000067)
    Samarendra Das (till 09.08.2017), PK Meher (since 10.08.2017), RK Paul and UK Pradhan (till January 10, 2017), Prakash Kumar (from 01.04.2017 to 05.02.2018): 20.10.2015- 15.05.2019
71. Non-linear modeling for genomic predictions based on multiple traits. (AGENIASRISIL201700500091)
    Neeraj Budhlakoti (till 11.09.2018), DC Mishra (since 12.09.2018), SB Lal, DC Mishra (from 31.03.2017 to 11.09.2018 as an Associate): 31.03.2017-10.07.2019
72. Platform for integrated genomics warehouse. (AGENIASRISIL201600900078)
    KK Chaturvedi, MS Farooqi, SB Lal, DC Mishra, Sanjeev Kumar: 10.06.2016-16.08.2019
73. Development of an improved hybrid De-novo whole genome assembler. (AGENIASRISIL201700100087)
    SB Lal, Anu Sharma, Sanjeev Kumar, DC Mishra, Neeraj Budhlakoti (till 11.09.2018): 04.01.2017-05.11.2019

Outside Funded

74. Stochastic differential equation models and their applications to agriculture. Funded by Science and Engineering Research Board (SERB), New Delhi. (AGENIASRICOP201600200071)
    Ex. Emeritus Scientist, ICAR: Prajneshu
    ICAR-IASRI: Himadri Ghosh, LM Bhar: 06.11.2015-19.02.2019

New Initiated

Institute Funded

75. Development of methodology for trait specific genes identification. (AGEDIASRISIL201900300149)
    MS Farooqi, DC Mishra, KK Chaturvedi: 02.02.2019-01.02.2021
76. Machine Learning Approach for Binning of Metagenomics Data. (AGEDIASRISIL201901200158)
    Anu Sharma, SB Lal, Sanjeev Kumar, DC Mishra: 24.7.2019-23.01.2022

Outside Funded

77. Molecular characterization, development of molecular markers and metabolite analysis of tree bean (*Parkia roxburghii*) landraces of North-East India. [BT/PR24912/NER/95/904/2017]. Funded by DBT. (AGEDIASRICOP201803100140)
    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
78. An integrative transciptomics and DNA methylomics approach to understand the dynamic features of biotic stress responses associated with mastitis in buffalos. Funded by CABin. (AGEDIASRICOP201900100147)
    ICAR-CIRB: Varij Nayan, SK Phulia, Anurag Bharadwaj
    ICAR-IASRI: MA Iquebal, Dinesh Kumar, Sarika: 16.01.2019-31.03.2020

DEVELOPMENT OF INFORMATICS IN AGRICULTURAL RESEARCH

On-going

Institute Funded

79. Management system for post graduate education - II. (SIX1218)
    Sudeep, PK Malhotra (30.09.2014), RC Goyal (till 30.06.2013), Yogesh Gautam (till 15.08.2014) and Pal Singh (w.e.f. 01.10.2013): 01.04.2012– 30.06.2019
80. National Information System on Agricultural Education Network in India. (NISAGENET-IV). (SIX1217)
    RC Goyal (till 30.06.2013), Sudeep (since 01.07.2013), Alka Arora, Pal Singh, Shashi Dahiya (on study leave from 03.07.2014 to 02.07.2017 rejoins the project as associate from 25.10.2017), Soumen Pal (till 30.09.2012), Anshu Bhardwaj (since 01.10.2014):01.04.2012–30.06.2019
81. Implementation of ICAR-ERP, unified communication and web hosting solution. (AGENIASRISIL201500600043)
    AK Choubey (till 21.01.2018), Sudeep (since 22.01.2018-PI & Associate till 21.01.2018), Alka Arora (on leave from 04.07.2016 to 22.03.2017 rejoins on 23.03.2017), N Srinivasa Rao (Transferred to NAARM from 24.09.2016), Mukesh Kumar, SN Islam (Deputed to ICAR HQ from 20.08.2016 for coordinating the implementation rejoins on 16.07.2018), Anshu Bhardwaj, Sangeeta Ahuja, Shashi Dahiya (from 05.08.2017): 10.04.2015-30.09.2019
82. Development and assessment of educational mobile apps for improving livestock health and production. (AGEDIASRICIP201701700103)
    ICAR-IVRI: Rupasi Tiwari, Triveni Dutt, Mahesh Chander, Sanjay Kumar, Amarpal, Putan Singh, JK Prasad, Bina Mishra, BHM Patel, Bablu Kumar, Mahendran
    ICAR-IASRI: Sudeep, Mukesh Kumar, Soumen Pal: 28.06.2017-30.09.2019
83. Development of direct benefit transfer portal for DARE schemes. (AGEDIASRISIL201801500124)
    Soumen Pal, Sudeep, Alka Arora: 26.03.2018-25.03.2020
84. Goat production Management Information System (GMIS). (AGEDIASRICOP201803700146)
    ICAR-CIRG: PK Rout
    ICAR-IASRI: SN Islam: 01.04.2017 (Association of ICAR-IASRI 03.12.2018) - 31.03.2020
85. Training Management Information System for ICAR (TMIS). (AGEDIASRISIL201801900128)
    Sudeep, Shashi Dahiya, Sangeeta Ahuja: 01.05.2018-30.04.2020

Outside Funded

86. 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 Bhardwaj, Soumen Pal
    ICAR-DKMA: Aruna T Kumar, Mitali Ghosh Rai: 14.02.2017-31.03.2020

87. 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: 04.03.2016-31.03.2020

New Initiated

Outside Funded

88. Investments in Indian Council of Agricultural Research leadership on Agricultural Higher Education under the National Agricultural Higher Education Project (NAHEP Comp-2 Project). (AGEDIASRISOL201900500151)
ICAR-IASRI: Sudeep, Alka Arora, Anshu Bhardwaj, Mukesh Kumar, Shashi Dahiya, Pal Singh, 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: 28.02.2019-31.03.2021
89. Artificial intelligence based mobile app for identification and advisory of maize diseases and insect pests. Funded by NASF ICAR Hq. (AGEDIASRISOL201901000156)
ICAR-IASRI: Sudeep, Alka Arora, Mukesh Kumar, SN Islam
ICAR-IIMR Ludhiana: KS Hooda
IIT, Delhi: Brejesh Lall: 01.01.2019-31.12.2021

