

## Abstracts of Papers<sup>1</sup>

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### THEME 1: STATISTICAL APPLICATIONS IN AGRICULTURAL RESEARCH

#### 1. A Multivariate Approach to Justify Need of Participatory Plant Breeding Programme

A. Ghosh, P. Satya and P. Mukhopadhyay

Participatory plant breeding in field crops like rice is gaining rapid attention and importance in modern crop improvement to minimize the yield gap between potential and realized yield in farmers' field. However, as the process is location specific and resource intensive, utility of the method should be tested before investing in such a venture. A group of rice farmers from Terai region of West Bengal were involved in developing a method for justification of initiating a participatory plant breeding programme. Weighted response matrices were constructed according to farmers' and breeders' choices of traits and were further partitioned into more and less important traits. Distances relationship of the matrices revealed that the attribute preferences differ considerably between farmers and breeders, which justify the need of PPB for rice in this region. Results indicated moderate deviation between farmers and breeders selection preferences.

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*Uttar Banga Krishi Viswavidyalaya, Cooch Behar*

#### 2. Estimation of Technical Efficiency of Carp Culture Farms of Kolleru Lake, Andhra Pradesh, India: An Application of Stochastic Production Frontier and Technical Inefficiency Model

A.K. Roy, N. Sarangi, G.S. Saha and  
Nibedita Jena

Kolleru Lake is the largest freshwater wetland ecosystem with shallow water area covering 955 sq. km upto 10.7' contour located in between Krishna & Godavari delta of southern India. Kolleru is known as

Carp Pocket of India producing quality protein and supplying carps almost all the eastern states of India. It is widely accepted that sustainable aquaculture requires increasing the efficiency of resources use and productivity at the farm level. Keeping this point in view, a study was conducted to estimate the technical efficiency of a sample of 221 carp farms and its determinants using stochastic production frontier function involving a model for technical inefficiency effects that in turn may facilitate assessment of present performance and potential for future improvement. The estimated mean technical efficiency was found to be 0.88. The highest significant elasticities of coefficients were observed for feed followed by organic manure justifying the importance of these two inputs in yield of carps. Inorganic fertilizer and labour also showed positive impact over yield. Out of twenty five farm specific variables considered for the analysis it was observed that source of water, method of application of drugs and feed, source of seed, periodical netting, harvesting technique and religion had significant positive association with technical efficiency. The study suggests that with the same level of input, yield can be enhanced to the extent of 12% from Kolleru Lake area through efficient use of resources and improvement of technical efficiency at farm level.

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#### 3. Estimating the Nutrient Contribution of Manures Alone and in the Presence of Fertilizers

Abhishek Rathore, Sanjay Srivastava,  
K.N. Singh and Y. Muralidharudu

In integrated plant nutrient supply system in addition to inorganic fertilizers and bio-cultures diverse sources of organic materials like rural and urban composts and crop residues differing in their composition and status of decomposition are used. Inorganic fertilizers are expensive hence unaffordable by most small holder

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<sup>1</sup> Poster Presentation Session

farmers. As an alternative, organic nutrient sources are available with most of these farmers but information about the right proportions of application is scanty. Depending upon the nutrients supplemented by the organic sources inorganic fertilizers can be discounted and cost towards purchase of the fertilizers can be saved.

To work out estimates the contribution of manure in absence and presence of chemical fertilizer Linear Regression Analysis with the help of dummy variables was used. The dummy variables were assigned for each level of nutrient and given value 0 or 1 according to the presence (1) or absence (0) of a particular level of that nutrient. The matrix of independent variables was computed and BLUE (Best Linear Unbiased Estimates) of parameters under study were obtained. By using this methodology the data sets of Hisar and Coimbatore centers of AICRP on STCR were analyzed and the fertilizer contribution of FYM in absence and presence of various levels of chemical fertilizers were calculated. Analysis revealed that on application of 5 t/ha FYM in soils of Hisar in absence of chemical fertilizer may contribute nearly 40 kg N/ha and 28 kg P/ha under Pearl millet crop. Moreover, the contribution of FYM declines with the increase in fertilizer doses of P and N. A similar trend on N and P contribution of FYM was noticed in Vertisols of Coimbatore, where in turmeric crop in absence of chemical fertilizer 12.5 t/ha FYM contributed nearly 28 kg N/ha and 19 kg P/ha.

*Indian Institute of Soil Science, Bhopal*

#### **4. Estimation of Missing Root Biomass for Eucalyptus Tereticornis Plantations in Complete Excavation Studies under Semi-Arid Conditions in India**

Ajit, Ritu Shrivastava, O.P. Chaturvedi,  
A.K. Handa, Ram Newaj and S.K. Dhyani

Tree excavation studies, conducted for determination of above and below ground biomass, usually results in underestimation of below ground component because of the broken or missing roots in the soil at the time of harvesting. This article addresses the estimation problem of missing biomass in root studies of 6 to 24-month old Eucalyptus tereticornis plantations. The trees were excavated with complete root system and observations were recorded on basal diameter of complete root and

its biomass. A method has been developed to estimate the biomass of missing roots of trees from root system excavations of sampled trees. Different functions were attempted for fitting the observed data. The parameters of some of them have biological explanations (viz allometric, sigmoid etc.) in relation to growth, whereas a majority of the others (high precision polynomial, fourier series polynomial, chebyshev polynomial etc.) do not have so. The choice of the function has to be governed by purpose and use of the equation. If the objective is limited to interpolation only, an equation with higher  $R^2$  values is more appropriate theoretically although practically it may be complicated in nature and subsequent use. However, if the function is intended for extrapolative predictions, then in addition to  $R^2$  values the behavior of the function outside the observed range of the explanatory variates and nature of function/biological interpretation of parameters is equally important and has been duly considered for the selection of equation. The allometric function, in this case, is recommended to be used for predictive purpose since it not only have a reasonable  $R^2$  value but also leads to acceptable logical predictions outside the pragmatic range of explanatory variates. The jackknife, an all-purpose re-sampling statistical technique was then used for creation of robust confidence intervals and to get an idea of relationship between the model parameter estimates. The fitted function  $Y = 26.34*(X)^{1.85}$  is proposed to be used for estimating the biomass of broken roots, where Y is biomass of missing root and X is diameter of broken root end. This estimated missing root biomass has to be added to the observed root biomass to obtain the complete below ground biomass and thus avoiding the underestimation problem associated with the underneath tree root weights otherwise.

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#### **5. Yield Estimation under Maize-Wheat Cropping System**

Anil Kumar, Sanjeev Panwar, Rajinder Kaur and  
Sanjeev Pawar

Under All India Co-ordinated Research Project on Cropping Systems an experiment "Long range effect of continuous cropping and manuring on soil fertility and yield stability" was initiated during 1977 with the objective to study the long range effect of a crop

sequence with high yielding varieties at graded fertilizer levels on yield stability and soil fertility. Being a compulsory experiment this was conducted at all the cropping systems research centres with the major prevailing cereal based cropping systems like rice-rice, rice-wheat, maize-wheat, sorghum-wheat and pearl millet-wheat.

Maize-wheat sequence at Ludhiana centre was selected for the study. Eighteen fertility combinations, comprising three levels of N (40, 80 and 120 kg/ha) and P (0, 40 and 80 kg P<sub>2</sub>O<sub>5</sub>/ha) and two levels of K (0 and 40 kg K<sub>2</sub>O/ha) were evaluated in a 32 × 2 partially confounded factorial design in three replications with one control (N<sub>0</sub>P<sub>0</sub>K<sub>0</sub>) in each replication.

Grain yield for maize and wheat crops for a period from 1979 to 2000 has been estimated using curve expert package. Different linear/ non-linear models viz. 3rd degree polynomial fit, MMF, logistic, linear fit, quadratic fit, rational function, exponential fit, etc. have been fitted to all the 19 treatments.

Since data for the year 1980 for both kharif (maize) and rabi (wheat) seasons were missing, best-fitted models for each treatment were used to interpolate the missing yield. Grain yield for further three years i.e. 2001, 2002 and 2003 to all the nineteen treatments were also obtained by using best-fitted models.

Under kharif season (maize) for treatment T18 (NPK: 120: 80: 40), missing yield by sinusoidal fit, 3rd degree polynomial fit and quadratic fit models were interpolated as 39.28 Q/ha, 39.68 Q/ha and 37.98 Q/ha respectively for the year 1980, whereas yield for years 2001, 2002 and 2003 were predicted by sinusoidal fit model predicted as 37.44 Q/ha, 35.94 Q/ha and 34.37 Q/ha respectively. Whereas 3rd degree polynomial fit model predicted as 39.45 Q/ha, 38.75 Q/ha and 37.64 Q/ha and quadratic fit model predicted as 44.56 Q/ha, 46.54 Q/ha and 48.67 Q/ha for years 2001, 2002 and 2003 respectively.

Under rabi season (wheat) for treatment T18 (NPK: 120: 80: 40), missing yield by 3rd degree polynomial fit, quadratic fit and reciprocal models were interpolated as 49.63 Q/ha, 48.64 Q/ha and 44.46 Q/ha respectively for the year 1980, whereas yield for years 2001, 2002 and 2003 were predicted by 3rd degree polynomial fit model as 55.59 Q/ha, 56.01 Q/ha and

56.24 Q/ha respectively. Whereas quadratic fit predicted as 58.56 Q/ha, 60.53 Q/ha and 62.64 Q/ha and reciprocal model predicted as 53.29 Q/ha, 53.81 Q/ha and 54.32 Q/ha for years 2001, 2002 and 2003 respectively.

