



Executive Summary

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

To achieve its goal and mandate, a number of research projects were undertaken during the year. Research was carried out under 68 research projects (01 National Professor Scheme, 38 Institute funded, 16 funded by other outside agencies and 13 in collaboration with other Institutes) in various thrust areas. This year 11 projects were completed and 19 new projects were initiated.

Some salient research achievements are as follows:

- To find a solution to the problem of unavailability of an efficient incomplete block design for given number of treatments, blocks and block sizes, the optimization techniques have been developed for construction of incomplete block designs.
- A R package called 'ibd' has been developed for construction of incomplete block designs using optimization techniques and is available on cran.r-project.org/web/packages/ibd/index.html. The

algorithm is fairly general in nature and can generate an efficient design for given parameters of the design, provided such a design is existent.

- Software Web Generation of Experimental Designs Balanced for Indirect Effects of Treatments (Webdbie) has been developed which generates randomized layout of series of Neighbour Balanced Block Designs and Crossover Designs. An online catalogue of these designs has also been included in the software.
- A class of minimally neighbour balanced row-column designs for even number of treatments with equal number of rows, columns and replications has been obtained which is variance balanced for the estimation of elementary contrasts pertaining to direct effects of treatments.
- Designs for veterinary trials for making comparisons of investigational products with active control(s)/ placebo have been obtained for the experimenters to establish superiority to placebo and at the same time allowing comparisons of the investigational products with an active control. Symmetric/asymmetric designs with factorial treatment structure suitable for multi-component drug-drug interaction study have also been obtained.
- In this era of decentralization, the thrust of planning process has shifted from macro to micro level, and so the thrust of research efforts has also shifted to development of precise estimators on small area inference using survey weights. The Pseudo empirical best linear unbiased prediction (Pseudo-

EBLUP) approach was used to develop design consistent small area estimator.

- Sample sizes for estimation of area and production of foodgrain crops, data of Crop Cutting Experiments (CCEs) for different crops (having smaller sample sizes) pertaining to number of States under Improvement of Crop Statistics (ICS) scheme were obtained from NSSO for the agricultural year 2010-11. Estimates of average yield for wheat and paddy crops at State level were obtained with suitable precision, however, for other foodgrain crops, these were obtained with very high estimates of percentage standard errors.
- Estimates of average yield of cotton along with percentage standard error has been obtained using double sampling ratio approach under stratified two stage sampling design framework for Aurangabad district of Maharashtra.
- The techniques of simple kriging, stratified kriging, simple co-kriging, stratified co-kriging were applied to remove cloud in the satellite images. Spatial imputation techniques were evolved for generation of cloud free images based on row-wise pixels, column-wise pixels, both row-wise and column-wise pixels, neighbouring pixels and by ratio and regression approach. Cloud free images were generated using all these techniques and then these techniques were compared by estimating area under paddy crop from the generated cloud free images.
- Different calibration estimators of the finite population total have been developed for two-stage sampling designs based on the assumption that the population level auxiliary information is available both at the psu and ssu levels. The variance of these estimators along with their estimators of variance has also been developed. The empirical evaluations revealed that all the developed calibration approach based estimators under two-stage sampling design were better than the usual estimator under two-stage sampling design with no auxiliary information.
- Sub-indices of Food Security Index (FSI) have been constructed for three states namely, U.P., Bihar and Punjab. Thematic maps were generated based on constructed FSI and their sub-indices for all the three States using Geographic Information System (GIS).
- Crop yield forecast model has been developed using Nonlinear Support Vector Regression (NLSVR) technique. The methodology has been illustrated to predict maize crop yield (response variable). NLSVR technique is found to be superior than that of Artificial neural network methodology in modelling and forecasting for the data under consideration.
- Semiparametric regression model using functional principal component scores was fitted to wheat-yield data and weekly weather data (temperature and sunshine hours) of Ludhiana district from 1984-85 to 2009-10 and was found to be superior to that of multiple linear regression model.
- Technology Forecasting (TF) tools have been employed to forecast future technological needs and trends in Indian agriculture. TF and Technology Assessment (TA) have been done with different tools, like Analytical hierarchy process, Brainstorming, Cross impact analysis, Fisher Pry/ Pearl, Gompertz and Lotka-Volterra substitution models, Framework forecasting, Scientometrics and Multi-Dimensional scaling. The agricultural subdomains/ commodities considered were Plant Breeding and Genetics, Rainfed Agriculture, Fisheries, Cotton and Rice. Implications of frontier sciences viz. Remote Sensing (RS) and Information and Communication Technology (ICT) on agricultural R&D have also been done.
- Secondary data on volumetric statistics on groundwater resources, groundwater table and source-wise irrigated area were analysed. The structure of water markets in North-Western Rajasthan was studied. It was observed that the three-fifths of net sown area in North-Western region were irrigated and the region was dominated by canal irrigation. Although, the annual growth in groundwater irrigated area was impressive (14 per cent) during 2000-01 to 2008-09, there was a further scope for groundwater development in the region as its development was 46 and 80 per cent in Sri-Ganganagar and Hanumangarh districts in 2009.
- A web based software for calculating codon usage indices and multivariate analysis for gene expression identification has been developed. It has modules for user management, reading or uploading nucleotide sequences, calculation of codon usage indices, and multivariate analysis with graphical output. A link between Java and R statistical package through JRI interface has been developed. This system is accessible any time from arbitrary platforms through internet.
- Microsatellite database and primer generation tool for pigeonpea (PIPEMicroDB) genome molecular

