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Executive Summary

Indian Agricultural Statistics Research Institute (IASRI) established in 1959 as an Institute of Agricultural Research Statistics is mainly responsible for conducting research and education/training in Agricultural Statistics. With the advances in information technology, the Institute has adapted itself to the current needs of agricultural research. In the changed scenario, the mandate of the Institute is to undertake basic, applied and adaptive research in Agricultural Statistics, to conduct post graduate and in-service training courses in Agricultural Statistics and Computer Applications, to provide consultancy services, to act as a repository of information on Agricultural Statistics for research, to develop the Institute as an Advanced Centre of Excellence in education and training in Agricultural Statistics and Computer Applications and to liaise with other ICAR Institutes and SAUs, State Agricultural/Animal Husbandry Departments, to assist in the development and strengthening of National Agricultural Statistics System and to undertake sponsored research and

training of national and international organisations in these disciplines.

A number of research projects were undertaken during the year in different Divisions of the Institute namely Sample Survey, Design of Experiments, Biometrics, Forecasting Techniques, Econometrics and Computer Applications. Research was carried out under 50 research projects in the Institute, of which 01 National Professor Scheme, 30 Institute funded, 05 NAIP funded, 01 AP Cess funded, 04 funded by other outside agencies and 09 in collaboration with other Institutes in various thrust areas. This year 12 projects were completed, 06 new projects were initiated and one project of ad-hoc nature was initiated and completed as well.

Some of the salient research achievements are:

- For the experimental situations in which the number of experimental units is less than the number of parameters to be estimated, efficient mixed-level

supersaturated designs (SSDs) have been generated by juxtaposing a uniform design with a Hadamard matrix. $E(s^2)$ -optimal two-level SSDs have been extended by adding more runs to the design. The extended design is also $E(s^2)$ -optimal according to the new lower bound obtained.

- The Design Resources Server has been strengthened by adding SAS and SPSS steps and syntax for (i) fitting of non-linear models and (ii) performing cluster analysis. A link on Statistical Genomics, essentially as an e-learning platform for the researchers particularly the geneticists, the biologists, the statisticians and the computational biology experts has been created. Another link for block designs with factorial structure has also been added. During the year, google analytics gave 5392 page views and usage of the server through 448 cities across 78 countries.
- For detecting t outlier observation vectors in multi-response experiments, general expression of Cook statistic has been obtained.
- Two methods of construction of designs for mixture experiments with process variables have been developed using orthogonally blocked response surface designs and projection matrices. The designs for mixture experiments with process variables obtainable from these methods of construction have been catalogued for both Linear and Quadratic models for 2-5 mixture components and one process variable with 2-levels.
- A series of designs involving sequences of treatments for comparing two disjoint sets of treatments has been obtained and variance of contrasts pertaining to direct as well as residual effects of test versus test, test versus control and control versus control treatments has also been obtained.
- For the experimental situations wherein experimental units are used for a series of tasks one after another in the experimental conditions whose levels are difficult to change, two classes of nested designs involving sequences of treatments with same number of experimental periods and units have been obtained.
- A method of construction of second order rotatable response surface designs in the presence of neighbour effects has been developed.
- The concept of Neighbour Balanced Block (NBB) designs has been defined for the experimental

situation where the treatments are the combinations of levels of two factors and only one of the factor exhibits neighbour effect. Some methods of constructing complete NBB designs for two factors in a plot strongly neighbour balanced for one factor has been obtained.

- Two three-class association schemes called tetrahedral association scheme and cubical association scheme have been defined along with methods of constructing partially balanced incomplete block designs.
- A module for online analysis of data generated through a general block design has been developed and uploaded on the home page of the Institute.
- A linear integer programming approach has been developed for obtaining polygonal designs for given number of treatments v , block size k , concurrence of treatments separated by a distance of $m + 1$ or more as λ and all other concurrences as zero, $m \leq \left\lfloor \frac{v}{2} \right\rfloor$, here $[.]$ denotes the greatest integer function. These designs are useful for obtaining balanced sampling plans.
- Fertilizer Response Ratio (FRR), average increase of grain yield in kilogram of a crop due to per kilogram use of fertilizer nutrient of 14 crops (5 cereals, 4 pulses, 5 oilseeds) at NARP zone level, state level and all India level have been obtained using the data from On-farm trials. The fertilizer response ratios of N over control are 9.20, 7.73 and 8.51 kg/kg for cereals, oilseeds and pulse group whereas these value of NPK over control are 10.80, 5.60 and 6.70 kg/kg respectively. The fertilizer response ratio for all foodgrain crops for NPK over control is observed as 9.27 kg/kg which is more than response observed for N, NP, NK over control.
- Crop yield forecast models have been developed using rice, wheat and sugarcane yields as response variable and weather variables as input variables using multi-layer perceptron (MLP) and radial basis function (RBF) based neural networks with one or two hidden layers.
- Disease forewarning models using MLP and RBF based neural networks are developed for *Alternaria Blight* and *Powdery Mildew* in mustard crop using weather variables as input variables.
- Weather based models for forecasting potato yield in Uttar Pradesh have been developed by using

weather data on maximum and minimum temperature and morning and evening relative humidity during the period 1971-2002.

