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ICAR - Indian Agricultural Statistics Research Institute

Library Avenue, Pusa, New Delhi - 110012

www.iasri.res.in

ISO 9001:2008 Certified Institute

ISO/IEC 20000 & ISO/IEC 27001 Certified Data Centre

Contents

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 Jan 2018
Dr. L.M. Bhar (A)...........	22 Jan 2018 – onwords

Vision

Statistics and Informatics for enriching the quality of Agricultural Research

Mission

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

Mandate

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

Preface

It is a matter of immense pleasure and great satisfaction to present the Annual Report 2017-18 of ICAR-Indian Agricultural Statistics Research Institute (ICAR-IASRI), an ISO 9001:2008 certified Institute with glorious tradition of carrying out research, teaching and training in the area of Agricultural Statistics and Informatics. This report highlights the research achievements made, new methodologies developed, significant advisory and consultancy services provided, dissemination of knowledge acquired and human resource development. The scientists, technical personnel, administrative, finance and other staff of the Institute have put in their best efforts in fulfilling the mandate of the Institute.

During the year, research was carried out under 93 research projects (35 Institute funded, 7 Collaborative, 51 externally funded), one National Fellow Scheme and 12 Consultancy Projects in various thrust areas.

A landmark for the Institute this year is that under an FAO funded consultancy, three separate guidelines for estimating post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries) / fish products were prepared and submitted to the FAO. These guidelines will be tested in the two countries (Namibia and Mexico). Suitable sampling methodology (aligned with existing Survey of Agriculture Census) for estimation of private food-grain stock and post-harvest losses at farm level has been developed under the FAO funded study. An innovative approach for small area estimation of crop yield, socio-economic and food insecurity parameters has been developed. Based on this approach, a web based software for small area estimation under an area level model has been developed. The software is available at: http://sample.iasri.res.in/ssrs/index_sae.jsp. This software provides small area estimates for both sampled as well as non-sampled areas along with standard error and percentage coefficient of variation.

An online portal named 'Education Portal' (https://education.icar.gov.in) has been developed for strengthening of Higher Agricultural Education in the Country. Two Mobile Applications namely PASHU-PRAJANAN (Animal-Reproduction) and SUKAR-PALAN (Pig-Farming) have been developed on Android platform in collaboration with IVRI, Izatnagar and are available at Google Play Store.

An R package called "Aoptbdtvc" has been developed to implement the algorithms for construction of A-optimal BTIB, GDT, BBPB and weighted A-optimal BTIB designs. The package is available on cran.r-project.org/web/packages/Aoptbdtvc/index.html.

Candidate genes and pathways of herbicide tolerance in chickpea has been successfully reported in collaboration with ICAR-IIPR, Kanpur. Genes offering herbicide tolerance can be further utilized in variety improvement programme. Cracking of genetic code of groundnut stem rot disease causing fungus Athelia rolfsii has been reported in collaboration with JAU, Junagarh. This finding will pave the way for genome based solution in stem rot disease management leading to better productivity of groundnut crop in tropical region of world. Composite measure for stability and high yield using Multiple Criteria Decision-Making (MCDM) has been developed.

Weather indices have been developed from weather variables using LASSO. IMD (India Meteorological Department) has been using the weather indices for crop forecasting of almost all districts in India. A new improved sieve bootstrap approach in constructing prediction intervals for bivariate autoregressive and Artificial Neural Network (ANN) models have been developed.

During the year, 22 training programmes (Five Consultancy National/International Trainings, Six under Centre of Advanced Faculty Training, One Winter School, Eight training programmes under HRM and Three other training programmes) were organized in which 461 participants were imparted training. During the year, a total of 32 students {6 Ph.D. (Agricultural Statistics), 7 M.Sc. (Agricultural Statistics), 6 Ph.D. (Computer Application), 6 M.Sc. (Computer Application), 3 Ph.D. (Bioinformatics) and 5 M.Sc. (Bioinformatics)} were admitted. A Senior Certificate Course in Agricultural Statistics and Computing was also organized.

The Institute has published 141 research papers in National and International refereed Journals along with 21 articles in Hindi-Sankhiki-Vimarsh, 23 Reference Manuals, 21 popular articles/short communications, 8 Research Project Reports,1 book, 11 book chapters, 22 e-Manuals and 3 Technical Reports and Bulletins.

I am extremely happy to share that some of our colleagues received academic distinctions during the year. Dr. Hukum Chandra was conferred as Fellow, NAAS under section Social Science, 2017 and Dr. Seema Jaggi and Dr. Ranjit Kumar Paul, were conferred as Fellow, NAAS under section Social Science, 2018. Dr. K.K. Chaturvedi, received Distinguished Scientist Award, in International Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2017). Dr. Santosha Rathod, received Dr. G R Seth Memorial Young Scientist Award by Indian Society of Agricultural Statistics. Dr. Kaustav Aditya was awarded "Krishi Vigyan Gourav" Award 2017 from Bhartiya Krishi Anusandhan Samiti and Krishi Anusandhan Sanchar Kendra. Dr. Ravindra Singh Sekhavat received Young Scientist Award by Science and Technology Society for Integrated Rural Improvement. Sh. Prakash Kumar, was awarded Netaji Subhas-ICAR International Fellowship. Dr. Sarika, received "SERS Computational Biologist 2017" award from Society for Educational and Scientific Research. Dr. M.A. Iquebal received "Young Scientist Award" in 5th Faculty Branding Award 2017 by EET-CRS Research Wing for Excellence in Professional Education and Industry.

During the period under report scientists were deputed on different assignments to Rome, Italy; Addis Ababa, Ethiopia; San Jose, Coasta Rica; Cali, Columbia; Kummings, China and Myanmar.

I am happy to share that the Institute has received ten copyrights during this year.

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. N.S. Rathore, DDG (Education), ICAR; Dr. P.S. Pandey, ADG (EP&HS), ICAR and Dr. G. Venkateshwarlu, ADG (EQA&R), ICAR for their constant direction, inspiration and backing. My sincere appreciation are to all Heads of Division, 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 the In-charge, Dr. Ajit for all the efforts and coordinating various activities. The sincere efforts of all members of Editorial Committee 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.

लालमोहन

(L.M. Bhar)
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
	•	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, tested and validated in four states. The methodology will be implemented at national level.
	•	Developed Personnel Management System, 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).
	•	Produced Poverty map of spatial inequality in distribution of poverty incidence in different districts of Bihar.
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.

ORGANOGRAM

RESEARCH ADVISORY COMMITTEE ⇄ **DIRECTOR** ⇄ **INSTITUTE MANAGEMENT COMMITTEE**

DIRECTOR

SENIOR FINANCE AND ACCOUNTS OFFICER
- AUDIT SECTION
- ACCOUNTS SECTION

SENIOR ADMINISTRATIVE OFFICER
- 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

VIGILANCE OFFICER
- OMV UNIT

PROF. (AG. STAT.)
PROF. (COM. APPLN.)
PROF. (BIOINFORMATICS) WARDEN
- TRAINING ADMINISTRATION CELL

OFFICER INCHARGE
- LIBRARY AND DOCUMENTATION
- CENTRE OF ADVANCED FACULTY TRAINING
- INSTITUTE TECHNOLOGY MANAGEMENT UNIT
- PME CELL
- AGRICULTURE KNOWLEDGE MANAGEMENT CELL
- NASM
- GUEST HOUSE / ITH

HEAD OF DIVISION
- DESIGN OF EXPERIMENTS
- STATISTICAL GENETICS
- FORECASTING AND AGRICULTURAL SYSTEMS MODELING
- SAMPLE SURVEYS
- COMPUTER APPLICATIONS
- CENTRE FOR AGRICULTURAL BIOINFORMATICS

Executive Summary

Poverty affect many people, but the ramifications and impacts affect all aspects of society. Information about the incidence of poverty is therefore an important parameter of the population for policy analysis and decision making. Disaggregate level estimates of poverty incidence and poverty map are useful information for identifying the districts/ regions with higher level of poverty rate. A small area estimation approach by linking data from the Household Consumer Expenditure Survey 2011-12 of NSSO and the Population Census 2011 has been implemented to generate reliable and representative estimates of poverty incidence at district level in the State of Bihar. A poverty map showing the spatial inequality in distribution of poverty incidence in different districts of Bihar has also been produced. This type of map is a useful aid for policy planners and administrators charged with taking effective financial and administrative decisions that can impact differentially across the region.

An efficient sampling methodology for estimation of area and production of horticultural crops has been suggested and is being validated in six states of the country namely, Maharashtra, Tamil Nadu, Andhra Pradesh, Himachal Pradesh, Haryana and Madhya Pradesh.

A 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 suggested. The output from this study has established the feasibility of inclusion of developed questionnaire in the future Input Survey of Agriculture Census in India in order to estimate the food grains stock including post-harvest loss at farm operations which will bridge the gap on post-harvest information and private food grains stock in on-farm and off-farm domains of the supply chain.

Under an FAO funded consultancy, three separate Guidelines for estimating post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries) were prepared and submitted to the FAO. These guidelines will be tested in the two countries.

Calibration estimator of population mean under Adaptive Cluster Sampling has been obtained. The approximate variance and the Yates-Grundy form of estimate of variance of the proposed calibration estimator has been developed.

For two-stage sampling design, efficient estimators of population total have been developed using two step calibration approach for different situations based on availability of auxiliary information.

To improve the data collection work, an Android Application named Mobile Assisted Personal Interview (MAPI) software was developed and deployed for data collection in Gujarat. The MAPI was found very advantageous over the existing paper based survey method with respect to timeliness, accuracy and reliability of data. Copyright for MAPI software and Data Entry Software for Crop Area and Yield Estimation Survey was obtained.

The general expression for the factor-wise as well as total changes of minimally changed first order response surface design with neighbour effects (FORDNE) has been obtained.

Designs for fitting first order response surface with indirect effects in smaller number has been obtained. A catalogue of designs for fitting second order response surfaces with smaller number of runs for factors upto 9 has been prepared.

A number of A-optimal balanced treatment incomplete block (BTIB) designs, group divisible treatment (GDT) designs, balanced bipartite block (BBPB) designs and weighted A-optimal BTIB designs are obtained in limited restricted parametric ranges and catalogues of these designs prepared. The layouts of the designs are available on Design Resources Server. These catalogues will serve as ready reckoner for experimenters as well as statisticians.

An R package called Aoptbdtvc has been developed to implement the algorithms for construction of A-optimal BTIB, GDT, BBPB and weighted A-optimal BTIB designs. The package is available on cran.r-project.org/web/packages/Aoptbdtvc/index.html.

A method of construction for obtaining incomplete split plot designs which are incomplete at main plot level and complete at subplot level has been developed. Methodology for analysis of incomplete split plot designs using fixed effects models has been attempted.

An online application has been developed to obtain incomplete split plot designs for each of the three scenarios (i) main plots complete and subplots incomplete (ii) main plots incomplete and subplots complete and (iii) when both main plots and subplots are incomplete.

A combined estimate of general combining ability (gca) of half and full parents and also the combined estimate of specific combining abilitty (sca) based on the model proposed under unblocked setup for complete three-way crosses have been derived.

A series of designs for three-way genetic cross under unblocked set up has been obtained and per cross efficiency of the series designs so obtained is calculated by comparing with CTC plan.

Two series of designs for three-way genetic cross under blocked set up using triangular association scheme and lattice has been obtained and the per cross efficiency of both the series of designs obtained is calculated by comparing with CTC plan.

A method of constructing PTC plans using incomplete block designs has been obtained for comparing test lines with a single control line and variance factor pertaining to gca effects of half as well as full parents for test vs. test lines and test lines vs. control line for the obtained series of designs has been proposed.

A method of constructing designs for partial four-way cross using block designs has been obtained for comparing test lines with test lines.

A web based application for obtaining 1st and 2nd order orthogonal Latin hypercube (OLH) design constructed using the proposed method of construction has been developed. Methodology for the construction of OLH designs with good space filling property has been developed. A number of new designs obtainable from the methods of construction is also obtained. A module has been deployed for obtaining Latin Hypercube (Orthogonal/Nearly Orthogonal) design with good space filling property.

The Indian NARS Statistical Computing 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 April 01, 2017- March 31, 2018 are 1,12,032 which is on an average more than 300 logged in per day.

Strengthened Design Resources Server (www.iasri. res.in/design) by adding the links of online generation of (i) A-optimal BTIB designs; (ii) A-optimal GDT designs; (iii) A-optimal BBPB designs and (iv) Weighted A-optimal BTIB designs. During April 01, 2017 to March 31, 2018, Google Analytics gave 11,688 page views across 353 cities of 81 countries. Average time taken on page is 3.12 minutes.

Obtained 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.

For Forecasting of spatio-temporal time series data using Space Time Autoregressive Moving Average (STARMA) model, STARMA-Genetic Algorithm (GA) and STARMA-Particle Swarm Optimization (PSO) models have been developed and were found to be better over the existing models. An improved STARMA model has been developed by including spatial heterogeneity among locations using inverse distance weightage derived from Euclidean distance of Riemannian great circle; the proposed model performed better as compared to univariate ARIMA and classical STARMA models. Formulae for two step ahead out of sample forecasts of STARMA model has been derived analytically by recursive use of conditional expectation.

For development of hybrid time series models using machine learning techniques for forecasting crop yield with covariates, Integrated approach of machine learning techniques over the residuals have brought about a significant improvement in the performance of traditional ARIMA and ARIMAX

model for time series forecast of crop yield. Hence, the hybrid time series approach using ANN and SVM may be recommended for yield forecast over a short forecasting horizon. The forecast values obtained through hybrid approach can be used for long term forecast through the proposed approach up to the desired forecast horizon which can be useful in formulating precise long term policy/vision.

For crop yield forecasting under Forecasting Agricultural Output using Space Agro-meteorology and Land based observations (FASAL)-Scheme, Wheat yield data of Araria district in Bihar was fitted using usual Regression, LASSO, GARCH, and GARCH using weather variables. GARCH using weather variables provided a better fit to the volatile yield data under consideration. Forecast were carried out for yield data of wheat along with weather variables. ARIMAX model was employed with weather indices as the exogenous variables. ARIMAX provided an improved forecast in comparison to usual ARIMA and regression methodology.

For scoping the future perspectives of Bt technology in Indian agricultural scenario, the technology forecasting tools viz., Scientometric analysis, Grey modeling and Cross impact analysis (CIA) technique were employed. The results revealed that Grey model improved by genetic algorithm performed better. Three 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 study reveals that Govt. policy, Bt seed sector and technological interventions are the main three factors for future perspectives of Bt technology in India.

For parameter estimation of time series models using Bayesian technique, 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. This study aimed at developing Bayesian estimation technique for ARIMAX and ARIMAX-GARCH model. Bayesian framework was implemented to basic ARIMA model and compared the forecasting performance with that of the classical estimates of ARIMA using total food grain production data of India for twenty five years.

Superior results were obtained for Bayesian ARIMA models.

A novel modified cross validation procedure has been developed for estimation of optimal bandwidth for applying kernel regression under correlated errors, and theoretical property of the methodology for estimating mean integrated squared error has been established. Exact formulae of conditional expectation of out-of-sample data of food-grain production has been obtained based on modelling of compound growth rate under long memory errors. Bonferroni Inequality has been used to obtain interval estimate of unknown regression function for out-of-sample analysis of regression function pertaining to food grain time-series data.

A modified mRMR technique based on bootstrap samples (called Boot-mRMR) for selection of informative genes in microarray data has been developed. This technique was applied to rice microarray dataset for identification of genes related to salt stress tolerance. The Boot-mRMR has an advantage over the usual mRMR in the sense that in Boot-mRMR the informative genes are selected based on statistical significance values unlike to the weights used in mRMR method. The developed approach outperformed several existing feature selection techniques, while compared using different performance metrics. Further, an innovative statistical approach has been proposed for interpreting gene expression data in context of gene sets with traits. The utility of the developed method was studied on five different complex abiotic and biotic stresses of rice, which yields specific trait/ stress enriched gene sets. The developed approach provides a valuable platform for integrating the gene expression data with genetically rich QTL data. An approach for finding associations among the nucleotides occurring at different position in a position-wise aligned sequence dataset has been developed.

Developed method for longitudinal study using the GEE in presence of both correlated random effects and correlated errors, that will help animal and plant breeders to understand the genetic architecture and biological variations over time. A more precise and accurate method for longitudinal study using Bayesian method has been developed to predict the breeding value for future trait. The developed models will help to study the behavior of breeding value on different correlated structures, through the simulation studies.

The multiplicative VBSDE model has been extended to the case of different carrying capacity for drift and

diffusion coefficient and exact solution of the equation has been obtained for estimation of parameter using linear estimating function approach.

For estimating farm income and facilitating the implementation of strategic framework for doubling farmers income, the value of production (VoP) from various commodity groups at 2004-05 prices have been used as the most appropriate indicator for commodity outputs. The commodity VoP series from 1950-51 to 2014-15 have been used to study the integration, causality and projections. Various linear and non-linear techniques along with their combinations have been applied for prediction of VoP in India till 2022-23. The VoP is projected separately for cereals, pulses, oilseeds, sugar, fibers, condiments & spices, fruits & vegetables, fisheries and livestock. The hybrid models based on wavelet has been used along with usual ARIMA model for projecting the VoP.

Hybrid Denovo Whole Genome Assembler: A web interface was developed to run the assembly program using web browser to enable the user to run the assembler on a user-friendly interface. A *manifest. conf* file is required to run the MIRA assembler program that is generated automatically after user supplies the input file(s) and related parameters. The MIRA program runs on the server in background while user will be notified by email about the completion of the job. The output files generated will be available for viewing online with the facility of downloading the same.

HRGPred: A software for prediction of herbicide resistant genes (http://webapp.cabgrid.res.in/hrgpred/) has been developed. The evolvement of herbicide resistance has been a major cause of concern for sustainable agricultural production. As far as target site resistance is concerned, seven classes of target proteins have been reported so far. Identification of the genes encoding for these target proteins in wet lab is certainly resource intensive. Thus, a computational tool HRGPred that can be used for predicting the genes encoding for the seven categories of target proteins has been developed. HRGPred will supplement the wet-lab experiments for annotation of herbicide resistance genes.

GSAQ: An R package has been developed for Gene Set Analysis with QTLs (https://cran.r-project.org/web/packages/GSAQ). The GSAQ approach provides a valuable platform for integrating the gene expression data with genetically rich QTL data.

ir-HSP: Improved recognition of Heat Shock Proteins (HSP) : Heat shock proteins (HSPs) are one of the largest groups of molecular chaperones that assist in correct folding of partially folded or denatured proteins, establishment of proper protein conformation and prevention of unalterable aggregation of damaged proteins. HSPs are also involved in other functions like modulation of their synthesis, participation in signal transduction pathways, RNA processing etc. HSPs also play vital role in maintaining the overall cellular protein homeostasis. Due to broad range of activities, they have received a considerable attention of the researchers. Keeping in view the wide range of functions of HSPs, this server has been developed for prediction of HSPs, their families and sub-types of DnaJ proteins. The *ir*-HSP achieved higher accuracy as compared to the existing approaches, and thus believed to supplement the existing efforts for annotation of protein sequences.

nifPred: A webserver for prediction of nitrogen fixation genes (http://webapp.cabgrid.res.in/nifPred/). Biological nitrogen fixation is an important biogeochemical process that plays a major role in conversion of atmospheric nitrogen to ammonia. All nitrogen fixing microbes depend upon the nitrogenase enzyme for nitrogen reduction, which is in fact an enzyme complex consists of two metallo proteins: iron-molybdenum (FeMo) and iron (Fe) proteins. The nifPred is the computational tool for identification of nitrogen fixing proteins viz., nifH, nifD, nifK, nifE, nifN and nifB.

PMDTDb: Pearl millet drough transcriptome database (http://webtom.cabgrid.res.in/pmdtdb/) catalogues the information related to assembled contigs or transcripts, DEGs, the pathways in which these are involved, detailed SSR markers, and variants such SNPs and indels and miRNAs. Web pages are developed for browsing the database along with the queries by user in client tier. All the information regarding contigs, markers, variants etc. are arranged in various tables MySQL in the database tier.

LrSATDb: A transcriptome database of seasonality associated genes in carp fish, *Labeo rohita* (http://webtom.cabgrid.res.in/lrsatdb/) was developed which catalogues tissue wise transcripts/contigs, putative SSRs, SNPs, Indels, transcription factors, miRNA targets representing two reproductive phases (IGA and PSR).

Web genomic resources for Wheat drought root transcriptome: An online relational database of wheat drought transcriptome has been developed which catalogues differentially expressed genes, miRNAs, transcription factors, KEGG pathways along with

markers (SSRs, SNPs and InDels). This genomic resource can be accessed at http://webtom.cabgrid.res.in/wdrotdb/.

Education Portal for ICAR (https://education.icar.gov.in) has been developed to provide vital education information/announcements/event schedules/e-learning resources from Agricultural Universities.

Mobile Apps- Pashu Prajanan (Animal Reproduction) and Sukar Palan (Pig Farming) have been developed in collaboration with ICAR-IVRI and are available on Google Play Store. Four copyrights have been obtained for Animal Reproduction and Pig Farming mobile apps for different languages. The App provides information in seven languages viz. Hindi, English, Punjabi, Bengali, Assamese, Gujarati and Tamil.

Academic Management System for CIFE Mumbai, NDRI Karnal, IVRI Izatnagar and CAU Imphal has been deployed and customized as per their needs.

ICAR-ERP system is operational across ICAR institutes. Support were provided to users over e-mail, remote connection sharing and Phone. Twenty short trainings were organized for ICAR users. Online Dashboard functionality was created for monitoring of transactional data. ER sheet functionality was enhanced in view of user's observations.

ICAR Data Center (DC) audit renewal for ISO 20000:2011 & ISO 27001:2013 was completed for year 2018-19 by the BSI. Under unified communication solutions, up to 31 March, 2018 16886 mail box users and 11,166 Lync users have been created. Seventy eight (78) websites are hosted from ICAR-Data Centre.

Krishi Vigyan Kendra Knowledge Network Portal and KVK Mobile APP (http://kvk.icar.gov.in) were developed to disseminate knowledge and information from KVKs to farmers. Major events like "Sankalp se Sidhi", "World Soil Day" and Krishi Unnati Mela 2018, were showcased from the Home page of the portal. Functionality has been developed to show the events organized at KVKs along with image gallery and downloadable report. This also includes searching facility based on state, district and date of the events. Link on "Video Gallery"

has been provided in the Home page of the portal and a number of technology video files have been uploaded.

A web portal has been developed to provide information about Farmer First Programme (FFP). This includes projects details, interventions, news and highlights, achievements, success stories, latest publications, FFP in media along with image gallery. The portal is targeted to impart agricultural knowledge which is relevant, searchable and up-to-date to the farmers and other stakeholders.

Personnel Management System for managing the cadre strength and transfer of the scientific staff has been developed and implemented in ICAR. The system has been used for FOCARS-106-Batch postings. Total six cycles have been completed successfully for posting/transfer through this system. Executive Record Sheet (ER Sheet) functionality for all scientific personnel has been added in the system and the ER Sheet has been filled by all the scientists across the ICAR institutes. Functionality has been incorporated in the transfer process that not more than 50% of the scientist in any Institute should be from the home-state and system does not allows person to apply to the particular institute based on this criteria. Multiple custom reports have also been added in the system.

A web portal has been developed to provide information about Pandit Deen Dayal Upadhyay Unnat Krishi Shiksha Yojana (PDDUUKSY) scheme under Ministry of Agriculture and Farmers Welfare. This scheme focuses on imparting training through identified farmers training centers across the country.

ICAR Portal is in the process of development at ICAR-IASRI under the guidance from ICAR(HQ). ICAR Portal is an integrated system which will provide information on all Institutions/ Regional Centres under a single roof on monitoring parameters. This system will also provide information on AICRP projects, major achievements, RAC/IRC/IMC/QRT meetings, land assets and RMPs which provides a master monitoring system to higher authority or nodal officers to keep an eagle eye on the institute activities as well as the Institutional network and availability of employee on particular Institute.

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 9001:2008 certificate in the year 2013. 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 and 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, Planning Commission, Ministry of Statistics and Programme Implementation (MoS&PI), 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 recently awarded a study by Food and Agriculture Organization (FAO) under the Global Strategy to Improve Agricultural and Rural Statistics on improving methods for estimating crop area, yield and production under mixed, repeated and continuous cropping.

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 Corelation (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 and 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.

- 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.

Statistical Genetics and Genomics

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.

- 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 being 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 with192 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' Welfares 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 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
- Statistical Genetics
- Forecasting and Agricultural Systems Modeling
- Sample Surveys
- 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 both under plan and non-plan is furnished as:

ICAR-IASRI Unified Budget Allocation vis-à-vis Expenditure (2017-18) at a Glance

(Rs.in Lakh)

	Allocation	Expenditure
Grant-in-Capital	109.00000	95.51450
Grant-in-Salary	2677.00000	2676.19387
Grant-in-General	3171.20000	3107.06462
Grand Total	**5957.20000**	**5878.77299**

Resource Generation (2017-18)

1.	License fee	17,17,703
2.	Application fee	83,850
3.	Diploma Charges	22,500
4.	Receipt from Service rendered	20,000
5.	Income from training	1,45,350
6.	Income from Consultancy	1,98,375
7.	Income from sale of technology	26,900
8.	Institutional Charges	14,15,397
9.	Miscellaneous Receipt	3,60,243
	Total	**39,90,318**

Staff Position (as on 31 March, 2018)

Manpoer	Sanction Posts	Filled Post
Director	1	1
Scientific	130	70
Technical	174	54
Administrative	84	62
Auxiliary	14	7
SSS	78	32
Total	481	226

Expenditure Statement (detailed) (Rs. In Lakhs)

HEAD	IASRI			CABin			IASRI + CABin		
	RE 2017-18	Progressive Expt. upto 31.3.18	Closing Balance	RE 2017-18	Progressive Expt. of CABin upto 31.3.18	Closing Balance	Total R.E. 2017-18 (IASRI & CABin)	Total Progressive expenditure. Up to 31.3.18 (IASRI & CABin)	Total Closing Balance (IASRI & CABin)
Grants for creation of Capital Assets (CAPITAL)									
Works									
A. Land									
B. Building									
i. Office building									
ii. Residential building									
iii. Minor works	10.00000	10.00000	0.00000				10.00000	10.00000	0.00000
Equipments	22.00000	18.05554	3.94446	5.00000	0.00000	5.00000	27.00000	18.05554	8.94446
Information Technology	20.00000	18.16846	1.83154				20.00000	18.16846	1.83154
Library Books and Journals	46.00000	45.99684	0.00316				46.00000	45.99684	0.00316
Vehicles & Vessels									
Livestock									
Furniture & fixtures	6.00000	3.29366	2.70634				6.00000	3.29366	2.70634
Others									
Total-CAPITAL (Grants for creation of Capital Assets)	104.00000	95.51450	8.48550	5.00000	0.00000	5.00000	109.00000	95.51450	13.48550
Establishment Expenses									
A. Salaries									
i. Establishment Charges	2676.20000	2676.19387	0.00613				2676.20000	2676.19387	0.00613
ii. Wages									
iii. Overtime Allowance	0.80000	0.00000	0.80000				0.80000	0.00000	0.80000

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Total-Establishment Expenses (Grant in Aid-Salaries	2677.00000	2676.19387	0.80613	0.00000	0.00000	0.00000	2677.00000	2676.19387	0.80613
Pension & Other Retirement Benefits	658.00000	657.35932	0.64068				658.00000	657.35932	0.64068
Traveling Allowance									
A. Domestic TA/ Transfer TA	15.00000	13.70184	1.29816	4.00000	3.37556	0.62444	19.00000	17.07740	1.92260
B. Foreign TA									
Total-Travelling Allowance	15.00000	13.70184	1.29816	4.00000	3.37556	0.62444	19.00000	17.07740	1.92260
Research & Operational Exp.									
A. Research Expenses	5.00000	2.38080	2.61920	156.00000	155.85158	0.14842	161.00000	158.23238	2.76762
B. Operational Expenses	85.00000	75.17377	9.82623	124.00000	120.05419	3.94581	209.00000	195.22796	13.77204
Total-Res. & Operational Exp.	90.00000	77.55457	12.44543	280.00000	275.90577	4.09423	370.00000	353.46034	16.53966
Administrative Expenses									
A. Infrastructure	395.0000	370.23777	24.76223	44.00000	43.75795	0.24205	439.00000	413.99572	25.00428
B. Communication	4.00000	3.02958	0.97042				4.00000	3.02958	0.97042
C. Repair and Maintenance									
i. Equipments, Vehicles & Others	41.00000	40.30903	0.69097	709.00000	705.91542	3.08458	750.00000	746.22445	3.77555
ii. Office building	25.00000	24.99870	0.00130				25.00000	24.99870	0.00130
iii. Residential building	40.00000	36.41887	3.58113				40.00000	36.41887	3.58113
iv. Minor works	20.00000	14.50664	5.49336				20.00000	14.50664	5.49336
D. Others (excluding TA)	154.00000	153.91993	0.08007	13.00000	11.26374	1.73626	167.00000	165.18367	1.81633
Total-Administrative Expenses	679.00000	643.42052	35.57948	766.00000	760.93711	5.06289	1445.00000	1404.35763	40.64237
Miscellaneous Expenses									
A. HRD (Domestic)	20.00000	19.65282	0.34718				20.00000	19.65282	0.34718
B. HRD (International)									
C. Other items (fellow ships, Scholarships etc.	73.00000	72.91100	0.08900				73.00000	72.91100	0.08900
D. Publicity & Exhibitions									
E. Guest House-Maintenance	2.20000	2.11840	0.08160				2.20000	2.11840	0.08160
F. Other Miscellaneous	584.00000	580.12771	3.87229				584.00000	580.12771	3.87229
Total-Miscellaneous Expenses	679.20000	674.80993	4.39007				679.20000	674.80993	4.39007
Total Grants in Aid-General		2121.20000	2066.84618	54.35382	1050.00000	1040.21844	9.78156	3171.20000	3107.06462	64.13538
Total Revenue (Grants in Aid-Salaries+Grants in Aid-General)		4798.20000	4743.04005	55.15995	1050.00000	1040.21844	9.78156	5848.20000	5783.25849	64.94151
Grand Total (Capital+Revenue)		4902.20000	4838.55455	63.64545	1055.00000	1040.21844	14.78156	**5957.20000**	**5878.77299**	78.42701
Loans and Advances	15.00000	0.00000	15.00000				15.00000	0.00000	15.00000

Research Achievements

The set research targets of the Institute are being implemented by six divisions, viz. Design of Experiments, Sample Surveys, Statistical Genetics, Forecasting and Agricultural Systems Modelling, Computer Applications and Centre for Agricultural Bioinformatics. The basic, applied, adaptive and strategic research in Agricultural Statistics and Informatics is carried out under following six broad programmes that cut across the boundaries of the divisions and encourage interdisciplinary research:
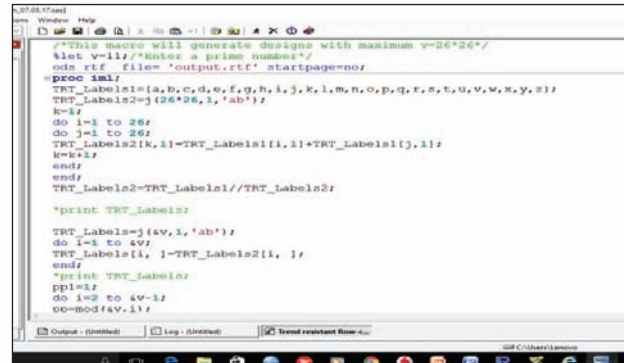
1. Development and Analysis of Experimental Designs for Agricultural System Research
2. Forecasting, Modelling and Simulation Techniques in Biological and Economic Phenomena
3. Development of Techniques for Planning and Execution of Surveys and Statistical Applications of GIS and Remote Sensing in Agricultural Systems
4. Development of Statistical Techniques for Genetics/Computational Biology and Applications of Bioinformatics in Agricultural Research
5. Development of Informatics in Agricultural Research
6. Teaching and Training in Agricultural Statistics and Informatics

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

Some Investigations on Trend Resistant Row-Column Designs

- In agricultural and allied experiments, situations are quite common where there may be evidences of two sources of variability apart from the treatment applied to the experimental material. Row-Column designs are useful for this situation. In agricultural experiments, response may be affected by systematic trend. Thus, trend component should be incorporated in to the row-column model. Trend resistant row-column designs should be obtained for this situation. Further, it may be the case that the observations may be correlated. Thus, this should also be

taken in to account for row-column designs incorporating trend component. Considering this, developed SAS macro for the generation of trend resistant designs under two-sources of

heterogeneity when treatment number is a prime. A catalogue of trend resistant designs under two-source of heterogeneity has been prepared for number of treatments less than equal to 75.

● SAS macro for the generation of trend resistant designs under two-source of heterogeneity in the presence of non directional neighbour effects has also been developed. A catalogue of trend free designs under two source of heterogeneity with non directional neighbour effects has also been prepared for number of treatments less than equal to 75.

Minimal response surface designs for resource optimization in agricultural experiments

The number of level changes is of serious concern to experimenters in many agricultural, post-harvest and processing, engineering and industrial experiments as in such experiments one may come across some situations where it is physically very difficult to change levels of some factors. In field experiments, the indirect effects from the adjacent plots may also arise, which may affect the response of the plot under consideration. Therefore, it is more realistic to postulate that the response depends not only on a particular plot but also depends on the adjacent plots.

The general expression for the factor-wise as well as total changes of minimally changed first order response surface design with neighbour effects (FORDNE) has been obtained. A SAS macro for the generation of FORDNE with minimum level changes in the run sequences has also been developed.

The SAS System

Minimally Changed FORDNE

Minimally_Changed_FORDNE		
1	-1	-1
-1	-1	-1
-1	-1	1
-1	1	1
-1	1	-1
1	1	-1
1	1	1
1	-1	1
1	-1	-1
-1	-1	-1

Factor-wise number of changes in the run sequence

Factor_Change		
3	2	4

Total number of changes in the run sequence

Total_change
9

Number of Runs

Runs
10

- Designs for fitting first order response surface with indirect effects in smaller number has been obtained. A catalogue of designs for fitting second order response surfaces with smaller number of runs for factors upto 9 has been prepared.

Generalized row-column designs for crop and animal experiments

When there is cross classified variation in the experimental unit, then Row-Column (RC) designs are useful for the experimental situation. These designs are used to control variability in field and animal experiments. Most of the row-column designs developed in the literature have one unit corresponding to the intersection of each row and column. However, when the number of treatments is large with limited experimental resources, Generalized Row-Column (GRC) designs are used. GRC design is an arrangement of v treatments in p rows and q columns such that the intersection of each row and column (cell) consists of more than one unit (k). 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. Considering this a series of GRC designs balanced for spatial indirect effects has been developed for prime number of treatments. The parameters of the developed designs are v, p = v, q = v-1, k = s(3 ≤ s ≤v-1) and λ=2(s-1). Another series of GRC designs balanced for spatial indirect effects has been developed using balanced incomplete block (BIB) design. The developed design is partially balanced for estimating elementary treatment contrasts following a varying circular association scheme.

A-optimal block designs for comparing treatments with control treatment(s): An algorithmic approach

There are many experimental situations in which the interest of the experimenter lies in comparing a set of new treatments called test treatments with one or more standard or control treatments. In the presence of one nuisance factor, block designs are advisable. Before conducting the experiment, a block design should be so chosen in a class of all connected block designs that it minimizes the average variance of the test versus control(s) contrasts. Such a design is called A-optimal design. In this study, the problem of obtaining A-optimal block designs for tests versus control(s) comparison has been dealt with algorithmic approach.

Algorithms have been developed to obtain A-optimal balanced treatment incomplete block (BTIB) designs, A-optimal group divisible treatment (GDT) designs, A-optimal balanced bipartite block (BBPB) designs for comparing test treatments with one or more control(s) and weighted A-optimal balanced treatment incomplete block designs for comparing test treatments with test treatments and test treatments with a control. The proposed algorithms mainly have two parts. In the first part, they obtain certain other parametric values from given number of treatments, number of blocks and block size utilizing the sufficient conditions of A-optimality and necessary parametric conditions of existence of these classes of designs. Then in the second part, the algorithms utilize linear integer programming

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approach to obtain the incidence matrix of A-optimal BTIB design. All the proposed methods have been implemented using R language. An R package called Aoptbdtvc has been developed and is available on cran.r-project.org/web/packages/Aoptbdtvc/index.html.

A number of A-optimal BTIB designs, GDT designs, BBPB designs and weighted A-optimal BTIB designs are obtained in limited restricted parametric ranges and catalogues of these designs are prepared. The layouts of the designs are available on Design Resources Server at http://iasri.res.in/design/AOPTBTIB/AOPTBTIB.htm, http://iasri.res.in/design/AOPTGDTD/AOPTGDTD.htm, http://iasri.res.in/design/AOPTBBPB/AOPTBBPB.htm, http://iasri.res.in/design/WAoptBTIB/WAoptBTIB.htm. These catalogues will serve as ready reckoner for experimenters as well as statisticians. The screenshots of these pages are given below.

Incomplete split-plot designs: construction and analysis

Split-plot designs are widely used in agricultural experiments where main-plot treatments are applied to larger plots and within each main-plot, all the subplot treatments are applied. However, in certain experimental situations, within each main plot, one cannot apply each of the subplot treatments. In such situations, number of subplot treatments to be applied in each main 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, main-plot treatments are generally applied in randomized complete block designs. Sometimes we may apply main-plot treatments in incomplete block design set up. In some situations, subplot treatments may be

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combinations of two factors. The analysis methods of incomplete split-plot designs are not readily available in standard statistical packages. This study addresses the problem of constructing incomplete split-plot designs for the three situations viz. when the sub-plots are incomplete, and (ii) when the main-plots are incomplete and when both the main plots and sub-plots are incomplete along with analyzing data and implementing the analysis method in a software module.

A method of construction for obtaining incomplete split plot designs with incomplete main plots and complete subplots has been developed. The method has been used to construct incomplete split plot designs of such nature and a total of 391 incomplete split plot designs has been obtained in the restricted parametric range of $v_1, v_2 \le 6$, $b \le 10$. Another method of construction of obtaining incomplete split plot designs which are incomplete at both main plots and subplots has been developed. Using the proposed method, 64 incomplete split plot designs have been constructed within restricted parametric range the restricted parametric range of $v_1, v_2 \le 6$, $b \le 10$.

Methodology for analysis of incomplete split plot designs using fixed effects models has been attempted. Partitioning of total sum of squares into sum of squares due to blocks sum of squares due to main plot treatments, sum of squares due to subplot treatments and sum of squares due to mainplot x subplot treatment interactions has been derived for incomplete split plot designs of all three kinds: (i) complete main plots, incomplete subplots (ii) incomplete mainplots, complete subplots and (iii) incomplete m

An online application has been developed to obtain incomplete split plot designs for each of the three scenarios (i) main plots complete and subplots incomplete (ii) main plots incomplete and subplots complete and (iii) when both main plots and subplots are incomplete.

Designs involving three-way and four-way genetic crosses for crop and animal breeding programmes

Plant and animal hybrids are increasingly gaining popularity due to increased performance of hybrids over the parents in terms of vigour and yield potential. Among various types of hybrids two-way cross hybrids are the simplest and easily manageable but, three-way and four-way cross hybrids are genetically more viable, stable and consistent in performance than two-way cross hybrids. As the number of lines increase, the number crosses increases manifold and breeders avoid using three-way or four-way crosses due to increased size of experimentation. This situation leads to taking a sample from all possible three-way or four-way crosses referred to as partial three-way or four-way Crosses (PTC/ PFC). The model for three-way cross experiments including specific combining abilities (sca) is as follows:

$$\tau_{(ij)k} = \bar{\tau}1 + Q'\begin{bmatrix} g \\ h \end{bmatrix} + S + e,$$

where Q is a 2n × N matrix with rows indexed by 1,2, , n and columns by the three-way cross (i×j)×k, (i, j, k =1,2, n), such that the {u,(i×j)×k}th entry of Q is 0.5 if u □(ij), is 1 if u □ k and zero otherwise.

Considering this,

- The general form of inverse of matrix (**QQ**') under the proposed model under unblocked setup for complete three-way crosses has been derived.

The combined estimate of gca of half and full parents and also the combined estimate of sca, based on the model proposed under unblocked setup for complete three-way crosses have been derived.

A series of Design for three-way genetic cross under unblocked set up has been obtained and per cross efficiency of the series designs so obtained is calculated by comparing with CTC plan.

Two series of Design for three-way genetic cross under blocked set up using triangular association scheme and lattice has been obtained and the per cross efficiency of both the series of designs obtained is calculated by comparing with CTC plan.

A method of constructing PTC plans using incomplete block designs has been obtained for comparing test lines with a single control line and variance factor pertaining to gca effects of half as well as full parents for test vs. test lines and test lines vs. control line for the obtained series of designs has been calculated.

A method of constructing Designs for Partial Four-way cross using block designs has been obtained for comparing test lines with test lines.

SAS codes has been developed for calculating variance estimates of elementary contrasts pertaining to the gca effects for designs involving three-way genetic crosses under unblocked set up and to obtain joint information matrix regarding gca effect of lines involved in four-way cross under unblocked setup.

On construction of orthogonal and nested orthogonal Latin hypercube designs

Web based application for obtaining 1st and 2nd order OLH constructed using the developed method of construction has been developed. Methodology for the construction of OLH designs with good space filling property and find out the new designs obtainable from the methods of construction has been developed. A module has been deployed in

Home Page

Resulted OLHD & SFLHD

website for obtaining Latin Hypercube (Orthogonal/Nearly Orthogonal) design with good space filling property.

Performance assessments of universities in agriculture education: A comparative analysis

Preparation of Questionnaire based on main and sub questions has been prepared. Also Self -Assessment Report (SAR)has been prepared after collection of questionnaire from all selected universities. All the data collected through self-assessments report are categorical in nature hence mostly categorical analysis are being used. All the type of categorical data analysis like Pearson's chi-squared test, Chi-square Test for independence of attribute, Wilcoxon-Mann-Whitney test, Spearman Rank Correlation, Multinomial Logistic Regression, and Kruskal Wallis test are used for Data analysis, summarization of result and suggestion of policy measure.

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

Data of 104 experiments for the year 2015- 16 have been received and analysis work for allthe experiments has been completed. 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. Data of 246 experiments for the year 2016-17 has been received and scrutiny and analysis work is in progress.

Coefficient of Variation tables of the experiments has also been prepared.

CV	0-3	3-5	5-10	10-15	15-20	≥20
Number of Experiments	11	28	36	19	8	2

Reference manual on analysis and methodology of data pertaining to various experiments planned on station has been prepared and released by Honourable Secretary, DARE and DG, ICAR on 30th October,2017 at IIFSR, Modipuram.

Attended Annual Group Meeting of AICRP on IFS during 03-05, November, 2017 held at Rajasthan Agriculture Research Institute, Durgapura (Sri Karan Narendra Agriculture University, Jobner), Rajasthan and presented progress of the project in Technical Session-I chaired by Dr. S. Bhaskar, ADG, ICAR.

In the process of developing /modifying on line
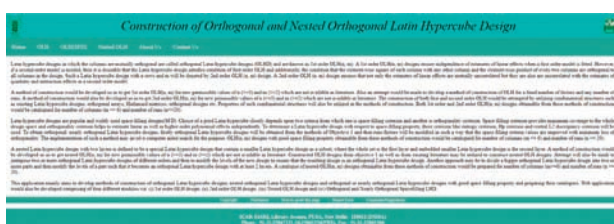
data entry and analysis of on station experiments conducting under AICRP on IFS, some more layouts have been changed in the initial pages.

ICAR research data repository for knowledge management as KRISHI-knowledge based resources Information Systems Hub for Innovations in Agriculture Strengthening and Maintenance of KRISHI Portal

- KRISHI Portal has been enriched through providing links of several online resources available/developed at different ICAR institutes. Total number of links from ICAR and other sources on the KRISHI Portal are **415** (as against 269 reported last year) including links of **85 mobile apps** under **17** broad headings for bringing more visibility and single window access. Added SSL certification on KRISHI Portal. Redesigned KRISHI home page for display of sublinks on same page in full view instead of on hover in earlier version for better accessibility. Using the application for identifying the inactive links and notifying to respective Institutes, URLs of 7 links were updated and 2 obsolete links were deleted.

- **Video/Audio Gallery:** Links of **539** videos and **52** Audios categorized SMD/Institute wise are also available. Officer, Incharge Data Management can also submit Video links. Video links can also be filtered based on language. Database on language is taken from data.gov.in. This includes 8 links on ICAR-DRMR Website which were got functional through a follow up by KRISHI team.

- **Reports on Find Institutes:** Developed an application for generation of selection based reports for Institutes and Regional Stations SMDs on the following parameters: SMD Name, Organization Name, State Name, District Name, Postal Address, Web Address, E-mail Address, Cities, Phone, Fax and Spatial Coordinates.

- **Publication and Data Inventory Repository:** KRISHI Publication and Data Inventory Repository has been migrated on new server with full functionality and SAN storage for better scalability and availability. PostgreSQL database DSpace had also been migrated to PostGreSql Enterprise Server 9.6. Three new ATARIs were added as publication and data inventory collections in the Community Agricultural Extension. Following new reports (i) Item List (provides list of Handle numbers submitted from a selected E-mail) and (ii) Item Count (provides number of submissions for each e-mail and clicking on E-mail gives the handle numbers submitted) have been created. Updated the report module and implemented with different authentication levels as Guest User, Nodal Officer, Administrator, etc. This repository has been enriched through populating data by Nodal

Officers and other researchers. **4990** (**2503** reported earlier) publications and **291** (117 reported earlier) dataset have been submitted from **106** Institutes (76 Reported earlier). **309** researchers (124 reported earlier) other than Nodal officers have registered themselves as submitters. This repository is indexed in **BASE (**Bielefeld Academic Search Engine) and **Google Scholar.** Since May 2017, there are more than **50,000** downloads including documents fetched by other harvester systems from this repository.

- **Interportal Harvester:** In order to bring agricultural research publications collected by various organizations within and as well as outside of ICAR, Interportal Harvester (http://krishi.icar.gov.in/ohs-2.3.1/) has been strengthened. Five new OAI enabled repositories have been added for meta data harvesting. Also added the links open access repositories, journals, books etc. and a user manual for interportal harvester. At present more than **4,00,427** records (1,84,466 reported earlier) from **24** repositories are available for unified search.

- **Technology Repository:** Workflow based information system for submission of proven technologies and generation of reports has been developed and opened for uploading the technologies on January 12, 2018. One can access it at https://krishi.icar.gov.in/TechReport/index.jsp. Six Institutes have initiated the work on Technology Submission in the information system for submission of proven technologies. Search facility in Technology Reports has

been provided. At present 11 technologies are available in public domain and 4 are in the workflow process. Deletion and updation of the approved technologies can be handled by the administrator.

Unit Level Data Repository

- **Experimental Data Repository:** Protoypes for Information System for All-India Coordinated Research Projects to plan and design experiments, generate data, analyse and preparing report of AICRP experiments have been developed for 03 different AICRPs (Two based on single crop and one based on multiple crops). Information System for AICRP on Maize has been made functional. The prototypes are being cusomized for AICRP on Fruits; AICRP in FIM; AICRP on Long Term Fertilizer Experiments; AICRP on Weed management.

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- Based on the information received from stakeholders, redesigned and strengthened website for following 11 AICRPs: (i) AICRP on Farm Implements & Machinery; (ii) AICRP on Fruits; (iii) AICRP on Foot and Mouth Diseases; (iv) AICRP on Long Term Fertilizer Experiments; (v) AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture; (vi) AICRP on Poultry Breeding; (vii) AICRP on Post Harvest Engineering & Technology; (viii) AICRP on Water Management Research; (ix) AICRP on Weed Management; (x) All India Coordinated Sorghum Improvement Project (AICSIP); (xi) All India Network Project on Jute and Allied Fibres.
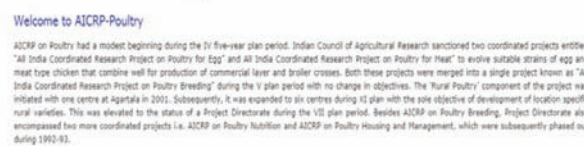
- **ICAR Observational Data Repository:** Strengthened the application developed to harvest meteorological data (using python script) from different ICAR Institutes. At present besides harvesting data from 10 AWS centres of AICRP on Agrometeorology, ICAR-CRIDA, Hyderabad, the data is being harvested from (i) ICAR-IARI, New Delhi; (ii) ICAR-IIHR, Bengaluru; (iii) ICAR-CRIJAF, Kolkata; (iv) ICAR-VPKAS, Almora; (v) ICAR-CCARI, Goa; (vi) ICAR-CSSRI, Karnal; (vii) ICAR-NIASM, Baramati and (viii) ICAR-IISWC, Dehradun. Uploaded old data of AICRP on AM Data (old) from 1985 to 2000 in Daily, Weekly and Yearly format for 28 stations. Monthly data in CSV files is available for download for the following: (i) March 2017 (10 centres of AICRP on AM); (ii) May 2017 (ICAR-IARI, New Delhi) and (iii) March 2016 (ICAR-IIHR, Bengaluru). Implemented the facility of multiple selection search in the data being harvested from AICRP on Agrometeorology.

- **Sensitization:** For sensitizing the researchers about the guidelines for Data Management in ICAR Institutes and spreading awareness about the importance of digitisation of research data, the seminars were delivered at 02 more organization, making it a total of 104. E-mails to all ICAR Scientists regarding Inter Portal Harvester and ICAR Geo-Portal were sent.

  ➢ **Policy Initiative:** (i) ICAR Data Use License also got approved and made available at KRISHI portal and (ii) A committee was

constituted for preparing quality research data acquisition guidelines.

➢ **Visibility**: KRISHI Portal has attracted more than **62,000** (48,498 reported earlier) page views since May 2015 across more than **1500** cities of **130** countries. This initiative has been included in 3 years of Modi Government-Continuous Progression on Prosperity Path publication of Ministry of Agriculture and Farmer's Welfare. ICAR Publication and Data Inventory Repository, there are more than 5**0,000** downloads since May 2017 and more than **19,700** page views across **118** cities of **21** countries.

Strengthening Statistical Computing for NARS

- License files for 2017-18 have been received from SAS. SAS Licenses files for 2017-18 have been uploaded on Resources Page of the Indian NARS Statistical Computing Portal for the exiting users in NARES. Indian NARS Statistical Computing Portal (http://stat.iasri. res.in/sscnarsportal/public) under the link SAS License 2017-18.

- Received JMP 14.0 version download link from SAS and accordingly it was downloaded.

Indian NARS Statistical Computing Portal

- 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 April 01, 2017- March 31, 2018 are **1,12,032** which is on an average more than **300** logged in per day.

- Website is registered under google analytics on
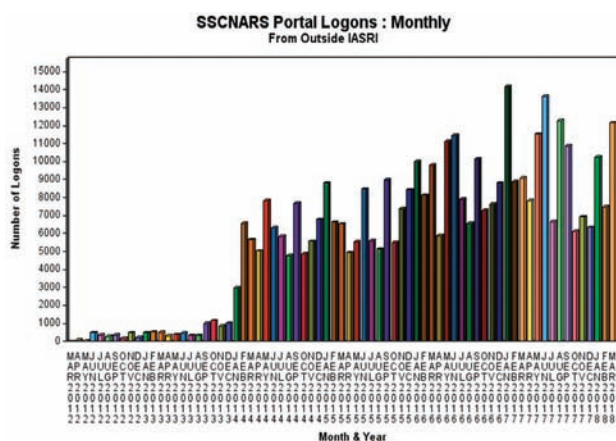
November 15, 2010. Till March 31, 2018, there were **113234** page views across 724 cities of 98 countries. Average time on each page was 2.59 minutes. During April 01, 2017 to March 31, 2018, there were **14,236** page views across **275** cities of **59** countries.

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

Development of hybrid time series models using machine learning techniques for forecasting crop yield with covariates

The ARIMAX model was applied on rice yield data along with rainfall, minimum temperature and maximum temperature as exogenous variables. On the basis of minimum values of goodness of fit, ARIMAX (0,1,1) model with rainfall as exogenous variable was found to be the suitable one as AIC and BIC are 7.02 and 11.688, respectively. P-vales of parameter estimates of ARIMAX (0,1,1) and rainfall as exogenous variable are estimated to be <0.0001 and 0.0312, respectively. Residuals were found to be white noise. Hence, the ARIMAX (0,1,1) model was found to be suitable model under rainfall as exogenous variable. MAPE under ARIMAX (0,1,1) model with rainfall as exogenous variable was estimated to be 12.18 as compare to 17.68 under usual ARIMA (2,1,0) model. ANN approach was also applied on the residuals of ARIMAX (0,1,1) for modeling and forecasting of the residuals. ANN model with 06:04s:1l (06-time delay and 04 hidden nodes) was identified as suitable model as this model was having minimum values of MAE i.e. 0.005 and 0.018 under training and testing sets of data, respectively. Using 06:04s:1l model, estimated the fitted values of residuals and these fitted residuals were used to correct the fitted values of yield obtained through ARIMAX (0,1,1) model and eventually get the fitted values under hybrid ARIMAX (0,1,1) model. MAPE under the hybrid ARIMAX (0,1,1)-ANN is estimated to be 0.37 as compare to 12.18 under ARIMAX (0,1,1) model. SVM was also applied on the residuals of the ARIMAX (0,1,1) model and got fitted residuals by SVM and the fitted values of yield obtained by ARIMAX (0,1,1) model were corrected by the fitted residuals of SVM. The MAPE for the corrected yield using fitted residuals of SVM is estimated to be 1.11. The significant reduction in MAPE from 12.18 (MA1,1) to

0.37 and 1.11 through ARIMAX (0,1,1)-ANN model and ARIMAX (0,1,1)-SVM, respectively, indicates a significant improvement in the performance of ARIMAX model using machine learning techniques. On the basis of these encouraging results for the two districts (Aligarh and Meerut) of Uttar Pradesh, hybrid ARIMA and ARIMAX using machine learning techniques can be recommended for yield forecast as it has caused significant reduction in MAPE both under training as well as testing sets of data.

Forecasting of spatio-temporal time series data using Space Time Autoregressive Moving Average (STARMA) model

Spatio-temporal modelling is characterized by a single random variable observed at N fixed sites in space wherein the dependencies between the N time series are systematically related to the location of the sites. A hierarchical series of weighting matrices specified prior to analysing the data is the basic mechanism for incorporating the relevant physical characteristics of the system into the model form. Building of spatial weight matrix plays a key role in STARMA model building.A weight can be given in different ways, the least difficult of which is the binary scheme, if two areas shared a common border then we relegate a weight as one otherwise zero. In majority of the cases, the uniform

spatial weight matrix is commonly used and it is built with assumption that the sites are irregularly spaced

As a contextual investigation monthly maximum temperature of nine districts north Karnataka (Figure 1) has been considered to evaluate the proposed methodologies. The spatial weight matrix has been constructed by assigning equal weightage to each neighbours. The map of nine locations under consideration is delineated in Figure 2 and each location are represented by numbers from one to nine. In light of the neighbouring locations, connectivity spatial weight matrices have been considered. For instance, for location 1, location 2 and location 8 are first order neighbours. Again, 3, 6 and 7 are second order neighbours to location one. In a similar manner, first and second order neighbours for all nine locations are reported in table 1. In uniform spatial weight matrix equal weights are relegate to each neighbours. To make row normalization i.e. making all rows sum to one we divide, one by number of neighbours. For example, for first location (Gulbarga) there are two first order neighbors, then we divide one by two and assign 0.5 as weight to each locations. As we calculated weight for first location, one can proceed in same manner to calculate weights for all nine locations. In light of this procedure first order spatial weight matrix has been calculated in Table 2 and 3.

1.Gulbarga 2. Bijapur 3. Bagalkot,
4.Belgaum 5. Dharwad 6. Gadag
7.Koppal 8. Raichur 9. Bellary

Fig. 1: Geographical map of karnataka
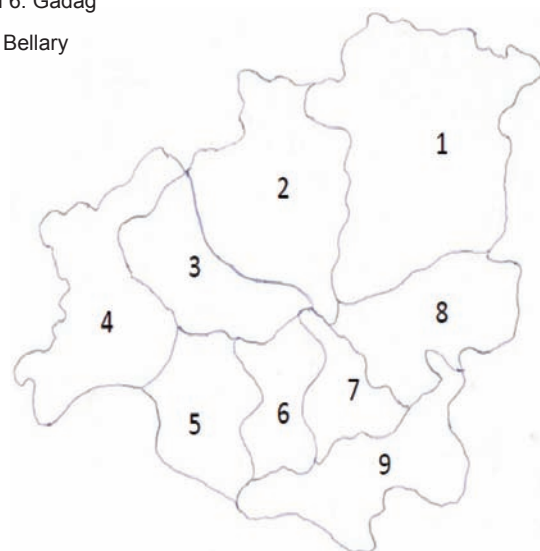
Fig. 2: Map of districts/locations considered

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Table 1: Neighbours of each site for each spatial order

Location	Order	
	1	2
1	2,8	3,6,7
2	1,3	4,8,7
3	2,4,5,6	7,8
4	3,5	2
5	3,4,6	9
6	3,5,7,9	2,8
7	6,8,9	1,2,3
8	1,7,9	2,3,6
9	6,7,8	5

Table 2: First order spatial weight matrix

Location	Gulbarga	Bijapur	Raichur	Bagalkot	Belgaum	Dharwad	Gadag	Koppal	Bellary
Gulbarga	0	0.5	0	0	0	0	0	0.5	0
Bijapur	0.5	0	0.5	0	0	0	0	0	0
Raichur	0	0.25	0	0.25	0.25	0.25	0	0	0
Bagalkot	0	0	0.5	0	0.5	0	0	0	0
Belgaum	0	0	0.33	0.33	0	0.33	0	0	0
Dharwad	0	0	0.25	0	0.25	0	0.25	0	0.25
Gadag	0	0	0	0	0	0.33	0	0.33	0.33
Koppal	0.33	0	0	0	0	0	0.33	0	0.33
Bellary	0	0	0	0	0	0.33	0.33	0.33	0

Table 3: Second order spatial weight matrix

Location	Gulbarga	Bijapur	Raichur	Bagalkot	Belgaum	Dharwad	Gadag	Koppal	Bellary
Gulbarga	0	0	0.33	0	0	0.33	0.33	0	0
Bijapur	0	0	0	0.33	0	0	0.33	0.33	0
Raichur	0	0	0	0	0	0	0.5	0.5	0
Bagalkot	0	1	0	0	0	0	0	0	0
Belgaum	0	0	0	0	0	0	0	0	1
Dharwad	0	0.5	0	0	0	0	0	0.5	0
Gadag	0.33	0.33	0.33	0	0	0	0	0	0
Koppal	0	0.33	0.33	0	0	0.33	0	0	0
Bellary	0	0	0	0	1	0	0	0	0

Each of the N time series is simultaneously modelled as a linear combination of past observations and disturbances at neighbouring sites. The space-time autoregressive moving average (STARMA) model class was first presented in the literature in the early eighties. Since then it has been applied to spatial time series data from a wide variety of disciplines such as river flow, spread of disease, spatial econometrics, etc. Resembling the univariate ARIMA models reflect the basic idea that the recent past exerts more influence than the distant past, so STARMA models reflect (through the specification of the weighting matrices) the idea that near sites exert more influence in each other than distant ones."As the space and time dimension increases the classical methods may not converge to the true parameter. The large sum of the squared residuals in Ljung-Box statistic indicates that the model is not

sufficient for the data. The Common zeroes in AR and MA process indicate parameter redundancy, which means that the model can be shortened by parameters and may not provide robust parameters. To overcome this difficulty, machine learning evolutionary techniques like Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) techniques were employed to estimate the parameters of STARMA model. As a contextual investigation monthly maximum temperature (°C) of nine districts of north Karnataka has been considered to evaluate of the proposed methodologies. The proposed STARMA-GA and STARMA-PSO models outperformed over traditional models in both training and testing data set. Further, the STARMA-PSO model performed better as compare to STARMA-GA model due to its global minimization capability. Spatial heterogeneity is the most oftenly occurring problem in spatio-temporal modelling. To overcome this problem, the spatial weight matrix has been built using Euclidean distance of Riemannian great circle using longitude and latitude of the locations. In this study the proposed inverse distance spatial weight matrix STARMA model is denoted as STARMA-*idw*. The row normalized Inverse distance spatial weight matrix, based on Riemannian great circle formula using latitude and longitude of different locations, have been used for building STARMA-*idw* model. The proposed STARMA-*idw* model is further illustrated in monthly maximum temperature of nine districts north Karnataka. The proposed STARMA-*idw* model outperformed the univariate ARIMA and proposed STARMA model in both training and testing data set.

