

Teaching and Training of Agricultural Statistics

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1. INTRODUCTION

The Global Strategy for improving Agricultural Statistics is based on three very important pillars as Establishment of a minimum core data set, the Integration of agriculture into national statistical system and Sustained efforts to build capacity and improve the e-governance of statistical activities at all levels. All these three pillars require technical competence and knowledge of statistical tools. In order to enhance the knowledge of personnel involved in these activities, training and teaching of Agricultural Statistics play a significant role. For instance persons responsible for identification and implementation of the core indicators need to acquire training in the field of Agricultural Statistics. Secondly for strengthening and improving Agricultural Statistics and its integration with national statistical systems, training has a crucial role to play. Skilled manpower in the field of Agricultural Statistics will prove to be very useful component for accelerating the process of integration of agriculture with national statistical systems. Further, for the third pillar also, training is very essential for good governance and human resource development.

For devising a comprehensive plan of training in the area of Agricultural Statistics, there is an urgent need of identify the information on various attributes such as number of persons to be trained, their knowledge in the area of agricultural statistics or level of the participants, availability of participants for training or duration of the training, subject matter areas of the training and finally the availability of the financial resources. The information on these will help in formulating very effective training modules. Having obtained the required information, the next step is to identify suitable institution or training provider. Here it is essential to look into those organizations who not only have qualified and trained faculty in imparting training in the area of Agricultural Statistics but also have adequate statistical computing, library and other laboratory facilities. The other infrastructure facilities which are also required for the conduct of the training programs are proper class rooms fitted with audio-visual aids, seminar hall, internet and hostel. In addition to these, the training providers must have cafeteria of training programmes and also capable of formulating customized, demand driven and tailor made training programmes on various topics of Agricultural Statistics.

Looking into all the above components and training needs of different organizations, Indian Agricultural Statistics Research Institute (IASRI), New Delhi, India, a premier Institute for research, teaching and training in Agricultural Statistics and Computer Application in agriculture who provides useful services and has established itself as International Institute of Excellence in the field of Agricultural Statistics can be considered as possible training provider institution. Besides having modern laboratories, up to date library and other infrastructure, the Institute has a dedicated team of qualified and experienced faculty in the field of Agricultural Statistics and Computer Application. The institute is also providing statistical methodology for national agricultural statistics system of the country for generating crop, livestock and fishery statistics. Several statistical packages and information systems for agricultural research have been developed by the institute. The brief description of the teaching and training activities of the Institute are described the following sections:

2. SHORTER DURATION TRAINING LEADING TO CERTIFICATE PROGRAMMES

Certificate Courses at IASRI

The training activities of the Institute had its beginning in 1945 when two regular Post Graduate courses viz. the *Certificate Course* and *Diploma Course* were introduced for Professional Statisticians. Another in-service training of about 8 to 9 months duration called an application course was also regularized. These courses became extremely popular and with the increased demand, during the year 1951, a Short Duration Course of six months duration called *Junior Certificate Course* was started for the benefit of in-service Agricultural Research Workers from various Institutes/Universities under the Indian Council of Agricultural Research (ICAR). These courses meant for training of professional statisticians and others, who dealt with statistical applications in fields of Agriculture and Animal Husbandry were re-organised into the following four courses:

- i. Junior Certificate Course of six months duration
- ii. Senior Certificate Course of one year duration
- iii. Professional Statisticians' Certificate Course of one year duration in Agricultural Statistics and
- iv. Diploma Course in Agricultural Statistics and Animal Husbandry of one year duration which was considered to be equivalent to one year research experience

The Diploma students were required to present their research work in the form of a thesis which was evaluated and on approval of the thesis, the diploma was awarded.

The total number of candidates who successfully completed the above courses is detailed below:

Course	Year of start	Total no. of participants
Junior Certificate Course	1946	261
Senior Certificate Course	1955	630
Professional Statisticians' Certificate Course	1960	320
Diploma in Agricultural Statistics and Animal Husbandry	1948	175
Diploma in Advanced Computer Programming	1981	10

The above courses had to be discontinued on the advice of ICAR. The Junior Certificate Course was discontinued from the year 1981. Senior Certificate Course, Professional Statisticians' Certificate Course and the Diploma Courses were discontinued from 1985. From October, 1983 to March, 1992 the Institute also functioned as the **Centre of Advanced Studies in Agricultural Statistics and Computer Applications** under the aegis of the United Nations Development Programme (UNDP). This programme was aimed at developing a Centre of Excellence with adequate infrastructure and facilities to undertake advanced training programmes and to carry out research on various aspects of Agricultural Statistics and Computer Application. In 1985, the following new short term courses, along with the number passed out, were introduced that continued till 1996:

- i. Refresher Course in Statistics for Agricultural Scientists – **57**
- ii. Certificate Course in Statistics and Computing – **13**
- iii. Short Term Course on Use of Computers in Agricultural Research – **676**
- iv. National Agricultural Research Project (NARP) Trainings – **105**
- v. Workshop-cum-Seminar on Software Development for Extension Personnel – **77**