markers have been developed and are available at <http://cabindb.iasri.res.in/pigeonpea/>. Micro-satellite database of Buffalo (BuffSatDb) has also been developed and is available at <http://cabindb.iasri.res.in/buffsatdb>

- 7746 expressed sequence tags (ESTs) expressed in salinity stress condition were mined from different web resources, clustered and assembled into 672 contigs. Biological functions were obtained through gene ontology and mapped on to rice genome and full length gene sequences were designed that may be useful in molecular breeding programme in rice salinity research.
- Synonymous codon usage patterns have been analysed to identify the molecular signatures governing salt tolerance adaptation in *Salinibacter ruber* for inferring critical halophilicity features. The unique salt tolerant traits and genes responsible for salt stress could potentially be used in agricultural crops that are almost exclusively glycophytes. These findings may facilitate developing biofertilizers for improving fertility of saline soils.
- The gene expression data of chickpea under abiotic stress was subjected to consensus clustering to identify the co-regulated genes. Customization of penalized classifier called Least Absolute Shrinkage and Selection Operator (LASSO) using kernel function was done. Code of customized classifier was written in MATLAB and applied to gene expression data of *Arabidopsis thaliana* (Model Plant). Accuracy of the developed model has been tested through Leave One Out Cross Validation technique.
- Indian NARS Statistical Computing Portal (<http://stat.iasri.res.in/sscnarsportal>) has been strengthened by adding 13 new modules of analysis of data generated from Completely Randomized Designs, Resolvable Block Designs, Row-Column Designs, Nested Block Designs, Split-Split-Plot Designs, Split Factorial (main A, sub B x C) Designs, Strip Plot Designs, Response Surface Designs, Univariate Distribution Fitting, Test of Significance based on t-test and Chi-square test, Discriminant Analysis, Correlation and Regression Analysis. The data can be analysed by uploading *.xls, *.xlsx, *.csv and *.txt files.
- The Institute is implementing the robust and flexible MIS & FMS system which includes solution for Financial Management, Project Management,

Material Management, Human Resource Management and Payroll at ICAR. Requirement study was carried out in collaboration with ICAR headquarters and partner organizations. System Design and Technical Development (Reports, Customizations) were developed in each functional area of FMS/MIS system.