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## 6. Ranking of Banana Cultivars Based on Performance by MCDM Approach

Anurup Majumder<sup>1</sup>, Kamal K. Mandal<sup>1</sup>,  
Kalyan Bhattacharya<sup>1</sup>, Arunava Ghosh<sup>2</sup> and  
Satyabrata Pal<sup>2</sup>

The conception of multiple criteria decision making (MCDM) approach has been applied to thirty desert banana cultivars under study. The study was conducted in Mondouri Horticultural Research Station, BCKV, during 2002-04. The identification of suitable cultivar has been done by the above approach on the basis of 16 physical and biochemical characters. The concept of entropy is employed to assign suitable weights to the recorded characters for their relative importance in the assessment process. This assessment approach has described the ranking among the thirty cultivars of desert banana on the basis of the overall performance of sixteen characters under study. The study also includes the clustering of the cultivars in different groups according to their overall performance.

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## 7. Sustainability of Fine Cereals in Bundelkhand Region of Uttar Pradesh: A Growth Performance Analysis

Prem Chandra, Udai Raj, P.P. Dubey and  
Ashok Kumar

In India, where agriculture is still the main stay of our economy, economic viability of crop's cultivation associated with its continuous growth is the key consideration of sustainability. The present paper in this direction, attempts to examine the growth behaviour of production, through its main concomitants area and

yield, as also working out its instability coefficient and exploring possible reasons there of, in Bundelkhand region of Uttar Pradesh, considering district Banda as a case and confining its scope to fine cereals viz. paddy and wheat. These crops, apart from being the major staple food for masses are of intrinsic worth on account of their nutritional contents. The main findings and conclusions thereof, of this paper, based on analysis of district's time series data for the period 1980-81 to 2002-03 are (i) Paddy and wheat when taken together account for 81.65 per cent of total area under cereals and 46.95 per cent of that of total foodgrains, while cereals as a whole account for only 57.48 per cent of total cropped area in the district, (ii) Both of these crops have potential to be grown in the region and are most favoured by the farmers for involving relatively low risk on account of frost, diseases and pests, (iii) Paddy reflected better in terms of growth of its yield but associated with continuous decrease in area resulting due to inadequate availability of assured irrigation at the required time and vagaries of monsoon, (iv) Wheat also faces the same crisis of irrigation and in addition those of timely availability of input mixes associated with price and marketing, (v) While paddy had no competing crop on its specified land, wheat has established competition with pulse crops like lentil, gram and pea. Finally, all these result to that self sustaining growth of these two crops in the region under study can be well maintained by considering environmental constraints and supply of land fixed; through better facility, adequate and timely supply of input mixes supplemented by price incentives and marketing facilities.

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### **8. Analysis of Production Parameters of Lactating Animals in Rural Areas of Jhansi District: A Case Study**

Ashok Kumar, Mahavir Singh, Manju Suman,  
Purshottam Sharma and Mallayya

Production traits of milch animals play a crucial role and have a profound influence on the cost and returns of dairy enterprise. There were so many parameters but some important traits like age at first calving, the interval between successive calving, number of dry days, month

of calving and lactation period along with the milking average have been considered and discussed here. For this purpose the data collected under the project entitled "Milk production function studies in prominent feeding system" have been utilized. Average number of animals, distribution of month of calving, age at first calving, lactation length, dry period, calving interval and average daily milk yield for animal belonging to both commercial and non commercial milk producer households separately for each zone have been estimated and discussed in this paper. From the study, it was found that the maximum calving was observed in the month of December and January respectively for cows and buffaloes. For cows, age at first calving varied between 38 to 48 months, lactation length from 288 days to 324 days, dry period varied between 78 days to 302 days and calving interval from 367 days to 637 days, on the other hand, for buffaloes, these estimates were 43 to 47 months, 301 to 333 days, 74 to 317 days and 407 to 618 days respectively. The average daily milk yield per day per cow in milk was observed as 3.59 kg and for buffalo in milk it was 4.83 kg. Average daily milk yield was observed lowest in the household belonging to traditionally rain fed areas for both cows and buffaloes, while maximum average daily milk production was observed in the household belonging to other zone and berseem zone for buffaloes and cows respectively. Hence a wide variation have been observed amongst different production parameters across different prominent zones existing in the area under study which may be attributed to different breeding, feeding, management practices and environmental factors prevalent in different zones.

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### **9. Yield Component Analysis and Selection Indices in Frenchbean (*Phaseolus vulgaris*, L.)**

B.H. Prajapati, M.P. Prajapati and  
G.K. Chaudhary

The interrelationship between grain yield and its eight contributing characters in Frenchbean (*Phaseolus vulgaris*, L.) was studied using data collected from an agronomical field experiment conducted at agriculture college farm, Gujarat Agricultural University, Sardar

Krushinagar during rabi season of 1999-2000. All the eight attributes viz. plant height, number of branches per plant, number of pods/plant, pod length, number of seeds/pod, leaf area index, green weight gm/plant and dry weight gm/plant were positively and significantly correlated with grain yield and accounted for 98 per cent of the total variation in grain yield. The attributes leaf area index and dry weight gm/plant showed negative direct effect on grain yield while remaining six attributes exhibited moderate positive direct effect. Selection indices indicated that plant height, number of branches/plant, number of pods/plant, number of seeds/pod and green weight gm/plant are the most influential attributes for grain yield.

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#### **10. Optimization of Fertilizer Nitrogen at Varying Levels of Soil Moisture and Soil Nitrogen for Sustainable Productivity of Rainfed Sorghum under Semi-Arid Vertisols of India**

G.R. Maruthi Sankar, K.P.R. Vittal, U.S. Victor, G. Ravindra Chary, Y.S. Ramakrishna, D.N. Deshpande, A.L. Pharande, D.K. Kathmale and A. Girija

The main and interactive effects of soil moisture, soil and fertilizer N on rainfed sorghum yield are assessed in this paper based on field experiments conducted during 20 post-monsoon (October to February) seasons from 1985 to 2004 in a permanent site under semi-arid vertisols at Solapur. The study was conducted with 8 fertilizer treatments comprising of 25 kg N/ha (urea), 50 kg N/ha (urea), 25 kg N/ha (crop residue), 25 kg N/ha (FYM), 25 kg N/ha (crop residue) + 25 kg N/ha (urea), 25 kg N/ha (FYM) + 25 kg N/ha (urea), 25 kg N/ha (crop residue) + 25 kg N/ha (Leucaena leucocephala) along with a control. Using the treatment-wise available soil moisture at sowing, a measure of crop season water stress (CSWS) from sowing to harvest was derived based on the procedure described by Rijtema and Aboukhaled (1975) and Doorenbos and Kassam (1979). Iterative regression models of yield were calibrated as a function of soil N and P, CSWS, fertilizer N, precipitation, runoff and crop growing period for selecting a superior fertilizer

treatment; efficient yield prediction; and optimizing fertilizer N at varying soil N and CSWS.

The study indicated that application of 25 kg N/ha (crop residue) + 25 kg N/ha (*Leucaena leucocephala*) was superior with maximum sustainability of 0.63 for attaining a mean yield of 1109 kg/ha. The regression model of yield as a function of CSWS, soil N and P and fertilizer N had a significant yield predictability of 0.68 with a prediction error of 152 kg/ha. Using the model, optimal fertilizer N doses were derived at varying soil N and CSWS measurements for attaining maximum sorghum yield. The N doses are valid for soil N in a range of 107 to 205 kg/ha and CSWS in a range of 0.13 to 0.94 observed during 20 years. At an available soil N of 100 kg/ha, the optimal N ranged from 46 to 57 kg/ha when a low CSWS occurred in a range of 0.1 to 0.3, while optimal N ranged from 30 to 41 kg/ha at a moderate CSWS of 0.4 to 0.6, and 13 to 24 kg/ha at a high CSWS of 0.7 to 0.9. Similarly, at an available soil N of 200 kg/ha, the optimal N ranged from 33 to 44 kg/ha at a low CSWS of 0.1 to 0.3, 17 to 28 kg/ha at a moderate CSWS of 0.4 to 0.6, and 0 to 11 kg/ha at a high CSWS of 0.7 to 0.9 based on the study.

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#### **11. Analysis of Uniformity Trial on Cotton**

H.R. Pandya, S.M. Upadhyay and B.A. Parmar

Uniformity trial was conducted at Dry Farming Research Station, Junagadh Agricultural University, Nanakandhasar during Kharif-2003 to find out optimum plot size for field experiment on cotton crop (variety G.Cot.H-8). The crop was raised at spacing of 90 cm × 30 cm. The yield data were obtained for 1200 basic units and the dimension of each basic unit was single row of 1.2 meter length. The coefficient of variation and soil heterogeneity index were used for determining optimum plot size, which was worked out to be of 12 units, i.e. 3 rows each of 4.8 meter length (4.8 m × 2.7 m = 12.96 sq. m.) Thus, it can be recommended that a plot of 12.96 sq. m. could be adequate for conducting cotton experiment at DFRS, Nanakandhasar. The CV% for different plot sizes were found to follow closely with Smith's variance law. The

equation obtained was  $Y = 44.53 X - 0.4566$  and  $R^2$  between plot size and CV was computed as 0.9925.