On the recommendation of high powered committee and requirements of different organisations, the discontinued Senior Certificate Course was revived in 1997 in modified form having two modules with emphasis on Statistical Computing. Institute is getting good response for this course from State Government Departments, ICAR Institutes, State Agricultural Universities (SAUs), SAARC Countries, Commonwealth Secretariat and other Afro-Asian Countries. After revival the structure of this course is as under:

Senior Certificate Course in Agricultural Statistics and Computing

Presently, the institute conducts Senior Certificate Course in Agricultural Statistics and Computing, for the benefit of research workers engaged in handling statistical data collection, processing, interpretation and employed in research Institutes of the Council, State Agricultural Universities and State Government Departments, etc. and foreign countries including SAARC countries with the main aim to train the participants in the use of latest statistical techniques as well as use of computers and software packages. The course is comprised of two independent modules of three months duration each. The participants of this course have the flexibility to do either of any one module or both the modules. The main topics covered under the course include Statistical Methods and Official Agricultural Statistics, Use of Computers in Agricultural Research, Sampling Techniques, Econometrics and Forecasting Techniques, Design of Experiments and Statistical Genetics.

77 participants have completed both modules, 21 have completed module-I and 12 have completed module-II since 1997.

3. LONGER DURATION TRAINING LEADING TO DEGREES PROGRAMMES

Post Graduate Education

DEGREE COURSES

The Institute conducts longer duration training programmes in collaboration with Post Graduate School of Indian Agricultural Research Institute (IARI), New Delhi, India which enjoys the status of Deemed University under the University Grants Commission Act. The teaching is organized on the basis of trimester system. An Academic Session consists of three trimesters, each consisting of nearly twelve weeks duration. The programme of studies at the Institute includes

- a) Ph.D. (Agricultural Statistics)
- b) M.Sc. (Agricultural Statistics)
- c) M.Sc. (Computer Application)

System of Admission

Ph.D. Degree Course

Admission to Ph.D. Course is made by the Indian Agricultural Research Institute on the basis of performance of the candidates in the entrance examination, academic score, and interview.

Eligibility requirements for Ph.D.

- a) Master's degree in Agricultural Statistics / Statistics / Mathematical Statistics / Biostatistics of IVRI / Professional Statisticians' Certificate Course (PSCC) from IASRI.
- b) Candidates must have obtained at least 60% marks OR an overall grade point average (OGPA) of 7.50 out of 10.00 OR 3.75 out of 5.00 OR 3.00 out of 4.00 OR 2.25 out of 3.00.

Residential Requirements and duration of studies

The minimum residential requirement for the Ph.D. degree is 2 academic years from the date of admission. The maximum time limit for completion of the Ph.D. degree is 5 years from the date of admission. Ph.D. students normally take 3 - 5 years to complete the programme.

Age Limit

The minimum age limits for admission to Ph.D. courses is 21 years. The age shall be reckoned as on 31st July of the year of admission.

Institute Scholarships / Fellowships

Scholarships are offered to all the admitted students. A Ph.D. student is granted a scholarship/fellowship along with a contingent grant for meeting out the expenditure on study tours, experimental material, purchase of books and preparation of thesis, etc.

Admission of Foreign Students

- i. Foreign students seeking admission shall forward their applications through their respective Embassies / Missions at New Delhi or through the respective Indian Missions abroad to the Government of India / Secretary, DARE, Krishi Bhawan, New Delhi -110 001 and their candidatures shall be considered only if they are sponsored by the Government of India / DARE / ICAR.
- ii. Eligibility: Foreign students are exempted from appearing in the written test and interview. Admission shall be made on the scrutiny of the biodata and on the recommendations of the Professor of the concerned discipline.
- iii. International Fellowship: The Indian Council of Agricultural Research (ICAR) provides fellowship to the Indian as well as overseas nationals having Master's degree in Agriculture and allied sciences for the "ICAR International Fellowships (ICAR-IFs)". The ICAR-IFs are available for pursuing doctoral degree in agriculture and allied sciences, in the identified priority areas, to the (i) Indian candidates for study abroad in the identified overseas Universities/Institutions having strong research and teaching capabilities and (ii) to overseas candidates for study in the best Indian Agricultural Universities (AUs) in the ICAR-AUs system. Detailed guidelines, priority areas of study and application proforma can be seen from ICAR website.

M.Sc. Degree course in Agricultural Statistics

The admission to M.Sc. programme is through All India Combined Competitive Examination conducted by the Education Division, Indian Council of Agricultural Research (ICAR). On the basis of the merit the ICAR finalizes the admission.

Eligibility requirements for M.Sc. (Agricultural Statistics)

Bachelor of Science degree in Agriculture / Horticulture / Forestry / Agroforestry / Sericulture / Agricultural Marketing/ B.Sc. degree with 60% marks or its equivalent Overall grade point average (OGPA).