It is generally agreed that forecasting methods should be assessed for accuracy by using out-of-sample forecasts rather than goodness of fit to past data. In order to understand the probabilistic behaviour of future data, out of-sample forecasts are required. Formulae for optimal out-of-sample forecasts were derived. The optimal predictor, which minimizes the mean one-step ahead squared prediction error is the conditional expectation, obtained from STARMA model. Firstly, the one step ahead out of sample forecasts have been derived analytically, then this is used to derive to obtain the two step ahead out of sample forecasts by recursive use of conditional expectation. Finally, as a contextual investigation monthly maximum temperature of nine districts north Karnataka has been considered to evaluate the proposed methodologies. The outcomes of the study reveals that the proposed methodologies outperformed the univariate ARIMA and classical STARMA model for modelling and forecasting. As a

future scope of the study the spatial heterogeneous STARMA approach can be extended to second order spatial lag, stationarity in space can be studied over varying spatial autoregressive and spatial moving average orders. Further, the application of STARMA model can be extended to various sectors of agriculture. The STARMA model can be extended to nonlinear set up to contribute into the theory of spatio-temporal time series modelling.

Nonparametric bootstrap approach for constructing prediction intervals for non-linear and bivariate time series models

Forecasting in a systematic and scientific way can play a crucial role in the domain of agriculture to formulate proper policy. There are two approaches of forecasting viz. point forecast and interval forecast. The outcome of point forecast is often expressed as single numbers, which give no guidance as to their likely accuracy. They may even be given with an unreasonably high number of significant digits implying spurious accuracy. Based on the outcome of point forecast policy makers can plan single strategies. On the other hand, an interval forecast usually consists of an upper and a lower limit between which the future value is expected to lie with a prescribed probability. Hence, interval forecast can assess future uncertainty. It helps the policy makers to plan different strategies for the range of possible outcomes indicated by the interval forecast. At the same time the interval forecast is good when its length is less. There are several studies which are concerned with Bootstrap prediction interval for linear autoregressive models. It is observed that bootstrap prediction interval is better as compare to traditional model based prediction interval. The vector autoregression (VAR) model is one of the most successful, flexible, and easy to use models for the analysis of multivariate time series. It is a natural extension of the univariate autoregressive model to dynamic multivariate time series. In this study, a modified sieve bootstrap approach for constructing prediction interval for bivariate time series has been developed. A rescaling factor to reduce the bias term has been derived for bivariate time series. Empirical results from simulated as well as real datasets reveals that modified sieve bootstrap approach perform better as compare to conventional approach as well as sieve bootstrap approach when the assumption of normality does not hold good. In time series forecasting parlance, the Artificial Neural Network (ANN) is a nonparametric nonlinear statistical model, however the drawback of ANN is that it cannot give prediction interval like

a statistical model. Hence, in this study a modified sieve bootstrap approach for constructing prediction interval in ANN has been developed. The proposed approach has been compared with sieve bootstrap approach. Empirical results from simulated as well as real datasets reveals that modified sieve bootstrap approach is better than sieve bootstrap approach.

Future perspective of Bt technology in Indian agriculture

For scoping the future perspectives of Bt technology in Indian agricultural scenario, the technology forecasting tools viz., Scientometric analysis, Grey modeling and Cross impact analysis (CIA) technique were employed. For performing scientometric analysis, research publication specific information relating to abstract, key words, authors, affiliation etc. relevant to 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. Activity Index (AI) has been 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. 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. For building Grey models, its conventional version 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. 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, overall efficiency in 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 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 study reveals that Govt. policy, Bt seed sector and technological

interventions are the main three factors for future perspective of Bt technology in India.

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

Compilation of data pertaining to three centres have been completed. Weekly pest count data from 2008-09 to 2012-13 on pest count of Jassids and white fly on cotton crop of Belgaum centre of Karnataka have been considered. Data from 28th week of 2008-09 to 41st week of 2012-13 (110 observations) were considered as training data set and data from 42nd to 51st week of 2012-13 (10 observations) were considered as testing data set. The integer based ANN has been implemented on these two data sets. As a benchmark model ARIMA have also been considered for modelling and forecasting comparison. The ANN model performed better as compared to univariate ARIMA model in both training and testing data set in both Jassids and White fly data sets.

Tractorization in Semi-Arid Tropic 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 of India. High proportionate of rural population depends on agriculture for their employment and livelihood. This study aims at historical analysis and economic modelling of farm household decision making towards extent of tractors uses in SAT India, utilizing five year of panel household data series of 850 households complied from the Village Dynamics in South Asia (VDSA) spread over five states of India. Panel modelling approaches allow us to control the household heterogeneity and separate out impact of tractorization from other associated factors like irrigation and input use. Collection and extraction of data has been done. Selection of variable with model specification is in progress.

Modelling and forecasting of drought index using machine learning techniques

Drought is a complex hydrologic feature of arid and semiarid regions with strong implications on the sustainability of water resources, agriculture and environmental management. Forecasting of drought are performed using drought indices (DIs) that are standardized metrics of rainfall, temperature or evapotranspiration etc. Drought indices or models are used for assessment of occurrence

and severity of droughts. The Drought Indices (DIs) were developed for specific regions using specific structures and forms of data input. Drought indices may be categorized into two broad categories; remote-sensing based and the data driven drought indices. The remote sensing based indices are presented from data obtained from remote sensors to map the conditions of land. Data driven indices are those calculated using ground based data recorded over time. This study is based on data driven indices. For this, monthly rainfall data of Bundelkhand region have been complied from 1901 to 2002. Bundelkhand region have 13 district of U.P and M.P. and data for each district have been collected separately. The daily rainfall over 41 years (1975 – 2015) for Sagar and Chhatarpur district of Bundelkhand region was obtained from India Meteorological Department (IMD). Trend analysis of rainfall was performed for Sagar and Chhatarpur district of Bundelkhand region on annual and seasonal data (pre-monsoon from March to May, monsoon from June to September, post-monsoon from October to November, and winter from December to February). The results show that there was no significant trend in the Sagar and Chhatarpur district of Bundelkhand region. Precipitation data are widely used to calculate drought indices, because long-term precipitation records are often available. Some of the well-known indices used in drought studies, monitoring and management are: Palmer Drought Severity Index (PDSI), Standardized Precipitation Index (SPI), Effective Drought Index (EDI), Surface Water Supply Index (SWSI), etc. In this study, Standardized Precipitation Index (SPI) and Effective Drought Index (EDI) are used for the forecasting of drought. The SPI is computed by fitting a probability density function to the frequency distribution of precipitation summed over the time scale of interest. For the converting the original data in to Standardized Precipitation Index, "spi" package of R software has been used. By using this package monthly precipitation data are converted in to 1, 3, 6, 9, 12, 18, 24 month standardized precipitation index. There is no R package, for converting the original data in to Effective Drought Index (EDI). So, an effort has been made to develop R function for converting the weather variable data in to Effective Drought Index. By using the developed R function, weather variable data are converted in to Effective Drought Index. Forecasting of drought index have been performed by using ARIMA, ANN and SVM models. Different performance measure like MAPE, MSE, RMSE etc. are used for evaluation of the performance. The result indicated that in both the district Sagar and Chhatarpur, SVM model perform better compare to the ARIMA and ANN models.

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 study we aim at developing Bayesian estimation technique for ARIMAX and ARIMAX-GARCH model. R packages will be developed for the proposed estimation technique. Implementation of Bayesian framework to basic ARIMA model has been initiated to compare the forecasting performance with that of the classical estimates of ARIMA using total foodgrain production data of India (1990-2015). R codes were written for implementation.

Crop yield forecasting under Forecasting Agricultural output using Space Agro meteorology and Land based observation (FASAL) scheme

Wheat yield data of Araria district in Bihar was fitted using usual Regression, LASSO, GARCH, and GARCH using weather variables. GARCH using weather variables provided a better fit to the volatile yield data under consideration. Forecast were carried out for yield data of wheat along with weather variables. Data were obtained from IMD. ARIMAX model was employed with weather indices as the exogenous variables. Further, it was also compared with traditional ARIMA and regression methodology. ARIMAX provided an improved forecast in comparison to usual ARIMA and regression methodology.

Efficiency of micro irrigation in economizing water use in India-learning from potential and unexplored states

India is a water stressed country, and on top of that we use twice or trice more water to produce a unit of agricultural produce. Close to 80% of fresh

water is used for agricultural purposes. The efficient application tools of water could be one measure amongst many to raise the water productivity. The Government of India embarked upon heavily on micro-irrigation in the past, but the growth has decelerated over time inspite of its beneficial impact on water saving and enhancing the efficiency of other critical inputs. It is believed that micro-irrigation economies about 25 to 30 per cent of water compared to conventional methods of irrigation. India reportedly has 8.6 million ha under micro-irrigation. The states with the largest area under micro-irrigation include: Rajasthan (1.75 M ha, 13% share), Andhra Pradesh (1.42 M ha, 15% share), Maharashtra (1.31 M ha, 15% share), Gujarat (1.1 M ha, 13% share), Karnataka (0.95 M ha, 11% share), and Haryana (0.58 M ha, 7% share). These six states occupy 81 per cent of the total area under micro-irrigation in the country. The micro-irrigation does yield good results but it has limitation related to credit, energy, application and above all the post-installation care and support. Besides, a huge amount of private investments are also happening in this activity, which has so far, not captured by any data base. NITI Aayog intends to get the first hand information through a structured study on micro-irrigation – its impact, reach out and outreach and the other characteristics which makes the technology the most

successful in some states while the least successful in some of the potential states. The states Gujarat, AP and Maharashtra amongst performing states and Punjab among potential but non-performing states are selected for the study. The three categories of farmers, small, medium and large will be considered amongst beneficiaries with comparative sets of non-beneficiaries for data collection. The study aims to capture water economy, area, expansion, productivity gains input usage, saving and income. Data related to physical and financial status of micro-irrigation (drip + sprinkler) has been collected for all the three categories of farmers.

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

Study to test the developed alternative methodology for estimation of area and production of horticultural crops: IASRI Component of CHAMAN Programme under MIDH

Testing and validation of the methodology for estimation of area and production of horticultural
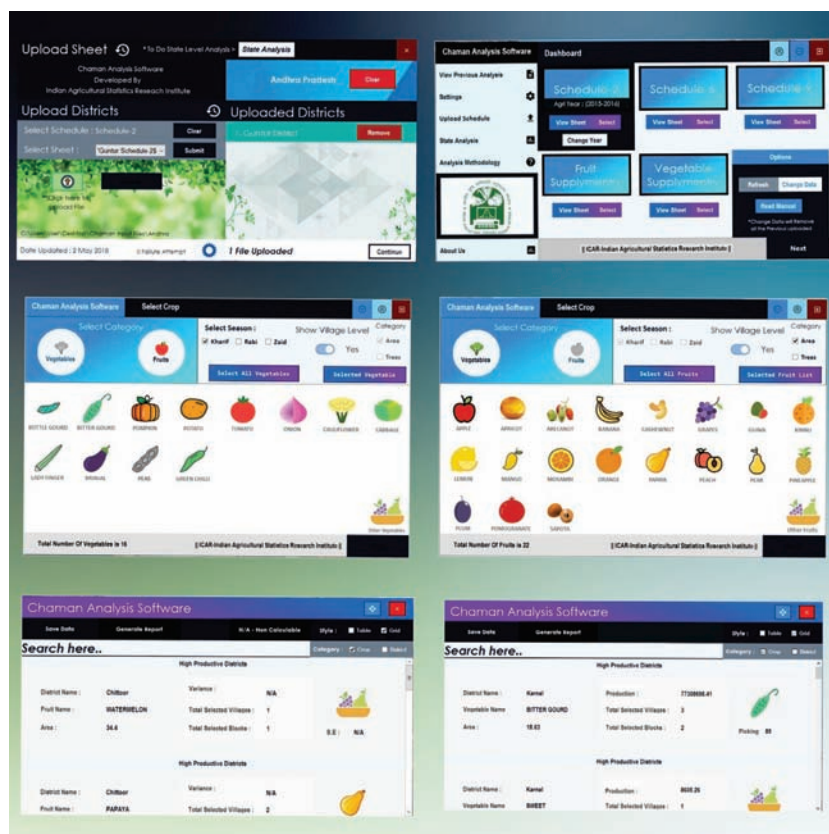
Data Analysis Software developed by ICAR-IASRI under CHAMAN

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crops developed by ICAR-IASRI is being carried out in four states namely, Andhra Pradesh, Tamil Nadu, Maharashtra and Himachal Pradesh. The proposed sampling design adopted for the survey is stratified multistage random sampling.

Data analysis software has been developed for giving the estimates of area and production for various fruits and vegetables under the project. Data collection using tablets (CAPI i.e. Computer Assisted Personal Interviewing) was done in Nashik district of Maharashtra State. Data entry was completed in all the four states except 3 districts of Tamil Nadu. House to house survey was conducted in 8-10 adjoining villages of an identified district in each of the three states namely Maharashtra, Andhra Pradesh and Tamil Nadu. Estimation of area under Mango fruit in Chittoor (Andhra Pradesh), Onion crop in Nashik (Maharashtra) and major horticultural crops for Erode district of Tamil Nadu using Remote Sensing technique has been completed. Scrutiny of entered data and data analysis is going on.

It is expected that the methodology being tested and validated under Coordinated Programme on Horticulture Assessment and Management using Geoinformatics (CHAMAN) may be implemented in all the states of the country in near future.

Pilot study for developing state level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee Report

In order to strengthen the existing system of generation of Agriculture Statistics, this study is being carried out in five states namely, Assam, Odisha, Gujarat, Karnataka and Uttar Pradesh. The data collection work for all 4 states namely Assam, Odisha, Karnataka and Uttar Pradesh was completed in agricultural year 2015-16 where as data collection work for state of Gujarat was completed in Rabi Season 2016-17. To digitize the collected data, a data entry software was developed and implemented at AERC, Anand, Gujarat. Copy right for Data Entry Software for Crop Area and Yield Estimation Survey developed under the project. has been obtained. The data entry work is completed in all the 5 states and data has been received. For scrutiny of data several field visits were organized. To improve the data collection work an Andorid Application named Mobile Assisted Personal Interview (MAPI) software was developed and deployed for data collection in Rabi season 2016-17 in the Gandhinagar District of Gujarat. The MAPI was found very advantageous over the existing paper based survey method with
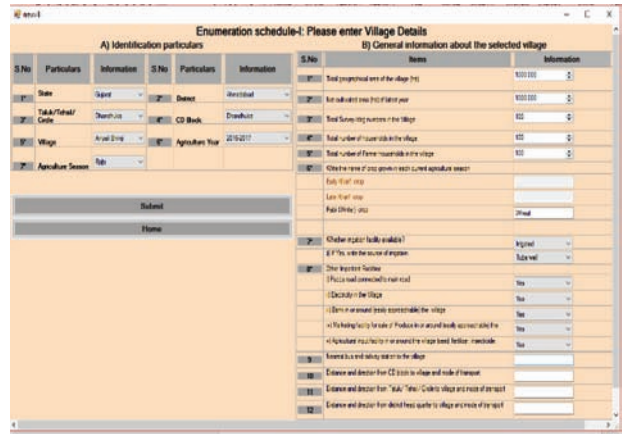
Fig. Data Entry Software for Crop Area and Yield Estimation Survey
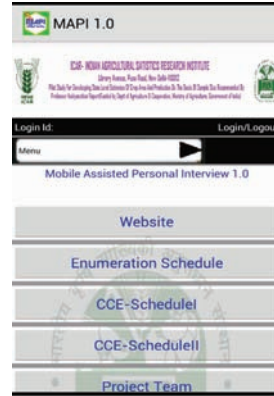
Fig. MAPI Software Version 4.1

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respect to timeliness, accuracy and reliability of data. Copy right for Mobile Assisted Personal Interview (MAPI) software has been obtained. An interim report containing the results of Assam and Uttar Pradesh has been submitted to the sponsoring agency. Data received from all states was cleaned and scrutiny of data is partially over. The estimation procedure for estimation of crop area and yield was finalized. R code for analysis of data has been written.

Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Madhya Pradesh State

Primary data collection has been completed in the State. Progress of the field work was reviewed, filled-in schedules were scrutinized and field visits were made to monitor the field work. Data entry work is in progress.

Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Haryana State

Primary data collection was completed in the State. Progress of the field work was reviewed, filled-in schedules were scrutinized and field visits were made to monitor the field work. Data entry has been completed. Scrutiny of entered data and data analysis are in progress.

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

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. 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 has been completed. Primary data collection with regard to detailed survey has been completed in 2 districts and is in progress in 3rd district.

An Investigation of causes of divergence between official and trade estimates of jute production

This study aims at finding out the causes of divergence between official and JAB estimates of Jute production. Survey (field data collection) relating to official estimates was conducted in all the three states under study namely, West Bengal, Assam and Bihar. Primary data collection work was completed. Supervision of data collection was carried out at regular interval. Scrutiny of filled-in schedules was done during the field visit and necessary guidance was provided to the state officials and primary workers. The Interim report of the study was prepared and submitted to the funding agency.

Crop Cutting Experiment on Jute in West Bengal

A study on calibration estimators under adaptive cluster sampling

Adaptive Cluster Sampling (ACS), is an efficient method for sampling geographically rare and hidden clustered population. Calibration estimator of population mean under ACS design has been obtained where the sampling units bearing a characteristic of interest are sparsely scattered in a geographically distributed population in unknown manner. New sets of calibration weights were obtained by minimizing the Chi-square distance between calibration weights and design weights of Horvitz-Thompson estimator under ACS design using the method of Lagrange multiplier subject to calibration constraints. The approximate variance and the Yates-Grundy form of estimate of variance of the proposed calibration estimator have been developed.

Calibration estimators of finite population ratio of two variables have also been proposed using respective available auxiliary information under ACS design. The expressions of approximate variance and the Yates-Grundy form of estimator of variance of the proposed calibration estimator have also been proposed. In order to empirically evaluate the statistical performance of proposed calibration estimators under ACS design, a simulation study will be carried out.

Two step calibration for estimation of finite population total under two-stage sampling design

Efficient estimators of finite population total using two step calibration approach under two-stage sampling design have been developed for different situation of the availability of auxiliary variables.

In the first situation, it is assumed that population aggregate of auxiliary variable (x) is unavailable at the primary stage unit (psu) level but it is available for additional auxiliary variable (z). At the first stage, a two phase sample was drawn to collect information on psu totals of auxiliary variable (x) at the first phase. In the first step calibration, only information on population total of additional auxiliary variable (z) was used and first step calibrated weights were obtained by minimizing chi-square type distance function subject to the calibration constraints using Lagrangian multiplier approach. Subsequently, the first step calibrated weights were used for estimation of population total of auxiliary variable (x). In the second step calibration, population level information on both auxiliary variable (x) and additional auxiliary

variable (z) were used and final calibrated weights were obtained for all the selected psus at the second phase. Based on the psu level calibrated weights (i.e., revised weights), the estimator of population total was developed. In the second situation, it is assumed that information on auxiliary variable (x) is unavailable at the second stage unit (ssu) level but it is known for additional auxiliary variable (z). Here, a two-phase sample was drawn at the second stage to collect information on auxiliary variable (x) and additional auxiliary variable (z). In the first step calibration, only information on psu total of additional auxiliary variable (z) were used and first step calibrated weights were obtained. Subsequently, the first step calibrated weights were used for estimation of psu total of auxiliary variable (x). In the second step calibration, psu total of both auxiliary variable (x) and additional auxiliary variable (z) were used and final calibrated weights were obtained. The proposed calibrated estimator of population total was defined using these calibrated weights. In the third situation, it is assumed that information on auxiliary variable (x) is unavailable at both psu and ssu level, i.e., selected psu total and population total is unavailable, but it is available for additional auxiliary variable (z). Here, a two-phase sample were drawn at the both the stages. Information on x and z is collected from the units in the first phase sample drawn from first phase psu's. In the first step calibration, only information on population total of additional auxiliary variable (z) were used and first step calibrated weights were obtained. Subsequently, the first step calibrated weights were used for estimation of population total of auxiliary variable (x). In the second step calibration, population total of both auxiliary variable (x) and additional auxiliary variable (z) were used and final calibrated weights were obtained. An efficient estimator of population total has been developed based on the final calibrated weights.

Pilot study on measurement of private food grains stock including estimation of on-farm post harvest losses under Input Survey of Agriculture Census in India.

A 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.

Under this study, a suitable questionnaire aligned with existing Input Survey of Agriculture Census was developed covering different on-farm food grains stock and post harvest management during storage at farm level. Stratified two stage sampling design

treating tehsils as strata, villages as first stage units (FSUs) and operational holders as second stage units (SSUs) being used in Input Survey was adopted. The ultimate sampling unit was an operational holder. Pilot survey was conducted in two states namely, Haryana and Madhya Pradesh taking one district in each states and two tehsils within each district was considered for the study. The four crops under AMIS study i.e. wheat, paddy, maize and soybean along with pulses were covered under this pilot survey. Primary data collection was carried out using Paper Assisted Personal Interviewing (PAPI) method. The data analysis was carried out using Statistical Analysis System (SAS) software. The SAS codes were written as per the proposed estimation procedures for suitable data analysis.

The estimates of food grains stock, pre-harvest opening stock, production obtained, quantity sold, quantity stored, quantity disposed, percentage stock and percentage post harvest loss at farm level were obtained along with its percentage Standard Error (%SE) and were found to be reasonably good for overall size classes. Therefore, it is expected that for overall holding size classes, the proposed methodology will provide farm level reliable estimates of food grains stock including post harvest losses at district level. Besides, percentage distribution of different parameters by size group of operational holders for all the crops under study has been obtained for both the districts. The study has established the feasibility of inclusion of developed questionnaire in the future Input Survey of Agriculture Census in India in order to estimate the food grains stock including post harvest loss at farm operations which will bridge the gap on post harvest information and private food grains stock in on-farm and off-farm domains of the supply chain.

Study on developing guidelines for estimating post harvest losses of horticultural crops, livestock products and fish and fish products.

Under this study, Guidelines for estimating post harvest losses of grains developed by the FAO was peer reviewed and comments on the guidelines were sent to the FAO for revision of the guidelines. The comments were incorporated by the FAO and revised guidelines was received for second review. The revised guidelines was reviewed again and comments on the revised guidelines were sent to the FAO which were accepted and incorporated. After incorporating our comments, the guidelines was sent to the FAO Editor by the FAO for editing. Three

separate Guidelines for estimating post harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries) were prepared and submitted to the FAO. Comments on the guidelines have been received from FAO and are being incorporated.

Study on field testing of the developed guidelines on estimating post harvest losses of horticultural crops, livestock products and fish and fish products.

Under this study, the countries for field testing the three guidelines for estimating post harvest losses of horticultural crops, livestock products and fish and fish products are being identified. Phillipines has been identified for field testing of two products whereas the process of finalization of Namibia for the third product is in progress. Preparatory work for field testing is in progress.

Robust and efficient small area estimation methods for agricultural and socio-economic surveys and their application in Indo-Gangetic Plain

In India, poverty estimation and analysis is mainly focused at state and national level. The poverty related statistics generated by the different agencies are available at this level. The measure of precision of the poverty estimates are also ignored. As a result, reliability level of estimates are also unknown. Major cause of concern is unavailability of reliable and quality disaggregate level statistics. The requirements of policy planers and Government agencies for target oriented interventions of several schemes and policies who often requires poverty assessment at various disaggregate level is lacking. The Indo-Gangetic Plain (IGP) region including the states of Uttar Pradesh (UP), Bihar, West Bengal (WB), Punjab and Haryana is one of the decisive region in term of agriculture. Despite of being extremely fertile, the states falling under IGP region in particular eastern IGP states namely Uttar Pradesh, Bihar and West Bengal are still extremely poor and their poverty rate is also very high. This study examines the disparities among the rural households with their standard of living in IGP region for different household categories such as major sources of occupation (i.e., self-employed in agriculture (SEA), self-employed in non-agriculture (SENA), regular wage/salary earning (RWS), casual labour in agriculture (CLA), casual labour in non-agriculture (CLNA) and others) and land holding size (i.e., marginal, small, semi-medium, medium

Table 1. Distribution of households (%) by major source of occupation and land holding size category.

Household type	UP	Bihar	WB	Punjab	Haryana
Major source of occupation					
SEA	44.5	33.8	18.5	23.8	37.8
SENA	16.5	20.6	22.6	16.8	12.8
RWS	5.2	3.9	7.2	17.8	17.6
CLA	11.0	25.3	35.6	13.6	11.9
CLNA	17.3	9.2	11.5	20.4	14.9
Others	5.6	7.2	4.7	7.7	5.1
Land holding size					
Marginal	83.0	86.9	97.0	80.0	70.4
Small	10.9	8.5	2.1	8.3	11.9
Semi Medium	4.7	3.7	0.7	6.2	13.1
Medium	1.1	0.7	0.2	4.8	4.3
Large	0.2	-	-	0.6	0.3

Table 2. Distribution of poverty incidence and coefficient of variation (CV) by household category.
The values are reported in percentage.

Household category	UP		Bihar		WB		Haryana		Punjab	
	Poverty incidence	CV	Poverty incidence	CV	Poverty	CV	Poverty incidence	CV	Poverty incidence	CV
All	26.0	3.6	28.8	5.06	19.6	6.0	9.0	16.4	6.1	13.5
Major source of Occupation										
SEA	19.4	7.0	23.4	10.6	19.6	20.0	3.5	41.9	0.5	96.8
SENA	23.7	7.6	22.9	9.1	10.7	12.2	4.7	49.2	3.7	35.3
RWS	14.9	18.4	18.5	32.9	11.0	29.9	6.1	63.8	4.1	32.5
CLA	39.2	9.0	44.1	8.4	8.7	7.8	25.8	25.2	13.2	27.7
CLNA	41.2	5.2	27.7	11.7	33.2	15.7	19.6	23.4	12.8	19.9
Others	19.1	20.1	23.7	19.1	15.2	28.6	-	-	2.6	53.7
Land holding size										
Marginal	28.4	3.7	30.1	5.2	20.0	6.0	11.1	17.7	7.0	13.8
Small	13.9	15.7	22.5	22.9	4.4	62.0	6.6	59.1	2.6	70.5
Semi-medium	14.6	26.5	16.1	33.1	14.8	87.4	2.6	76.7	-	-
Medium	5.3	79.4	14.0	88.0			1.2	82.7	-	-

and large) categories. The estimates of poverty incidence and the measure of reliability of the estimates have been produced with respect to major source of occupation and land holding size category of households. The poverty incidence is defined as the proportion of households below the poverty line and the reliability is measured as the percent coefficient of variation (CV). Table 1 summarises the distribution of households in different household categories. In IGP region, the majority of households in rural areas are involved in SEA and SENA. Further, most of the households in rural areas belongs to marginal followed by small farm category. Table 2 depicts the inequality in poverty incidence among different household categories within and between the states in IGP region. The results clearly indicate the disparities within and between the states with respect to different household categories. The results also identify the regions and household categories with low and high rate of poverty incidence.

Localised Estimates and Spatial Mapping of Poverty Incidence in the State of Bihar

Bihar is third-most populous state in India. According to the 2011 Population Census, the population of state is 103 million, which is about 8.58 percent of the total population of the country. Poverty is a very complex issue in Bihar and there is an exigent need to devise a focused strategy for poverty eradication. Reliable, qualitative and timely disaggregate level data is essential for effective planning, implementation and monitoring of various Government schemes in Bihar. Spatially disaggregated level data is inevitable
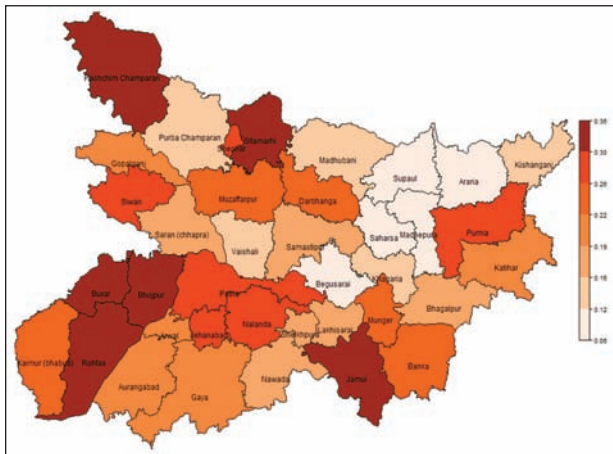
Poverty mapping generated for the state of Bihar in 2011-12

for identifying the areas more in need and for developing focused and target oriented intervention programs. Surveys are typically designed and planned to produce reliable estimates of population characteristics of interest mainly at higher geographic area such as state level. Sample sizes are usually not large enough to provide reliable estimates for disaggregated analysis. For areas with small sample sizes, direct survey estimation of population characteristics based only on the data available from the particular area tends to be unreliable. We employed small area estimation approach to improve the precision of estimates of poverty incidence at district level in the State of Bihar by linking data from the Household Consumer Expenditure Survey 2011-12 of NSSO and the Population Census 2011. The district level poverty incidence generated by small area estimation method are more precise and representative. In contrast, the direct survey estimates based of survey data alone are less stable. The district-wise poverty incidence generated by the small area estimation method in rural areas of Bihar ranges from 6 to 36% with average of 21%. The poverty map provides the spatial inequality in distribution of poverty incidence, i.e. the degree of inequality with respect to distribution of poor households in different districts. This map is very useful in identifying the districts and regions with low and high level of poverty incidence in the state.

Agricultural Research Data Book (ARDB) 2017

The Agricultural Research Data Book (ARDB) 2017 was published by the Division of Sample Surveys. The ARDB 2017, which is twentieth in the series comprises of 170 tables organized into 10 sections namely, Natural Resources, Agricultural Inputs, Animal Husbandry, Dairying and Fisheries,

Horticulture, Production and Productivity, Agricultural Engineering & Produce Management, Export & Import, India's Position in World Agriculture, Investment in Agricultural Research & Education and Human Resources under National Agricultural Research System (NARS). Apart from updation of the previous tables, twenty-two new tables have been added, which consisting of state-wise data on area and production of seven food grains including rice, wheat, jowar, bajra, maize, pulses, oilseeds; area and production of five fruit crops namely mango, banana, sweet orange, apple and papaya; area and production of three vegetable crops namely potato, tomato and onion; production and per capita availability of livestock products like milk, egg and production of meat and wool. For depicting state-wise data, thematic maps were prepared using Geographical Information System (GIS).
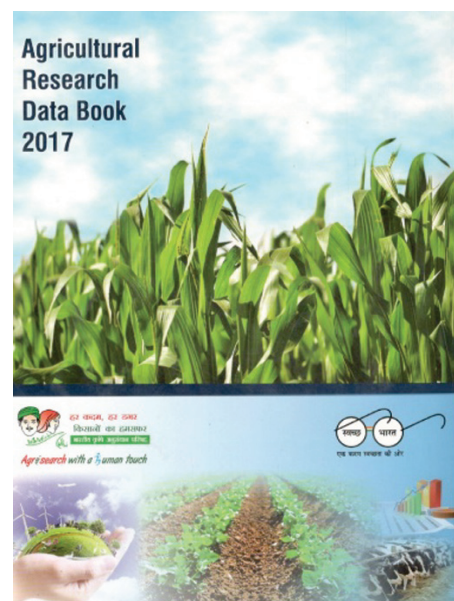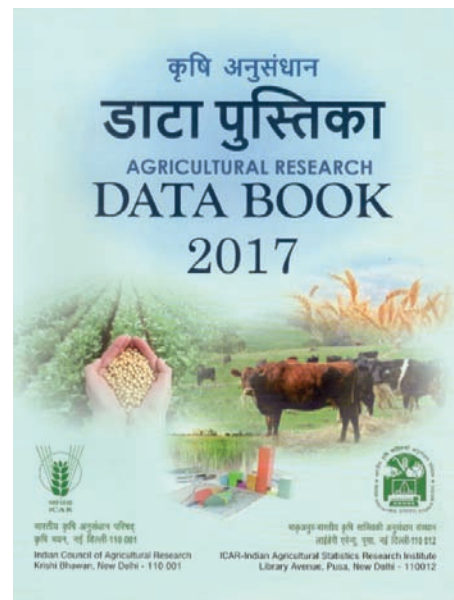
Programme-4: Development of Statistical Techniques for Genetics/Computational Biology and Applications of Bioinformatics in Agricultural Research

Development of rank based stability measures for selecting genotypes.

Rank based stability index (RSI) is a nonparametric stability measures and give a reliable robust stability measures. Being a rank based measure, easy to calculate and understand, it can be used for qualitative data in future. Nonparametric methods are preferred for analyzing METs data when some of assumptions such as normality are violated. This study has been taken up in two parts by rank approach; the first part was related to theoretical explanation of two-way data such as G × E structure as well as focusing on the stability of METs data; The concept of stability is extremely important and along with to identify consistent performing high-yielding genotypes is also important. Because the most stable genotype may not be the highest yielding, integration of high performance and stability to select superior genotypes is important. Hence, it is required to develop simultaneous index for accessing yield stability. A composite stability measures has been proposed in study by using MCDM technique to select stable genotypes using all of parametric and nonparametric stability procedures. This technique is a decision making method to identify favorable genotypes using a set of stability methods, simultaneously. The basic principle is that the chosen genotypes should have the shortest distance from the negative ideal parameter and the farthest distance from the positive ideal parameter. We should select the genotypes in this method with composite stability measure (CSM) which is closer to 0 ($0 \leq CSM \leq 1$).

Development of methodology for nonparametric modelling of time-series data and its application in Agriculture.

A novel modified cross validation procedure has been developed for estimation of optimal bandwidth for applying kernel regression under correlated errors, and theoretical property of the methodology for estimating mean integrated squared error has been established. Exact formulae of conditional expectation of out-of-sample data of food-grain production has been obtained based on modelling of compound growth rate under long memory error. Bonferroni Inequality has been used to obtain interval estimate of unknown regression function for out-of-sample analysis of regression function pertaining to foodgrain time-series data.

Gene selection for classification of crop gene expression data

Developed a modified mRMR technique based on bootstrap samples (called Boot-mRMR) for selection of informative genes in microarray data. This technique is applied to rice microarray dataset for identification of genes related to salt stress tolerance. The Boot-mRMR has an advantage over the usual mRMR in the sense that in Boot-mRMR the informative genes are selected based on statistical significance values unlikely to the weights used in mRMR method. The developed approach outperformed several existing feature selection techniques, while compared using different performance metrics. Further, an innovative statistical approach was proposed for interpreting gene expression data in context of gene sets with traits. The utility of the developed method was studied on five different complex abiotic and biotic stresses of rice, which yields specific trait/stress enriched gene sets. The developed approach provides a valuable platform for integrating the gene expression data with genetically rich QTL data.

A study on sequence encoding based approaches for splice site prediction in agricultural species

Approach for finding associations among the nucleotides occurring at different position in a position-wise aligned sequence dataset has been developed. The R-program was developed for the finding associations based on the developed statistical approach. The associations were computed on fish dataset. No associations were noticed among the occurrences of A and G at different positions surrounding splice junctions in true donor sites. Further in true donor sites, the associations were mostly observed among the occurrences of Y as well as between Y and R at different positions of motif. On the contrary to donor sites, associations were mostly found among the occurrences of nucleotides A and G of different positions in acceptor splice sites. On the other hand, least associations were seen among the occurrences of Y as well as between Y and R of different positions in acceptor splice site motif, unlike donor splice sites. Interestingly, no associations among nucleotides of different positions were found in case of false donor and acceptor splice sites.

Study of long memory and periodicities in climate variables in different agro-climatic zones of India

The long memory behaviour of monthly minimum and maximum temperature of India for the period 1901 to

2007 by means of fractional integration techniques has been investigated. The results show that the time series can be specified in terms of autoregressive fractionally integrated moving average (ARFIMA) process. Both the series were found to be integrated with orders of integration smaller than 0.5 ensuring the long memory stationarity. Wavelet methodology in frequency domain with Haar wavelet filter was applied in order to see the oscillation at different scale and at different time epochs of the series. Multiresolution analysis (MRA) was carried out to explore the local as well as global variations in both the temperature series over the years. The variability in minimum temperature is found to be more than maximum temperature. Though there is no clear significance trend in the temperature series in the long run, but there are pockets of change in the temperature pattern. The predictive ability of ARFIMA model was investigated in terms of relative mean absolute percentage error.

The trend in rainfall in different regions have been computed using parametric as well as nonparametric techniques. A time series data consisting of two quite different parts; namely, a non-stochastic or trend and a stochastic component. The trend assessment is difficult particularly in the presence of long-memory. In order to estimate the trend in presence of long memory, the non-parametric wavelet method has become popular in the recent time. The discrete wavelet transformation (DWT) re-expresses a time-series in terms of coefficients that are associated with a particular time and a particular scale. In the present study, DWT has been applied to estimate the monthly rainfall trend for the months June-September using "Haar" filter in different subdivisions of India. The results from DWT were cross checked with the non-parametric Mann-Kendall (M-K) test. The investigation reveals that the monthly rainfall trend for the monsoon months of different zones in India are significantly decreasing over the years. However, in some of the sub-divisions, rainfall trend is increasing. DWT reveals the significant trend in most of the zones whereas M-K test reveals that most of the trends are not significant at 5% level.

Stochastic differential equation models and their applications to agriculture.

Stochastic differential equation version of Gompertz growth model is more realistic for modelling growth data as it is capable of taking into account the effect of randomly fluctuating parameters, such as Birth and death rates. The solution of Stochastic differential equation version of Gompertz growth

model is found to be log-normal with the conditional expectation and variance of logarithmic process being exponential in time lag. Therefore, the transition probability density function is stationary. To make the above process to follow certain non-homogenous transition probability density, attempt has been made to consider infinitesimal first order moment as time-dependent linear function of state variable. However, this process is not capable to describe the data in certain time intervals in case of presence of exponential trend. Therefore, an extension of Gompertz homogeneous diffusion process by introducing time-functions pertaining to exogenous factors for affecting trend. After obtaining its transition probability density function, the inference on the parameters of the process is obtained by considering discrete sampling of the sample paths. It may be noted that the conditional mean of logarithmic process is non-homogeneous due to time-varying exponential trend only in the Gaussian mean function. Therefore, the process has been further generalized to the process, by taking into account the effect of time trend in the diffusion. The proposed model is solved analytically which shows that conditional mean is non-stationary in both conditional mean and conditional variance. Finally, attempt has been made to apply the proposed model by smoothing the time function pertaining to exogenous factors using wavelet transforms. It has been found that the proposed model performs better that existing non-homogeneous Gompertz model in modeling and forecasting of time-series data of Agriculture using weather as exogenous variables.

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

Pest infestation data (2011-2016) for mean and maximum severity on groundnut crop of Andhra Pradesh state was analyzed using Standard Meteorological Weeks (SMW) for the pests namely, Peanut Stem Necrosis Disease (PSND) (%Incidence), Jassids (%infestation) and Thrips (%infestation). The weather parameters have also been considered for model development. ARIMA model, ARIMAX model and INAR model were used for the analysis.

Studies on field incidence of SMD carried out for five consecutive *kharif* seasons (2012-15) indicated the commencement of its infestation during second week of August with peak severity

during third week of October to November. Mean incidence of SMD was higher in 2012 (7.9%), 2013 (5.9%), 2014 (5.4%) with the least in 2015 (1%). Correlation analyses of SMD incidences with weather parameters of current, one and two weeks prior indicated significant and negative influence of minimum temperature (r = -0.34*; p<0.05) and evening humidity (r = -0.48*; p<0.05) of current to two lagged weeks on mean and maximum SMD. The multiple linear regression analysis for modelling the mean and maximum incidence revealed that evening relative humidity and rainfall prior to two weeks collectively accounted 74 per cent variability for mean incidence. Morning relative humidity prior to one week and evening relative humidity and rainfall lagged by two weeks prior accounted for 86 per cent variability for maximum incidence based on the pooled data over five seasons respectively. Advanced statistical models namely autoregressive integrated moving average (ARIMA) model, ARIMA with exogenous variable (ARIMAX) model, support vector regression (SVR) model and artificial neural network (ANN) have been applied for predicting the mean and maximum SMD. A comparative performance of different models carried out in terms of root mean square error (RMSE) and mean square error (MSE) indicated that both MSE and RMSE of SVR model was less in comparison to regression, ARIMAX and ANN models for forecasting of sterility mosaic disease of pigeonpea.

Creation of Policy and Strategy Cell (PSC) at ICAR-NIAP for Doubling Farmers' Income in India by 2021-22: Estimating farm income and facilitating the implementation of strategic framework

Identification of major sources of growth from agricultural and allied sector would provide the way forward for strategic framework for enhancing farmers' income. As the gross domestic product data is available to the disaggregated forms of crops, livestock, fisheries and forestry sub-sector, the value of production (VoP) from various commodities groups at 2004-05 prices have been used as the most appropriate indicator for commodity outputs. The commodity VoP series from 1950-51 to 2014-15 have been used to study the integration, causality and projections. Various linear and non-linear techniques along with their combinations have been applied for prediction of VoP in India till 2022-23. The VoP is projected separately for cereals, pulses, oilseeds, sugar, fibers, condiments and spices, fruits and vegetables, fisheries and livestock. The

hybrid models based on wavelet is used along with usual ARIMA model for projecting the VoP. Integration among the VoP from different sources is investigated along with the existence of causality. It is found that VoP from crop, fisheries and livestock are cointegrated among themselves. The pairwise cointegration was also found to be significant and there exists bi-directional causality in the long run in most of the cases indicating the complementarities and growth linkages. Accordingly, Vector error correction model (VECM) was used for estimating the speed of adjustment and also for forecasting the VoP. The present study delineated entire country into four zones; viz., Least Performing Zone (LPZ), Average Performing Zone (APZ), Good Performing Zone (GPZ) and Well Performing Zone (WPZ) based on district level livestock income for effective policy formulation and implementation. The drivers of livestock income were identified through multiple regression framework for regional interventions. Crossbred adoption and crossbred milk yield with elasticity of 0.09 and 0.42, respectively, are found to be significantly contributing in enhancing livestock income. Further, special attention required for strengthening marketing network through co-operatives for better procurement and prices with utmost priority in LPZ as only 12 per cent milk quantity is sold to co-operatives.

RiceMetaSys: Understanding rice gene network for blast resistance and drought tolerance through system biology approach

In this study, an attempted has been made to develop a web interface which combines the information from functional genomic studies across different genetic backgrounds with DNA markers so that they can be readily deployed in crop improvement. In the current version of the database, we have included drought and salinity stress studies since these two are the major abiotic stresses in rice.RiceMetaSys, a user-

Figure : Screen shot of RiceMetaSys Database

friendly and freely available web interface, provides comprehensive information on salt responsive genes (SRGs) and drought responsive genes (DRGs) across genotypes, crop development stages and tissues, identified from multiple microarray datasets. The aim of this database is to facilitate users with a simple and straight-forward search options for identification of robust candidate genes from among thousands of SRGs and DRGs so as to link variation in expression profiles to variation in phenotype.

Genome-wide identification of NBS genes in 11 Oryza species

Wild species of agronomically important crops always remain a potential source of unexploited genes and allelic variations. Since half of the world is dependent on rice for its carbohydrate need, use of gene prospecting and allele mining from wild relatives of rice is a valuable approach for search of superior genes and alleles. Following this notion, the present study has been carried out to identify all NBS genes from 3 cultivated and 8 wild rice species representing three diploid genomes,and analyzed their chromosomal positions, gene clusters on genomes, conservedness among species, species-specificity and evolutionary pattern to exploit best NBS genes for disease resistance in rice.
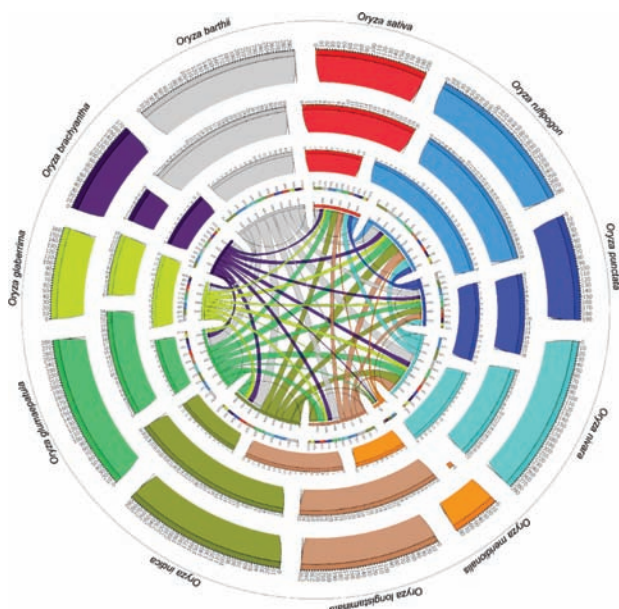
Figure: A four layered circos diagram with the outermost ring showing the number of genes having orthologs, followed by the rings with the number of genes with paralogs, number of species-specific genes and the number of orthologous and paralogous pairs between predicted NBS genes, moving from outermost to innermost ring.

Identification of genes associated with blast disease in rice using RNAseq data

In this study, transcriptome profiling of M. oryzae infected panicle tissue in blast resistant Tetep and susceptible HP2216 rice varieties has been carried out. Various samples of RNAseq data from infected and non infected plants has been taken for the analysis. Differentially expressed genes has been identified. Further annotation of differentially expressed genes has been done. This provide us information of not only differentially expressed genes but also due to use of resistant and susceptible varieties, DEG linked with blast trait.
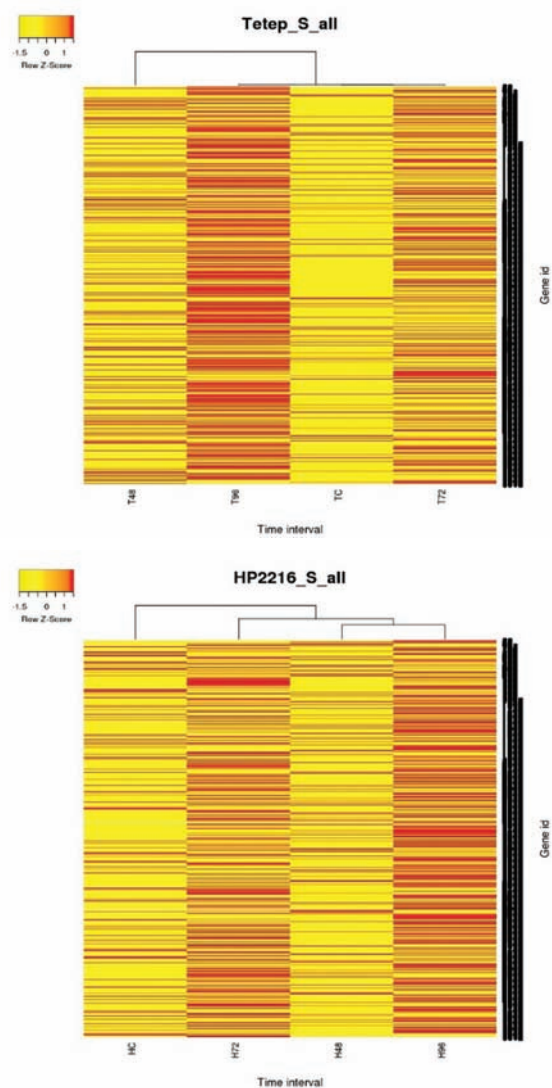
Figure: Heatmaps of Tetep and HP2216 representing the comparative relations of DEG's at four-time intervals i.e. control, 48hpi, 72hpi and 96hpi (hpi = hour post infection), with Yellow color designates for most downregulated and Red for most upregulated gene.

Computational identification and modelling of genetic variation in relation to performance traits in buffaloes

In this study, the SNPs related to four important traits of buffalo i.e., milk yield, age at first calving, post-partum cyclicity and feed conversion efficiency have been identified based on data generated using ddRAD (double digest Restriction-site Associated DNA) sequencing technology. These identified SNPs have been assembled in the form of web based database for its wider accessibility and applicability in upcoming molecular breeding program. This database facilitates easy search of SNPs and Haplotypes along with their important feature like minor and major allele frequencies. This database will help to accelerate the molecular breeding program for developing trait specific breeds of buffalo to meet the need of the country.
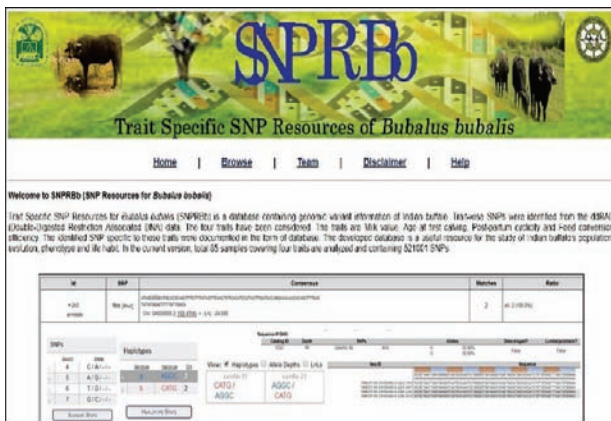
Figure : Homepage of Trait Specific SNP Resources of Bubalus bubalis (SNPRBb)

Identification of trait associated genes using RNAseq data in *Bubalus bubalis*

In this study, genes related to four important traits i.e., milk yield, age at first calving, post-partum cyclicity and Feed conversion efficiency in buffalo (*Bubalus bubalis*) have been identified using RNAseq data. RNAseq data of low and high performing animals related to four traits have been generated and subsequent analysis of these datasets have been carried out. Finally, genes related to each trait have been identified. More over annotation of

	Up-regulated Genes	Down-regulated Genes
Trait 1	2020	2206
Trait 2	726	525
Trait 3	2970	2498
Trait 4	1474	1782

these identified genes have also been carried out. Statistics of the identified genes has been given below.

Identification of microRNA and their related genetic variants for corpus luteum tropism in buffalo

The present study was designed to decipher the miRNA-related markers for corpus luteum tropism in buffalo (Bubalus bubalis).The data obtained from deep sequencing of corpus luteum tissue from different physiological stages was mined in silico for the identification of variants (SSRs & SNPs). For sequences were subjected to BLAST with Bos Taurus genome and using Triplet SVM, MFold and MatureBayes software the free energy, stem lop structure and precursor sequences were deduced. The data obtained were analysed with BLAST2GO for detection of variants (SSRs & SNPs). From the present study, 5 naanoated and 176 annotated miRNA were deduced while comparing with Bos Taurus genome. In addition, 4 SSRs and 9 SNPs were deduced in the miRNA sequences. This study reports the occurrence of SSRs and SNPs in the target gene of the miRNA controlling corpus luteum tropism in buffalo (*Bubalus bubalis*).
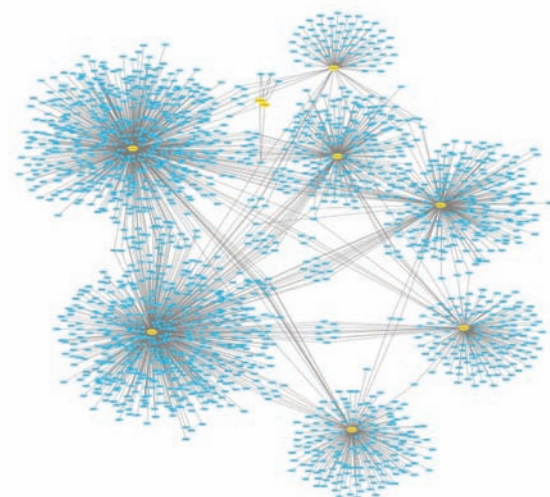
Figure. Network of SNP related microRNA with their targets genes

Gene regulatory networks modeling for heat stress responses of source and sink for development of climate smart wheat

In this study, transcriptome profiling of leaf and root tissues of two varieties of wheat i.e. sensitive and tolerant (HD2967 and BT-Schomberg) under heat has been carried out. Various samples of RNAseq data from plants under normal sowing

and late sowing has been taken for the analysis. Differentially expressed genes has been identified. Further annotation of differentially expressed genes has been done. This provide us complete profile of genes associated with heat stress in wheat.
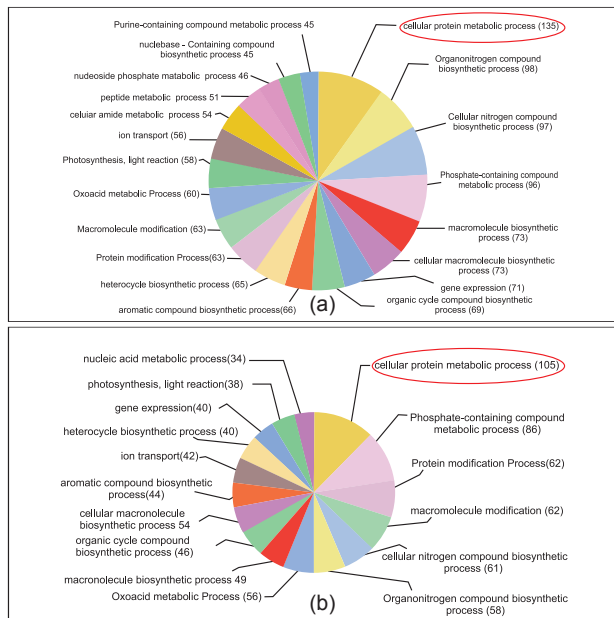
Figure: Distribution of differentially expressed genes in various Biological Processes in (a) HD2967 and (b) BT Schomberg

Identification of Single Nucleotide Polymorphism (SNP) and Simple Sequence Repeat (SSR) in wheat (*Triticum aestivum*) under heat stress using NGS data

Wheat (Triticum aestivum) is a very important cereal crop in the word. Its production is severely limited due to various environmental stresses. Particularly heat stress adversely affects the production of wheat during reproductive development and grain-filling stages. Now a days, a variety of molecular markers like simple sequence repeats (SSRs) and single nucleotide repeats (SNPs) have become the markers of choice to understand the molecular mechanism in various plants. Thus the objective of the study was to identify the markers SSRs and SNPs in wheat under heat stress. SSRs and SNPs markers were identified in wheat crop under heat stress NGS data. Two contrast i. e. sensitive and resistant varieties of wheat (HD2967 and BT-Schomberg) were selected for marker detection using computational approach. Total number of 2129 and 2196 SSRs markers were identified in normal sowing and delayed sowing plants. Five major classes of SSRs that is, mono, di-, tri-, tetra- and pentanucleotide repeats were targeted for identification of SSRs. These SSR markers have extensive range of applications, like genome mapping, phenotype mapping, marker assisted selection, a range of molecular ecology and diversity studies.
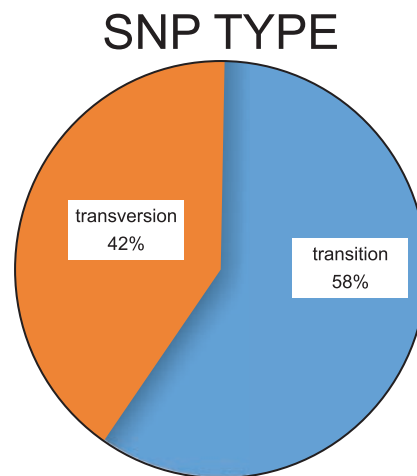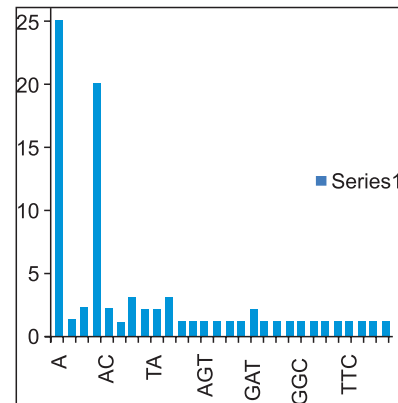
Figure: Distribution graph and Pie-chart of identified (a) SSRs and (b) SNPs respectively

Construction of gene regulatory network of genes associated with heat stress and identification of differentially connected genes between the network constructed under heat stress and normal condition in wheat *(Triticum aestivum)*

In this study, differentially expressed genes are identified as a part of marginal analysis under heat stress in wheat. These differentially expressed genes are further used for reconstruction of gene regulatory networks under control and heat stress conditions based on partial least square technique. Their differential connectivity was investigated using permutation based statistical tests and the top most genes with differential connectivity are identified as key genes. In silico validation of identified key genes has been done by their functional classifications. Major functional classes identified in this study are luminal binding, chlorophyll binding, callose synthase, amino terminal protease. These functional classes of differentially connected genes reveal their possible roles during heat stress.

(a)
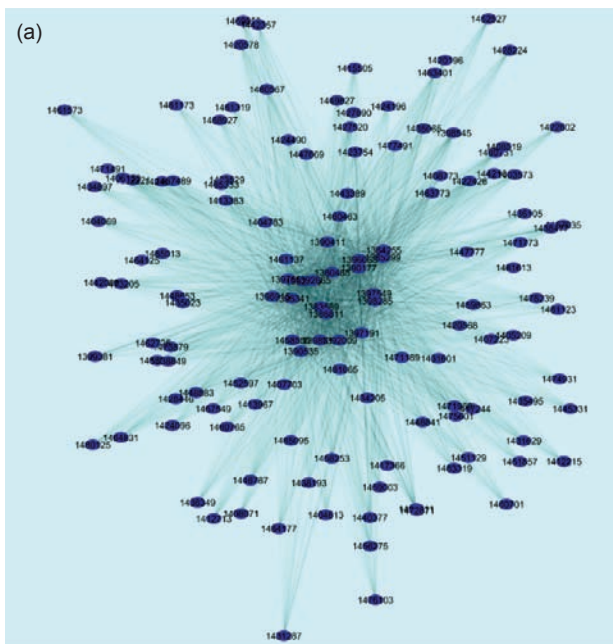
(b)

Description	Length
uncharacterized protein LOC109740361	352
phospholipase D alpha 1	797
luminal-binding 2	536
catalase	743
U-box domain-containing 62	404
Retrovirus-related Pol poly from transposon TNT 1-94	994
Callose synthase 10	403
5-methyltetrahydropteroyltriglutamate--homocysteine methyltransferase 1	358
70 kDa peptidyl-prolyl isomerase	327
probable serine incorporator	377
CAAX amino terminal protease	442
Chlorophyll a-b binding CP24 chloroplastic	448
glutamate decarboxylase 1-like	476
callose synthase 9	511
Glucan endo-1,3-beta-glucosidase 13	604
probable pyridoxal 5 -phosphate synthase subunit PDX1	618

Figure: (a) Gene Regulatory Network of Common DEG (b) List of Differentially Connected Genes

Development of database of genetic variants associated to abiotic stress in wheat

As abiotic stress data for wheat are spread all over the existing databases, first and foremost need is to integrate the data into one place for the easy and quick access of wheat (abiotic stress data) that includes SNP's, SSR's and miRNA data. In order to fulfill this fundamental aspect of integrating the data from various sources, various genes associated

to heat, drought and salt stress were mined and attempt has been made to develop a database of genetic variants such as SSR, miRNA, SNP etc. related to the genes responsible for these abiotic stresses in wheat (*Triticum* sp.). This database is user friendly where search as well as upload facility available for users. Information of abiotic stress associated SNP's, SSR's and miRNA in wheat crop can be used to develop the variety resistant towards heat, salt, drought tolerance.

Identification of genetic polymorphisms for pathogenicity in vibrio sp.

Putative pathogenic genes were obtained from the pathogenicity islands though integrated method. Vibrio gene polymorphism database was populated.

Bioinformatics analysis of sequence data of brinjal and bitter gourd for identification of functional and regulatory genes for traits of economic importance

The database of Virdiplantae genes was populated. . Besides this analysis of sequence data of bitter gourd for identification of genes and their regulatory apparatus involved in biotic stress and pharmaceutical traits was performed.

Computational approach for harnessing genome information and its integration with wheat phenome for efficient varietal development.

An online relational database of wheat drought transcriptome was developed which catalogues differentially expressed genes, miRNAs, transcription factors, KEGG pathways along with markers (SSRs, SNPs and InDels). This genomic resource can be accessed freely for non-commercial use at http://webtom.cabgrid.res.in/wdrotdb/. The client tier is concerned with browsing and user query through web pages. 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.

Figure: Length distribution of transcripts in assembled transcripts.

De novo transcriptome assembly of wheat terminal heat stress

In this study, total sixteen samples of control and treated data were generated at four different developmental crop stages. Both control and treated samples have two biological replicates. After quality trimming and removal of rRNA reads, total 253046594 (20.5%) poor quality reads were dropped and then finally retained 979825192 (79.47%) high quality reads for *de novo* transcriptome assembly and further downstream analysis. Trinity generated 2,302,239 transcripts with minimum read length of 200 and GC content of 50.24%. Finally 1,696,570 transcripts were obtained after removal of redundant sequences with N50 value of >= 473 bp (50% of total sequence length is contained in the 356290 sequences), GC content was 50.48 % and transcript lengths was ranging 200 to 18,870 bp (Figure 1).

In-silico molecular marker predictions

Total 98412 simple sequences repeats (SSR) were identified from 1696570 transcripts of wheat *de novo* transcriptome assembly and 4261 repeats were present in compound formation. Out of 98412 markers, we found maximum number of markers in mononucleotides i.e. 37716, followed by 27697, 29659, 2773, 381 and 186 SSR markers in di-, tri-, tetra-, penta- and hexa nucleotide repeats respectively (Supplementary file 6). In dinucleotide repeats, we found the maximum number of repeats was GA i.e. 4601, followed by AG (3247) and CT (3101). In case of trinucleotides, maximum was GGC repeats i.e. 1799, followed by GCG (1487) and GAG (1393) (Table).

