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Executive Summary

Indian Agricultural Statistics Research Institute (IASRI) established in 1959 as an Institute of Agricultural Research Statistics was 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 53 research projects in the Institute, of which 35 were Institute funded, 08 AP Cess funded, 09 funded by outside agencies and 01 in collaboration with other institute in various thrust areas. This year, 13 projects were completed and 28 new projects were initiated.

Some of the salient research achievements were:

- Search for Efficient Design of Experiments for Quality Agricultural Research has generated two-level factors Super Saturated Designs (SSDs) using a column-wise coordinate exchange algorithm. The algorithm generates designs for two situations, (a) the design is balanced in the sense that for an n run design, the +1 and -1 levels appear $n/2$ times each for all the factors, n even;

(b) the design is balanced and there is a subset of factors that are mutually orthogonal in the sense that the inner product of any two columns in this subset vanishes to zero, *n* is a multiple of 4. Catalogue of efficient designs generated are available at Design Resources Server (www.iasri.res.in/design). The concept of unbalanced mixed-level factors SSDs has been introduced and efficiency criteria have been modified for these designs. Lower bounds to these efficiency criteria have been obtained.

- For complete multi-response experiments, it was shown that the designs that were efficient for single response experiments were also efficient for complete multi-response experiments provided that the number of response variables is less than the error degrees of freedom.
- A method of construction of designs for incomplete multi-response experiments was obtained using combination of randomized complete block (RCB) designs and balanced incomplete block (BIB) designs. The designs obtainable from this method are economical from resource point of view.
- A step wise procedure of analysis of incomplete multi-response designs obtained as a combination of RCB design and BIB design was developed.
- Robustness of cyclic designs against correlated observations was studied for Nearest Neighbor [NN] and autoregressive of order 1 correlation structures for different values of correlation coefficients and a list of these designs for number of treatments upto 10 giving A-efficiency was prepared for different values of correlation coefficient.
- A series of repeated measurements designs for comparing a set of test formulations with another set of reference formulations in bioequivalence trials was obtained and a package Statistical Package for Repeated Measurements Designs (SPRMD) has been developed.
- A new criterion for identifying robust designs against presence of more than one outlier was developed. Using this criterion, all binary variance balanced block designs were shown to be robust against the presence of two outlying observations. Graphic user interface based software was developed for analyzing experimental data in the presence of outlying observations.
- In mixture experiments, the efficient designs were obtained by using the criteria of minimizing $trace(\mathbf{X}'\mathbf{X})^{-1}$ (A-efficiency criterion), minimizing $|(\mathbf{X}'\mathbf{X})^{-1}|$ (D-efficiency criterion) and G-efficiency (G for global) criterion.
- Two criteria of robustness of block designs for parallel line and slope ratio assays were developed. Criterion I was based on connectedness property and Criterion II was based upon the A-efficiency of the residual design obtained after deletion of observations from the original design. Robust designs for bioassays against the loss of data were also catalogued.
- A series of designs involving sequences of treatments with two non-interacting factors for symmetric factorial experiments was obtained. These designs were partially variance balanced for levels of each factor based on circular association scheme.
- For chracterising unimodality or bimodality of rainfall distribution, it was concluded that for unimodal rainfall data sets, the family of Generalized Lambda Distributions (GLD) might be used and on the other hand for bimodal data sets the rainfall distribution could be explained by mixtures of distribution.
- An alternative methodology for estimation of area and production of horticultural crops was developed which provides integrated design for vegetables and fruit crops and utilised additional information on market arrivals etc. The new methodology is cost effective and procedures are simplified.
- Biplot analysis was done for identification of subset of genotypes for different subset of locations.
- For crop forecasting using state space models, Bivariate time series models viz. linear Gaussian state space and Vector Auto-Regression (VAR) were fitted. Using these models, forecasts were obtained for subsequent years and compared with those obtained earlier from corresponding univariate models viz. ARIMA and state space models. At state level, cotton production forecasts obtained using VAR model were found better as against the other models.
- Neural network models using multilayer perceptron (MLP), radial basis function (RBF)

architectures and weather indices based regression models for forecasting yield of rice, wheat and sugarcane were developed and out of 36 fitted models, it was found that model based on MLP architecture were better in 13 cases, RBF architecture were better in 6 cases and weather based regression models were better in 17 cases.

