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 27 research projects in the Institute, of which 16 were Institute funded, 5 AP Cess funded and 6 funded by outside agencies in various thrust areas. This year, 7 projects were completed and 4 new projects were initiated.

Some of the salient research achievements were:

- Three series of Super Saturated Designs (SSDs) were generated for asymmetrical factorial experiments. The SSDs generated were also evaluated for optimality on the basis of different efficiency criterion. Catalogues of designs were prepared.
- Web enabled software was developed for online generation of Hadamard matrices in a semi-normalized or a normalized form up to the order

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1000. No construction method is available for orders **668**, **716** and **892** and, therefore, these orders have not been implemented**.**

- 6574 incomplete binary block designs for making all possible pair wise treatment comparisons for number of treatments, blocks and block sizes smaller than 36, 50 and 34, respectively such that average replication number of treatments was not more than 20 were added on the DESIGN RESOURCES. The A- and D- efficiency of the design generated was also given. These designs have high efficiency and can always be used by the experimenter.

- A step wise procedure for the analysis of block designs was developed for complete multi-response experiments where corresponding to the application of a treatment, observations on more than one response variable were recorded. A method based on Euclidean distance and J-plot was developed for identification of best treatment.

- To tackle the problem of outlier(s) in multi-response experiments, a test statistic was developed for detection of a single outlier vector in complete multi-response experiments run in a block design. This statistic was developed on the lines of Cook-statistic for single response variable in a block design. Proposed test statistic was illustrated with the help of an example.

- Extended Group Divisible (EGD) designs for three factors that permit the estimation of all main effects with no loss of information were obtained using self-complementary GD designs with replication number and block size smaller than 11. A catalogue of such designs along with efficiencies for main effects and interactions was prepared.

- Nested block designs for nearest neighbour correlation structure within sub-blocks of a block in a nested block design setup and for zero correlation structure in bigger blocks ignoring the sub-block classification were obtained.

- Efficient designs for 2-colour microarray experiments were obtained and analytical procedure based on mixed effects model considering array effects as random to identify differentially expressed genes from microarray experiments were developed.

- Analytical techniques based on linear mixed effects models and biplots were developed for the analysis of data from Farmers Participatory Research Trials conducted by Rice-Wheat Consortium for Indo-Gangetic Plains.

- From agroforesty experiments, it was observed that tree, year and its interaction (tree × year) had significant impact on the yield of main crop barley. The impact of siris, neem and shisham was more or less same but more than babul on the yield of crop. Similarly the combined analysis of gram from 6 years data indicated significant effect of tree, distance, year, tree x year and distance × year on the yield.

- Efficiencies of 21 BIB, 26 GD designs for $v \leq 10$ and all 18 cyclic designs reported in Clatworthy (1973) were worked out for NN and AR(1) error structures for different values of correlation coefficient.

- In statistical and algorithmic approach for improved estimation of treatments effects in repeated measurements designs, an input data management module was developed in SPRMD (Statistical Package for Repeated Measurements Designs).

- All binary variance balanced block designs were robust against the presence of two outlying observations. A robust testing procedure for testing the treatment contrasts was developed. This testing procedure was also applied to experimental data.

- Statistical analysis of experiments on determining level and frequency of phosphorus application in different cropping systems, revealed that for judicious use of phosphorus for various crop sequence like rice-rice, rice-groundnut, rice-wheat, rice-gram, its application at the different rate of application of P_2O_5 per hectare applied in either season in alternate years might be economical for different locations.

- In the study on crop forecasting using state space models, exponential smoothing models, ARIMA and state space models were fitted for acreage, production and yield of Cotton crop in Maharashtra and at all-India level using 30 years data (1970–71 to 1999–2000). State space models were found better than exponential and ARIMA models for most of the forecast of subsequent years.

- Under the study developing remote sensing based methodology for collecting agricultural statistics in Meghalaya, attempts were initiated to generate agricultural statistics of six important crops potato, ginger, pineapple, banana, maize and paddy of the state by combining the information of remote sensing and survey data.

- Under the study on assessment of survey capabilities of private sector, the inception report

was prepared which contained a questionnaire for assessment of survey capabilities of the public/ private sector agencies and useful for consultancy wing

- Under the pilot study to develop an alternative methodology for estimation of area and production of horticultural crops, the work related to primary data collection in different districts of Maharashtra and Himachal Pradesh was carried out.

- Under the study to investigate the causes of variation between official and trade estimates of cotton production, the sampling designs and estimation procedure adopted by the State Government, Maharashtra for estimation of area and production of Cotton (Official estimate) were reviewed.

- The study on an econometric approach for measurement of indemnity and premium rates under Crop Revenue Insurance was completed. A comparison of estimated revenue premium rates for Karnataka and Uttar Pradesh state showed that the majority of crop strata were having low premium rates in Uttar Pradesh in comparison to Karnataka state.

- An econometric study of estimation of elasticities of demand and supply of major fruits and vegetables in India was completed and the results showed that there was an increasing trend in proportion of households consuming various vegetables and fruits over the years in the urban as well as rural India.