	De novo assembly	DEGs (unique DEGs of all sets)
Total number of sequences examined	1696570	60051
Total number of identified SSRs	98412	2730
Number of SSR containing sequences	89321	2379
Number of sequences containing more than 1 SSR	7986	292
Number of SSRs present in compound formation	4261	243
Mono	37716	668
Di	27697	832
Tri	29659	1154
Tetra	2773	59
Penta	381	3
Hexa	186	14

Table: Details of SSR markers obtained from de novo transcriptome assembly as well as unique differential expressed genes of all the stages

Molecular and computational approach to delineate metabolic pathways for better carbohydrate utilization in Labeo spp.

The study was performed on discovery of miRNA and their targets in the liver tissues of farmed carp

rohu, *Labeo rohita* fed with different carbohydrate regime. The small RNA libraries were obtained from liver tissues were sequenced using Illumina Hiseq technology. A total of 22,612,316, 44,316,046, 13,338,434, 7,867,012 and 36,958,918 clean reads were obtained from these five RNA libraries, respectively. The bioinformatics analysis identified 138 conserved miRNAs and 161 putative novel miRNAs. We could identified the five randomly
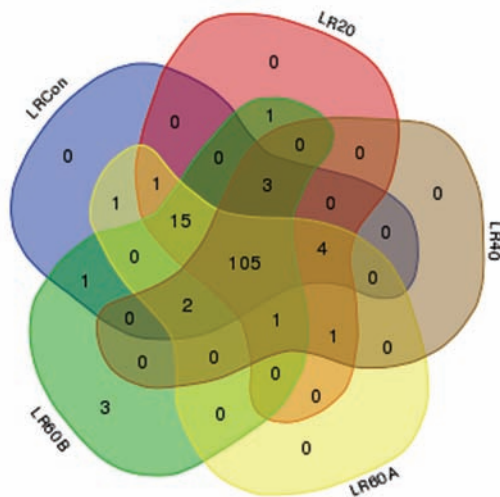
Figure. Comparison of novel miRNAs of liver tissues from different treatment groups.
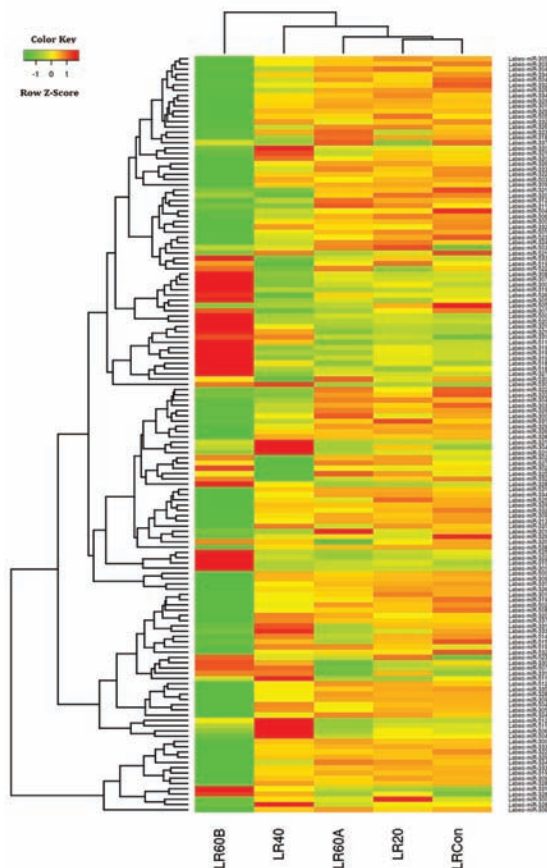
Figure. Heat map depicting the differentially expressed miRNAs expression patterns

selected miRNAs expression profiles involved in metabolic related genes were validated by RT-PCR. MicroRNA target prediction, gene ontology (GO) annotation analysis indicated that a variety of biological pathways. Further analysis depicted mature miRNA and their predicted target sites in genes were involved in development biology, cellular activities, transportation etc. This is probably the first report of presence of miRNA in the expressed genes of farmed carp, rohu. Overall our finding from this study will rationalize the way for *in vivo* study of the role of miRNA in farmed carp.

Genomic data analysis for identification of *economically important markers and viral diagnostics in pulses*

Cytoplasmic male sterility (CMS) in pigeonpea was studied by comparative transcriptome analysis of young floral buds from the CMS line (ICPL 88039A) carrying A_2 cytoplasm and its cognate maintainer line (ICPL 88039B). The differential gene expression profiling uncovered a group of 311 genes that showed altered expression in response to CMS. Of these, 17 genes were downregulated while 214 remained upregulated in ICPL 88039B as compared to the isogenic sterile line. Based on GO and KEGG analyses, we could potentially associate CMS in pigeonpea with disturbed functions of genes and transcription factors involved in "Glucose and lipid metabolism" "ATP production", "Pollen development and pollen tube growth" "ROS elimination". To the best of our knowledge, this is probably the first study
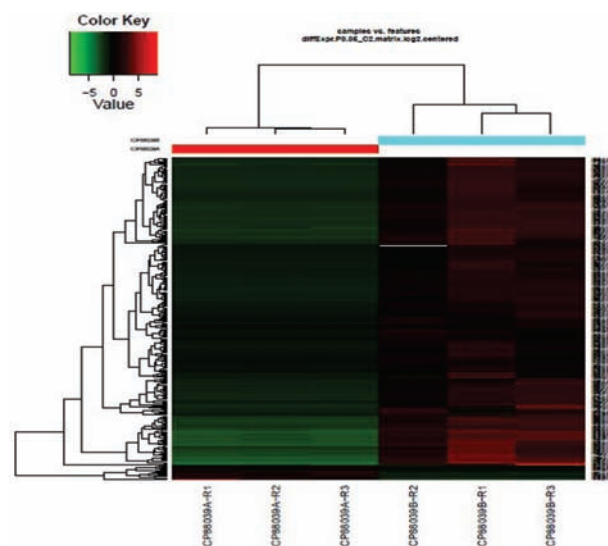
Figure: Heat map and hierarchical clustering represents the differentially expressed genes of three biological replicate of sample ICP88039A and ICP88039B of Pigeonpea by taking log2 ratio ±2 and false discovery rate (FDR) <0.05. Green and red color represented the downregulated genes and upregulated genes respectively.

to report transcripotome analysis involving CMS in pigeonpea. This study offers a global view on important candidate genes and metabolic pathways associated with pollen development and male sterility in pigeonpea, which in turn paves the way for detailed dissection of the molecular mechanism that confers CMS trait in pigeonpea. The transcriptome data generated here will be a valuable genomic resource in understanding of CMS and improving pigeonpea productivity.

Mining and validation of candidate gene markers and screening on antimicrobial peptides of black pepper and small cardamom

Compilation of genomic resource generated in transcriptomic experiment of biotic i.e., mosaic disease caused by *Cardamom mosaic virus* (CdMV) was competed and an online database was developed. The database catalogues 123338 transcripts from control and mosaic virus infected samples assembly, 5317 differential expressed genes with blast results, 24 thousand geneic region putative markers, 147442 and 154217 SNPs and Indels from control and mosaic virus infected samples, respectively. Also 2267 transcriptional factors, 1219 domains and 807 families were found in DEGs along with pathways.

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

13 drought-responsive MicroRNA families consisting of 65 members regulating 42 unique target mRNAs were identified, characterized and functionally validated in Subtropical Maize Inbreds. miR156, miR 159, miR 160, etc. 240 maize subtropical lines phenotyped for drought at different environments using 29,619 cured SNPs and seven agronomic traits (ASI, GY, EL, EG, KR, KRN, 100HKW) were tested for breeding value prediction. The prediction accuracies for GY using Ridge Regression, LASSO, ElasticNet, RF, RKHS, Bayes A and Bayes B are 0.56, 0.56, 0.61, 0.85, 0.89, 0.89 and 0.90 respectively.

Development of database on snps associated with economically important traits in indian goats

The online SNP database has been updated with the new SNP sequences of leptin, Adipose differentiation-related protein (ADFP) [important for regulation of lipid metabolism and insulin secretion in beta-cells] and Insulin-like growth factor 1 (IGF-1) genes for Jamunapari, Barbari, Jakharana and Sirohi breeds of goat.

Development of database repertoire for Clostridium perfringens strains prevalent in causing Enterotoxaemia in goats

Experimental enterotoxaemia in adult goats revealed severe congestion and infiltration of neutrophils in intestinal mucosa, degenerative and necrotic changes in kidneys, marked interstitial infiltration of inflammatory cells and edema of lungs and congestion and edema of brain tissue. Five unique isolates of *Clostridium perfringens* Type A, D and two new isolates of *Paraclostridium benzoelyticum* associated with diarrhoea in goats have been characterized and submitted to National Centre for Veterinary Type Culture (Accession Nos. VTCCBAA1197, 1198, 1199, 1200 & 1201). The full gene epsilon toxin of four typed isolates were submitted to NCBI genbank (Accession Nos. KY938004, KY938005, KY938006 & KY938007). The same unique sequences have also been included in the database repertoire.

Metagenomic applications and transcriptome profiling for inland aquatic environmental health surveillance

The de novo Assembly and Scaffolding of metagenomic data of all the soil samples collected from river Ganga near Kanpur, Farakkha was carried out by following standard metagenomics analysis pipeline. The geodiversity among bacteriophages was found at different sites of Kanpur and Farakka locations. A large number of pathogenic and zoonotic bacteria like Mycobacterium tuberculosis, Mycobacterium bovis, Bacillus anthracis, Vibrio

cholerae, Salmollea typhi, Pseudomonas aeruginosa, Acinetobacter baumannii,etc. and their respective bacteriophages like Mycobacterium phage ArcherNM, phage pYD21-A, Salmonella phage SJ46, Escherichia phage phiX174, Pseudomonas phage AF, Acinetobacter phage AM24 etc were found at the said locations. Other virus species present at different sites of Kanpur location are Costelytra-Zealindica- iridescent-virus, EBPR-podovirus-2, Anopheles-minimus-irodovirus, Megavirus-lba. Whereas, miscellaneous species like Faustovirus, Moumouvirus goulette, Megavirus chiliensis, Acanthamoeba polyphaga mimivirus etc are present at different sites of Farakka location.

In silico analysis of data for identification of functional alleles for stress tolerance and quality traits using Bioinformatics in potato

The de novo assembly of aphid genome has been completed and the SSRs at genome level have been identified.
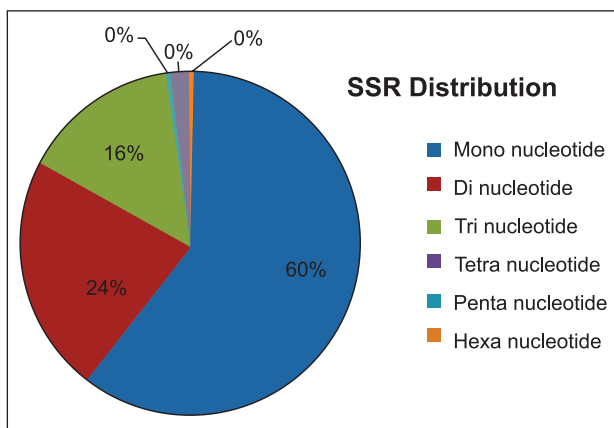
Whole genome sequencing and development of allied genomics resources in two commercially important fish-Labeo rohita and Clarias batrachus

During the period reported upon rohu fish genome assembly was improved further with additional dataset. The statistics of improved assembly is as below.

No. Of Scaffolds	13,477
No. Of bases	1,486,261,063
Max. scaffold size	15,225,769
Avg. Scaffold size	110,281
N50	2,422,972
No. Of N's	59,281,486 [3.98%]

Above assembly was used for genome annotation.

- Gene Prediction (Augustus)
- No.of Genes Predicted : 40,099
- Unique genes : 34,338
- No. Of tRNAs : 2537

Functional Annotation (Blast2go)

Blasted	37623
Mapped	28198
InterPro	40099
Annotated	24525
GO-SLIM	29750

Comparative genomic analysis

The *Labeo rohita* genome sequence were compared with 25 chromosomes of well characterized Zebrafish genome against 13, 477 scaffolds of rohu using Satsuma synteny program (http://satsuma. sourceforge.net/) (Grabherr *et al.,* 2010). This highly sensitive sequence alignment was used to define the conserved synteny blocks using Fast Fourier Transform (FFT) algorithm by aligning two entire fish genomes. The whole genome alignment output from Satsuma synteny was graphically represented using MizBee - a multiscale synteny browser (Meyer *et al.,* 2009). Resequencing of wild rohu was performed to compare with the selectively bred rohu.

Whole genome based SNP mining and development of breed signatures for dairy and dual-purpose indigenous cattle

During the period reported upon, remaining 3 cattle breeds *viz.* Ongole, Hariana, and Kangayam SNP data were generated using Bovine HD SNP chip 777K. They were further analyzed to obtain Runs of Homozygosity (ROH), genomic F (inbreeding coefficient) derived from ROH (F_{ROH}), F_{GRM}, F_{HOL}, F_{MOLi} and F_{MOLij} in remaining 3 breeds of indigenous covering a total 7 indigenous cattle breeds in the project representing major ecological regions of India.

We excluded all SNPs not assigned to a *Bos taurus* chromosome (BTA) or assigned to chromosomes X and Y. Markers were filtered according to quality criteria that included: (i) call frequency (≥0.95), (ii) minor allele frequency (MAF≥0.01) and (iii) Hardy-Weinberg equilibrium (P-value = 0.001). SNPs that did not satisfy these quality criteria were excluded. Therefore, unlinked SNPs were selected using -indep option of PLINK with the following parameters: 50 SNPs/window, a shift of five SNPs between windows

Analysis Progress [merged_gapclosed_scafs_2000_fa_masked_interpro_26_09_2017_final]

Top-Hit Species Distribution [merged_gapclosed_scafs_2000_fa_masked_interpro_26_09_2017_final]
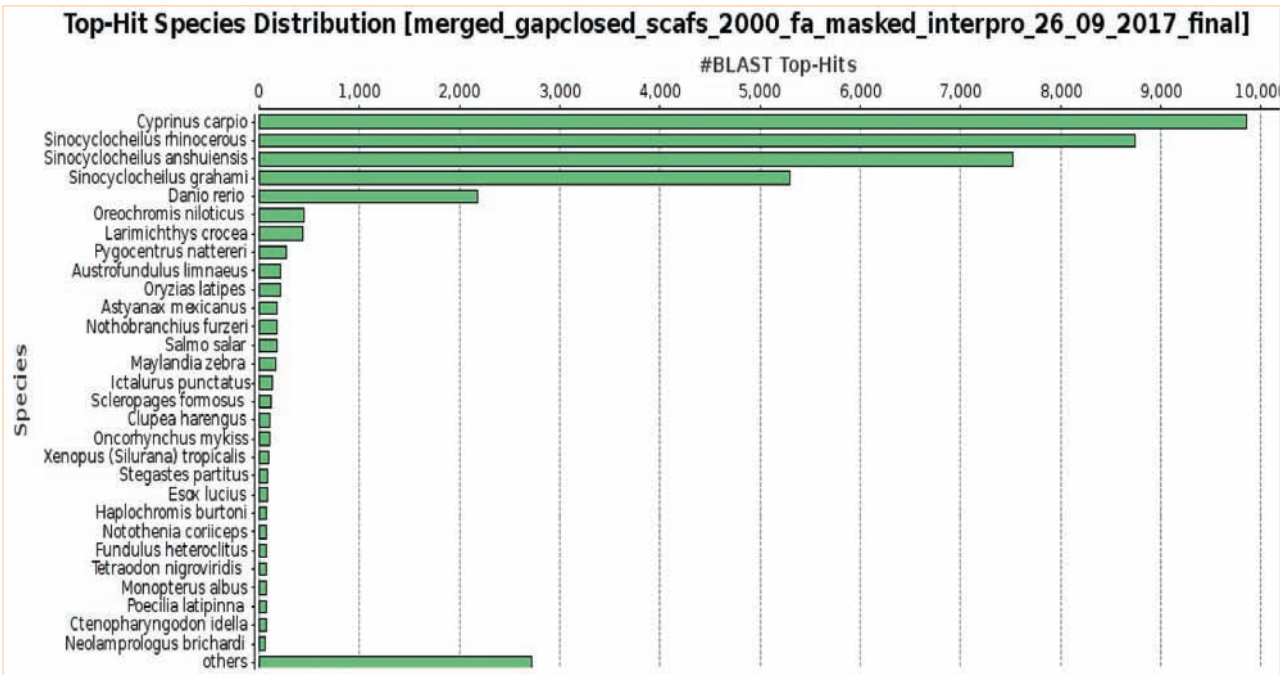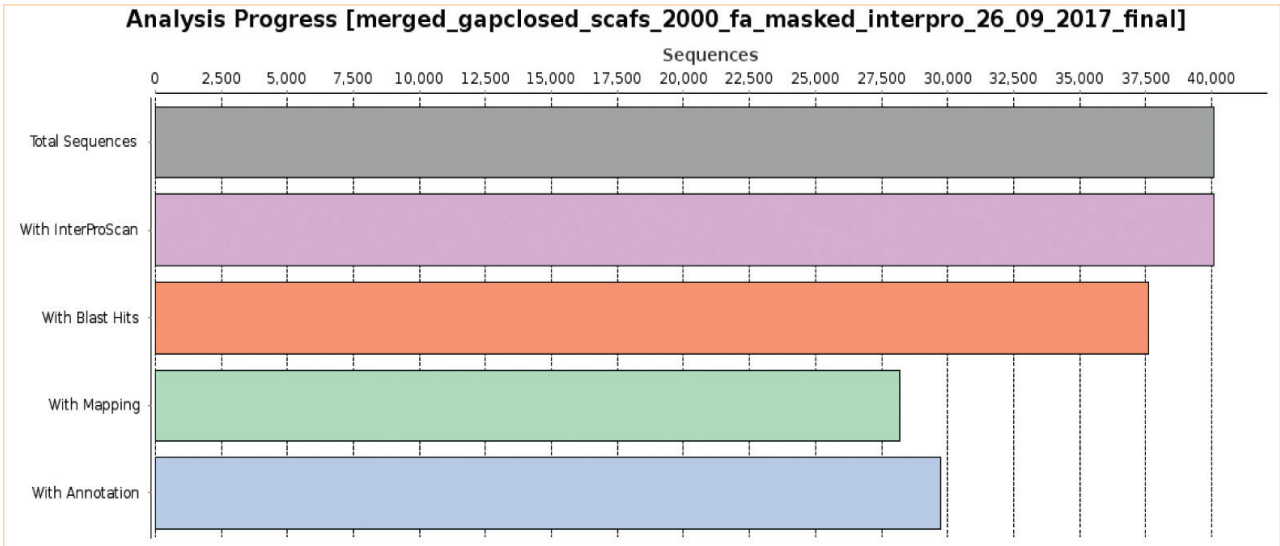
and r^2 threshold of 0.5. A total of 682036 SNPs in Ongole, 617219 SNPs in Hariana, and 525626 SNPs in Kangayam cattle breeds were retained after quality control and were used to estimate F_{ROH}.

Run of homozygosity: F_{ROH} were calculated as the proportion of genome in ROH over the overall length of the genome covered by the involved SNPs using the PLINK whole-genome association analysis toolset. The following criteria were used to define the ROH: (i) the minimum number of SNPs included in the ROH was fixed to 40; (ii) the
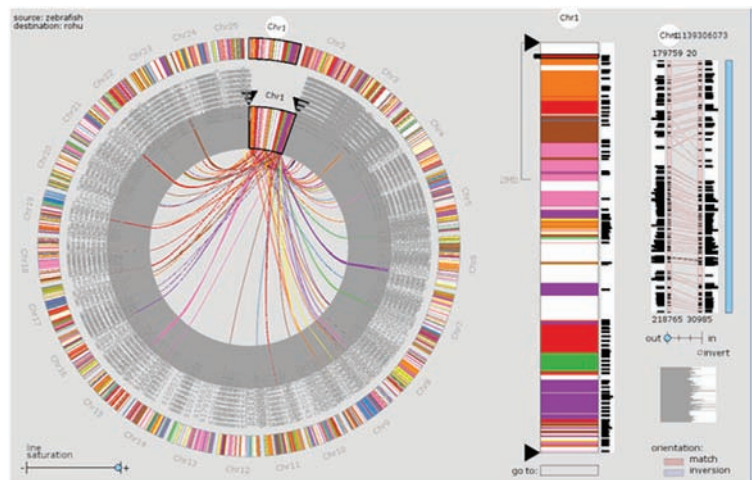
Developed genome browser for Rahu.
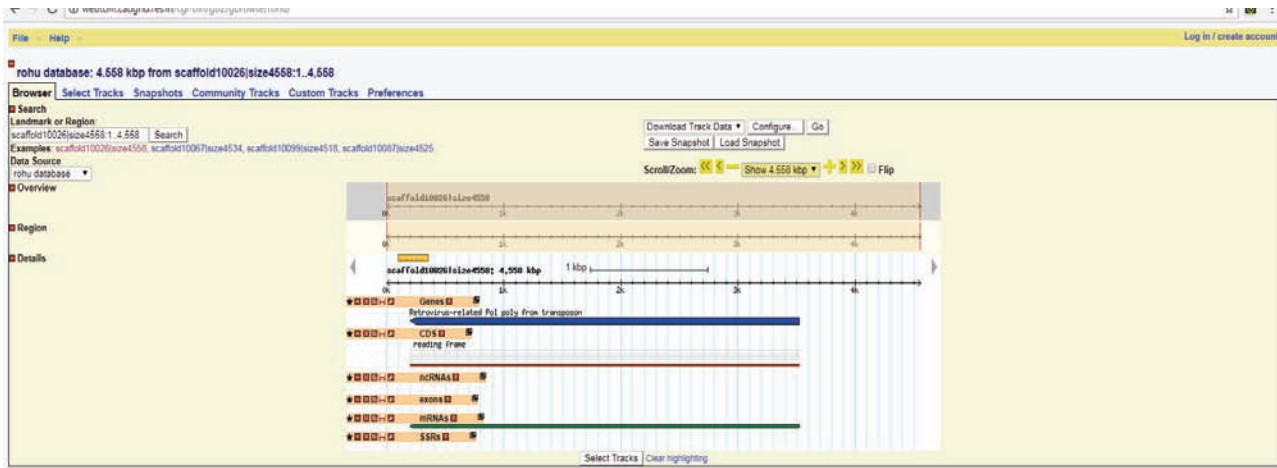
minimum length that constituted the ROH was set to 4 Mb; (iii) two missing SNPs were allowed in the ROH; (iv) minimum density of one SNP every 100 kb; (v) maximum gap between consecutive SNPs of 1 Mb.

Moreover, the number of allowed heterozygous SNPs was set to different values: from one to three. Mean F_{ROH} values obtained allowing different numbers of heterozygous SNPs were compared within the same breed using paired t-tests. The mean number of ROH per individual per breed (MN_{ROH}), the average length of ROH (L_{ROH}) and the sum of all ROH segments per animal (S_{ROH}) were estimated.

Table: Descriptive statistics for runs of homozygosity (ROH) for each cattle breed

Breed	MNROH	FROH>4Mb	LROH	SNPs
Ongole	7.39	0.041$^\pm$ ± 0.033	7.56	149 to 24887
Hariana	16.24	0.089$^\pm$ ± 0.034	16.27	145 to 24241
Kangayam	11.13	0.068$^\pm$ ± 0.021	11.26	150 to 18874

Genomic inbreeding analyses: Alternative estimates of inbreeding and coancestry coefficients were also calculated. In particular: (1) F estimated from the Genomic Relationship Matrix, GRM (F_{GRM}); (2) the genomic inbreeding coefficient based on the difference between observed v. expected number of homozygous genotypes (F_{HOM}); (3) the molecular coancestry coefficient (F_{MOLij}) between individuals i and j; (4) the molecular inbreeding coefficient (F_{MOLi}) of individual i, calculated as $F_{MOLi} = 2 f_{MOLii} - 1$ where f_{MOLii} is the molecular self-coancestry.

Table: Estimated average of genomic inbreeding and coancestry coefficients for each cattle breed

Breed	FGRM	FHOM	FMOLi	FMOLij
Ongole	0.073	0.026	0.614	0.615
Hariana	0.038	0.011	0.626	0.636
Kangayam	0.049	0.017	0.649	0.654

Genetic distance between all pairwise combinations of individuals (D) was estimated as one minus the average proportion of allele shared where the average proportion of allele shared was calculated as Dst using Plink v1.07. The average genetic distances between the different breeds are shown in Table.

Table: Average genetic distances among the breeds.

Breeds	Ongole	Hariana	Kangayam
Ongole	0.000	0.197	0.211
Hariana	0.197	0.000	0.254
Kangayam	0.211	0.254	0.000

Elucidating the mechanism of Pashmina fibre development: An OMICS approach

The RNA-Seq samples received from the lead centre SKUAST-K were subjected to quality control analysis and trimming and filtering processes. Cashmere goat genome was used as reference genome and Bowtie2 was used for indexing. The trimmed transcriptome sequences were subjected to TopHat aligner for mapping. The mapped bam files of the transcriptome were used as input to the SAMtools and GATK for detection of SNPs between goats having white, black and brown hair follicles. The chromosome wise distribution of SNPs for the above three goat samples has been studied under SAMtools and GATK. Besides, the SNPs between pair-wise samples, i.e., white *vs* black, white *vs*

brown and black *vs* brown as well as between all the three samples have been identified and annotated.

Network Project on Transgenic in Crops

SNP database MiSNPDb has been updated. The phylogenetic tree of 84 varieties of mango was constructed using PHyML in order to classify the varieties according to their geographical relatedness. The phylogenetic tree constructed from the phylip file of these common RAD loci are shown in Figure 1. When we compared varieties in this phylogenetic tree with their respective geographical distribution in India, we found all 70 indigenous mango varieties to fall in three zones, *viz.,* North, East and South zones except 13 hybrid/ exotic varieties. Our analysis revealed three major lineages which showed that varieties belonging to northern and eastern India were found to be overlapping (merged) in geographical distribution.

This study reveals distinct genetic differentiation in consonance with geographical distribution, thus
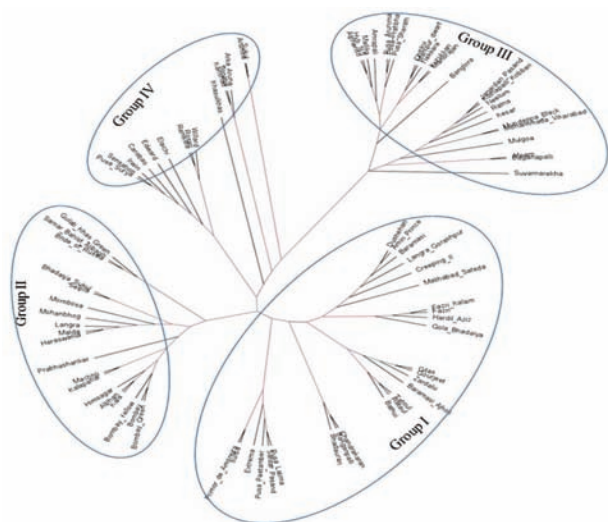
these SNPs can be used in varietal differentiation of indigenous mango varieties along with traceability of mango produce/products. Hybrid/ exotic varieties taken under present study could not be assigned to any of these major lineage/ group over three geographical zones. This is obviously expected due to attribute of hybrid having been originated from two parental varieties. This unassigned group also includes Indian mango varieties having exotic in origin/exotic parental variety. Small, separate cluster of these hybrid/exotic mango varieties might be also due to limitation of RAD based SNPs itself due to restriction fragment bias, restriction site heterozygosity and PCR GC content bias.

Transcriptome and proteome analysis for identification of candidate genes responsible for pistillate nature in castor

- *De novo* assembly of the 12 transcriptomes was done and the number of contigs was 71418. 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.

- Comparison of male and female buds with hermaphrodite flowers resulted in higher DEGs in male buds (1592) as compared to those of female (218).

- The study also provided valuable leads with regard to the transcription factors that are differentially expressed (1054) and the DE unigenes (540).

Identification of differentially expressed genes (DEGs)

The number of DEGs were shown in following tables

Table: Castor transcriptome and differentially expressed genes in different tissues

Sample	FDR	logFC	Up-Regulated	Down-Regulated	Total
Leaf sample vs Female flower pistillate plant (1 vs 2)	0.05	5	1130	1068	2198
Leaf sample vs Male buds from male line 574 (1 vs 11)	0.05	10	928	126	1054
Hermaphrodite flowers vs Male buds from male line 574 (9 vs 11)	0.05	5	1227	365	1592
Female buds from a completely female line M574 vs Hermaphrodite flowers (8 vs 9)	0.05	5	41	177	218
Female buds from a completely female line M574 vs Male buds from a completely male line M574 (8 vs 11)	0.05	5	910	543	1453
Male buds from monoecious line DCS-107 vs Female buds from monoecious line DCS-107 (10 vs 12)	0.05	5	401	409	810

Identification of SSRs

MISA- MIcroSAtellite (http://pgrc.ipk-gatersleben.de/misa/) identification tool was used for mining of microsatellites in castor transcriptome.

Table: SSR markers motif in castor transcriptome

Repeat Type	Number of SSRs in Total transcripts	Number of SSRs in unique DEGs
Mono	948	262
Di-nucleotide	2679	742
Tri- nucleotide	4883	1126
Tetra- nucleotide	178	34
Penta- nucleotide	32	2
Hexa- nucleotide	100	11

Platform or Integrated Genomics Warehouse

After exploring the existing genomic resources related to rice, the identified parameters for genetic variants related to SNP, SNP haplotypes, InDels, CNV and SSR variants are documented. The software architecture has been finalized. The logical schema of warehouse for the data mart development has also been finalized. The workflows for populating these data marts are being initiated.

Software architecture for genomics warehouse

The data warehouse keeps data in a specialized type of repository that stores cleaned, processed and integrated data from various related data sources such as machine-generated log files, social-media data, multimedia data, genomic sequence data, transactional data or historical transactional data. Popular database management system packages are relational data base management systems such as Oracle and MySQL or Big Data enabled platform such as MongoDB, Cloudera and HBase. These database packages are used for the development of warehousing platform. Primarily, the MySQL serves as platform for staging area where the data is transformed and cleansed. The cleaned and transformed data is transported to the warehousing

platform using Oracle or Big Data enabled platform. The implementation of warehousing is being done by using open source Pentaho Software Suite. This suite will provide data integrator, schema workbench and BI server. The genomic data is available in the form of SRA sequences, processed sequences, derived databases and many more web based resources. The connectivity is established by using different types of database connectivity. The connected data sources are integrated using a specialized tool called Data Integrator. The data integration step allows extracting, transforming and loading the required data into the databases. The OLAP schema is developed by using the Schema Workbench tool and finally the OLAP cubes is published to the web server based business intelligence platform. The BI system is used to develop and host various types of reports for improved access of the integrated data.

Workflow for developing data mart of genetic variants

Once data is integrated by applying the dimensional modeling and regenerating the schema, the modelled data is need to be loaded into the developed schema which is different from the traditional relational database management system. Various workflow need to be developed to transport the data from the existing platform to the warehousing platform. The data mart approach has been applied to develop the data warehousing solution. The genomic data are being made available by different ways of access to researchers. The required data was fetched including the raw data to derive some more parameters related to specific task. The bioinformatics tools were incorporated, installed and executed to obtain the derived parameters.

Further, the genome sequence contains coding and non-coding regions. The coding region

Process flow for SSR mart development
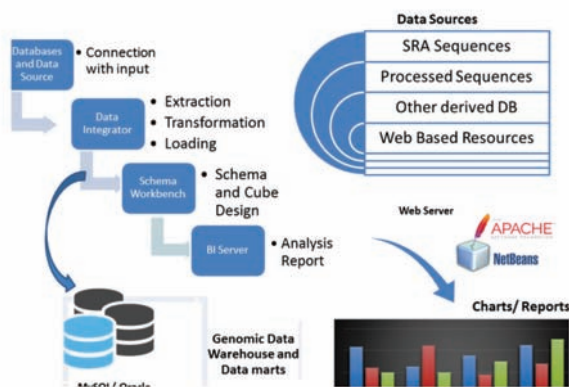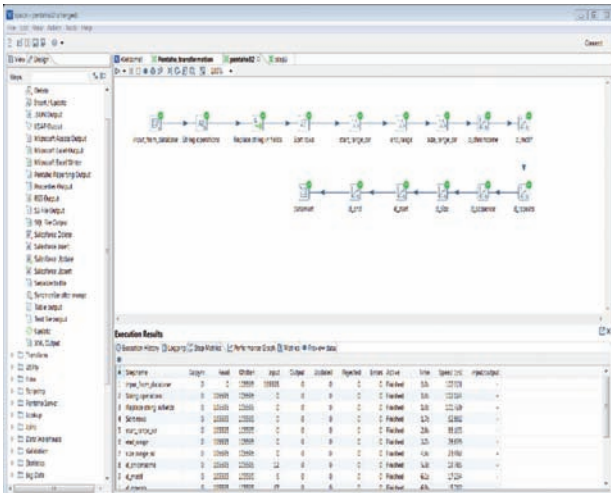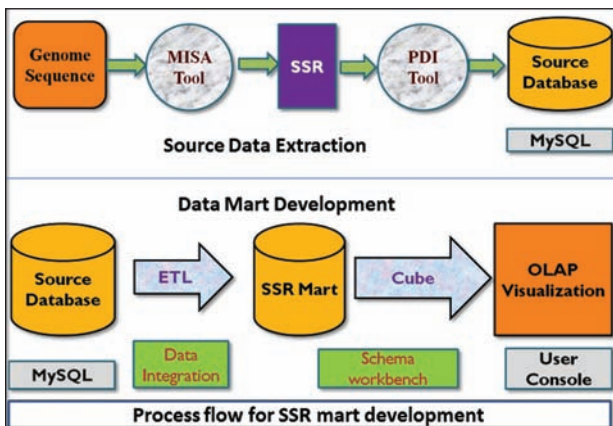
contains genes and having the information related to its functions and expression. Genes are having sequence, structure and functions. These are determined by applying and executing the bioinformatics tools and validated the generated information through experiments. The sequence contains different type of genetic variants such as SNP, SNP haplotypes, SSR, InDels and CNVs. On the other side, the structure contains intron, exon, splice sites, promoters etc. The functions of the genes retrieved by using pathway analysis, identification of enzymes, linking with domains and ontology based analysis. This hierarchical flow is useful in developing the dimensional hierarchies in genomics domain.

Data mart for Simple Sequence Repeats

A simple sequence repeats (SSR) is a tract of repetitive DNA in which certain DNA pattern (ranging in length from 2–10 base pairs) are repeated, typically 5–50 times. SSR are stretches of DNA containing tandem repeating di, tri, tetra, penta or hexa nucleotide units distributed throughout the genomes. These are found to be abundant in plant genomes and are considered as major source of genetic variation in quantitative traits. Retrieving

SSR markers for any species requires the execution of bioinformatic tools. The output generated from these tools is in text format and export into database. This database is accessible by using SQL queries or by developing any web based front end tool. The analytical capabilities are missing in such kind of retrieval and there is a need to develop some front end for exploring these SSR. Dimensional modelling plays an important role in developing the data mart for exploratory analysis using star schema. Here, the SSR data mart has been developed by merging and splitting some attributes/values that make the data analysis friendly. The source data extraction and process for data mart development is shown in the diagram. The ETL workflow has been developed to convert the existing data into dimensional models. There are seven dimension tables and one fact tables which contain the primary keys of the associated dimension tables.

The ETL process is shown in the figure

Data mart for Single Nucleotide Polymorphism

Single Nucleotide Polymorphisms (SNPs) are most abundant genomic variations in a DNA sequence that occurs when a single nucleotide in the DNA sequence differs from the reference sequence in at least one percent of the population. They may be responsible for the diversity among individuals, genome evolution, the most common familiar traits such as physical appearance, differences in drug effect, and response towards complex and common diseases.

The SNP data mart has been developed by integrating the data from multiple sources specifically *RiceVarMap, PlantGDB* and *Gramene*. *RiceVarMap* and SNP-SEEK contain identified SNP's of rice species. The *PlantGDB* provides *g*enes information and *Gramene* database contained Quantitative Trait Loci (QTLs) for rice species. The ETL workflow has
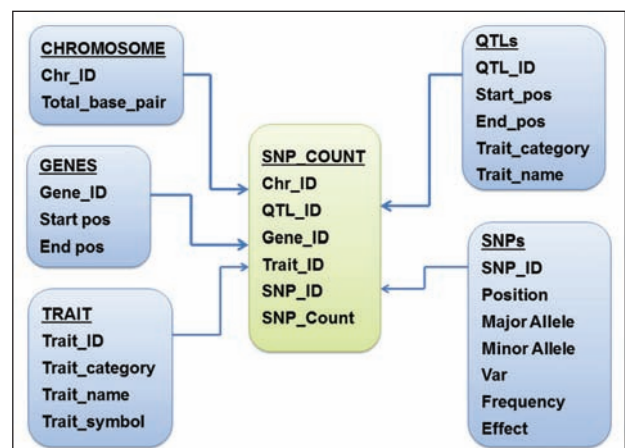
been developed by integrating the data from these resources. There are five dimension tables and a central fact table that contains the number of SNPs. The drill down facility enables the user find the other details of the SNPs.

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

The experimental design, namely, Square Lattice design was suggested for all the five locations (PAU, Ludhiana; GBPUAT, Pantnagar; DRMR, Bharatpur; IARI, Delhi and Kota, Rajasthan) with two replications and 289 (treatments) mustard germplasm lines. The randomized layout plan for the lattice design has been provided to the lead centre as well as to the four partner centres. 14 phenotypic traits are being measured on the said germplasm lines. All the partner centers were provided with the data entry sheets for supplying the required data on different phenotypic traits. Bharatpur centre has been visited to have an idea on the implementation of the recommended experimental plan. An information system with several modules like data-upload, data analysis, and sequence analysis of mustard germplasm has been initiated. Login entry form for each centre has been provided in the information system.
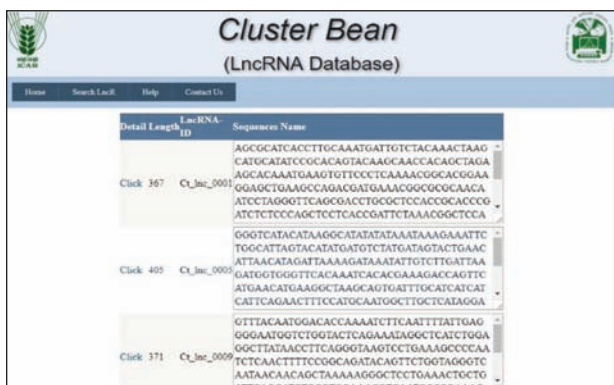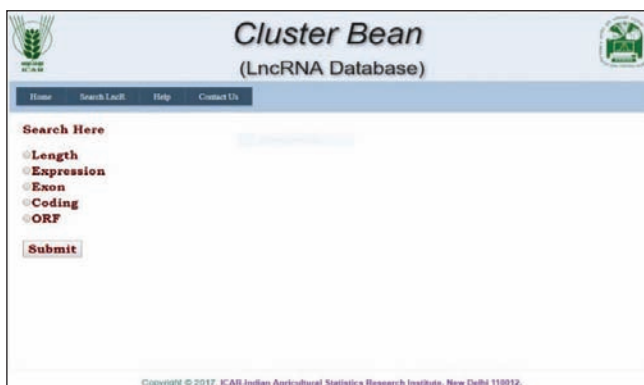
The chloroplast genome sequence data of *Brassica juncea*, *Brassica rapa* and *Brassica nigra* species received from the lead centre were analyzed. We identified differentially expressed genes between the species and further annotated them using Blast2go. A total of 191, 22 and 195 differentially expressed genes in *Brassica juncea - Brassica nigra*, *Brassica juncea - Brassica rapa* and *Brassica rapa - Brassica nigra* respectively, were identified. These genes were found to be involved in different metabolic pathways, namely, purine, pyramidine, oxidative phosphorylation, glyoxylate and dicarboxylate

metabolisms and carbon fixation in photosynthetic organisms. The SSR marker analysis for the said three species reveals 371, 173 and 155 SSRs distributed over the chloroplast genomes. Primers have also been designed for 10 SSRs belonging to B.rapa and B.nigra for further validation in wet lab. Single nucleotide polymorphism (SNP) has also been detected for *Brassica juncea*, *Brassica rapa* and *Brassica nigra*. A total of 518, 1173 and 638 SNPs have been identified in *Brassica nigra*, *Brassica juncea* and *Brassica rapa* respectively [Phred score QUAL>30]. Rooted phylogenetic tree has also been generated for the genes of *Brassica juncea*, *Brassica rapa* and *Brassica nigra* species. Different methodologies/pipelines have been suggested for the analysis of phenotypic and genomic data of mustard germplasm. For population stratification, STRUCTURE software with admixture model was opted whereas for association analysis, R code invoking FarmCPU package was finalized. For data visualization purposes, Falpjack pipeline was finalized as it allows visualization of high-throughput genotype data, rapid navigation and comparison between lines, markers and chromosomes, SNP calls per chromosome.

ICAR Consortium research platform on genomics: computational and analytical solutions for high-throughput biological data

The NGS data on five samples of guar crop has been received from the partner centre, ICAR-NRCPB and the assembly of genome sequence is under progress. The transcriptome data of guar genome from NRCPB for three tissues: root, shoot and leaf has been retrieved and assembled by following standard transcriptome data analysis pipeline and assembly has been done. From the assembled transcriptome, lncRNAs and miRNAs have been predicted. These predicted ncRNAs were further
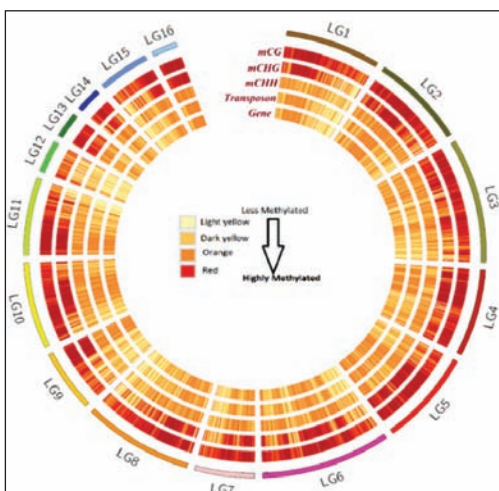
analyzed for identifying their target genes. Simple sequence repeats present on the ncRNAs have also been identified.
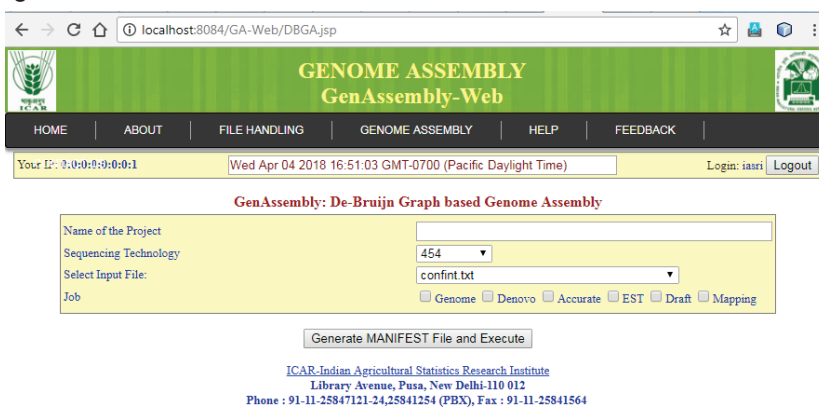
Potential gene mining from salt tolerant grasses for improvement of salt tolerance in crops.

Salt tolerant genes to be used further for analysis were identified from literature. These genes were: Chaperons (Dna J) genes protecting already acidic proteins in high salt environment. These acidic proteins otherwise make salt bridges with the internal salt environment of the cell. High expression of metal P-type ATPases helps the cell to detoxify. These ATPases are of two types one being for monovalent metals like copper and one for divalent metals like zinc. These metals are required in low amount for the enzymes to function and their high amount is toxic to cell. The cell's activity is lowered in salinity stress thus needing much more lower amount of these metals, resulting in their efflux. Many ABC transporter permease and ABC transporters are involved in the transport of substances through the transmembrane. Most of the known prokaryotic ABC transporters are importers so probably the halophilic archaea is almost shutting down the import of materials in the cell, may be due to energy deprived conditions to perform translocation. The expression of heat shock protein is increased in salinity conditions conditions and could be due to the fact that it prevents the already energy deprived cell from thermal stress

Development of an improved hybrid de-novo whole genome assembler

A web interface has been developed to run the assembly program using web browser to enable the user to run the assembler on a user-friendly interface. A *manifest.conf* file is required to run the MIRA assembler program that is generated

automatically after user supplies the input file(s) and related parameters. The MIRA program runs on the server in background while user will be notified by email about the completion of the job. The output files generated will be available for viewing online with the facility of downloading the same.

Non linear modelling for genomic predictions based on multiple traits

In recent years of animal and plant breeding research, genomic selection became a choice for selection of appropriate candidate for breeding as it significantly contributes in enhancing the genetic gain. Various studies related to genomic selection has been done in recent past. These studies were mostly confined to single trait. Though genomic selection based on single trait does not perform well in the case of pleiotropy, missing data and when the trait under study has low heritability. Gradually, some studies were carried out to explore the possibility of methods for genomic selection based on multiple trait in the view of overcoming above mentioned problems in the method of single trait genomic selection. Currently multi trait based genomic selection methods are getting importance as it exploit the information of correlated structure among response. In this study, we have compared various methods related to single trait genomic

selection such as Stepwise regression, RR, LASSO, Bayseian, BLUP, SVM and multi trait based genomic selection methods like MRCE, cGGM, Mixed model, LASSO etc. In almost all cases, multi trait based methods are found to be more accurate. Based on the results of this study, it may be concluded that multi-trait based methods have great potential to increase genetic gain as they utilize the correlation among the response variable as extra information which contributes to, estimates breeding value more precisely.We have studied method related to single trait genomic selection including Stepwise regression, RR, LASSO, Bayseian, BLUP, SVM and methods like MRCE, cGGM, Mixed model, LASSO related to Multi trait genomic selection. We compared the performance of these methods on real dataset. Almost all cases we have found that MTGS methods performs better than STGS methods. As an evaluation measure Prediction error i.e. mean Square error (MSE) with its standard error (SE) is calculated between observed response value and estimated response. Prediction error can be simply calculated using following formula.

$$PE = \frac{1}{n}\sqrt{\left(Y - \hat{Y}\right)^2}$$

Where Y is observed response in testing set whereas Yˆ is estimated response which is calculated from marker effect estimated from training set.

Methods under single trait and multi trait genomic selection has been studied in detail. Comparative study of single trait and multi trait genomic selection methods has been done.

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

- Images of total 150 wheat cultivars with three replication 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 11 phases covering growth period of wheat during January to March 2017.

- Following analysis were carried out classify the wheat varieties into different groups with respect to drought stress: data cleaning and pre-processing, variable selection, SVM classification, K-mean clustering, hierarchical clustering, PCA and self-organizing map.

- To support the analysis of large-scale image data sets of different camera systems, an Integrated Analysis Platform (IAP) has been designed and work is in progress for development of following modules:

- Project Management: Creation and management of projects and data.

- Pre-processing: Addition, Deletion, Updation, removal of null/blank values, Normalization, outliers detection etc.

- Statistical Analysis: variable selection using variance inflation factors and other features selection methods, SVM, Clustering, ANOVA, Self-Organizing Map, Principal Component analysis etc.

- A data base has been designed for storing and managing the image data, development work is in progress.

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:

- Merger of plan or non-plan scheme budget has been implemented.

- GPF subscription and GPF withdrawal functionalities have been incorporated in ICAR-ERP

- New reports have been customized i.e. Institutes wise total employees based on employee category, Institutes wise sanctioned budget details, supplier level bank details end date, supplier form restriction etc.

- The following new modifications have been made in the system:

  ➢ Enable the PFMS Number enter on payment form.

- All the reports related to PFMS number on payments.
- Enabled calculations on fund enquiry report.
- Restricting currency on account analysis Report.
- User accessibility to change the Email Ids through self service.
- Employee profile report enablement on self service and Institute level.
- Budget change restriction on invoice level and distribution level cash base report delivered to client which is under testing
- Alerts activation on leaves (EL & CCL) more than 15 days to supervisor

- Online Dashboard functionality has been developed and strengthened. Budget expenditure and release can be seen till Institute level. The dashboard is available at http://iasri.res.in/misfms/Financial_report.aspx.

- Created ERP ids of newly recruited scientists including entering their basic details and assignment of two responsibilities of employee self service and purchasing requisition.

- Payroll was run for three large institutes viz., ICAR-IARI, ICAR-IVRI and ICAR-NBPGR

End User Training & Support:

- About twenty short trainings were organized viz., ICAR – CAZRI, Jodhpur for Payroll and Finance module during April 05-07, 2017; ICAR-NDRI Bangalore for HRMS, Finance and SCM during April 17-22, 2017; ICAR-CIBA, Chennai for HRMS and Finance module during April 17-19, 2017; ICAR-CCARI, Goa for HRMS and Payroll module during 24-26, April, 2017; ICAR-HQ (IPTM) for Finance Module on May 05, 2017; ICAR- CISH, Lucknow on Payroll module during May 05-12, 2017; ICAR-ATARI, Jodhpur for HRMS and Payroll during May 08-09, 2017; ICAR-NRCSS, Ajmer for all modules during May 08-11, 2017; ICAR-CIRC, Meerut for HRMS module on May 15, 2017; ICAR-DKMA, New Delhi for Payroll on May 05, 2017; ICAR-IVRI for Payroll Module during May 25-16, 2017; ICAR-CAZRI, Jodhpur for Payroll Module on May 25, 2017; ICAR-IIHR, Bangalore for Finance Module, HR and Payroll during June 19-22, 2017; IISR for Payroll, HRMS and Finance during August 23-24, 2017; ASRB for Payroll module on August 24, 2017; ICAR-ATARI, Jodhpur for Payroll, HRMS and Finance during September 16-17, 2017; ICAR-IVRI, Mukteshwar Campus for Payroll, HRMS and Finance during September 25-27, 2017;IARI for Project module on December 06, 2017; DWR, Jabalpur for payroll and HRMS during February 26-27, 2018

- ER sheet functionality has been streamlined with feedback from the users. 4782 personnel have updated information.

- Managed online session through team viewer for various institutes.

- Monitoring the day to day transactions in ICAR-ERP system and issues

Monitoring & Coordination for Effective Implementation:

- MSR Meeting with IBM personnel for reviewing the progress and issues.

- Monitoring the day to day transactions in ICAR-ERP system and issues.

- First draft of RFP for renewal the support and service of ICAR-ERP for next three years has been prepared.

- Review of the ICAR-ERP progress in e-governance meetings.

- Number of review meetings were organized for implementation of finance module in totality.

Instruction materials

Following documents were prepared

- EFT payment through cheques
- Annual Account Reports
- Creation of supplier and its TDS
- Pay-roll process
- Finance module
- HRMS Module

All these documents are available on MIS/FMS website.(http://misfms.icar.gov.in/FAQGeneral.aspx)

ICAR-DC (Data Centre)

- Successful Completion of ISO 27k1 and 20k Surveillance Audit.

- Renewal of ICAR Data Centre services and AMC for next three years.

- Support is being provided from central help desk for ICAR-ERP and Unified Communication Services.

- Unified communication solution up to March

2018: AD- 17010, Mail Box Users 16886 and Lync user 11166.

- Archival mailbox enabled for all the Directors ID, IASRI and NBPGR users.

- Seventy eight websites are hosted and running through ICAR-DC

- MSR Meeting with IBM personnel for reviewing the progress and issues

Development and assessment of educational mobile apps for improving livestock health and production in collaboration with IVRI

IVRI-Pashu Prajanan (Animal Reproduction) App, designed and developed by ICAR-IVRI and ICAR-IASRI, is targeted to impart knowledge and act as a ready reckoner for the graduating veterinarians, field veterinary officers and livestock entrepreneurs about reproductive diseases/disorders in cattle and buffaloes and measures to treat and control them. Twelve (12) major reproductive diseases/disorders are covered in the App. All the information of reproductive problems/disorders is provided under the major heads viz. What and How, Symptoms, Treatment and Prevention. The App additionally provides basic information on heat detection and artificial insemination in cattle and buffaloes. Presently, the App provides information in seven languages viz. Hindi, English, Punjabi, Bengali,
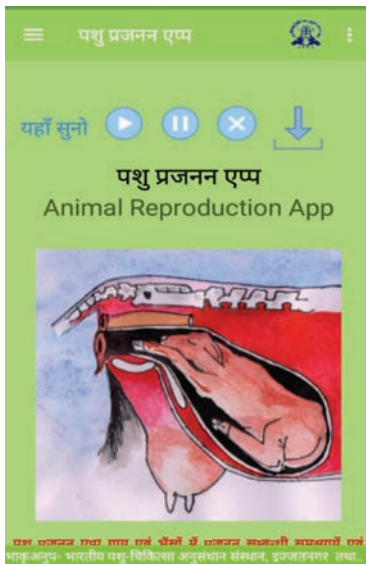
Assamese, Gujarati and Tamil. The App is available on Google Play Store for free.

The *IVRI- Shukar Palan (Pig Farming) App* has been designed and developed by ICAR-IVRI in association with ICAR-IASRI to impart 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 providing information on about all the aspects of scientific pig farming from selection of the right breed of pig to its housing, scientific feeding, low cost feeding, breeding management, complete health care and general management. The App also provides information about various centers in the country from where the entrepreneurs can procure pigs/piglets of specific breeds. The App additionally provides support for development of commercial pig farming projects of various sizes. Further, it will also help the livestock entrepreneurs to market their pigs and piglets. The App provides answers to FAQs in various aspects of pig farming. It also has a section where the Do's and Don'ts for each segment of pig farming are elaborated. Thus, the pig farming App is a complete guide for the establishment of a pig farm on scientific lines in the country. This App is developed for Android platform. It is available on Google Play Store for free. The information contained in the App is presently in Hindi language and its English version would be launched soon.

- Both Mobile Apps (Animal Reproduction and Pig Farming) were launched by Hon'ble Union Minister of Agriculture and Farmers Welfare on March 08, 2018 during Director Conference at NASC Complex, New Delhi.

- Four copyrights have been obtained for Animal Reproduction and Pig Farming mobile apps for different languages.

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Management and Impact Assessment of Farmer FIRST Project

- A web portal of the project has been designed and developed. It has been hosted at ICAR Data Centre, ICAR-IASRI, New Delhi. The portal can be visited through URL https://ffp.icar.gov.in/.

Fig. Home Page of FFP Web Portal

- The developed system provide information about FFP programme, projects details, interventions, news and highlights, achievements, success stories, latest publications, FFP in media along with image gallery. This system can facilitate to disseminate the knowledge generated under FFP projects to the farmers and other stakeholders. The developed system has the potential to impart agricultural knowledge which is relevant, searchable and up-to-date.

- Role-based user module has been developed for PI(s) of the project, ATARI(s), ICAR Headquarter and Administrator. PI can upload and edit information of the respective project. ATARI user can monitor the progress (based on the information uploaded by SAUs/Institutes under its zone) of the projects. ICAR Headquarter can monitor the progress of all projects under FFP.

- Login credentials for all 52 PIs and ATARIs have been created and communicated to the respective stakeholder.

- Functionality has been created for project PI to add intervention, budget of project and event/ training programme organized under the project.

- Developed the functionality to upload images, videos and publications by selecting the category

viz. event, intervention and others activities under the respective project.

- Report module has been developed. The user can view ATARI and organization wise report. Public user can view all the project information except budget.

Fig. List of Projects under FFP

- Reset password functionality has been provided for PI(s), ATARI(s) and ICAR Hq.

- Functionality for monitoring of projects has been developed for ATARIs, ICAR Hq and Admin.

- All FFP Project locations can be viewed through GIS map.

- The homepage of the portal has been updated regularly.

- The portal is being viewed extensively since February 2018 from different locations as shown in cluster map. Hence, the portal is gaining popularity among its various stakeholders.

- Training cum Workshop on Methodological framework for implementation of FFP have been jointly organized by ICAR-NAARM, ICAR-NIAP, ICAR-IASRI and ICAR-DKMA at i) ICAR-IISS, Bhopal during 18-21 September, 2017; ii) ICAR-CISH, Lucknow during 03-06 Oct., 2017; iii) TANUVAS, Chennai during 10-13 Oct., 2017;iv) ICAR-IARI, New Delhi during 23-26 Oct., 2017 and v) ICAR-IISWC, Dehradun during 06-09 November, 2017.In these workshops, SRS and probable input forms for the portal have been presented and discussed with Farmer FIRST project PIs and Co-PIs and the feedback has been incorporated in designing/developing the portal accordingly.

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

Honourable Minister of Agriculture and Farmer Welfare Shri Radha Mohan Singh has released the Education portal of ICAR in the Conference of Vice Chancellor of Ag. Universities and Directors of ICAR Institutes on 8th March 2018 at NASC Complex, Pusa, New Delhi.

Education Portal-ICAR (https://education.icar.gov.in) has been developed as a single window platform for providing vital education information/announcements/event schedules/e-learning resources from Agricultural Universities across the country to the rural youth in an easy and fast way on their doorsteps. The portal also helps in management, monitoring and promoting activities/schemes of Education Division, ICAR. Education Portal-ICAR has been designed and developed under the guidance of Agricultural Education Division, ICAR.

- Home page of the Education portal has been redesigned. It provides information about all programmes of Strengthening, Scholarships, Trainings, e-learning resources and Faculty Strengthening managed by Education Division, ICAR under section "Strengthening and Development of Higher Agricultural Education in India" and relevant information for students from the Agricultural Universities.

- Provision for generation of Unique Student ID (USID) under different course streams and degree level by the universities/colleges has been made and the information on the same is displayed university wise under different categories on the home page under the link USID.

- Functionality has been developed to upload Scheme Wise Progress report of the university and monitoring report for the same at the ADG level.

- Functionality and reports have been developed for release of Grants. Functionality for AUC submission has been done. Functionality to view demand status (submitted/pending)has been developed. Functionality for activation and deactivation to fill demand has been developed.

- Forms have been developed to upload list of equipment /Civil work /Repair and renovation /IT component by university.

- Database was designed and developed to accommodate new functionality. Style sheets were developed for website layout and content delivery.

- Page has been developed to provide information for students from Agricultural Universities. Information from 73 universities has been added. Various forms have been developed to enter the university Information under different heads.

- Forms has been developed to enter details of seats for admission along with admission criteria and brochure at the university level. Data management forms at university level has been modified for inclusion of "update" and "delete" functionality.

- Forms has been developed to capture and present, University basic details: About the University, Rank, VC Details, University Information, Courses, Achievements, DBT Schemes, Image gallery, Contact details with GIS map.

  - Scholarship details, Admission announcement, Hostel details
  - Faculty strength, Courses offered, Student Strength
  - Facilities (Sports,Wi-Fi, Lab, Auditorium)
  - Image Gallry
  - Upload Event

- Students can search information on courses (Bachelor, Masters & Doctoral) from different Universities at college level. Search functionality has been added on various criteria of Stream, Subject, Course names and University/College.

- Functionality has been developed to enter events. Provision has been made to search events on State, Keyword and Event category.

- Users can locate Centres for tribal plan and Agricultural Universities through maps on the Education Portal.

- Image gallery of multiple facilities, events at Universities/colleges has been made available from the homepage of Education Portal.

- Functionality for uploading notification in the database and displaying the same from home page has been done.

- Several checks, Standard and MIS reports have been developed in the Portal to aid in the monitoring of data.

- Massive operational support has been provided to universities for filling the information.

Knowledge Management System for Agriculture Extension Services in Indian NARES:

- 'Krishi Vigyan Kendra Knowledge Network' or KVK Portal is operational to disseminate knowledge and information from KVKs to farmers. It is hosted at data center ICAR in IASRI and available at URL (https://kvk.icar.gov.in/). The following new functionalities have been added in the KVK Portal:

- ATARI wise reports have been developed on OFT and FLD Schemes under DBT.

- Advance level report has been developed to monitor the status of information on package of practices both ATARI wise and state wise.

- Reports for Monthly Progress Report (MPR) and

Agricultural Extension Monthly Progress Report (AE MPR) have been developed ATARI wise.

- Report for monitoring of KVK events (past, ongoing and upcoming) has been developed both ATARI and State wise based on event category viz. Kisan Mela, Skill Development Training etc; additionally the report can further be filtered with event start date and end date.

- Input proforma for capturing KVK events has been standardized. Report for monitoring of KVK events (past, ongoing and upcoming) has been modified based on this standardized input form.

- Based on requirement from Agricultural Extension Division of ICAR, report has been generated on data upload status of KVKs (ATARI wise) into KVK Portal for various parameters.

- Reports for monitoring of KVK Events and KVK Facilities have been further extended with details of each event/facility both at ATARI and Admin level.

- Forms have been developed and implemented to capture KVK Achievements, Farmers' Outreach and Land Assets of KVK.

- Addition of new ATARIs and rezonation of KVKs in the system have been done.

- Recent news from KVKs and ATARIs has been uploaded in the KVK portal under News Section.

- Preparation of User Manuals and Poster for KVK portal and KVK mobile app. has been updated.