- A study on editing and imputation using neural networks showed that ANN model performed well for editing non-response.
- The study on adoption and impact of Resource Conservation Technologies (RCT) on Farm Economy showed that RCT helped significantly in increasing the net returns of both rice and wheat growers in various states on Indo-Gangetic Plains of India.
- Under impact assessment of fisheries research in India, it was observed that the share of fisheries sector in Gross Fixed Capital Formation (GFCF) as well as Agriculture GFCF was increasing at a steady pace at constant prices since mid eighties. The Incremental Capital Output Ratio (ICOR) in fisheries sector was very high due to poor growth in fish Gross Domestic Product (GDP) during late seventies and it decelerated to a very low level during eighties due to impressive GDP growth and during late nineties there was a large increase in ICOR due to slow growth in GDP especially due to stagnation in marine production.
- In a study on stable and robust clustering procedures it was seen that the relative percentage misclassification under multiple imputation was found to be low irrespective of the clustering method and distance measure.
- From long term fertilizer experiments, decline in crop yields with the continuous use of nitrogenous fertilizer in soils was observed at most of the centers except at Coimbatore, Ludhiana and Pantnagar. The decline in yield with N alone was quite high in acidic soils at Palampur, Ranchi and Bangalore.
- From intensive cropping experiments for determination of balanced optimum application of NPK, it was observed that integrated application of 100% NPK inorganic (Optimal dose) with organic FYM @ 10-15 t ha^{-1} yr^{-1} enhanced and sustained crop productivity and soil fertility. These findings were also corroborated by their respective yield sustainability indices worked out across the years. The application of FYM besides supplying additional quantities of NPK had its beneficial effect on the soil properties.
- Regression analysis between grain yield and auxiliary characters showed that plant height was not significantly contributing to the grain yield whereas number of grains/panicles followed by number of ear bearing tillers/s.u. were significantly contributing to the grain yield.
- From a statistical investigation on production, economic and energy potential of crop sequences in different agro-ecosystems, it was concluded that the three crop sequences including onion as one of the crop could preferably be tried at CSR Junagarh centre like pearlmillet-onion-cowpea and soyabean-onion-cowpea. It not only enhanced the net return but also provided the cereal, pulses, oilseeds along with carbohydrates and iron energy enriched onions. Land use efficiency was also found to be maximum of these sequences.
- A web-enabled Agricultural Field Experiments Information System (AFEIS) has been developed wherein information relating to informed agricultural field experiments (excluding pure varietal trials) conducted in the country are stored and maintained on-line. The system has potential to serve as a reference material for scientists, research workers and planners, etc. in the field of agricultural sciences. Presently, the database has an information relating to 24000 agricultural field experiments conducted at various Agricultural Universities, ICAR Research Institutes, Project Directorates, All India Coordinated Research Projects and Directorates of Agriculture of State Governments, etc.
- A Beta-version of software for generation of nested block designs both for independent errors and correlated errors was developed.
- A “National Information System on Agricultural Education Network in India (NISAGENET)” was developed and implemented at 42 participating organizations that included State Agricultural Universities, ICAR Deemed to be Universities, Allahabad Agricultural Institute, Central Agricultural University and Central Universities imparting agricultural education in India.
- Software for Survey Data Analysis (SSDA) was developed. This software estimates the

population parameters based on the sampling data collected using the important common sampling designs like simple random, stratified, systematic, cluster, two stage and stratified two stage.

- Existing PERMISnet has been upgraded to .NET platform and strengthened with new modules and manpower planning reports. System has been enriched with many new features like RMP (Research Management Personnel) module, Modification in access rights, new forms and reports for improved decision support.
- "Statistical Package for Animal Breeding 2.1 (SPAB2.1)", was initiated and eight programs of the package were developed.
- "Decision support system for manpower planning - PERMISnet" was initiated. Data of online PERMISnet system was merged with the new database structure of PERMISnet-II system. Some new reports for manpower planning were developed and integrated with PERMISnet-II system.
- "Web solutions for Partially Balanced Incomplete Block (PBIB) Designs" was initiated. Methods of construction of some classes of PBIB designs were compiled from the literature. Computer module was developed for generating the randomized layout of these designs. Designing of e-learning material on PBIB designs has been initiated.
- "Knowledge data warehouse for agricultural research" was initiated. OLAP cubes for the Census Survey Data (2001) were prepared for some states.
- Data on IVT from NRC on R&M, Bharatpur and from DWR, Karnal were analyzed to examine the usefulness of resolvable incomplete block designs in controlling the variability in the experimental material.
- Design Resources Server was strengthened by adding links on α-designs, designs for bioassays, supersaturated designs, modules for generation of randomized layout of square lattice designs, basic designs such as completely randomized designs, RCB designs, latin square designs and augmented designs. A new page "Analysis of Data" has been created on Design Resources Server that provides steps of analysis of data generated through designed experiments using SAS and SPSS. A Discussion Board has been initiated for sharing research with fellow scientists over the globe and for flagging issues for attention of scientific community. A list of experts in design of experiments over the globe is uploaded which will be useful for establishing linkages.
- The methodology developed by the Institute for estimation of area under paddy crop was implemented in the whole Meghalaya State and another study "Developing remote sensing based methodology for collecting agricultural statistics in North-East hilly region, was initiated to develop remote sensing based sampling methodology for multiple crops acreage.
- For identifying the causes of variation between the official and trade estimates of cotton production, the re-analysis of data pertaining to crop cutting experiments was taken up for methodological developments.
- A study entitled "Estimation of extent of farming practices, resources and activities with energy use" was initiated.
- A study "to develop sampling methodology for estimation of production of mushroom" was initiated.
- "Study on status and projection estimates of agricultural implements and machinery", was initiated.
- "Strengthening, refining and implementation of expert system on wheat crop management" was initiated. Few interfaces were designed in Hindi.
- National Information System on Agricultural Education Network in India (NISAGENET II) was initiated.
- The Institute had taken lead in publication of Agricultural Research Data Books since 1996. The Agricultural Research Data Book 2007 which was eleventh in the series was published.