- For fitting of non-parametric functional autoregressive models, the coefficient functions have been estimated using Taylor's series expansion in which unknown coefficients are estimated by the method of weighted least squares, weights being the kernel density function. The applicability of self-exciting threshold autoregressive (SETAR) family of non-linear time series models with more than one threshold is demonstrated in the field of agriculture, having time series data that depicts cyclical patterns.
- For multimodal rainfall data, methodology of fitting mixture of distributions to 'body' and 'tail' using statistical learning theory is demonstrated. Three estimators of extreme value index are computed to fit the theoretical tail distribution to the rainfall data.
- Spatial market integration has been studied using advanced econometric tools namely Augmented Dickey Fuller technique for testing stationarity of time series, Johansen's Co-integration method for finding the co-integrating vectors and Vector Error Correction mechanism for finding out the speed of adjustment of price series to equilibrium for whole sale market of important cereals (rice, wheat, jowar, bajra, maize), oilseeds (ground nut, mustard), edible oils (coconut oil, ground nut oil, mustard oil) and pulses (gram, moong, arhar, urd, etc.) using time series data on wholesale prices. The analysis revealed that the integration among the markets has improved over the recent years. The prices of agricultural commodities tend to converge among a few selected state-level wholesale markets in India.
- In the area of futures trading, price volatility, price discovery and risk management are studied for important crops, and the contract designs of Indian wheat and maize crops are compared with US contracts. The volatility of futures market is greater than the spot market volatility.
- Multidimensional scaling (MDS) approach is used for identifying the factors contributing towards enhancing agricultural productivity pertaining to the subdomain "Plant Genetics and Breeding". It is found that India is focusing not only on abiotic and biotic stresses but also on evolving areas such as bioinformatics, molecular assisted selection, transgenics, etc.
- Estimators of both domain and population totals for an item of interest are developed under two-phase sampling where the domain identity is realized, but the item response is not necessarily available from a phase I sampled unit.
- An approximately unbiased estimator of the variance of ratio estimator under the two-phase sampling has been developed.
- Small Area Estimation (SAE) that accounts for presence of excess zeros in the data has been developed using the mixture model (a combination of linear mixed model and generalized linear mixed model). This proposed approach works in three steps. Firstly, a linear mixed model is fitted for positive values of the variable and then at the second step, a generalized linear mixed model is fitted for probability of positive values. Finally, the two models are combined at estimation stage.
- For situations in which the variable of interest is negatively correlated with sizes of units, the concept of inclusion probability inversely proportional to size sampling (IPIPS) scheme is introduced. IPIPS scheme ensures that the first order inclusion probabilities of units are inversely proportional to size measures of the units.
- For computational analysis of SNPs in rice genome, a web based information system on functional elements of rice genome has been developed. Online facilities have been created to access the information on Single Nucleotide Polymorphisms (SNPs) at functional elements. Web information system on rice functional elements help facilitate users to extract sequence information on promoter regions, untranslated regions, translation start sites, splice sites, exons, introns, translation stop sites, etc. Information on classification of splice sites, position weight matrices, phylogenetic relationships etc. is also provided in the Splice Store.
- The variety selection and disease diagnostic modules of the expert system on wheat crop management have been developed in Hindi using SQL server that accepts UNICODE for the support of Hindi language.
- In presence of outliers, it is seen that the estimates of genetic correlation are highly under estimated with the result that the bias increases considerably. The standard error in the presence of outliers also increases considerably.