- Dashboard monitoring system has been developed for ATARI and Admin level.

- Data entry form and report of MPR have been modified as per user feedback to incorporate additional parameters on *Kishan Gosthi*, soil health card and skill development training. Additionally, as per the requirement from ICAR Extension Division, provision has been made in the MPR proforma to incorporate information on Mera Gaon Mera Gaurav (MGMG).

- ATARI wise separate MPR reports on Area (ha.)/No./Quintal and Beneficiaries (No.) and a compiled report consisting of the total from all ATARIs (of Area/(ha)/No./Quintal and Beneficiaries (No.)) have been developed.

- Form has been developed at ATARI level to upload information for News section of KVK Portal. At Admin level, a reporting module has been developed to approve the news items for

final uploading after checking and editing (if needed) the contents. Accordingly, recent news from KVKs and ATARIs has been uploaded in the KVK portal under News Section.

- A link on "Video Gallery" has been provided in the Home page of the portal and a number of video files have been uploaded. Videos have been categorized on the basis of technology to be disseminated to farmers.

- Links for major events like "Sankalp se Sidhi", "World Soil Day" and Krishi Unnati Mela 2018, has been provided in the Home page of the portal. Functionality has been developed to show the events organized at KVKs along with image gallery and downloadable report. This also includes searching facility based on state, district and date of the events. All these activities have been done in guidance with Office of the Minister of Agriculture & Farmers Welfare. Functionality has been developed to show the "Live telecast of Krishi Unnati Mela 2018" event organized at KVKs along with image gallery

Video Gallery in KVK Portal

Report on "Live telecast of Krishi Unnati Mela 2018"event organized at KVKs

and downloadable report. This also includes searching facility based on state and district.

KVK Mobile App for the farmers is operational in the Android platform. The app is available at Google Play Store and consists of the following features: KVK, Facilities, Package of Practices, Send Query, Upcoming Event, Past Event, Weather Advisory, Market, Change KVK and KVK Portal. Farmers can ask any farm related query to the experts in KVK and get solution for that through this app. Provision has also been provided for KVK Heads to log into the KVK mobile app and perform the following activities for their respective KVKs: Viewing of farmers' query and replying back the solutions, viewing and uploading of package of practices, viewing the KVK Events, updating KVK Location (latitude and longitude).

Development of Direct Benefit Transfer Portal for DARE Schemes

A web portal which will facilitate ICAR organizations, SAUs, CAUs and Krishi Vigyan Kendras to report all transactions (in cash or kind) under various DBT schemes (of DARE) is being developed. The requirement analysis for the portal has been done in consultation with Nodal Officer of DARE for DBT, Education Division of ICAR and DBT Mission. Database of the proposed system has been designed and beta version of the portal has been hosted (https://dbtdare.icar.gov.in) at ICAR Data Centre in IASRI.

Management System for Post Graduate Education (MS-PGE) is an online academic management system developed by ICAR-IASRI for management of various academic activities of a university. The system automates various academic processes and caters to the requirements of different users: Dean, Registrar, Heads, Guides, Faculty, Teachers, Students, Administrators and Officials for performing their assigned tasks.
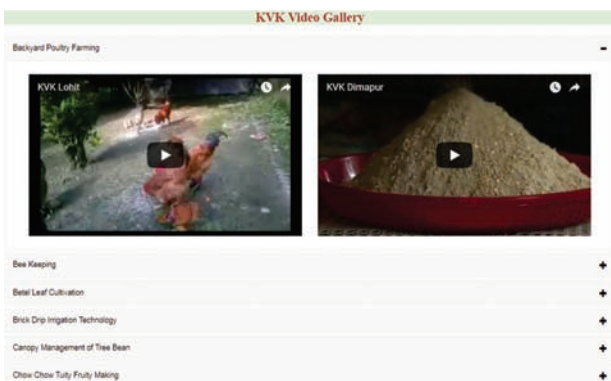
Fig. Home page of Ph.D. Entrance Examination Module

During 2017-18, a module for entrance examination has been integrated which has functionalities for receiving online application and center allocation for appearing candidates. The module has been implemented for conducting Ph.D. entrance examination of P.G. School IARI for admission in the academic year 2017-18.

Management System for Post Graduate education (MS-PGE)

CIFE Mumbai has adopted the system and implemented it from 2016-17 onwards. During the year internal cum external Examination Module, Progress Report Module, Registration of students, have been customized and implemented. Various other reports like student wise course report with major and minor courses distinction, course wise student report with no. of credits along with excel export facility etc. were created. M.F.Sc. and Ph.D. students of 2018-19 batch were admitted and registered in the system. All the courses were offered and faculty were assigned to respective courses. Students have registered in the I and II semesters for their respective courses. Module was developed to give and accept assignments to the students in the registered course. Management of the servers and regular backup of the system at the server side along with support to the users was provided.

Fig. Home page of the CIFE Academic Management System

NDRI has adopted the Academic Management System from the academic year 2017-18. Multiple new functionalities have been customized as per the requirement of the NDRI. Payment gate way for receiving the fees has been integrated with the system. Multiple new restriction and validations were introduced in the system. The result sheet has been modified as per the attendance in the

examinations. Multiple SKYPE/LYNC meetings have been conducted with NDRI officials from time to time to provide support and for gathering requirements for further customization.
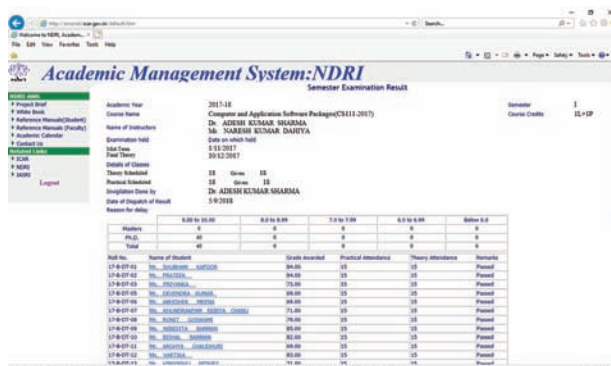
Fig. Result sheet of a Course of AMS-NDRI

IVRI has also adopted the Academic Management System from the academic year 2017-18. The system was customized as per their need as IVRI have significantly different type of courses. IVRI has same course offered with different numbers for theory as well as for practical. So, accordingly the system was customized. Controller of examination module was added in the system. Controller of examination was also added in the workflow of the system.

Multiple SKYPE/LYNC meetings have been conducted with NDRI officials from time to time to provide support and for gathering requirements for further customization.

Since, the MSPGE system is a success story of an in house system adopted by various ICAR deemed universities. It has been in demand in NARES system and the institute has received multiple requests for its customization and adoption in various State Agriculture universities. Central Agriculture University, Imphal and University of Horticulture Sciences (UHS), Bagalkot has started its customization and implementation in their universities. Some of the other universities which demanded the MSPGE are Bihar Agriculture University Sabour, UAS Dharwad, Konkan Vidyapeeth Dapoli, SVBPUAT Modipuram, SKAUST Jammu and PDKV Akola.

Pandit Deen Dayal Upadhyay Unnat Krishi Shiksha Yojana (PDDUUKSY):

Pandit Deen Dayal Upadhyay Unnat Krishi Shiksha Yojana (PDDUUKSY) scheme under Ministry of Agriculture and Farmers Welfare has been implemented by Education Division of ICAR. This scheme focuses on imparting training through farmers training centers across the country. These

Select & Search Filter in PMS
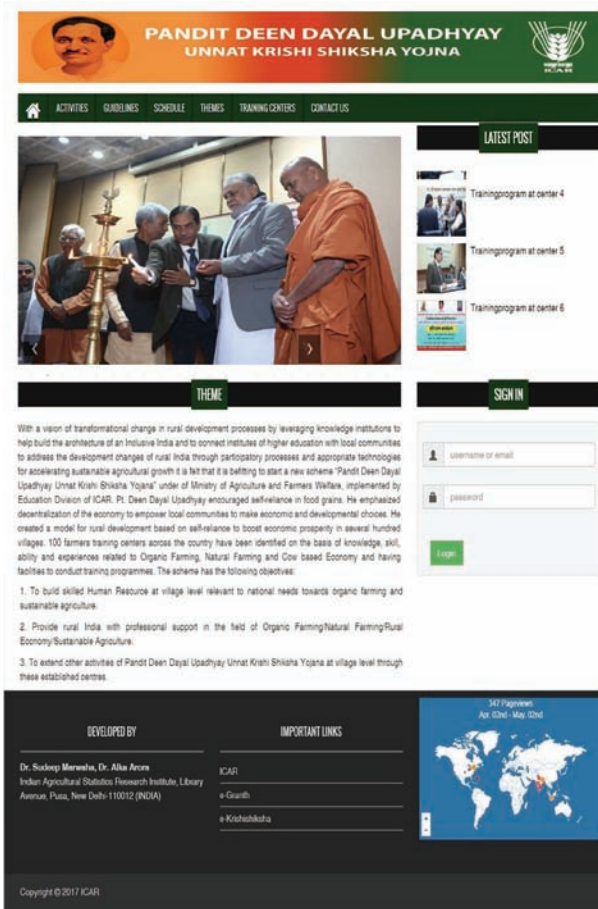
farmers have been identified on the basis of knowledge, skill, ability and experiences related to Organic Farming, Natural Farming and Cow based Economy and having facilities to conduct training programmes.

- Home page of the website was designed and developed. Static information was added under different menu items.

- Database design and development was done basis requirement study. Master tables were created and data was uploaded for all training centers, zonal in-charges and center owner.

- Functionality for Image Gallery was done.

- Login functionality was done for Zone wise center in-charges. Forms were designed and developed for entering center owner information and nodal agency details.

- Reports were developed to present the center Information State wise and Zone wise.

ICAR Personnel Management System (PMS)

ICAR Personnel Management Information System has been designed, developed and implemented across ICAR. The system was designed using n-tier architecture of web development using .Net technology for application layer and MS SQL Server as database layer. The system is accessible at http://pms.icar.gov.in

The system has following functionalities:

- As per the revised guidelines that not more than 50% of the Scientist in any institute should be from the home-state, CMS system ensured and not allows them to apply to the particular institute. Mechanism has been developed and implemented in system.

- Standard Operating Procedure (SOP) was developed and approved by the competent authority.

- Home page has been modified with responsive features.

- Block individual scientist vacancy has been implemented in system.

- Workflow based Transfer application module has been merged into one (previously 4 types) transfer cycle has been developed and is ready to be implemented.

- ER sheet report has been developed at scientist level and implemented. Most of the information corrected through scientist/ Institute establishment section. Report viewable at reporting and reviewing and director personnel level.

- Almost 4845 scientist personnel information has been updated in CMS system.Out of it 4515 has been updated their contribution information in system.

- Development of transfer cycle for administrative and finance staff of the institute is in progress.

- Support was provided across ICAR institutes to resolve reported issues from time to time like programming bug, deletion of wrongly uploaded

AIPRs, change in sanctioned strength of institutes, discipline names, ERP ID etc.

ICAR Portal

- ICAR Portal is being developed at ICAR-IASRI under the guidance from ICAR(HQ). ICAR Portal is an integrated system which will provide information on all Institutions/ Regional Centres and KVKs under a single roof on monitoring parameters. This system will provide information on AICRP project, major achievements, RAC/ IRC/IMC/QRT meeting, land assets and RMPs which provides a master monitoring system to higher authority or nodal officers to keep an eagle eye on the institute activities as well as the Institutional network and availability of employee on particular institute.

  ➤ Home page of the portal has been developed featuring activities of Users & Role Management, Nodal Officer and other users like PME, Finance, Works, Admin etc.

  ➤ Functionality for Image Gallery has been added.

  ➤ Functionality has been developed to present the Institute information on various parameters (Mandate, Vision, Awards, Publication, Project, Flagship schemes, Significant Achievements, Image Gallery and Contact details).

  ➤ Database has been developed and tables designed to accommodate features. Style sheets have been developed for website layout and content delivery.

  ➤ Various forms have been developed for data management. Role based access rights have been provided for all the forms.

  ➤ System has been hosted in the production environment and testing is being done.

Technology Assessed and Transferred

- **DIRProt:** A web server for discriminating the insecticide resistance proteins from non-resistant proteins has been developed. The DIRProt can be used for discriminating the insecticide resistance proteins from non-resistant proteins. Here, four types of resistance proteins encoded by four categories of insecticide resistance genes viz., Cytochrome P450, Acetylcholinesterase (AChE), Knock down resistance (KDR), resistance to dialdrin (RDL) have been considered. The server has been trained with Di-Peptide Composition (DPC) features. Moreover, the SVM machine learning technique with the RBF kernel is used in the background for prediction purpose.

- *iAMPpred*: An SVM based classification tool for prediction of Anti-Microbial Peptides has been developed. Antimicrobial peptides (AMPs) are important innate immune molecules, which have been found effective against several pathogenic micro-organisms like bacteria, virus, fungus, parasites etc. AMPs have been found almost in all forms of life viz., animal, plant, bacteria, fungi etc. constituting the first line of host defence against microbes. Due to the growing resistance of microbes against conventional antibiotics, AMPs are gaining attention as an alternative to chemical antibiotics worldwide. The antimicrobial specificity of AMPs towards the target cells depends upon the interaction of peptides with microbial cells, which enables them to kill the target cells without affecting the host cells. The AMPs cause cell death either by disrupting the cell membrane of microbes or by disrupting its intracellular functions. Due to broad spectrum of activity and low propensity for resistance development, AMPs are receiving attention in clinical application. Identification and designing of AMPs through wet lab experiments may be resource intensive. Thus, computational identification will supplement in identifying and designing new antimicrobial agents. By using the computational tool, the best candidate peptide can be identified prior to synthesis and testing against microbes.

- ***ir*-HSP** for improved recognition of Heat Shock Proteins (HSP) and their families has been developed. Heat shock proteins (HSPs) are one of the largest groups of molecular chaperones that assist in correct folding of partially folded or denatured proteins, establishment of proper protein conformation and prevention of unalterable aggregation of damaged proteins. HSPs are also involved in other functions like modulation of their synthesis, participation in signal transduction pathways, RNA processing etc. HSPs also play vital role in maintaining the overall cellular protein homeostasis. Due to broad range of activities, they have received a considerable attention of the researchers. Keeping in view the wide range of functions of HSPs, we developed this server for prediction of HSPs, their families (HSP20, HSP40, HSP60, HSP70, HSP90 and HSP100) and sub-types of DnaJ proteins (Type I, Type II, Type III, Type IV). The *ir*-HSP achieved higher accuracy as compared to the existing approaches, and thus believed to supplement the existing efforts for annotation of protein sequences.

- **HRGPred** – A software for prediction of herbicide resistant genes (http://webapp.cabgrid.res.in/hrgpred/) has been developed. According to the herbicide resistance action committee,

herbicide resistance is the inherent ability of plant species to survive and reproduce after exposed to herbicidal dosage which is lethal to its wild types. Globally, the evolvement of herbicide resistance has been a major cause of

concern for sustainable agricultural production. The mechanism of herbicide resistance can be classified into two classes (i) target site resistance, and (ii) non-target site resistance. The target site resistance is mainly due to the mutations in the genes encoding the target sites of herbicides, whereas the non-target site resistance is due to the metabolic detoxification of herbicides.
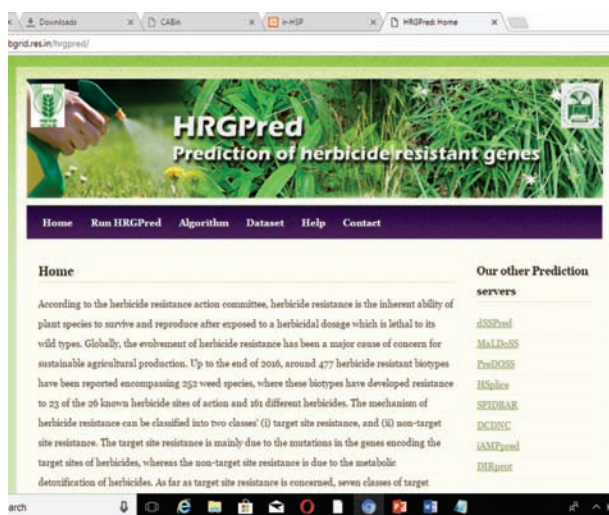
- As far as target site resistance is concerned, seven classes of target proteins have been reported so far. Identification of the genes encoding for these target proteins in wet lab is certainly resource intensive. Thus, a first computational tool HRGPred that can be used for predicting the genes encoding for the seven categories of target proteins has been employed. It is expected that the HRGPred will supplement the wet-lab experiments for annotation of herbicide resistance genes.

- **nifPred** – A webserver for prediction of nitrogen fixation genes (http://webapp.cabgrid.res.in/nifPred/) has been developed. Biological nitrogen fixation is an important biogeochemical process that plays a major role in conversion of atmospheric nitrogen to ammonia. All nitrogen fixing microbes depend upon the nitrogenase enzyme for nitrogen reduction, which is in fact an enzyme complex consists of two metallo proteins: iron-molybdenum (FeMo) and iron (Fe) proteins. The main structural genes for nitrogenase enzyme are nifH, nifD and nifK. The nifH is the structural gene for Fe protein, whereas nifD and nifK are the respective structural genes for α and β sub units of FeMo protein. In addition to these three coding genes, co-occurence of three more

genes viz., nifE, nifN and nifB are assumed to be essential for a functional nitrogenase enzyme in characterized systems (diaztrophs). The nifPred probably the the first computational tool for identification of nitrogen fixing proteins viz., nifH, nifD, nifK, nifE, nifN and nifB.

- **PMDTDb:** Pearl millet drough transcriptome databasehttp://webtom.cabgrid.res.in/pmdtdb/ has been developed. Pearl millet transcriptome database (*PMDTDb*) catalogues the information related to assembled contigs or transcripts, DEGs, the pathways in which these are involved, detailed SSR markers, and variants such SNPs and indels and miRNAs. It has *three-tier architecture*, i.e., client tier, middle tier and database tier. Web pages are developed for browsing the database along with the queries by user in client tier. All the information regarding contigs, markers, variants etc. are arranged in tables in various tables in MySQL in the database tier. For execution and fetching of user's query, scripting is done in PHP (Hypertext Preprocessor) in the middle tier.

- **LrSATDb:** A transcriptome database of seasonality associated genes in carp fish, Labeo rohita http://webtom.cabgrid.res.in/lrsatdb/ has been developed. This database performs to web genomic resources of evolutionary conserved BCGs and candidate genes of seasonality. An online relational database of rohu fish transcriptome was developed which catalogues tissue wise transcripts/contigs, putative SSRs, SNPs, Indels, transcription factors, miRNA targets representing two reproductive phases (IGA and PSR). The architecture is-three-tier architecture viz., client-, middle- and database tier. In order to browse and query, user can go through the web pages in client tier. All the information are available in various tables corresponding to MySQL in the database tier. Server side scripting in PHP was done in the middle tier for database connectivity, query execution and fetching. In order to generate primers over selected markers, Primer3 executable was integrated at the backend.

- **CnTDB:** Coconut Transcriptome Database (http://webtom.cabgrid.res.in/cntdb) has been developed. The coconut transcriptome database (CnTDB) catalogues 285235 assembled contigs from the two contrast genotypes considered under study. It houses 22021 DEGs and transcriptional factors in its database. About 10126 and 97117 SSR markers mined from DEGs and de novo transcriptome assembly respectively are catalogued. Beside this, 71877 SNPs and 5887 indels from both, resistant and susceptible varieties are populated along with the description of gene ontologies and pathways of the assembled contigs.

- **VmTDb:** Vigna mungo Transcriptome Database (http://webtom.cabgrid.res.in/vmtdb/) has been developed. The developed web transcriptomic resources of V. mungo catalogues detailed description of the transcripts/contigs, markers and miRNA targets, which is of immense use to Vigna breeders across the globe. The *V. mungo* Transcriptome database (VmTDB) provides transcriptomic information of two genotypes of *V. mungo* viz. VM84 (resistant) and T9 (susceptible) cultivars. It includes 240,945 assembled transcripts, differential expressed genes and expression values of four datasets, i.e., infected VM84 vs. infected T9, infected VM84 vs. control VM84, infected T9 vs. control T9 and control VM84 vs. control T9. Beside this, it provides the information related to pathways, simple sequence repeats, single nucleotide polymorphism, transcriptional factors, domain and families and miRNA targets.
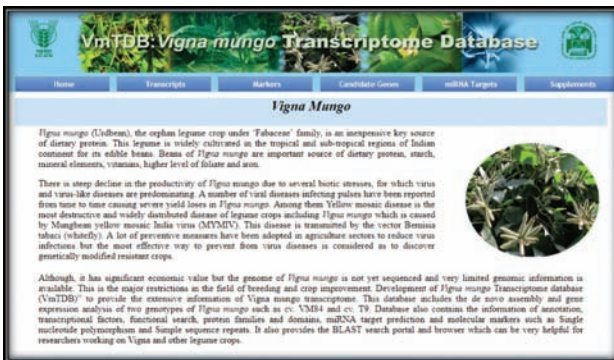
- **CBP Vortal**: CBP vortal has been designed and developed at IASRI to facilitate the online management of all training programs (Centre for Advanced Faculty Training (CAFT), Summer-Winter Schools (SWS) and Short Courses (21/10 days duration) under Capacity Building Program (CBP) sponsored by Agricultural Education Division, ICAR. System is hosted at IASRI server and can be accessed from the URL cbp.icar.gov.in. The system has in-built work

flows for effective training management dealing with proposal submission, approval, financials, participant application to feedback submission and report submission at the end of the training program. It provides a platform for knowledge sharing in the form of e-books generated from the training program. Regular support is being provided through E-mail/ Phone to the Course Director/ CAFT Director and participants of the training program. Approx 1700 e-mail were answered along with providing support through phone calls.

- For year 2017-18 training programs management was done online. Participants applied online for the Summer/Winter/ Short Courses and CAFT. Approval was also done online in work flow manner. Total 4353 personnel attended various training programs. Apart from this, system has database of all applicant who applied in different training programs. System has good database of e-resources/ training manuals created in training programs.

- For the year 2018-19, proposals were invited online and evaluation and approval done online in work flow manner.

- As per Google analytics vortal has been visited by 491,912; pageviewed by 44,558 users in 2017-18. This vortal is becoming popular and very helpful in overall management of training program funded by Education Division, ICAR.

- **HYPM Portal:** A web based system for Half-Yearly Progress Monitoring (HYPM) of the agricultural scientists working in ICAR institutes has been developed and maintained (http://www.hypm.iasri.res.in). System is operational since April, 2012. The individual scientist fill their research targets and the achievements (under different heads of teaching, training, extension and other prioritized activities) against the proposed targets twice in a year. Those target and achievement are evaluated by reporting and then reviewing officer.

- In year 2017-18 and for period I (April to September), 78% scientist submitted their target out of which 95% were evaluated by reporting officer and 92% were reviewed by their reviewing officer across all ICAR institute. Approximately 70% scientist submitted their achievement for year 2016-17 and period II (Oct to Mar). Out of them 96% were evaluated by reporting officer and 91% were reviewed by reviewing officer. In year 2017-18 and for period II (Oct to Mar), 77% scientist submitted their target out of which 93% were evaluated by reporting officer and

89% were reviewed by reviewing officer across all ICAR institute. Approximately 68% scientist submitted their achievement for year 2017-18 and for period I (April to September). Out of them 94% were evaluated by reporting officer and 88% were reviewed by reviewing officer. HYPM website has been visited approximately 76,364 time during April, 01 2017 to March, 31 2018. Regular support is provided through email and phone calls. Provided the support to Scientists, reviewing officer and reporting office for filling the targets and achievements.

- **R Package Aoptbdtvc:** is a collection of functions to construct A-optimal block designs for comparing test treatments with one or more control(s). Mainly A-optimal balanced treatment incomplete block designs, weighted A-optimal balanced treatment incomplete block designs, A-optimal group divisible treatment designs and A-optimal balanced bipartite block designs can be constructed using the package. The designs are constructed using algorithms based on linear integer programming. To the best of our knowledge, these facilities to construct A-optimal block designs for comparing test treatments with one or more controls are not available in the existing R packages.

- **Web resource on A-optimal balanced treatment incomplete block (BTIB) designs**: A catalogue of A-optimal BTIB designs has been published at http://iasri.res.in/design/AOPTBTIB/AOPTBTIB.htm. The web resouce contains 119 A-optimal BTIB designs with their layouts.

- **Web resource on A-optimal group divisible treatment (GDT) designs:** A catalogue of A-optimal GDT designs has been published at http://iasri.res.in/design/AOPTGDTD/AOPTGDTD.htm. The web resouce contains 106 A-optimal GDT designs with their layouts.

- **Web resource on A-optimal balanced bipartite block (BBPB) designs:** A catalogue of A-optimal BBPB designs has been published at http://iasri.res.in/design/AOPTBBPB/AOPTBBPB.htm, http://iasri.res.in/design/WAoptBTIB/WAoptBTIB.htm. The web resouce contains 198 A-optimal BBPB designs with their layouts.

- **Web resource on weighted A-optimal BTIB designs:** A catalogue of weighted A-optimal BTIB designs has been published at http://iasri.res.in/design/WAoptBTIB/WAoptBTIB.htm. The web resouce contains 369 weighted A-optimal BTIB designs with their layouts.

- **A Five Dimensional Managerial Competency**

Battery (5D MCB) has been developed in collaboration with IARI, New Delhi and is available at http://5dmcb.iari.res.in/5D_MCB/intro.jsp. 5-Dimensional Managerial Competency Battery (5D-MCB) is a psychometric instrument which captures the managerial competencies of a person. Managerial competency is defined as people and task oriented skills and underlying personal qualities that lead to effective leadership and outstanding performance as a manager making them winners. Considering this, an online software named 5D-MCB has been designed and developed. The 5D-MCB focused on eighteen most important qualities of a competent manager. These are further converged in five competency dimensions viz. (1) communication and negotiation, (2) strategic decision making, (3) proactive goal setting, (4) leadership, team work and courage and (5) lifelong learning and perseverance.

- Developed the online version of the Mobile Assisted Personal Interview (MAPI) Software under the project "Pilot study for developing State level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee report" for data collection using smart phones with android operation system.

- Implemented the offline version of MAPI Software under the project "Pilot study for developing State level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee report" in the state of Gujarat for data collection work in the Rabi season 2016-17.

- Developed Data Entry Software for Crop Area and Yield Estimation Survey under the project "Pilot study for developing State level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee report". The data entry software was implemented in the state of Gujarat and Odisha in the state headquarters for digitization of data under the project "Pilot study for developing State level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanathan Committee report".

- Developed online data analysis software for Small Area Estimation technique under the project entitled "Development of Innovative Approaches for Small Area Estimation of Crop Yield, Socio-economic and Food Insecurity Parameters".

5

Education and Training

The Institute conducts post graduate teaching and in-service courses in Agricultural Statistics, Computer Application and Bioinformatics for human resource development. Institute is conducting M.Sc. and Ph.D. programmes in Agricultural Statistics 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.

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)	06	05
2	M.Sc. (Agricultural Statistics)	07	07
3	Ph.D. (Computer Application)	06	00
4	M.Sc. (Computer Application)	06	08
5	Ph.D. (Bioinformatics)	03	01
6	M.Sc. (Bioinformatics)	05	04

Faculty Members of P.G. School, IARI In Agricultural Statistics

S. No.	Name	Year of Induction
1.	Dr. U.C. Sud, Director (till 31.07.2017)	1995
2.	Dr. L.M. Bhar, Director (A) (since 22.01.18)	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. Tauqueer Ahmad, Principal Scientist	1998
7.	Dr. Rajender Parsad, Principal Scientist	1995
8.	Dr. Amrit Kumar Paul, Principal Scientist	1998
9.	Dr. A.R. Rao, Principal Scientist	1998
10.	Dr. Girish Kumar Jha, Principal Scientist (at IARI)	1999
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. V. Ramasubramanian, Principal Scientist 2017
19. Dr. Amrender Kumar, Senior Scientist (at IARI)2003
20. Md. Wasi Alam, Scientist 2003
21. Dr. Ranjit Kumar Paul, Scientist 2011
22. Dr. Mir Asif Iqubal, Scientist 2011
23. Dr. B.N. Mandal, Scientist 2011
24. Dr. Susheel Kumar Sarkar, Scientist 2011
25. Dr. Eldho Varghese upto 22 July 2017 2011
26. Dr. Kaustav Aditya, Scientist 2012
27. Dr. Bishal Gurung, Scientist 2013
28. Dr. Sukanta Dash, Scientist 2013
29. Dr. Arpan Bhowmik, Scientist 2014
30. Dr. Ankur Biswas, Scientist 2015
31. Mr. Kanchan Sinha, Scientist 2016
32. Dr. Anindita Datta, Scientist 2017
31. Dr. Soumen Pal, Scientist 2017
32. Dr. Sarika, Scientist 2018

Faculty Members of P.G. School, IARI in Computer Application

S. No.	Name	Year of Induction
1.	Dr. A.K. Choubey, Head (Computer Application) (till 21.01.2018)	2014
2.	Dr. Sudeep Marwaha, Professor (Computer Application)	2002
3.	Dr. Rajni Jain, Principal Scientist (at NIAP)	2007
4.	Dr. Alka Arora, Principal Scientist	2001
5.	Dr. Anu Sharma, Senior Scientist	2004
6.	Dr. Shashi Dahiya, Senior Scientist	2001
7.	Md. Samir Farooqi, Scientist	2001
8.	Dr. K.K.Chaturvedi, Senior Scientist	2002
9.	Dr. S.B. Lal, Senior Scientist	2004
10.	Dr. Anshu Bhardwaj, Principal Scientist	2004
11.	Dr. Sangeeta Ahuja, Scientist	2002
12.	Sh. Pal Singh, Scientist	2010
13.	Dr. Mukesh Kumar, Principal Scientist	2014
14.	Dr. A.K. Mishra, Principal Scientist(at IARI)	2014
15.	Ms. Shaloo, Scientist (at WTC, IARI)	2016

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)	2010
3.	Dr. Rajender Parsad, Principal Scientist	2010

4. Dr. Seema Jaggi, 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. T. Napolean, Principal Scientist (at Genetics) 2010
9. Dr. P.K. Singh, Principal Scientist (at IARI) 2010
10. Dr. A.K. Mishra, Principal Scientist (at IARI) 2010
11. Dr. U.B. Angandi, Senior Scientist 2014
12. Dr. S.B. Lal, Senior Scientist 2010
13. Mohd. Samir Farooqi, Scientist 2010
14. Dr. Anu Sharma, Senior Scientist 2010
15. Dr. Sunil Archak, Principal Scientist (at NBPGR) 2010
16. Dr. D.C. Mishra, Scientist 2010
17. Dr. Sarika, Scientist 2010
18. Sh. Sanjeev Kumar, Scientist 2010
19. Dr. Mir Asif Iquebal, Scientist 2013
20. Dr. Monendra Grover, Principal Scientist 2013
21. Dr. K.K. Chaturvedi, Senior Scientist 2014
22. Dr. M.G. Mallikarjuna, Scientist (at IARI) 2017
23. Dr. Yasin Jeshma K., Scientist (at NBPGR) 2018

Dissertations Approved

Ph.D. (Agricultural Statistics)

i) **Name of Student: Pratyush Dasgupta**
Chairperson: Dr. Tauqueer Ahmad
Roll No.: 10090

Title of Thesis: A Study on Multiple Frame Approach in Ranked Set Sampling under Finite Population Framework

Multiple frame survey utilizes more than one frame in situations where a unique reference frame is not available to cover the whole population or even if available, individual accessibility to each unit is very costly. For example, an area frame completely covers the population whereas a list frame may not have the complete list of names and addresses of agricultural operators. Besides coverage, area frame is very expensive to sample but list frames are usually less costly. Thus, it constitutes a problem of multiple frame survey. Multiple frame survey provides flexibility of using any sampling design in each frame.

In this dissertation, a new sampling theory, under dual frame survey using ranked set sampling (RSS) as a sample selection procedure in each frame, was proposed

because of growing application of RSS as a cost-efficient alternative to simple random sampling (SRS). A suitable methodology related to selecting an RSS sample was evolved under different situations in case of a dual frame survey. In the context of finite population frame work, an unbiased estimator of population total was proposed under two different situations. First situation assumes the identification of domain membership of a sampling unit before sampling and also the knowledge of frame sizes, while the second situation was defined for the cases when it is not possible to know the domain membership of a sampling unit before sampling. Sampling variance of each estimator was also derived under finite population frame work. The estimators were compared with respective Hartley's usual simple random sample estimators. A simulation study was carried out under first situation whereas, to investigate the statistical property of the proposed dual frame ranked set sample estimator under second situation, an empirical study was carried out. Allocation of sample sizes to each frame was also carried out. Comparison of the proposed estimator with Hartley's usual SRS estimator suggested that the proposed estimator is more efficient than Hartley's usual SRS estimator.

New re-sampling variance estimation techniques namely, rescaled Jackknife and rescaled Bootstrap resampling procedures were developed for estimating the sampling variance of the proposed dual frame ranked set sample estimator as the standard Jackknife and standard Bootstrap resampling procedures failed to provide an unbiased estimator for the sampling variance. Both these developed rescaled resampling techniques provided the unbiased estimator of the sampling variance of the proposed estimator. A comparison among the proposed resampling variance estimation procedures was made by conducting a simulation study.

The study showed that the proposed estimator is superior than Hartley's usual SRS estimator for estimating population total, in terms of percentage gain in efficiency. The results from the simulation study also suggested that rescaled Jackknife and Bootstrap variance estimators are more stable than their standard counterpart

ii) Name of Student: Shwetank Lall
Chairperson: Dr. Seema Jaggi
Roll No.: 10254

Title of Thesis: Experimental Designs for Nonlinear Response Surfaces

In agricultural and industrial experiments, response surface methodology (RSM) deals with designing the experiment so that the data obtained can be used for fitting the underlying model and finding the optimum input setting for optimal response. The designing problem in RSM becomes challenging if the underlying model is believed to be nonlinear where the design will depend upon the initial parameter guesses. Available literature mostly focuses on optimal designs for nonlinear models with one predictor and the work on algorithmic aspect deals with finite and discrete design space. The present study mainly focuses on development of algorithm to construct optimal designs for nonlinear models with multiple continuous predictors. The expression for design search computation is derived for saturated designs and is found to be efficient. Exponential model has been considered and D-optimal designs have been generated for one and two predictor cases. The same has been extended to Michaelis-Menten model, which is useful in chemical kinetics study. The clustering approach has been implemented to find robust designs in a given parametric space. The study also investigates the case of generalized nonlinear models where the errors do not follow normal distribution. Logistic and Poisson regression models have been considered for one predictor and different setups of two predictors for obtaining D-optimal designs. The general equivalence theorem is implemented to validate the optimality of the obtained designs in many cases. The experimental setup incorporating indirect effects has also been investigated. The model with neighbour effect is nonlinear and several empirical results related to designing issues have been provided. The study also addressed the issue of autoregressive error structure in case of Poisson regression model with one continuous predictor and for given values of the correlation coefficient, D-optimal designs are found. All the computations in this study have been done using R software and the relevant codes are also provided

iii) Name of Student: Nirupam Ghosh
Chairperson: Dr. U.C. Sud
Roll No.: 9944

Title of Thesis: Some Contributions to Calibration Estimators in Successive Sampling

The conventional calibration approach is appropriate when study and auxiliary variable are linearly related. However, when study and auxiliary variable are non-linearly related model based calibration technique is appropriate. In this article we propose two model based calibration estimators along with their variances and estimator of variances in two occasion successive sampling. The performance of the proposed estimators are studied via a simulation study vis-à-vis design based calibration estimator and an estimator which doesm"t consider auxiliary information at estimation stage.

iv) Name of Student: Yashavanth B.S.
Chairperson: Dr. K.N. Singh
Roll No.: 10095

Title of Thesis: Vector Autoregressive Time Series Models and their Applications in Agriculture

Time series analysis includes modelling and forecasting the chronologically collected data to extract meaningful inferences and predict the future values. In agriculture, time series analysis includes modelling and forecasting of production, yield, area and prices of crop produces, import and export of commodities and forewarning of pest and disease incidences. The importance of times series analysis in agriculture is very well emphasized by researchers as it helps farmers, agri-business industrialists and policy makers to take appropriate decisions. Although many time series models are available in literature, they are mostly restricted to univariate scenario. However, when many series are considered, these require each series to be modeled separately consuming bundle of resources. Hence, the multivariate vector autoregression (VAR) models have become popular of late. But, VAR models when estimated using ordinary least squares (OLS) assume homoscedasticity of the residual series and often give locally optimum parameter estimates. To address

this, the genetic algorithm (GA) approach for parameter estimation is investigated. By empirical evaluations, it is found that the GA approach performs better than OLS method under heteroscedastic conditions and performs as good as OLS method under homoscedasticity. Another assumption of VAR models is that the time series under study are stationary. In practice, the non stationary series are made stationary by differencing which leads to loss of observations. In this study, the functional coefficient autoregression (FCAR) is extended to the multivariate scenario to model non stationary time series by estimating the functional coefficients by local linear regression technique. Superiority of the proposed methodology is established by modelling the price of clean coffee seeds in different consuming centres. Besides these assumptions, the VAR models become richly parameterized when large numbers of variables are considered. To shrink such over parameterized models, the use of Octagonal Shrinkage and Clustering Algorithm for Regression (OSCAR) algorithm is investigated in this study. The performance of VAR using OSCAR is evaluated by comparing with Bayesian VAR and Lasso VAR techniques using the data on estimated annual landings of six different fish species in India.

v) Name of Student: Sadikul Islam
Chairperson: Dr. Hukum Chandra
Roll No.: 10413

Title of Thesis: Development of Efficient Approaches for Combined Survey Inference

The demand for reliable small area statistics, when only reduced sample sizes are available from survey, has promoted the development of small area estimation (SAE) methods. Many often two surveys conducted independently with same or different objectives, may have some auxiliary variables in common. The first survey, which has small sample size, collects both variable of interest as well as auxiliary variables. The second survey, relatively larger in sample size, has only some auxiliary variables in common to the first survey. In some situations, the larger survey in addition to the common variables, can have extra set of variables which are not collected in the first survey. SAE methods are developed under such situations by combining data from two

independent surveys. The mean squared error (MSE) estimation are also discussed for the developed small area predictors. The performance of the developed SAE methods are evaluated through two types of simulations namely, model-based and design-based simulations. The first type of simulation uses synthetic population generated under the assumed model and second type of simulation is based on a realistic population generated using real survey data. The empirical results show that the developed SAE methods provide gains in efficiency. The gain in efficiency is further enhances when additional set of variables of the second survey, are incorporated in development of SAE methods. The simulation studies further show that the developed MSE estimator is performed well

M.Sc. (Agricultural Statistics)

i) **Name of Student: Prakash Lakra**
   Chairperson: Dr. Himadri Ghosh
   Roll No.: 20521

   Title of Thesis: A Study of Bivariate Structural Time-Series Models and Their Applications

   A Bivariate structural time series model based on the traditional decomposition into trend, seasonal and irregular components is defined. Purpose of present thesis is to discuss STM methodology utilized for modeling time-series data in the present of trend, seasonal and cyclic fluctuations. Structural time-series model are formulated in such a way that their components are stochastic, i.e. they regarded as being driven by random disturbances. A number of methods of computing maximum likelihood estimators are then considered. Once a model is estimated, its suitability can be assessed using goodness of fit statistics and model used to predict for some leading years. In this study the model developed for food-grain production using the best fitted VARX and ARIMA model and are used to obtain the forecast of the production data. The models are evaluated by computing Mean absolute percentage error (MAPE), Relative mean absolute percentage error (RMAPE), Mean squared error (MSE) and Root mean squared error (RMSE). Lesser values of MAPE, RMAPE, RMSE and MSE indicate better forecasting ability of VARX approach of forecasting.

ii) **Name of Student: Dipankar Mitra**
   Chairperson: Dr. Ranjit Kumar Paul
   Roll No.: 20652

   Title of Thesis: A Study of Long Memory Time – series Models for Price Forecasting

   Time-series analysis and forecasting is a challenging area of statistical modelling. In agriculture, price forecasting is an important concern among both the farming community and policy makers. Most of the agricultural commodities are characterized with a high degree of price volatility. For, the government, the unforeseen variation in prices can change the budgetary planning and skeleton of policies. Therefore, more accurate forecast of price volatility is extremely important for efficient planning and monitoring. Many agricultural data, particularly commodity price data have characteristic feature of long memory or long range dependency. The time-series process exhibiting long memory property may be subjected to a structural break in mean or a shift in the long memory parameter. In this study, forecasting agricultural commodity prices with long memory and break in mean or long memory parameter based on Two stage forecasting (TSF) approach (Papailias and Dias, 2015) is addressed. The better performance of this methodology is demonstrated using the daily wholesale price data of pigeon pea in Bhopal market of Madhya Pradesh, India. The joint test is also applied to the pigeon pea price data to test the degree of integration and the structural break at known time point simultaneously. To capture the volatility and long memory in squared return series, AR-FIGARCH model is fitted to the minimum and modal wholesale price of pigeon pea in India. The residuals of the fitted models have been investigated and no systematic pattern is found in the residuals series confirming the adequacy of the model. The formulae for out-of-sample forecasts of fitted AR-FIGARCH model along with the corresponding forecast error variances are derived up to two-steps ahead by recursive use of conditional expectations and conditional variances. An attempt has also been made to study the dual long memory in agricultural commodity prices. As an illustration, modal price of potato for Agra and Amritsar markets have been considered. The potential presence of long memory both in mean and volatility of the data under consideration has been found.

Accordingly, ARFIMA-FIGARCH model is fitted to the price data and the best model is chosen on the basis of minimum AIC and SBC value. The predictive performance of the selected models is carried out in terms of RMAPE and RMSE.

iii) **Name of Student: Ronit Jaiswal**
Chairperson: Dr. U.C. Sud
Roll No.: 20653

Title of Thesis: Chain Type Product Estimators for Two Stage Sampling Design

Two different chain type product estimators are developed under two-stage sampling design using two auxiliary variables. Two control estimators are also considered i.e. the product estimator and the simple linear estimator under two-stage sampling design. The performances of the four estimators are compared in terms of the criteria of relative bias and relative mean square error through an empirical study using simulated data. A suitable cost function is also considered. Optimum values of sample sizes are determined by minimizing the cost for a fixed value of mean square error. The performances of the four estimators are considered using the optimum values of sample size with the help of an empirical study.

iv) **Name of Student: Ashis Ranjan Udgata**
Chairperson: Dr. Prachi Misra Sahoo
Roll No.: 20654

Title of Thesis: Estimation of Acreage under Mango Integrating Remote Sensing and Survey Data in West Godavari District

Horticulture which is fastest growing sector within agriculture is now contributing more to nations GDP as compared to agriculture thus needs utmost emphasis in terms of reliable agricultural statistics. Mango the king of fruits is cultivated in 42 % of total area accounting for 40% of total production in the country. Therefore, reliable and timely estimates of area under mango at national level is essential for policy makers and planners for market planning and export. Previously only survey methodologies were used for area estimation under horticultural crops which are time consuming, requires extensive ground survey and involves huge cost. Modern space technology i.e. satellite data can be used as auxiliary variable to improve estimates obtained by survey. One category of classifiers is parametric, of which The traditional maximum likelihood classifier (MLC) is the most popular, reliable and widely used for land use land cover classification. Besides this, there are other recent machine learning classifiers like Artificial Neural network (ANN) and Support Vector Machine (SVM). SVMs are particularly appealing in the remote sensing field due to their ability to successfully handle small training data sets, often producing higher classification accuracy than the traditional methods. ANN have also demonstrated remarkable accuracy in dealing with multiple sourced data. Therefore, Support Vector Machine using three different kernel functions namely Radial basis function, Sigmoid kernel and polynomial kernel and Artificial Neural Network were used to improve the classification accuracy for delineation of mango. Best classification method was selected on the basis of kappa coefficient and overall accuracy. SVMRBF outperformed over all the methods with overall accuracy of 94.44 and kappa coefficient 0.9218. The present methods used for area estimation of horticulture crops relies on extensive field data collection. Modern space technology i.e. satellite data can be used as auxiliary variable to improve estimates obtained by survey. The estimates of area under Mango were obtained by usual method of estimation using survey data and by classified image. These estimates were further improved by integrating survey data and satellite data as auxiliary variable in ratio and regression estimators. From the results it was observed that the regression estimator was found to be better than ratio and survey estimate with minimum percentage standard error. Thus, the study concludes that by integrating survey data and remote sensing data as auxiliary variable improved estimates of area under mango can be obtained.

v) **Name of Student: Md. Yeasin**
Chairperson: Dr. K.N. Singh
Roll No.: 20655

Title of Thesis: Bayesian Technique for Modelling and Forecasting Crop Yield and Volatile Agricultural Data

Bayesian technique is one of the most powerful methodology in modern era of statistics. Bayesian technique has a lot of

advantages over the traditional frequency or point estimation. Indian economy depends to a great extent on the production and marketing of agriculture commodities. For planning new scheme to develop the condition of Indian economy, Government needs a reliable forecast of crop yield andmarketing price index. The most extensively used technique for forecasting of crop yield is regression analysis. But the significance of parameters is one of the major problem of regression analysis. Non-significant parameters leads to faulty planning and this forecast valuesare not reliable. Time series data with volatility such as prices index can be modelled and forecasted with the help of Generalized Autoregressive Conditional Heteroscedastic(GARCH) model. The GARCH model imposed some constraints on their parameter estimate for ensure positive variance. In many cases, the MLE estimates of the GARCH model parameters fails to meet the constraints. In such situation, GARCH model is not able to capture the volatility of the dataset. So the results from GARCH model may not be reliable. So in some cases, both regression and GARCH model are need to be improved. To improve both the models, we incorporated prior knowledge through Bayesian technique and investigate the superiority of these models under Bayesian framework. We discussed different types of prior (informative priors, non-informative priors, conjugate prior). We also elaborate the MCMC method briefly for estimation of parameter under Bayesian framework. To illustrate these two model, production data of banana, mango and wheat are taken for regression analysis under Bayesian framework and time series data of price index of International edible oils and Black gram are taken. We compare the traditional models with the models under Bayesian framework. From this study, we conclusively infer that the models estimated under Bayesian framework provided superior results as compared to the models estimated under classical approach.

vi) **Name of Student: Akhilesh Jha**
Chairperson: Dr. Cini Varghese
Roll No.: 20656

Title of Thesis: Block Designs for Experimentation on Uneven Land

Many a times, experimental research stations are set up in hilly regions to study the performance of new technologies under real farming conditions. Mostly these places receive high rainfall, and hence beds (blocks) are formed with longer sides in the direction of possible water flow. When the land is uneven it may be difficult to get a suitable continuous area to have all the replications at one go. A resolvable block design in irregular block sizes will enable the experimenter to conduct a multi-site experiment with one (or more) replication(s) at one site.Two methods of constructing resolvable block designs with irregular block sizes for experimentation on uneven land have been developed. These methods are explained along with appropriate examples. Both these classes of designs are partially variance balanced, first following a group divisible association scheme and the later following a new four associate class association scheme. Further, considering the scarcity of continuous even land, compactly packed blocks with regular/irregular size would be suitable where there is a chance that the observation taken from a unit is also influenced by treatments applied to adjacent units. Resolvable neighbour balanced designs with regular/irregular block sizes are suitable for such situations. Two series of resolvable neighbour balanced designs have been obtained that are variance balanced. Also, SAS programs have been developed to calculate efficiency factors of various designs obtained. Parameters of designs along with these efficiency factors have been tabulated and presented after each method of construction.

vii) **Name of Student: Samir Barman**
Chairperson: Dr. Hukum Chandra
Roll No.: 20658

Title of Thesis: Prediction of Finite Population Total for Geo – Referenced Data

In recent years, the model-based approach of survey estimation has received considerable attention of survey statistician. The popularity of model-based method is due to two mutually reinforcing trends in modern sample surveys. First, the need to provide sample survey solutions for inferential problems that lies outside the domain of design-based theory, particularly situations where standard probability based sampling methods are not possible. Second, the need for methods of

survey inference that can efficiently integrate the increasing volume and complexity of data sources provided by modern information technology. In model based approach the population is assumed to follow a model. In general, a linear model is assumed with underlying assumption that the population units are independent. In many surveys (for example, agriculture, forestry, environmental, ecological surveys), data are spatially correlated and independence assumption is questionable. As a result, the existing estimators for population total (or mean) based on standard survey estimation methodcan be biased and less efficient.Use of spatial information in survey estimation is expected to provide a better estimation of population parameters. We developed estimator for finite population total which incorporates spatial information. The proposed estimator for finite population total was also evaluated through simulation studies using synthetic population generated under the assumed models. The empirical results show that the developed estimator has smaller bias and better efficiency as compared to existing estimators.

M.Sc. (Computer Application):

i)   **Name of Student: Sapna Nigam
Chairperson: Dr. K.K. Chaturvedi
Roll No.: 20540**

Title of Thesis: Development of Data Mart for Single Nucleotide Polymorphism in Rice

India's agriculture is the strength of its economy and rice being the most important food staple crop continues to be the lifeline for more than half of the Indian population and covers about one-fourth of the total cropped area. However, our agricultural sector is confronted with numerous challenges at a national and global level, with low productivity and climate changes. The demand for rice is steeply rising but at the same time agriculture sector is struggling with declining profitability. Every year, due to pest and diseases, around 37% of the rice production loss is faced by farmers *(http://www.knowledgebank.irri.org)*.Thus, the current research focus is on increasing rice productivityastheexistingrateofincreasingrice yield by conventional breeding is inadequate to feed the growing population. Therefore, the

solution is the application of new molecular breeding technologies to current rice breeding programs. Modern breeding techniques are used to increase disease resistance, drought tolerance, and other traits. With relations to the differences in genomic structures and genetic variation SNPs may help in developing predictive models.

The aim of research work is toidentify numerous variations in rice gene sequence and analysing their effects for better understanding of their impact on gene function in order to develop new disease resistant varieties. Single Nucleotide Polymorphisms (SNPs) being the most abundant genomic variations in a DNA sequence, its effect can be used to treat the most common disorders in plants, making them disease resistant towards a particular disease. SNP occurs when a single nucleotide in the DNA sequence differs from the norm in at least one percent of the population. Single nucleotide polymorphisms (SNPs) are distributed numerously and have a high-density occurrence in rice *(Oryzasativa)* genome. This work emphasis on delivering all the genomic variation and rice genetic diversity information to researchers and breeders. It will revolutionizethe plant breeding and genetic research field in the future.As genomic data for rice are spread all over the existing databases, so firstly the data was extracted and integrated at a single place for the easy and quick access of QTLs, Genes and SNPs data. In order to accomplish the aspect of integrating the data from various sources and giving the analytical view of the data, data mart is developed. The advantage of analytical view approach is that query intensive work of ad hoc data analysis can be performed using summarized data in the cube. Users can also import the results of their query in pdf, xml or doc form.

ii)   **Name of Student: Mudenge Fabrice
Chairperson: Dr. A.K. Choubey
Roll No.: 20612**

Title of Thesis: Decision Support System for Evaluating Agricultural Activities on Ergonomics Parameters

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. However, the studies or evaluations conducted by these researchers are done manually, hard work, time consuming and sometimes can lead to the wrong decisions due to the wrong calculations conducted while evaluating workers. Hence, Decision Support System for Evaluating Agricultural Activities on Ergonomics Parameters was designed and developed to answer all these issues that can be faced by some of the evaluators. It helps to evaluate workers, store data, display various reports (based on search criteria of state wise, district wise, activity wise, mode of activity wise, gender wise and date), export data to excel for further analysis, provide authentication to different users that include administrator, internal user (under ICAR-Institutions) and external user. The software developed can be installed on person machine or shared on a network. It was 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 HTML, CSS and JS languages. The server application layer that is used for processing information from the user's form to the database, database to the web pages and performing calculations was developed by using PHP which is a server side scripting language. The database layer that holds available information is implemented by using MySQL with the help of PhpMyAdmin that is build inside XAMPP and this XAMPP is an open source tool that is used to develop as well as to test a web page application. The software developed is hosted on default apache that comes inside XAMPP. After hosting in to ICAR-Data Centre, it can be available for access to any user. The software can be upgraded in future, by adding other more ergonomics parameters that are involved in agricultural activities, developing mobile application and graphs such as pie chart.

iii) **Name of Student: Karangwa James**
Chairperson: Dr. Anshu Bharadwaj
Roll No.: 20613

Title of Thesis: Web-based Tool for Small Area Estimation Under Unit Level Model

Small Area Estimation(SAE)plays a prominent role in survey sampling due to growing demands for reliable small area statistics from both public and private sectors. Sample surveys, whether conducted by government organizations or by private entities, aim to produce reasonably accurate direct estimators, not only for the characteristics of whole population but also for a variety of subpopulations or domains. Many policymakers and researchers also want to obtain statistics for small domains. These small domains are also called small areas, because the sample size in the area or domain from the survey is small. Due to small sample size domain-specific direct estimators provide unacceptably large coefficient of variation. Therefore, it becomes necessary to employ indirect small area estimators that make use of the sample data from related areas or domains through linking models, and thus increase the effective sample size in the small areas. Such estimators can provide significantly smaller coefficient of variation than direct estimators, provided the linking models are valid. No information could be found regarding any existing standard software either stand alone or web based for small area estimation with unit level model, although few efforts have been made to develop a software for SAE under Sample Survey Resource Server being developed at ICAR-IASRI. In this software small area estimation for basic area level model has been developed but this doesn't include the unit level effects in the model. Since it is a very potential area of survey sampling, an effort is proposed here to be taken up in this research work to develop a Web based Tool for Small Area Estimation under Unit level Model. This tool will help the researchers, academicians, data analysts, students and other domain groups who have been working in the area of SAE.

iv) **Name of Student: Arpan Kumar Maji**
Chairperson: Dr. A.K. Choubey
Roll No.: 20671

Title of Thesis: On-Line Analytical Processing Solution for Human Resource Management in Indian Council of Agricultural Research

ICAR is the apex body for managing research and education in agriculture and allied sciences in the country and have to manage a large scale of human resource working in its

institutes locate across the country for improved organizational efficiency and productivity. ICAR has implemented ICAR-ERP System with Human Resource Management, Finance Management, Project Management, Supply Chain Management and Payroll modules for bringing standardization and transparency in reporting with budgetary control. This is a secured system and provides access of information based on standard reports, which is already developed and static in nature. New reports as per the need are developed by the concerned technical team, which take time depending upon the nature of report. The existing reports are serving the needs of MIS at operational and middle level management.

Literature review reveals that Business Intelligence application has been increasing for building the Decision Support Systems. In the present research work, On-Line Analytical Processing (OLAP) solution using Pentaho BI Enterprise suit, an open source Business Intelligence system, is developed for generating fast and user interactive reports. The solution envisages empowering decision makers associated with HRM activities in ICAR like management of workforce, recruitment, training, promotion and transfer to provide incentives or honorarium for maximizing the organizational value. Pentaho provides tools that covers the full spectrum of BI technology from ETL, dimensional modelling, Data Warehouse, and Reporting. Pentaho BI is actually a data processing technology for developing data warehouse with MySQL to store multidimensional data and quick analytical platform in gaining insight into data using consistent interface to a wide variety of possible views of information. Three Pentaho tools namely Pentaho Data Integrator, Schema Workbench and Pentaho BI Server and NetBeans environment are used to implement the whole path of data to analysis forum for quality decisions in managing the Human Resource of ICAR

v) **Name of Student: Asit Kumar Pradhan**
Chairperson: Dr. Anshu Bharadwaj
Roll No.: 20672

Title of Thesis: Web Based System for Generation of Structurally Incomplete Generalized Row-Column Designs

The rapid advancement on the internet technology has expanded the use of statistical packages for the analysis of data and sharing the findings with researchers quickly and conveniently. Experimentation is an integral part of any research endeavor. Designing an experiment is therefore very important so as draw valid inferences from the data generated from the experiment keeping in view the objectives of the study and hypothesis to be tested. Block designs are used when the heterogeneity present in the experimental material is in one-direction. However, when the heterogeneity present in the experimental material is in two directions then row-column designs are used and in these designs double grouping is done to eliminate the errors equally all differences among rows and columns. Designs used for the above situations are termed as Row-Column Designs (RCD) or designs for two-way elimination of heterogeneity. However, there may be instances when the number of treatments is substantially large with limited number of replicate then two-dimensional designs with multiple units per cell are used. These type of designs are called generalized row-column designs (GRCD). There are two types of GRCDs, one is structurally complete GRCD and other one is structurally incomplete GRCD. There are some software are available for generation of structurally complete GRCD ,but no information regarding any existing standard software either stand alone or web based could be found for generation of structurally incomplete GRCD. Due to their wide use in agricultural experiments and various other fields, a web based software for generation of structurally incomplete GRC designs has been developed. It has been developed on .NET framework using C#. The software will be used for generation of SIGRC designs. Four different series of SIGRC designs can be generated by entering the no of treatments. Study materials of all four series of SIGRC designs have been given in the About Design module of the software. The software has six modules namely Home, About Design, Generate Design, Catalogue, Contact and Disclaimer accessible to user through Home page. Catalogue has been developed for user so that they directly generate design of their interest by clicking the design link. It also provides a framework which is easy to

use, extend and integrate with other .NET compatible software.

vi) Name of Student: Himanshu Shekhar Chaurasia
Chairperson: Mr. Shah Nawazul Islam
Roll No.: 20673

Title of Thesis: Mobile Application for Selecting Seed Spices Crop

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. Growing a good crop depends on multiple factors like soil condition, climatic condition, rainfall, selection of good variety etc. and above all, selection of crop plays a very important role in getting a good return. Seed spices are cash, economy and revenue crops. Some major seed spices are Cumin, Coriander, Fennel and Fenugreek and minor seed spices are Ajwain, Nigella, Aniseed, Dill, Caraway, and Celery.There are a number of mobile apps developed for various agricultural issues, still, there is a need for an application that can guide a farmer as a crop advisor. A farmer is always in a dilemma about which crop to grow.The mobile app named SSADV i.e. seed spices crop advisory has been developed on Android Studio 2.3.x and the minimum requirement for the app is a device running on API 15: Android 4.0.3 (IceCreamSandwich). Java and XML programming languages are used. Tools used to develop the app are Android Studio IDE, SQLite, Android Device Monitor, and Mozilla Firefox. The app provides an easy interface to the user which suggests specific seed spice crop based on different criteria like climatic conditions which include annual rainfall and average temperature, growing conditions which include duration, season, soil type, and availability of irrigation water and available resources which include budget of the farmer, that to without internet connection. The user can also see information about all seed spices crops in one go. In future, more information can be easily added in the mobile app like cultivation practices, crop economics, and value addition etc.Subsequently, other crops can also be added in the app itself very easily. Further, in this field apps can also be developed for various agronomic and

horticultural crops using the same design and format of this mobile app.

vii) Name of Student: Ramesh Prajapat
Chairperson: Dr. K.K. Chaturvedi
Roll No.: 20674

Title of Thesis: Development of Data Mart for Copy Number Variation

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.Data mart of CNV has been developed and enabled end users in identifying the association between CNV and cultivar with respect to various types of traits. Pentaho Business Analytics platform is an open source set of software tools and MySQL database has been used.Different kind of reports such as dashboard, interactive and OLAP reports can be generated and viewed through the web interface using BI server which was hosted on Apache web server. The exploration of data from data mart and OLAP cube visualizations will provide the CNV related information in various dimensions viz. chromosome wise, gene wise, structural variation wise, CNV detection mechanism wise, cultivar wise and repeat type wise through a single window access. The CNV martcan 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 associationof different cultivars.

viii) Name of Student: Dilip Kumar
Chairperson: Md. Samir Farooqi
Roll No.: 20675

Title of Thesis: Development of Data Mart for Simple Sequence Repeats

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 fulfill this need, we have to apply modern methods oncropproduction. In modern agricultural practices, genetics and plant breeding plays a significant role in increasing the agricultural products. Simple sequence repeats (SSR) help in indicating the change in DNA sequences as well as marks the points where change occurs. Retrieving SSR markers for any species requires running of various tools, which is a cumbersome task. The output generated from these tools can be stored into database, so that retrieval of SSR and its related information becomes easy for the user.Data Mart is a promising technology for quick retrieval of the data. Further, exploratory analysis of these markers can be achieved by using the OLAP visualization. Data Mart helps to speed up the queries by minimizing the volume of data present in database to be scanned.Development of Data Mart for simple sequence repeats marker is a big step towards collecting information about marker in proper manner and stores them on a database from where researchers can be extract information for their research purpose easily. In this research program, Data Mart of SSRhas been developed with the sample data of rice crop (Oryza sativa Japonica Group cultivar Nipponbare). It serves as a useful tool for getting information on different aspects of SSR of rice crop in the form of OLAP cubes and interactive reports for the users. By studying and visualizing information of SSR on rice, breeders and researchers can develop new varieties which are disease resistant and high in food grain production.

Ph.D (Bioinformatics):

i) Name of Student: Purru Supriya
Chairperson: Dr. K.V. Bhat
Roll No.: 10430

Title of Thesis: Development of Bioinformatics Framework for Enhanced Utilization of Genomic Resources in Sesame (Sesamum indicum L.)