Eligibility requirements for M.Sc. (Computer Application)

Bachelor of Science degree in Agriculture / Computer Science/ Agricultural Engineering/Veterinary Science/ Horticulture / Forestry / Home Science / Maths / Statistics/ Physics/Biology/B.Sc. degree with 60% marks or its equivalent Overall grade point average (OGPA).

Residential requirements and duration of studies

The minimum residential requirement for both the M.Sc. degrees is 2 academic years from the date of admission. The maximum time limit for completion of the M.Sc. programme of studies is 4 years from the date of admission. However, a M.Sc. student from Agricultural stream takes 2 years and from non agricultural stream 3 years to complete the programme of studies.

Age Limit

The minimum age limits for admission to M.Sc. is 19 years. The age shall be reckoned as on 31st July of the year of admission.

Institute Scholarships / Fellowships

Scholarships are offered to all the admitted students. An M.Sc. student is granted a scholarship / fellowship along with a contingent grant for meeting out the expenditure on study tours, experimental material, purchase of books and preparation of thesis, etc.

Areas of Specialisation

Students pursuing for Ph.D. and M.Sc. degrees programmes in the discipline of Agricultural Statistics have a option to choose different field of specialisation as

- i. Sample Surveys
- ii. Design of Experiments
- iii. Statistical Genetics
- iv. Statistical Modelling
- v. Crop Forecasting Techniques

So far large number of students have been awarded various degrees which are as under:

- a. **Ph.D. (Agricultural Statistics)**
Awarded : 176
- b. **M.Sc. (Agricultural Statistics)**
Awarded: 292
- c. **M.Sc. (Computer Application)**
Awarded : 89

4 NATIONAL/INTERNATIONAL TRAINING PROGRAMMES

Programmes under Centre of Advanced Faculty Training

The functioning of the Institute as a Centre of Advanced Studies in Agricultural Statistics and Computer Application during October 1983 to March 1992 under the aegis of United Nations Development Programme was another landmark in the history of the Institute. The purpose of this programme was to develop the Institute as a centre of excellence with adequate infrastructure and facilities to undertake advanced training programmes and to carry out research in various emerging areas of Agricultural Statistics and Computer Application. Under this programme, a number of illustrious statisticians and computer scientists from abroad visited the Institute with a view to interacting with the scientists, giving seminars/lectures and suggesting gaps in the research programmes of the Institute. Under the programme some scientists of the Institute received training for capacity building from abroad. Another singular development in the growth of the Institute was the Centre of Advanced Studies programme in Agricultural Statistics and Computer Application established by ICAR in 1995. Under this program the institute have organized number of training programmes on various topics of current interest for the benefit of scientists of National Agricultural Research System (NARS). These training programmes covered specialized topics of current interest in statistics and agricultural sciences. During the period under report the Centre of Advanced Studies (CAS) is renamed as Centre of Advanced Faculty Training (CAFT). So far 44 training programmes have been organised under the aegis of Centre of Advanced Faculty Training. In all a total of 781 participants have been benefited.

Summer/Winter Schools in Agricultural Statistics and Computer Applications

Institute also conducts Summer and Winter Schools on newer and current topics in the field of Agricultural Statistics and Computer Application for enhancing skills of researchers and teachers. In the recent past, topics like Bioinformatics and Statistical Genomics and e-learning have been considered for imparting training.

Customised Training Programmes

There is yet another form of training courses, 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 Services probationers and Senior officers of Central Statistical Organization and many other organizations. Recently the following were organised:

- A training programme on Data Analysis with Statistical Tools sponsored by Central Statistical Organization (CSO), Ministry of Statistics and Programme Implementation, Government of India
- A refresher course on Applications of Information Technology in Statistical Computing and Data Dissemination Techniques for in-service ISS officers and senior officers of State Governments/UT for Central Statistical Organization (CSO)
- A refresher training course on Research Methodology for Official Statistics sponsored by CSO, Ministry of Statistics and Programme Implementation, Govt. of India for twelve Indian Statistical Service (ISS) officers and statistical Personnel
- A refresher training programme on Small Area Estimation for the Indian Statistical Services and other senior officers of States/Union Territories
- A refresher training programme on Agricultural Statistical System in India for Statistical Personnel of States/UTs/PSUs of Ministry of Statistics & Programme Implementation, Government of India

International Training Programmes

The Institute has also conducted several international training programmes on request from FAO, particularly for African, Asian and Latin American countries. The Institute has also conducted training programmes for the scientists/research personnel of CGIAR organizations such as ICARDA and Rice-Wheat Consortium for Indo-Gangetic plains. A number of research workers from the Institute have served as consultants and advisors in Asian, African and Latin American countries. Also, a number of statisticians and students of the Institute are at present occupying high positions in universities and other academic and research institutions of USA, Canada and other countries. The following programmes have been organised recently:

- An International training Programme on Advances in Design and Analysis of Experiments at ICARDA, Aleppo Syria
- An International Training Programme on Applications of Remote Sensing and GIS in Agricultural Surveys sponsored by Afro Asian Rural Development Organization (AARDO)
- An International training programme on Experimental Designs and Data Analysis for the CAC Staff at Tashkent

Training for Corporate Sector

The Institute has broadened the horizon of capacity building by opening its doors to the agro-based private sector. One such training programme was organized for research personnel of E.I. DuPont Pvt. Ltd.