Consultancy Projects

90. Knowledge Management System for DUS characteristics of crops.
Sudeep, Alka Arora, Soumen Paul and LM Bhar: 05.01.2019 – 04.01.2020
91. Customization and Implementation of Academic Management System (AMS) for PG and UG education at BAU, Sabour (Bhagalpur).
Sudeep, Mukesh Kumar and MM Maurya: 25.06.2018 – 24.06.2019
92. Customization and Implementation of Academic Management System for Post Graduate & Under Graduate Education at Birsa Agricultural University (BAU), Kanke, Ranchi.
Sudeep, Alka Arora, MM Maurya: 30.07.2018 – 29.07.2019

National Fellow Scheme

93. Robust and efficient small area estimation methods for agricultural and socio-economic surveys and their application in indo-gangetic plain.
Hukum Chandra: 25.11.2014-24.11.2024

Annexure-II

LIST OF PERSONNEL AT OUR INSTITUTE

Dr. Lal Mohan Bhar, Director (A) till 27.10.2019
Dr. Tauqueer Ahmad, Director (A) from 28.10.2019

Division of Design of Experiments

Name of the Scientist	Designation
Dr. (Smt.) Seema Jaggi	Principal Scientist and Head (A)
Dr. Rajender Parsad	Principal Scientist
Dr. (Smt.) Cini Varghese	Principal Scientist
Dr. Anil Kumar	Principal Scientist
Dr. Susheel Kumar Sarkar	Senior Scientist
Dr. B.N. Mandal	Senior Scientist
Dr. Sukanta Dash	Scientist
Dr. Arpan Bhowmik	Scientist
Sh. Sunil Kumar Yadav	Scientist
Sh. Mohd. Harun	Scientist (on study leave)
Dr. Anindita Datta	Scientist

Division of Sample Surveys

Name of the Scientist	Designation
Dr.Tauqueer Ahmad	Principal Scientist and Head
Dr. (Smt.) Prachi Misra Sahoo	Principal Scientist
Dr. Kaustav Aditya	Scientist
Dr. Ankur Biswas	Scientist
Sh. Deepak Singh	Scientist
Dr. Raju Kumar	Scientist
Dr. (Smt.) Vandita Kumari Choudhary	Scientist
Dr. Pradip Basak	Scientist

Division of Statistical Genetics

Name of the Scientist	Designation
Dr. Lal Mohan Bhar	Principal Scientist and Head till 27.10.2019' Head (A) from 28.10.2019
Dr. Amrit Kumar Paul	Principal Scientist
Dr. Himadri Ghosh	Principal Scientist
Dr. Ranjit Kumar Paul	Senior Scientist
Dr. P.K Meher	Scientist
Sh. Samarendra Das	Scientist (on study leave)
Sh. Upendra Kumar Pradhan	Scientist (on study leave)
Sh. Prakash Kumar	Scientist (on study leave)
Dr. Himadri Shekhar Roy	Scientist

Division of Forecasting and Agricultural Systems Modeling

Name of the Scientist	Designation
Dr. K.N.Singh	Principal Scientist and Head (A)
Dr. Ramasubramanian V.	Principal Scientist (till 06.05.2019 in the Division)
Dr. Prawin Arya	Principal Scientist
Dr. Mohd. Wasi Alam	Senior Scientist
Dr. Bishal Gurung	Scientist (on deputation to Bhutan)
Dr. Kanchan Sinha	Scientist (on study leave till 22.08.2019; rejoined on 23.08.2019)
Dr. Mrinmoy Ray	Scientist
Dr. Ravinder Singh Shekhawat	Scientist
Sh. Rajeev Ranjan Kumar	Scientist (on study leave)

Name of the Scientist	Designation
Dr. Achal Lama	Scientist
Sh. Rajesh T.	Scientist
Dr. (Smt.) Anuja A.R.	Scientist
Dr. (Smt.) Shivaswamy G.P.	Scientist
Dr. Harish Kumar H.V.	Scientist

Division of Computer Applications

Name of the Scientist	Designation
Dr. Sudeep	Principal Scientist and Head (A)
Dr. Alka Arora	Principal Scientist
Dr. (Smt.) Anshu Bharadwaj	Principal Scientist
Dr. Mukesh Kumar	Principal Scientist
Dr. (Smt.) Shashi Dahiya	Senior Scientist
Sh. Pal Singh	Scientist
Sh. Shahnawazul Islam	Scientist
Dr. (Smt.) Sangeeta Ahuja	Scientist
Dr. Soumen Pal	Scientist

Centre for Agricultural Bioinformatics (CABin)

Name of the Scientist	Designation
Dr. Anil Rai	Principal Scientist and Head (A)
Dr. Dinesh Kumar	Principal Scientist
Dr. A.R. Rao	Principal Scientist
Dr. Monendra Grover	Principal Scientist
Dr. Sunil Kumar	Principal Scientist (Joined the Institute on 02.12.2019)
Dr. Ulavappa B. Angadi	Principal Scientist
Dr. S.B. Lal	Senior Scientist
Dr. Krishna Kumar Chaturvedi	Senior Scientist
Dr. (Smt.) Sarika	Senior Scientist
Dr. Mir Asif Iquebal	Senior Scientist
Dr. (Smt.) Anu Sharma	Senior Scientist
Sh. Sanjeev Kumar	Scientist
Sh. Mohd. Samir Farooqi	Scientist
Dr. Dwijesh Chandra Mishra	Scientist
Dr. Sudhir Srivastava	Scientist (rejoined on 20.08.2019 after study leave)
Sh. Neeraj Budhlakothi	Scientist (on study leave)

PME Cell

Dr. Ajit	Principal Scientist & Incharge, PME Cell (till 06.05.2019 & from 24.07.2019 onwards)
Dr. Ramasubramanian V.	Principal Scientist & Incharge, PME Cell (from 07.05.2019 to 23.07.2019) & Officer In-Charge, ICAR Regional Committee No. V (24.07.2019 onwards)

National Fellow

Dr. Hukum Chandra	ICAR-National Fellow

Professors

Dr. Seema Jaggi	Agricultural Statistics
Dr. Sudeep Marwaha	Computer Applications
Dr. A.R. Rao	Bioinformatics

Administration and Finance

Sh. Vijay Kumar	Senior Administrative Officer & Head of Office (till 31.03.2019); after technical resignation, went to IIT Patna
Sh. Yogesh Kadian	Administration Officer & Head of Office (from 01.04.2019 to 30.06.2019)
Sh. Piyush Shukla	Senior Administration Officer & Head of Office (from 01.07.2019 onwards)
Sh. Arvind	Senior Finance and Account Officer (till 18.12.2019) & transferred ICAR-NDRI, Karnal