Scientists of the Institute published 67 research papers in National and International refereed Journals along with 7 abstracts, 10 popular articles, 3 book chapters, 13 project/technical reports, 2 monographs, 1 e-manual, 1 lesson series and 1 seminar write-up.

Several meetings of the QRT were held with different scientific, technical. and administrative groups. QRT also met with IMC of the Institute for getting feedback from the members of the IMC. Finally Chairman, QRT

on the advice of Director General of the Council submitted the report of QRT to the Director of the Instiute.

The first meeting of common Research Advisory Committee (RAC) of the Indian Agricultural Statistics Research Institute (IASRI) and National Centre for Agricultural Economics and Policy Research (NCAP) was held under the Chairmanship of Dr. P.V. Shenoi, Former Special Secretary, Ministry of Agriculture, Govt. of India.

Dr. Rajender Parsad, National Fellow received the NAAS- Associateship.

Dr. Cini Varghese, Senior Scientist, received the Lal Bahadur Shastri Young Scientist Award for the Biennium 2005-2006 in the field of Social Sciences.

Dr. P. Visakhi, Librarian was awarded a prestigious award of "Young Information Scientist for 2006" by Society for Information Science (SIS).

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

Dr. Prajneshu, Head Biometrics, participated in the International Conference on Advances in Interdisciplinary Statistics at Greensboro, U.S.A. during 12-14 October 2007.

Dr. V.K. Bhatia, Professor (Agricultural Statistics) and In-charge(RCMU) participated in Fourth International Conference in Agricultural Statistics at Beijing, China during 22-24 October 2007.

Dr. Sushila Kaul, Senior Scientist, participated in Economic Modelling Conference at Moscow during 12-14 September 2007 and Ist CIRIEC International Conference on Social Economy at Victoria, BC, Canada during 22-25 October 2007.

To promote Hindi, a poster presentation was organized at the Institute and scientists were also awarded for their outstanding contributions in preparation of Hindi posters.

XV National Conference of Agricultural Research Statisticians of ICAR was organised by the Institute at Birsa Agricultural University, Ranchi during 03-04 December 2007.

For installation and implementation of application softwares developed for NISAGENET, 2 days onsite trainings were organized and the software was made operational at the LAN of all the 42 participating organisations.

A two days workshop was organized on PERMISnet and Intelligent Reporting System of ICAR.

Four 21 days duration training programmes under Centre of Advanced Studies on Spatial and Non-Spatial Information Management and Mining in Agriculture, Advances in Quantitative Techniques for Policy Analysis in Agricultural Economics, Advances in Biometrical Techniques and Development of Web Applications for Knowledge Dissemination in Agriculture were organised.

One day training course entitled "Official Statistics and related Methodology", was organised on 31 October 2007 for the International participants.

A study tour for the two participants of Senior Certificate Course from Afghanistan was conducted.

A FAO sponsored Study Visit of participants from Afghanistan was organised during 10-29 December, 2007. As part of the study visit, the participants were taken to DES, Trivandrum during 16-19 December 2007 and to DES, Hyderabad during 25-27 December 2007.

A winter school on "Sample Survey Techniques in Agricultural Research", was organized at the Institute from 16 January to 05 February, 2008.