- A β -version of Statistical Package for Animal Breeding (SPAB 2.1) has been developed. The package is quite useful for animal breeders for estimation of genetic parameters and for formulating sound breeding strategies and selection processes.
- In knowledge data warehouse for agricultural research, multidimensional model for the Integrated Data Mart has been designed. Models have been developed and implemented for on-line analysis and prediction/forecasting based on time series data to different data marts. Three types of models i.e. trend, growth, and auto regression are incorporated for this on-line prediction.
- Decision support system for manpower planning (PERMISnet-II) has been implemented in ICAR from IASRI server at the URL <http://permisnet.iasri.res.in>.
- Developed an online management system for PG School, IARI, New Delhi. It has five modules for management of courses, students, faculty, administration and e-learning. At present the system has 267 registered students and 412 faculty members. The system has 536 courses listed in 23 disciplines. All the students have been registered online for I, II trimesters of academic year 2009-10.
- In the e-Learning solution for agricultural education using MOODLE (*Modular Object Oriented Dynamic Learning Environment*), the courses "Elementary Statistical Methods" under the discipline of Agricultural Statistics and "Fundamentals of Computers and Programming" under the discipline of Computer Applications have been prepared.

Scientists of the Institute published 61 research papers in National and International refereed Journals along with 24 popular articles, 06 book chapters, 24 projects/technical reports/reference manuals, 03 pamphlets and 04 workshops proceedings. The Agricultural Research Data Book 2009 which is thirteenth in the series has been published.

Dr. Hukum Chandra received Cochran-Hansen Prize 2009 from International Association of Survey Statisticians.

Dr. AK Vasisht received the Best Research Paper Award during national level Workshop-cum-Seminar held at Pondicherry University, Puducherry during 11-12 September 2009.

Dr. Himadri Ghosh received Mrs. Bhargavi and Professor CR Rao Award for Best Poster Presentation during International Conference on Frontiers of Interface between Statistics and Sciences held at University of Hyderabad, Hyderabad during 30 December 2009 to 02 January 2010.

Dr. AK Gupta received III prize for oral presentation during the National Symposium on Lifestyle Floriculture: Challenges and Opportunities held at Dr.YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP) on 20 March 2010.

Expert System on Wheat Crop Mangement received Manthan Award South Asia 2009 for best e-content and best e-learning solution.

Scientists of the Institute were deputed for presentation of their papers in several National/International conferences.

This year following eleven training programmes were organized in which 182 participants were imparted training

- A twenty one days training programme under Centre of Advanced Faculty Training on Recent Advances in Web Technologies for Information Management in Agriculture.
- Winter School on Bioinformatics and Statistical Genomics.
- Three International training programme on (i) Experimental Designs and Data Analysis for the CAC Staff at Tashkent, (ii) Advances in Design and Analysis of Experiments at ICARDA Aleppo, Syria and (iii) Applications of Remote Sensing and GIS in Agricultural Surveys sponsored by Afro Asian Rural Development Organization at the Institute.
- CSO Sponsored 26 days training programme on Data Analysis with Statistical Tools for Indian Statistical Service (ISS) Probationers of XXIX batch.
- Four refresher training programmes on (i) Applications of Information Technology in Statistical Computing and Data Dissemination Techniques for in-service ISS officers and senior officers of State Governments/UT (ii) Small Area Estimation for the Indian Statistical Services and other senior officers of States/Union Territories

(iii) Research Methodology for Official Statistics for twelve ISS officers and statistical personnel and (iv) Agricultural Statistical System in India for statistical personnel of States/UTs/PSUs of CSO.

- One special training programme on financial matters for the officials of ICAR Hqrs.
- Three Travel Training programmes on Advances in Design of Experiments were organized for the scientists of Acharya NG Ranga Agricultural University, Rajendra Nagar, Hyderabad and its centres and 245 researchers were sensitized.
- 05 Dissemination workshops as part of Golden Jubilee celebrations of the Institute were organized
 - Design of Experiments
 - Applications of Small Area Estimation Techniques
 - Expert Systems in Agriculture
 - Remote Sensing and GIS for Decision Support in Agriculture
 - Statistical and Computational Issues in Genomics
- Ten other Symposium/Workshop/lecture sessions/special invited talks during International Conference were organised.

- Two Brainstorming Sessions on Establishment of Centre of Agricultural Bioinformatics were organised.

The activities relating to education and training which include 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 16 students, 03 Ph.D. (Agricultural Statistics), 05 M.Sc. (Agricultural Statistics) and 08 M.Sc. (Computer Application) completed their degrees. 23 new students 07 Ph.D. (Agricultural Statistics), 08 M.Sc. (Agricultural Statistics) and 08 M.Sc. (Computer Application) were admitted.

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

To promote Hindi, a poster presentation was organized at the Institute and awards were distributed for the outstanding performances.

The Library of the Institute with a status of Regional Library under NARS, played a vital role in meeting the information needs of the in-house users as well as users from other research organisations.

ORGANOGRAM