Vigilance

Dr. L.M. Bhar	Vigilance Officer (till 17.03.2019)
Dr. Amrit Kumar Paul	Vigilance Officer (from 18.03.2019 onwards)

Right to Information (RTI) and Liaison

Dr. Mukesh Kumar	Transparency Officer & Nodal Officer, RTI
Sh. Chander Vallabh	Public Information Officer (till 30.06.2019)
Sh. Vishal Lakhanpal	Public Information Officer (from 01.07.2019 onwards)
Sh. Anil Kumar	Liaison Officer

ICAR-IASRI PERSONNEL

Scientists

Name of post	Sanctioned as on 01.04.2019	Filled as on 31.12.2019
RMP	1	0
Principal Scientist	18	1
Sr. Scientist	32	6
Scientist	80	62
Total	130 +1 RMP	69 +0 RMP

Administration & Finance

Name of post	Sanctioned as on 01.04.2019	Filled as on 31.12.2019
Sr. AO	01	01
AO	01	02
Sr. F&AO	01	00
AF&AO	01	01
AAO	08	06
Assistant	32	19
UDC	15	10
LDC	10	08
Personal Secretary	03	03
Personal Assistant	10	08
Steno	02	00
Total	84	58

Technical and Supporting Staff

Group/Category	Sanctioned as on 01.04.2019	Filled as on 31.12.2019
Technical Staff	174	46
Skilled Supporting Staff	39	24
Auxiliary (Canteen Staff)	14	06

LIST OF ADMINISTRATIVE STAFF WORKING AT IASRI

AS ON 31.12.2019 (TOTAL 58)

S. No.	NAME OF THE EMPLOYEE	DESIGNATION
1	Sh.Piyush Shukla	Sr.A.O & Head of Office (Joined on 01-07-2019)
2	Sh.Yogesh Kadian	A.O (Joined on 14.01.2019)
3	Sh. Prabhu Dayal	A.A.O (till 25.09.2019) & A.O (from 26.09.2019 onwards)
4	Sh.Amit Kumar Marwari	A.F.&A.O
5	Sh.Rajinder Kumar Koli	A.A.O
6	Sh. Chander Vallabh	A.A.O
7	Sh. Dilip G. Khapekar	A.A.O
8	Sh. Vishal Lakhanpal	A.A.O
9	Sh Rohit Rustogi	A.A.O
10	Sh. K.B.Sharma	A.A.O
11	Sh. Prem Prakash	P.S
12	Sh. Surat Ram	P.S
13	Smt. Vijyalakshmi Murthy	P.S
14	Smt. Meenu Kohli	P.A
15	Smt. Laxmi Devi	P.A
16	Smt. Suman Popli	P.A
17	Sh. Nanak Chand	P.A
18	Smt. Alka Nayyar	P.A
19	Smt. Sunita	P.A (from 01.07.2019 onwards)
20	Smt. Suman Khanna	P.A
21	Smt. Renuka Ahuja	PA (retired on 31.12.2019)
22	Sh. K.K.Hans	Assistant
23	Smt. Kanta Bahl	Assistant
24	Smt. Neelam Sethi	Assistant
25	Smt. Harsh Kapoor	Assistant
26	Smt. Anita Malik	Assistant

S. No.	NAME OF THE EMPLOYEE	DESIGNATION
26	Sh. Mayank Singh Pundir	Assistant
27	Sh. Raj Kumar Verma	Assistant
28	Sh. Basant Kumar	Assistant
29	Smt. Megha Chopra	Assistant
30	Sh. Trilok Saini	Assistant
31	Smt. Chanderkala	Assistant
32	Sh. Sanjay Kumar Jain	Assistant
33	Sh. Krishan Kumar	Assistant
34	Sh. Anish Wadhwa	Assistant
35	Sh. Pushpender Yadav	Assistant
36	Sh. Vineet Kumar Morya	Assistant
37	Sh. Pradeep Kumar –II	Assistant
38	Sh. Fabian Minz	Assistant
39	Sh. Ashok Kumar	Assistant
40	Sh. Mukesh Kumar	U.D.C
41	Smt. Rakhi Soni	U.D.C
42	Sh. Satyavir Singh	U.D.C
43	Sh. Sunil Kumar-I	U.D.C
44	Sh. Sunil Kumar-II	U.D.C
45	Sh. P.R.Paite	U.D.C
46	Smt. Seema Dahiya	U.D.C
47	Sh. Ranveer Singh	U.D.C
48	Sh. Shesha Deva Raut	U.D.C.
49	Sh. Dharmendra	U.D.C.
50	Sh. Sunil Kumar-III	L.D.C.
51	Sh. Neerav Harit	L.D.C.
52	Sh. Hitesh Kapoor	L.D.C.
53	Sh. Hanuman Sahay Meena	L.D.C.
54	Amit Kumar	L.D.C. (Resigned on 28.12.2019)
55	Dazy Kumari	L.D.C. (Joined on 01.03.2019)
56	Dinesh Kumar	L.D.C. (Joined on 22.10.2019)
57	Manisha Kumari	L.D.C. (Joined on 22.10.2019)
58	Mamta Verma	L.D.C. (Joined on 10.12.2019)
59	Sh. Manosh Chaudhary	A.A.O (till 05.08.2019) & promoted to A.O and transferred to ICAR-IARI, New Delhi
60	Sh. Arvind	Senior Finance and Account Officer (till 18.12.2019) & transferred to ICAR-NDRI, Karnal
61	Smt. Sushma Nigam	PA (retired on 30.06.2019)
62	Smt. Neelam Negi	PA (retired on 31.07.2019)
63	Smt. Sudesh Arora	PA (retired on 31.10.2019)
65	Sh. Khushiyal Singh	Assistant (retired on 28.02.2019)
66	Sh. Pradeep kumar	Assistant (retired on 31.05.2019)
67	Smt. Rajni Gupta	Assistant (retired on 30.09.2019)
68	Smt. Manju Gulati	Assistant (retired on 31.10.2019)