5. AD HOC TRAINING PROGRAMMES

Besides organizations of regular courses of short term, post graduate courses and national/international training programmes, the institute also conducts several popular ad-hoc training programmes. Some of them are as under:

Early Warning System for Food Security

The course aims at educating the participants about techniques for estimation of agricultural production and issues involved in food security. The imbalance between demand and supply of food is also dealt.

Course Contents

Module 1: Statistical methods Graphical presentation of data; measures of central tendency and dispersion: probability theory; probability distributions; correlation and regression. Concept of testing of hypotheses

Module 2: Sampling techniques Concepts of survey sampling: simple random sampling; systematic sampling; varying probability sampling; stratified sampling ratio and regression estimators; cluster sampling; multi-stage sampling

Module 3: Techniques used in studying food security, elementary econometric methods, regression analysis, time series analysis, ARIMA models

Module 4: Forecasting techniques, Introduction to early warning system for food security; forecasting models; techniques of crop forecasting based on agro-meteorological parameters; crop monitoring/forecasting using remote sensing data; assessment of demand and supply; monitoring factors affecting the food security-weather, prices, inputs, infrastructure, storage, transportation, public distribution system, stocks, diseases, pests, drought, etc.

Module 5: Data Processing Fundamental of computers introduction to MS Windows and MS Office; exposure to statistical packages like SPSS, PCCARP

Forecasting Techniques in Agriculture

The course has been developed with short objectives of

- educating the participants on the state of art in forecasting techniques,
- acquainting the participants on latest developments in related fields,
- to identify gaps and needs in the field of forecasting research.

Course Contents

Software packages useful in forecasting techniques; regression analysis, modelling and diagnostics; ridge regression; principal component of regression and discriminant function; planning of surveys/experiments for forecast studies

Different approaches of forecasting crop yields based on weather, plant characters and remotely sensed data—between/within year models, GMDH procedure, Markov chain, Bayesian and simulation models, Agrometeorological models; Forewarning systems for pests and diseases—models for qualitative and quantitative response variables; Forecasting yield loss due to various factors; Use of non-linear ANN, linear and non-linear time series models in forecasting agricultural phenomena; forecast models in fisheries; drought monitoring; composite forecasts

Experimental Designs for Agricultural Research

The course aims at exposing the participants to the concepts and usage of designed experiments and use of statistical software packages in research.

Course Contents

Planning of experiments; principles of design of experiments; Basic experimental designs; missing plot technique, balanced incomplete block designs, partially balanced incomplete block designs, lattice designs, augmented designs, row column designs, nested designs; Designs for multifactor experiments including balanced confounded designs, fractional replication, split plot, strip-plot designs, designs for cropping systems research, inter-cropping experiments, agro-forestry experiments, long-term fertilizer experiments, change-over designs; Contrast analysis; Multiple comparison procedures; Competition effects; Analysis of covariance, etc.; Exposure to software packages like SAS, SPSS and SPBD release 1.0; Statistical Package for factorial experiments (SPFE) 1.0, etc.

Application of Remote sensing and GIS in Agricultural Surveys

The course aims at:

- familiarizing the participants with the basic concepts of remote sensing and GIS and
- acquainting the participants with Use of GIS and Remote Sensing Software Packages
- exposure to application of remote sensing and GIS in agricultural surveys.

Course Contents

Module 1: Indian agricultural statistics system; sampling methods; use of computers in agricultural surveys; statistical techniques for spatial data analysis; crop forecasting techniques; spatial statistics in GIS

Module 2: Introduction to remote sensing and Indian space program; principles of remote sensing; satellite data reception and image interpretation; remote sensing platforms and sensors; map projection and coordinate system; digital image processing; accuracy assessment in remote sensing; use of spectral indices in agriculture; introduction to ERDAS IMAGINE; data loading and image interpretation and georegistration; classification and accuracy assessment

Module 3: Introduction to geographic information system; data models in GIS spatial analysis of vector and raster data; spatial interpolation techniques using GIS; data quality and errors in GIS; introduction to ARCVIEW; creating, editing and manipulating spatial and non-spatial data; querying from spatial and non spatial databases; creating a map layout; introduction to global positioning system and its applications

Module 4: Use of remote sensing for crop yield estimation and crop yield forecasting; crop yield simulation; effect of misclassification on post stratified estimators of crop yield; application of GIS in agro-forestry; application of GIS in spatial sampling for agricultural surveys; application of GIS and remote sensing in land use statistics

Statistical Software Packages in Agriculture

The course has been developed with short objectives to train the research workers in computer literacy and research data analysis.