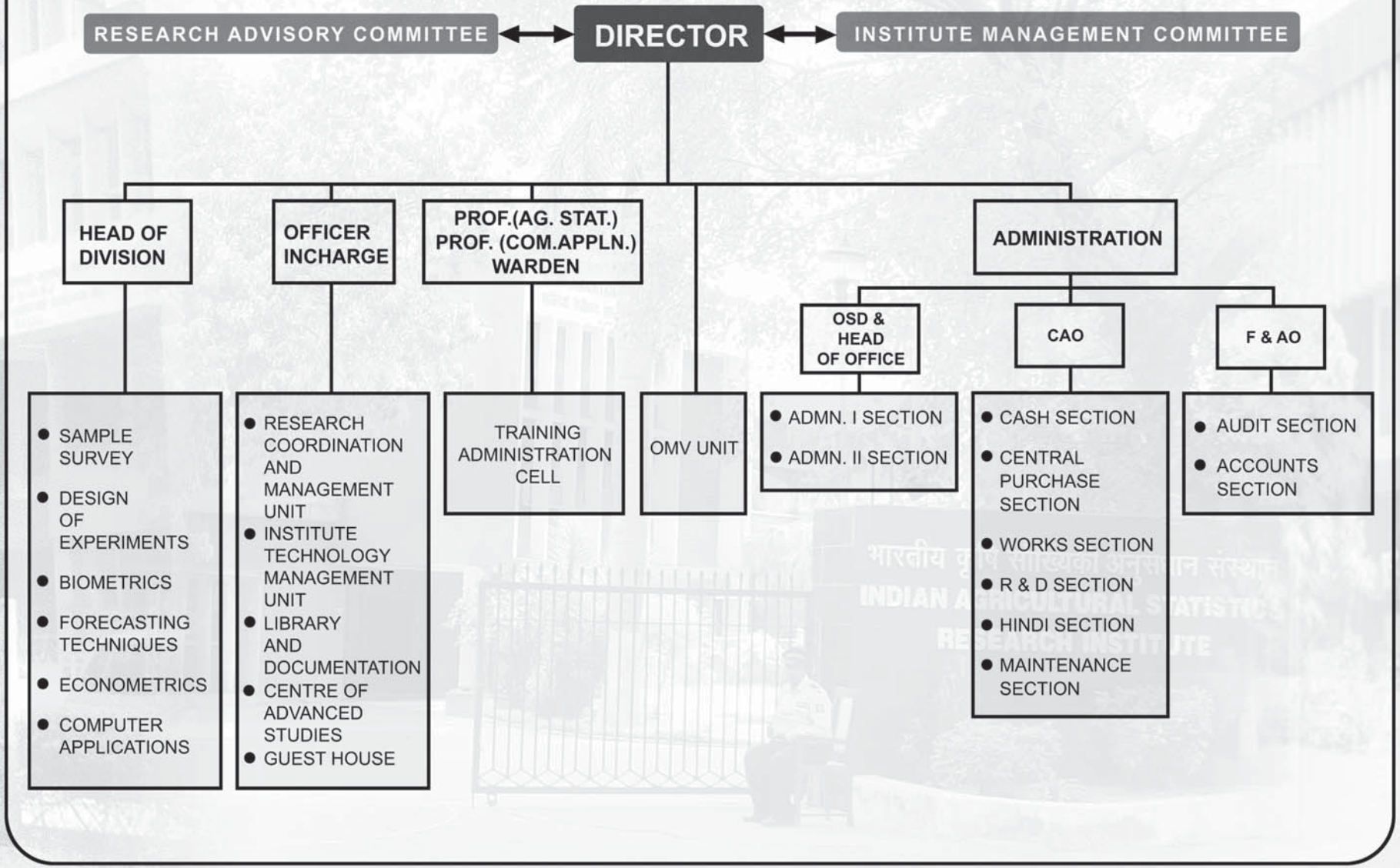
A training programme on "Research Methodology" was organized from 07 to 18 January 2008 for scientists of Indian Council of Forestry Research and Education (ICFRE).

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 19 students 07 Ph.D. (Agricultural Statistics), 05 M.Sc. (Agricultural Statistics) and 07 M.Sc. (Computer Application)] completed their degrees. 12 new students 03 Ph.D. (Agricultural Statistics), 05 M.Sc. (Agricultural Statistics) and 04 M.Sc. (Computer Application) were admitted.

A "Senior Certificate Course in Agricultural Statistics and Computing" was organised for the benefit of research workers engaged in handling statistical data collection, processing, interpretation and employed in research Institutions/Universities of India and foreign including SAARC countries. Eight officials participated in this Certificate Course.

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. The library services have been totally transformed into digital form with the launch of elaborated and well featured website of Library (http://lib.iasri.res.in) with link to all resources and services available in Library.

ORGANOGRAM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