List of Supporting Staff

S. No	NAME OF THE EMPLOYEE	DESIGNATION
1	Sh. Ashok Kumar	Skilled Supporting Staff
2	Sh. Shyam Swaroop	Skilled Supporting Staff
3	Sh. Raghubir Singh	Skilled Supporting Staff
4	Sh. Budh Ram	Skilled Supporting Staff
5	Sh. Niranjan Singh	Skilled Supporting Staff
6	Sh. Vivekanand Shah	Skilled Supporting Staff
7	Sh. Yashraj Nagar	Skilled Supporting Staff
8	Sh. Janak Kumar	Skilled Supporting Staff
9	Sh. Girish	Skilled Supporting Staff
10	Sh. Gopal Singh	Skilled Supporting Staff
11	Sh. Om Prakash Tiwari	Skilled Supporting Staff
12	Sh. Mohan Kumar	Skilled Supporting Staff
13	Sh. Harpal Singh	Skilled Supporting Staff
14	Sh. Ram Kanwar	Skilled Supporting Staff
15	Sh. Chhathu Sah	Skilled Supporting Staff
16	Sh. Vijay Kumar	Skilled Supporting Staff
17	Sh. Bhoop Singh	Skilled Supporting Staff
18	Sh. Raj Karan	Skilled Supporting Staff
19	Sh. Jot Singh	Skilled Supporting Staff
20	Sh. Raj Kumar	Skilled Supporting Staff
21	Sh. Chhedi Prasad Chauhan	Skilled Supporting Staff
22	Smt. Laxmi Devi	Skilled Supporting Staff
23	Sh. Anand Sharma	Skilled Supporting Staff

S. No	NAME OF THE EMPLOYEE	DESIGNATION
24	Sh. Ram Awadh Pal	Skilled Supporting Staff
25	Sh. Diwan Singh Rawat	Auxiliary (Canteen Staff)
26	Sh. Deben Chandra Rabidas	Auxiliary (Canteen Staff)
27	Sh. Singeshwar Paswan	Auxiliary (Canteen Staff)
28	Sh. Shiv Kumar	Auxiliary (Canteen Staff)
29	Sh. Raghibir Singh	Auxiliary (Canteen Staff)
30	Sh. Mukardhan Rai	Auxiliary (Canteen Staff)
31	Sh. Ram Chander Chodhary	Skilled Supporting Staff (Retired 31-05-2019)
32	Smt. Raj Rani Singh	Skilled Supporting Staff (Retired on 31-08-2019)
33	Sankar Pratap Raut	Auxiliary staff (Retired on 30.04.2019)
34	Bhim Sen	SSS (Retired on 30.11.2019)

List of Technical Staff

S. No.	Employee Name	Post Name
1	Smt. Manjeet Kaur	C.T.O.
2	Smt. Uma	C.T.O.
3	Sh. Pratap Singh	C.T.O.
4	Sh. Rakesh Kumar Saini	C.T.O.
5	Sh. Arun Pratap Singh	C.T.O.
6	Sh. Devendra Kumar	C.T.O.
7	Sh. Gyan Singh	C.T.O.
8	Sh. Pramod Kumar	C.T.O.
9	Sh. Rajender Singh Tomar	C.T.O.
10	Smt. Jyoti Gangwani	C.T.O.
11	Sh. Anil Garg	C.T.O.
12	Sh. Anil Kumar	C.T.O.
13	Sh. Naresh Kumar	C.T.O.
14	Sh. Vijay Pal Singh	C.T.O.
15	Dr. Adarsh Kumar Mogha	C.T.O.
16	Sh. Umesh Chandra Bandooni	C.T.O.
17	Smt. Neelam Chandra	C.T.O.
18	Smt. Savita Wadhwa	C.T.O.
19	Sh. Sanjeev Pawar	A.C.T.O.
20	Smt. Rajni Bala Grover	A.C.T.O.
21	Sh. Subhash Chand	A.C.T.O.
22	Sh. Udai Vir Singh	A.C.T.O.

S. No.	Employee Name	Post Name
23	Sh. Murli Manohar Maurya	A.C.T.O.
24	Sh. Modak Ram Bhakt	A.C.T.O.
25	Sh. Ramesh Anantacharya Joshi	A.C.T.O.
26	Sh. Satyapal Singh	A.C.T.O.
27	Sh. V.R. Senthil Kumar	A.C.T.O.(Civil Engineer) (Joined on 30-10-2019)
28	Smt. Usha Jain	A.C.T.O. (Hindi Translator)
29	Sh. Jai Bhagwan	Sr. T.O.
30	Sh. Virender Kumar	Sr. T.O.
31	Sh. Manoj Kumar	Sr. T.O.
32	Sh. Sunil Bhatia	T.O.
33	Sh. Ratan Singh	T.O. (Carpenter)
34	Sh. Hari Lal Rai	T.O. (Driver)
35	Sh. Mohan Singh	T.O. (Electrician)
36	Sh. Hari Singh	Sr.T. A. (Electrician)
37	Sh. Roop Singh	Tech. Assistant (Driver)
38	Smt. Shreya	Tech. Assistant (T-3)
39	Sh. Parveen Mangal	Tech. Assistant (T-3)
40	Smt. Hema Meena	Tech. Assistant (T-3)
41	Mr. Manish Kumar	Tech. Assistant (T-3)
42	Sh. Nitin Joshi	Tech. Assistant (T-3)
43	Sh. Dinesh Kumar Ray	Sr.Technician (Library)
44	Ms. Neha Narang	Tech. Assistant (T-3) (Joined on 01-01-2019)
45	Smt. Rinku Verma	Tech. Assistant (T-3) (Joined on 08-01-2019)
46	Sh. Rajesh	Tech. Assistant (Joined on 21.06.2019 & Technical resignation on 03.08.2019)
47	Sh. Lakhmi Chand	Sr. T.O. (Retired on 31-03-2019)
48	Sh. Ram Shay	A.C.T.O. (Retired on 31-01-2019)
49	Sh. Arbind Kumar	C.T.O. (Retired on 31-01-2019)
50	Sh. Santosh Kumar	C.T.O. (Retired on 31-03-2019)
51	Dr. Man Singh	C.T.O. (Retired on 30-06-2019)
52	Sh. Sheoraj Singh	C.T.O. (Retired on 30-06-2019)
53	Sh. Rajendra Singh	C.T.O. (Retired on 31-07-2019)

S. No.	Employee Name	Post Name
54	Sh. Om Prakash Singh	C.T.O. (Retired on 31-07-2019)
55	Sh. Shridhar Vasudeo Bhagwat	A.C.T.O. (Retired on 31-07-2019)
56	Sh. Ashwini Kumar	C.T.O. (Retired on 30-09-2019)
57	Sh. Brahma Jeet Gahlot	C.T.O. (Retired on 31-12-2019)

Seniority-wise List of Scientists (As on 31.12.2019)