Course Contents

Module 1: Computer fundamentals; Introduction to computers; Windows operating system

Module 2: MS Office: Introduction to MS Office; Microsoft word for text processing; Microsoft excel for spreadsheet applications; Microsoft access for database management; Microsoft power point for presentation

Module 3: Statistical packages: Use of statistical packages like SAS; STATISTICA, MINITAB, SPSS, SPAR 2 etc, practicals covering application of these packages for solving real life problems in agricultural research such as analysis of variance, regression analysis and multivariate techniques

Statistical Techniques for Agricultural Research

The course aims at exposing the participants to the concepts and usage of designed experiments and use of statistical software packages in agricultural research.

Course Contents

Module 1: Descriptive statistics, probability, random variables, probability distributions, normal distribution, sampling distributions, tests of significance (large sample, chi-square, t and F tests), estimation of parameters, regression and correlation, general linear model and analysis of variance, non-parametric tests, diagnostic measures in linear models.

Module 2: Sampling techniques: Sample surveys vs complete enumeration; planning and execution of sample surveys, questionnaire designing for socio-economic studies, simple random sampling and sample size determination, stratified sampling, systematic sampling, ratio and regression methods of estimation, successive sampling on two occasions, varying probability sampling, cluster sampling and multiple stage sampling, non sampling errors.

Module 3: Design of Experiments: Planning and designing of experiments, size and shape of plots of blocks, basic experimental designs, missing plot techniques, balanced incomplete block designs, partially balanced incomplete block designs, lattice designs, augmented designs, factorial experiments, concepts of confounding and fractional factorials, split plot designs, Strip plot design, S.P.B.D. Release 1.0, SPFE 1.0, analysis of covariance, designs for multistage experiments, repeated measurement designs, groups of experiments, design of experiments for agro forestry system.

6. TRAINING NEEDS FOR THE CONDUCT OF SAMPLE SURVEYS

The purpose of sample survey is to obtain information about a population. If the units constituting the population vary considerably in respect of the character under study the method by which to draw a sample plays a critical role. A sampling method is a scientific and objective procedure of selecting units from the population and provides a sample that is expected to be representative of the population. In a sample survey the data can be analyzed with greater speed. In certain investigations it may be essential to use specialized equipment or highly trained field staff and to employ efficient supervisor staff to ensure completeness of returns from the reliability of the data. Planning and organization of a survey is not simple and several problems arise during the conduct of survey. Naturally, these problems vary greatly depending upon the nature of the investigation, the type of data to be collected and the conditions prevalent in the region where the survey is to be carried out. The survey passes through several stages starting from planning, data collection, development of estimation procedure etc. until writing the final report is finished. There is a team for conducting the survey work which consists of senior level officers, field supervisors, field investigators and staff for data processing. They need to be familiar with the objectives of the survey, the type of data to be collected and other matters connected with the organization of the survey. Senior level officers are required intensive training regarding project activities, methods to be used for collecting data and also the method to be used in case of non-response. Senior level officers must be very clear with each and every activity of survey because they are the key person of the survey. Further they generally impart the training to field supervisors, field investigator and data processing staff. The next step is to make the arrangements for training to the field supervisors and field investigators. The field supervisors and investigators are required to know the purpose of the survey and also possibly that how the results are used. The manner in which the data are to be collected and the interviews to be conducted should be explained in detail with examples. The training may be given with the help of instruction manuals. The training to the staff for data processing must be given in time for scrutinizing the data, coding the data, analysis of data and preparation of output tables. Thus in short, training is required at various stages for the smooth conduct of sample survey. The details of the training required at various stages of survey are mentioned in the following table and institute is capable to provide these trainings:

Various Steps to conduct Sample Surveys		Training Needs at various levels
1)	Planning	
	Formulation of problem & Objectives and scope of the survey	
	Formation of statistical units	Technical Officials needs to be trained for this purpose.
2)	Sampling Design	Training to be imparted to high level officials and technical Officials.
	Construction of Sampling Frame	
	Population under investigation and determination of sample size	
	Sample Selection	
2)	Data collection	
	Methods of collecting data	Technical Officials needs to be trained for this purpose.
	Designing of schedules and instruction manual	Technical Officials needs to be trained for this purpose.
	Testing of schedules	Technical Officials as well as field supervisors, field investigator/ enumerators/ primary workers need to be trained for this purpose.
	Selection of field supervisors and field investigators	Training to be imparted to high level officials, planners and technical Officials.
	Training to the senior level officers, field supervisors and field investigators for data collection	Training to be imparted to high level officials, technical Officials as well as field supervisors, field investigator/ enumerators/primary workers.
	Supervision of field work and editing of data at the field level	Field supervisors need to be trained.
	Follow up of non-response	Technical Officials as well as field supervisors need to be trained.
3)	Scrutiny, Editing and Tabulation of data	Training to be imparted to data processing staff.
4)	Processing and Presentation of data	Technical Officials needs to be trained for this purpose.
5)	Data analysis according to the estimation procedure.	Technical Officials needs to be trained for this purpose.
	Data analysis through survey software.	Technical Officials can also be trained for data analysis using statistical and survey software.
6)	Interpretation of data	Technical Officials needs to be trained for this purpose.
7)	Report writing and presentation of results	