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## 12. Stability Analysis by GGE-Biplot

Hemant Kumar and Shiv Kumar

Yield data from multi-environment trials are usually quite large and it is difficult to grasp the general pattern of the data without some kind of graphical presentation. The GGE (Genotype and Genotype  $\times$  Environment) biplot is one of the graphical approaches which allows visual examination of the Genotype  $\times$  Environment (GE) interaction of multi-environment trials (MET) data. Seven promising lines of chickpea (*cicer arietinum* L.) BG 372, Annigiri, JG 11, PDG 84-16, CSJ 160, ICCV 96028, IPC 94-94 were evaluated at Gulberga, Lam, Sehore, Rahuri, Durgapura, Hisar and Faizabad. The yield data were subjected to GGE biplot analysis to assess the nature of GE interaction. The result showed that among the genotypes tested, JG 11 was the best genotype followed by CSJ 160 and BG 372 whereas ICCV 96028 turned out to be poorest on the basis of average yield and stability. Among the locations Lam was the best location based on its discriminating ability and representativeness whereas Faizabad was the poorest test location. The result suggested two mega environments, one represented by Rahuri, Gulberga, Durgapura and Lam and another by Hisar, Faizabad and Sehore.

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## 13. Prediction of Mango Generation in West Bengal using Neural Network and Statistical Model

J. Pal Choudhury<sup>1</sup> and Kalyan Chakrabrty<sup>2</sup>

The production of a plant in terms of fruit generation plays a major role in economic and financial condition of the state. If the information related to production is available before time, the planners of the state in various fields find it easy to perform their work in various fields related to them. In this paper an effort has been made to predict the generation of fruit mango in the state West Bengal in the next two years. Prediction is made based

on previous years available data. The method of least square using linear, exponential, curvilinear (parabolic) equation, using orthogonal polynomial and using neural network have been used.

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## 14. Some Observations on 'Debt and Investment' and 'Land and Livestock Holdings' Surveys NSS 59th Round (January – December 2003)

Jagbir Singh, U.C. Sud and H.V.L. Bathla

Agriculture ensures livelihood security to almost two-third population and contributes nearly 21% to GDP and 11% to total exports signifying apparently the farmers' achievements as a result of industrial inputs' use, mechanized activities' use, access to modern technology etc. for farming by them in India. A comprehensive socio-economic investigation entirely focused on Farmer Households (FHHs), as desired by Union Ministry of Agriculture, was practically taken up in whole of India by NSSO during calendar year 2003 in its 59th round of NSS comprising of four subjects of enquiry viz. Land and Livestock Holdings (Sch.18.1), Debt and Investment (Sch.18.2), Consumer Expenditure (Sch.1.0) and Situation Assessment Survey of Farmers (Sch.33). In this paper two survey reports brought out by NSSO on the subjects "Debt and Investment" and "Land and Livestock Holdings" have been considered and some observations have been made thereon. The stratified multi-stage sampling design with census villages/ panchayat wards/ NSSO Urban Frame Sampling (UFS) blocks in Rural (R)/ Urban (U) sector as First Stage Units (FSUs), R/U Households as Ultimate Stage Units (USUs) and  $\geq 1200$  populated large FSU's parts viz-hamlet-groups (hg's)/ sub-blocks (sb's) as Intermediate Stage Units (ISUs) was adopted under the surveys. The first NSS report "Household Assets and Liabilities in India (as on 30-6-2006)" is based on the data collected from the 143285 HHs of 10608 FSUs (including 520903 HHs of 3824 UFS blocks). Average Value of land & buildings as major Assets(AVA) per RHH and per UHH were accounted for Rs. 2.66 (i.e. Rs. 3.73 lakh IFHH & Rs. 1.07 lakh/ Non-FHH) and Rs. 4.17 lakh (i.e. Rs. 5.55 lakh/self-employed HH & Rs. 3.39 lakh/other HH) respectively. Of the total value of assets at the national level, land

share was accounted for about 2.5 times of building share (24% points) in rural area and for 38% points equal to building share in urban area. About 27% of RHHs and 18% of UHHs reported Rs. 7539/RHH and Rs. 11771/UHH as debt (cash loan) outstanding the "debt-assets" ratio at all India level was approximately equal (2.82%) for both urban and rural areas. For bringing out the second NSS report "Livestock Ownership Across Operational Land Holding Classes in India 2002-03" in all 82158 HHs of 10402 FSUs (including 29893 HHs of 3764 UFS blocks) were surveyed for the data collection. As regards the findings 69% RHHs and 11% UHHs operated some land during kharif season of 2002-03. In kharif season of 2002-03 < 1 ha and < .002 ha land was possessed by 79% and 32% of RHHs respectively. In rural areas the cattle population, stock of poultry and number of sheep and goats declined from 160-170 million, 193 million and 85 per 100 HHs in 1991-92 respectively to 154 million, 182 million and 64 per 100 HHs in 2002-03. Broadly the following issues arising from the results of the above mentioned surveys are raised:

- Use of previous survey information for the refinement of subsequent surveys
- Reliability of estimates
- Estimation at Small Area Level
- Deeper analyses of data for value addition
- Use of Intelligent Character Recognition (ICR) technology
- Use of IASRI findings for estimation of flow of number/ assets/ debt of households

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### **15. Soil Fertility Mapping of Hoshangabad District using GIS and GPS Tools for Precise Fertilizer Recommendations Based on Spatial Variability**

K.N. Singh, A.K. Tripathi, N.S. Raju,  
Abhishek Rathore, A. Subba Rao, Sonali Saxena  
and V. Patil

An attempt has been made to prepare soil fertility maps using actual samples collected by stratified multistage random sampling. For proper recommendation of fertilizer applications for different crops, the knowledge of fertility status is essential. However, it is not always

possible to collect soil samples from every location. Therefore, unknown values must be estimated from data taken at specified locations that can be sampled. The exact locations of samples were recorded using GPS. The collected samples were analyzed for major soil nutrients (viz. N, P and K), Ph and electrical conductivities (EC). District boundary of Hoshangabad was digitized using Toposheet at 1:50,000 scales. Spatial analysis (kriging) was carried out using sample data within district boundaries. The results from Hoshangabad and Bawai tehsil suggest that the soils are mainly neutral to alkaline in nature. The organic carbon status in the soil is medium to high. The soils are low in electrical conductivities and available nitrogen (N) and medium to high in available phosphorus (P) and potash (K).

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### **16. Sustainable Rice Seed Production in the Union Territory of Pondicherry - An Economic Evaluation**

K. Thimmappa, A. Pouchepparadjou, G. Sarada  
and K. Vijayasarathy

The Government of Pondicherry has established Seed Certification Agency during January 2000. The basic functions are production, collection, storage, testing and distribution of mainly the certified paddy seeds. In the present paper, an attempt has been made to study the economics of paddy seed production vis-à-vis commercial production and the variables that are discriminating the seed production from commercial production. Primary data on the cost of cultivation of both seed crop and commercial production of paddy were collected from the 120 selected sample farmers through a suitable pre-tested schedule during the agricultural year 2005-06. The tabular and linear discriminant function techniques were used for the analysis. The findings of the study indicate that the cost of cultivation was higher in seed production as compared to the commercial production of paddy. Further, the total return was higher in seed production than commercial crop production. The discriminant analysis indicated that there were significant differences in the gross return between seed production and commercial production in paddy. Similarly it is evident from the analysis that the expenditure on miscellaneous

items like drying, marketing, registration and field inspection charges etc. contributed towards the significant differences between the seed and commercial production.

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### 17. Functional Analysis in Relation to Milk Production for District Bareilly of UP

Mallayya, Ashok Kumar, Mahavir Singh, Purushottam Sharma and R.K. Sharma

The objective of the study was to estimate average milk yield of local cow, crossbred cow and buffalo, green fodder, dry fodder, concentrates fed to animals and labour utilized etc. and to develop suitable functional relationship between milk yield and their influencing factors for cattle and buffaloes of district Bareilly of U.P.

For this purpose, data collected on various aspects like milk yield, feeds and fodder fed to animals, grazing behavior etc. under large-scale sample survey for the National Agricultural Technology Project "Livestock crop production system analysis for sustainable production in Uttar Pradesh" has been utilized for the study. From Bareilly district 150 farmers were selected randomly and they were interviewed and the interview schedules were filled up. Regression equation between dependent and independent variables has been developed by using  $X_1$ : Green Fodder,  $X_2$ : Dry Fodder,  $X_3$ : Concentrates,  $X_4$ : Labour,  $X_5$ : Miscellaneous Expenses and Y: Milk Yield as the variables. To identify the input-output relationship between the milk output and the various factors influencing the milk production, multiple linear function was fitted for both cattle (local and crossbred) and buffaloes which provide better regression coefficients. All the variables were taken in monetary terms.