- In the study on neural network based forecast modeling in crops, models using multilayer perceptron (MLP) architecture for forecasting rice and wheat yields for eastern plain zone (Allahabad, Varanasi, Faizabad and Ballia), central plain zone (Kanpur, Lucknow, Fatehpur and Hardoi) and Bundelkhand zone (Jhansi, Banda, and Jalaun) of Uttar Pradesh were developed taking crop yield as output variable and data on maximum and minimum temperatures, rainfall and morning relative humidity as input variables. The forecasts obtained for rice and wheat were in agreement with the observed ones for most of the districts considered. For forewarning pests count, viz. American bollworm (1985–2001) and pink bollworm (1985–1995) for Nagpur in Cotton and *Helicoverpa armigera* (1983–2002) for Kanpur in Pigeon pea, models were developed with weekly lagged weather variables (1–2 weeks for Cotton pests and 1–5 weeks for *H. armigera*) as input

variables. Forecasts were found close to the observed ones in most of the cases.

- In another study on editing and imputation using neural networks, accuracy of imputing missing values using neural network and regression imputation procedures was studied. Performance of neural network imputation were found better than regression imputation.

- Under the study on statistical investigation on the performance of non-parametric stability measures when the genotype by environment data is non-normal, different simultaneous selection measures useful for selecting genotypes for yield and stability were developed It was noticed that for increasing number of genotypes the power was increasing. Some new nonparametric stability measures were also developed.

- Under the study some investigations on stable and robust clustering procedures, the frequency of misclassification against different combinations of clustering methods and distance measures were obtained. The effect of outliers on the proposed variable selection method as well as on different clustering methods were also examined in terms of percentage misclassification.

- Under the study on identification and validation of functional SNPs in complex diseases, genetic networks and evolution, a new procedure was developed to identify SNPs at splice sites of Arabidopsis and Human species.

- Information pertaining to agricultural research, education and related aspects available from different sources were compiled together in the form of Agricultural Research Data Book 2006 which was tenth in the series.

- A Statistical Package for Animal Breeding 2 (SPAB 2), was developed.

- An expert system was developed that would provide expert advice on wheat crop management.

- For the NISAGENET project, two sets of application software were designed and developed - one for data management at local server of the participating organizations and other one for data integration at the central server located at IASRI, New Delhi. At the central server at IASRI a query/ reports system having capability to provide information at country, state, university and/or college level was also implemented.

- Under the project development of software for the analysis of survey data modules on data management, imputation, class libraries for

sampling methods, Descriptive statistics and output modules were developed for sampling schemes with and without replacement in the form of reusable class libraries.

● PERMISnet-II was updated with new data values as well as with fresh requirements of ICAR.

Scientists of the Institute published 48 research papers in National and International refereed journals along with 25 popular articles, 4 book chapters, 6 project/technical reports and 2 e-books.

Revised perspective plan of the Institute Vision-2025 was also finalised.

Institute received first prize under the aegis of 'Rajrishi Tondon Rajbhasha Puraskar Yojna' of Indian Council of Agricultural Research.

'Sankhyaki Vimarsh 2006–07' hindi patrika published by the Institute received Ganesh Shankar Vidhyarthi (second) prize of Indian Council of Agricultural Research.

Dr. V.K. Sharma, Head, Division of Design of Experiments & Professor (Ag. Stat.) received the Best Teacher Award of IARI, New Delhi for his outstanding contribution to teaching in the discipline of Agricultural Statistics for the year 2006.

Dr. Rajender Parsad, National Fellow, ICAR was elected as Associate Fellow of National Academy of Agricultural Sciences, New Delhi from 01 January 2007.

Dr. Rajender Parsad, National Fellow, was deputed for a study visit on hands-on experience on analysis of farmer participatory research trials conducted by Rice-Wheat Consortium for Indo-Gangetic plains to CIMMYT, Mexico from 24 May to 28 June 2006. He was also deputed for participating in 14th Regional Technical Coordination Committee Meeting of Rice-Wheat Consortium for Indo-Gangetic plains held at Kathmandu, Nepal during 13–16 February 2007.

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

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.

An International Conference on Statistics and Informatics in Agricultural Research ICSI2006 was organized by IASRI, New Delhi during 27–30 December 2006 to mark the Diamond Jubilee Celebration of the foundation of Indian Society of Agricultural Statistics. 155 posters were presented during the conference. Many important recommendations have emerged from the conference.

As a prologue to the conference, two pre-conference workshops on "Hotspot Geoinformatics" and "Regression Diagnostics" were organized on 26 December 2006.

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 at NASC Complex, Pusa, New Delhi.

A study visit for three member delegation from Department of Statistics, Malaysia was organised.

Several training programs of different categories like trainings under Center of Advanced Studies, Summer School, Ad-hoc and sponsored National and International training programs 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 this year, a total of 12 students [4 Ph.D. (Agricultural Statistics), 5 M.Sc. (Agricultural Statistics) and 3 M.Sc. (Computer Application)] completed their degrees. 12 new students [2 Ph.D. (Agricultural Statistics), 5 M.Sc. (Agricultural Statistics) and 5 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. Six 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.