Various surveys related to agriculture are conducted in our country at national level. Some of the important ones are mentioned below:

- Surveys for Crop Acreage Estimation
- Surveys for Estimation of Yield of Field Crops
- Surveys for Fruit Crops
- Surveys for Vegetable Crops
- Surveys for Fishery
- Surveys for Livestock
- Cost of Cultivation Surveys
- Small area estimation
- Agricultural Statistics System in India

For conducting various surveys the basic methodology remains the same except that there is change in sampling design and estimation procedure which varies with commodity. Thus, for conducting various surveys basic training which is required for conducting the survey is same. Some training can be provided specific to the sampling design and estimation procedures to be adopted for individual commodity like fruit crops, vegetable crops, fishery, livestock etc. Besides this there is need for the training in the use of survey data analysis packages for analysis.

Training for Application of Remote Sensing and GIS in Sample Surveys

There is significant application of remote sensing and GIS techniques in sample survey, hence training in these areas are also important.

Training of Remote Sensing

- Basic principles of Remote Sensing
- Basics of Digital Image Processing
- Practical on Remote Sensing software
- Practical on Digital image processing
- Crop Area Estimation through satellite data
- Data Acquisition
- Removal of noise
- Geometric correction/ Geo-referencing
- Mosaicing/Subset Data
- Image Enhancements
- Ground Truthing of the study area
- Collecting Signature Keys by Ground truth data and Signature and Spectral reflectance
- Digital image classification
- Classification and Accuracy Assessment
- Land Use and Land Cover map Preparation
- Estimation of Area using LULC layers
- Use of Spectral Indices in Agriculture
- Estimation Crop production using satellite data

Training for GIS

- Introduction to GIS
- Data Models in GIS
- Creating and editing spatial data.
- Linking Spatial and attribute data
- Manipulating and Querying from Spatial Databases
- Creation of Maps
- Spatial Analysis of Vector and Raster Data
- Spatial Statistics in GIS
- Data quality and Errors in GIS
- Spatial Interpolation techniques using GIS
- Web GIS

Application of GIS and Remote Sensing for Agricultural Statistics done at institute level

- Application of RS and GIS for Integrated surveys in hilly regions for estimation of crop acreage and production
- Application of GIS and Remote Sensing for Land Use Statistics
- Application of Remote Sensing and GIS in Spatial Sampling for Agriculture Statistics
- Use of Remote Sensing and GIS for Crop Yield Estimation
- Application of Remote Sensing for Crop Yield Forecasting
- Use of Remote Sensing for Crop Yield Simulation
- Application of GIS in Agro-forestry

- Application and use of Global Positioning System in Agricultural Surveys
- Use of Remote Sensing and GIS in Precision Agriculture
- Use of Spatial modeling for prediction of crop production
- Spatial stratification techniques in Agriculture

7. STATISTICAL SOFTWARE PACKAGES

The Institute has developed number of statistical software packages. Some of them are mentioned below.

SPAR 2.0: Statistical Package for Agricultural Research data analysis (SPAR 2.0) is useful for the analysis of experimental research data in Plant Breeding and Genetics. The package consists of eight modules (i) Data Management (ii) Descriptive Statistics (iii) Estimation of Breeding values (iv) Correlation and Regression Analysis (v) Variance and Covariance Components Estimation (vi) Stability Analysis (vii) Multivariate Analysis (viii) Mating Design Analysis.

SPAD: Statistical Package for Augmented Designs (SPAD) is useful for designing agricultural experiments conducted for comparing existing practices / check varieties, called controls, with new practices / varieties / germplasm collections, called tests, where the experimental material for the tests is limited and it is not possible to replicate them in the design. The package generates a randomized layout of an augmented randomized complete block (RCB) design and augmented complete block design with equal or unequal block sizes. The optimal replication number of the control treatments in every block is obtained by maximizing the efficiency per observation for making tests vs controls comparisons. User has a flexibility to choose the replication number of the control(s) in each of the blocks. The package generates randomized layout of the design as per the procedure of Federer (1956), which is generally overlooked while conducting such experiments. The package also performs the analysis of data generated from augmented block designs (complete or incomplete). The treatment sum of squares is partitioned into different components of interest *viz.* (i) among test treatments, (ii) among control treatments and (iii) among test treatments and control treatments. Multiple comparison procedures for making all possible pairwise treatment comparisons can also be employed through this package. A null hypothesis on any other contrast of interest can also be tested.

SPFE 1.0: Statistical Package for Factorial Experiments generates the designs for symmetrical and asymmetrical factorial experiments with and without confounding. It also generates the randomized layout of the designs for factorial experiments. The design is generated on listing the independent interactions to be confounded. It also generates fractional factorial plans for symmetrical factorial experiments. The data generated through these designs are analyzed as per usual procedure of designs for single factor experiments. Contrast analysis is carried out to obtain the sum of squares of main effects and interactions. A null hypothesis on any other contrast of interest can also be tested. This package, besides being useful for the experimenters in the NARS, will be quite useful for teaching of Design and Analysis of Factorial Experiments in the classroom.