Sesame (Sesamum indicum L) is an ancient diploid (2n) dicotyledonous oilseed crop belonging to family pedaliaceae. Sesame, as a source of high quality oil, is valued for its stability, nutritional value and resistance to rancidity and is often referred as the "Queen of oil seeds". The recent advances in whole genome sequencing particularly, the evolution of next generation sequencing technologies led to the availability of large amounts of genomic data covering the entire genome. The genomic information of pedaliaceae family is quite limited as genomes from this family have not previously been sequenced. Hence, it is essential to explore the sesame plant with state of the art of sequencing technology to improve the quality and yield.

In the present investigation, the whole genome sequencing of Swetha variety of sesame generated 30 Gb data and provided 85x coverage using different NGS technologies. The high quality reads were assembled in to 16 linkage groups which covered ~340 Mb of the estimated genome size and showed 96.32% genome coverage. A total of 24579 genes were predicted from whole genome which were classified into 59 functional groups and found to involve in pathways such as fatty acid biosynthesis, purine metabolism, starch and sucrose metabolism etc. Furthermore, a total of 8244 genes had significant matches in PlantTFDB corresponding to 76 transcription factor families in which FAR1 (1132) was the most abundant TF followed by MADS (517), bHLH (499) and NAC (420).

Microsatellite mining resulted in the identification of 90378 SSRs which includes di, tri, tetra, penta and hexa nucleotide repeats with one SSR present per 1.76 kb genome. The distribution of SSRs varies from one linkage group to other, however, the density

is almost similar in all linkage groups ranging from 1.64 kb to 1.90 kb. Furthermore, 119710 SNPs were identified from the whole genome using CLC genomics workbench. The whole transcriptome assembly resulted in 16,612 transcripts with N50 value of 905 bp. A total of 16548 unigenes were predicted among which 15, 438 unigenes were assigned a total of 58 gene ontology (GO) terms in three ontologies namely, biological process (23), molecular function (16) and cellular component (19). Moreover, 1716 unigenes had significant matches in the KEGG database and were assigned to 22 KEGG pathways such as translation pathway, energy metabolism, carbohydrate metabolism and amino acid metabolism. The whole genome bisulphite sequencing analysis was done in order to obtain whole genome methylation patterns in sesame and the results suggested that 48% of DNA methylation was in CG context, 26% in CHG and 25% in CHH context. Micro RNA prediction and target identification revealed that predicted miRNAs of sesame target the genes involved in regulation of transcription, proteolysis, ATP binding, signal transduction and brassinosteroid mediated signaling pathway.

The present study enhances the availability of genomic resources of sesame and provides significant amount of information which could serve as a valuable basis for future studies. The data generated and analyzed in the present investigation are made available through Sesame Genomic Information Resource (SGIR) which is an integrated genomic resource for sesame crop and can be freely accessible at http://202.141.12.147/sgir/. SGIR houses sesame genes with associated annotations, unigenes, microsatellite markers, SNPs, whole genome wide methylated regions and also contains a comprehensive set of query and display options. Furthermore, SGIR will continue to enhance the genomic information of sesame to benefit users in the discovery, use and combination of modules. The newly identified genes, markers and primers are expected to help sesame breeders in developing marker tags for the traits of economic importance thereby bringing about greater efficiency in marker assisted selection programs.

ii) **Name of Student: Sneha Murmu**
Chairperson: Dr. Sunil Archak
Roll No.: 20667

Title of Thesis: Transcriptome analysis of moisture stress responsive genes in *Lathyrus sativus* using RNA-Seq data

Lathyrus has a great agronomic importance as it is grown for both human consumption and livestock feed and is well adapted to the arid conditions and is one of the hardiest pulses known till date. Together with the growing popularity of RNA-Seq, a number of data analysis methods and pipelines have already been developed for transcriptome analysis. There is a common assumption that substantial gains occur in the quality of the results as read length increases and when paired-ends (PE) are used. Currently, however, there are no clear consensus about the best practices for SOLiD short read single end data, which makes the choice of an appropriate method a daunting task especially for a basic user. Hence a comparative study of RNA-Seq analysis tools, in this study commercialized *CLC bio Genomics Workbench* vs open-source software like *Velvet-Oases* and *TopHat-Cufflinks* for de novo and reference-genome based approach respectively,was made with the aim to understand and assist the choice of selection of such methods for SOLiD transcriptome data. *Velvet-Oases* and *TopHat-Cufflinks* were chosen to carry out the transcriptome analysis of *Lathyrus sativus* based on their performance against *Glycine* max test dataset. Drought negatively impacts plant growth and the productivity of crops around the world. Understanding the molecular mechanisms in the drought response is important for improvement of drought tolerance using molecular techniques. In this study, we found 57 differentially expressed genes in case of *de novo* based approach and 140 in case of reference-genome based approach. The findings of this study is expected to facilitate the decision of choosing an optimal tools for the analysis of short read SOLiD transcriptome data. The result is also expected to provide an improved understanding and identification of sources for resistance against moisture stress for future genetic research in this hitherto under-researched, valuable legume crop.

iii) Name of Student: Ritwika Das
Chairperson: Dr. Sarika
Roll No.: 20668

Title of Thesis: Development of Webserver for Discovery of Polymorphic Microsatellite DNA Markers

Microsatellite or SSR markers are codominant DNA markers useful for various biological studies. Polymerase slippage during DNA replication, or slipped strand mispairing, is the main cause of variation in the number of repeat units, resulting in length polymorphism in SSR markers. The present scenario warrants the need of bulk marker mining from the whole genome or from the specific location of the chromosome along with their primer generation. *In vitro* polymorphism discovery has limitation of both time and cost, hence warranting in *silico* approaches. *PolyMorphPredict* is developed using Perl (64 bit, version 5), R (version 3.0) and Java (version 7) and launched at Apache. The user interface is built using Javascript and HTML and integrates MISA and Primer3 for SSR marker mining and primer generation, respectively. In-house PERL scripts were developed for string/ pattern matching to detect polymorphic markers. It consists of major modules like SSR Mining, Primer Generation and Polymorphism Detection. This server at present includes two whole genome sequence, *viz.*, sugarbeet and rice. It detects polymorphic markers, in case both self-designed primers and external primers are provided along with the graphical visualization developed in R software. It is freely available for scientific community at *http://webtom.cabgrid.res.in/polypoly/.* Revalidation of webserver based e-PCR was done using re-sequencing data of 4 Indian rice varieties (i.e., Co-36, Dubraj, Co-39 and Cauvery) of 3K genome project, IRRI, Philippines and was found in concordance which increases reliability of the developed webserver. PolyMorphPredict is a user friendly, cost effective and time saving web-based tool. It has applications in DUS test for variety identification and management, MAS/GAS, QTL and gene mapping, germplasm improvement, traceability of product/produce, tracing hybridization and introgression events, differentiation of edible derived varieties/ initial varieties, marker development for screening the mapping-based population for the genes involved in several key traits, identification and differentiation of fungi, parentage testing in animals and fish, breed signature of animal and fish and genome finishing.

iv) Name of Student: Aamir Khan
Chairperson: Dr. Mir Asif Iquebal
Roll No.: 20669

Title of Thesis: Development of Transcriptome based webgenomic resource of small cardamom *(Elettaria cardamomum maton)*

Small cardamom, scientifically known as *Elettaria cardamomum* belong to *Zingiberaceae* family and mostly cultivated in the tropical region of world. It is also called as *"queen of spices"* as it is most economical important spices crop which is famous due to its aroma and used in various medicinal purposes. *Mosaic* or *katte* diseases, the most destructive disease caused by *Cardamom mosaic virus* (CdMV), is the major biotic stress leading to the declination of crop production and greater economic loss. The paired end reads of control and mosaic virus infected samples of small cardamom was generated using illumina Hiseq 2000 technology for the identification of differential expressed genes which were associated with plant defense and plant immunity against mosaic disease. *De novo* transcriptome assembly was performed using *trinity* assembler followed by expression analysis and markers identification such as SSR, SNP and Indels. A total of 123338 transcripts were generated with N50 of 1520 bp, 5317 differential expressed genes, 24475 putative SSR markers, 147442 SNPs and 154217 Indels from control and mosaic virus infected samples respectively, 2267 transcriptional factors, 1219 domains and 807 families. We found some genes which may play an important role in plant defense and plant immunity such as disease resistance RGA1 and RGA3, RNA dependent RNA polymerase gene, LRR receptor-like serine threonine- kinase, Mitogen-activated protein kinase kinase kinase (MAPKKK) ANP1-like, HSP81-1, NAC, PR1, Thaumatin-Like Protein (PR5), NBS-LRR, MYB, bHLH, WRKY. Further, 12 genes were selected from differential expressed analysis of RNA-seq for q-PCR validation experiment. In this study, we

identified differential expressed genes as well as novel transcripts may play an important role in plant defense against mosaic disease, whereas mined markers and variants will be useful for breeder for development of disease resistant small cardamom crops. Also, we developed web transcriptomic resources *"SmTMVD:* Transcriptome Based Mosaic Virus Database in small cardamom (http://webtom. cabgrid.res.in/smallcard-mosaicmosaic/)" of small cardamom which can be useful for researchers all over the globe who are working on small cardamom.

**v)   Name of Student: Shweta Kumari
Chairperson: Dr. K.V. Bhat
Roll No.: 20670**

Title of Thesis: Bioinformatics tool for analysis of Crop DNA Fingerprints

Cultivar identification is one of the crucial and most important aspects in today's agricultural scenario. Application of molecular tool for identification of cultivar by analysis of DNA profile have brought it in limelight for its accuracy as it uses nucleotide sequence to study the differences between individuals. Major advancement in the field of molecular biology and genomic technology promoting explosive growth in biological information that need to be managed on a single platform. A Bioinformatics tool for Crop DNA Fingerprint data has been developed to store and retrieve information according to user's choice and will help to perform data analysis and germplasm management of different. Development work has been carried out using some technologies like Java Server Pages (JSP), Hyper Text Markup Language (HTML), Java script, Cascading Style Sheet (CSS) for front end interface, SQL for backend database and R has been used for statistical analysis. The developed conservation system stores large and scattered information about plant DNA profile data and also to provide retrieval system to show the results of user's choice. Apart from database, it also performs statistical analysis for the present data to know the different characteristics of cultivar by using some statistical measure like Dice coefficient, polymorphic information content (PIC), Genetic Diversity, Shannon Diversity Index and also generates phylogenetic tree. This database

will continuously be updated with another DNA fingerprint data of newly cultivated plant varieties. The information in the database will be used for cultivar identification, parentage analysis and population studies and also it would appear to have application in the legal protection of new cultivars through Patents and Plant Variety Rights submissions.

Awards to Students

- Sh. Shwetank Lall (Agricultural Statistics)

  ➢ Received IARI Medal Award for best Ph.D. Agricultural Statistics student during 56th Convocation 2018.

  ➢ Received Diversity Scholarship for UseR!2017 International Conference (July 04-07, 2017) at Brussels, Belgium to present following paper:

  ➢ Shwetank Lall, Seema Jaggi, Eldho Varghese, Arpan Bhowmik and Cini Varghese. mimimalRSD and FMC: R packages to construct cost efficient experimental designs.

- Sh. Dipankar Mitra (Agricultural Statistics)

  ➢ Received IARI Medal for M.Sc. (Agricultural Statistics) student during 56th Convocation 2018.

- Gopal Saha (Agricultural Statistics)

  ➢ Received Nehru Memorial Gold Medal 2017 of IASRI for being Best M.Sc.(Agricultural Statistics) Student during the Annual Day of the Institute

- Ashraful Haque (Computer Application)

  ➢ Received Nehru Memorial Gold Medal 2017 of IASRI for being Best M.Sc. (Computer Application) Student during the Annual Day of the Institute

- Ms. Soumya Sharma (Bioinformatics)

  ➢ Received Nehru Memorial Gold Medal 2017 of IASRI for being Best M.Sc. (Bioinformatics) Student during the Annual Day of the Institute

Research Fellowships

During 2017-18,46 Ph.D. and 33 M.Sc. students received research fellowship. 30 Ph.D. students received IASRI fellowship at the rate of Rs. 13,125/- p.m. in addition to Rs 10,000/- per annum as the contingent grant. 05 Ph.D. students received Rajeev Gandhi Fellowship @ Rs. 16,000/- P.M.02 Ph.D. students received DST-Inspire scholarship @

Rs. 18,000/-+30% H.R.A. P.M. in addition to Rs. 20,000/- per annum as contingent grant.05 Ph.D. student received National Fellowship @ Rs. 16,000- P.M. in addition to Rs.10,000/- P.A. as contingency grant. 10M. Sc. students received ICAR Junior Research Fellowship at the rate of Rs. 8640/- p.m. in addition to Rs. 6000 /- per annum as the contingent grant and 23 M.Sc. students received IASRI fellowship at the rate of Rs. 7560/- p.m. in addition to Rs. 6000/- per annum as the contingent grant.

Courses for the Academic Session 2016-17 (Agricultural Statistics)

Code	Course Title	Credits		Course Instructors 2016-17
		L	P	
Trimester-III (2015-16)				
PGS 504	Basic Statistical Methods in Agriculture	2	1	Sarika, Ajit, Anindita Datta
AS 503	Basic Sampling and Non-parametric Methods	2	1	Kaustav Aditya, Ankur Biswas, Deepak Singh
AS 563	Statistical Inference	4	1	K.N. Singh, Arpan Bhowmik, Prabina Kumar Meher
AS 564	Design of Experiments	3	1	Seema Jaggi, Eldho Varghese,Anindita Datta
AS 566	Statistical Genetics	3	1	L.M. Bhar, A.K. Paul, Ranjit Kumar Paul
AS 662	Advanced Designs for Multi-factor Experiments	2	1	Rajender Parsad, Sukanta Dash
AS 664	Inferential Aspects of Survey Sampling and Analysis of Survey Data	2	1	Taqueer Ahmad, Hukum Chandra, U.C. Sud
AS 666	Advanced Quantitative Genetics	2	1	A.R. Rao, Prabina Kumar Meher
AS 667	Forecasting Techniques	1	1	Amrender Kumar, Bishal Gurung
AS 668	Bayesian Inference in Survey Sampling	1	1	Hukum Chandra, G K Jha
AS 691	Seminar	1	0	Prawin Arya
Trimester-I (2017-18)				
PGS 504	Basic Statistical Methods in Agriculture	2	1	Susheel Kr. Sarkar, Wasi Alam, Anindita Datta
AS 501	Basic Statistical Methods	2	1	Mir Asif Iquebal, Prakash Kumar
AS 550	Mathematical Methods	4	0	Cini Varghese, Himadri Ghosh, Sushil Kumar Sarkar
AS 560	Probability Theory	2	0	K.N. Singh, V. Ramasubramanian
AS 561	Statistical Methods	2	1	Seema Jaggi, V. Ramasubramanian, Ranjit Kumar Paul
AS 567	Applied Multivariate Analysis	2	1	A.R. Rao, Bishal Gurung
AS 568	Econometrics	2	1	G.K. Jha, Prawin Arya, Ravindra Singh Shekhawat
AS 569	Planning of Surveys/Experiments	2	1	Tauqueer Ahmad, Prachi Misra Sahoo, Ajit
AS 572	Statistical Quality Control	2	0	Wasi Alam, Deepak Singh
AS 600	Advanced Design of Experiments	1	1	Rajender Parsad, Cini Varghese
AS 601	Advanced Sampling Techniques	1	1	Hukum Chandra, Prachi Misra Sahoo
AS 602	Advanced Statistical Genetics	1	1	A.K.Paul
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	Amrender Kumar, Achal Lama
AS 691	Seminar	1	0	A.K. Paul

Code	Course Title	Credits		Course Instructors 2016-17
		L	**P**	
Trimester – II (2017-18)				
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 Kumar Sarkar, Sukanta Dash, Sunil Kumar Yadav
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 Ahmed, Ankur Biswas
AS 570	Statistical Modeling	2	1	Ranjit Kumar Paul, Bishal Gurung, Achal Lama
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
AS 605	Advanced Statistical Inference	1	1	K.N.Singh, L.M. Bhar
AS 607	Stochastic Processes	3	0	Himadri Ghosh, Santosh Rathore, Mrinmoy Ray
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, Prabina Kumar Meher
AS 691	Seminar	1	0	V. Ramasubramanian

Courses for the Academic Session 2016-17 (Computer Application)

Code	Course Title	Credits		Course Instructors 2016-17
		L	**P**	
Trimester – III (2016-17)				
CA 503	Statistical Computing in Agriculture	1	2	Rajender Parsad, Ranjeet Kumar Paul, Bishal Gurung
CA 563	Operating System	2	1	Soumen Pal
CA 568	Software Engineering	2	0	A.K. Choubey, Anu Sharma
CA 567	Computer Networks	2	1	S.N. Islam, Mukesh Kumar
CA 571	Modeling and Simulation	2	1	Anshu Bharadwaj, Ankur Biswas
CA 613	Artificial Neural Networks	2	1	Anshu Bharadwaj, G.K. Jha
CA 614	Knowledgebase Systems for Semantic Web	2	1	Sudeep Marwaha, Alka Arora
CA 691	Seminar	1	0	S.B. Lal
Trimester I (2017-18)				
CA 551	Mathematical Foundations in Computer Application	4	0	Sukhanta Dash, Sunil Kumar Yadav
CA 552	Computer Oriented Numerical Methods	2	1	Pal Singh, Deepak Singh

Code	Course Title	Credits		Course Instructors 2016-17
		L	P	
CA 560	Computer Organization and Architecture	3	0	Shashi Dahiya, Sudeep Marwaha, Anil Rai
CA 561/ BI 505	Principles of Computer Programming	2	1	Alka Arora, K.K. Chaturvedi,S.B. Lal
CA 565	Compiler Construction	2	1	Soumen Pal,A.K. Mishra
CA 569	Web Technologies and Applications (2+1)	2	1	Alka Arora, S.B. Lal
CA 570	Computer Graphics	2	1	Pal Singh
CA 575	Artificial Intelligence	2	1	Rajni Jain, Sudeep Marwaha
CA 611	Design and Analysis of Algorithms	2	1	Mukesh Kumar, Shashi Dahiya
CA 691	Seminar	1	0	Anshu Bhardwaj
Trimester II (2017-18)				
CA 501	Computer Fundamentals and Programming	3	2	Pal Singh, Ajit
CA 562	Object Oriented Analysis and Design	2	1	Sudeep Marwaha, Anu Sharma, Sangeeta Ahuja
CA 564	Data Structures and Algorithms	2	1	A.R. Rao, A.K. Mishra
CA 566/ BI 507	Data Base Management System	2	2	S.B. Lal, Soumen Pal
CA 572	GIS Principles and Applications	2	1	Anshu Bhardwaj,Prachi Mishra Sahoo
CA 573	Data Warehousing	2	1	K.K. Chaturvedi, Shashi Dahiya
CA 577	Data Mining Techniques	2	1	Alka Arora,Anshu Bhardwaj, Shashi Dahiya
CA 578	Information Security	2	1	Mukesh Kumar, Samir Farooqi
CA 612	Soft Computing Paradigms	2	1	Alka Arora, Rajni Jain
CA 691	Seminar	1	0	Pal Singh

Courses for the Academic Session 2017-18 (Bioinformatics)

Code	Course Title	Credits		Course Instructors 2016-17
		L	P	
Trimester – III (2016-17)				
BI 502	Protein Structure Analysis	2	1	Anil Rai, Sarika
BI 503	Computational Biology	2	1	A. R. Rao,D. C. Mishra
BI 504	Evolutionary Biology	2	1	Sunil Archak,A. K. Mishra
BI 612	Quantum Theory and Applications in Biology	2	1	Monendra Grover
BI 643	Graphics and Visualization of Biological Data	2	1	U.B. Angadi, Sudeep Marwaha
Trimester - I (2017-18)				
BI 501/ MBB 509/ GP 540	Introduction to Bioinformatics	2	1	Amole Kumar U. Solanke,AR Rao, Kishore Gaikwad
BI 505/ CA 561	Principles of Computer Programming	2	1	Alka Arora, KK Chaturvedi, SB Lal

Code	Course Title	Credits		Course Instructors 2016-17
		L	P	
BI509/BIO601	Nucleicacids	2	1	Archna Sachdev, Archna Singh, Suneha Goswami
BI 510/ MBB 501	Principles of Biotechnology	4	0	Ramcharan Bhattacharya, Debasis Pattanaik, Amol Kumar U. Solanki
BI 511 /BIO 501	Basic Biochemistry	4	1	Anil Dahuja, Aruna Tyagi, Shelly Praveen
BI 512	Advanced Programming in Bioinformatics	2	2	UB Angadi, Anu Sharma
BI 601	Genome Assembly and Annotation	1	2	Sanjeev Kumar, DC Mishra
BI 602	Biomolecular Modelling and Simulation	2	1	UB Angadi, M. Grover, Anil Rai
BI 611	Metagenomics Data Analysis	2	1	MS Farooqi, Anu Sharma
BI 614	Biological Network Modelling and Analysis	2	1	Sanjeev Kumar
BI 691	Seminar	1	0	Sarika
Trimester – II (2017-18)				
BI 506	Computational Genomics	3	1	D.C. Mishra,M.A.Iquebal, Sarika, T. Napoleaon
BI 507/CA566	Data base Management System	2	2	S.B. Lal, Soumen Pal
BI 508	Computer Application in Bioinformatics	2	1	S.B. Lal, K.K. Chaturvedi, Anu Sharma
BI 603	Machine Learning Techniques in Bioinformatics	2	1	Sanjeev Kumar, D.C. Mishra, V. Ramasubramanian
BI 604	Computational Techniques for Transcriptomics and Metabolomics	1	1	Samir Farooqui, Monendra Grover
BI 632	Peptide Design, Synthesis and Applications	2	1	Monendra Grover, U.B. Angadi
BI 623	Optimization Techniques in Bioinformatics	2	1	U.B. Angadi, A.R. Rai
BI 624	Genome Wide Association Study	2	1	Sunil Archak, T. Napolean, Anil Rai
BI 691	Seminar	1	0	K.K. Chaturvedi

Board of Studies for Academic Year 2017-18

Agricultural Statistics

1. Dr. Seema Jaggi,Professor (Agricultural Statistics) Chairperson
2. Dr. U.C. Sud, Director (till 31.07.2017), Member (Ex-officio)
    Dr. A.K. Choubey, Director (01.08.2017 to 21.01.2018)
    Dr. L.M. Bhar, Director (since 22.01.2018)
    Dr. Anil Rai, Head CaBin Member
3. Dr. B.N. Mandal, Scientist Member
4. Dr. Bishal Gurung, Scientist Member Secretary
5. Sh. Rahul Banerjee, Student Students' Representative

Computer Application

1. Dr. Sudeep Marwaha, Professor (CA) Chairman
2. Dr. U.C. Sud, Director (till 31.07.2017), Member (Ex-officio)
    Dr. A.K. Choubey, Director (01.08.2017 to 21.01.2018)
    Dr. L.M. Bhar, Director (since 22.01.2018)
3. Dr. Alka Arora, Principal Scientist Member

4. Dr. Mukesh Kumar, Principal Scientist — Member
5. Dr. Shashi Dahiya,Senior Scientist — Member Secretary
6. Ms. Sonica Priyadarshini — Students' Representative

Bioinformatics

1. Dr. A.R. Rao Professor (Bioinformatics) — Chairman
2. Dr. U.C. Sud, Director (till 31.07.2017), — Member (Ex-officio)
   Dr. A.K. Choubey, Director (01.08.2017 to 21.01.2018)
   Dr. L.M. Bhar, Director (since 22.01.2018)
3. Dr. Monendra Grover, Principal Scientist — Member
4. Dr. T. Napolean, Senior Scientist — Member
5. Dr. D.C. Mishra, Scientist — Member Secretary
6. Mr. Tanmaya Kumar Sahu — Students' Representative

Central Examination Committee for Academic Year 2017-18

Agricultural Statistics

1. Dr. U.C. Sud, Director (till 31.07.2017),
   Dr. A.K. Choubey, Director (01.08.2017 to 21.01.2018)
   Dr. L.M. Bhar, Director (since 22.01.2018)
2. Dr. Seema Jaggi, Professor (Agricultural Statistics)
3. Dr. Anil Rai,Head, CABin
4. Dr. K.N. Singh, Head, FASM
5. Dr. Rajender Parsad, Principal Scientist
6. Dr. Hukum Chandra, National Fellow

Computer Application

1. Dr. U.C. Sud, Director (till 31.07.2017),
   Dr. A.K. Choubey, Director (01.08.2017 to 21.01.2018)
   Dr. L.M. Bhar, Director (since 22.01.2018)
2. Dr. Sudeep Marwaha,Professor (Computer Application)
3. Dr. Alka Arora,Principal Scientist
4. Dr. Mukesh Kumar,Principal Scientist
5. Dr. Shashi Dahiya,Senior Scientist
6. Dr. Soumen Pal,Scientist

Bioinformatics

1. Dr. U.C. Sud, Director (till 31.07.2017),
   Dr. A.K. Choubey, Director (01.08.2017 to 21.01.2018)
   Dr. L.M. Bhar, Director (since 22.01.2018)
2. Dr. A.R. Rao,Professor (Bioinformatics)
3. Dr. Anil Rai, Head CABin
4. Dr. Kishore Gaidkwad, Principal Scientist
5. Sh. Sanjeev Kumar,Scientist

National / International Training Programmes

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 19, 2017 to Nov. 18, 2017. The Course comprise of two independent modules of three months duration each. One officer participated in both the modules. Module – I was organized during June 19, 2017 to August 18, 2017. Module-II was organized during September 01, 2017 to November 18, 2017. Oneofficers participated in Module – I and one officer participated in Module - II.

Topic	Instructor
Module-I	
Statistical Methods	Sh. Santosh Rathore, Dr. Mrinmoy Roy, Md. Wasi Alam
Official Agricultural Statistics	Dr. Kaustav Aditya, Dr. Ankur Biswas, Dr. Pradip Basak
Use of Computers in Agricultural Research	Sh. Pal Singh, Sh. Neeraj Budlakoti, Sh. Rajeev Ranjan
Module-II	
Sampling Techniques	Dr. Kaustav Aditya,Dr. Ankur Biswas, Sh. Deepak Singh
Statistical Genetics	Dr. Amrit Kumar Paul, Dr. Himadri Shekhar Roy, Sh. Prakash Kumar
Econometrics and Forecasting Techniques	Md. Wasi Alam, Dr.Ravinder Singh Shekhavat, Sh. Rajeev Ranjan Kumar
Design of Experiments	Dr. Arpan Bhowmik,Md. Harun, Sh. Sunil Kumar Yadav

Programmes under Centre of Advanced Faculty Training (CAFT)

S. No	Title	Course Coordinators	Period	No. of Participants
1	Advanced Statistical Techniques in Biometrics	Dr. A.K. Paul Mr. Prakash Kumar	10.08.17 - 30.08.17	25
2	Recent advances in sample surveys and survey data analysis using statistical software	Dr. Kaustav Aditya Dr. Ankur Biswas	01.12.17 -21.12.17	25
3	Recent Developments in Statistical Modeling and Forecasting in Agriculture	Dr. K.N. Singh Sh. Rajeev Ranjan Kumar	28.12.17 - 17.01.18	25
4	Application on OMICS Tools and Techniques for Agricultural Germplasm Improvements	Dr. Sarika Dr. Mir Asif Iquebal	08.02.18 -01.03.18	24
5	Statistical Advances for Agricultural Data Analysis	Dr. Seema Jaggi Dr. Anindita Datta	03.03.18 - 23.03.18	25
6	Computational and Statistical Advances for analysis of Biological Data in Agriculture	Dr. Anu Sharma Dr. S.B. Lal	24.03.18 – 13.04.18	20

Winter School

S.No.	Title	Course Director/ Co-Director	Period	No. of Participants
1	Advanced Statistical Tools and Techniques for Modeling and Forecasting Agricultural data	Dr. Santosha Rathod Dr. R.S. Shekhawat	08.11.17 - 28.11.17	25

Training Programmes under HRM

Sr. No	Title	Course Coordinator	Period	No. of Participants
1	ICAR-ERP System for Technical Personnel	Dr. Alka Arora Dr. Anshu Bharadwaj	17.07.17-22.07.17	25
2	Experimental Data Analysis for Technical Personnel	Dr. Cini Varghese Mr. Mohd. Harun	26.07.17 -08.08.17	20
3	Networking: Basics and Management for Technical Personnel	Dr. Mukesh Kumar Dr. Soumen Pal	04.09.17 - 08.09.17	23
4	Experimental Designs and Statistical Data Analysis for Scientific Personnel	Dr. Seema Jaggi Dr. Arpan Bhowmik	11.09.17 – 20.09.17	16
5	Computer Application for Technical Personnel	Dr. Sudeep Marwaha Sh. Pal Singh	22.09.17 - 27.09.17	22
6	Recent Advances of Bioinformatics in Agriculture:A Practical Perspective for Scientific Personnel	Dr. D.C. Mishra Sh. Neeraj Budlakoti	01.12.17 – 21.12.17	16
7	ICAR-ERP Systemfor Technical and Administrative Personnel	Dr. Anshu Bharadwaj Dr. Shashi Dahiya	22.12.17 - 27.12.17	25
8	Statistical Techniques for Agricultural data Analysisfor Technical Personnel	Dr. Susheel Kumar Sarkar Sh. Sunil Kumar Yadav	15.02.18 - 24.02.18	11

Other Training Programmes

S.No.	Title	Course Coordinator	Period	No. of Participants
1	Sampling methodology, field organization and data quality	Dr. Tauqueer Ahmad Dr. Hukum Chandra	17.04.17 – 21.04.17	14
2	Data Analysis and interpretation for Indian Statistical Service Probationers	Dr. Seema Jaggi Dr. B.N. Mandal	24.04.17 – 05.05.17	28
4	Sampling methodology, field organization and data quality	Dr. Tauqueer Ahmad Dr. Hukum Chandra	01.05.17 – 05.05.17	12
5	Data analysis and interpretation for Indian Statistical Service Probationers	Dr. Rajender Parsad Dr. Eldho Varghese	15.05.17 – 26.05.17	28
6	Application of Bioinformatics in Agriculture	Dr. Sarika Dr. Mir Asif Iquebal	27.06.17 – 29.06.17	10
7	Refresher Course on Statistical Analysis using SAS at Directorate of Groundnut Research, Junagarh	Dr. Susheel Kumar Sarkar Sh. R.S. Tomar	14.09.17 – 16.09.17	--
8	Recent Advances in Agricultural surveys remote sensing and GIS Applications	Dr. Prachi Mishra Dr. Tauqueer Ahmad	22.11.17 – 12.12.17	09
9	Statistical and Computational Analysis and Phenotypic and Genomic Data of Mustard Germplasm	Dr. A.R. Rao Dr. Cini Varghese Dr. P.K. Meher	07.03.18 – 09.03.18	18
10	Basic Statistical Computing procedure for Analysis of Experimental Data in collaboration with Bihar Animal Science University at Patna	Dr. Rajender Parsad Dr. Sukanta Dash Sh. R.S. Tomer	15.03.18 – 17.03.18	35

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Awards and Recognitions

Dr. Hukum Chandra
- Conferred as Fellow, National Academy of Agricultural Sciences (NAAS) under section Social Science, in the AGM held on 05 June 2017 at NASC Complex, New Delhi.

Dr. Seema Jaggi
- Conferred as Fellow, National Academy of Agricultural Sciences (NAAS) under section Social Science, 2018

Dr. Ranjit Kumar Paul
- Conferred as Fellow, National Academy of Agricultural Sciences (NAAS) under section Social Science, 2018

Dr. K.K. Chaturvedi
- Received Distinguished Scientist Award, in International Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2017) held during 02-04 Dec. 2017 at MPUA&T , Udaipur

Dr. Santosha Rathod
- Received Dr. G. R. Seth Memorial Young Scientist Award by Indian Society of Agricultural Statistics in the 71st Annual National Conference of Indian society of agricultural statistics held

ICAR-DRMR, Bhartapur from 25-27 November, 2017.

Dr. Pradip Basak

- Received M. K. Bose award for being the best student in Ph.D. (Agricultural Statistics) at ICAR-IASRI during 2013-2016 at the Annual Day of the Institute on 03 July, 2017.

Dr. Ranjit Kumar Paul

- Received ICAR Lal BahadurShastri Outstanding Young Scientist Award in Social Sciences for 2016 in ICAR foundation day on 16th July, 2017 at NASC complex, Pusa, New Delh

Dr. Kaustav Aditya

- Awarded "Krishi Vigyan Gourav" Award 2017 from Bhartiya Krishi Anusandhan Samiti and Krishi Anusandhan Sanchar Kendra (ARCC), Karnal.

Dr. Ravindra Singh Sekhavat

- Received Young Scientist Award by Science and Tech Society for Integrated Rural Improvement (S&T SIRI) on the occasion of National Conference on Promoting Reinvigorating Agri-Horti, Technology Innovation (PRAGATI - 2017), 11th -12th November, 2017.

Dr. Ajit

- Conferred as Fellow of Indian Society of Agroforestry for the year 2017

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Sh. Prakash Kumar
- Awarded Netaji Subhas-ICAR International Fellowship.

Dr. Sarika
- Received "SERS Computational Biologist 2017" award from Society for Educational and Scientific Research.

Dr. M.A. Iquabal
- Received "Young Scientist Award" in 5th Faculty Branding Award 2017 by EET-CRS Research Wing for Excellence in Professional Education and Industry.

Poster Awards

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- सिमेंटिक्स और सॉफ्टवेयर एजेंट आधारित वेब पर्सनलाईजेड सूचना बहाली. सर्वश्रेष्ठ शोध पत्र प्रस्तुति भारतीय भाषाओं में प्रथम विज्ञान संगोष्ठी, 22 अगस्त, 2017, राष्ट्रीय प्रौद्योगिकी संस्थान, कुरुक्षेत्र

vuq'ks[kZ,ts IBVh], l-ch yky] ds ds prq3h] ,e-,l- Qk dh,oavfuy jk;

- संगणनात्मक विधियों द्वारा अरहर में माइक्रो आर. एन. ए. की पहचान. डिजिटल हिन्दी शोध–पत्र प्रस्तुति प्रतियोगिता में 11 सितम्बर, 2017 को तृतीय पुरस्कार से सम्मानित किया गया

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- कृषि जीवद्रव्य के लिए पशु नस्ल एवं पौधा किस्म हस्ताक्षर निर्माण में संगणक की भूमिका एवं आवश्यकता, भा.कृ.अनु. प. – भारतीय कृषि सांख्यिकी अनुसन्धान संस्थान, नई दिल्ली द्वारा 11 सितम्बर, 2017 को आयोजित डिजिटल शोध पत्र प्रस्तुति प्रतियोगिता में प्रथम पुरस्कार

Alka Arora, Sudeep and Soumen Pal
- Received second prize for digital poster presentation in hindi on the paper "KVK Portal and Mobile App: Digital Tools for Effective Dissemination of Extension Activities" in the Hindi pakwara organized at ICAR-IASRI.

Recognitions

Dr. Anil Rai
- Representative of D.G. ICAR as a Member of National Committee on " Data Analytics"
- Chairman of the committee related to implementation of e-Office in ICAR
- Member of interview board for selection of scientist in Dessert Medicine Research Centre (ICMR), Jodhpur.
- Member of School Board of Physical Sciences, North Eastern Hill University, Shillong Megalaya
- Member of Board of Studies of P.G. School, IARI New Delhi in Agricultural Statistics
- 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
- Local Coordinating Officer for Delhi for examination for recruitment of technical personal in the institute.
- Member of Assessment and Promotion committee under CAS in ICAR Headquarter, New Delhi.
- Member of tender finalization committee on Bid/Tender document to outsource the Pre- and Post-Examination processing work, online counselling, etc. in respect of ICAR's All India Entrance Examination for Admission (AIEEA) in Agricultural Universities to Bachelor, Master and Ph.D. degree Programmes for the Academic Session 2017-18.

Dr. A.R. Rao
- Member, Academic Council of IARI, New Delhi

Dr. Shashi Dahiya
- Chaired a session on "Applied Statistics" in the International Conference on Changing Paradigms and Emerging Challenges in Statistical Sciences (IPECS-2018) held during 29th-31st January 2018 at Pondicherry University, Pondicherry.

Dr. Arpan Bhowmik
- Received Financial Assistance Commitment Letter (Application No.- ITS/5049/2017-18) under International Travel Support Scheme of Science and Engineering Research Board, Department of Science and Technology, Government of India to participate in III LACSC: LATIN AMERICAN CONFERENCE ON STATISTICAL COMPUTING to be held from 27-02-2018 to 02-03-2018 in SAN JOSÉ,COSTA RICA.

Dr. B. N. Mandal
- Resource person in the Faculty Development Programme on SPSS, R and Excel at MMU, Mullana-Ambala, Haryana on 21st November, 2017.
- Resource person in the first National Faculty Development Programme on Recent Trends in

Applied Science Teaching during 21-27 July, 2017 organized at Saheed Rajguru College of Applied Sciences for Women, University of Delhi, New Delhi.

- Resource person in the ICAR summer school on Advanced Analytical Tools for Decision Making in Agriculture organized at ICAR-National Institute of Agricultural Economics and Policy Research during July 10-30, 2017.

Dr. Susheel Kumar Sarkar and Dr. Sukanta Dash

- Chaired a contributory paper session on Design of Experiments during 71st Annual Conference of the Indian Society of Agricultural Statistics held at ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321 303, Rajasthan, India during November 25-27, 2017.

Dr. Ramasubramanian V. and Dr. Prawin Arya

- Faculty Coordinators for Fourth year B.Sc.(Ag.) students of Agricultural College and Research Institute (TNAU), Eachangkottai, Thanjavur.

Dr. Ramasubramanian V. and Dr. K. K. Chaturvedi

- Faculty Coordinators for Fourth Year B.Tech. (Agricultural Information Technology) students of TNAU, Coimbatore and gave a presentation on "Institute's training, research and teaching activities" and also interacted with the students on 19.12.2017.

Dr. Rajender Parsad

- Member, (i) Management and Systems Division Council; (ii) MSD 3: Statistical Methods for Quality and Reliability and (iii) MSD3:3.4 Basic Statistical Methods of Bureau of Indian Standards, Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi.
- Member, Governing Body, Institute of Applied Statistics and Development Studies, Lucknow.
- Chairman for preparing the RFP for ICT Roadmap for ICAR.
- Chaired an Invited Paper session on Rapeseed-Mustard Cultivation in India during 71st Annual Conference of the Indian Society of Agricultural Statistics held at ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321 303, Rajasthan, India during November 25-27, 2017.
- Chaired the session of Invited Talks on Information and Knowledge Management Systems on 30.01.2018 organized during the International Conference on Changing Paradigms and Emerging Challenges in Statistical Sciences

(20th Annual Conference of Society of Statistics, Computer and Applications) at Department of Statistics, Pondicherry University, Pondicherry during January 29-31, 2018.

- Chaired Two sessions of Invited Talks on (i) Contributions to optimality issues in real life statistical designs and (ii) Advances in Design of Experiments in the International Conference on Statistics held at Hyderabad during 28-30 December, 2017.

Dr. Anil Kumar

- Training Facilitator for summer school on Advanced Analytical Tools for decision making in agriculture organised at National Institute of Agricultural Economics and Poliocy Research during July 10-30, 2017.

Dr. K.K. Chaturvedi

- Member, Technical Program Committee, 7th International Conference on. Reliability, Infocom Technologies and. Optimization (ICRITO 2017). (Trends and Future directions) during August 29-31, 2018.
- Member, Technical Program Committee, 6th International Conference on. Reliability, Infocom Technologies and. Optimization (ICRITO 2018). (Trends and Future directions) during September, 20-22, 2018.
- Member, Technical Program Committee, International Conference on Infocom Technologies and Unmanned Systems (ICTUS›2017) during December 18-20, 2017.
- Member (Technical Expert), Rebuilding the Data Centre for GenomeInformatics lab, ICAR-NRCPB, New Delhi.

Dr. A.K. Choubey

- Expert member for the meeting of APEDA funded project "Effect of Buffaloes Slaughter and Meat Export Policy on Livestock, Milk, Draught, Power and Eco-Balance in India" on 9th August, 2017 at ICAR-NRC Meat, Hyderabad to finalise the final report.
- Member of Research Advisory Committee of Agricultural Economics Research Centre, Directorate of Economics & Statistics.
- Member of Technical Advisory Committee of PMFBY/RWBCIS.

Dr. Sudeep Marwaha

- Member of the committee for the development of Terms of Reference for Request for Proposal for

the development of ICT Roadmap of ICAR.

- Member of the committee for the development of Terms of Reference for Request for Proposal for the development of Agriculture Education Digital Information System (AEDIS) under NAHEP.

- Member of the committee for the development of specification for the operationalization and maintenance of the ICAR Data Center.

- Chairman of the committee for evaluation of bids for the development of ICT Roadmap of ICAR

- Member of the team for developing the PIP and EFC of the component 2a of NAHEP project.

- Member of Technical Advisory Committee, Delhi University Computer Center, University of Delhi.

- Member of Network Purchase Committee, Delhi University Computer Center, University of Delhi.

- Nodal officer from DARE/ICAR for the problem selection and conduct of Hackathon 2018 at Chandigarh.

- Member secretary of the committee for finalization of qualifications, terms and conditions, and mode of recruitment for IT Professionals I,II,III and IV.

- Member of Technical Committee for the establishment of Video Conferencing System across all Institutes of ICAR

- Member of the Committee to fine tuning of scorecard for the direct selection of Sr. Scientist, Pr. Scientist, Directors, ADG and DDG.

- External examiner for the setting the paper of Scientific Computing for the B.Tech. Course of SVBPUAT Modipuram.

Dr. Alka Arora

- Member of the committee to decide services and equipment which can be spared on, including cost of service /unit basis and submission of the same on the ICAR portal

Dr. Mukesh Kumar

- Member Secretary for Data Disaster Management Committee for preparing the ToR to develop the ICT roadmap of ICAR.

- Coordinated to conduct the classes and examination for PG Diploma in Technology Management in Agricultural (PG-TMA), ICAR-NAARM, Hyderabad during 9th-15th September, 2017 at ICAR-IASRI, New Delhi.

- Convened a session on "E-Learning and E-Initiative in Farmers Outreach" in the 71st Annual Conference of the Indian Society of

Agricultural Statistics during 25th-27thNovember, 2017 at ICAR-DRMR, Bharatpur (Rajsthan).

Dr. Soumen Pal

- Question paper setter for course No. AST-201 (Agri-informatics & Computer Applications) of end term examination in III Semester, 2017 for B.Sc. (Hons.) Horticulture students of Uttar Banga Krishi Viswavidyalaya (UBKV) West Bengal.

Dr. Ramasubramanian V.

- Member Secretary for Watch-Group on Artificial Intelligence and Digital Agriculture (WGAIDA) Committee

- Chairman, Students' Contributed Paper Session at 71st Annual Conference of ISAS (Indian Society of Agricultural Statistics) at DRMR, Bharatpur, Rajasthan held during 25-27 Nov. 2017

- Question Paper Setter for Course No. FES-11 (Statistical methods) of End Term Examination in I Semester, 2017 for B.Sc. (Hons) Fisheries Science students of Birsa Agricultural University, Ranchi on 13.12.2017.

Dr. Prawin Arya

- Conducted examination as External examiner at Dept. of Statistics and OR, AMU, Aligarh on 8th May, 2017.

- Chairman, for organizer cum exhibitor of ICAR-IASRI stall in Krishi Unnati Mela organized by ICAR-IARI between 16 -19 March, 2018.

Dr. Wasi Alam

- Convened a technical session of contributory talks in 3rd international conference on "statistics for twenty-first century" held during Dec. 14-16, 2017 at Department of Statistics, University of Kerala, Trivandrum, Kerala.

Dr. K. N. Singh

- Convened one session and was invited speaker in two sessions at 71st Annual Conference of at DRMR, Bharatpur, Rajasthan held during 25-27 Nov, 2017.

Dr. Ranjit Kumar Paul

- Resource person in the ICAR summer school on Advanced Analytical Tools for Decision Making in Agriculture organized at ICAR-National Institute of Agricultural Economics and Policy Research during July 10-30, 2017.

- Resource person for the winter school on "Advanced Analytics in Developing Agricultural

Market Intelligence" at ICAR-NAARM during Nov.14-Dec.04, 2017

- Chairman in the session on Statistical Modelling in the 71st Annual Conference of Indian Society of Agricultural Statistics (ISAS) at ICAR-DRMR, Bharatpur during 25-27th November 2017

- Speaker in National Meeting of Experts on Agriculture Markets, Price Data Visualization and Early Warning System at Hotel Taj Mahal, Mansingh Road, New Delhi, during 11-12 September 2017 organized by FAO.

- Resource person in the workshop on Real Time Pest Dynamics on 13th October, 2017 at NCIPM, New Delhi

- Chairman in the session on Stochastic Modelling in International conference on Changing Paradigms and Emerging Challenges in statistical sciences (PECS-2018) of Society of Statistics, Computer and Applications (SSCA) during 29-31 January, 2018 at Pondicherry University, Puducherry.

- Resource Person in the Faculty Development Programme at Jagannat International Management School (JIMS), Vasant Kunj on 22-26, May, 2017

- External Examiner of Narendra Agricultural University, Faizabad

- Secretary, Institute Seminar Association, ICAR-IASRI

- Secretary, Division Research Committee, Statistical Genetics, ICAR-IASRI

- Member, Watch-Group on ArtificialIntelligence and Digital Agriculture (WGAIDA)Committee

- Member in the interview board on 14th July, 2017 for selection of Research Associate and SRF for the project "Modelling insect pests and diseases under climate change and development of digital tools for pest management" at ICAR-NCIPM.

- Invited to attend the meeting on possible application of Artificial Intelligence technique in Agricultural Sector at NITI Aayog on 13th February, 2018

Sh. Prakash Kumar

- Awarded Netaji Subhas-ICAR International Fellow.

Dr. A.K. Paul

- Worked as External Examiner of Narendra Ag.

Uni. of Faizabad.

- Nodal Officer-MGMG *(Mera Gaon Mera Gaurav)*

- Convener of the invited paper session on Designs, Bioinformatics and Statistical Genetics for farmers' welfare in the 71st Annual Conference of Indian Society of Agricultural Statistics (ISAS) at ICAR-DRMR, Bharatpur during 25-27th November 2017

- Member in the interview board on 14th July, 2017 for selection of Research Associate and SRF for the project "Modelling insect pests and diseases under climate change and development of digital tools for pest management" at ICAR-NCIPM.

- President, Institute Seminar Association

Dr. Tauqueer Ahmad

- Invited by the Food and Agriculture Organization of the United Nations (FAO), Rome as an Expert for Expert Consultation meeting on "SDG 12.3 – Measurement and action to meet the target on reducing food losses and food waste" held at FAO Headquarters, Rome, Italy during September 28-29, 2017.

- Nominated as one of the Expert Members of Selection Committee by the Vice Chancellor, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Srinagar for recruitment of Associate Professor, Statistics on 16.02.2018.

- Nominated as one of the Expert Members of Selection Committee by the Vice Chancellor, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Srinagar for conducting interviews for recruitment of Assistant Professor-cum-Junior Scientist, Statistics on 31.07.2017.

- Appointed as External Examiner by Interdisciplinary Department of Remote Sensing and GIS Applications, Aligarh Muslim University, Aligarh for conducting the Viva-voce of M.Sc. students on 02.06.2017.

- Appointed as External Examiner by AMU, Aligarh for Conducting viva voce examination of M.Sc. students of Department of Statistics and Operations Research, AMU, Aligarh on 16.12.2017.

- Appointed as External Examiner by AMU, Aligarh for Conducting viva voce examination of M.Sc. students of Department of Interdisciplinary Remote Sensing and GIS, AMU, Aligarh on 14.12.2017.

- Invited by NSSTA, Greater Noida, MoSPI, Govt. of India for delivering two lectures on "Horticulture Statistics" at NSSTA, Greater Noida in a training programme for ISS probationers as Guest Speaker.

- Invited by Directorate of Arecanut & Spices Development, Kozhikode, Kerala for participation in "Third National Consultative Meeting on Spices Statistics" held at Thiruvananthapuram, Kerala on 18.01.2018.

Dr. M. A. Iquebal:

- Member, Scientific Board, Online Journal of Bioinformatics.

- Member, Editorial Board, International Journal of Genetics and Genomics

- Editorial board member Journal of Plant Sciences (http://www.jplantsciences.org/editorialboard)

- Member Editorial Board of Computational Biology and Bioinformatics

- Journal Editor:Annals of Experimental Biology http://www.scholarsresearchlibrary.com/ journals/annals-of-experimental-biology

Dr. Sarika:

- Member Editorial Board of Computational Biology and Bioinformatics.

Dr. Hukum Chandra

- International Consultant, Food and Agricultural Organization of the United Nations, Myanmar during 15-22 November, 2017.

- Expert Member, "*Ethiopia Statistics from Space*" project under Global Strategy to Improve Agricultural and Rural Statistics, Food and Agricultural Organization of the United Nations, Addis Ababa, Ethiopia during 23-27 April, 2017.

- Expert, Annual Work Plan 2018-19 of the Population Research Centers, Ministry of Health and Family Welfare, Government of India, New Delhi during 27-28 March, 2018.

- Expert, Support for Statistical Strengthening Project, Directorate of Economics and Statistics, Odisha, 2017-18.

- Expert, Advisory Committee of All India Financial Inclusion Survey, National Bank for Agriculture and Rural Development, Mumbai.

- Convened three sessions (a) "Small Area Estimation" (b) "Advances in Survey Methodology

and (c) "Recent Advances in Analysis of Complex Survey Data, in the International Conference on Statistics, Hyderabad, India during 28-31 December, 2017.

- Resource Person, National workshop on "Statistical techniques for data Analysis, Amity Institute of Applied Sciences, Amity University, Noida, Uttar Pradesh during 20-21 July, 2017.

- Resource Person, Directorate of Economics and Statistics, Thiruvananthapuram, Kerala on 27 July, 2017.

- Resource Person, workshop on "Statistical Techniques Using R", Banasthali University, Rajasthan on 03 September, 2017.

- Resource Person, training program on "Use of Statistical Software for Analysis of Life Science Data, University of Agricultural Science & Technology of Kashmir, Sri Nagar, Kashmir on 26 September, 2017.

- Resource Person, training program on "Advanced Sampling Techniques" for ISS officers from 04-08 December 2017, the National Statistical Systems Training Academy, Ministry of Statistics & Programme Implementation, Govt. of India, Greater Noida on 05 December, 2017.

- Resource Person, training program on "Agriculture & Allied Statistics" for the ISS Probationers of 40th ISS Batch, National Statistical Systems Training Academy, Ministry of Statistics & Programme Implementation, Greater Noida on January 11, 2018.

- Resource Person, National workshop on «Statistical Techniques and Data Analysis using R», Central University of Haryana, Mahendergarh, Haryana on 21 March, 2018.

- Chaired a session in the 71th Annual Conference of the Indian Society of Agricultural Statistics, Bharatpur, Rajasthan during 25-27 November, 2017.

- Chaired invited technical session on "Recent Advances in Analysis of Complex Survey Data". The International Indian Statistical Association Conference 2017, Hyderabad, India during 28-39 December, 2017.

- Chaired an invited technical session in the International Conference on Theory and Applications of Statistics and Information Sciences, Coimbatore, Tamil Nadu during 05-07 January, 2018.

- Chaired contributed paper session, National Seminar on «Recent Advance in Statistics for Industries and Corporates», Department of Statistics, Anand, Gujarat during 10-11 February, 2018.

- Jury member, evaluated papers presented for best paper award, National Seminar on «Recent Advance in Statistics for Industries and Corporates», Department of Statistics, Anand, Gujarat during 10-11 February, 2018.

- Fellow of the National Academy of Agricultural Sciences.

- Krishi Vigyan Gourav Award of 2017 from Bhartiya Krishi Anusandhan Samiti and Krishi Anusandhan Sanchar Kendra (ARCC), Karnal for a co-authored Hindi Article.

- Elected Member, International Statistical Institute, The Netherlands.

- Member, International Association of sirvey Statisticians.

- Fellow, Member, Centre for Statistical and Survey Methodology, University of Wollongong, Australia.

- Associate Member, Southampton Statistical Sciences Research Institute, U.K.

- Member Secretary, Quinquennial Review Team, ICAR-Indian Agricultural Statistics Research Institute, New Delhi, 2018-19.

- 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 Committee of Direction for improvement of Animal Husbandry and Dairying Statistics, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi during 25-26 July, 2017.

- Member, Technical Advisory Committee for the Coverage Evaluation Survey 2018, Ministry of Health & Family Welfare, Government of India, 2018.

- Expert Member, Madras Institute of Development Studies, Chennai, India, 2017-18.

- Expert, Annual Work Plan 2018-19 of the Population Research Centers, Ministry of Health and Family Welfare, Government of India, New Delhi during 27-28 March, 2018.

- Expert Member, Socio-economic Panel Survey on the Elderly Population in Tamil Nadu: J-PAL South Asia, Indian Institute of Financial Management and Research in Chennai, in collaboration with Government of Tamil Nadu, India, 2017-18.

- Expert, Support for Statistical Strengthening Project of Directorate of Economics and Statistics, Bhubaneswar, Odisha, India, 2018.

- Member Group of Experts, Pooling data from DLHS-4 and AHS, Ministry of Health & Family Welfare, Government of India, 2018.

Offices in Professional Societies and Research Journals

Society of Statistics, Computer and Applications

Dr. Rajender Parsad	Executive President
Dr. L.M. Bhar	Joint Secretary
Dr. Alka Arora	Member Executive Council
Dr. B.N. Mandan	Member Executive Council (upto Dec., 2017)
Dr. Hukum Chandra	Joint Secretary
Dr. Anshu Bhardwaj	Member Executive Council

Journal of Society of Statistics, Computer and Application

Dr. Rajender Parsad	Executive Editor
Dr. Lal Mohan Bhar	Managing Editor
Dr. Alka Arora	Associate Editor
Dr. Hukum Chandra	Associate Editor

Indian Society of Agricultural Statistics

Dr. L.M. Bhar (from 22nd Jan, 2018)	Secretary
Dr. A.K. Choubey (1st Aug, 2017 to 21st Jan, 2018)	
Dr. U.C. Sud (upto 31st July, 2017)	
Dr. Amrit Kumar Paul	Joint Secretary
Dr. S.K. Sarkar	Joint Secretary
Dr. Ranjit Kumar Paul	Member, Executive Council

Dr. Sudhir Srivastava	Member, Executive Council
Dr. Mir Asif Iquebal	Member, Executive Council
Dr. Sukanta Dash	Member, Executive Council
Dr. Ankur Biswas	Member, Executive Council
Dr. Sarika	Member, Executive Council
Dr. Anshu Bharadwaj	Member, Executive Council
Dr. Samir Farooqi	Member, Executive Council
Dr. Kaustav Aditya	Member, Executive Council

Computer Society of India, Delhi Chapter.

| Dr. Alka Arora | Nomination Committee (NC) Chairman |
| Dr. Sudeep Marwaha | Nomination Committee (NC) Chairman |

International Association of Survey Statisticians

Dr. Hukum Chandra   Council Member

Dr. Anil Rai
- Member of Editorial Board of Indian Journal of Agricultural Sciences in ICAR, New Delhi.

Dr. 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.

Dr. Soumen Pal
- Member of Editorial Board of the Journal 'RASHI' of the Society for Application of Statistics and Allied Sciences (SASAA).
- Reviewer of Journal of Ecology and Environmental Sciences.

Dr. Ramasubramanian V.
- Associate Editor, Statistics and Applications journal
- Associate Editor, Journal of Fisheries and Life Sciences

Dr. Prawin Arya
- Reviewer for International Journal of Basic and Applied Agricultural Research.

Dr. Wasi Alam
- Member, Editorial Board, Journal of Agro-ecology and Natural Resource Management.
- Member, Editorial Board, Journal of Energy Research and Environmental Technology.

Dr. Ravindra Singh Shekhawat
- Associate Editor and Reviewer in Bio-info Publication.
- Editorial member of MARUMEGH Kisan e-Patrika.

Dr. Bishal Gurung
- Reviewer for International Journal of Agriculture Sciences.

Dr. R.K. Paul
- Reviewer of Journal of Indian Society of Agricultural Statistics and Agricultural Economics Research Review.

Dr. Hukum Chandra
- Guest Editor, Special issue on "Randomized Response Techniques and Their Applications", Statistics and Applications, 2017.
- Guest Editor, Special issue on "Survey Methodology and Applications", in honour of Professor J.N.K. Rao on his 80th birthday, Statistics and Applications, 2017-18.
- Guest Editor, Special issue to felicitate and honour Prof Arun Nigam on his 75th birthday, Statistics and Applications, 2017-18.
- Associate Editor, Journal of Statistical Theory and Practice, published by Taylor and Francis.
- Member Editorial Board, Journal of Model Assisted Statistics and Applications.
- Member Editorial Board, Journal of Safe Agriculture.