- A web enabled Statistical Package for Factorial Experiments (SPFE 2.0) has been developed that gives the designs for symmetrical and asymmetrical factorial experiments and also performs analysis of the data generated. It generates randomized layout of the designs for factorial experiments with or without confounding. It also generates regular fractional factorial plans for symmetrical factorial experiments.
- Web based software for Half Yearly Progress Monitoring (HYPM) of scientists in ICAR (<http://hypm.iasri.res.in>) has been implemented from 1st April 2012 for online submission of data regarding the proposed targets for the half yearly period (01-04-2012 to 30-09-2012). It would be possible to monitor online progress of the scientists, manpower status, research projects, prioritized activities and salient research achievements at institute/SMD/ICAR level.
- For providing e-advisory and e-learning in sample surveys initiated a Sample Survey Resources Server (<http://js.iasri.res.in/ssrs/>) that provides calculator for sample size determination for population mean and population proportion among other material.
- For dissemination and e-advisory on designed experiments, strengthened Design Resources Server by adding links on Row-Column Designs in Two Rows; Block Designs with factorial treatment structure with Block Size 2 for Baseline parameterization; Books on Design of Experiments; Efficient binary proper incomplete block designs and Balanced Treatment Incomplete block designs.

Scientists of the Institute published 94 research papers in National and International refereed Journals along with 27 popular articles, 3 books, 11 book chapters, 19 papers in Conference proceedings and 52 project reports/technical reports/reference manuals. Seven macros/e-resources available at institute's website were also developed.

This year, 21 training programmes were organized in which 374 participants were imparted training

- Two International training programmes (one on Techniques of Estimation and Forecasting of Crop Production in India sponsored by FAO and other on Application of Remote Sensing and GIS in Agricultural Surveys for the participants from Afro-Asian Rural Development Organization (AARDO) member countries).
- Four 21 days training programmes under Centre of Advanced Faculty Training on Statistical Models for Forecasting in Agriculture, Recent Advances in Sample Surveys and Analysis of Survey Data using Statistical Software, Recent Advances in Designing and Analysis of Agricultural Experiments and Development of Expert System through AGRIdaksh were organised.
- Two Summer/Winter Schools on Forecast Modelling in Crops and Recent Advances on Quantitative Genetics and Statistical Genomics were organised.
- Two training programmes on Elementary Data Analysis and Website Development and Hosting for Technical Personnel of ICAR were organised.
- Five Resource Generation training programmes were conducted on Data Analysis and Interpretation: Use of Statistical Software for ISS probationers, Agricultural Statistics for Department of Agriculture, Govt. of Andhra Pradesh, Small Area Estimation for CSO, Functions and Activities of IASRI for NASA and Study tour on Agricultural System and Food Security Policy in India for DPR Korea sponsored by FAO.
- Six training programmes were conducted under National Agricultural Innovation Projects: Dissemination cum Training Workshop on Technology Forecasting Application in Agriculture Policy Analysis, Forecast Modelling in Crops using Weather and Geo-informatics, Sensitization programme under the project Strengthening Statistical Computing for NARS, Statistical Approaches for Genomic Data Analysis and Data Analysis using SAS.

Dr. VK Bhatia received Bharat Ratna Dr. C Subramaniam Award for Outstanding Teachers in Agriculture and Allied Sciences 2011 for excellent teaching in the field of social sciences from ICAR. Dr. VK Bhatia and Dr. VK Gupta received ISAS Fellow, Dr. Prajneshu was conferred on the prestigious title of Sankhyiki Bhushan, Dr. Seema Jaggi received Prof. PV Sukhatme Gold Medal Award for the year 2012 for her significant contribution in Agricultural Statistics, Dr. Hukum Chandra received

Dr. DN Lal memorial Award for the year 2012 for his significant contribution in Agricultural Statistics and Dr. Ranjit Kumar Paul received Dr. GR Seth Memorial Young Scientist Award for the Year 2012 from Indian Society of Agricultural Statistics. Dr. Himadri Ghosh received Bose-Nandi Award (jointly with Dr. Ramakrishna Singh and Dr. Prajneshu) for the best publication in the section application of statistics of Calcutta Statistical Association Bulletin. Dr. Anil Kumar received Smt. Kadambini Devi Award-2013 for best research paper by the Indian Society of Animal Production and Management.