1	Dr. Tauqueer Ahmad	Director (Acting) & Head
2	Dr. K.N. Singh	Principal Scientist & Head (A)
3	Dr. Anil Rai	Principal Scientist & Head (A)
4	Dr. (Smt.) Seema Jaggi	Principal Scientist & Head (A)
5	Dr. Rajender Parsad	Principal Scientist
6	Dr. Ajit	Principal Scientist
7	Dr. Lal Mohan Bhar	Principal Scientist & Head (A)
8	Dr. Dinesh Kumar	Principal Scientist
9	Dr. Amrit Kumar Paul	Principal Scientist
10	Dr. A.R. Rao	Principal Scientist
11	Dr. Himadri Ghosh	Principal Scientist
12	Dr. Ramasubramanian V.	Principal Scientist
13	Dr. (Smt.) Cini Varghese	Principal Scientist
14	Dr. Hukum Chandra	National Fellow & Principal Scientist
15	Dr. Anil Kumar	Principal Scientist
16	Dr. Prawin Arya	Principal Scientist
17	Dr. Sudeep	Principal Scientist & Head (A)
18	Dr. (Smt.) Alka Arora	Principal Scientist
19	Dr. (Smt) Prachi Misra Sahoo	Principal Scientist
20	Dr. Monendra Grover	Principal Scientist
21	Dr. (Smt.) Anshu Bharadwaj	Principal Scientist
22	Dr. Sunil Kumar	Principal Scientist
23	Dr. Mukesh Kumar	Principal Scientist
24	Dr. Ulavappa B. Angadi	Principal Scientist
25	Dr. Krishna Kumar Chaturvedi	Senior Scientist
26	Dr. S.B. Lal	Senior Scientist
27	Dr. Mohd. Wasi Alam	Senior Scientist
28	Dr. (Smt.) Anu Sharma	Senior Scientist
29	Dr. (Smt.) Shashi Dahiya	Senior Scientist
30	Dr. (Smt.) Sarika	Senior Scientist
31	Dr. Mir Asif Iquebal	Senior Scientist
32	Dr. Susheel Kumar Sarkar	Senior Scientist
33	Dr. B.N. Mandal	Senior Scientist
34	Dr. Ranjit Kumar Paul	Senior Scientist
35	Dr. Mohd. Samir Farooqi	Scientist
36	Sh. Pal Singh	Scientist
37	Sh. Shah Nawazul Islam	Scientist
38	Sh. Sanjeev Kumar	Scientist
39	Dr. (Smt.) Sangeeta Ahuja	Scientist
40	Dr. Dwijesh Chandra Mishra	Scientist
41	Dr. Soumen Pal	Scientist
42	Dr. Kaustav Aditya	Scientist
43	Dr. Bishal Gurung	Scientist
44	Dr. Sukanta Dash	Scientist
45	Dr. P.K. Meher	Scientist
46	Dr. Ankur Biswas	Scientist
47	Dr. Arpan Bhoumik	Scientist
48	Dr. Sudhir Srivastava	Scientist
49	Sh. Deepak Singh	Scientist
50	Dr. Kanchan Sinha	Scientist
51	Sh. Upendra Kumar Pradhan	Scientist
52	Sh. Samarendra Das	Scientist
53	Dr. Raju Kumar	Scientist
54	Sh. Prakash Kumar	Scientist
55	Dr. Mrinmoy Ray	Scientist
56	Dr. (Smt.) Vandita Kumari Choudhary	Scientist
57	Sh. Sunil Kumar Yadav	Scientist
58	Dr. Ravinder Singh Shekhawat	Scientist
59	Sh. Rajeev Ranjan Kumar	Scientist
60	Sh. Mohd. Harun	Scientist
61	Dr. (Smt.) Anindita Dutta	Scientist
62	Sh. Neeraj Budhlakoti	Scientist
63	Dr. Himadri Shekhar Roy	Scientist
64	Dr. Achal Lama	Scientist
65	Dr. Pradeep Basak	Scientist
66	Dr. (Smt.) Anuja A.R.	Scientist
67	Dr. Shivaswamy G.P.	Scientist
68	Sh. Rajesh T.	Scientist
69	Dr. Harish Kumar H.V.	Scientist

Annexure-III

Various ICAR-IASRI Committees

Consultancy Processing Cell (CPC)

1.	Dr. Rajender Parsad, Principal Scientist	Chairman
2.	Dr. Seema Jaggi, Principal Scientist and Head(A), Design of Experiments	Member
3.	Dr. Anil Kumar, Principal Scientist	Member
4.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	Member
5.	Dr. Ajit, Principal Scientist	Member
6.	Senior Finance and Accounts Officer (Ex-Officio)	Member
7.	Head of Office (Ex-Officio)	Member
8.	Sh. Naresh Kumar, CTO	Member Secretary

Institute Technology Management Committee (ITMC)

1.	Dr. L.M. Bhar, Director(A) & Head, Division of Statistical Genetics	Chairman
2.	Dr. Anil Rai, ADG (ICT) & Head(A), Centre for Agricultural Bioinformatics	Member
3.	Dr. K.S. Rana, Professor and Head, Division of Agronomy, ICAR-IARI, New Delhi	Member
4.	Dr. Seema Jaggi, Principal Scientist and Head(A), Design of Experiments	Member
5.	Dr. Rajender Parsad, Principal Scientist & Incharge, ITMU	Member Secretary

Institute Technology Management Unit (ITMU)

1.	Dr. Rajender Parsad, Principal Scientist	Office Incharge & Member Secretary
2.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	Member
3.	Sh. Naresh Kumar, CTO	Member

Institute Deputation Committee

1.	Director	Chairman
2.	All Heads of Divisions	Members
3.	Senior Administrative Officer	Member
4.	Sr. Finance & Account Officer	Member
5.	Incharge, PME Cell	Member Secretary

Project Monitoring Committee (PMC)

1.	Director	Chairman
2.	All Heads of Divisions	Members
3.	Incharge, PME Cell	Member Secretary

Institute of Joint Staff Council

Official Side Members

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	Chairman
2.	Dr. Ajit, Principal Scientist	Member
3.	Dr. Prawin Arya, Principal Scientist	Member
4.	Dr. S. B. Lal, Senior Scientist	Member
5.	Dr. Shashi Dahiya, Scientist	Member
6.	Senior Finance and Accounts Officer	Member
7.	Head of Office	Member Secretary