सांख्यिकी-विमर्श 2017-18 Editorial Board

Dr. Ajit	Chairman
Dr. Anil Chikara	
Mrs. Usha Jain	
Dr. D.C. Mishra	
Sh. D.P. Sharma	Member
Sh. B.J. Gahlot	
Dr. S.K. Sarkar	
Sh. Santosh Kumar	
Sh. S.K. Singh	

Foreign Visits

Dr Tauqueer Ahmad

Rome, Itly to participate in Expert Consultancy on SDG 12.3-Measurement and action to meet the target on reducing food waste at FAO HQ, Rome, Itly during 28-29 September, 2017

Dr Hukum Chandra

Myanmar, for a Short Term FAO Consultancy service under Global Strategy to Improve Agricultural and Rural Statistics in Myanmar during 16-21 November, 2017

China, to attend International Conference on Contemporary Theory and Practice of Survey Sampling at J.N.K. Rao Yunnan University, Kunming, China during 24-27 May, 2017

Ethiopia, to attend Expert Meeting on Statistics from Space project, Addis Ababa, Ethiopia during 24-26 April, 2017

Dr Sudeep Marwaha

Colombia, to attend CGIAR First Annual Conventional of Big Data Analytics at Cali, Colombia during 18-22 September, 2017

Dr. U.B. Angadi

Ethiopia, to attend workshop under Consultancy Institution Project Development of Database & Package for Data Analysis and Feed Resources, Addis Ababa, Ethiopia during 31 July-04 August, 2017

Dr. Arpan Bhowmik

Costa Rica, to participate in III Latin American Conference on Statistical Computing, University of Costa Rica, San Jose, Costa Rica during 25 Feb-05 March, 2018

7

Linkages and Collaborations in India and Abroad including Outside Funded Projects

S.No.	Title	Collaborative/ Funding Agency	Date of Start	Date of Completion
ICAR Institutes/ SAUs				
1	Planning, designing and analysis of experiments planned on stations under All India Coordinated Research Project on Integrated Farming Systems.	ICAR-AICRP on IFS, IIFSR, Modipuram.	01 April 2017	31 March 2020
2	Designing and Analysis of ON FARM Research Experiments Planned under AICRP on IFS.	ICAR-AICRP on IFS, IIFSR, Modipuram.	01 April 2017	31 March 2020
3	Planning, designing and analysis of data relating to experiments for AICRP on Long Term Fertilizer Experiments.	ICAR-AICRP on Long Term Fertilizer Experiments, IISS, Bhopal	01 April 2017	31 March 2019
4	Performance Assessments of Universities in Agriculture Education: A comparative analysis.	ICAR-Extramural	02 August 2017	31 March 2018
5	Development of 16s rDNA rumen specific microb database	ICAR-NIANP, Bangalore	01 April 2014 (IASRI association w.e.f. 23 July 2014)	30 April 2017
6	Tobacco Agridaksh: An online expert system	ICAR-CTRI, Rajahmundry	20 October 2014	19 January 2018
7	ICAR network project on transgenics in crops	ICAR-NRCPB, New Delhi	27 January 2015	31 March 2020
8	Development and assessment of educational mobile apps for improving livestock health and production.	ICAR-IVRI	28 June 2017	31 March 2019
9	Computational identification and modelling of genetic variation in relation to performance traits in buffaloes.	ICAR-CIRB, Hisar	06 June 2015	31 March 2018
10	Genomic data analysis for identification of economically important markers and viral diagnostics in pulses.	ICAR-IIPR, Kanpur	06 June 2015	30 September 2017
11	Computational approach for harnessing genome information and its integration with wheat phenome for efficient varietal development.	ICAR-IIWBR, Karnal	15 June 2015	30 September 2017

S.No.	Title	Collaborative/ Funding Agency	Date of Start	Date of Completion
12	Mining and validation of candidate gene markers and screening on antimicrobial peptides of black pepper and small cardamom.	ICAR-IISR, Kozhikode	15 June 2015	30 September 2017
13	Bioinformatics analysis of sequence data of brinjal and bitter gourd for identification of functional and regulatory genes for traits of economic importance.	ICAR-NBPGR, New Delhi	16 June 2015	30 September 2017
14	Molecular and computational approach to delineate metabolic pathways for better carbohydrate utilization in Labeo spp.	ICAR-CIFA, Bhubaneshwar	16 June 2015	30 September 2017
15	Elucidating the mechanism of Pashmina fibre development: An OMICS approach.	SKUAST-Kashmir and ICAR-NDRI, Karnal	01 July 2015	31 December 2018
16	Microbial domain research projects on computational aspects.	ICAR-NBAIM, Mau	03 July 2015	30 September 2017
17	Development of database repertoire for Clostridium perfiringens strains prevalent in causing Enterotoxaemia in goats.	ICAR-CIRG, Makhdoom	04 July 2015	30 September 2017
18	Development of database on SNPs associated with economically important traits of Indian goats.	ICAR-CIRG, Makhdoom	04 July 2015	30 September 2017
19	RiceMetaSys: Understanding rice gene network for blast resistance and drought tolerance through system biology approach.	ICAR-NRCPB, New Delhi	08 July 2015	30 September 2017
20	ICAR Research Data Repository for Knowledge Management as KRISHI: Knowledge based Resources Information System Hub for Innovations in Agriculture. Funded by ICAR Headquarter Plan Scheme under XII Plan period (2012-2017).	ICAR-NAARM, Hyderabad, ICAR-NBSS&LUP, Nagpur, ICAR-IARI, New Delhi, DKMA, New Delhi, ICAR-CMFRI, Kochi, ICAR-CRIDA, Hyderabad	24 July 2015	31 March 2020
21	Identification of genetic polymorphisms for pathogenicity in Vibrio sp.	ICAR-CIBA, Chennai	19 August 2015	30 September 2017
22	Potential gene mining from salt tolerant grasses for improvement of salt tolerance in crops.	National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA), Indian Council of Agricultural Research, New Delhi	01June 2017	31 March 2020
23	Rice-metasys: understanding rice gene network for blast resistance and drought tolerance through system biology approach.	ICAR-NRCPB, New Delhi	01 March 2018	31 March 2020
24	Computational and experimental biology approaches for delineation of selected secondary metabolite pathways and antimicrobial peptides (AMPs) in major spices.	ICAR-IISR, Kozhikode	05 March 2018	31 March 2020

S.No.	Title	Collaborative/ Funding Agency	Date of Start	Date of Completion
25	Metagenomic applications and transcriptomes profiling for inland aquatic environmental health surveillance.	ICAR-CIFRI, Kolkatta	01 September 2015	30 September 2017
26	Deciphering genetic variation in the carbohydrate metabolism of farmed rohu families.	ICAR-CIFA, Bhubaneshwar	05 March 2018	31 March 2020
27	Genomic data analysis to elucidate the regulatory network and candidate genes underlying cytoplasmic male sterility in pigeonpea.	ICAR-IIPR, Kanpur	05 March 2018	31 March 2020
28	Computational approach for genomic resource improvement and precision phenotyping of less explored yield traits in Wheat.	ICAR-IIWBR, Karnal	05 March 2018	31 March 2020
29	Computational biology approach for deciphering stress induced transcriptomic and proteomic changes rice-microbial interaction system.	ICAR-NBAIM, Mau	06 March 2018	31 March 2020
30	Investigations on stipe rust-defence response, identification of defence genes/QTLs associated with rust resistance in Wheat.	ICAR-NBPGR, New Delhi	09 March 2018	31 March 2020
31	Investigations on pathogenic microorganisms of shrimp aquaculture using metagenomic and other bioinformatic approaches.	ICAR-CIBA, Chennai	09 March 2018	31 March 2020
32	Genomic and transcriptome sequencing of coriander (Coriandrum sativum) to reveal insight of its genomic architechture and breeding targets. Colloboration with Junagadh Agricultural University, Junagadh)	Junagadh Agricultural University, Junagadh	14 March 2018	31 March 2020
33	Gene regulatory networks modeling for heat stress responses of sources and sink for development of climate smart Wheat.	ICAR-IARI, New Delhi	26 November 2015	30 September 2017
34	Studying drought-responsive genes in subtropical maize germplasm and their utility in development of tolerant maize hybrids.	ICAR-IARI, New Delhi	26 November 2015	30 September 2017
35	Transcriptome and proteome analysis for identification of candidate genes responsible for pistillate nature in castor.	ICAR-IIOR, Hyderabad, ICAR-IARI, New Delhi, JAU, Junagadh	21 January 2016	31 March 2018
36	Development of web server for phenotype analysis for cattle breeding management.	ICAR-CIRC, Meerut	12.Mach.2018	11.March.2021
37	Knowledge management system for agriculture extension services in Indian NARES. Funded by Extramural funded under Agricultural Extension Division, ICAR.	Agricultural Extension Division, ICAR.	04 March 2016	31 March 2020
38	In silico analysis of data for identification of functional alleles for stress tolerance and quality traits using bioinformatics in Potato.	ICAR-CPRI, Shimla	12. September 2016	30 September 2017

S.No.	Title	Collaborative/ Funding Agency	Date of Start	Date of Completion
39	Computational and Analytical Solutions for High-throughput Biological Data	All Bureaux /ICAR Consortium Research Platform on Genomics	04 September 2017	31 March 2020
40	Whole genome sequencing and development of allied genomics resources in two commercially important Fish-Labeo rohita and clarias batrachus.	ICAR-NBFGR, Lucknow, ICAR-CIFRI,Kolkatta, ICAR-CIFA, Bhubaneshwar	28 January 2014	31 Marh 2018
41	Whole genome based SNP mining and development of breed signatures for dairy and dual purpose indigenous cattle.	ICAR-NBAGR, Karnal ICAR-NDRI, Karnal ICAR-IASRI, New Delhi	09 July 2014	31 December 2017
42	Assessment of post harvest losses in fruits and vegetables and strategies for their reduction in Andman and Nicobar Islands.	ICAR-CIARI, Port Blair	01 June 2015 (Association of IASRI w.e.f. 03 October 2016)	31 August 2018
43	Phenomics of moisture deficit stress tolerance and nitrogen use efficiency in Rice and Wheat – Phase II.	ICAR-IARI, New Delhi,	01 January 2017	31 March 2019
44	Management and impact assessment of farmer first project.Funded by ICAR farmer first programme under KVK scheme (ATARI-I)	ICAR- NIAP, New Delhi, ICAR-NAARM, Hyderabad, DKMA, New Delhi	14 February 2017	31 March 2020
45	Doubling farmers' income in India by 2021-22: Estimating farm income and facilitating the implementation of strategic framework.	ICAR-NIAP, New Delhi	31 March 2017	31 March 2022
46	Modeling insect pests and diseases under climate change and development of digital tools for pest management National Innovations in Climate Resilient Agriculture (NICRA).	ICAR-NCIPM, New Delhi ICAR-CRIDA, Hyderabad	20 June 2017	31 March 2020
47	Efficiency of micro irrigation in economizing water use in India-learning from potential and unexplored states. Funded by NITI Ayog	ICAR-NIAP, New Delhi BACA, Anand, Gujrat ICAR-IASRI, New Delhi	20 December 2017	30 June 2018
48	Creating a fully characterized genetic resource pipeline for mustard improvement programme in India.	PAU, Ludhiyana, ICAR-IARI, New Delhi, Directorate of Rapeseed-Mustard Research, Bharatpur; GBPUAT, Pantnagar	01 January 2017	31 December 2019
49	Development of varietal and hybrid technologies of pearl millet [Pennisetum glaucum (L). R. Br.] For higher yield and nutritional improvement.	ICAR-IARI, New Delhi	26 September 2016	06 October 2017
	Government of India			
50	Study to test the developed alternative methodology for estimation of area and production of horticultural crops. (CHAMAN program under MIDH)	Department of Agriculture and Cooperation (DAC), Ministry of Agriculture (MoA), Government of India.	16 September 2014	31 Julyt 2018

S.No.	Title	Collaborative/ Funding Agency	Date of Start	Date of Completion
51	Pilot study for developing state level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanthan Committee Report	Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.	16 February 2015	31 August 2018
52	Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production.	Directorate of Economics & Statistics (DES), Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Govt. of India.	01 September 2015	31 July 2018
53	Stochastic differential equation models and their applications to agriculture.	Science and Engineering Research Board (SERB), New Delhi.	06 November 2015	05 November 2018
54	Forecasting Agricultural output using Space Agrometeorology and Land based Observations (FASAL). Funded by IMD, New Delhi.	IMD, New Delhi	13 April 2016	31 May 2018
55	Incomplete split-plot designs: construction and analysis. Funded by SERB.	Science and Engineering Research Board (SERB), New Delhi.	16 August 2016	15 August 2019
	Consultancy Studies			
56	Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Madhya Pradesh State.	DAC, Ministry of Agriculture, GOI	01 June 2015	28 February 2018
57	Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Haryana State.	DAC, Ministry of Agriculture, GOI	06 August 2015	05 May 2018
58	Development of database and package for data analysis and visualization tool for analysis Development and visualization of feed resources in Ethiopia.	ILRI, Hyderabad (FAO)	15 July.2017	15 December 2017
59	Pilot study on measurement of private food grains stock including estimation of on-farm post harvest losses under Input Survey of Agriculture Census in India. Funded by Food and Agriculture Organization of the United Nations, India (FAO-India)	Food and Agriculture Organization of the United Nations, India (FAO-India)	01 June 2017	31 July 2017
60	Study on developing Guidelines for estimating post harvest losses of horticultural crops, livestock products and fish and fish products. Funded by Food and Agriculture Organization of the United Nations (FAO), Rome, Italy	Food and Agriculture Organization of the United Nations (FAO), Rome, Italy	17 November 2017	15 March 2018

S.No.	Title	Collaborative/ Funding Agency	Date of Start	Date of Completion
61	Study on field testing of the developed guidelines on estimating post harvest losses of horticultural crops, livestock products and fish and fish products. Funded by Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.	Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.	17January 2018	31October 2018
62	Strengthening Agricultural Market Information in India (AMIS) using Innovative Methods and Digital Technology	FAO, Delhi Office	20 May 2017	19 June 2017
63	Global Strategy to improve agricultural and rural statistics in Myanmar.	FAO, Delhi Office	45 days during 2017& 2018	
64	Customization and Implementation of Academic Management System (AMS) for Post Graduate and Under Graduate Education at UHS	UHS, Bagalkot	10 July 2017	09 July 2018
65	Customization and Implementation of Academic Management System for Post Graduate & Under Graduate Education at Birsa Agricultural University (BAU), Kanke, Ranchi.	Birsa Agricultural University (BAU), Kanke, Ranchi.	24 February 2018	23 February.2019
66	Customization and Implementation of Academic Management System for Post Graduate & Under Graduate Education at University of Agricultural Sciences, Dharwad.	University of Agricultural Sciences, Dharwad	24 February 2018	23 February.2019
67	Customization and Implementation of Academic Management System for Post Graduate & Under Graduate Education at Balasahib Sawant Konkan Krishi Vidyapeeth, Dapoli.	Balasahib Sawant Konkan Krishi Vidyapeeth, Dapoli	24 February 2018	23 February.2019

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Publications

Referred Research Articles:

1. Aditya, K, Chandra, H, Sud, UC, Bharadwaj, A and Dahiya, R (2018). Development of Software for Digitization of Collected Data Under a Pilot Study to Estimate Crop Area and Production Based on the Sample Sizes Recommended by Professor Vaidyanathan Committee Report. *Journal of the Indian Society of Agricultural Statistics,* 72 (1):15-26.

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3. Anjoy, P, Paul, RK, Sinha, K, Paul, AK and Ray, M (2017). A hybrid wavelet based neural networks model for predicting monthly WPI of pulses in India. *Indian Journal of Agricultural Sciences*, 87 (6): 834-839.

4. Aravind, J Rinku, S, Pooja, B, Shikha, M, Kaliyugam, S, Mallikarjuna, MG and Rao, AR (2017). Identification, characterization, and functional validation of drought-responsive microRNAs in subtropical maize inbreds. *Frontiers in plant science* 8: 941.

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8. Basak, P, Sud, UC and Chandra, H (2018). Calibration Estimation of Regression Coefficient for Two-stage Sampling Design using Single Auxiliary Variable. *Journal of the Indian Society of Agricultural Statistics,* 72(1): 1-6.

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13. Bhowmik. A, Varghese, E, Jaggi, S and Yadav, SK (2017). Designs for Animal experiments under two-way blocking structure in the presence of systematic trend. *Indian Journal of Animal Sciences*, 88 (1): 121–124.

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SN	Name of Technology(Software)/ Literary Work	Author(s)	Applied on	Diary Number	Copyright Registration Number	Copyright Granted on
1.	Statistical Analysis of Agricultural Experiments Part 1: Single Factor Experiments	V. K. Gupta, Rajender Parsad, Lal Mohan Bhar, Baidya Nath Mandal	22/09/2016	12198/2016-CO/L	L-67363/2017	17/07/2017
2.	Mobile Assisted Personal Interview version 1(MAPI ver. 1)	Kaustav Aditya, Hukum Chandra, AK Gupta, Ankur Biswas, Anshu Bharadwaj, Anil Kumar, Ajit, Vandita Kumari, Raju Kumar	22/03/2017	5478/2017-CO/SW	SW-9378/2017	05/09/2017
3.	Data Entry Software for estimation of harvest and post harvest losses of crop/commodities	Tauqueer Ahmad, Anil Rai, Prachi Misra Sahoo	22/09/2016	11986/2016-CO/L	SW-9295/2017	03/08/2017
4.	Web Generation of Factorial Experiments with Minimum Level Changes in Run Sequences (webFMC)	Arpan Bhowmik, Eldho Varghese, Cini Varghese, Seema Jaggi	15/02/2016	2183/2016-CO/SW	SW-9312/2017	14/08/2017
5.	Web Generation of Polycross Designs (webPD)	Cini Varghese, Seema Jaggi, Eldho Varghese, Arpan Bhowmik	15/02/2016	2187/2016-CO/SW	SW-9311/2017	14/08/2017
6.	Pilot Study to Develop an Alternative Methodology for Estimation of Area and Production of Horticultural Crops	Tauqueer Ahmad, H.V.L. Bathla, Anil Rai, D.C. Mathur, R.M. Sood	18/03/2015	2675/2015-CO/L	L-71033/2017	09/12/2017
7.	Data Entry Software for Crop Area and Yield Estimation Survey	Kaustav Aditya, Hukum Chandra, Anshu Bharadwaj, Man Singh, CP Singh	22/03/2017	5477/2017-CO/SW	SW-10006/2018	13/01/2018
8.	Significance of Experimental Designs in Agricultural Research	V.K. Gupta, Rajender Parsad, Baidya Nath Mandal	15/02/2016	2189/2016-CO/L	L-73008/2018	02/02/2018
9.	IVRI-Pashu Prajanan App (Hindi)	Sudeep Marwaha, Mukesh Kumar, Soumen Pal		24/2018-CO/L	L-73430/2018	16/02/2018
10.	IVRI-Pashu Prajanan App (Punjabi)	Sudeep Marwaha, Mukesh Kumar, Soumen Pal		21/2018-CO/L	L-73889/2018	09/03/2018

Consultancy and Advisory Services

International Consultancy

Hukum Chandra

Dr. Hukum Chandra, worked as International Consultant for the Food and Agricultural Organization (FAO) of the United Nations in Myanmar. He provided consultancy on Global Strategy to Improve Agricultural and Rural Statistics activities on the "Improvement of Crop Statistics" and the "Improvement of Livestock Statistics" in Myanmar

Dr. Hukum Chandra with Dr. Aung Thu, Hon'ble Union Minster of Agriculture, Myanmar observing crop cutting experiment in paddy field in Myanmar

during November 15-22, 2017. During this mission in Myanmar, he reviewed the current methodologies for estimating paddy including details on measuring area sown, area harvested, and the crop yield, and also made assessment of existing methodologies for the estimation of livestock production statistics.

U.B. Angadi

The consultancy service was awarded by International Livestock Research Institute, ICRISAT, Hyderbad, Patancheru, Telangana under Development of Database and software for demand-supply of feed resources in Ethiopia. The consultant has visited Addis Ababa, Ethiopia to attend the workshop on Introduce their key staff to Ideas and Approach of the Project "Development of Database and Package for Data Analysis and Feed Resources in Ethiopia", at Addis Ababa, Ethiopia. During the workshop the consultant has presented work regarding Introduction of FeedBase – the Indian concept, approach and experience. Also, He has delivered an advisor talk and discussion on "From static feed

supply – demand scenario to interactive decision making tool" with working group on decision making tools. Data standardization, database design and development, analysis tool, evaluation and testing of data of eight districts of four regions of Ethiopia was finalized.

Tauqueer Ahmad, U.C.Sud, Ankur Bishwas and Man Singh

Under the FAO-India (Food and Agricultural Organization) funded consultancy project entitled "Pilot study on measurement of private food grains stock including estimation of on-farm post-harvest losses under Input Survey of Agriculture Census in India", a 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. A suitable questionnaire aligned with existing Input Survey of Agriculture Census was developed covering different on-farm food grains stock and post-harvest management during storage at farm level. Stratified two stage sampling design treating tehsils as strata, villages as first stage units and operational holders as second stage units being used in Input Survey was adopted. The ultimate sampling unit was an operational holder. Pilot survey was conducted in two states namely, Haryana and Madhya Pradesh taking one district in each of the two states and two tehsils within each district was considered for the study. The four crops under AMIS study i.e. wheat, paddy, maize and soybean along with pulses were covered under this pilot survey. Primary data collection was carried out using Paper Assisted Personal Interviewing (PAPI) method by enquiry by the Field Investigators/Enumerators nominated by ICAR-IASRI with the cooperation of respective district and tehsil Revenue officers and Patwaris of the selected villages for all the three seasons. The data analysis was carried out using Statistical Analysis System (SAS) software available at ICAR-IASRI. The SAS codes were written as per the proposed estimation procedures for suitable data analysis.

The estimates of food grains stock, pre-harvest opening stock, production obtained, quantity sold, quantity stored, quantity disposed, percentage stock and percentage post-harvest loss at farm level were obtained along with its percentage Standard Error (%SE) and were found to be reasonably good for overall size classes. Therefore, it is expected that for overall holding size classes, the proposed methodology will provide farm level reliable estimates of food grains stock including post-harvest losses at district level. Besides, percentage distribution of different parameters by size group of operational holders for all the crops under study has been obtained for both the districts. The study has established the feasibility of inclusion of developed questionnaire in the future Input Survey of Agriculture Census in India in order to estimate the food grains stock including post-harvest loss at farm operations which will bridge the gap on post-harvest information and private food grains stock in on-farm and off-farm domains of the supply chain.

Tauqueer Ahmad, Anil Rai, AK Choubey, Prachi Misra Sahoo, Ankur Biswas, Man Singh and GM Pathak

This project entitled "Study on developing Guidelines for estimating post-harvest losses of horticultural crops, livestock products and fish and fish products" was awarded to ICAR-IASRI by Food and Agriculture Organization of the United Nations (FAO), Rome, Italy, under Institutional Consultancy project mode. Under this project, three different sampling methodologies for estimation of quantitative harvest and post-harvest losses of (i) horticultural crops (fruits and vegetables), (ii) livestock (meat and milk) and (iii) fish (capture and culture fisheries) have been developed. As one of the objectives of the study, Guidelines for estimating post-harvest losses of grains developed by the FAO was peer reviewed and comments on the guidelines were sent to the FAO for revision of the guidelines. After incorporating the comments, revised Guidelines was sent to the FAO Editor by the FAO for editing. Three separate Guidelines for estimating post-harvest losses of horticultural crops (fruits and vegetables), livestock (meat and milk) and fish (capture and culture fisheries) were prepared and submitted to the FAO. Comments on the guidelines were received from FAO and the revised Guidelines after incorporating the comments were submitted to FAO. Clearance of Guidelines from FAO is awaited.

Tauqueer Ahmad, Anil Rai, Prachi Misra Sahoo, Ankur Biswas, Kaustav Aditya and Man Singh

This project entitled "Study on field testing of the

developed guidelines on estimating post-harvest losses of horticultural crops, livestock products and fish and fish products" was awarded to ICAR-IASRI by Food and Agriculture Organization of the United Nations (FAO), Rome, Italy under Institutional Consultancy project. Under this project, newly developed Guidelines on estimating post-harvest losses of (i) horticultural crops, (ii) livestock products and (iii) fish and fish products are to be field tested in 2-3 developing countries. Namibia from Africa Region has been identified for field testing the Guidelines on livestock products (meat and milk), whereas an attempt is being made by the FAO to finalize Philippines from Asia-Pacific region for field testing the Guidelines on (i) horticultural crops (fruits and vegetables) and (ii) fish and fish products (capture and culture fisheries). Coordination with Namibia through FAO for planning of survey is being made.

Ranjit Kumar Paul

FAO-India (Food and Agricultural Organization) funded consultancy entitled "Identification of Principal Markets and Framework of Market co-integration" under Strengthening Agricultural Market Information in India (AMIS) using innovative methods and digital technology, is an attempt to investigate the market integration of wholesale prices of pulses in India based on major pulses viz. Pigeon pea (Tur), Chick peas (Gram), Lentil and Moong.

The present investigation has used different statistical techniques namely testing stationarity, concept of cointegration, testing for rank of cointegration, vector error correction model (VECM) and Granger causality testing. The study reveals that the changes in wholesale prices of pulses in one market will cause change in wholesale prices in other markets. It is inferred that the price signals are transmitted across regions indicating that price changes in one market are consistently related to the price changes in other markets and are able to influence the prices in other markets. However, the direction and intensity of price changes may be affected by the dynamic linkages between the demand and supply of pulses. It has been revealed that most of the markets are co-integrated and rate of adjustments is high when prices are assumed to be influenced by the changes in each other's price. Thus, the price changes are temporary and would converge to an equilibrium within a given time span. A proper focus on domestic supply management along with international trade coupled with strong market surveillance and intelligence efforts would help control escalating prices and also help in minimizing the distortions widening the gap in the prices of pulses among the markets.

National Consultancy

Tauqueer Ahmad, UC Sud, Prachi Misra Sahoo, Anil Rai, Ankur Biswas, Vandita Kumari, Man Singh, GM Pathak and Neelam Chandra

This project entitled "Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Haryana State" was awarded to ICAR-IASRI by Haryana State Government under Institutional Consultancy project mode. Under this project, an alternative sampling methodology developed by ICAR-IASRI for estimation of area and production of horticultural crops is being tested and validated in Haryana State. Primary data collection was completed in the State in June 2017. Progress of the field work was reviewed, filled-in schedules were scrutinized and field visits were made to monitor the field work. The ICAR-IASRI Scientists, Field Officer and Technical officers carried out supervision of data collection in all the selected districts of the State. Data entry and scrutiny of entered data have been completed. Data analysis has been completed for 4 out of 6 selected districts. An interim report of the study including results for these 4 districts was prepared and submitted to the funding agency in February, 2018.

Tauqueer Ahmad, UC Sud, Prachi Misra Sahoo, Anil Rai, Kaustav Aditya, Raju Kumar, Man Singh, GM Pathak and Neelam Chandra

This project entitled "Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Madhya Pradesh State" was awarded to ICAR-IASRI by Madhya Pradesh State Government under Institutional Consultancy project mode. Under this project, an alternative sampling methodology developed by ICAR-IASRI for estimation of area and production of horticultural crops is being tested and validated in Madhya Pradesh State. Primary data collection was completed in the State in June 2017. Progress of the field work was reviewed, filled-in schedules were scrutinized and field visits were made to monitor the field work. The ICAR-IASRI Scientists, Field Officer and Technical officers carried out supervision of data collection in all the selected districts of the State. Data entry is in progress.

Research Advisory:

Dr. Anil Rai

- Providing consultancy to FAO for writing three

guidelines/manuals for Estimation of harvest and Post-Harvest Losses of Horticultural crops, Fisheries and Livestock products

Dr. K.K. Chaturvedi

- Mr. Himanshu, Scientist, ICAR-DKMA, New Delhi was advised in writing the shell scripts and job submission to SMP server of ASHOKA.

- Four B.Tech. students from TNAU, Coimbatore were advised on genetic variants related to stress in wheat from the literature and compile the collected material in the form of database.

Dr. M.A. Iquebal

- Advised Dr. Soham Roy, Scientist, ICAR-CRIJAF, Barrackpore regarding insilico finding of polymorphic SSR markers.

- Advised Mr. Ashutosh Kumar, Ph.D. student, PAU, Ludhiana regarding insilico mining of SNP markers.

- Advised Dr. Shrawan Singh, Scientist, Division of Vegetable Science, ICAR-Indian Agricultural Research Institute on analysis of augmented design with 160 hybrids and 4 checks of cauliflower.

- Advised Dr. S.V. Sai Prasad, Head, Regional Station, ICAR-Indian Agricultural Research Institute, Indore on analysis of augmented design with 603 lines and 5 checks of wheat.

- Advised Dr. Subrata Dutta, Associate Professor, Department of Plant Pathology (AICRP on Vegetable Crops), BCKV, Kalyani on effect of different dates of planting on Rhizoctonia solani using Artificial Neural Network methodology.

- Advised Dr. S.C. Dubey, Head, Division of Plant Quarantine, ICAR-National Bereau of Plant Genomic, New Delhi on analysis of RBD-Factorial experiment for individual year as well as pooled analysis.

- Advised Dr. Amlendu Ghosh, Scientist, IARI, New Delhi regarding designing of transcriptome experiment for further data generation.

Dr. Sarika

- Advised Mr. Ashutosh Kumar, Ph.D. student, PAU, Ludhiana regarding diversity analysis using of SNP markers.

- Advised Dr. Sonia Sheoran, Scientist, Plant Biotechnology, ICAR-Indian Institute of Wheat and Barley Research, Karnal on association

analysis using Plink software.

- Advised Pooja Singh Patil, Ph.D. student, Anand Agricultural University, Anand on analysis of split-split plot experiment using SAS 9.3 software.

- Advised Dr. Amita Das, Scientist, ICAR-IARI, New Delhi regarding phylogenetic analysis.

- Advised Mr. Sudhir PN, Research Scholar, Department of Mycology and Plant Pathology, BHU, Varansi regarding SNP data analysis and population structure analysis.

Sh. Neeraj Budhlakoti

- Sudhir, Research associate, BHU, Varanasi was advised on the procedure of analysis of an experiment conducted for Wheat genotype (With different genome A, B, D) with 479 SSR markers for 55 accessions with multiple traits. Population structure has been identified and association study has been done to mine important marker.

- Ram Narayan, Ph.D student, BHU, Varanasi was advised on the procedure of analysis of an experiment conducted for 288 Wheat genotype with 35 K wheat SNP markers observed for multiple traits. Population structure has been identified and association study has been done to mine important marker.

- Mr. Anjan Kumar Pradhan, M.Sc. (Bioinformatics) a student of OUAT, Bhubaneshwar was advised for analysis of DDRAd sequencing data.

- Dr. Kumaraswamy, Scientist from ICAR-IIOR, Hyderabad was advised on the procedure of analysis of an experiment conducted for Wheat genotype (With different genome A, B, D) with 14 SSR markers for 618 accessions. The number of genotype were compared and and population structure has been identified using STRUCTURE and STRUCTURE Harvestor.

- Dr. Richa varsney, Scientist, ICAR-NBAIR, Bengaluru has been advised on fitting of functional response among prey and predator. The analysis has been carried out using R.

Dr. Soumen Pal

- Carried out data analysis (trend estimation of time series data) of Mr. Sayak Mahato, M.Sc. Student, Department of Agricultural Meteorology, Bidhan Chandra Krishi Viswavidyslaya, Mohanpur, West Bengal.

- Provided advisory to Mr. Devendra Pratap Singh, Research Scholar, IGKV, Raipur regarding analysis of paddy production/productivity data

using different nonlinear growth models.

Dr. Eldho Varghese and Dr. Rajender Parsad

- Mr. Aravind Jayaram, Scientist, ICAR-NBPGR, was advised on the analysis procedure of an experiment conducted using reinforced alpha design.

Dr. Mohd. Harun

- Dr. Ajay Verma, Scientist at ICAR-Central Institute for Arid Horticulture, Bikaner was advised to calculate the Correlation Coefficient and test the significance of Correlation Coefficient and also to calculate partial Correlation Coefficient along with the test the significance.

- Ms. Sunita Yadav, Scientist, CESCRA, ICAR-IARI was advised regarding analysis of data. The data was collected for the assessment of crop residues burning on soil physico-chemical and biological properties.

- D. Yadav, a Ph.D student of the division of Agronomy, ICAR-IARI, New Delhi, was advised regarding the analysis of data. The design used for the experiment was split plot design. The experiment consisted of 5 main plot and 4 subplot factors with 3 replications. The data was analyzed using MS excel software.

- Mr. Mohammed Mustafa Ibrahim a Ph.D. Scholar of Deptt. of Entomology, ICAR-IARI, New Delhi, was advised on analysis of data on hygienic behavior of honeybee against Varroa Mites. The data was collected monthly for a period of six months on different attributes like number of damaged mites, number of damaged legs, number of damaged body, number of damaged females, number of damaged male, total no. of mites etc. As per researcher's interest correlation and regression analysis was done using SPSS and SAS.

- Mr. V. Bhargav, a Ph.D. Scholarof Deptt. Of Floriculture and Landscape Architecture, ICAR-IARI:IIHR, Bengaluru was advised on cluster analysis of data. There were 42 genotypes of Pea and 14 parameters/characters like plant height, number of leaves per plant, plant spread, number of branches per plant, days to first flowering etc. The analysis was performed using SAS and SPSS software to find out the inter-cluster distances, intra-cluster distances and cluster mean for different characters. Dendrogram was also prepared.

- Ms. Lalita Rana a Ph.D (Agronomy) student of

BCKV, W.B. was advised regarding analysis of data. The factorial experiment was conducted using split plot design with three replications, three varieties, three Plant spacing and three 3 DOS. The varieties are main plot factors and others are sub plot factors.

Dr. Eldho Varghese

- Dr. Bhupender, Scientist, IIMR, New Delhi was advised to use the following four alpha design for four different trials on maize varieties and also provided the randomized layout of the same

- Dr. Dibakar Mahanta, VPKAS, Almora was advised on the use of principle component analysis in reducing the dimensionality of the data pertaining to soybean and wheat crop and also provided him the SAS code for doing the same.

Dr. Rajender Parsad

- Professor R.M. Sharma, Principal Scientist, Division of Fruits & Horticultural Technology, ICAR-IARI, New Delhi was advised on the analysis of data generated from augmented designs.

- Dr. Sujay Rakshit, Indian Institute of Maize Research, Ludhiana were advised on use of alpha designs (i) v=250, r=3, k=25; v=250, r=3, k=10; (ii) v=285, r=2, k=15; (iii) v=165, r=2, k=11 and (iv) v=750, r=2, k=25.

Sh. Sunil Kumar Yadav

- Mr. Pradeep Maurya, a student of PG School IARI was advised on analysis of the data pertaining to an experiment conducted using CRD to the study of leaf curl disease susceptibility of a chilli variety 'Pusa jwala' by introducing white fly at 4 different growth stages.

Dr. 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, ICAR-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. scholar of the 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).

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Dr. B N Mandal

- Advisory service was provided to a M.Sc. Student in Genetics and Plant Breeding from UAS, Bengaluru on construction of a simple lattice design for 121 genotypes.

- Advisory services was provided to Mr. Sandeep Kumar, Scientist, Environmental Sciences, Centre for Environment Science and Climate Resilient Agriculture (CESCRA) on principal component analysis of a dataset using R software.

Sh. Santosha Rathod

- Provided advisory services for developing Gene Co-expression Network of Genes Responsible to Multiple Stress in Chickpea to Dr. Aravind Kumar, Scientist, ICAR-IIPR, Kanpur Ph.D. Scholar in R and Cytoscape.

- Provided advisory services for analyzing augmented design and cluster analysis for "genotypic and phenotypic traits of Soybean in Western Himalya" of Mr. Yegappa, Ph.D. Scholor, ICAR-IARI, New Delhi in SAS V9.4.

- Provided advisory services for analyzing data using cluster analysis and Response Surface Design for drying Kinetics and Osmatic Dehydration of Pine Apple to Mr. Tayeeb, Ph.D. scholar, UHS Bagalkot, Karnataka, in R and SAS software.

- Provided advisory services for analyzing data of study entitled Effects of Six Weeks of Aerobic Dance Training on Health Related Fitness among High School Boy of Mr. Siddappa Nandar, Assistant Professor, Dept. of Physical Education University of Agricultural Sciences, Dharwad in R software.

- Carried out RBD data analysis in SAS of Mr. Mahesh Badiger, Ph. D. Scholor (Vegetable Science), ICAR-IARI, New Delhi, for his Ph.D. thesis entitled Studies on Genetic Diversity and Crossability Between A. Esculentus and Its Wild Species for Resistance to BYVMV.

- Carried out group of experiment data analysis in SAS of Mr. Hemaraj Bhandari, Scientist, ICAR on Stability Analysis of Different Genotypes Over Different Locations and Year.

- Carried out analysis of stability analysis, path analysis and D-square analysis of Dr. Mukesh A. Patel, Assistant Professor, Navsari Agricultural University for the project entitled Assessment of genetic diversity and stability of African marigold (Tagetes erecta L.) under the south Gujarat conditions.

- Carried out wavelet neural network analysis of black pepper data of Karnataka for Mr. Hanumantya, Ph.D. Scholar, IAS, BHU, Varanasi.

- Carried of data analysis on "Forecasting of Maximum Temperature of Cuttack region using ARIMA model" of Dr. P. S. Hanjagi, Scientist, ICAR-National Rice Research Institute, Cuttack in R software.

Sh. Achal Lama

- Provided advisory services for Factorial RBD data using SAS software to Dr. Sumita Pradhan, Assistant Professor, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar.

- Provided advisory services for analysing CRD data using SAS software for Ms. Pritika Rai, M.Sc. student of Sikkim University, Gangtaok. .

- Analyzed Sugarcane price and production data for Dr. Rajesh Kumar, Principal Scientist, ICAR-IISR, Lucknow in SAS using GARCH family models.

Sh. Mrinmoy Ray

- Dr. Debasish Chakraborty, Scientist, ICAR Research Complex for NEH Region, Barapani was advised on R software packages for fitting Copula and GARCH model

- Carried out data analysis (ANN, Trend impact analysis, grey model, fuzzy clustering and fuzzy factor) for Mr. Anirban Mukherjee, Scientist, ICAR-VPKAS, Almora.

Sh. Ravindra Singh Shekhawat

- Provided advisory services for analysing stability analysis in dual purpose sorghum to Rumana Khan, Ph.D. student at RCA, MPUAT, Udaipur, Rajasthan.

- Provided advisory services to Dr. Madhusudhan Bhattarai, Independent Consultant, New Delhi on Break Even Point (BEP) analysis for tractor.

- Provided advisory services to Dr. Madhusudhan Bhattarai, Independent Consultant, New Delhi on Break Even Point (BEP) analysis for tractor.

Dr. Wasi Alam

- Provided advisory service about analysis of augmented design using SAS to Dr. Ratna Preeti Kaur, Scientist-Genetics, ICAR- Central Potato Research Station, Jalandhar, Punjab.

- Provided advisory service on nonparametric test for ordinal data to Mr. Saleh Md. Hedayatullah, a Ph. D. scholar of Department of Linguistics, AMU, Aligarh.

Dr. Bishal Gurung

- Advised Ms. Ampee Tasung, a Ph.D. Scholar, Division of Soil Science, ICAR-IARI, New Delhi on the use of Factorial Designs using SAS software.

Dr. Bishal Gurung and Dr. K.N. Singh

- Provided supervision and guidance to Ms. Ampee Tasung, Scientist, ICAR Research Complex for NEH Region, on her Professional Attachment Training from 29 November, 2017 to 28 February, 2018 on the research work "Study on nonlinear models and optimization in soil science".

Dr.V. Ramasubramanian

- Provided advisory services to Mr. Kharatmol Rudrappa Balaji, Ph. D Scholar (FRM), ICAR-CIFE, Mumbai for determining sample sizes of various stakeholders for sending questionnaire on FAO Code of Conduct for Responsible Fishing.

Sh. Rajeev Ranjan Kumar

- Carried out Co-integration analysis, Factor analysis and PCA for kinnow price data. All these analysis has been done using R software of Ph.D. Student, Vikram Yogi from Division of agricultural Economics, ICAR-IARI, New Delhi.

- Carried out PCA, correlation analysis for different species of apple data of Mr. Chavlesh kumar Sahu, Scientist, ICAR-IARI, New Delhi. All these analysis has been done using R software.

Ms. A R Anuja

- Advised Jesna V. K., A Ph. D. Scholar of Division of Ag. Extension, ICAR-IARI, New Delhi on logistic regression.

Sh. G.P Shivaswamy

- Carried out tobit regression analysis for Jesna V. K., a Ph. D Scholar of the Division of Ag. Extension, ICAR-IARI, New Delhi.

Dr. H V Harish Kumar

- Assisted Dr. Sagar, M. Post doctoral fellow, IIM (B) in formulation and solving of linear programming for arriving least cost fertilizer using straight as well complex fertilizers.

Dr. P.K. Meher

- 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 Dr. S. P. Singh, Division of Genetics, ICAR-IARI, New Delhi. Structure analysis was carried out using 34 individuals whose SSR markers were available for 44 loci. The analysis was conducted using STRUCTURE software, which is freely available in public domain.

- Guided a Bioinformatics student of OUAT, Bhubaneswar, Odisha for a period of four months to complete a project related to her M.Sc. thesis work.

- Provided advisory service to Mr. Jitendra Kumar, a Post-doc student at CCS University, Meerut, UP. Performed 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.

R.K. Paul

- Provided advisory to Dr. S. Vennila, Principal Scientist, ICAR-NCIPM, New Delhi for Analyzing the data for forecasting pest count in different districts of Andhra Pradesh, Gujarat, Karnataka and Maharashtra

- Provided advisory to Mr Rohit Kumar, PhD Student of BHU in Agricultural Economics for forecasting potato prices in different markets of Uttar Pradesh.

- Provided advisory to Dr. Manoj Kumar Goyal, College of Agriculture CCSHAU Campus Kaul (Kaithal) regarding time series data analysis using ARIMAX model.

- Provided consultancy to Dr. Tanmoy Karak, Principal Scientist, Tea Research Association regarding stepwise regression analysis and time series trend estimation in climate variables.

- Provided advisory to Dr. Santosh Kumar, Scientist, ICAR-RCER, Patna for analyzing the data using Factorial analysis.

Sh. Prakash Kumar

- Provided consultancy to Mr. Krishan Prakash and Ram Mr. Narayan singh, Ph.D and M.Sc. students of ICAR-IARI New Delhi for statistical analysis of data.

- Provided consultancy work to Mr. Kaushik, M.Sc. a student of the Division of Vegetable Science, ICAR-IARI, New Delhi for statistical analysis of partial diallel cross of watermelon data.

- Provided consultancy work to Ms. Puja Kumari M.Sc. a student of BAU, Sabour, Bhagalpur for statistical analysis of factorial CRD with contrast analysis of data provided by.

Dr. Himadari S. Roy

- Provided guidance to Yogesh, 4th year Ph.D (Ag. Statistics) scholar of Banaras Hindu University, Varanasi on analysis of Bayesian time-series and generalized linear model of

- Provided some suggestions to Mr. Harkirshna Yadav, Scientist, Division of Genetics, IARI, New Delhi to analyze QTL mapping also analysis has been done of alpha Lattice of Raghunandan K., Scientist, Division of Genetics , IARI, New Delhi.

- Analyzed data on pest management for Dr. Sabita Kumar Senapati, Professor, Division of Entomology, UBKV, Pundibari.

- Analysis and interpretation was done for Mr. Om Prakash, Scientist, ICAR-CAZRI, Jodhpur.

- Advised about the analysis and layout of Lattice Design to Dr. Harendra Verma, Scientist, Indian Council of Agricultural Research | RC – NEH.

- Advised on the analysis to Shabnam Mehta. Ph.D. Scholar, Department of Soil Science, CSK Himachal Pradesh Agriculture University.

Sh. Pradip Basak

- Analyzed data on wheat grain quality for DMRT comparison for Mr. Raghunandan, K., Scientist, ICAR-IARI, New Delhi.

- Advised in developing R codes for simulation study of Ph. D. thesis problem of Mr. Sandeep Pundir, a Ph. D. scholar, Narendra Dev University of Agriculture and Technology, Faizabad.

- Advised Samir Barman a M.Sc. (Agricultural Statistics) Student of ICAR-IASRI, New Delhi in developing R codes for simulation study for his thesis problem.

- Analyzed the ergonomic data of Mrs. Kumari Chanchala Priya, a Ph. D. scholar, ICAR-IARI, New Delhi. Institute.

- Provided advisory services to Mr. Utpal Ekka, Scientist, ICAR-IARI, New Delhi. Institute.

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RAC, Management Committee and IRC

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 to review the progress of on-going research projects periodically. It also monitors the follow up action on the recommendations of the Quinquennial Review Team (QRT), 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 reported period, 31 new research projects were approved and progress of 116 on-going research projects was reviewed and 32 research projects were declared complete and 01 project was declared as merged.

Two meetings (87th and 88th) of the IRC were held during October 06-07, 2017 and April 06-07, 2018 respectively.

- In the 87th meeting, 13 new research projects (06 Institute funded, 01 in collaboration with other Institutes, 05 outside funded and 01 extramural funded) were approved and progress of 62 ongoing research projects (24 Institute funded, 05 in collaboration with other Institutes and 33 outside funded) were discussed and 21 research projects were declared as complete and 01 project was declared as merged.

- In the 88th meeting, 18 new research projects (05 Institute funded, 13 outside funded) were approved and progress of 54 on-going research projects (25 Institute funded, 04 in collaboration with other Institute and 25 outside funded) were

reviewed and 11 research projects were declared as complete.

Institute Management Committee (IMC)

- 66th Meeting of the Institute Management Committee was held on 29th December, 2017. The important issues discussed are as below:

- The Proceeding of 65th IMC meetings were confirmed.

- Incharge (PME-cell) made a presentation on Institute Research activities, including completed research projects and ongoing projects. The members appreciated the research activities especially technologies developed and copyrights received. It is the need of hour to highlight the revenue generated from research and services offered by the Institute for enhancing the public value of the Institute.

- Incharge-Training & Administration Cell made a presentation on Teaching and Training Activities of the Institute. The house was satisfied with the teaching and training activities going on at IASRI.

- The list of equipment's to be procured for the financial year 2017-18 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.

- The members were briefed with present condition of staff quarters at Krishi-Niketan, Paschim Vihar and with present condition of Sample Survey Block (Back wing of building) of IASRI. Both these

sites needs intense repairing and renovation. Having been discussed the agenda in meeting thoroughly, committee members recommended that the Institute may process both these cases separately with ICAR for necessary decision/ action on the matter.

- Budget Estimate for the year 2017-18 and actual expenditure incurred upto 15.12.2017 was presented before the members. While going through the expenditure, the members took a note that 61.59% of the total allocation has since been spent. The members were assured for full utilization of funds in time.

Research Advisory Committee (RAC):

The 18th meeting of the Research Advisory Committee (RAC) of ICAR-IASRI was held on 22nd April, 2017 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. Alok Bhattacharya** Professor, School of Life Sciences, JNU, New Delhi	Member
4.	**Dr. S.D. Sharma** Former-Vice Chancellor, DSVV, Haridwar and Former-Director, IASRI	Member
5.	**Dr. V.K. Gupta** Former National Professor (ICAR), New Delhi	Member
6.	**Dr. G. Venkateshwarlu** Assistant Director General (EQA&R), ICAR, New Delhi	Member
7.	**Dr. U.C. Sud** Director,ICAR-IASRI	Member
8.	**Dr. Ajit** Principal Scientist & Incharge-PME Cell, ICAR-IASRI	Member Secretary
9.	**Dr. A.K. Choubey** Head, Computer Application, ICAR-IASRI	By invitation
10.	**Dr. Anil Rai** Head, Centre for Agricultural Bioinformatics, ICAR-IASRI	By invitation
11.	**Dr. K.N. Singh** Head, Forecasting and Agricultural System Modelling, ICAR-IASRI	By invitation
12.	**Dr. Seema Jaggi** Head, Design of Experiments and Incharge, TAC, ICAR-IASRI	By invitation
13.	**Dr. Lal Mohan Bhar** Head, Statistical Genetics, ICAR-IASRI	By invitation
14.	**Dr. Tauqueer Ahmad** Head, Sample Surveys, ICAR-IASRI	By invitation
15.	**Dr. Rajender Parsad** Principal Scientist, PI-KRISHI, ICAR-IASRI	By invitation
16.	**Dr. A.R. Rao** Principal Scientist and Professor (Bioinformatics)	By invitation
17.	**Dr. Hukum Chandra** ICAR-National Fellow, ICAR-IASRI	By invitation

Dr. (Mrs.) Sangeeta Verma, Principal Advisor, Department of Consumer Affairs and Member-Research Advisory Committee, could not attend the meeting because of personal reasons. Dr. Sudeep, Principal Scientist and Professor (Computer Applications) could not attend the meeting because of some other official engagements.

From the day long deliberations, presentations and discussions, particularly with the emphasis made by the Chairman, RAC, the following action points emerged:

Recommendation-1	Institute has made outstanding contributions in research, innovative applications and human resource development. All out efforts need to be made to reach out to stakeholders by showcasing its achievements. The Institute needs to find out ways to remove boundaries among various Departments/Universities and IASRI for stronger collaborations. The Institute should develop revival strategy for strengthening of Discipline of Statistical Sciences in AUs. ICAR-IASRI is playing an important role across all SMD's of the Council. In view of the important role played by this Institute, ICAR-IASRI may be accorded the status of a National Institute so that it can play its role more effectively.
Recommendation-2	For strengthening the Statistical Sciences in ICAR an appropriate scientific strength is essential. Therefore, while deciding the seats for Agricultural Statistics, Computer Applications and Bioinformatics, the positions available in 2011 cadre strength of ICAR for Computer Applications should also be taken into account as vacant positions by ICAR rather than considering only the vacant positions of Agricultural Statistics. Further, for strengthening the discipline of Bioinformatics, some positions from relevant disciplines of biological sciences should be converted into Bioinformatics. While deciding the vacancy positions in different disciplines, Statistics should be given due importance as research in statistics is essential for development of Information Sciences. A comprehensive note may be prepared for this purpose for consideration of the Council.
Recommendation-3	For attracting talented students for admission to PG Programmes in Statistical Sciences i.e. Agricultural Statistics, Biostatistics, Statistics, Computer Applications and Bioinformatics throughout NARES • B.Sc. with Statistics/ Mathematics/ Bioinformatics/ Computer Science or equivalent or Graduate having one of the subjects of Statistical Science/ Mathematics should be included in educational qualifications, • Provision may be made to allow remedial courses as extra credit hours in each trimester/ semester to PG students in Statistical Sciences possessing B.Sc. in Statistics/ Mathematics so that they can complete their degree requirements without spending one extra year and simultaneously gain knowledge of agricultural sciences and • Admission for M.Sc./M.V.Sc. in Biostatistics should be done through Statistical Sciences rather than Animal Sciences as it is being done at present. A comprehensive note may be prepared for consideration of the Council.
Recommendation-4	The Institute has been involved in doing quality research in basic statistics particularly basic research and innovative applied research in the areas of Design of Experiments and Theory of Survey Sampling. As a matter of fact, the foundation of the IASRI was laid on the premises of research in Design of Experiments and subsequently Survey Sampling. Experimental Designs form the backbone of the research in agricultural systems research. Similarly Survey sampling has a very important role in agricultural research and also in the national statistical system. Several efficient experimental designs and advanced analytical techniques, Sample Survey Designs and Strategies have been used in NARES through Web Resources on Designed Experiments, Indian NARS Statistical Computing Portal, Advisory Services, Sample Survey Resources Server, and state Departments of Agriculture, Animal Husbandry, Fisheries, Horticulture, etc. These efforts need to be pursued more rigorously with renewed zeal, enthusiasm and passion so as to meet the challenges of agricultural research in the emerging areas of research in agricultural sciences. The research on development of efficient/ cost effective experimental / survey designs and analytical techniques, keeping in mind the volume of data, the number of parameters and number of observations, etc., need to be carried out for making agricultural research globally competitive and acceptable. Of utmost importance is the fact that the basic research in statistics should encompass within its gamete the boundary constraints of applicability in agricultural sciences and the solutions have to be optimal in the restricted region defined by these applicability constraints. Agriculture is a very complex system with many synergistic and antagonistic interactions and very large intrinsic variability and the research in statistics must address these.

Recommendation-5	The ICAR-IASRI has expertise for developing statistical models for forecasting, expressing agricultural systems and also developing stochastic time series models, bivariate and hybrid time series models, machine learning techniques, etc. Linear and non-linear models, State space models, ARIMA, ARCH and GARCH models, Space Time Autoregressive Moving Average (STARMA) models for forecasting spatio-temporal time series data, etc. have been used successfully in crop forecasting and agricultural systems. More concerted efforts should be made for developing admissible forecasting models that are applicable for wide range of data sets. The forecasting of incidence of pests and disease, quick estimation of losses through vagaries of weather like floods and droughts, volatility forecasting say prices of perishable commodities, etc. need to be developed.
Recommendation-6	Centre for Agricultural Bioinformatics should take up projects in priority areas such as Genome editing (CRISPER), Genomic Data Ware House and development of algorithms for biological data analysis. In order to support the supercomputing facilities i.e. ASHOKA, efforts may be made to develop a mechanism for automation of data submission and its curation in Bio-computing Portal. A brief note may be prepared depicting the importance of on-going research in Bioinformatics in the Council including role of ASHOKA.
Recommendation-7	Institute should make efforts for undertaking studies in the emerging field of national importance and priorities of Government of India such as "Crop-Insurance", "Monitoring and assessing Soil/ Water Health" "Data-Integration" etc. Efforts may also be made to develop Indices for Hunger, Farmer Welfare, Food Security, Soil Reclamation, Female Empowerment etc. Basic research in Statistics and innovative applications should be taken up with more zeal and enthusiasm. Enabling environment for this may be prepared.
Recommendation-8	There should be more emphasis on multi-disciplinary team work. Therefore, the Institute should make attempts to develop multi-disciplinary research projects. IASRI and NIAP should institutionalize and strengthen their collaboration. Efforts should continue for involvement of the Institute in all AICRPs/Network Projects. A list of priority areas of research for next three years should be prepared for each Division of IASRI. In view of resource constraints, more efforts should be made for getting funds from outside for maintaining and upgrading the facilities rather than depending on the parent funding alone.
Recommendation-9	A background document for employability of students of IASRI, in ARS/AUs/elsewhere, may be prepared. Efforts should be made for obtaining sanction from the Council for initiation of Virtual Classrooms at IASRI for helping the AUs.
Recommendation-10	In view of the important role played by IASRI for providing Computational/ Informational services to the Council such as ERP, Unified Communications, Various Portals such as KRISHI, Indian NARS Statistical Computing Portal, Web Resources, Computational Resources etc., provision be made for adequate funding and required manpower to support the same.
Recommendation-11	The presence of abnormal observations or violation of any kind of statistical assumption may lead to erroneous conclusions from any kind of data analysis. Therefore, for detecting outliers in genetic data as well as estimating genetic parameters robustly in presence of outliers, suitable statistical methodologies should be developed. Efforts should also be made for developing statistical methodologies for predicting an individual's genetic potential of a single phenotype or more than one phenotype using genome-wide single nucleotide polymorphism (SNP) markers.

Quinqunnial Review Team (QRT):

Quninqunnial Review Team for ICAR-IASRI has been constituted by the Council for the period 01-04-2011 to 31-03-2016 (vide Council letter No: Agril.Edn-14/14/2017-A&P dated 4th August, 2017 and 6th March, 2018) and the constitution is as below:

Dr. G.C. Manna,	Ex-DG, CSO, MOS&PI	Chairman
Prof. Rita Saha Ray	ISI, Kolkata	Member
Dr. Ashish Kumar	Former Advisor, Planning Commission	Member
Dr. N. Balakrishna	Professor, CUSAT, Cochin	Member
Dr. BVS Sisodia	Former Professor, NDUAT, Faizabad	Member
Dr. Shridhar Shiv Sibbu	IGIB, CSIR, New Delhi	Member
Dr. Hukum Chandra	ICAR-National Fellow, ICAR-IASRI, New Delhi	Member Secretary

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Papers Presented and Participation of the Institute at the Conferences/Workshops etc.

Papers Presented

- 14th International Conference on Urban Health "Health Equity: The New Urban Agenda and Sustainable Development Goals" organized in Coimbra, Portugal during 26-29 September, 2017.
  - ➢ Daniel, M., Patil, A., Pramanik, S., Basak, P., Hira, S. and Balasubramaniam, *Malaria management as a bellwether for efficient urban governance: findings from a western Indian megacity.*
- 5th International Conference on "Computing for Sustainable Global Development (INDIACom - 2018)"; technically sponsored by IEEE Delhi Section, held during 14-16 March, 2018 at Bharati Vidyapeeths Institute of Computer Applications and Management, New Delhi (INDIA).
  - ➢ Arora, A., Saravanakumar R., Jain, R. and Marwaha, S., *Automated approach to apportion time series data for dynamic district boundaries.*
  - ➢ Marwaha, S., Deb, C. K., Jain, R., Arora, A. and Das, M., *Connective based taxonomy extraction from specialized text for ontology learning in agriculture.*
  - ➢ Dahiya, S. and Bharadwaj, A., *Educational data mining in agriculture.*
  - ➢ Bharadwaj, A., *Online software for structurally incomplete GRC designs.*
- 3rd International Conference on Statistics for Twenty-first Century-2017 at Kerala University, Thiruvananthapuram during 14-16 December, 2017.
  - ➢ Paul, R. K., Yadav, S. K., Vennila, S., Vemana, K., Chandrayudu, E., Panwar, H., Tomar, A. and Roy, Himadri S.

    Time series models predicting jassids and thrips on groundnut at Kadiri of Andhra Pradesh (India).
  - ➢ Kumar, P., Bhar, L. M. and Paul, A. K.

    Simultaneous stability measure for yield stability based on existing stability measures by using TOPSIS technique".
  - ➢ H.S. Roy and R. K. Paul

    "INARX model for forecasting pest population in agriculture: An application".
  - ➢ Sunil Kumar Yadav*

    3×3 Factorial Experiments with Logistic Error Distribution
- International Conference on Sustainability of Smallholder Agriculture in Developing Countries Under Changing Climatic Scenario (AgriCon2018) at CSA University, Kanpur during 14-17 February, 2018.
  - ➢ Vennila S., Tomar, A., Bhat, M. N., Singh, N., Paul, R. K., Singh, A. K., Nisar, S., Sharma, V. K., Yadav, S. K., Murari, K., Rao, M. S., Prabhakar, M. and Ahuja, D. B.

    Web and mobile-based insecticide and fungicide calculators for judicious use of agrochemicals for higher crop productivity and environmental safety.
- International Symposium titled "Emerging Areas in Biosciences and Biomedical Technologies (eBBT) 2018" during 05-06 January, 2018, at IIT Indore, Madhya Pradesh.
  - ➢ Meher, P.K., *Computational identification and categorization of nitrogen fixation proteins of diaztrophs using support vector machine*
- International Workshop on 'Bio Diversity and Climate Change 2018' during 24-27 February, 2018 at Indian Institute of Technology, Kharagpur.

- ➢ Vennila S, Singh, N., Tomar, A., Rao, M. S., Prabhakar, M., Bhat, M. N., Tanwar, R. K., Sharma, O. P., Sardana, H. R., Paul, R. K., Mehta, N., Nisar, S., Sharma, V. K., Yadav S. K., Murari K and Yadav, H. , *Tools of information and communication technology for study on spatial and temporal on dynamics of insect pests and diseases in relation to climatic variability and development of adaptive management strategies.*

- ● 71st Annual Conference of Indian Society of Agricultural Statistics at ICAR-DRMR, Bharatpur (Raj) during 25-27 November, 2017.

  - ➢ Anindita Datta*, Mohd. Harun, Seema Jaggi and Cini Varghese, *Neighbour Balanced Generalized Row-Column Designs.*

  - ➢ Rajender Parsad*, *Importance and Applications of Design of Experiments in Agricultural Research: Case Studies. (Invited Talk during invited paper session on Statistical Designs, Genetics and Bioinformatics for Farmers' Welfare: 26.11.2017*

  - ➢ Rajender Parsad, A. Dhandapani, Mukesh Kumar*, Jai Kumar, and Anshu Bhardwaj, *Digital Institutional Publications Repository for Knowledge Management. (Invited Talk during invited paper session on E-learning and E-initiatives in Farmers' Outreach: 26.11.2017*

  - ➢ Pal S, Marwaha, S., Arora, A., Adhiguru, P. and Poswal, R.S., *KVK Mobile App for Krishi Vigyan Kendra: Knowledge Dissemination and Farmers' Query Resolution.*

  - ➢ Harish Kumar, H. V. An insight into farmer's income in India.

  - ➢ Rajesh, T., *Growth, poverty and inequality paradox in India: An overview.*

  - ➢ Shivaswamy, G. P., Gurung, B., *Estimation of Hedge ratio using Kalman filter.*

  - ➢ Rathod, S., *An improved space time autoregressive moving average model for Modeling and Forecasting spatio-temporal time series Data.*

  - ➢ Lama, A., *A comparative study between classical and Bayesian structural time series models.*

  - ➢ Ray, M., *Modified Sieve Bootstrap Based Prediction Intervals for Neural Network Forecasting.*

  - ➢ Kumar, R. R., *Application of artificial neural network model for prediction of drought index.*

  - ➢ Datta, A., Mohd., H., Jaggi, S. and Varghese, C., *Neighbour Balanced Generalized Row-Column Designs.*

- ➢ Mohd., H., Varghese, C., Datta, A. and Jaggi, S., *Three-way Cross Designs for Hybrid Production*

- ➢ Saurav, S., Varghese, C., Varghese, E. and Jaggi, S., *Designs for sensory trials involving foods of animal origin.*

- ➢ Jha, A., Varghese, C., Varghese, E., Mohd., H. and Jaggi, S., *Affine resolvable block designs with unequal block sizes.*

- ➢ Banerjee, R., Bhowmik, A., Lall S., Varghese, C., Varghese, E., Datta, A. and Jaggi, S., *Efficient designs for mixture experiments using non-linear model.*

- ➢ Dash, S., *Designs for consecutive crop sequence.*

- ➢ Yadav, S. K., *2×3×3 Factorial Experiments with Gompertz Error Distribution*

- ➢ *Aditya, kaustav and Chandra, Hukum (2017): Mobile Assisted Personal Interview (MAPI)-Implementation in the staate of Gujarat.*

- ➢ *Chandra, H. (2017). Role of Small Area Statistics for the welfare of farmers. (Invited talk.*

- ➢ *Aditya, K. and Chandra, H.* (2017). MAPI Software for data collection using Smart Phone-A way Forward for Fast, Cost Effective and Quality Data.

- ➢ Kumari, V., Sud, U.C. and Chandra, H. (2017). Calibration Approach Based Estimation of Regression Coefficient using multi Auxiliary Variables.

- ➢ Biswas, Ankur, Aditya, Kaustav and Sud, U.C. (2017). Calibration estimators under two stage sampling design when auxiliary variable is inversely related with study variable".

- ➢ Lal, S.B., Sharma, A., Chaturvedi, K.K., Angadi, U.B., Farooqi, M.S. and Rai, A. (2017) Impact of internet of things (IOT) on E-learning

- ➢ D C Mishra*, Sanjeev Kumar, NeerajBudhlakoti,S. B. Lal and Anil Rai (2017) Genomic markers and its application in *Brassicas*

- ➢ Farooqi, M.S.*, Kumar, D., Mishra, D.C., Rai, A., Chaturvedi, K.K., Lal, S.B., Sharma, A. and Kumar, N. (2017) Gene Expression analysis for RNASeq data using order statistics based mixture model

- ➢ Chaturvedi, K.K., Lal, S.B., Farooqi, M.S., Angadi, U.B., Kumar, S., Rai, A. Sharma, A.ICT intervention for enhancing farmers income

- ● III LACSC: Latin American Conference On Statistical Computing held at University of

Costa Rica, SAN JOSÉ,COSTA RICA during 27 February to 2 March, 2018

- ➢ Bhowmik, A*., varghese, E., Jaggi, S., Varghese, C. and Lall, S., *Computational Tools for Generation of Cost-effective Run Orders Useful for Agricultural and Industrial Research*

- National Conference for Women in Statistics and Analytics" organized by Department of Statistics, Savitribai Phule Pune University, Pune during February 14-16, 2018].

  - ➢ Varghese, C., *Some series of partially balanced incomplete block designs*
  - ➢ Jaggi, S., *Generalized Row-Column Designs*

- National Conference on Innovative Technological interventions for Doubling Farmers Income at Jammu

  - ➢ Susheel Kumar Sarkar, *Impact of Integrated Farming System on Farmers' income*

- International Conference on Changing Paradigms and Emerging Challenges in Statistical Sciences in conjunction with Bi-Decennial Convention of Society of Statistics, Computer and Applications during 29-31 January, 2018 at Pondicherry University, Puduchery.