The equations were as given below:

#### Local Cow:

$$Y = 2.6857 + 0.3272^{***}X_1 + 0.1296 X_2 + 0.3267^{**}X_3 + 0.1467^* X_4 + 0.0365 X_5$$

(0.0875)      (0.1112)  
(0.1138)      (0.0850)      (0.0289)

$R^2 = 41.63\%$

#### Crossbred Cow:

$$Y = 4.5938 + 0.6231^{***}X_1 + 0.2342 X_2 + 0.4442^{***}X_3 + 0.1659 X_4 + 0.0467 X_5$$

(0.1889)      (0.1876)  
(0.1136)      (0.0465)      (0.0349)

$R^2 = 48.52\%$

#### Buffalo:

$$Y = 5.2357 + 0.3659^{***}X_1 + 0.2461^* X_2 + 0.4979^{***}X_3 + 0.2959^* X_4 + 0.0119 X_5$$

(0.0927)      (0.1637)  
(0.1136)      (0.1857)      (0.0103)

$R^2 = 44.92\%$

Note : Figures in parenthesis indicate percentage standard errors

\* Significant at 10% level, \*\* Significant at 5% level and \*\*\* Significant at 1% level

The study indicated that the explanatory variables included in the study explained 41.63 per cent and 48.52 per cent variation respectively in case of local and crossbred milk yield, whereas, in case of buffalo the explained variation is found of the order of 46.92 per cent. The expenditure on green fodder ( $X_1$ ) and concentrates ( $X_3$ ) had a positive and significant influence while, dry fodder ( $X_2$ ) was having non-significant influence on milk yield for both local & crossbred cows and significant for buffaloes. Labour cost ( $X_4$ ) showed significance influence in case of local cows and buffaloes only. Expenditure on miscellaneous items ( $X_5$ ) showed non-significant effect on milk yield of both cows and buffaloes. Hence, if expenditure on green fodder and concentrates will increase then milk yield of both cows and buffaloes will also increase.

*Indian Grassland and Fodder Research Institute, Jhansi*

### 18. A Statistical Study on Freshwater Resources and Fish Production in Orissa

Nirupama Panda, Nibedita Jena and A.K. Roy

The present study was undertaken to analyze the trend in the time series data of water resources, fish production, seed production and the gap between the actual rate of production and the potentiality of different freshwater resources in Orissa for the period from 1980-81 to 2004-05. The relationship between fish production and various inputs i.e. water resources, seed production and plan expenditure are established.



Significant relationship was observed between fish production & water resources and fish production & seed production. Graphical presentation of gap between the actual rate of production and the potentiality is highlighted for research and development work.

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*Central Institute of Freshwater Aquiculture, Bhubaneswar*

### **19. Influence of Integrated Nutrient Management on Nutrient Uptake and Growth of Sugarcane Grown on Saline-Sodic Soil**

P.B. Jagtap, C.A. Nimbalkar and M.T. Patil

A pot culture experiment was conducted during 2002 at Department of Agricultural Chemistry and Soil Science, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra) to know the effect of integrated nutrient management on nutrient uptake and growth of sugarcane grown on saline-sodic soil. The soil used was medium black belonging to Sawargaon series (Vertic Ustropepts). The sugarcane variety CO-86032 was grown with fertilizer dose 400 : 170 : 170 :: N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O ha<sup>-1</sup>, respectively. The micronutrient fertilizers i.e. FeSO<sub>4</sub> and ZnSO<sub>4</sub> were applied @25 kg ha<sup>-1</sup> each. The biofertilizers viz., Azotobactor, p-solubilizers, Thiobacillus ferrooxidans @ 5 kg ha<sup>-1</sup> each and FYM @ 25 mg ha<sup>-1</sup> were applied. The sugarcane crop was harvested after 150 days. The experiment was carried out in factorial randomized block design.

The results clearly indicated that the uptake of N, P, K, Fe and Zn was significantly increased due to integral use of nutrients along with FYM. The use efficiency of nutrients applied through fertilizers was enhanced by the conjoint use of inorganic fertilizers with organic. The integral use of recommended NPK, micro-nutrients (Fe and Zn) and biofertilizers with and without FYM significantly influenced the shoot and root dry matter of sugarcane in saline-sodic soil.

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*National Agricultural Research Project (Plain Zone), Pune*

### **20. Determination of Optimum Time for Conducting Cloud Seeding Experiments**

K.L.A.P. Sarma and B. Ravi Kumar

Water is the most essential factor for the life on the earth. Surface water resources and ground water resources are mainly depending on the rainfall. There is a basic necessity to improve the rainfall particularly in drought-prone areas like Anantapur district. Recently, Andhra Pradesh Government conducted many Cloud Seeding Experiments in this district. Earlier, Sarma and Ravindra Reddy presented many papers and also submitted a Ph.D. thesis and proposed a Markov Chain Model to determine the behavior of rainfall and obtained steady state probabilities.

In the present paper the concept of optimization of Cloud Seeding Experiments is considered based on the inflow into various important dams like T.B. dam, M.P.R. dam and M.L.V dam. This type of effort will help us to improve the rainfall in the catchment's areas of these dams, so that inflows into these dams are improved.

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*Sri Krishnadevaraya University, Anantapur*

### **21. Non-linear Model for Height-diameter of Populus Deltoides Planted on Farmlands in Haryana**

R.H. Rizvi, Diwakar Khare and R.S. Dhillon

Seven non-linear functions widely used for height-diameter relationship were fitted for Populus deltoides tree because high correlation ( $r = 0.956$ ) exists between height and diameter at breast height. Out of seven models fitted, the model  $H = \exp(1.618 + 0.196 D^{0.587})$  adjudged best on the basis of statistical criteria. The developed model has been validated on an independent data set and found that predictions were quite precise. The mean absolute error in predictions comes out to be 57.2 cm only. Residuals of this model do not violate any assumptions of regression theory. The proposed model gives realistic predictions of height on the basis of diameter at breast height in the range 5-35 cm. The proposed non-linear model outperforms the linear model

in precision and may be used in the situations where it is not possible to measure height of the tree.

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*National Research Centre for Agroforestry, Jhansi*

## **22. Crop Planning vis-a-vis Soils and Climate for Sustainable Sugarcane and Sugar Productivity in India**

Rajesh Kumar, Rajendra Gupta and D.V. Yadav

Agro-climatic condition and productivity distribution pattern of sugarcane in India was studied to delineate the reasons for variation in sugarcane production, yield, distribution of area and sugar recovery from place to place and year to year. It was found that prominent sugarcane growing soils of the country are recent alluvium, red sandy, medium black, red loamy and deep black soils but highest yield has been observed in coastal loamy soil. Soil-climatic factors influencing sugar cane yield significantly are found to be organic matter content, cation exchange capacity, pH of soil and mean annual minimum temperature. Higher sugar cane yield were observed at the places where pan evaporation and bio mass productivity potential are higher whereas higher irrigation water use efficiency has been recorded at the places of higher moisture availability index. Based on sugar recovery contours, entire country has been classified in low, medium, high and very high sugar productivity potential zones.

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*Indian Institute of Sugarcane Research, Lucknow*

## **23. Plot Technique Study in Castor**

S.M. Upadhyay, H.R. Pandya and A.D. Kalola

Optimum size and shape of plot has been worked out from uniformity trial on castor (variety GCH-6) at Dry Farming Research Station, Junagadh Agricultural University, Jamkhambhalia during Kharif-2003. The seed yield data of 1200 plots (basic unit 0.90 m × 0.90 m) were recorded and analyzed to find out the optimum size and shape of the plot using maximum curvature method. The results revealed that coefficient of variation (CV%) per unit area decreased with the increase in size of plot. It could be concluded that the plot size of 15 basic unit (i.e. 4.5 m × 2.7 m = 12.15 sq.m.) consisting of three rows and five plants in each

row as the optimum plot size for conducting field experiment in castor at Jamkhambhalia.

For the yield data, the value of b, Smith's coefficient of heterogeneity, varied from 0.57 to 0.92 for different plot size. The equation obtained was  $Y = 43.47 X - 0.3889$ . The  $R^2$  between plot size and CV was computed as 0.9537.

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*Junagadh Agricultural University, Junagadh*

## **24. Measuring Sustainability of Different Nutrient Combinations in a Long Term Rice-Wheat Cropping System**

Satyabrata Pal, Pradip Kumar Sahu,  
A. Majumder and V.K. Katyal

Depending upon the climate, culture and other factors, food habit of the people in a certain region/locality is determined. In India, to most of the people, rice-wheat is the major staple food since time immemorial. Rice-wheat cropping system is one of the most widely adopted crop sequence not only in India but also in many parts of the world. In India near about 10.5 million hectare of land is occupied under this sequence. As the soil, climate and eco-geographic situations are not the same throughout the rice-wheat growing zone in India, different management, particularly nutrient, practices are followed in different parts of India. The practice is in vogue for a long period of time in India. To harvest maximum yield from the above mentioned rice-wheat crop sequence in a sustainable manner is a challenge to the agricultural scientists. Region specific efficient and sustainable management practice(s) could be identified only through a long term permanent plot experiment. Crop yields of a plot over the years are the cumulative effects of application of the same nutrient treatment over the years. Such experiments are in practice in Rathamsted Experimental Station, UK along with others parts in the world. Different authors viz. Soni, Narain, Singh, Katyal, Gangwar have studied the statistical aspects with respect to crop yield from long term fertilizer experiments. In this paper an attempt has been made to measure to measure the stability/ sustainability of different nutrients with the help of different methods. Each and every method has its own advantages and limitations. The term sustainability mostly implies

persistent capacity of any thing to continue for a long time without damaging or degrading the natural resources. In the context of sustainability of rice-wheat cropping system, we perceive sustainability as the steady production of a plot treated with a particular nutrient for a long period of time without making any damage to the environmental factors like soil and water. The material (data) used for this paper has been taken from a permanent plot field experimentation at Bidhan Chandra Krishi Viswavidyalaya under All India Co-ordinated Research Project. The experiment on rice-wheat cropping sequence was initiated in the year 1986 with twelve nutrient treatments made out of different sources and combinations of inorganic or both inorganic and organic nutrients in a Randomised Block Design and has been continuing till now. In this paper a review of the existing measures of sustainability has been presented. Further, some new measures of sustainability have been proposed and such measures are applied to identify the best sustainable nutrient treatment under long term rice-wheat cropping system.