Staff Side Members

1.	Sh. Janak Kumar, SSS	Secretary
2.	Sh. Ashok Kumar, SSS	Member (CJSC)
3.	Sh. Dharmendra Tanwar, UDC	Member
4.	Sh. K.B. Sharma, Assistant	Member
5.	Sh. Harilal Rai, Driver	Member
6.	Sh. Hari Singh, Technical Assistant (Electrician)	Member

Grievance Committee

Official Side Members

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Statistical Genetics	Chairman
2.	Dr. (Mrs.) Seema Jaggi, Principal Scientist and Head(A), Design of Experiments	Member
3.	Head of Office	Member
4.	Senior Finance and Accounts Officer	Member
5.	Assistant Administrative Officer (Admn. II)	Member Secretary

Staff Side Members

1.	Dr. Arpan Bhowmik, Scientist	Member, Scientific Group
2.	Sh. Virendra Kumar, Chief Technical Officer	Member, Technical Group
3.	Sh. Divan Singh, Clerk	Member, Auxiliary Group
4.	Sh. Ashok Kumar, Assistant	Member, Administrative Group
5.	Sh. Harpal Singh, SSS	Member, Skilled Supporting Staff Group

ICAR Staff Welfare Fund Scheme

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	Chairman
2.	Dr. Prawin Arya, Principal Scientist	Welfare Officer
3.	Head of Office	Member
4.	Senior Finance and Accounts Officer	Member
5.	Dr. Prachi Mishra Sahoo, Principal Scientist	Female Member
6.	Sh. K.B. Sharma, Secretary, IJSC(SS)	Member
7.	Sh. Shyam Swaroop, SSS	Member
8.	Assistant Administrative Officer (Admin-II)	Member Secretary

Women Cell

1.	Dr. (Mrs.) Seema Jaggi, Principal Scientist and Head(A), Design of Experiments	Chairperson
2.	Dr. (Mrs.) Mansi Mishra, Head, Research and Knowledge Management, Centre for Social Research	Member
3.	Dr. (Mrs.) Cini Varghese, Principal Scientist	Member
4.	Smt. Savita Wadhwa, CTO	Member
5.	Smt. Suman Khanna, Stenographer	Member
6.	Sh. Raj Kumar Verma, Assistant	Member
7.	Smt. Neelam Sethi, Assistant	Convener

Institute Ranking Committee

1.	Dr. Hukum Chandra, National Fellow	Chairman
2.	Dr. Ramasubramanian V. Principal Scientist	Co-Chairman
3.	Dr. Sukanta Dass, Scientist	Member
4.	Dr. Soumen Paul, Scientist	Member
5.	Dr. Mir Asif Iquabal, Scientist	Member
6.	Dr. Ranjit Kumar Paul, Scientist	Member
7.	Dr. Mrinmay Roy, Scientist	Convener
8.	Dr. Sunil Kumar Yadav, Scientist	Member
9.	Dr. Pravin Mehar, Scientist	Member
10.	Dr. Pradip Basak, Scientist	Member
11.	Sh. B.J. Gahlot	Member-Secretary

Committee for editing & compilation of QRT documents (for 2011-18)

1.	Dr. Ajit, Principal Scientist	Chairman
2.	Dr. Hukum Chandra, National Fellow	Co-Chairman
3.	Dr. Soumen Paul, Scientist	Member
4.	Dr. Mir Asif Iquabal, Scientist	Member
5.	Dr. Ranjit Kumar Paul, Scientist	Member
6.	Dr. Bishal Gurung, Scientist	Member
7.	Dr. Sukanta Dash, Scientist	Member
8.	Sh. Sunil Kumar Yadav, Scientist	Member
9.	Dr. Pradip Basak, Scientist	Member

International Training Hostel (ITH)

1.	Dr. Anil Kumar, Principal Scientist	Coordinator
2.	Sh. Diwan Singh, Clerk	Caretaker
3.	Sh. Dilip Ghashyam Khapekar, AAO	Incharge, Guest House

International Training Hostel Catering Services Inspection Committee

1.	Dr. Hukum Chandra, National Fellow	Chairman
2.	Dr. Anil Kumar, Principal Scientist	Co-Chairman
3.	Dr. Kaustav Aditya, Scientist	Member
4.	Sr. Finance & Accounts Officer	Member

5.	Administrative Officer	Member
11.	Asstt. Admn. Officer (Central Purchase Section)	Member-Secretary

Hostel Executive Committee

1.	Warden	Dr. K.N. Singh
2.	Prefect	Sh. Kapil Choudhary
	Assistant Prefect	Sh. Vinayaka
3.	Mess Secretary	Sh. Nitesh Sharma
4.	Cashier	Sh. Amit Saha
5.	Maintenance Secretaries	Sh. Debopam Rakshit Sh. Rishabh Singhshyam Sh. Rahul Gupta Sh. Baibhav
6.	Sport Secretaries	Sh. Jitendra Kumar Sh. Sandip Garai Sh. Lalit Birla Sh. Appaji Nayak
7.	Cultural Secretaries	Sh. Jutan Das Sh. Dilip Kumar Sh. Mailarlinga Sh. Jagadeesh MS
8.	Gym Secretaries	Sh. Vinay Kumar Sh. Sharan B.
9.	Health Secretary	Sh. Aamir khan Sh. Rohit Singh
10.	News Paper & Magazine Secretary	Sh. Mohit Jat
11.	Common Room Secretary	Sh. Harsh Sachan Sh. Abhisek MP
12.	Communication Secretary	Sh. Naveen HS
13.	Auditors	Sh. Samir Barman Sh. Dilip Kumar Sh. Bijoy Chanda Sh. Baibhav Kumar
14.	Food Committee	Md. Asif Khan Sh. Sumit Saurabh Sh. Arpan Manjhi Sh. Sharan B. Sh. Mohit Jat
17.	Warden's Nominee	Sh. Nitin Varshney

Institute Recreation Club

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	President
2.	Dr. K.N. Singh, Principal Scientist & Head(A), Division of Forecasting and Agricultural Systems Modeling	Vice President
3.	Head of Office	Member
4.	Senior Finance and Accounts Officer	Member
5.	Sh. Raj Kumar Verma, Assistant	Member
6.	Sh. Mayank Pundir, Assistant	Secretary