  - ➢ Paul, R.K., *Wavelet based forcasting models and their applicatins.*
  - ➢ Pal, S., Marwah, S, Arora, A., Choubey, A.K., Adhiguru, P. and Poswal, R.S., *knowledge dissemination and farmer's query resolution through KVK Portal and KVK Mobile App.*
  - ➢ Rajender Parsad*, A. Dhandapani, G.P. Obi Reddy, V.K. Sehgal, Mukesh Kumar, Anshu Dixit and A.K. Choubey, *ICAR Research Data Repository for Knowledge Management. (Invited Talk in Session on Information and Knowledge Management Systems in the International Conference on Changing Paradigms and Emerging Challenges in Statistical Sciences (*
  - ➢ B N Mandal* Rajender Parsad and Sukanta Dash, *Algorithmic construction of weighted A-optimal balanced treatment incomplete block designs*
  - ➢ Mohd. Harun*, Cini Varghese, Seema Jaggi, Eldho Varghese and Anindita Datta, *PTC for Comparing Test-lines with Single Control-line.*
  - ➢ Anindita Datta*, Seema Jaggi, Cini Varghese, Eldho Varghese and Mohd. Harun, *Generalized row-column designs: construction and web generation.*
  - ➢ Sukanta Dash*, B N Mandal, and Rajender Parsad, *Orthogonal and Nearly Orthogonal space filling Latin Hypercube Designs.*

- ➢ Chaturvedi, K.K., Lal, S.B., Farooqi, M.S., Angadi, U.B., Kumar, S., Rai, A. and Sharma, A., *ICT intervention for enhancing farmers income.*

- 25th Annual Conference of Agricultural Economics Research Association (AERA) at ICAR-NAARM, Hyderabad during 07-09 November, 2017.

  - ➢ R. K. Paul, Raka Saxena and Deepika Joshi *Integration, causality and prediction of agricultural commodity outputs in India.*
  - ➢ Saxena, R., Singh, N. P., Choudhary, B. B., Balaji, S.J., Paul, R. K., Ahuja, U., Joshi, D., Kumar, R. and Khan, M.A., *Can livestock sector be the game changer in enhancing the farmers' Income? Reinvesting thrust with special focus on dairy sector.*

- National Seminar on Recent Trends in Microbiology and Biotechnology (RTMB-2018) organized by the Department of Biotechnology, during 16-17 March, 2018 at MITS School of Biotechnology, Bhubaneswar, ODISHA.

  - ➢ P.K. Meher, *Computational prediction of eukaryotic gene structures: probabilistic and machine learning methods.*

- International conference on "contemporary Theory and Practice of Survey Sampling: A Celebration of Research Contributions of J.N.K. Rao" at yunnan, University, Kunming, Yunnan, China during May 24-27, 2017.

  - ➢ Chandra, H., Salvati, N. and Chambers. R. (2017). *Small Area Estimation of Counts under Aggregated Level Spatial Model. (Invited talk).*

- National Academy of Agricultural Sciences foundation day, 04 June, 2017 at NASC Complex, New Delhi.

  - ➢ Chandra, H. (2017). *Some Innovative Approaches for Small Area Estimation of Agricultural and Socio-economie Parameters. (Invited talk).*

- National Seminar on the survey result relating to the subjects covered to the subjects covered during NSSO 70th & 71st rounds, Goa, India during 10-13 September, 2017.

  - ➢ Chandra, H. (2017). *Disaggregate Level Estimation and Spatial mapping of Incidence of Indebtedness in Rural Households by Combining Survey and Census Data-An Application of small Area Estimation Technique. (Invited talk).*

- 14th International Conference on Urban Health "Health equity: the New Urban Agenda and

Sustainable Development Goals" organized in Coimbra, Portugal during 26-29 September 2017.

➢ Daniel, M., Patil, A., Pramanik, S., Basak, P., Hira, S. and Balasubramaniam, P. (2017). *Malaria management as a bellwether for effieient urban governance: findings from a western Indian mega city.*

● The International Indian Statistical Association Conference (IISA 2017) at Hyderabad, India during 28-30 December, 2017.

➢ Chandra, H. (2017). *Small Area Prediction of Counts under a Spatial Dependent Generalized Linear Mixed Model. (Invited talk).*

➢ Aditya, K. and Chandra, H. (2017). *District Level Crop Yield Estimation using Calibration Approach. (Invited paper).*

➢ Aditya, Kaustav, Gupta, A.K. and chandra, (2017). *Crop Yield estimation using calibration approach.*

➢ Rajender Parsad*, Sukanta Dash, Pratheesh P Gopinath and B.N. Mandal., *Row-Column Designs with Factorial Treatment Structure (Invited Talk during the Session on Experimental Designs and Data Analysis*

➢ Bhowmik*, Arpan, Varghese, Eldho, Jaggi, Seema and Varghese, Cini., *Factorial Experiments and Response Surface Designs with Hard-to-change Factors*

➢ B N Mandal*, Rajender Parsad and Sukanta Dash, *A-optimal designs for test vs controls comparison – an algorithmic approach*

➢ Chatuvedi, K.K. (2017) *Genomic data warehousing: issues and challenges*

● International Conference on "Theory and Applications of Statistics and Information Sciences" held at Coimbatore, Tamil Nadu during 05-07 January, 2018.

➢ Chandra, H. (2018), *Small Area Prediction of Survey Weighted counts. (Invited talk).*

● The international Conference on " Changing Paradigms at Emerging Challenges in Statistical Sciences" in Conjunction with the Bi-Decennial Conference of the society of Statistics, Computer and Applications held at Pondicherry University, Puducherry during 29-31 January, 2018.

➢ Aditya, Kaustav and Chandra, Hukum (2018). *Estimation of Yield of Major Crops at District Level Based on Reduced Sample Sizes.*

➢ Chandra, H. (2018). *The use of sampling weights in small area estimation of Proportions under Area Level Model. (Invited talk).*

➢ Lal, S.B.*, Sharma, A., Kumar, S., Mishra, D. C. and Budhlakoti, N. (2018), *Computational Challenges for Genome Assembly*

➢ D C Mishra, Neeraj Budhlakoti, S B Lal, Sanjeev Kumar and Anil Rai (2018) *Genomic Prediction : A Way Forward to Molecular Breeding*

● National Seminar on "Reecent Advance in statistics for Industries and Corporates" at Department of Statistices, Gujarat 10-11 February, 2018

➢ Chandra, H. (2018) Small Area Estimation of Poverty and Social Exclusion Indicators. (Invited talk).

● International Symposium on Health Analytics and Disease Modeling, New Delhi, India During 08-09 March, 2018

➢ Chandra, H.(2018). *Small Area Estimation in Health Sector by Combining Demographic Health Survey and Census Data. (Invited talk).*

● International Conference on Emerging Trends in Biomaterial, Bioscience, Bioinformatics, Biomedical Engineering, Cancer Biology, Stem Cell Research, Cell Apoptosis and Applied biotechnology (BCS-2018) at Jawaharlal Nehru University, New Delhi on January 18, 2018

➢ MA Iquebal, Rukam S Tomar, MV Parakhia, Deepak Singla, Sarika Jaiswal, VM Rathod, SM Padiyar, Neeraj Kumar, Anil Rai, Dinesh Kumar (2018). *Deciphering pathogenicity related genes of groundnut stem rot causing fungus Sclerotiumrolfsii by whole genome sequencing.*

● International Conference on Recent Trends in Agriculture, Food Science, Forestry, Horticulture, Aquaculture, Animal Sciences, Biodiversity, Ecological Sciences and Climate Change (AFHABEC-2018)at Jawaharlal Nehru University, New Delhi on February 10, 2018.

➢ Sarika Jaiswal, Sonia Sheoran, Vasu Arora, Ulavappa B. Angadi, Mir Asif Iquebal, NishuRaghav, Bharti Aneja, Deepender Kumar, Rajender Singh, Pradeep Sharma, G.P. Singh, Anil Rai, Ratan Tiwari and Dinesh Kumar (2018). TaSSRDb: *The putative microsatellite DNA marker-based wheat genomic resource for germplasm management.*

● International Symposium on Biodiversity and Biobanking (BIODIVERSE 2018)at Indian Institute of Technology Guwahati (IITG) in association with Association for Promotion of DNA Fingerprinting and Other DNA Technologies (ADNAT) during January 27-29, 2018

➢ Sarika, MA Iquebal, Anil Rai and Dinesh Kumar*(2018), *Agricultural biodiversity and legal frame work in India: Issues, opportunities and challenges (Invited talk)*

● IX Asian Buffalo Congress (ABC-2018) at ICAR-CIRB, Hisar during February 1-4 February, 2018

➢ KK Chaturvedi, DC Mishra, AR Rao, Neeraj Budhlakoti, Sunita, Jyotika, Anil Rai and Punam Sikka (2018), *SNPRBb: Trait specific SNP Database of Bubalus bubalis.*

● भारतीय भाषाओं में प्रथम अंतर्राष्ट्रीय विज्ञान संगोष्ठी, राष्ट्रीय प्रौद्योगिकी संस्थान, कुरुक्षेत्र 22 अगस्त, 2017

➢ एस. बी. लाल, अनु शर्मा, के. के. चतुर्वेदी, यू. बी. अंगाडी, एम. एस. फारूकी एवं अनिल राय (2017) *आई. ओ. टी. और कृषि: एक अवलोकन।*

● South-South cooperation: India-Africa partnership for food security and capacity building conference at University of Mumbai, Mumbai, Maharashtra during January 23-24, 2018

➢ Angadi, U.B., Animut ,Getachew, Anandan, S., Blümmel, Michael, Moyo, Siboniso, Rahman, Habibar and Jones, Chris (2018), *Feed Base-Ethiopia: Database and decision making tool for supply and demand of livestock feed resources in Ethiopia*

Poster Presentation

● Posters presentation in the International Conference: 38th Asian Conference on Remote Sensing "Space Applications: Touching Human Lives" held during 23-27 October, 2017 in New Delhi.

➢ Sahoo, P. M., Ahmad, T and Krishna, G.
Species-wise discrimination of area under Agroforestry using satellite data in Ludhiana district

➢ Krishna, G., Sahoo, Rabi N., Bajpai, V., Patra, H., Kumar, S., Raju, D., Viswanathan, C., Ahmad, T., Sahoo, P. M. and Singh, P.
Evaluation of Spectral Indices, Multivariate and ANN Techniques for Monitoring of Crop Water Deficit Stress.

➢ Paul, N. C., Rai, A., Krishna, G. and Sahoo, P.M.
Pseudo Invariant Features Normalization and Multispectral Image Classification for Spatio-Temporal Change Detection.

➢ Udgata, A. R., Sahoo, P. M., Ahmad, T. and Rai, A.
Acreage Estimation of Mango by Integrating Survey Data and Satellite Data in West Godavari District.

Lecture Delivered

Dr. Anil Rai

● Agricultural Bioinformatics in National Workshop cum Training on "Tools and Techniques in Bioinformatics*"* during 12-14 March, 2017 at ICAR-IARI, New Delhi

● Initiative of Agricultural Bioinformatics in NARES on September 14, 2017 at 106th FOCARS at NAARM Hyderabad.

Dr. Rajender Parsad

● Principles of Field Experimental Designs to the participants of the Training Programme on layout and maintenance of Field Experiments and Recording Observations organized at Division of Agronomy, ICAR-IARI, New Delhi during October 03-12, 2017. (Lectures was delivered on October 03, 2017).

● Introduction to SAS to the participants of Summar School on Advanced Analytical Tools for Decision Making in Agriculture organized by ICAR-NIAP, New Delhi during July 10-30, 2017. (Lecture was delivered on 14.07.2017).

● (i) Combined analysis of experimental data; (ii) Web Resources on Designed Experiments and (iii) Indian NARS Statistical Computing Portal to the participants of the training programme on Stability/combined analysis methodology for NPOF experimental data organized at ICAR-IIFSR, Modipuram during July 25-26, 2017. (lectures were delivered on July 25, 2017).

● (i) Statistics introduction and concepts and (ii) Web-Resources to the participants of the first National Faculty Development Programme organized at Shaheed Rajguru College of Applied Sciences for Women, Delhi during July 12-27, 2017 (Lectures were delivered on July 26, 2017).

● Multivariate Data Analysis: Dimension Reduction and Classificatory Techniques to the participants of the Faculty Development Programme on Advanced Data Analysis using SPSS, Excel, R and MatLab organized during 17-22 November 2017 at Maharishi Markandeshwar University, Mullana-Ambala (lectures were delivered on 21.11.2017).

● (i) Design and analysis of experiments in incomplete blocks; (ii) Augmented design; (iii) Web Resources on Designed Experiments; (iv) Analysis of multi-environment trials and (v) Multivariate analysis methods to the participants

of the Training Programme on Advanced Experimental Designs and Statistical Analysis for Breeding and Agronomic Trials organized at ICAR-IASRI, New Delhi by ICARDA during October 24-November 03, 2017.

- Significance of Statistics in Agrochemical Research to the participants of the Winter School on „New generation smart agrochemical oriented approaches for crop and human health management" organized at Division of Agricultural Chemicals, ICAR-IARI, New Delhi during December 07-27, 2017 (lecture was delivered on December 26, 2017).

- Application of SAS for Survey Data Analysis to the participants of the training programme organized under the aegis of CAFT at Division of Agricultural Economics, ICAR-IARI, New Delhi during January 23 to February 12, 2018. (The lecture was delivered on February 03, 2018).

- Significance of Experimental Designs to the participants of Annual Inter college Statistics Fest Random Walk organized during February 26-27, 2018 at Ram Lal Anand College of Delhi University, Delhi. (The lecture was delivered on February 26, 2018).

- Significance of Statistics and Web Resources to the B.Sc. (Statistics) students of Kirori Mal College of Delhi University, Delhi on February 20, 2018.

Dr. Seema Jaggi

- Testing of Hypothesis and Basic Design of Experiments in a Faculty Development Programme on Biostatistics and Bioinformatics Tools in Research at Manav Rachna International University, Faridabad during 25-29 July, 2017.

- SPSS: An Overview and Correlation and Regression using SPSS in the Summer School on Advanced Analytical Tools for Decision Making in Agriculture organized by ICAR-NIAP during 10-30 July, 2017.

- SPSS: An Overview, Testing of Hypothesis and Analysis of Variance in a Faculty Development Programme on SPSS, R, Excel and MatLab at MMU, Mullana-Ambala, Haryana during 17-18 November, 2017.

Dr. Tauqueer Ahmad

- Horticulture Statistics at the NSSTA, Greater Noida in a training programme for ISS probationers on 25 January, 2018.

Dr Hukum Chandra

- Statistical techniques for data Analysis at Amity Institute of Applied Sciences, Amity University, Noida, Uttar Pradesh on 20 July, 2017.

- Training on mobile software application, Directorate of Economics and Statistics, Thiruvananthapuram, Kerala on 27 July, 2017.

- Statistical Techniques Using R organized by Dept. of Mathematics & Statistics, Banasthali University, Rajasthan on 03 September, 2017.

- Training program on Use of Statistical Software for Analysis of Life Science Data, University of Agricultural Science & Technology of Kashmir, Sher-e-Kashmir on 26 September, 2017.

- Training program on "Advanced Sampling Techniques for ISS officers during 04-08 December 2017.

- International training programme organised at ICAR-IASRI on behalf of NSSTA, MoSPI, Govt. of India for participants from various countries on 26 December, 2017.

- Training progrmamme on Agriculture & Allied Statistics for the ISS Probationers of 40th ISS Batch during 01-12 January, 2018, at the National Statistical Systems Training Academy, Ministry of Statistics & Programme Implementation, Govt. of India, Greater Noida on 11 January, 2018.

- National workshop on Statistical Techniques and Data Analysis using R, at Central University of Haryana, Mahendergarh, Haryana on 21 March, 2018.

- Invited Speaker, International conference on Contemporary Theory and Practice of Survey Sampling: A Celebration of Research Contributions of J.N.K. Rao, Kunming, China during 24-27 May, 2017.

- Invited Speaker, National Academy of Agricultural Sciences Foundation day, NASC Complex, New Delhi on 04 June, 2017.

- Invited Speaker, National Seminar on the survey results relating to the subjects covered during NSSO 70th & 71st rounds, organized by the NSSO, Ministry of Statistics and Programme Implementation, Government of India, Goa University, Goa during 10-13 September, 2017.

- Invited Speaker, The 71st Annual Conference of Indian Society of Agricultural Statistics, Bharatpur Rajasthan during 25-27 November, 2017.

- Invited Speaker, International Indian Statistical Association 2017 International Conference

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on Statistics, Hyderabad, India during 28-31 December, 2017.

- Invited Speaker, The International Conference on Theory and Applications of Statistics and Information Sciences in conjunction with the XXVII Annual Convention of Indian Society for Probability and Statistics, Coimbatore, Tamil Nadu during 05-07 January, 2018.

- Invited Speaker, International Conference on Changing Paradigms and Emerging Challenges in Statistical Sciences, Pondicherry, India during 29-31 January, 2018.

- Invited Speaker, National Seminar on «Recent Advance in Statistics for Industries and Corporates», Department of Statistics, Anand, Gujarat during 10-11 February, 2018.

- Invited Speaker, International Symposium on Health Analytics and Disease Modeling, New Delhi, India during 08-09 March, 2018.

Dr. A.R. Rao

- "Statistical Genomics" in training programme on "Next generation sequencing and its applications in crop science" on 8 Decembe, 2018 at ICAR-NRCPB, New Delhi.

- "Machine Learning in Bioinformatics" in Faculty Development Programme of Manav Rachna International University, Faridabad on 28th July, 2017.

- "Omics tools and databases for genomics data and their utility" in training programme on "Whole Genome Sequencing of plant pathogens: Methods and application" during 12 December, 2017 to 19 January, 2018 at ICAR-IARI, New Delhi.

Dr. Sudeep Marwaha

- Academic Management System at Birsa Agriculture University, Ranchi on 20th January 2018.

Dr. Cini Varghese

- (i) Levels of measurements and descriptive statistics, (ii) MS Excel: An overview and (iii) MS Excel for data analysis under the Faculty Development Programme on SPSS, R and Excel at MMU, Mullana-Ambala, Haryana during 17-18 November, 2017.

- Farmers' field trials data analysis in IFS in a summer school on Integrated farming systems for farmers empowerment and entrepreneurial development organized during 23 June, to 13 July, 2017 at the Division of Agronomy, ICAR-

IARI, New Delhi

- OFR Data processing and analysis and Statistical tools and techniques for data pooling and analysis in a summer school on Modern concepts and practices of organic farming for safe, secured and sustainable food production organized during 14 July to 3 August, 2017 at ICAR- IIFSR, Modipuram.

Dr. Anil Kumar

- Random Control Design in Social Science in summer school on Advanced Analytical Tools for decision making in agriculture organized at National Institute of Agricultural Economics and Policy Research, New Delhi during 10-30 July, 2017.

Dr. Dinesh Kumar

- (i) Why computational agri-genomics is needed? (ii) Genome Annotation at ICAR Short Course training programme on "Harnessing NGS data for genetic enhancement in crops" during 3-12 October, 2017 organized by ICAR-IIWBR, Karnal.

- "Why computational agri-genomics is needed?" at ICAR Winter school on Omic technologies and modern breeding approaches for conservation and productivity enhancement of indigenous cattle to be held at ICAR- CIRC, Meerut during 1-21 November, 2017.

- Application of computational biology in agricultural germplasm improvement in ICAR Winter School on "Genomic, proteomic and metabolomic application in crop improvement" during September 4-24, 2017 at the Department of Biotechnology, JAU, Junagadh.

- Gene Prediction: Whole genome sequencing of plant pathogens: Methods and Applications" in Advanced Faculty Training (CAFT) on Whole genome sequencing of plant pathogens: Methods and Applications during December 29-January 17, 2018 at Division of Plant Pathology, ICAR-IARI, New Delhi.

- Ecological informatics in Capacity building workshop-cum-brainstorming session on River Ecosystems and Fresh Water Biodiversity Research (REFRESH 2018) held on 2nd February, 2018 at Centre for the Environment, IIT Guwahati

- Global Status of Agricultural Bioinformatics and India: Issues and challengesin National Symposium-cum-Bioinformatics Workshop On Trends in Genomics: Congruence

with Contemporary Biotechnological Tools (Sponsored by the UGC, DST and DBT, Govt. of India) during MARCH 20-21, 2018 organised at Interdisciplinary Biotechnology Unit, Aligarh Muslim University, Aligarh-202002.

- Computational Genomics Approach for Anti-Microbial Peptides (AMP) discoveryin National Symposium on thrust areas of relevance to Livestock research, Session: Animal genomics and Bioinformatics, at National Institute of Animal Biotechnology (DBT-NIAB), Hyderabad during March 27-28, 2018.

Dr. Anshu Bharadwaj

- GeM Rules and regulations through Video Conferencing in aTraining for SFAOs organised at NAARM, Hyderabad.

Dr. Shashi Dahiya

- *POODLE, A Portable Object Oriented Dynamic Learning Environment* in CAFT training programme held at Agricultural Extension Division, ICAR-IARI, New Delhi during 13 October- 2 November, 2018.

Dr. Anindita Datta

- Exploratory Data Analysis, SPSS for Testing of Hypothesis under the Faculty Development Programme on SPSS, R and Excel at MMU, Mullana-Ambala, Haryana duging 17-18 November, 2017.

Dr. Arpan Bhowmik

- Multiple Regression Analysis with Qualitative Information: Binary and Dummy variables, Logistic Regression, Multivariate Data Analysis: Cluster Analysis and Multivariate Data Analysis: Principal Component Analysisin a five days FDP programme on Advanced Data Analysis using SPSS, Excel & R at JIMS,Vasantkunj, New Delhi during 22-26 May 2017.

- Basics of Regression analysis and diagnostic tests: Theory and practical in a training programme on Advanced Analytical Tools for Decision Making in Agriculture during 10-30 July, 2017 at ICAR-NIAP, New Delhi.

- SPSS, R and Excel at MMU, Mullana-Ambala, Haryana: i) Correlation, regression and regression diagnostics and ii) Logistic regression on 20 Nov 2017.

Dr. B N Mandal

- Overview of R in the ICAR summer school on Advanced Analytical Tools for Decision Making in

Agriculture organized at ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi on July 12, 2017.

- Data analysis using R in the first National Faculty Development Programme on Recent Trends in Applied Science Teaching organized at Saheed Rajguru College of Applied Sciences for Women, University of Delhi, New Delhi during 21-27 July, 2017.

- R: an overview and "R for Data Analysis" as Resource Person in the Faculty Development Programme on SPSS, R and Excel at MMU, Mullana-Ambala, Haryana on 21 November, 2017.

Dr. Mohd Harun

- SPSS for correlation, Regression and Diagnostics, Multiple Regression analysis with Qualitative Information: Binary or Dummy Variables under the FDP on SPSS, R and Excel at MMU, Mullana-Ambala during 17-18 November, 2017.

Dr. Sukanta Dash

- Fundamentals of design of experiments, Basic Statics, Multivariate analysis and Statistical genomics to 21 faculty of BASU and also students of UG 2nd year and PG of BASU, Patna in the three day workshop on "Basic Statistical Computing procedures for analysis of experimental data" during 15-17 November, 2017.

- Application of Conjoint Analysis: Theory and practical on 29 july,2017 in ICAR-Summer school training on " Advanced Analytical Tools for Decision Making in Agriculture" organized by ICAR-National Institute of Agricultural Economics and Policy Research New Delhi during July 10-30, 2017.

Dr. Susheel Kumar Sarkar

- PCA and Cluster Analysis in ICAR- Summer school training on "Advanced Analytical Tools for Decision Making in Agriculture" during 10-30, 2017 July at NIAP, New Delhi.

Dr. Kaustav Aditya

- Crop yield estimation using calibration approach at IISA 2017 International Conference on Statistics on 30 December, 2017.

Dr Ankur Biswas

- Sampling Methods: Theory and Practical, on 27 July, 2017 in the ICAR Summer School on

Advanced Analytical Techniques for Decision Making in Agriculture, held at National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi during July 10-30, 2017.

Dr. K.K. Chaturvedi

- "Application of Super-computing in Agriculture" for IES (Indian Economics Services) probationers from NIAP, New Delhi on 6 June, 2017.
- "Ashoka: Super Computing in Agriculture" on 26th July 2017 in ICAR sponsored summer school "Advanced Analytical Techniques for Decision Making in Agriculture" being organized at NIAP, New Delhi during 10th to 30th July 2017.
- "Basics of R", "Ways of Data Handling in R" and "Control Statement of R" at ICFRE Dehradun in the workshop during 19-20 February, 2018.
- "Internet of Things (IoT) for Sustainable Agriculture" in International Conference on GRIAAS-2017 at MPUA&T Udaipur on 3rd December, 2017.
- "ICT intervention for enhancing farmers income" on 26 November 2017 in the session "E-Learning and E-initiatives for Farmers outreach" in the 71st Annual conference of ISAS on 26 November, 2017.
- "Recent Development in Bioinformatics" in the IISA-2017 International Conference on Statistics at Hyderabad International Convention Centre, Hyderabad on 29 December, 2017
- "Application of Machine Learning Techniques: End User Perspectives" on 26 December 2017 in the UGC sponsored National Workshop "Machine Learning: Techniques and Applications" held at DDU college (University of Delhi), Dwarka during 26 December to 1 January 2018.

Dr. Sarika

- Data Cleaning and Pre-Processing, miRNA identification and its target prediction, Transcriptome Analysis at ICAR Short Course training programme on "Harnessing NGS data for genetic enhancement in crops" organized by ICAR-IIWBR, Karnal during October 3-12, 2017.
- Genome Annotation, SNP marker discovery and Phylogenetic Analysis at ICAR Winter school on Omic technologies and modern breeding approaches for conservation and productivity enhancement of indigenous cattle to be held at ICAR- CIRC, Meerut during 1-21 November, 2017.

Dr. M.A. Iquebal

- Genome Assembly, Allele mining and its applications in agriculture at ICAR Short Course training programme on "Harnessing NGS data for genetic enhancement in crops" organized by ICAR-IIWBR, Karnal during October 3-12, 2017.
- Omic technologies and modern breeding approaches for conservation and productivity enhancement of indigenous cattle at ICAR Winter School held at ICAR- CIRC, Meerut during 1-21 November, 2017.
- Data cleaning and pre-processing, Genome assembly, Allele mining and Transcriptome at ICAR Winter School on "Genomic, proteomic and metabolomic application in crop improvement" at the Department of Biotechnology, JAU, Junagadh during the 4-24 September, 2017.
- "Application of computational genomics in agriculture" during Winter School on "Molecular Breeding for higher productivity, quality, food colorants, nutraceutical and bioactive health compounds in vegetable crops" at Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi on February 26, 2018.
- Application of computational genomics techniques in agriculture" during Winter School on Computational biology: an advanced tool for molecule discovery" at Division of Agricultural Chemicals, Indian Agricultural Research Institute, New Delhi on 13 November, 2017.

Dr. D.C. Mishra

- Next Generation Sequencing Techniques and Genome Assembly: Concept and Challenges in the training on Biostatistics & Bioinformatics Tools in Research at Manav Rachna International University, Faridabad during 25-29, July, 2017.
- Advanced Statistical Techniques using R at Indian Council of Forestry Research and Education, Dehradun, Uttrakhand during 19-23, February, 2018.
- Statistical Techniques and Data Analysis using R in Central University of Haryana, in National Workshop during 19-23, March, 2018.

Dr. R.K. Paul

- Data analysis using excel, GARCH models and Hybrid time series models at ICAR- Summer school training on "Advanced Analytical Tools for Decision Making in Agriculture" at ICAR-National Institute of Agricultural Economics and Policy Research New Delhi during 10-30 July, 2017.

- Modeling approaches for pest-weather relations at workshop on Real Time Pest Dynamics at NCIPM, New Delhi on 13 October, 2017.
- Panel data Analysis, Forecasting using ANN tools and Volatility modelling at Winter school on "Advanced Analytics in Developing Agricultural Market Intelligence" at ICAR-NAARM during 14 November-04 December, 2017
- Data analysis using excel, GARCH models and Hybrid time series models in ICAR- Summer school training on " Advanced Analytical Tools for Decision Making in Agriculture" at ICAR-National Institute of Agricultural Economics and Policy Research New Delhi during July 10-30-2017.
- P*anel data Analysis, Forecasting using ANN tools and Volatility Modeling and worked as resource person for the winter school on "Advanced Analytics in Developing Agricultural Market Intelligence" at ICAR- NAARM during Nov. 14-Dec. 04, 2017.*
- Time Series Models for Forecasting Agricultural Commodity Prices in the National Meeting of Experts on Agriculture Markets, Price Data visulization and Early Warning System at Hotel Taj Mahal, Mansingh Road, New Delhi, Organized by FAo during 11-12 September, 2017.
- Modeling approaches for Pest-weather relations in the worlshop on Real Time Pest Dynamics at NCIPM, New Delhi on 13 October, 2017.

Dr. Soumen Pal

- Designing and development of a mobile app for agriculture applicable for KVKs: resource person in the HRD training in the HRD training programme for KVK staffs during 12-13 Feb,2018 organized by Directorate of Extemsion Education, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal at KVK Cooch Behar on 13 February, 2018.

Participation

- 71st Annual Conference of the Indian Society of Agricultural Statistics during 25-27 November, 2017 at ICAR-DRMR, Bharatpur (Rajasthan)
  - ➢ Mukesh Kumar, Soumen Pal, Anindita Datta, Mohd. Harun, Rajender Parsad, Sukanta Dash, Susheel Kumar Sarkar, Sunil Kumar Yadav, K. N. Singh, Ramasubramanian V., R.K. Paul, Tauqueer Ahmad, Hukum Chandra, Kaustav Aditya, Ankur Biswas and Vandita Kumari Choudhary, Wasi Alam, Bishal Gurung, Ravindera Singh Shekhawat

Santosha Rathod, Mrinmoy Ray, Achal lama, Rajeev Ranjan Kumar, Rajesh T., Shivaswami G.P., Anuja A.R., Harish Kumar H.V., Anil Rai, A.R. Rao, Md. Samir Farooqi, S.B. Lal, D.C. Mishra.

- International Conference on Changing Paradigms and Emerging Challenges in Statistical Sciences (IPECS-2018) in conjunction with Bi-Decennial Convention of Society of Statistics, Computer and Applications during 29th -31st January, 2018 at Pondicherry University, Puduchery.
  - ➢ Rajender Parsad, Anindita Datta, B N Mandal, Sukanta Dash and Mohd. Harun, Mukesh Kumar, Anshu Bharadwaj, Shashi Dahiya and Soumen Pal, R.K. Paul, Hukum Chandra and Kaustav Aditya, S.B. Lal, D.C. Mishra
- Annual Review Workshop of Farmer FIRST Programme held during 21-22 February, 2018 at ICAR-IARI, New Delhi.
  - ➢ Mukesh Kumar and Soumen Pal
- NAHEP workshop with World Bank officials on 14 March 2018 at NASC complex, Pusa, New Delhi.
  - ➢ Sudeep Marwaha
- 5th Edition of Global Conference on Cyber Space (GCCS 2017) organized by the Ministry of Electronics and Information Technology, Government of India during 23-24 November, 2017
  - ➢ Rajender Prasad
- National Workshop on Reshaping Agricultural Research, Education and Extension Systems Management for 2030 held at ICAR-NAARM, Hyderabad on 31 August, 2017.
  - ➢ Seema Jaggi and Rajender Parsad
- National Workshop on Developing a Roadmap for Agricultural Knowledge Management in India organized by ICAR-DKMA at NASC Complex, New Delhi during 27-28 September, 2017.
  - ➢ Rajender Parsad, Hukum Chandra, B. N. Mandal, Sukanta Dash, Wasi Alam, Ravindra Singh Shekhawat and Rajeev Ranjan Kumar, K.K. Chaturvedi, Anu Sharma
- International Indian Statistical Association (IISA)-2017 International Conference on Statistics during 28-30 December, 2017 at Hyderabad.
  - ➢ Rajender Parsad, Arpan Bhowmik, BN Mandal, Hukum Chandra, Kaustav Aditya, S.B. Lal, K.K. Chaturvedi, Anu Sharma, D.C. Mishra
- Workshop on "Digitalization of Breeding Database

through Breeding Management System (BMS) of Integrated Breeding Platform (IBP)" at NASC Complex, New Delhi on 4 August, 2017.

➢ Susheel Kumar Sarkar

- National Seminar on Challenges of Agricultural Policy Reforms organized by Centre for Agricultural Policy Dialogue and Techno-Economic Research Institute, New Delhi, at India International Center, New Delhi on 05 January, 2018.

➢ Susheel Kumar Sarkar

- National Conference on Innovative Technological interventions for Doubling Farmers Income organized by Society for Integrated Development of Agriculture, Veterinary and Ecological Sciences during 08-10 February, 2018

➢ Susheel Kumar Sarkar

- National Conference for Women in Statistics and Analytics organized by Department of Statistics, Savitribai Phule Pune University, Pune during 14-16 February, 2018.

➢ Seema Jaggi and Cini Varghese

- 3rd International Conference on Statistics for Twenty-first Centrury-2017 at Kerala University, Thiruvananthapuram during 14-16 December, 2017.

- Wasi Alam, Bishal Gurung, Ravindera Singh Shekhawat Santosha Rathod, Mrinmoy Ray, Achal lama, Rajeev Ranjan Kumar, Sunil Kumar Yadav, R. K. Paul, Prakash Kumar and H.S. Roy.

- Workshop on Technology Enhanced Learning in Agricultural Education-The Roadmap during 24-25 January, 2018 at ICAR-NAARM, Hyderabad.

➢ Ramasubramanian V.

- Workshop entitled Recent Trends in Distribution Theory, during 11-13 December, 2017 at Department of Statistics, University of Kerala, Trivandrum, Kerala.

➢ Wasi Alam,

- Workshop on Agricultural Markets, Prices and Market Integration in India-Conceptual and Methodological Issues, organized by FAO in New Delhi on 21 August, 2017 .

➢ R.K. Paul

- National Meeting of Experts on Agriculture Markets, Price Data Visualization and Early Warning System at New Delhi, during 11-12 September, 2017 organized by FAO.

➢ R.K. Paul

- Annual Conference of Agricultural Economics Research Association (AERA) at ICAR-NAARM, Hyderabad during 07-09 November, 2017.

➢ R.K. Paul

- International symposium on *Emerging Areas in Biosciences and Biomedical Technologies (eBBT)* during 05-06 January, 2018, at IIT Indore, Madhya Pradesh.

➢ P.K. Meher

- National seminar on Recent Trends in Microbiology and Biotechnology (RTMB-2018) organized by Department of Biotechnology during 16-17 March, 2018 at MITS School of Biotechnology, Bhubaneswar, Odisha.

➢ P.K. Meher

- International Conference on Contemporary Theory and Practice of Survey Sampling: A Celebration of Research Contributions of J. N. K. Rao at Yunnan, University, Kunming, Yunnan, China during 24-27 May, 2017.

➢ Hukum Chandra

- USDA-India Agricultural Outlook Forum 2017, organized by the Directorate of Economics & Statistics, Department of Agriculture & Cooperation and Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi on 31 August, 2017.

➢ Tauqueer Ahmad and Hukum Chandra

- Workshop on Statistical Techniques Using R organized by Department of Mathematics & Statistics, Banasthali University, Rajasthan on 03 September, 2017.

➢ Hukum Chandra

- National Seminar on the survey results relating to the subjects covered during NSSO 70 & 71 rounds, organized by the NSSO, Ministry of Statistics and Programme Implementation, Govt of India, at Goa University, Goa during 10-13 September, 2017.

➢ Hukum Chandra

- National Conference on Agriculture for Rabi Campaign during 19-20 September, 2017 at Vigyan Bhawan, New Delhi.

➢ Prachi Misra Sahoo

- 38th Asian International Conference on Remote Sensing Space Applications: Touching Human Lives during 23-27 October, 2017 at New Delhi.

➢ Prachi Misra Sahoo

- International Conference on Theory and Applications of Statistics and Information Sciences, at Coimbatore, Tamil Nadu during 05-07 January, 2018.

➢ Hukum Chandra

- National Seminar on Recent Advance in Statistics for Industries and Corporates at

Department of Statistics, Anand, Gujarat during 10-11 February, 2018.

➢ Hukum Chandra

- International Symposium on Health Analytics and Disease Modeling (HADM 2018), jointly organized by the Public Health Dynamics Laboratory of University of Pittsburgh, USA, National Institute of Medical Statistics, New Delhi, and SHARE India, New Delhi during 08-09 March, 2018.

➢ Hukum Chandra and Sushil Kumar

- International Conference on Emerging Trends in Biomaterial, Bioscience, Bioinformatics, Biomedical Engineering, Cancer Biology, Stem Cell Research, Cell Apoptosis and Applied biotechnology (BCS-2018) at Jawaharlal Nehru University, New Delhi on January 18, 2018

➢ MA Iquebal

- International Conference on Recent Trends in Agriculture, Food Science, Forestry, Horticulture, Aquaculture, Animal Sciences, Biodiversity, Ecological Sciences and Climate Change (AFHABEC-2018) at Jawaharlal Nehru University, New Delhi on February 10, 2018.

➢ Sarika Jaiswal

- International Symposium on Biodiversity and Biobanking (BIODIVERSE 2018) at Indian Institute of Technology Guwahati (IITG) in association with Association for Promotion of DNA Fingerprinting and Other DNA Technologies (ADNAT) during January 27-29, 2018

➢ Dinesh Kumar

- IX Asian Buffalo Congress (ABC-2018) at ICAR-CIRB, Hisar during February 1-4 February, 2018

➢ Neeraj Budhlakoti

- भारतीय भाषाओं में प्रथम अंतर्राष्ट्रीय विज्ञान संगोष्ठी, राष्ट्रीय प्रौद्योगिकी संस्थान, कुरुक्षेत्र 22 अगस्त, 2017

➢ Anu Sharma

- International Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2017) at MaharanaPratap University of Agricultural Sciences and Technology, Udaipur (Raj) during December 02-04, 2017.

➢ K.K Chaturvedi

- International Conference on Drug Design at Jawaharlal Nehru University, New Delhi during April 7-9, 2017

➢ U.B. Angadi

- South-south Cooperation: India-Africa partnership for food security and capacity building conference at University of Mumbai,

Mumbai, Maharashtra during January 23-24, 2018

➢ U.B. Angadi

- International Workshop-cum-Training on Bioinformatics in Fisheries and Aquaculture at ICAR-CIFRI, Barrackpore on June 19-21, 2017

➢ A.R. Rao

Meetings Attended

Dr. Rajender Parsad

- Attended the meeting on monitoring of e-Govermance Activities Under the chairmanship of the Secretary (ICAR)on April 12, 2017.

- Participated in the Meeting held with Superintending Engineer/ Executive Engineer of CPWD on April 19, 2017 to decide the further course of action on view of the report submitted by NCCBM regarding conditional Assessment of Quarters at Krishi Niketan of ICAR-IASRI, New Delhi.

- Attended 18 th Research Advisory Committee Meeting organized at IASRI, New Delhi on April 22, 2017

- Attended the Meeting on monitoring of e-Governance Activities under the chairmanship of the Secretary (ICAR) on May 22, 2017

- Attended the Annual General Boby Meeting and Foundation Celebrations of National Academy of Agricultural Sciences, New Delhi (June 05,2017).

- Attended a Meeting of the Sub-Committee for Basic Statistical Methods MSD 3:4 of Bureau of Indian Standards on 17.11.2017.

- Participated in 5 th Edition of Global Conference on Cyber Space (GCCS 2017) organized by the Ministry of Electronics and Information Technology, Government of India November 23-24,2017 (attended through webinar/webcast).

Dr. Anil Kumar

- Attended executive council meeting of FSRDA at IIFSR, Modipuram on 27.7.17.

- Attended Annual Group Meeting of AICRP on IFS during 03-05, November, 2017 held at Rajasthan Agriculture Research Institute, Durgapura (SKN University of Agriculture and Technology, Jobner), Rajasthan and presented progress of the project "Planning, Desigming and analysis of experiments planned ON STATION under AICRP on IFS" and it was appreciated by Dr. S. Bhaskar, ADG, ICAR, the then chairman of the session and other delegates also.

Dr. Cini Varghese

- Attended(first day) in the Annual group meet of AICRP on Integrated Farming Systems orgamized at Rajasthan Agriculturte Institute (SKN Agriculture University), Durgapura-Jaipur during November 03-05-,2017 and made a presentation on "progress on statistical analysis of on -farm farming system experiments (OFR2 &3)" in the first technical session.

Dr. UC Sud

- Review meeting of FASAL at IARI, New Delhi
- 39वीं उच्च स्तरीय तकनीकी समन्वय समिति की बैठक 07 अप्रैल 2017 को कृषि निदेशालय राजपंत कृषि भवन, जयपुर में आयोजित बैठक में सहभागिता की ।
- Interactive meeting with the Agricultural Education, Natural Resource Management and Agricultural Extension Division on 11 April 2017 at NIAP, New Delhi
- नगर राजभाषा कार्यान्वयन समिति के एक दिवसीय प्रशिक्षण कार्यक्रम, भा.कृ.अ.सं. पूसा, नई दिल्ली के उदघाटन समारोह में भाग लिया।
- Meeting of Sh. Rajju shroff , Chairman & MD, UPL with Dr. Mohapatra, Secretary, DARE & DG., ICAR on 17 April 2017
- As a Leader of Flying Squad of the entrance examination for admission to Ph.D. degree programme for academic session 2017-18 on 23 April 2017
- ICAR Interactive Portal meeting with Secretary, ICAR on 26 April 2017 at Krishi Bhawan, New Delhi
- Participated as a Chairman of PMC meeting to review the progress of the project and difficulties being faced by Directorate of Economics and Statistics, Orissa in field data collection work etc. under the Project entitled "Pilot study for developing State level estimates of crop área and production on the basis of simple sizes recommended by Professor Vaidyanathan Committee report" funded by DES, MoA, Govt. Of India on 12 May 2017
- Meeting of the Award Committee for selection of awardees for Prof. CR Rao National Award in Statistics for Young Statisticians-2017 at Ministry of Statistics and Programme Implementation on 16 May 2017
- Book release of Dr MS Swaminathan on The Quest for a world without hunger at Hon'ble Prime Minister's House on 19 May 2017.
- To attend meeting with the Officials of Directorate of Economics & Statistics, Karnataka at

Bengaluru in connection with resolving technical issues relating to field work pertaining to Area Enumeration and Crop Cutting Experiments, data entry work etc. under the project "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 DES, MoA, Govt. of India on 15 June 2017 at Bengaluru.

- 13th meeting of the Technical Monitoring Committee (TMC) to monitor the component of Strengthening of Database and Geographical Information System for the Fisheries Sector in the "Blue Revolution: Integrated Development and Management of Fisheries" on 19 June 2017
- Central Joint Staff Council meeting on 21 June 2017 at NASC Complex, New Delhi
- Technical Advisory Committee meeting on Crop Insurance on 27 June 2017 at Krishi Bhawan,New Delhi
- Hon'ble Prime Minister's call for Doubling Farmers' income by 2022 at Krishi Bhawan, New Delhi on 27 June 2017 at Krishi Bhawan, New Delhi
- Review meeting of KVK Portal on 29 June 2017 under the Chairmanship of Secretary, ICAR at Krishi Bhawan, New Delhi

Dr. A.K. Choubey

- GPF functionally meeting with ICAR Administrative & Finance staff on 18 August 2017
- दिनांक 01 सितम्बर 2017 से 14 सितम्बर 2017 तक हिन्दी पखवाडा मनाया गया जिसमें बहुत सी प्रतियोगिताएं जैसे काव्य गोष्ठी, अंताक्षरी, काव्य पाठ, प्रश्न मंच, दरोगा सिंह व्याख्यान (डॉ, रणधीर सिंह, पूर्व प्रधान वैज्ञानिक द्वारा प्रस्तुत किया गया) चल–शील्ड इत्यादि आयोजित की गयी तथा सभी प्रतिभागियों को सम्मानित किया गया।
- दिनांक 05 सितम्बर 2017 को शिक्षक दिवस मनाया गया ।
- Meeting of Research Advisory Committee (RAC) for setting up institute specific annual work plan and targets for Agro-Economic Research Centers/Units on 05 August 2017 at Institute of Economic Growth (IEG), Delhi University Enclave, Delhi
- Meeting regarding the proposal of redevelopment of existing residential areas of ICAR Institute located in Delhi under the Chairmanship of

Director General, ICAR on 03 August 2017 at Krishi Bhawan, New Delhi

- Meeting of APEDA funded project "Effect of buffaloes slaughter and meat export policy on livestock, milk, drought power and eco-balance in India" at ICAR-NRC on Meat, Hyderabad on 09 August 2017

- Technical Advisory Committee of PMFBY/ RWBCIS to discuss the issues relating to settlement of claims of Kharif 2016 season in Gujarat under PMFBY on 18 August 2017 at Krishi Bhawan, New Delhi

- Meeting with Director (Finance) to discuss the terms of reference for preparing ICT roadmap for ICAR on 23 August 2017

- Directors meeting for discussion on methodology and work plan of the newly allotted studies on 25 August 2017 at Institute Economic Growth (IEG), Delhi University Enclave, Delhi

- Meeting with Dr. RB Singh, Ex Vice Chancellor, CAU, Imphal for organization of ICAS-VIII 2019

- National Workshop on Developing a Roadmap for Agricultural Knowledge Management in India on 28 September 2017 at NASC New Delhi

- EFC meeting for consideration of ICAR Headquarters schemes for the period 2017-2020 under the Chairmanship of Secretary,DARE & DG, ICAR on 29 September 2017 at Krishi Bhawan, New Delhi

- For Restructuring and revamping of Agricultural Scientist Recruitment Board (ASRB), ICAR on 03 October 2017 at NASC , New Delhi

- Assessment and Screening committee of the CAS meeting on 09-10 October 2017 at ASRB, Krishi Bhawan, New Delhi

- Inauguration of the training programme on Biometrics Designs & Analysis of Data organized by ICARDA on 23 October 2017

- A meeting on Implementation of e-office at ICAR Institutes under the Chairmanship of AS, DARE & Secretary, ICAR on 02 November 2017 at Krishi Bhawan, New Delhi

- Review of the status of implementation of FMS-ERP in ICAR units under the Chairmanship of AS, DARE & Secretary, ICAR on 14 November 2017 at Krishi Bhawan, New Delhi

- Participated in the 71st Annual Conference on Statistics and Informatics for Farmers' Welfare during 25-27 November 2017 at ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur, Rajasthan

- Expert committee meeting to consider the proposals of project/studies/workshops/ seminars/conferences and Travel Grant assistance under the Grant-in-aid component of the Plan scheme capacity Development of CSO, on 28 November 2017

- Participation in the Indian Council of Agricultural Research & International Center for Agricultural Research in the Dry Areas (ICARDA) inaugural ceremony of 5th Regional Coordination meeting on Strategic Partnership towards Enhancing Food & Nutritional Security in South Asia and China. Honourable Sh. Radha Mohan Singh (Chief Guest and Sh. Shobhana K. Pattanayak Secretary, DoAC were (Special Guest) on this occasion on 05 December 2017 at NASC Complex.

Dr. L.M. Bhar

- Review meeting of Horticulture Domain under the project Network Project on Agricultural Bioinformatics under Centre for Agricultural Bioinformatics scheme on 02 February 2018

- Technical Advisory Committee (TAC) meeting to discuss the discrepancies in the final yield data submitted for settlement of claims of Cotton under PMFBY during Kharif 2016 season in Gujarat and Karnataka on 05 February 2018 at Krishi Bhawan, New Delhi

- Discuss the status of various important issues pertaining to ICAR under the chairmanship of Secretary, ICAR on 09 February 2018 at ICAR, Krishi Bhawan, New Delhi

- Fifth Meeting of Steering Committee of Network Project on Agricultural Bioinformatics under Centre for Agricultural Bioinformatics scheme on February 20, 2018

- 89th Annual General Meeting on 28 February 2018 at NASC Complex, New Delhi

- Training Programme Approval Committee meeting of NSSTA, CSO, MoSPI on 07.03.2018 at R.K. Puram, New Delhi

- Directors' Conference during 08-09 March 2018 at NASC Complex, New Delhi

- Review the progress of e-governance/e-office meeting on 15 March 2018 at Krishi Bhawan, New Delhi

- Participated in the Krishi Unnati Mela during 16-18 March 2018

- Evaluation of Proposal for Pilot Studies on uses of Technology in PMFBY for CCE Optimisation

on 26 March 2018 at IARI, New Delhi

Dr Tauqueer Ahmad

- Annual Review Committee meeting of CHAMAN project at MNCFC, New Delhi on 11.04.2017

- Review meeting of CHAMAN project at Krishi Bhawan, New Delhi on 03.05.2017.

- Meeting regarding finalization of EFC Memo for the Scheme "Improvement on Horticulture Crops Statistics Scheme" held on 20.06.2017 at Krishi Bhawan, New Delhi under CHAMAN Phase-II.

- Review meeting of MP-CHAMAN project held at Bhopal on 06.06.2017.

- Review meeting of MP-CHAMAN at Ratlam on 07.06.2017.

- Meeting related to the project entitled "An Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" held at DES, Guwahati on 07 July,.

- Meeting related to the project entitled "An Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" held at DES, Patna on 25 July, 2017.

- Technical Committee of Direction (TCD) meeting for improvement of Animal Husbandry Statistics and Dairying Statistics for the year 2016 organized by Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India held at Indian Institute of Public Administration, ITO, New Delhi on 26 July, 2017.

- Meeting related to the project entitled "An Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" held at New Secretariat, Nabanna, Kolkata on 27 July, 2017.

- Chaired a meeting at Barrackpore, North 24 Parganas, West Bengal (W.B.) to discuss the activities to be carried out in order to supervise the implementation of Crop Cutting Technique for Jute crop in W.B. State under the project "Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" on 08 August, 2017.

- Chaired a meeting at DES, Guwahati, Assam to discuss the activities to be carried out in order to supervise the implementation of Crop Cutting Technique for Jute crop in Assam State under the project "Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" on 22 August, 2017.

- Chaired a meeting with Dr. Sachi Swain, Senior Scientist and PI of the project from ICAR-CIARI, Port Blair, Andaman and Nicobar Islands and project team at ICAR-IASRI, New Delhi on 19 August, 2017 to discuss the activities to be carried out under the project "Assessment of post harvest losses in fruits and vegetables and strategies for their reduction in Andaman and Nicobar Islands".

- Chaired a meeting with Mr. Samaresh Kumar Haldar, Additional Director of Agriculture (Evaluation), Directorate of Agriculture, Govt. of W.B., Technical Officer, Agril. Census Division, Govt. of W.B. and project team members at ICAR-IASRI, New Delhi to discuss about the survey conducted by the ICAR-IASRI officials in W.B. State and other activities of the project "Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production".

- Chaired a meeting with Scientist, Consultant, other officials of MNCFC, New Delhi and project team members of CHAMAN project at ICAR-IASRI, New Delhi to discuss about the work to be carried out in common districts and research work to be carried out in future under CHAMAN project by both the organizations.

- National Family Health Survey meeting at Nirman Bhawan, New Delhi on 07.09.2017.

- Progress Review meeting on 04 October, 2017 at Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare, New Delhi.

- Crop Insurance meeting under the Chairmanship of Dr. Ashish Kumar Bhutani, Joint Secretary (Credit & Coop), DACFW, MoAFW, Govt. of India held at Krishi Bhawan on 09.10.2017.

- Convened Skype meeting with Officials of Food and Agriculture Organization of the United Nations (FAO), Rome on 23.10.2017 relating to FAO funded Post Harvest Losses study.

- Mid-term Review meeting of the CHAMAN project held at Krishi Bhawan on 24.10.2017.

- Convened Video Conferencing meeting with Officials of Food and Agriculture Organization of the United Nations (FAO), Rome on 26.10.2017 relating to FAO funded Post Harvest Losses study.

- Convened Video Conferencing meetings with Officials of Food and Agriculture Organization of the United Nations (FAO), Rome on 08.12.2017 and 22.12.2017.

- "Third National Consultative Meeting on Spices Statistics" at Thiruvananthapuram, Kerala on 18.01.2018 organized by Directorate of Arecanut & Spices Development, Kozhikode, Kerala.

- Technical Advisory Committee meeting of Crop Insurance on 05.02.2018 held at Krishi Bhawan, New Delhi.

- Convened meeting with Additional Director, Agriculture and other officer of the Directorate, Govt. of West Bengal related to the project entitled "An Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" held at ICAR-IASRI on 22 February 2018.

- Review meeting under the Chairpersonship of Smt. Sudha P. Rao, Principal Adviser, DACFW, MoAFW, Govt. of India held at Krishi Bhawan, New Delhi on 26.02.2018.

- Convened Video Conference meetings with Food and Agriculture Organization of the United Nations (FAO), Rome Statistics Division team on 06.02.2018, 19.02.2018 and 23.02.2018 regarding the progress and monitoring of two FAO funded projects being conducted at ICAR-IASRI.

Dr Hukum Chandra

- Meeting of Officials of Department of Agriculture Statistics and Crop Insurance Lucknow, Uttar Pradesh to discuss the results of Uttar Pradesh generated from the "Vaidyanathan Committee Report" project during 05-07 February, 2018.

- Meeting of Officials of DES, Govt. of Odisha to discuss the results of Odisha generated from the Project "Vaidyanathan Committee Report", Bhubaneshwar, Odisha during 22-23 February, 2018.

- Technical Committee of Direction for improvement of Animal Husbandry Statistic, organized by the Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agricultural & Farmers Welfare, Government of India, New Delhi during 25-26 July, 2017.

- Training Programme Approval Committee for the year 2018-19, NSSTA, MoSPI, Government of India, New Delhi on 07 March, 2018.

- Technical Advisory Committee for the Coverage Evaluation Survey, Ministry of Health and Family Welfare, Government of India, New Delhi on 28 March, 2018.

- Support meeting for statistical strengthening project (SSSP), Directorate of Economics and Statistics, Odisha during 22-23 February, 2018.

Dr Prachi Misra Sahoo

- Annual Review Committee meeting of CHAMAN project at MNCFC, New Delhi on 11.04.2017.

- Annual Review meeting of CHAMAN project at Krishi Bhawan, New Delhi on 03.05.2017.

- Review meeting under CHAMAN Phase-II held on 20.06.2017 at Krishi Bhawan, New Delhi.

- Review meeting related to the project entitled "An Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" held at DES, Guwahati on 07 July, 2017.

- Review meeting related to the project entitled "An Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" held at DES, Patna on 25 July, 2017.

- Review meeting at Barrackpore, North 24 Parganas, West Bengal (W.B.) to discuss the activities to be carried out in order to supervise the implementation of Crop Cutting Technique for Jute crop in W.B. State under the project "Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" on 08 August, 2017.

- Meeting at DES, Guwahati, Assam to discuss the activities to be carried out in order to supervise the implementation of Crop Cutting Technique for Jute crop in Assam State under the project "Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" on 22 August, 2017.

- Progress Review meeting on 04 October, 2017 at ICAR, Krishi Bhavan, New Delhi.

- Review meeting of the CHAMAN project under the Chairmanship of Sh. Dinesh Kumar, Joint Secretary (MIDH), MoAFW, Govt. of India held at Krishi Bhawan on 24.10.2017.

- Video Conferencing meeting with Officials of Food and Agriculture Organization of the United Nations (FAO), Rome on 26.10.2017, 08.12.2017 and 22.12.2017 relating to FAO funded Post Harvest Losses study.

Dr Kaustav Aditya

- Review meeting with Sh. B Mahapatra, Depty. Director, DES, Odisha at Bhubaneswar Odisha.

Dr. Ankur Biswas

- Review meeting at Barrackpore, North 24

Parganas, West Bengal (W.B.) to discuss the activities to be carried out in order to supervise the implementation of Crop Cutting Technique for Jute crop in W.B. State under the project "Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production" on 08 August, 2017.

Dr. Sudeep Marwaha

- Meeting for monitoring of e-Governance activities at ICAR on 22nd May, 2017.
- Convened a meeting to review and speed up the progress of ICAR-ERP modules at CAZRI Jodhpur on 14th August 2017.
- Meeting on implementation of ICAR-ERP payroll module for IARI held at NASC Complex on 27th February, 2018.
- Conference of VCs of AUs and Directors of ICAR institutes from 7-9th March 2018 and presented the progress of ERP in the conference.
- NAHEP workshop with World Bank officials on 14th March 2018 at NASC complex.
- Review Meeting on ICAR-ERP for Delhi based Institute held at NASC Complex on 27th February, 2018.
- Meeting held regarding security auditing of VOICE software on 12.3.18 at ICAR, Krishi Bhavan, New Delhi

Dr. Alka Arora

- Inter-Ministerial Meeting for National Mission on Interdisciplinary Cyber Physical System (ICPS) on 6th October, 2017 at Department of Science & Technology, Technology Bhawan, New Delhi.
- Meeting regarding Direct Benefit Transfer (DBT) and KVK Portal on 17th November, 2017 at Krishi Anusandhan Bhawan, New Delhi.
- Meeting in the Ministry of Electronics and Information Technology (MeitY) for new project proposal presentation on "Disbursal of Agri-based Information using Translation Service in Local Language" with C-DAC Noida.

Dr. Mukesh Kumar

- Meeting for monitoring of e-Governance activities at ICAR on 22nd May, 2017.
- Zonal Review meeting of Farmer FIRST programme held on 18th December, 2017 at ATARI, Jodhpur.
- Meeting on review of ICAR-ERP for Delhi based

Institute held at NASC Complex on 27th February, 2018.

Dr. Soumen Pal

- Meeting regarding Direct Benefit Transfer (DBT) and KVK Portal on 17th November, 2017 at Krishi Anusandhan Bhawan, New Delhi.
- Meeting with Mr. Mohit Bali from Price water house Coopers (PwC), India at DBT Mission, Connaught Place, New Delhi related to integration of 'DBT Portal of DARE' and 'DBT Bharat Portal' on 22nd January, 2018.
- Meeting in the Ministry of Electronics and Information Technology (MeitY) for new project proposal presentation on "Disbursal of Agri-based Information using Translation Service in Local Language" with C-DAC Noida on 26 February, 2018.
- Meeting for Presenting the Progress of KVK Portal and KVK Mobile App under the chairmanship of DDG (Agricultural Extension) on 15 th May, 2017 at Krishi Anusandhan Bhawan, New Delhi.
- Meeting for presenting the progress on KVK portal to AS (DARE) & Secretary, ICAR on 17th July, 2018 at Krishi Bhawan, New Delhi.
- Meeting regarding Direct Benefit Tramsfer (DBT) Portal with ADG (EP & HS) on 21 st November, 2017 at Krishi Anusandhan Bhawan, New Delhi.
- Meeting regarding Direct Benefit Transfer (DBT) Portal with ADG (EP & HS) and Dr. Nidhi Verma, Pr. Scientist (EP & HS) on 19 th January, 2018 at Krishi Anusandhan Bhawan, New Delhi.
- Meeting regarding Direct Benefit Transfer (DBT) Portal with ADG (EP & HS) on 21st February, 2018 at Krishi Anusandhan Bhawan, New Delhi.

Dr. M.A. Iquebal

- Attended DBT project review meeting at Anand Agricultural University, Anand on May 12, 2017.
- Attended Task Force Meeting on Aquaculture and Marine Biotechnology on May 25, 2017 in DBT Office, CGO Complex, New Delhi.
- Attend Twinning research and development (CFTP) 2017-18 meeting at Conference Room 2nd Floor NER-BPMC, Defence Colony, New Delhi on February 19, 2018.

Dr. Ranjit K. Paul

- Chaired a session on Stochastic Modelling as Chairman in International conference on changing paradigms and Emerging Challenges

in statistical sciences (PECS-2018) of Society of Statistics, Computer and Applications (SSCA) during 29-31 January, 2018 at Pondicherry University, Puducherry.

- Conducted a full day session and delivered four lectures on theory and practical on time series analysis, panel data analysis, simultaneous equation modelling and two stage least squartes in the faculty development programme at Jagannat international Management School (JIMS), Vasant Kunj on May, 2017

- Organized the contributory Paper session on Statistical Modelling as chairman in the 71 st Annual Conference of Indian Society of Agricultural Statistics (ISAS) at ICAR-DRMR, Bharatpur during 25-27 th November 2017.

- National Meeting of Experts on Agriculture Markets, Price Data Visualization and Early Warning System at Hotel Taj Mahal, Mansingh Road, New Delhi, during 11-12 September 2017 organized by FAO.

- Review workshop of NICRA during 12-13 February 2018 at NASC complex.

- Meeting on possible application of Artificial Intelligence technique in Agricultural Sector at NITI Aayog on 13th February, 2018

Dr. Tauqueer Ahmad and Prachi Mishra Sahoo

- Attended one day workshop on " Development of yield models for horticultural crops under CHAMAN Project" organized by the MNCFC, Ministry on Agriculture & Farmers Welfare, Government of India, New Delhi held at MNCFC, ICAR-IARI Campus, New Delhi on 18 August, 2017 in which Dr. Tauqueer Ahmad made a presentation on " Yield estimation for Horticulture crops under CHAMAN Project Through field Survey".

Dr. Arpan Bhowmik

- III LACSC: Latin American Conference on Statistical Computing held from 27-02-2018 to 02-03-2018 at University of Costa Rica, San José,Costa Rica.