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*Bidhan Chandra Krishi Viswavidyalaya, Nadia*

## **25. Modified Forms of Wood Model for Poultry Egg Production**

Shiv Prasad, Rajendra Singh and D.P. Singh

The Wood's model [ $Y_t = a t^b \exp(-ct) + e_t$ ] for milk production was modified as  $Y_t = a t^b \exp(-ct + d / t^{1/2}) + e_t$  to estimate poultry egg production curves. It was compared with McNally model that is a modified form of Wood's model and compartment model on the basis of live data. The proposed model suitably estimated the egg production curve.

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*Indian Veterinary Research Institute, Izatnagar*

## **26. Estimating Abundance of Wild Elephants Based on Dung Piles : Survey Methods and Statistical Models**

M. Sivaram, K.K. Ramachandran and E.A. Jayson

Information on abundance of elephants in various parts of forests is essential for its effective management

and conservation. Different methods have been used for the direct survey of wild elephants like total count, water hole count and line transect sampling. These direct methods are usually more prone to sample error due to scattered occurrence of elephants, group behavior and its vast home range. Further, direct sighting of elephants over vast forest area is practically problematic. However, elephants leave indirect evidence such as dung, which continues to be present in the area for a considerable time period. In this paper, we present the survey methods and statistical models followed for the estimation of abundance of wild elephants based on dung in the Elephant Reserves of Kerala State, India during the year 2005. The methodology followed has implications for estimating the population of other wild animal species based on indirect evidences.

The forest area of each Forest Division was divided into number of small blocks utilizing the Survey of India maps. A random sample of blocks was chosen in each Forest Division for the survey. Standing Crop method was followed for the estimation. It is based on the assumption that there is a stable relationship between the amount of dung present and the number of animals. This method requires one time survey of dung and dung count is corrected by defecation and decay rate using the following formula to obtain elephant density.

The dung density was estimated through Line Transect Sampling. In each of sampled blocks, transect of about 2 km length was laid. These transects were covered on foot recording the perpendicular distance to the geometric center of the dung piles. The perpendicular distances formed the input data and univariate half normal distribution with the series expansion of simple polynomial was used as detection function of dung piles for estimating the dung density for different Elephant Reserves. The choice of detection function was based on model fit statistics such as Akaike's Information Criterion.

Defecation rate was borrowed from other studies. The dung decay rate is the reciprocal of the estimated mean time to decay. It was estimated through dung decay experiments conducted on a sample of fresh dung piles representing different vegetation types following the retrospective method. In this method, fresh dung piles of the animals are located in the survey area and marked on several dates in the lead-up to the survey, chosen so that the proportion of dung piles surviving from the

earliest date to the survey is expected to be small, and to return to marked dung piles just once, at the time of the survey. Data on status of the dung piles are then binary, recording whether or not the dung piles survive to date of the survey. This binary data was subjected to Kaplan-Meier survival analysis and dung decay rate estimated. The total number of animals estimated based on dung survey for the State is 5135.

*Kerala Forest Research Institute, Peechi, Thrissur*

### **27. Predictive Assessment of Understorey Pasture Production in *Leucaena Leucocephala*-*Panicum Maximum* Silvopastoral System**

T.A. Khan<sup>1</sup>, R.K. Bhatt<sup>1</sup> and G. Suresh<sup>2</sup>

Silvipastoral system of management of rangeland has been recognized as a low input technology for rehabilitation of degraded land. Estimation of perennial output of understorey pasture is essential to assess the expected system productivity as a whole. A model for estimation of pasture production over the years was formulated and compared with the earlier estimations, based on stochastic approach.

Estimation of understorey grass yield by the stochastic model has been compared with the formulated model, showed minimal departure with observed pasture production obtained for the first four-years. This model also solved the problem of over and under-estimation of understorey grass production as observed in the stochastic model.

<sup>1</sup>*Indian Grassland and Fodder Research Institute, Jhansi*  
<sup>2</sup>*Directorate of Oilseed Research, Hyderabad*

### **28. Comparison of Wheat Genotypes – A Statistical Analysis**

Y.N. Havaldar and N.O. Pradeepkumar

In order to assess best general and specific combiners among twelve dicoccum wheat genotypes and to find the relationship between genetic divergence among the parents and heterosis for grain yield investigation was undertaken. The data were collected from Dr. Sanjaya Rajaram Wheat Laboratory, MARS,

UAS, Dharwad. The data subjected to Griffing's method-2, model-1 for half diallel analysis. ANOVA was carried out to find out the variance associated among the genotypes for 17 characters under both timely and late sown conditions.

Estimation of general combining ability effects was undertaken. The genotypes DDK-1001, DDK-1013, DDK-1017 and MACS-2925 identified as the best general combiners in timely sown condition as well as in late sown condition. In specific combining ability effects estimation, the crosses DDK-1001 × MACS-2928, DDK-1009 × DDK-1013, DDK-1001 × MACS-2912, DDK-1013 × MACS-2931, DDK-1001 × MACS-2931 and DDK-1017 × MACS-2928 were the best specific combiners in timely sown condition.

*University of Agricultural Sciences, Dharwad*

### **29. Response of Rainfall on Groundnut Productivity of Amreli District in Gujarat State**

P.R. Vaishnav, R.S. Parmar, J.S. Patel and S.K. Dixit

The district-wise average yield data of groundnut and daily rainfall data were used over a period of 33 years i.e. from 1970-2002. Five broad approaches were tried to study the impact of rainfall on groundnut productivity. They were (1) Aggregate rainfall, (2) Monthly rainfall, (3) Fortnightly rainfall, (4) Week-wise rainfall and (5) Crop phase-wise rainfall. Comparison of different regression equations with respect to the coefficient of determination ( $R^2$ ) revealed that response of rainfall on groundnut yield was found beneficial during pre-sowing period in stage-wise approach. The same effect was observed for other two approaches (fortnightly and week-wise). Total quantum of rainfall during flowering and peg initiation stage had positive and significant influence on yield. However, in case of week-wise approach, out of the four weeks, corresponding to flowering and peg initiation stage, the effect was observed positive and significant only in 2<sup>nd</sup> week of this stage. The effect was also positive in 2<sup>nd</sup> fortnight of July. In case of full pegging to pod development stage, the rainfall had positive impact on yield in week-wise approach, which corresponded to 2<sup>nd</sup> week of full pegging to pod development stage. Positive

and significant effect was also observed in 2<sup>nd</sup> fortnight of August.

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*Anand Agricultural University, Anand*

### 30. Fertilizer Consumption Forecast Model

S. Loidang Devi, B.M. Singh and  
G.K.N. Chhetry

The paper deals with a new fertilizer consumption model in the existing socio-economic and agro-climatic conditions of Manipur following regression analysis procedure. Tests for goodness of fit and diagnostic checks satisfy the fitted model. Retaining only significant variables, we apply stepwise regression estimation procedure. Value of the multiple correlation co-efficient (R) indicates that 95.4 per cent of the variation in the consumption of fertilizers is explained by the independent variables under consideration whereas 97.8 per cent of the variation is explained by significant independent variables as shown by stepwise regression analysis. As such, the model may be claimed as a good fitted model. Further, as the model so constructed is consistent with the survey data and existence of some amount of discrepancy might be due to sampling fluctuation alone.

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*Manipur University, Canchipur, Imphal*

### 31. Occupational Exposure and Hodgkin's Lymphoma: A Case-Control Study

G. Vishwakarma, P. Pahwa, H.H. McDuffie and  
the Cross Canada Study of Pesticides and  
Health Researchers

Hodgkin's lymphoma is one of a group of cancers that develop in the lymphatic system. The causes of the disease are still not completely understood. The Cross Canada Study of Pesticides and Health was conducted from 1991 to 1994. Postal questionnaires were mailed in six provinces of Canada viz. Ontario, Manitoba, British Columbia, Saskatchewan, Quebec and Alberta. Data were gathered from 1506 controls and 316 newly diagnosed males with a mean age ( $\pm$ SD) of 51.7 ( $\pm$ 17.1) years. Cases with Hodgkin's lymphoma (ICD-9 201) were identified from cancer registries in five provinces

and from hospital registers in Quebec. Controls were identified randomly from population-based sources in each province and the same questionnaire was mailed. The aim of the present study was to find associations among Hodgkin's lymphoma, selected occupations and different types of occupational exposures such as chemicals, pesticides and radiation.