SPBD Release 1.0: Statistical Package for Balanced Incomplete Block Designs enables a user to select and generate a randomized layout of Balanced Incomplete Block (BIB) Design. The package generates BIB designs with replication numbers up to a maximum of 20 for asymmetric BIB designs and 30 for symmetric BIB designs. The package also provides the analysis of variance with both treatments adjusted and blocks adjusted sum of squares, adjusted treatment means, variance of the estimated treatment contrasts and the contrast sum of squares, etc. The definitions of the terminology used are available on-line. The package is useful for the experimenters, classroom teaching as well as for the researchers in Statistics with special interest in Design of Experiments or computing genetic parameters for one-way and two-way classified data.

SPAB2.0: Statistical Package for Animal Breeding (SPAB2.0) has been developed keeping in view, the computing requirements of scientists/students, mainly working in Animal Breeding and Animal Genetics research. The package is Window based, Menu driven and works in a User friendly manner. In the present version of the package, 37 useful programs of maximum utility are included. These programs have been grouped into ten modules. It has provisions for Analysis of Mixed Model Data as provided in LSML Package developed by Walter R. Harvey, Best linear unbiased prediction (BLUP) for Single traits, Best linear unbiased prediction (BLUP) for multiple traits, Adjustment for different non-genetic effects, Sire evaluation using SRLS and Sire evaluation using REML. Computation of Mean and SE for different classifications, Genetic parameters for half sib data, Genetic parameters for Full sib data, Coefficient of Repeatability and Producing Ability. It provides computation of Selection Index (Hazel's Method) Restricted Selection Index, Sire Indices for different models, Osborne's index, Cunningham's Selection Index. Diallel analysis can be performed for data with unequal classifications, for different modeling situations viz., Analysis of complete 3 x 3 non-orthogonal Diallel crosses data, Analysis of complete 4 X 4 or above non-orthogonal Diallel cross data with or without pure breeds, Analysis of 4 X 4 or above non-orthogonal Diallel cross data without reciprocals and pure breeds. One can calculate Inbreeding coefficient, Genetic Gain and Genetic trend. Multivariate Analysis has programs for D Square analysis, Multiple Regression Analysis (Step-up / Step-down methods, all possible combinations) and Principal Component Analysis. Most of the Non-Parametric tests can also provided in the package. Help is provided and it is having a User Manual which one can study and use. This package can aid in teaching the subject of statistical genetic to the post-graduate students and helpful for the researchers in statistics with interest in animal sciences.

SSDA1.0: Software for Survey Data Analysis (SSDA 1.0) is useful for the analysis of survey data. SSDA analyzes the data collected using systematic, simple random sampling (SRS), probability proportional to size (PPS), stratified, cluster, two stage and stratified two stage sampling schemes. It provides the estimates of population mean, variance and design efficiency of the sampling scheme in comparison to the simple random sampling without replacement. It also provides descriptive statistics of the data without consideration of sampling design i.e. measures of central tendency like mean and median and measures of dispersion like range, variance, coefficient of variation, skewness and kurtosis. The software is completely menu driven and guides users step-by-step through data analysis process. It also has the facility to impute missing data, if any, using commonly used imputation methods. This package is an aid in teaching the subject of analysis of sample survey data to the post-graduate students and is also helpful to the researchers in statistics with interest in sample surveys.

8. E-RESOURCES AND E-LEARNING

Design Resource Server

Design Resources Server <http://www.iasri.res.in/design> (Parsad and Gupta, 2009) has been developed to popularize and disseminate research in design of experiments among experimenters in agricultural sciences, biological sciences, animal sciences, social sciences and industry in planning and designing their experiments for making precise and valid inferences on the problems of their interest, generally treatment contrasts. It also provides support for analysis of data generated so as to meet the objectives of experiments. This server also aims at providing a platform to the researchers in design of experiments for disseminating research and also strengthening research in newer emerging areas so as to meet the challenges of agricultural research. This server attempts to spread advances in theoretical, computational and statistical aspects of design of experiments among the mathematicians and statisticians in academia and among the practicing statisticians involved in advisory and consultancy services. The material available on the server has been partitioned into four main components:

- **Useful for Experimenters:** Electronic Books, online generation of randomized layout of designs, online analysis of data, analysis of data using various softwares

- **Useful for Research Statisticians:** Literature and catalogues of BBB designs, designs for making test treatments-control treatment comparisons, supersaturated designs, online generation of Hadamard matrices, MOLS and orthogonal arrays
- **Other Useful Links:** Discussion Board, Ask a Question, Who-is-where
- **Site Information:** Feedback, How to Quote Design Resources Server, Copyright, disclaimer, contact us and site map



The Design Resources Server is like a mobile library on design of experiments in particular and statistics in general. It provides useful information both for active researchers in statistics as well as stake holders like scientists in NARS and others all over the globe. It is expected that the material provided at this server would help the experimenters in general and agricultural scientists in particular in improving the quality of research in their respective sciences and making their research globally competitive.