Dr. Anil Rai

- Attended meeting as member of School Board of Physical Sciences, North Eastern Hill University, Shillong at North Eastern Hill University, Shillong on April 10, 2017

- Attended meeting as member of the tender committee related to conducting All India Examinations for admission in UG and PG in ICAR at ICAR-IARI, New Delhi on April 17, 2017.

- Attended meeting as member of DPC of Scientists in ICAR Headquarter at ICAR Headquarter on April 18, 2017

- Meeting for on-line examination in the Education Division in the Council at ICAR-IASRI, New Delhi on June 16, 2017 and June 26, 2017

- Review workshop of CRP-Genomics under the Chairmanship of DDG (Fisheries), at ICAR-NBFGR, Lucknow during July 26-27, 2017

- Empowered Committee project review meeting, NASF on August 8th, 2017 as a capacity of CO-PI of the project "Phenomics of Moisture Deficit Stress Tolerance and Nitrogen Use Efficiency in Rice and Wheat – Phase II" at ICAR-IARI, New Delhi on August 8, 2017

- National Workshop on Reshaping Agricultural Research Education and Extension Systems Management for 2030 at ICAR-NAARM, Hyderabad on August 31, 2017

- Attended a special review meeting of the Phenomic Project under the Chairmanship of D.G. ICAR. Board Room of NASC Complex, New Delhi on October 27, 2017

Dr. A.R. Rao

- 29th BTIS net Coordinators meeting held by DBT, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu during February 03-05, 2018

- 405th and 406th Academic Council meeting of PG School, IARI at IARI, New Delhi December 16 2017 and February 8, 2018.

12

Conferences, Workshops, Meetings, Seminars etc. Organized

Mukesh Kumar, Anshu Bharadwaj and Soumen Pal

- Training cum Workshop on Methodological Framework for Implementation of FFP have been jointly organized by ICAR-NAARM, ICAR-NIAP, ICAR-IASRI and ICAR-DKMA at following organizations:
  i. ICAR-IISS, Bhopal during 18-21 September, 2017
  ii. ICAR-CISH, Lucknow during 03-06, October 2017
  iii. TANUVAS, Chennai during 10-13 October, 2017
  iv. ICAR-IARI, New Delhi during 23-26 October, 2017
  v. ICAR-IISWC, Dehradun during 06-09 November, 2017.

Sudeep Marwaha

- Smart India Hackathon (SIH) 2018 at Chandigarh as Nodal Officer from ICAR/DARE during 30-31 March, 2018

B.N. Mandal and Sukanta Dash

- Organized a Hindi Workshop on Multivariate Statistical Analysis using SAS during 30 November - 04 December, 2017.

Seema Jaggi and Cini Varghese

- Hindi Workshop on Statistics and Informatics for Farmers' Welfare organized at the institute for the Scientists on 20 January, 2018.

A.K. Paul and Susheel Kumar Sarkar

- 71st Annual Conference of Indian Society of Agricultural Statistics at ICAR-Directorate of Rapeseed-Mustard Research, Bharatpur (Rajasthan) during 25-27 November, 2017.

Prawin Arya, Santosha Rathod, Ravindra Singh Shekhawat and Rajeev Ranjan Kumar, Ranjit Kumar Paul, Soumen Pal, Sunil K Yadav, U.B.

Angadi, Sukanta Dash, Neeraj Budhlakoti,

- Organizer cum Exhibitor of ICAR-IASRI stall in Krishi Unnati Mela organized by ICAR-IARI during 16 -19 March, 2018.

Kaustav Aditya

- Organized a PMC meeting 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" as member secretary on 12 May, 2017 at Bhubaneswar, Odisha.

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- संगणक अनुप्रयोग प्रभाग में एक दिन की हिन्दी कार्यशाला "कृषि में संगणक अनुप्रयोग" विषय पर दिनांक 09 जनवरी 2018 को आयोजित की गई।

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- प्रतिदर्श सर्वेक्षण प्रभाग द्वारा संस्थान में दिनांक 25—27 सितम्बर, 2017 के दौरान ''कृषि में प्रतिदर्श सर्वेक्षण तकनीकों का उपयोग'' नामक विषय पर एक हिन्दी कार्यशाला का आयोजन किया गया ।

Annual Day Celebrations

- The Annual Day of the Institute was celebrated on July 3, 2017. Dr.N.S. Rathore, Deputy Director General (Education) delivered the Nehru Memorial Lecture on "Agriculture Education in India".Dr. Kirti Singh, Ex-Chairman ASRB & Advisor, Govt. of Nepal for Establishment of Agricultural University, presided over the function. Dr. R.B. Singh, Chancellor, Central Agricultural University, Imphal was the Guest of Honour.

Teacher's Day Celebrations

- The Teacher's Day was celebrated on 5th September, 2017 in which Dr. S.K. Raheja, Ex-Director presided over the function and Dr. R.K. Pandey, Ex-Director IASRI was honored on this occasion.

Technology Data Repository

KRISHI: Technology Collections Developed by ICAR institutes

Welcome: Krishi

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TECHNOLOGY REPOSITORY

Technology Repository consists of technologies generated by ICAR institutions in the areas of Crop Improvement, Natural Resource Management, Fisheries, Veterinary, Dairy, Animal sciences, Horticulture, Engineering and Social Sciences. The technologies include only those which were developed and tested. Information is also available on commercialized technologies. The repository provides an easy way to search and locate appropriate technologies based on regional, subjects, institutions and related resources such as reports, success stories, media resources/contents, etc. This repository is made available under the aegis of open access policy of ICAR for viewing. Additions/modifications to the items in the repository is restricted only to authorized persons.

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WDRoT Db
Wheat Drought Root Transcriptome Database

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Wheat drought root transcriptome database

Bread wheat (*Triticum aestivum L.*) is the most widely grown crop of the world which is grown over 220 million hectares. It caters staple food need of 30% of global population. It has been projected that climate change may adversely affect the wheat production by 29%. Since for one degree celsius rise in global temperature, there is decline of wheat productivity by 6%, thus by 2080 projected global temperature of 4.5 degree Celsius will further compound the demand gap. Global increase in population with climate change has resulted into major challenge for water and food security.

SNPRBb
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Welcome to SNPRBb (SNP Resources for *Bubalus bubalis*)

Trait Specific SNP Resources for Bubalus bubalis (SNPRBb) is a database containing genomic variant information of Indian buffalo. Trait-wise SNPs were identified from the ddRAD (Double-Digested Restriction Associated DNA) data. The four traits have been considered. The traits are Milk value, Age at first calving, Post-partum cyclicity and Feed conversion efficiency. The identified SNP specific to these traits were documented in the form of database. The developed database is a useful resource for the study of Indian buffalo's population, evolution, phenotype and life habit. In the current version, total 85 samples covering four traits are analyzed and containing 521001 SNPs.

SmTMVD : Transcriptome based Mosaic Virus Database in Small Cardamom

Elettaria cardamomum (Small Cardamom) is a perennial, herbaceous, rhizomatous, monocot spice plant belongs to zingiberaceae family which is mostly cultivated in the tropical regions of the world. Cardamom, the "queen of spices", is the world's third-most-expensive spice after vanilla and saffron and most important economical spices. Guatemala, India, Srilanka, Tanzania, El Salvador, Vietnam, Laos, Cambodia and Papua New Guinea are the major cardamom growing countries. There are three natural varieties of *Elettaria cardamomum* on the basis of panicle, size and shape of fruits i.e. Malabar, Mysore and Vazhuka. In 2015-16, the total export was 5500 tonnes worth Rs 44982 lakhs. Genome of small cardamom is not yet sequenced and very less information of genic SSRs, SNPs and Indels.

The present database "Transcriptome Based Mosaic Virus Database in small cardamom (SmTMVD)" contains the information of differential expressed genes, microsatellites, variants, transcriptional factors, pathways, domain and families. In small cardamom, Mosaic or katte or marble disease are the most destructive disease caused by *Cardamom mosaic virus* (CdMV). This study was performed was to discover the candidate genes associate the mosaic disease. This web transcriptomic database having 123338 transcripts, 5317 differential expressed genes, 24 thousand geneic region putative markers, 147442 and 154217 SNPs and Indels from control and mosaic virus infected samples, 2267 transcriptional factors, 1219 domains and 807 families.

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संस्थान में हिन्दी के प्रगामी प्रयोग की रिपोर्ट

भा.कृ.अनु.प. – भारतीय कृषि सांख्यिकी अनुसंधान संस्थान में हिन्दी के प्रगामी प्रयोग में महत्वपूर्ण अभिवृद्धि हो रही है। संस्थान द्वारा समस्त प्रशासनिक कार्य शत–प्रतिशत हिन्दी में और यथाआवश्यक द्विभाषी हो 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। संस्थान द्वारा समस्त प्रशासनिक कार्य शत–प्रतिशत हिन्दी में और यथाआवश्यक द्विभाषी हो रहा है।

भारत सरकार, राजभाषा विभाग की नगर राजभाषा कार्यान्वयन समिति (उत्तरी दिल्ली) द्वारा संस्थान में हिन्दी के प्रगामी प्रयोग से सम्बन्धित मार्च 2017 एवं सितम्बर 2017 को समाप्त छःमाही रिपोर्टों के आधार पर संस्थान को ''उत्कृष्ट श्रेणी'' में वर्गीकृत किया गया।

नगर राजभाषा कार्यान्वयन समिति (उत्तरी दिल्ली) द्वारा सदस्य कार्यालयों के लिए आयोजित प्रश्नोत्तरी प्रतियोगिता के प्रथम चरण में संस्थान के प्रतिभागियों द्वारा दूसरा स्थान प्राप्त किया गया जिसके लिए 30 नवम्बर 2017 को आयोजित नराकास (उ.दि.) की छःमाही बैठक में संस्थान के निदेशक को प्रमाण–पत्र से सम्मानित किया गया।

संस्थान की वैज्ञानिक, डॉ. अनिंदिता दत्ता को भारतीय कृषि अनुसंधान समिति एवं कृषि अनुसंधान संचार केन्द्र द्वारा उनके शोध–पत्र ''जर्नलाइज्ड रो–कॉलम अभिकल्पनाएँ : एक सिंहावलोकन'' के लिए उन्हें जून 2017 में ''कृषि विज्ञान गौरव'' सम्मान से पुरस्कृत किया गया।

संस्थान की वैज्ञानिक डॉ. अनु शर्मा को राष्ट्रीय प्रौद्योगिकी संस्थान, कुरूक्षेत्र में 22 अगस्त 2017 को आयोजित भारतीय भाषाओं में प्रथम विज्ञान संगोष्ठी में उनके द्वारा प्रस्तुत शोध–पत्र ''सिमेंटिक्स और सॉफ्टवेयर एजेंट आधारित बेव पर्सनलाइज्ड सूचना बहाली'' को सर्वश्रेष्ठ शोध–पत्र प्रस्तुति से सम्मानित किया गया।

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 शामिल किये गये। वैज्ञानिकों द्वारा अपनी परियोजना रिपोर्टों में कवर पेज, आमुख, प्राक्कथन एवं सारांश द्विभाषी रूप में प्रस्तुत किये गये तथा कुछ वैज्ञानिकों द्वारा अपनी परियोजना रिपोर्टों में विषय–सूची एवं तालिकाएँ भी द्विभाषी रूप में प्रस्तुत की गयीं। संस्थान के वैज्ञानिकों द्वारा हिन्दी में वैज्ञानिक विषयों पर हिन्दी कार्यशालाओं का आयोजन किया गया। 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।

गृह मंत्रालय, राजभाषा विभाग से प्राप्त 29 फरवरी 2016 के कार्यालय ज्ञापन सं. 12019 / 81 / 2015– रा.भा.(का–2) / पार्ट–2 में निहित दिशानिर्देश कि दो वर्ष के निर्धारित लक्ष्य में संस्थान के समस्त अधिकारियों / कर्मचारियों को कम से कम एक बार हिन्दी कार्यशाला में सहभागिता करने का अवसर मिलना अनिवार्य है। उक्त दिशानिर्देशों के अनुपालन के उद्देश्य से संस्थान में सितम्बर 2016 से मार्च 2018 तक अनेक हिन्दी कार्यशालाएँ आयोजित की गयीं जिनमें अभी तक 60 वैज्ञानिकों, 45 तकनीकी कर्मियों तथा 43 प्रशासनिक

कर्मियों द्वारा सहभागिता की जा चुकी है। शेष बचे अधिकारियों / कर्मचारियों द्वारा शीघ्र ही हिन्दी कार्यशालाओं में सहभागिता कर निर्धारित लक्ष्य को पूरा करने की आशा है।

इसी क्रम में, प्रतिवदेनाधीन अवधि के दौरान संस्थान के विभिन्न वर्ग के कर्मियों के लिए सात हिन्दी कार्यशालाएँ आयोजित की गयीं जिनमें से छः कार्यशालाएँ पूर्णतः वैज्ञानिक विषयों पर थीं। पहली कार्यशाला 24 से 26 मई 2017 के दौरान कृषि जैव सूचना केन्द्र के वैज्ञानिक, डॉ. द्विजेश चन्द्र मिश्र एवं श्री नीरज बुढ़लाकोटी द्वारा ''जैव–सूचना विज्ञान : एक परिचय'' विषय पर आयोजित की गयी जिसमें 08 वक्ताओं द्वारा विषय से सम्बन्धित 11 उप–विषयों पर व्याख्यान दिये गये। इस कार्यशाला में 13 अधिकारियों द्वारा सहभागिता की गयी। दूसरी कार्यशाला भी कृषि जैव सूचना केन्द्र के वैज्ञानिक, डॉ. सारिका एवं डॉ. मीर आसिफ इकबाल द्वारा 27 से 29 जून 2017 के दौरान ''कृषि में जैव–सूचना का उपयोग'' विषय पर आयोजित की गयी। इस कार्यशाला में 09 वक्ताओं द्वारा विषय से सम्बन्धित 11 उप–विषयों पर व्याख्यान दिये गये तथा इस कार्यशाला में 09 अधिकारियों एवं 01 कर्मचारी ने सहभागिता की। तीसरी कार्यशाला प्रतिदर्श सर्वेक्षण प्रभाग के वैज्ञानिक, सुश्री वन्दिता कुमारी चौधरी, श्री दीपक सिंह एवं श्री प्रदीप बसाक द्वारा 25 से 27 सितम्बर 2017 के दौरान ष्कृषि में प्रतिदर्श सर्वेक्षण तकनीकों का उपयोगष् विषय पर आयोजित की गयी। इस कार्यशाला में 11 वक्ताओं द्वारा 11 विभिन्न विषयों पर व्याख्यान दिये गये। इस कार्यशाला में 12 अधिकारियों ने सहभागिता की। चौथी कार्यशाला हिन्दी एकक की प्रभारी एवं वरिष्ठ तकनीकी अधिकारी, सुश्री ऊषा जैन द्वारा 30 अक्टूबर 2017 को ष्राजभाषा नियम एवं अनुपालनष् विषय पर आयोजित की गयी। इस कार्यशाला में 08 अधिकारियों एवं 30 कर्मचारियों द्वारा सहभागिता की गयी। पाँचवीं कार्यशाला परीक्षण अभिकल्पना प्रभाग के वैज्ञानिक, डॉ. बी.एन मंडल एवं डॉ. सुकान्त दाश द्वारा 30 नवम्बर से 04 दिसम्बर 2017 के दौरान ''एस.ए.एस. द्वारा बहुचर सांख्यिकीय विश्लेषण'' विषय पर आयोजित की गयी जिसमें 08 वक्ताओं द्वारा विषय से सम्बन्धित 15 उप–विषयों पर व्याख्यान दिये गये। इस कार्यशाला में 14 अधिकारियों एवं 01 कर्मचारी द्वारा सहभागिता की गयी। छठी कार्यशाला संगणक अनुप्रयोग प्रभाग के वैज्ञानिक, श्री पाल सिंह एवं डॉ. सुदीप कुमार द्वारा 09 जनवरी 2018 को ''कृषि में संगणक अनप्रयोग'' विषय पर आयोजित की गयी जिसमें 07 वक्ताओं द्वारा 07 विभिन्न विषयों पर व्याख्यान दिये गये। इस कार्यशाला में 18 अधिकारियों एवं 02 कर्मचारियों द्वारा सहभागिता की गयी। उक्त वैज्ञानिक विषयों पर आयोजित

हिन्दी कार्यशालाओं में अनेक वक्ता हिन्दीतर थे जिन्होंने बड़ी निपुणता के साथ हिन्दी में व्याख्यान दिये। कार्यशालाओं के आयोजकों / वक्ताओं द्वारा प्रतिभागियों को व्याख्यानों की सामग्री, मैनुअल के रूप में, हिन्दी भाषा में उपलब्ध करायी गयी। सातवीं कार्यशाला विशेष रूप से संस्थान के वैज्ञानिक वर्ग के लिए 20 जनवरी 2018 को ''कृषक कल्याण के लिए सांख्यिकी एवं सूचना–विज्ञान का योगदान'' विषय पर परीक्षण अभिकल्पना प्रभाग की अध्यक्षा, डॉ. सीमा जग्गी एवं प्रमुख वैज्ञानिक, डॉ. सिनी वरगीस के संयोजन में हिन्दी एकक द्वारा आयोजित की गयी। इस कार्यशाला में आई.सी. एम.आर. के पूर्व अपर महानिदेशक एवं राष्ट्रीय सांख्यिकीय आयोग के सदस्य, डॉ. पदम सिंह, राष्ट्रीय कृषि आर्थिकी नीति अनुसंधान संस्थान (एन.आई.ए.पी.) के निदेशक, डॉ. सुरेश पाल, संस्थान की पूर्व प्रमुख वैज्ञानिक, डॉ. रंजना अग्रवाल तथा संस्थान के पूर्वानुमान एवं कृषि प्रणाली मॉड. लिंग प्रभाग के अध्यक्ष, डॉ. कमलेश नारायन सिंह एवं परीक्षण अभिकल्पना प्रभाग के प्रमुख वैज्ञानिक, डॉ. राजेन्द्र प्रसाद द्वारा संस्थान के कार्यक्षेत्र से सम्बन्धित विभिन्न विषयों पर हिन्दी में व्याख्यान दिये गये। इस कार्यशाला में 58 वैज्ञानिकों द्वारा सहभागिता की गयी।

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 तथा संस्थान के कर्मियों ने इन योजनाओं में भाग लिया।

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 हिन्दी आशुलिपि एवं हिन्दी टंकण के प्रशिक्षण का लक्ष्य भी संस्थान द्वारा पूरा कर लिया गया है।   राजभाषा विभाग से प्राप्त दिशा–निर्देशों के अनुसरण में वर्ग 'घ' से वर्ग 'ग' में गये कर्मियों में से वर्ग 'ग' श्रेणी के लिए निर्धारित शैक्षिक योग्यता रखने वाले कर्मियों को रोस्टरबद्ध कर उन्हें भी केन्द्रीय हिन्दी प्रशिक्षण संस्थान से हिन्दी टंकण का प्रशिक्षण दिलवाया जा चुका है। परीक्षा में अनुत्तीर्ण 03 कर्मियों द्वारा पुनः टंकण परीक्षा दी जानी है।

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

संस्थान द्वारा प्रकाशित हिन्दी पत्रिका, 'सांख्यिकी–विमर्श' के तेरहवें अंक का प्रकाशन मार्च 2018 में किया गया। इस वर्ष से इस पत्रिका में अनुसंधान खण्ड के साथ–साथ राजभाषा खण्ड को भी शामिल किया गया है। 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 जाता है। पाठकों के हिन्दी ज्ञानवर्धन के लिए दैनिक स्मरणीय शब्द–शतक (हिन्दी व अँग्रेजी में) के साथ–साथ द्विभाषी पदनाम तथा लैटिन शब्दों के हिन्दी समानक भी पत्रिका में शामिल किये गये हैं।

संस्थान में 01 से 14 सितम्बर 2017 के दौरान हिन्दी पखवाड़े का आयोजन किया गया। दिनांक 01 सितम्बर 2017 को हिन्दी पखवाड़े का उद्घाटन संस्थान के निदेशक, डॉ. अंजनी कुमार चौबे जी द्वारा किया गया। हिन्दी पखवाड़े के उद्घाटन के तत्पश्चात काव्य–पाठ का आयोजन 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, वाद–विवाद, प्रश्न–मंच, अन्ताक्षरी, काव्य–गोष्ठी, डिजिटल

हिन्दी शोध–पत्र प्रस्तुति, हिन्दीतर कर्मियों के लिए हिन्दी श्रुतलेख एवं ॉब्दार्थ 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। संस्थान में प्रत्येक वर्ष हिन्दी दिवस के अवसर पर डॉ. दरोगा सिंह स्मृति व्याख्यान का आयोजन किया जाता है। इस वर्ष इस कड़ी का छब् बीसवाँ व्याख्यान संस्थान के पूर्व प्रोफेसर (कृषि सांख्यिकी), डॉ. रणधीर सिंह जी द्वारा 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 14 सितम्बर 2017 को हिन्दी पखवाड़े के समापन समारोह के अवसर पर इस दौरान आयोजित प्रतियोगिताओं के सफल प्रतियोगियों को पुरस्कृत करने के साथ–साथ वर्ष 2016–17 के दौरान ''सरकारी कामकाज मूल रूप से हिन्दी में करने के लिए प्रोत्साहन योजना'' के अन्तर्गत भी नकद पुरस्कार प्रदान किये गये। इसके अति. रिक्त, इस अवसर पर जुलाई 2016 से जून, 2017 तक की अवधि के दौरान संस्थान में अयोजित हिन्दी कार्यशालाओं के वक्ताओं को भी सम्मानित करने के साथ–साथ संस्थान द्वारा प्रकाशित हिन्दी पत्रिका : सांख्यिकी विमर्श 2016–17 के सम्पादक मंडल के सदस्यों को भी प्रशस्ति–पत्र प्रदान किये गये।

नराकास (उत्तरी दिल्ली) द्वारा आयोजित प्रश्नोत्तरी प्रतियोगिता के प्रथम चरण में संस्थान के प्रतिभागियों द्वारा द्वितीय स्थान प्राप्त करने पर संस्थान के निदेशक प्रमाण–पत्र प्राप्त करते हुए

LIST OF RESEARCH PROJECTS

1st April, 2017 to 31st March, 2018

DEVELOPMENT AND ANALYSIS OF EXPERIMENTAL DESIGNS FOR AGRICULTURAL SYSTEMS RESEARCH

On-going

Institute Funded

1. Some investigations on trend resistant row-column designs. (AGENIASRISIL201502900066) Arpan Bhowmik, Seema Jaggi, Eldho Varghese (till 6 October, 2017) and Sunil Kumar Yadav: 24.09.2015-30.06.2018

2. On construction of orthogonal and nested orthogonal Latin hypercube designs. (AGENIASRISIL201503200069) Sukanta Dash, Rajender Parsad, BN Mandal and Susheel Kumar Sarkar: 16.11.2015-15.11.2018

3. Design involving multi-way genetic crosses for agricultural and animal breeding programmes. (AGENIASRISIL201700300089) Harun, Anindita Datta, Cini Varghese, Seema Jaggi: 09.03.2017-08.03.2020

4. Generalized row-column designs for cop and animal experiments. (AGENIASRISIL201700400090) Anindita Datta, Harun, Seema Jaggi, Cini Varghese: 31.03.2017-30.03.2020

Outside Funded

5. 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 Sarkar, Arpan Bhowmik, Raju Kumar (till 04.06.2017: on study leave), 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

6. 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)

Completed

Institute Funded

7. Development of varietal and hybrid technologies of pearl millet [Pennisetum glaucum (L). R. Br.] For higher yield and nutritional improvement. (Collaboration with ICAR-IARI) (AGENIASRICIP201601200081) ICAR-IARI: C Tara Satyavathi, SP Singh, Mukesh Sankar, MB Arun Kumar, RS Banna, Sudhir Kumar, N Srinivasa, Dabas, Gynander Singh, Anil Dahuja

   RS Dharwar: Jayant Bhat

   RS Karnal: Raj Kumar

   ICAR-NRCPB: Jasdeep Chatrath Padaria

   ICAR-FS&PHT: SK Jha

   ICAR-SSA&C: MC Meena

   ICAR-IASRI: Eldho Varghese: 26.09.2016-06.10.2017

8. Minimal response surface designs for resource optimization in agricultural experiments. (AGENIASRISIL201401500034) Eldho Varghese, Arpan Bhowmik, Seema Jaggi and Cini Varghese: 04.09.2014-30.11.2017

9. A optimal block designs for comparing test treatments with control treatment(s)-an algorithmic approach. (AGENIASRISIL201500200039) BN Mandal, Rajender Parsad, VK Gupta (till 16.03.2016) and Sukanta Dash: 18.02.2015-19.03.2018

Completed
Outside Funded

10. Information system for planning and analysis of experiments on All-India Coordinated Research Project on Vegetable Crops. Funded by AICRP (VC), ICAR-IIVR, Varanasi. (AGENIASRICOL201400200021) ICAR-IASRI: Rajender Parsad and Sukanta Dash, ICAR-NAARM: A Dhandapani, ICAR-IIVR: B Singh, PM Singh (January 2015-10.12.2015), Satyandra Singh (October 2014-May 15, 2015), Major Singh (since 11.12.2015) and T Choubey: 05.02.2014-31.03.2017

11. Performance Assessments of Universities in Agriculture Education: A comparative analysis. Funded by ICAR-Extramural. (AGEDIASRISOL201701800104) Sukanta Dash, Anil Kumar: 02.08.2017-31.03.2018

New Initiated
Institute Funded

12. Analytical procedure for factorial experiments with Logistic and Gompertz error distributions. (AGEDIASRISIL201701300099) Sunil Kumar Yadav: 25.05.2017-24.05.2019

Outside Funded

13. Planning, designing and analysis of experiments planned on stations under All India Coordinated Research Project on Integrated Farming Systems. Funded by AICRP on IFS, ICAR-IIFSR. (AGEDIASRISOL201701900105) Anil Kumar, Md. Harun, Susheel Kumar Sarkar: 01.04.2017-31.03.2020

14. 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

15. 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. (AGEDIASRISOL201702100107) BN Mandal, Anindita Datta, Sunil Kumar Yadav: 01.04.2017-31.03.2019

FORECASTING, MODELLING AND SIMULATION TECHNIQUES IN BIOLOGICAL AND ECONOMIC PHENOMENA

On-going
Institute Funded

16. Future perspective of Bt technology in Indian agriculture. (AGENIASRISIL201601700086) Mrinmoy Ray, Santosh Rathod, Bishal Gurung, KN Singh and Ravindra Shekhawat (from 15.12.2016), Ramasubramanian V (since 17.07.2017): 01.12.2016-31.12.2018

17. Development of methodology for nonparametric modelling of time-series data and its application in agriculture. (AGENIASRISIL201500800045) Himadri Ghosh and Soumen Pal (October, 2015):06.06.2015-05.06.2018

Outside Funded

18. 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: 13.04.2016-31.05.2018

19. Creation of Policy and Strategy Cell (PSC) at ICAR-NIAP for 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: Director, Raka Saxena, Naveen P Singh, Usha R Ahuja

ICAR-IASRI: Ranjit Kumar Paul: 31.03.2017-31.03.2022

20. 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: Ranjit Kumar Paul: 20.06.2017-31.03.2020

Completed

Institute Funded

21. Smallholder's productivity and agricultural growth through technology, sustainable intensification and ecosystem services. (AGENIASRICIP201600800077)

ICAR-IARI: Girish Jha

ICAR-IASRI: Prawin Arya: 13.04.2016- 31.03.2017

22. A Study on price efficiency in agricultural commodity market. (AGENIASRISIL201500700044)

SP Bhardwaj (till April 30, 2017), Bishal Gurung and Kanchan Sinha: 13.05.2015-12.09.2017

23. Nonparametric bootstrap approach for constructing prediction intervals for non-linear and bivariate time series models. (AGENIASRISIL201502200059)

Mrinmoy Ray, Santosha Rathod, Wasi Alam and KN Singh: 19.08.2015-18.08.2017

24. Forecasting of spatio-temporal time series data using Space Time Autoregressive Moving Average (STARMA) model. (AGENIASRISIL201502300060)

Santosha Rathod, Mrinmoy Ray, Ajit, KN Singh and Bishal Gurung (from 20.09.2015): 20.08.2015-19.02.2018

25. Development of hybrid time series models using machine learning techniques for forecasting crop yield with covariates. (AGENIASRISIL201502000057)

Wasi Alam, Kanchan Sinha (till August 22, 2016), Mrinmoy Ray, Santosha Rathod, KN Singh and Rajeev Ranjan Kumar (since August 23, 2016): 14.07.2015-22.02.2018

New Initiated

Institute Funded

26. Developments of count time-series models for predicting pest dynamics using weather variables. (AGEDIASRISIL201700900095) Prawin Arya, Bishal Gurung: 19.04.2017-18.10.2019

27. Modelling and forecasting of drought index using machine learning techniques. (AGEDIASRISIL201701200098) Rajeev Ranjan Kumar, Ravindra Singh Shekhawat, Sanjeev Panwar: 22.05.2017-21.10.2019

28. Tractorization in Semi Arid Tropic (SAT) India: Determinants and implications. (AGEDIASRISIL201701100097) Ravindra Singh Shekhawat, Rajeev Ranjan Kumar: 01.05.2017-01.05.2019

29. Parameter estimation of time series models using Bayesian technique. (AGEDIASRISIL201702200108) Achal Lama, Bishal Gurung, Santosh Rathod: 01.11.2017- 31.10.2020

New Initiated

Outside Funded

30. 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: 20.12.2017-30.06.2018

31. Studying dynamics of markets integration and price transmission of agricultural commodities under ICAR's Lal Bahadur Shastri Young Scientist Award 2016. (AGEDIASRISOL201801600125)

Ranjit Kumar Paul: 02.04.2018- 31.03.2021

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

On-going
Institute Funded

32. Assessment of post harvest losses in fruits and vegetables and strategies for their reduction in Andman and Nicobar Islands. (AGENIASRICIP201601400083)

    ICAR-CIARI: Sachidananda Swain, SK Zamir Ahmad, LB Singh, Chandrika Ram, Manoj Kumar

    ICAR-IASRI: Prachi Mishra Sahoo, Tauqueer Ahmad: 03.10.2016-31.07.2018 (Association of ICAR-IASRI w.e.f. 03.10.2016)

33. A study on calibration estimators under adoptive cluster sampling. (AGENIASRISIL201601500084)

    Raju Kumar (till 03.06.2017), Ankur Biswas (since 04.06.2017), Pradeep Basak, Deepak Singh: 25.10.2016-24.10.2018

Outside Funded

34. Study to test the developed alternative methodology for estimation of area and production of horticultural crops. IASRI component of CHAMAN program under under MIDH, Funded by Department of Agriculture and Cooperation (DAC), Ministry of Agriculture (MoA), Government of India. (AGENIASRISOL201401700036)

    Tauqueer Ahmad, UC Sud (till 31.07.2017), Prachi Misra Sahoo, Kaustava Aditya, AK Gupta (till 31.07.2016) Ankur Biswas and Deepak Singh (since 02.08.2016): 16.09.2014- 31.07.2018

35. Pilot study for developing state level estimates of crop area and production on the basis of sample sizes recommended by Professor Vaidyanthan 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- 31.08.2018

36. Investigation of Causes of Divergence between Official and Trade Estimates of Jute Production. Funded by Directorate of Economics & Statistics (DES), Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Govt. of India. (AGENIASRISOL201502800065)

    Prachi Misra Sahoo, UC Sud (till 31.07.2017), Tauqueer Ahmad, Ajit, Kaustav Aditya and Ankur Biswas: 01.09.2015-31.07.2018

New Initiated
Institute Funded

37. 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

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

On-going
Institute Funded

38. Gene Selection for Classification of Crop Gene Expression Data. (AGENIASRISIL201503000067)

    Samarendra Das (till 09.08.2017), PK Meher, RK Paul and UK Pradhan (till January 10, 2017): 20.10.2015-19.09.2018

39. A study on sequence encoding based approaches for splice site prediction in agricultural species. (AGENIASRISIL201600100070) Prabina Kumar Meher, UK Pradhan (till January 10, 2017), SD Wahi (till August 31, 2016) and AR Rao: 01.01.2016-30.06.2018

40. Platform for integrated genomics warehouse. (AGENIASRISIL201600900078)

KK Chaturvedi, MS Farooqi, SB Lal, DC Mishra, Sanjeev Kumar: 10.06.2016-09.06.2019

41. Development of an improved hybrid De-novo whole genome assembler. (AGENIASRISIL201700100087)

    SB Lal, Anu Sharma, Sanjeev Kumar, DC Mishra, Neeraj Budhlakoti: 04.01.2017-03.01.2019

42. Non-linear modeling for genomic predictions based on multiple traits. (AGENIASRISIL201700500091)

    Neeraj Budhlakoti, DC MIshra, SB Lal: 31.03.2017-30.03.2019

Outside Funded

43. Whole genome sequencing and development of allied genomic research in two commercially important *Fish-Labeorohita* and *Clarias batrachus.* Funded by DBT (AGENIASRISOL201301400015)

    ICAR-IASRI: Dinesh Kumar, Sarika (w.e.f. 28.01.2014) and MA Iquebal (w.e.f. 28.01.2014), ICAR-NBFGR: NS Nagpure (till 07.12.2015), Basdeo Kushwaha and Ravindra Kumar, ICAR-CIFA: Paramananda Das, P Jayasankar and L Sahoo, Anand Agricultural University: Chaitanya G Joshi, PG Koringa: 10.09.2013-31.03.2018

44. 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

45. Elucidating the mechanism of Pashmina fibre development: An OMICS approach. Funded by National Agricultural Science Fund (NASF) (AGENIASRICOP201501500052)

    SKUAST-K: Nazir : A Ganai

    ICAR-IASRI: AR Rao and PK Meher

    ICAR-NDRI: Jai K Kaushik: 01.07.2015-31.12.2018

46. 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, Dwijesh Chandra Mishra:04.09.2015-31.03.2020

47. 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, Lal Mohan Bhar: 06.11.2015-05.11.2018

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), (PI)

    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: 01.01.2017-31.03.2019

Completed

Institute Funded

50. Development of a tool for comparison of protein 3D structure using graph theoretic approach. (AGENIASRISIL201400500024)

    UB Angadi, KK Chaturvedi, Monendra Grover and Sudhir Srivastava (till 01.08.2015): 18.03.2014- 15.04.2017

51. Multilevel functional classification of abiotic stress related proteins in poaceae. (AGENIASRISIL201400600025)

Monendra Grover, UB Angadi and Sudhir Srivastava (till 01.08.2015): 20.03.2014-16.05.2017

52. Development of rank based stability measures for selecting genotypes.(AGENIASRISIL201502500062)

Prakash Kumar, Amrit Kumar Paul, Samrendra Das and LM Bhar: 10.09.2015-05.10.2017

53. Development of 16s rRNArumen specific microbes database. (Collaboration with ICAR-NIANP) (AGENIASRICIP201401400033)

ICAR-NIANP: M Bagath and AP Kolte, ICAR-IASRI: UB Angadi and Monendra Grover (since 21.11.2014): 23.07.2014-30.04.2017

Outside Funded

54. Computational identification and modelling of genetic variation in relation to performance traits in buffaloes. Funded by CABin. (AGENIASRICOP201500900046)

ICAR-CIRB: Punam Sikka, KP Singh, SS Paul, A Jerome, S Balhara and Varij Nayan

ICAR-IASRI: Dwijesh Chandra Mishra, AR Rao and KK Chaturvedi: 06.06.2015-31.03.2018

55. Genomic data analysis for identification of economically important markers and viral diagnostics in pulses. Funded by CABin. (AGENIASRICOP201501000047)

ICAR-IIPR: Abhishek Bohra, Khela Ram Soren and Akram

ICAR-IASRI: MA Iquebal, Dinesh Kumar, Sarika and UB Angadi: 06.06.2015-30.09.2017

56. Mining and validation of candidate gene markers and screening on antimicrobial peptides of black pepper and small cardamom. Funded by CABin. (AGENIASRICOP201501100048)

ICAR-IISR: Johnson K Greorge, P Umadevi, KV Saji and Sharon Aravind

ICAR-IASRI: UB Angadi, Dinesh Kumar, MA Iquebal and Sarika: 15.06.2015-30.09.2017

57. Computational approach for harnessing genome information and its integration with wheat phenome for efficient varietal development. Funded by CABin. (AGENIASRICOP201501200049)

ICAR-IIWBR: Ratan Tiwari, Pradeep Sharma, Rajender Singh and Sonia Sheoran

ICAR-IASRI: Dinesh Kumar, MA Iquebal, Sarika and UB Angadi: 15.06.2015-30.09.2017

58. Bioinformatic analysis of sequence data of brinjal and bitter gourd for identification of functional and regulatory genes for traits of economic importance. Funded by CABin. (AGENIASRICOP201501300050)

ICAR-NBPGR: KV Bhat, Soma S Marla, AB Gaikwad, S Archak and DP Wankhede

ICAR-IASRI: Monendra Grover and SB Lal: 16.06.2015-30.09.2017

59. Molecular and computational approach to delineate metabolic pathways for better carbohydrate utilization in Labeo spp. Funded by CABin. (AGENIASRICOP201501400051)

ICAR-CIFA: JK Sundaray, S Nandi, PK Maher, L Sahoo, KD Rasal, P Nandanpawar and UK Udit

ICAR-IASRI: Sarika, Dinesh Kumar, MA Iquebal and UB Angadi: 16.06.2015-30.09.2017

60. Microbial domain research projects on computational aspects. Funded by CABin. (AGENIASRICOP201501600053)

ICAR-NBAIM: DP Singh, Renu and Lalan Sharma

ICAR-IASRI: Sanjeev Kumar, KK Chaturvedi, Samir Farooqi: 03.07.2015-30.09.2017

61. Development of database repertoire for Clostridium perfiringens strains prevalent in causing Enterotoxaemia in goats. Funded by CABin. (AGENIASRICOP201501700054)

ICAR-CIRG: RVS. Pawaiya

ICAR-IASRI: AR Rao: 04.07.2015-30.09.2017

62. Development of database on SNPs associated with economically important traits of Indian goats. Funded by CABin. (AGENIASRICOP201501800055)

ICAR-CIRG: RVS Pawaiya

ICAR-IASRI: AR Rao: 04.07.2015-30.09.2017

63. RiceMetaSys: Understanding rice gene network for blast resistance and drought tolerance through system biology approach. Funded by CABin. (AGENIASRICOP201501900056)

ICAR-NRCPB: Amol Kumar U Solanke, TR Sharma, Amitha SV Mithra and Ramawatar

ICAR-IASRI: Dwijesh Chandra Mishra, KK Chaturvedi: 08.07.2015-30.09.2017

64. Identification of genetic polymorphisms for pathogenicity in Vibrio sp. Funded by CABin. (AGENIASRICOP201502100058)

ICAR-CIBA: Ashok Kumar Jangam, SV Alavandi, K Vinaya Kumar, B Sivamani and Satheesha Avunje

ICAR-IASRI: Monendra Grover: 19.08.2015-30.09.2017

65. Metagenomic applications and transcriptomes profiling for inland aquatic environmental health surveillance. Funded by CABin. (AGENIASRICOP201502700064)

ICAR-CIFRI: BK Behera, ICAR-IASRI: AR Rao:01.09.2015-30.09.2017

66. Network project on computational biology and agricultural bioinformatics under two sub-projects: Funded by CABin. (AGENIASRICOP201600300072): 26.11.2015-30.09.2017

Sub-project 1:

Gene regulatory networks modeling for heat stress responses of source and sink for development of climate smart Wheat.

ICAR-IARI: C Viswanathan, RR Kumar, Suneha Goswami, GP Singh, PK Singh, Neelu Jain and Puja Rai

ICAR-IASRI: DC Mishra, M Grover, Sanjeev Kumar and KK Chaturvedi

Sub-project 2:

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

ICAR-IARI: T Nepolean, MG Mallikarjuna and Shailendra K Jha,

ICAR-IASRI: AR Rao and PK Meher

67. In silico analysis of data for identification of functional alleles for stress tolerance and quality traits using bioinformatics in Potato. (AGENIASRICOL201601300082)

ICAR-IASRI: Anil Rai, AR Rao, Sanjeev Kumar, DC Mishra

ICAR-CPRI: Shashi Rawat, Sanjeev Sharma, Vinay Bhardwaj, Som Dutt, Jagesh Tiwari, Sundresha, Sridhar, VU Patil: 12.09.2016-30.09.2017

68. Whole genome based SNP mining and development of breed signatures for dairy and dual-purpose indigenous cattle. Funded by DBT. (AGENIASRICOL201401600035)

ICAR-NBAGR: Satpal Dixit, Jaya Kumar S, ICAR-NDRI: Ajay Kumar Dang, Avtar Singh, ICAR-IASRI: MA Iquebal, Dinesh Kumar: 09.07.2014-31.12.2017

69. Transcriptome and proteome analysis for identification of candidate genes responsible for pistillate nature in castor. Funded by Extramural funded under Crop Sciences Division. (AGENIASRICOP201600400073)

ICAR-IIOR: M Sujatha

ICAR-IASRI: MA Iquebal: 21.01.2016-31.03.2018

New Initiated

Institute Funded

70. Study of long memory and periodicities in climate variables in different Meteorological Subdivisions of India. (AGEDIASRISIL201701000096)

Ranjit Kumar Paul, LM Bhar, Amrit Kumar Paul: 19.04.2017-18.04.2020

71. Estimation of breeding value using generalized estimating equation and Bayesian approach. (AGEDIASRISIL201800100110)

Prakash Kumar (study leave), Himadri Shekhar Roy, LM Bhar, AK Paul: 30.01.2018-29.01.2021

72. A study on detection and interpretation of expression Quantitative Trait Loci (eQTL) mapping. (AGEDIASRISIL201800200111)

Himadri Shekhar Roy, LM Bhar. RK Paul, P Kumar, AK Paul: 03.02.2018-02.02.2021

73. 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: 12.03.2018-11.03.2021

74. Study on heritability estimation.

(AGEDIASRISIL201801300122)

AK Paul, Himadri Sekhar Roy, LM Bhar, RK Paul: 22.03.2018-21.03.2021

Outside Funded

75. 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

76. 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

77. 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 Sjvaranjani

ICAR-IASRI: UB Angadi (CCPI), Dinesh Kumar, MA Iquebal, Sarika: 05.03.2018-31.03.2020

78. 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

79. 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

80. 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

81. 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, Samir Farooqi: 06.03.2018-31.03.2020

82. 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: 09.03.2018-31.03.2020

83. 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

84. Genomic and transcriptome sequencing of coriander (Coriandrum sativum) to reveal insight of its genomic architechture and breeding targets. Colloboration 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

85. 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, Samrendra Das, Upendra Kumar Pradhan: 16.03.2018-15.03.2021

DEVELOPMENT OF INFORMATICS IN AGRICULTURAL RESEARCH

On-going
Institute Funded

86. 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– 31.03.2018

87. National Information System on Agricultural Education Network in India. (NISAGENET-IV). (SIX1217)

RC Goyal (till 30.06.2013), Sudeep, Alka Arora, Pal Singh, Shashi Dahiya (on study leave from 3rd July, 2014 to 2nd July, 2017. Rejoins the project as associate from 25th October, 2017) and Soumen Pal (till 30.09.2012) and Anshu Bhardwaj (since 01.10.2014):01.04.2012–30.09.2018

88. Implementation of ICAR-ERP, unified communication and web hosting solution. (AGENIASRISIL201500600043)

AK Choubey, Alka Arora, Sudeep, N Srinivasa Rao (till September 24, 2016), Mukesh Kumar, SN Islam (Deputed to ICAR HQ from August 20, 2016 for coordinating the implementation), Anshu Bhardwaj and Sangeeta Ahuja: 10.04.2015-30.09.2018

Outside Funded

89. 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

90. Knowledge management system for agriculture extension services in Indian NARES. Funded by ICAR Extra Mural Research Projects-Agricultural Extension Division. (AGENIASRICOL201600500074)

ICAR-IASRI: Alka Arora, AK Choubey, NS Rao (till September 24, 2016), SN Islam, Soumen Pal and Sudeep

ICAR: P Adiguru: 04.03.2016-31.03.2020*

*In-principle approval for extension of the project has been obtained from DG, ICAR. For 3 years i.e. 01.04.2017 to31.03.2020

Completed
Institute Funded

91. Tobacco Agridaksh: An online expert system. (AGENIASRICIP201401800037)

ICAR-CTRI: H Ravisankar, D Damodar Reddy, U Sreedhar, K Sivaraju, K Sarala, S Kasturi Krishna and M Anuradha, ICAR-IASRI: N Srinivasa Rao (till September 24, 2016) and Sudeep: 20.10.2014-19.01.2018

New Initiated
Institute Funded

92. 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: 28.06.2017-31.03.2019

93. Development of direct benefit transfer portal for DARE schemes. (AGEDIASRISIL201801500124)

Soumen Pal, Sudeep, Alka Arora: 26.03.2018-25.03.2020

Consultancy Projects

On-going

94. Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Madhya Pradesh State.

    Tauqueer Ahmad, UC Sud (upto 31.07.217), Prachi Misra Sahoo, Anil Rai, Kaustav Aditya, Raju Kumar, Man Singh, GM Pathak and Neelam Chandra: 01.06.2015-28.02.2018

95. Testing and validation of alternative methodology developed by IASRI for estimation of area and production of horticultural crops in Haryana State.

    Tauqueer Ahmad, UC Sud (upto 31.07.217), Prachi Misra Sahoo, Anil Rai, Ankur Biswas, Vandita Kumari, Man Singh, GM Pathak and Neelam Chandra: 06.08.2015-05.05.2018

New Initiated

96. Study on developing guidelines on estimating post harvest losses of horticultural crops, livestock products and fish and fish products (FAO Rome).

    Tauqueer Ahmad, Anil Rai, AK Choubey (upto 20.01.218), Prachi Misra Sahoo, Ankur Biswas, Man Singh and GM Pathak: 16.10.2017 – 15.03.2018

97. Study on field testing of the developed guidelines on estimating post harvest losses of horticultural crops, livestock products and fish and fish products (FAO Rome).

    Tauqueer Ahmad, Anil Rai, Prachi Misra Sahoo, Ankur Biswas, Man Singh and Kaustav Aditya: 21.12.2017 – 31.10.2018

98. Development of database and package for data analysis and visualization tool for analysis Development and visualization of feed resources in Ethiopia (ILRI, ICRISAT, Patancheru, Telangana). UB Angadi: 15.07.2017 – 15.12.2017

99. Pilot study on measurement of private food grains stock including estimation of on-farm post harvest losses under Input Survey of Agriculture Census in India (FAO, Delhi Office).

    Tauqueer Ahmad, UC Sud, Ankur Biswas, Man Singh: 09.05.2017 – 08.06.2017

100. Strengthening Agricultural Market Information in India (AMIS) using innovative methods and digital technology. (FAO, Delhi Office).

    Ranjit Kumar Paul: 20.05.2017 – 19.06.2017

101. Global strategy to improve agricultural and rural statistics in Myanmar. Hukum Chandra as a Sampling expert. Total 45 days during 2017& 2018. (FAO, Bangkok)

102. Customization and implementation of Academic Management System (AMS) for post graduate and under graduate education at UHS Bagalkot.

    Sudeep, AK Choubey (upto 20.01.218): 10.07.2017 – 09.07.2018

103. 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: 24.02.2018 – 23.02.2019

104. Customization and implementation of academic management system for post graduate & under graduate education at University of Agricultural Sciences, Dharwad.

    Sudeep, Alka Arora: 24.02.2018 – 23.02.2019

105. Customization and implementation of academic management system for post graduate & under graduate education at Dr. Balasahib Sawant Konkan Krishi Vidyapeeth, Dapoli. Sudeep, MM Maurya: 24.02.2018 – 23.02.2019

National Fellow Scheme

106. Robust and efficient small area estimation methods for agricultural and socio-economic surveys and their application in indo-gangetic plain.

    Hukum Chandra: 25.11.2014-24.11.2019

ICAR-IASRI PERSONNEL

Dr. Lal Mohan Bhar , Director (A)	22nd January, 2018 to till date
Dr. A. K. Choubey, Director (A)	1st August 2017 to 21st January, 2018
Dr. U. C. Sud, Director	Upto 31st July, 2017

Division of Design of Experiments

Name of the Scientist	Designation
Dr. Seema Jaggi	Principal Scientist and Head (A)
Dr. Rajender Parsad	Principal Scientist
Dr. Cini Varghese	Principal Scientist
Dr. Anil Kumar	Principal Scientist
Dr. Susheel Kumar Sarkar	Scientist
Dr. B.N. Mandal	Scientist
Dr. Sukanta Dash	Scientist
Dr. Arpan Bhowmik	Scientist
Sh. Sunil Kumar Yadav	Scientist
Mohd. Harun	Scientist
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 Aditiya	Scientist
Sh. Deepak Singh	Scientist
Dr. Ankur Biswas	Scientist
Sh. Raju Kumar	Scientist
Smt. Vandita Kumari Choudhary	Scientist
Dr. Pradip Basak	Scientist
Sh. Sushil Kumar	Scientist

Division of Statistical Genetics

Name of the Scientist	Designation
Dr. Lal Mohan Bhar	Principal Scientist and Head
Dr. Amrit Kumar Paul	Principal Scientist
Dr. Himadri Ghosh	Principal Scientist
Dr. Ranjit Kumar Paul	Scientist
Dr. P.K Meher	Scientist
Sh. Samarendra Das	Scientist
Sh. Upendra Kumar Pradhan	Scientist
Sh. Prakash Kumar	Scientist
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
Dr. Prawin Arya	Principal Scientist
Dr. Wasi Alam	Scientist
Dr. Bishal Gurung	Scientist
Sh. Kanchan Sinha	Scientist
Dr. Santosha Rathod	Scientist
Dr. Mrinmoy Ray	Scientist
Dr. Ravinder Singh Shekhawat	Scientist
Sh. Rajeev Ranjan Kumar	Scientist
Dr. Achal Lama	Scientist
Sh. Rajesh T.	Scientist
Smt. Anuja A.R.	Scientist
Sh. Shivaswamy G.P.	Scientist
Dr. Harish Kumar H.V.	Scientist

Division of Computer Applications

Name of the Scientist	Designation
Dr. Sudeep Marwaha	Principal Scientist and Head (A)
Dr. Alka Arora	Principal Scientist
Dr. Anshu Bhardwaj	Principal Scientist
Dr. Mukesh Kumar	Principal Scientist
Dr. Shashi Dahiya	Scientist
Sh. Pal Singh	Scientist
Sh. Shahnawazul Islam	Scientist
Dr. 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. Ulavappa B. Angadi	Senior Scientist
Dr. S.B Lal	Senior Scientist
Dr. Krishna Kumar Chaturvedi	Senior Scientist
Mohd. Samir Farooqui	Scientist
Dr. Anu Sharma	Scientist
Sh. Sanjeev Kumar	Scientist
Dr. Sarika	Scientist
Dr. Mir Asif Iquebal	Scientist
Dr. Dwijesh Chandra Mishra	Scientist
Sh. Sudhir Srivastava	Scientist
Sh. Neeraj Budlakothi	Scientist

National Fellow

Dr. Hukum Chandra	ICAR-National Fellow

PME Cell

Dr. Ajit	Principal Scientist & Incharge-PME-Cell

Professors

Agricultural Statistics	Dr. Seema Jaggi
Computer Applications	Dr. Sudeep Marwaha
Bioinformatics	Dr. A.R.Rao

Administration and Finance

Senior Administrative Officer & Head of Office	Sh. Suresh Kumar Gajmoti
Senior Finance and Account Officer	Sh. Arvind

Vigilance

Vigilance Officer	Dr. L.M. Bhar

Right to Information (RTI) and Liaison

Transparency Officer & Nodal Officer, RTI	Dr. Mukesh Kumar
Public Information Officer	Sh. Chander Vallabh
Liaison Officer	Sh. Anil Kumar

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, DE	Member
3.	Dr. Anil Kumar, Principal Scientist	Member
4.	Dr. Tauqueer Ahmad, Principal Scientist	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	Chairman
2.	Dr. Anil Rai, Head (CABin)	Member
3.	Dr. LM Bhar, Head, Statistical Genetics	Member
4.	Dr. KS Rana, Professor and Head of Divisionj of Agronomy	Member
5.	Dr. Seema Jaggi, Principal Scientist and Head, DE	Member
6.	Dr. Rajender Parsad, Principal Scientist & Incharge, ITMU	Member-Secretary

Institute Technology Management Unit (ITMU)

1.	Dr. Rajender Parsad, Principal Scientist	Office Incharge & Member Secretray
2.	Dr. Tauqueer Ahmad, Principal Scientist	Member
3.	Sh. Naresh Kumar, CTO	Member

Institute Deputation Committee

1.	Director	Chairman
2.	All Heads of Divisions	Member
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	Member
3..	I1ncharge-PME Cell	Member Secretary

Institute of Joint Staff Council

Official Side Members

1.	Dr. L.M. Bhar (Director)	Chairman
2.	Dr. Parwin Arya	Member
3.	Dr. Anil Kumar	Member
4.	Sh. S.K. Gajmoti, Head of Office	Member
5.	Sh. Arvind, Sr. F&AO	Member
6.	Dr. Tauqueer Ahmed	Member
7.	Sh. A.K. Paul	Member Secretary
8.	Dr. Alka Arora	Member

Staff Side Members

1.	Sh. K.B. Sharma	Secretary
2.	Sh. Dharmendra	Member
3.	Sh. Sunil Bhatia, Technical Officer	Member
4.	Sh. Hari Singh, Technical Assistant(Electricion)	Member
5.	Sh. Ashok Kumar, SSS	Member
6.	Sh. Janak Kumar, SSS	Member

Grievance Committee

Official Side Members

1.	Dr. L.M. Bhar (Director)	Chairman
2.	Sh. S.K. Gajmoti, Head of Office	Member
3.	Sh. Arvind, Sr. F&AO	Member
4.	Assistant Administrative Officer (Admn. II)	Member Secretary

Staff Side Members

1.	Sh. Pal Singh, Scientist	Member, Scientific Group
2.	Sh. Satya Pal Singh, Assistant Chief Technical Officer	Member, Technical Group
3.	Sh. Basant Kumar, Assistant	Member, Administrative Group
4.	Sh. Vivekanand, SSS	Member, Skilled Supporting Staff Group

ICAR Staff Welfare Fund Scheme

1.	Dr. L.M. Bhar (Director)	Chairman
2.	Dr. Prawin Arya	Welfare Officer
3.	Sh. S.K. Gajmoti, Head of Office	Member
4.	Sh. Arvind, Sr. F&AO	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.	AAO, Admn-II	Member Secretary

Women Cell

1.	Dr. Seena Jaggi, Principal Scientist	Chairperson
2.	Dr. Cini Varghese, Principal Scientist	Member
3.	Smt Savita Wadhwa, CTO	Member
4.	Smt. Suman Khanna, Stenographer	Member
5.	Smt. Poonam Singh, Administrative Officer	Convener

International Training Hostel (ITH)

1.	Dr. Anil Kumar, Principal Scientist	Coordinator
2.	Sh. Diwan Singh	Caretaker

Hostel Executive Committee

1.	Warden	Dr. A.K. Chaubey(Till 31.12.2017) Dr. K.N. Singh (From 01.01.2018)
2.	Prefect	Sh. Tanuj Misra
3.	Mess Secretary cum Assistant Prefect	Md. Ashraful Haque
4.	Cashier	Sh. Samir Burman Sh. Dipro Sinha
5.	Maintenance Secretary	Sh. Rahul Banerjee
6.	Sport Secretary	Sh. Mohd Yeasin Sh. Mahalinga Sh. Sanchita Naha Sh. Puru Supriya
7.	Cultural Secretary	Sh. Subrajit Sathpaty Ms. Sonica Priyadarshini Ms. Debdali Chowdhuary Sh. Vivek Kumar
8.	Gym Secretary	Ms. Nalini Kant Chowdhaury Sh. Akhilesh Jha
9.	Health Secretary	Sh. Samir Burman
10.	Magazine Secretary	Sh. Rajeev Kumar Sh. Rohit Kundu
11.	Common Room Secretary	Sh. Sashank Ji
12.	Communication Secretary	Sh. Anubhav Roy
13.	Auditors	Ms. Nalini Kant Chowdhury Sh. Asith Kumar Pradhan Sh. Shyam Sunder Parui Sh. Pramod Kumar Maurya
14.	Food Committee	Md. Asif Khan Sh. Chandan Kumar Deb Sh. Sreekumar Biswas Sh. Pramod Kumar Maurya
15.	Girl's Representative	Ms. Shabana BeGum
16.	Warden's Nominee	Sh. Amit Kairi

Institute Recreation Club

1.	Dr. L.M. Bhar (Director)	President
2.	Dr. K.N. Singh, Head of Division	Vice President
3.	Sh. S.K. Gajmoti, Head of Office	Member
4.	Sh. Arvind, Sr. F&AO	Member
5.	Sh. Raj Kumar Verma Assistant	Member
6.	Sh. Mayank Pundeer, Assistant	Secretary
7.	Sh. Dharmendra Tanwar, LDC	Treasurer
8.	Smt. Vijay Laxmi Murthy, PA	Women Member

Institute Sports Committee

1.	Dr. L.M. Bhar(Director)	President
2.	Dr. K.N. Singh, Head of Division	Vice President
3.	Sh. S.K. Gajmoti, Head of Office	Member
4.	Sh. Arvind, Sr. F&AO	Member
5.	Dr. Sushil Kumar Sarkar, Scientist	Member
6.	Sh. RS Tomar, Assistant Chief Technical Officer	Convener
8.	Sh. KB Sharma, Assistant & Secretary, IJSC	Member
9.	Sh. Sunil Kumar	Member
10.	Sh. Krishan Kumar	Member
11.	Sh. Janak Kumar	Member
12.	Sh. Santosh Kumar	Member
13.	Sh. Naresh Kumar	Member
14.	Sh. Ankur Vishwas	Member
15.	Dr. Sukant Das	Member
16.	Sh. Raj Kumar Verma	Member
17.	Smt. Vijay Laxmi Murthy, PA	Women Member
18.	Assistant Administrative Officer-II	Member

IASRI Employees Co-operative Thrift and Credit Society Limited

1.	Dr. L.M. (Director)	Patron
2.	Sh. Shri Pal Singh (From 25-05-2017)	President
3.	Sh. B.J.Gahlot (Till 24-05-2017 Sh. Anil Kumar (From 25-05-2017)	Vice-President
5.	Sh. SP Singh (Till 06-07-2017) Sh. MM Mourya (From 07-07-2017)	Secretary
7.	Sh. Sunil Bhatia	Treasurer
8.	Sh. VP Singh	Member
9.	Sh. Ashok Kumar	Member
10.	Sh. Sukanta Dash	Member
11.	Sh. Dinesh Kumar Rai	Member
12.	Dr.Sarika	Member
13.	Dr. Anshu Bhardwaj	Member

ICAR-NATIONAL AGRICULTURAL SCIENCE MUSEUM

National Agricultural Science Museum (NASM) was conceived by ICAR and executed by the National Council of Science Museum (NCSM), Ministry of Culture, Government of India during 2004. The responsibility of up-keep and maintenance of NASM rests with ICAR-Indian Agricultural Statistics Research Institute, Pusa, New Delhi. NASM is situated at NASC Complex, DPS Marg, Opposite Dasghara village, Pusa campus, New Delhi

The Management Committee of National Agricultural Science Museum for modernization/strengthening of NASM the following:

Dr. Alagusundaram, DDG(Engg)	Chairman
Dr. K.K. Singh, ADG (Engg)	Member
Dr. A.K. Vasisht, ADG (PIM&ESM), ICAR	Member
Dr. S.K. Singh, PD, DKMA	Member
Sh. Devendra Kumar, Director (Finance), ICAR	Member
Dr. Lal Mohan Bhar, Director (A), IASRI	Member
Sh Grish Bhatt, DS (GAC), ICAR &Nodal Officer, NASM	Member
Sh. V P Kotyal, Director (Works), ICAR	Member
Sh. S K Singh, CTO, IASRI	Member Secretary

Under the guidance of above committees, 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 holidays). There is a nominal fee of Rs. 10/- per head but the groups of farmers, children from school/college are from entrance fee. General Information about museum is available at http://www.icar.org.in/en/node/306 and virtual tour of museum is also available at http://www.icar.org.in/en/node/2095

Annual Visitors Information

During the year 2017-18 (April, 2017 to March, 2018), 245876 visitors visited NASM out of them 2099 tickets were sold, 237919 students from 640 Schools/College/Ag. University of Delhi/NCR & different States of India, 1438 farmers from different States of India, 401 Trainees from different training programmes conducted by ICAR Institutes and other Govt Departments, 2748 ICAR staff visitors, 140 media publication visitors and 52 Foreign delegates of various countries also visited the NASM.

Krish Unnati Mela, 2018

National Agricultural Science Museum (NASM) participated in the Pusa Unnati Krishi Mela, 2018 held at IARI mela ground, New Delhi during 16-19 March, 2018 and IASRI presented some attractive posters of NASM exihibits demonstrated to the general visitors, researcher, students and farmers to give them adequate knowledge about NASM. 276 visitors including students, farmers, Govt and non govt. agencies visited and NASM material was distributed to the visitors like books & pamphlets.