To select predictor variables, a descriptive analysis was done for each variable related to various reported occupational exposures. The longest held jobs reported most often were manager (20 cases and 131 controls), professional driver (14 cases and 70 controls) and farmer (13 cases and 115 controls). The conditional logistic regression analysis, stratifying by age-groups and province of residence, was conducted to compute the adjusted odds ratio [OR<sub>adj</sub>; (95% CI)] for all predictor variables included in the model. None of the "longest held jobs" was found to be significant in the model but following predictor variables increased the risk of Hodgkin's lymphoma: immediate family member diagnosed with cancer [1.95; (1.42, 2.69)], nurseryman as short term job [2.99; (1.17, 7.64)], exposed to pitch (Coal product) [2.34; (1.12, 5.29)] and exposed to uranium at work [3.44; (1.26, 9.35)]. Two predictor variables showed lower risk of Hodgkin's lymphoma: Positive skin prick allergy test [0.65; (0.42, 0.98)] and exposure to gas (sour) [0.41; (0.21, 0.82)].

We concluded that Hodgkin's lymphoma was associated with an immediate family history of cancer, short term job as a nurseryman, exposure to pitch and exposure to uranium at work.

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*University of Saskatchewan, Saskatoon, Canada*

### 32. Technical Efficiency of Dairy Farms in Tamil Nadu, India - A Stochastic Frontier Production Function Approach

V. Saravanakumar<sup>1</sup> and D.K. Jain<sup>2</sup>

Indian dairying has emerged to be the fastest growing enterprise with India becoming global leader with the milk production of 88 million tons (Economic Survey, 2004-05). Although it has made rapid strides but milk productivity is 917 kg/milch animal/year which is lower than the world average of 2038 kg/milch

animal/year (FAO, 2000). The per capita availability (232 gms/day) is also lower than the ICMR recommended level. Price and technological changes are the important instruments for accelerating growth and productivity in dairy sector. The present study was undertaken in Tamil Nadu state with the specific objective to study the estimation of technical efficiency of milk production. In order to achieve various objectives of the study, multi-stage stratified random sampling technique was adopted to select the sample households. Two districts namely, Erode (Western Zone) and Trichy (Cauvery Delta Zone) were purposely selected based on agro-climatic variation and level of milk production. Two blocks were selected randomly from each district and two villages from each block. A sample of 20 households was selected randomly from each village with a minimum of five from each of two herd size categories, namely, small ( $\leq 2$  milch animals) and large ( $> 2$  milch animals). Thus, a total sample of 160 households were selected for the present study. The detailed data was collected on socio-economic characteristics and input-output parameters of dairy enterprise for the year 2002-03 for flush and lean seasons. Stochastic frontier production function technique developed independently by Aigner *et al.* (1977) and Meeusen and Broeck (1977) was used to analyse the data in order to achieve the objective. Maximum Likelihood Estimation (MLE) technique was used to obtain the parameter estimates of the Translog Stochastic Frontier Production Approach and estimated the farm specific technical efficiencies. The measure of technical efficiency was 81 and 85 per cent for crossbred cow and buffalo farms, respectively, which implied 81 and 85 per cent differences in milk output across the farms was due to farm specific technical efficiency and remaining was due to random error. This suggests that the milk production in the study area can be increased by an average of 19 and 15 per cent for crossbred cows and buffaloes across sample households using the existing resources. The study further revealed that only 31 and 22 per cent of crossbred cow and buffalo farms, respectively, realized more than 90 per cent of its output and remaining farms lost their output by more than 10 per cent under the existing technology. The estimates of technical efficiency obtained for the study area clearly suggested that the average and the least efficient farm could increase their milk production by 16.32 and 26.22 per cent in the case of crossbred cow farms and 14.04 and 30.70 per cent in the case of

buffalo farms by following the practices of most efficient farmer. It can be concluded that there is a scope to improve the milk production of crossbred cows and buffaloes using the existing resources. In nutshell the milk production can be increased by educating the farmers periodically with regard to appropriate feeding practices, maintaining optimal herd size, balanced feeding, artificial insemination and new technologies in dairying.

<sup>1</sup> Horticultural College and Research Institute, TNAU, Periyakulam

<sup>2</sup> National Dairy Research Institute, Karnal

### 33. Impact of Rainfall on Groundnut Productivity of Rajkot District in Gujarat State

R.S. Parmar, P.R. Vaishnav, J.S. Patel and Arun Patel

The district-wise average yield data of groundnut and daily rainfall data were used over a period of 33 years i.e. 1970-2002. Five broad approaches were tried to study the impact of rainfall on groundnut productivity. They were (1) Aggregate rainfall, (2) Monthly rainfall, (3) Fortnightly rainfall, (4) Week-wise rainfall and (5) Crop phase-wise rainfall. Comparison of different regression equations with respect to the coefficient of determination ( $R^2$ ) revealed that impact of rainfall on groundnut yield was found favourable during pre-sowing, in stage-wise approach. The same response was observed in other two approaches (fortnightly and week-wise), while in case of germination and vegetative growth stage, the positive effect was observed in week-wise approach. For flowering and peg initiation stage, the effect was found positive and significant in stage wise approach. However, in case of week-wise approach, out of the four weeks, corresponding to flowering and peg initiation stage, the effect was observed positive and significant only in 2<sup>nd</sup> and 3<sup>rd</sup> week of this stage. The effect was also positive in 2<sup>nd</sup> fortnight of July. In case of full pegging to pod development stage, the rainfall had positive impact on yield in week-wise approach, which corresponds to 4<sup>th</sup> week of full pegging to pod development stage. Positive and significant effect was also observed in 2<sup>nd</sup> fortnight of August and 1<sup>st</sup> fortnight of September in lesser number of runs. Wu and Hamada

(2000) made a remark that minimum aberration criterion cannot be used for choosing good combined arrays; one should choose a design with a large number of clear control  $\times$  noise interactions, control main effects, noise main effects and control  $\times$  noise interactions. It may be very well dealt in the concept of maximum estimation capacity as it takes care of the aliasing pattern. They have compared the properties of minimum aberration designs and maximum estimation capacity designs for two-level combined arrays based on the number of eligible and clear estimable main effects and two-factor interactions. Evangelaras *et al.* have given a complete catalogue of non-isomorphic two-level designs under the criteria of generalized minimum aberration and maximum estimation capacity. So far maximum estimation capacity has been studied for two-level fractional factorial designs under the concept of combined array. In agricultural experiments there are situations when three levels of the factors can be maintained or experimenter is concerned about the curvature in the response function for which three-level fractional factorial designs may be useful.

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Anand Agricultural University, Anand

## THEME 2: EMERGING ISSUES IN AREAS OF BASIC STATISTICAL RESEARCH

### 1. Heritability of Growth Curve Parameters of Pigs

A.K. Paul and M.G. Kundu

Most of the strategies of breeding plan in animal depend on heritability which is one of the most important genetic parameter. Data from 698 pigs were used to examine the potential usefulness of growth curve parameters as selection criteria for altering the relationship between body weight and age. A logistic growth function was found to be best fitted to model growth through 24 weeks of age. Estimates of asymptotic body weight ( $K$ ), maximum growth rate ( $R$ ) and age at point of inflection ( $t^*$ ) have been obtained by non-linear least squares. Phenotypic and genetic parameters were estimated for the estimated growth curve parameters and for body weights through 24 weeks of age. Half-sib model were used for computing genetic parameters. *Heritabilities of estimated growth*

*curve parameters were:  $K$  (0.301 $\pm$ 0.121),  $R$  (0.102 $\pm$ 0.070) and  $t^*$  (0.874 $\pm$ 0.228).*

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Indian Agricultural Statistics Research Institute, New Delhi

### 2. Construction of Doubly Nested Balanced Incomplete Block Design

B.N. Mandal, Rajender Parsad and V.K. Gupta

Doubly nested balanced incomplete block designs were introduced by Preece *et al.* (1999) as a generalization of nested balanced incomplete block designs. In these designs, there are  $n$  experimental units that can be arranged in  $b$  blocks such that there are  $m_1$  sub-blocks within each block and  $m_2$  sub-sub-blocks within each sub-block. A set of general methods for constructing doubly nested balanced incomplete block design is presented. A catalogue of the constructed designs for  $v \leq 30$  is also attached.

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Indian Agricultural Statistics Research Institute, New Delhi

### 3. CATANOVA Method for Analysis of Mixed Effects Model for Categorical Data

B. Singh

The CATANOVA method, a categorical extension of ANOVA method for quantitative data, is developed for analysis of categorical data from two-way mixed effects model for balanced and unbalanced designs. Estimates of model variance components based on appropriate reductions in sums of squares are obtained by using the fitting constants method. Unbiased tests for main effects and interaction in the model are presented by using the least square analysis technique and the Satterthwaite method for synthesis of variance. The methodology is illustrated for two biological data sets. The method is computationally simple, uses categorical data in original form and provides significance level of tests for parameters in the model closer to those based on large sample theory such as weighted least squares and generalized estimating equations.