An eLearning Solution for Agricultural Education using MOODLE

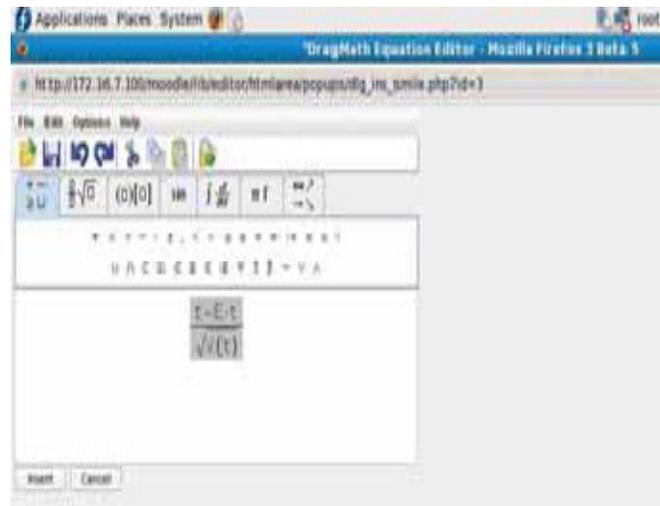
In the course “Elementary Statistical Methods” under the discipline of Agricultural Statistics, the standardized contents (Chapters, Glossary, Quiz, Power point presentations) for various lessons are prepared. The lessons covered are: Testing of Hypothesis: Normal, t, Chi - square and F – Test, Sampling distributions: t, Chi-square and F. A page from the lesson “Testing of Hypothesis” is depicted as:



In the course “Fundamentals of computers and programming” under the discipline of Computer Applications in Agriculture, the standardized course contents are prepared on the following topics: Fundamentals of Programming, Problem Solving, Flow charts and Algorithms, Constants and Variables, Data Types in C and Strings and Arrays in C. A page from the lesson “Problem Solving, Algorithms and Flowcharts” is depicted as:



The contents of the Lessons “Fundamentals of Programming”, “Flow charts and Algorithms”, “Number Systems” and “Testing of Hypothesis” are integrated with the eLearning site. The equations for these lessons are prepared using the DRAGMATH Equation Editor integrated with MOODLE. Construction of an equation using the editor is shown below and preparation of the other modules of Agricultural Statistics is in progress:



9. ABSTRACT

For bringing overall improvements in the functioning of Agricultural Statistical Systems across the world, the training and teaching of the discipline of Agricultural Statistics is of paramount importance. The development of newer statistical applications for data collection, policy planning and maintenance of information systems on various components of economic interest are very important. The teaching and training aspects associated with these components are essential and the role played by the Indian Agricultural Statistics Research Institute (IASRI) has been very significant, both in research as well as teaching and training in the field of Agricultural Statistics and Computer Application. The Institute is world-wide recognized for its contribution to research and teaching in the field of agricultural statistics. In addition to in-service training programs at national and inter-national levels, the Institute has been contributing towards Human Resource Development Programme by way of conducting M.Sc. and Ph.D. programme in Agricultural Statistics since 1964-65. Many foreign nationals have been benefited from these programmes.

In this article, the contribution of IASRI in the area of teaching and training in Agricultural Statistics is highlighted. The various issues of training needs in Agricultural Statistics and career development have also been focused. The usefulness and emergence of new technological innovation like e-learning, distance learning and access of websites for teaching material are also dealt at length. The Institute's strong training components in the areas of Designing of Sample Surveys, Remote Sensing and Application of GIS in Area and Crop Yield Estimation Surveys, Livestock and Fisheries Surveys, Crop Forecasting and Forewarning of Pest and Diseases and Use of different Statistical Software Packages in carrying out statistical analysis of voluminous data are highlighted. The contributions in other areas of design and analysis of field experiments including quantitative genetic analysis and bioinformatics for researchers are also of great significance.

10. REFERENCES

An Era Of Excellence - Indian Agricultural Statistics Research Institute Publication (2009)

Dahiya, Shashi (2009). eLearning Solution for Agricultural Education using MOODLE. IASRI Annual Report, 44-45.

Indian Agricultural Statistics Research Institute Annual Report (2009-2010)

Indian Agricultural Statistics Research Institute, International Training Manual (2009-2010)

Jaggi, Seema, Bhatia, V.K. and Malhotra, P.K. (2009). Teaching and Training Activities at IASRI. *IASRI- An Era of Excellence*, IASRI Golden Jubilee Publication, 185-190.

Malhotra, P.K. and Goyal, R.C. (2009). Information and Software Development at IASRI: An Overview. *IASRI-An Era of Excellence*, IASRI Golden Jubilee Publication, 161-184.

Mishra, Prachi and Sud, U.C. (2010). Training Needs for Sample Surveys.

Prasad, R and Gupta, V.K. (2009). Design Resources Server, IASRI, New Delhi.