Dr. UC Sud was nominated by the Ministry of Statistics and Programme Implementation as Non-official Member for Constitution of Working Group for formulating methodology for the 70th Round of NSS. Dr. Hukum Chandra elected as Member of International Statistical Institute, Netherlands. Dr. BN Mandal selected for Indo-Australia Early Career S&T Visiting Fellowship 2012-13.

Dr. VK Gupta visited UK to attend the meeting of the CRP 1.1 Dryland Systems - Integrated Agricultural Production Systems for the Poor and Vulnerable Dry Areas of the CGIAR at University of Reading, UK.

Dr. VK Bhatia was deputed to study the infrastructural facilities, exploring the possibility of collaboration and capacity building as a member of the team of five scientists constituted by ICAR at EBI, London and SIB Switzerland and to second meeting of the Steering Group of Agricultural Statistics Bangkok, Thailand.

Dr. UC Sud was deputed to attend Regional Workshop on Sampling for Agricultural Censuses and Surveys in Bangkok, Thailand and for the Consultancy on Harmonization and Dissemination of Unified Agricultural Production Statistics in Bangladesh.

Dr. Rajender Parsad was deputed to attend Session on Design of Experiments of 2nd Institute of Mathematical Statistics Asia Pacific RIM Meeting and presented an invited talk on Efficient Row-Column Designs for 2-colour single factor microarray experiments at Tsukuba, Japan.

Dr. Prajneshu was deputed to attend 13th International Pure Mathematics Conference 2012 and delivered an invited talk entitled Some Parametric Nonlinear Time-Series Models and their Applications in Agriculture at Islamabad, Pakistan and to participate in the International Conference on Advances in Interdisciplinary Statistics and Combinatorics held at UNCG, USA.



Dr. Anil Rai was deputed to study the infrastructural facilities, exploring the possibility of collaboration and capacity building as a member of the team of five scientists constituted by ICAR at EBI, London and SIB Switzerland.

Dr. Hukum Chandra was deputed to attend the 22nd Colombian Symposium in Statistics at Bucaramanga, Colombia.

Dr. AK Paul was deputed to attend three months NAIP HRD training in the area of Crop Bioinformatics (Comparative genomics in soybean's pathogens) at Iowa State University, Ames, Iowa, USA.

Dr. Prawin Arya was deputed to attend three months international training under NAIP on Policy Analysis: Sub area : Modeling for Land Use Planning (Social Sciences) at Iowa State University, Ames, Iowa, USA.

Sh. Sanjeev Kumar was deputed to attend training programme in the area of Bioinformatics and Comparative Genomics at Iowa State University, Ames, Iowa, USA.

The activities relating to education and training which included planning, organization and coordination of the entire Post-graduate teaching programmes of the Institute were undertaken in collaboration with PG School, IARI. During the year, a total of 17 students {03 Ph.D. (Agricultural Statistics), 09 M.Sc. (Agricultural Statistics) and 05 M.Sc. (Computer Application)} completed their degrees. 27 new students {10 Ph.D. (Agricultural Statistics), 07 M.Sc. (Agricultural Statistics), 06 M.Sc. (Computer Application) and 04 M.Sc. (Bioinformatics)} were admitted.

A Senior Certificate Course in Agricultural Statistics and Computing was organised and 07 officials participated in this Certificate Course.



ORGANOGRAM

RESEARCH ADVISORY COMMITTEE ↔ **DIRECTOR** ↔ INSTITUTE MANAGEMENT COMMITTEE



HEAD OF DIVISION

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

OFFICER INCHARGE

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

**PROF. (AG. STAT.)
PROF. (COM. APPLN.)
PROF. (BIOINFORMATICS)
WARDEN**

- OMV UNIT
- TRAINING ADMINISTRATION CELL

VIGILANCE 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

SENIOR ADMINISTRATIVE OFFICER

- AUDIT SECTION
- ACCOUNTS SECTION

SENIOR FINANCE AND ACCOUNTS OFFICER