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Indian Veterinary Research Institute, Izatnagar

#### 4. Determination of Optimum Plot-Size in Field Trials

Satyabrata Pal<sup>1</sup>, Satyananda Basak<sup>2</sup>,  
Banjul Bhattacharyya<sup>1</sup>

Determination of optimum plot size and shape with respect to a particular crop, which will enable to maintain the organization and conduction of the experiment at a high level of precision, has been a problem not yet solved very satisfactorily, though several attempts have been made in the regard commencing with the well known works of Smith. This paper presents an analytic method by which the optimum plot size can be determined.

<sup>1</sup>Bidhan Chandra Krishi Viswavidyalaya, Mohunpur, Nadia

<sup>2</sup>Uttar Banga Krishi Viswavidyalaya, Coochbehar

#### 5. Testing the Scale Parameter of an Exponential Distribution with Known Coefficient of Variation in a Type II Right Censored Situation - Conditional Approach

C.D. Ravindran

The two-parameter exponential distribution  $E(m, q)$ ,  $q > 0$ , is a well known probability model used for life-length studies owing to the useful description of observed variation it gives for many real life situations. In the context of life-length studies, the location parameter  $m$  and the scale parameter  $q$  respectively represent the minimum guaranteed life and the average excess life of an equipment or system. The parameters  $m$  and  $q$  are functionally unrelated and the statistical inference about these parameters make use of the existence of complete minimal sufficient statistics. This brings about a substantial simplification in the inferential problems. There however exist situations where the average life  $q$  depends on the guaranteed life  $m$  and the functionally independent nature of the parameters no longer hold, resulting in the loss of optimal properties of the statistics. In this situation the two-parameter model reduces to a one-parameter model  $E(aq, q)$ , where  $a$  is known. Ironically though the reduced model looks simplified with a single parameter  $q$ , however from the inference point of view, the problem

of inference about  $q$  becomes complicated. Several authors including the present author, have studied this kind of inference problem. In the present paper, the problem of testing a simple hypothesis about  $q$  in the reduced model  $E(aq, q)$  has been studied in the type II right censored situation from a conditional view point.

Central Institute for Research in Cotton Technology,  
Mumbai

#### 6. Two Modes Failure Machining System with Reneging: Diffusion Approximation Technique

Charan Jeet Singh

This paper proposes a non-Markovian machine repair system in which  $M$  machines are in operating state under the care of  $R$  repairmen with facility of  $S$  warm standby components to replace the failed machines. The machines may fail in two modes in operating as well as in standby states. The Diffusion approximation technique for the machine repair system has been developed by assuming the discrete flow of machines by continuous one. By using the mean and square coefficient of variation of failure and repair time distribution, under the assumption that failure times and repair times of machines are independent identical distributed random variables, the queue size distribution has been established. Various performance indices have been derived by using queue size distribution.

Guru Nanak Dev University, Amritsar

#### 7. Occurrences and Distributions of Arsenic in Bengal Delta Plain (BDP) Aquifer of South-East Asia

Dileep K. Panda<sup>1</sup>, A. Kumar<sup>1</sup>, B.K. James<sup>1</sup> and Anita Misra<sup>2</sup>

In recent past, many authors have studied the increased reliance of percentiles for developing and setting monitoring compliance with water quality standards. Often it is of interest to test whether a percentile is different from some standard specified value. Here, the null hypothesis tested is that not more than 10% of the district wise samples should exceed the



regulatory standard of BBS (Bangladesh Bureau of Standards) and WHO at the 95% level of confidence in all the districts of Bangladesh. The confidence intervals (CI) of the non-exceedance percentiles are compared with the CI of the 90<sup>th</sup> percentiles of district wise As data. If the lower limit of the CI of the 90<sup>th</sup> percentiles exceeds the upper limit of CI of the non-exceedance percentiles, then the district has been identified to be highly significant as far as As infestation is concerned.

<sup>1</sup>Water Technology Centre for Eastern Region,  
Bhubaneswar

<sup>2</sup>SCB Medical College, Cuttack

### 8. Simplified Linear Invariant Estimators of Parameters of Log-Logistic Distribution under Type-II Right Censoring

Somappa N. Megeri<sup>1</sup> and M.S. Chikkagoudar<sup>2</sup>

Best linear unbiased estimators (BLUE) are required to obtain best linear invariant estimators (BLIE) as proposed by Mann. Lloyd's procedure requires full knowledge of expectations  $a_i$  and the covariance matrix  $B$ , of the order statistics  $Y_i$  to obtain BLUE. Since it is very difficult to determine the covariances we considered simple method proposed by Gupta for estimating the parameters and these estimators are called as simplified linear unbiased estimators (SLUE). By using these SLUE we obtained simplified linear invariant estimators (SLIE) for the parameters of log-logistic distribution under type-II right censoring. We studied the bias, variance and mean square errors of these estimators through simulation.

<sup>1</sup>University of Agricultural Sciences, Dharwad

<sup>2</sup>Karnatak University, Dharwad

### 9. Nonlinear Statistical Model for Characterising Culm Growth of *Bambusa Cacharensis*

Gitasree Das<sup>1</sup>, Arun Jyoti Nath<sup>2</sup> and  
Ashesh Kumar Das<sup>2</sup>

*Bambusa Cacharensis* is an important village bamboo species in the Barak valley region of Assam. Villagers prefer to grow this species in their home

gardens because of its multiple use and having straight culm, preference being as high as 70% compared to other species growing in this region. The study on growth pattern of bamboos is important in developing proper scientific management systems for optimum yield. In this article nonlinear statistical models were used to characterise the culm height growth of *B. Cacharensis*. The adequacy of the models was judged by testing the validity of the assumptions of randomness and normality of residuals. Gompertz model with additive and AR(1) error structure is found to be the most suitable model for describing the culm growth of *B. Cacharensis*. The physical interpretation of the parameters is also being discussed. Wilk's Lambda test confirms significant difference between the growth parameters of bamboo culms for clumps of different age groups ranging from 2 years to 40 years.

<sup>1</sup>North-Eastern Hill University, Shillong

<sup>2</sup>Assam University, Silchar

### 10. Bioassay - An Efficient Tool to Prove the Bioefficacy of Biopesticides

J.J. Jani<sup>1</sup>, H.H. Patel<sup>2</sup>, D.J. Patel<sup>3</sup>, P.R.  
Vaishnav<sup>1</sup> and V.B. Darji<sup>1</sup>

Laboratory bioassays of native *Bacillus Thuringiensis* (Bt) isolate JD2 were carried out by diet contamination technique in multi-cavity trays against *Helicoverpa Armigera* (Hübner), and *Spodoptera Litura* (Fabricius). Test insects were subjected to 5 concentrations of native Bt strain JD1; while Bt HD-1-S-1980 @ 10<sup>9</sup> was taken as standard check and Endosulphan (0.07%) was chemical check along with untreated control. Each treatment was replicated four times with 10 larvae/replication. Percent mortality was recorded at 12 hours interval upto 120 hours. Results revealed that percent larval mortality was observed to increase with a consequent increase in dose as well as time up to 120 h; however the quantum of increase lowered after 96 h of the treatment. Further the result of Probit analysis revealed that Bt isolate JD1 was effective against both the lepidopteran test insects with lowest LC<sub>50</sub> value for *S. Litura* but the LT<sub>50</sub> was lowest for *H. Armigera*. It was observed that the percent larval mortality increased with a consequent increase in dose as well as time up to the last period (120 h), however,

the quantum of increase lowered after 108 h of the treatment.

<sup>1</sup>Anand Agricultural University, Anand

<sup>2</sup>Bhavnagar University, Bhavnagar

<sup>3</sup>Sheth P.T. Arts and Science College, Godhra

### 11. Optimum Size and Shape of Plot for Field Experiments on Potato (*Solanum tuberosum* L.)

J.K. Patel, R.I. Prajapati and G.K. Chaudhary

An uniformity trial on potato (*Solanum tuberosum* L.) was carried out at the Potato Research Station, S.D. Agricultural University, Deesa to determine optimum size and shape of plot for field experiments using maximum curvature method and fair field Smith's variance method. The variability as judged by coefficient of variation per unit area (C.V.) decreased with the increase in plot size. A plot of 8 sq. m having 2 m. width  $\times$  4 m. length (i.e. 4 rows each of 4m length) a rectangular shape of plot (net) was considered as optimum size and shape of plot for field experiments on potato on sandy loam soil of North Gujarat.

S.D. Agricultural University, Sardar Krushinagar

### 12. Grouping of Genotypes Based on $G \times E$ Interaction Mean Square and its Linear Function in Wheat

J.S. Patel, S.K. Dixit, P.R. Vaishnav and R.K. Shukla

When genotypes are tested in multi location trials the pooled analysis provides information on significance of genotype  $\times$  location interaction indicating in consistent response of genotypes over location generally termed as  $G \times E$  interaction. Wheat yield data of such an experiment having 20 genotypes tested at five different locations in Gujarat state during 1999-2000 were used for present study. The experiment was conducted in randomized block design with four replications. The  $G \times E$  interaction was found significant and hence these data were further examined for the methods of grouping of genotypes. Two approaches (i) based on dissimilarity index (Abou-El-Fittouh *et al.* 1969) and (ii) dissimilarity index based on linear function of  $G \times E$

interaction (Lin and Thompson 1975) were examined. The former method provides information of genotypes within a group which do not represent  $G \times E$  interaction while latter method provides information of genotypes having similarity in slope. If there is a well established genotype in a group, then the remaining genotypes of the same group will be more suitable for the same environment where the well established genotype is grown. This information will be helpful to breeders in recommending a variety over environments. The grouping by these two approaches have been discussed in the paper.