7.	Sh. Dharmendra Tanwar, LDC	Treasurer
8.	Smt. Vijayalakshmi Murthy, PA	Women Member

Institute Sports Committee

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	President
2.	Dr. K.N. Singh, Principal Scientist & Head(A), Division of Forecasting and Agricultural Systems Modeling	Vice President
3.	Head of Office	Member
4.	Senior Finance and Accounts Officer	Member
5.	Dr. Susheel Kumar Sarkar, Scientist	Member
6.	Sh. RS Tomar, Chief Technical Officer	Convener
7.	Secretory, IJSC	Member
8.	Dr. Sukanta Dash, Scientist	Member
9.	Dr Ankur Biswas, Scientist	Member
10.	Sh. KB Sharma, Assistant	Member
11.	Sh. Sunil Kumar	Member
12.	Sh. Janak Kumar	Member
13.	Sh. Yashraj Nagar	Member
14.	Sh. Dharmendra Tanwar, LDC	Member
15.	Sh. Naresh Kumar	Member
16.	Sh. Raj Kumar Verma	Member
17.	Smt. Vijayalakshmi Murthy, PA	Member
18.	Assistant Administrative Officer (Admin-II)	Member

IASRI Employees Co-operative Thrift and Credit Society Limited

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	Patron
2.	Sh. M.M. Maurya, Sr.TO	President
3.	Sh.Virendra Kumar, Sr.TO	Vice-President
4.	Sh. Sunil Bhatia, TO	Secretary
5.	Sh. Ashok Kumar	Treasurer
6.	Dr. (Mrs.) Anshu Bharadwaj, Principal Scientist	Women MC Member
7.	Dr. (Mrs.) Sarika, Senior Scientist	Women MC Member
8.	Dr. Arpan Bhowmik, Scientist	MC Member
9.	Sh. Dharmendra Tanwar	MC Member
10.	Sh. Manoj Kumar, Sr. TO	MC Member
11.	Sh. Ashok Kumar, SSS	MC Member
12.	Sh. Janak Kumar, SSS	MC Member

Sankhyaki Vimarsh Committee

1.	Dr. Anil Kumar, Principal Scientist	Chairman
2.	Md. Samir Farooqi, Scientist	Member
3.	Dr. Susheel Kumar Sarkar, Scientist	Member
4.	Dr. Dwijesh Chandra Mishra, Scientist	Member
5.	Dr. Sukanta Dash, Scientist	Member

6.	Sh. B.J. Gahlot, CTO	Member
7.	Smt. Usha Jain, ACTO	Member
8.	Smt. Savita Wadhwa, CTO	Member
9.	Smt. Neha Narang, TO	Member

Newsletter Preparation Committee

1.	Dr. L.M. Bhar, Director(A) & Head, Division of Statistical Genetics	Chairman
2.	Dr. Ajit, Principal Scientist	Member
3.	Dr. Ramasubramanian V., Principal Scientist	Member
4.	Dr. Shashi Dahiya, Scientist	Member
5.	Dr. Susheel Kumar Sarkar, Scientist	Member
6.	Dr. (Mrs.) Sarika, Senior Scientist	Member
7.	Dr. Mrinmoy Ray, Scientist	Member
8.	Dr. Anindita Dutta, Scientist	Member
9.	Dr. Himadri Shekhar Roy, Scientist	Member
11.	Sh. Brahmajeet Gahlot, CTO	Member

Proprietary Articles Purchase Committee

1.	Dr. Ramasubramanian V., Principal Scientist	Chairman
2.	Dr. Sudeep, Principal Scientist & Head(A), Division of Computer Applications	Member
3.	Dr. Ranjit Kumar Paul, Scientist	Member

Institute Seminar Association Committee

1.	Dr. Amrit Kumar Paul, Principal Scientist	President
2.	Dr. Ranjit Kumar Paul, Scientist	Secretary
3.	Dr. (Mrs.) Shashi Dahiya, Scientist	Member
4.	Dr. Dwijesh Chandra Mishra, Scientist	Member
5.	Dr. Arpan Bhowmik, Scientist	Member
6.	Dr. Ankur Biswas, Scientist	Member
7.	Dr. Mrinmoy Ray, Scientist	Member

Institute Krishi Vigyan Mela Committee

1.	Dr. Prawin Arya, Principal Scientist	Chairman
2.	Dr. Shashi Dahiya, Scientist	Member
3.	Dr. Anu Sharma, Scientist	Member
4.	Dr. Susheel Kumar Sarkar, Scientist	Member
5.	Dr. Sukanta Dash, Scientist	Member
6.	Dr. Soumen Pal, Scientist	Member
7.	Dr. Dwijesh Mishra, Scientist	Member
8.	Dr. Ankur Biswas, Scientist	Member
9.	Dr. Ravindra Singh Shekhawat, Scientist	Member
10.	Dr. Raju Kumar, Scientist	Member
11.	Sh. Deepak Singh, Scientist	Member
12.	Dr. Kanchan Sinha, Scientist	Member

13.	Dr. Sudhir Srivastava, Scientist	Member
14.	Sh. Sunil Yadav, Scientist	Member
15.	Sh. Ravidas, SSS	Member

Institute Mera Gaon Mera Gaurav Coordination Committee

1.	Dr. Amrit Kumar Paul, Principal Scientist	Nodal Officer
2.	Dr. Krishna Kumar Chaturvedi, Senior Scientist	Member
3.	Dr. Ranjit Kumar Paul, Scientist	Member
4.	Dr. Kaustav Aditya, Scientist	Member
5.	Dr. Soumen Pal, Scientist	Member
6.	Dr. Arpan Bhowmik, Scientist	Member
7.	Dr. Mrinmoy Ray, Scientist	Member

Institute Swachhata Committee

1.	Dr. Monendra Grover, Principal Scientist	Chairman
2.	Dr. Arpan Bhowmik, Scientist	Secretary
3.	Sh. Pal Singh, Scientist	Member
4.	Sh. Deepak Singh, Scientist	Member
5.	Dr Achal Lama, Scientist	Member
6.	Dr. Arpan Bhowmik, Scientist	Member
7.	Dr. P.K. Meher, Scientist	Member

HPC Management and Maintenance Committee

1.	Dr. U.B. Angadi, Principal Scientist	Chairman
2.	Dr. Krishna Kumar Chaturvedi, Senior Scientist	Member
3.	Dr. Shashi Bhushan Lal, Senior Scientist	Member
4.	Dr. (Mrs.) Anu Sharma, Scientist	Member
5.	Sh. Jai Bhagwan, Sr. TO	Member Secretary

Institute Data Book Committee

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys	Chairman
2.	Dr. Prachi Misra Sahoo, Principal Scientist	Member
3.	Dr. Ankur Biswas, Scientist	Member
4.	Sh. Deepak Singh, Scientist	Member
5.	Dr. Raju Kumar, Scientist	Member
6.	Dr. Pradip Basak, Scientist	Member
7.	Smt. Neelam Chandra	Member

संस्थान राजभाषा कार्यान्वयन समिति के अध्यक्ष एवं सदस्य

1.	डॉ॰ लाल मोहन भर, निदेशक	अध्यक्ष
2.	डॉ॰ तौकीर अहमद, अध्यक्ष, प्रतिदर्श सर्वेक्षण प्रभाग	सदस्य
3.	डॉ॰ अनिल राय, अध्यक्ष, कृषि जैव सूचना केंद्र	सदस्य
4.	डॉ॰ सीमा जग्गी, अध्यक्ष, परीक्षण अभिकल्पना प्रभाग	सदस्य
5.	डॉ॰ कमलेश नारायण सिंह, अध्यक्ष, पूर्वानुमान कृषि प्रणाली मॉडलिंग प्रभाग	सदस्य

6.	डॉ॰ सुदीप मारवाह, अध्यक्ष, संगणक अनुप्रयोग प्रभाग	सदस्य
7.	डॉ॰ रामासुब्रमनियन वी॰, प्रभारी, पी॰एम॰ई॰ प्रकोष्ठ	सदस्य
8.	श्री योगेश कादियान, प्रशासनिक अधिकारी	सदस्य
9.	श्री अरविंद, वरिष्ठ वित्त एवं लेखा अधिकारी	सदस्य
10.	श्री चंद्रवल्लभ, सहायक प्रशासनिक अधिकारी	सदस्य
11.	श्री दिलीप खापेकर, सहायक प्रशासनिक अधिकारी	सदस्य
12.	श्री मानस चौधरी, सहायक प्रशासनिक अधिकारी	सदस्य
13.	श्री विशाल लखनपाल, सहायक प्रशासनिक अधिकारी	सदस्य
14.	श्री रोहित रस्तोगी, सहायक प्रशासनिक अधिकारी	सदस्य
15.	श्री प्रभु दयाल, सहायक प्रशासनिक अधिकारी	सदस्य
16.	श्री राजेंद्र कुमार कोली, सहायक प्रशासनिक अधिकारी	सदस्य
17.	श्री अमित कुमार मारवाड़ी, सहायक वित्त एवं लेखाधिकारी	सदस्य
18.	डॉ॰ सिनी वरगीस, प्रमुख वैज्ञानिक	हिंदीतर प्रतिनिधि
19.	डॉ॰ सौमेन पाल, वैज्ञानिक	हिंदीतर प्रतिनिधि
20.	डॉ॰ अनिल कुमार, प्रमुख वैज्ञानिक एवं अध्यक्ष, संपादक मण्डल	सदस्य
21.	पुस्तकालयाध्यक्ष	सदस्य
22.	सुश्री ऊषा जैन, सहायक मुख्य तकनीकी अधिकारी एवं प्रभारी, हिन्दी एकक	सदस्य–सचिव

Purchase Advisory Committee

1.	Dr. Tauqueer Ahmad, Director(A) & Head, Division of Sample Surveys (till 04.12.2019) Dr. Lal Mohan Bhar, Head (A) (from 05.12.2019 onwards)	Chairman
2.	Dr. Mukesh Kumar, Principal Scientist	Co-Chairman
3.	Senior Administrative Officer	Member
4.	Senior Finance & Accounts Officer	Member
5.	Asstt. Finance & Accounts Officer	Member
6.	Administrative Officer	Member
7.	AAO, Central Purchase Section	Member Secretary

Annexure-IV

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. The responsibility of up-keep and maintenance of NASM rests with our institute. 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

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 entrance fee. During the period under report, a total of 243116 visitors visited the NASM. 2407 tickets were sold, 235687 students from Schools/ College/Ag. University of Delhi/NCR & different states of India, 1336 farmers from different States of India (Fig.), 265 Trainees from different training programmes conducted by ICAR Institutes and other Govt. Departments, 3309 ICAR staff visitors, 36 media publication visitors and 68 Foreign delegates of various countries also visited the NASM. The monthwise number of visitors under these various categories are given in Table subsequently.

Table: Number of Visitors during the year 2019 to ICAR-National Agricultural Science Museum

Month	Tickets	ICAR Visitors	Farmers	Students of school/ college	Foreigners	Trainees	VIP	Media & publication	Total
Jan	271	1065	80	70701	5	36	0	0	72158
Feb	205	166	97	31645	19	10	0	0	32142
Mar	217	164	337	13255	5	22	0	4	14004
Apr	217	92	0	501	5	0	8	0	823
May	151	68	6	179	0	15	0	0	419
Jun	354	261	60	105	0	0	0	0	780
Jul	196	125	80	535	0	25	0	0	961
Aug	135	195	35	21416	0	42	0	32	21855
Sep	178	256	145	13633	0	50	0	0	14262
Oct	141	113	66	22699	26	11	0	0	23056
Nov	187	544	187	25187	0	54	0	0	26159
Dec	155	260	243	35831	8	0	0	0	36497
Total	2407	3309	1336	235687	68	265	8	36	243116

The staff of our institute who were and are presently In-charge of the museum are given below:

SN	Name	Designation	From	To
1.	Sh. S.K. Sablania	Chief Technical Officer	03.11.2004	31.05.2005
2.	Sh. RP Jain	Scientist	01.06.2005	30.03.2010
3.	Dr. Sushila Kaul	Scientist	30.03.2010	31.03.2014
4.	Sh. Pal Singh	Scientist	13.05.2014	31.10.2017
5.	Sh. Arbind Kumar	Chief Technical Officer	01.11.2017	31.01.2019
6.	Sh. Rajendra Singh	Chief Technical Officer	01.02.2019	31.07.2019
7.	Sh. Anil Garg	Chief Technical Officer	August 2019	Till date

Fig.: Visit by farmers from different states of India to National Agricultural Science Museum

Participation in Pusa Unnati Krishi Mela

Our institute participated in Pusa Unnati Krishi Mela, 2019 held at IARI mela ground, New Delhi during 05-07 March, 2019. Our institute presented some attractive posters of NASM exhibits to the general visitors, researchers, students and farmers to give them adequate knowledge about NASM (Fig.). 221 visitors including students, farmers, Government and non govt. agencies visited the museum and also NASM booklet & Pamphlets were distributed to the visitors.

Fig.: Our institute staff at Pusa Unnati Krishi Mela 2019