B.A. College of Agriculture, Anand Agricultural University, Anand

### 13. On Synthetic and Composite Estimators for Small Area Estimation under Lahiri-Midzuno Sampling Scheme

K.K. Pandey and G.C. Tikkiwal

This paper studies performance of synthetic ratio estimator and composite estimator, which is a weighted sum of direct and synthetic ratio estimators under Lahiri-Midzuno (L-M) sampling scheme. Both the estimators under L-M scheme are unbiased and consistent if the assumption of synthetic estimator is satisfied. Further, this paper compares performance of the estimators empirically under L-M and SRSWOR schemes for estimating crop acreage for small domains. The study suggests that both the estimators under L-M scheme perform better than under SRSWOR scheme, as having smaller absolute relative biases and relative standard errors.

Banasthali Vidyapith, P.O. Box Banasthali Vidyapith

### 14. Use of Random Parameter Models in Tree Volume Prediction

K. Jayaraman

Application of random parameter models for deriving localized tree volume prediction equations is discussed and illustrated using data obtained on rubber trees. Unlike in the case of fixed effect models, parameters of a random parameter model are allowed to vary from subpopulation to subpopulation with

certain distributional assumptions. After estimating the relevant parameters, it will be possible to predict the random deviations through best linear unbiased predictor. The theory was found well applicable for localizing tree volume prediction equations, the parameters of which are subject to variation from stand to stand. The test results made through simulated calibration showed that the  $R^2$  (prediction) was much higher for localized function when compared to that of the mean function. The methodology though illustrated for rubber trees, is well applicable for all timber yielding crops.

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*Kerala Forest Research Institute, Peechi, Thrissur*

### 15. Application of Clustering Techniques in Mango and Litchi Germplasm of West Bengal

Kalyan Chkraborty<sup>1</sup>, Amrit Paul<sup>2</sup> and Wasi Alam<sup>2</sup>

Different clusters were obtained through the application of Ward's method under Euclidean distance. Roughly all the nineteen mango varieties along with average have been grouped into three clusters on the basis of three traits. Except middle cluster with varieties Bombai, Himsagar and Langra remaining two clusters have been further grouped into two sub clusters. All the three clusters may be considered as genetically divergent group of mango varieties. The member of these clusters may be useful in hybridization program.

Different clusters have been obtained through the application of average within group linkage method under squared Euclidean distance. Altogether, there are total seven clusters. Cluster-II (SG\_JAL4), Cluster-VI (SG\_JAL8) and Cluster-VII (SG\_JAL6) each having a single member germplasm. These germplasm are highly genetically divergent with the germplasm of other clusters. These may be considered as the base population for selection of genetically divergent germplasm in litchi breeding program.

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<sup>1</sup>AICRP on Subtropical Fruits, BCKV, Kalyani, Nadia

<sup>2</sup>Indian Agricultural Statistics Research Institute, New Delhi

### 16. A Wider and More Efficient Class of Estimators of Population Variance under Sub-Sampling Scheme

Lovleen Kumar Grover

Here, it is assumed that the prior information regarding the parameters of first auxiliary variable  $x$  is not available, but the prior information regarding the parameters of second auxiliary variable  $z$  is available for improving the estimators of parameters of interest. We consider the situation when the auxiliary variable  $x$  is directly and highly correlated with both the study variable  $y$  and the second auxiliary variable  $z$ . Whereas the variables  $y$  and  $z$  are not directly correlated with each other but they are just correlated with each other only due to their direct correlation with the first auxiliary variable  $x$ . In this paper, we propose a class of estimators of population variance  $S_y^2$  of study variable  $y$  when the population mean and variance of auxiliary variable  $z$  are known in advance. The comparison between the efficiencies of various classes of estimators of  $S_y^2$  has been made. It has been shown that the proposed class is wider and more efficient than the two existing classes defined by Jhaji *et al.* (2005) inspite of using the same prior information about the second auxiliary variable  $z$ .

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*Guru Nanak Dev University, Amritsar*

### 17. Unified Theory of Sampling – Golden Jubilee

S.G. Prabhu Ajgaonkar<sup>1</sup> and M.N. Deshpande<sup>2</sup>

In 1955 Godambe's paper appeared in JRSS and since then attention of many researchers in sampling theory was attracted to it. Many books, research papers are published since then. In this paper we try to take a brief review of the developments.

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<sup>1</sup>Anupan Society, Shreya Nagar, Aurangabad

<sup>2</sup>Panchadeep Nagar, Wardha Road, Nagpur

## 18. Optimum Stratification for PPS Sampling using Auxiliary Information

M.R. Verma

The paper considers the problem of optimum stratification for two study variables when the units from different strata are selected with probability proportional to size sampling scheme. Minimal equations solution to which gives optimum points of stratification have been obtained by minimizing trace of variance covariance matrix. A cumulative cube root rule  $\sqrt[3]{M_1(x)}$  has been proposed to find approximate solution to the minimal equations. Limiting expressions for the generalized variance-covariance matrix, the optimum numbers of strata and expression for the approximate sample sizes have also been obtained.

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*ICAR Research Complex for NEH Region, Umiam, Barapani*

## 19. On the Use of Modified Randomized Response Devices for Non-sensitive Question Model

M. Javed and I.S. Grewal

In this paper two improved randomization devices RD-I and RD-II are proposed which consist of pack of cards having three types of statements written on it and on each card there is only one statement. A comparison of proposed devices is made with the existing unrelated question model for quantitative characters, which shows that the proposed randomization devices are better. A comparison within the proposed randomization devices has also been undertaken which shows that the RD-I is better than RD-II.

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*Punjab Agricultural University, Ludhiana*

## 20. Multivariate Statistical Analysis of Water Quality Data in Narmada River

N. Okendro Singh<sup>1</sup>, Surinder Kumar<sup>2</sup> and P.C. Mahanta<sup>1</sup>

Multivariate statistical techniques are gaining popular in the analysis of various water quality data due

to its simplicity when handling a large number of variables simultaneously and more easily interpretable results for the evaluation of observed quality data. In this study, factor analysis and cluster analysis are applied to water quality data set obtained from Narmada river and it is attempted to present a strategy that reduces the measured parameters, locations and frequency without compromising the quality of the original data. Factor analysis shows that river water quality data consists of three significant components viz., animal waste discharges, sewage discharges and industrial discharges whereas Chloride, Bicarbonate Alkalinity and pH are the respective indicator variables. Cluster analysis also suggests that number of sampling sites as well as the sampling frequency can be consolidated. This reduced set of parameters, sampling sites and sampling frequency could be monitored over larger areas within the watershed to provide more detailed spatial information about sources and processes.

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<sup>1</sup>*National Research Centre on Coldwater Fisheries, Bhimtal*

<sup>2</sup>*Kumaon University, Nainital*

## 21. Length-weight Relationship and Growth Pattern of *Tor putitora* (Hamilton) under Monoculture and Polyculture Systems: A Case Study

N. Okendro Singh<sup>1</sup>, Md. Wasi Alam<sup>2</sup> and Amrit Kumar Paul<sup>2</sup>

As the catches of *Tor putitora* (golden mahseer) has sharply declined in many parts of the country, mahseer stock is threatened with multifaceted dangers, which are partly due to overexploitation and consequently reduced yield from many fish stocks. The size of fish is very important as concerned with the fish stock. Furthermore, growth pattern of the fish species itself is an important factor to know the size of fish over a period of time which ultimately assists in estimation of fish stock. Again, length-weight relationship of fishes are important in fisheries biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relationship between the above two traits. Like any other morphometric characters, the length-weight relationship can be used as a character for the differentiation of taxonomic units

and this relationship seems to change according as various developmental events of life cycle such as metamorphosis, growth and the onset of maturity. This paper aims to contribute the length-weight relationship of *Tor putitora* under monoculture and polyculture systems for direct use in fishery assessment and also to describe growth pattern in terms of weight of this fish species in above two different culture systems. The Von-Bertalanffy model was found to be the best suitable model to describe the growth pattern of *Tor putitora*.

<sup>1</sup>National Research Centre on Coldwater Fisheries, Bhimtal

<sup>2</sup>Indian Agricultural Statistics Research Institute, New Delhi

## 22. Constructions for Some Classes of Neighbour Designs and its Analysis

N.K. Chaure

In this paper some new methods of construction of neighbour designs are given. Section I comprises of series of neighbour designs for any even  $v$  (Theorem 1) and  $v = 2t+2$ ,  $t$  is any odd positive integer (Theorem 2). Section II comprises of series of incomplete block neighbour designs for any odd  $v$  (Theorems 3 & 4). Lastly in Section III, analysis of neighbour design with random effect model is presented.

Indira Gandhi Agricultural University, Bilaspur

## 23. Bayesian Analysis of $P[X > Y]$ Reliability Model in Respect of Min X and Min Y

Namita Jaggi, K.K. Sharma and Bhupendra Singh

In the present study stress-strength reliability  $P[X > Y]$  has been remodeled to suit the requirement of designer for whom system is working at its minimum strength and has to be used at minimum stress for proper functioning of the system. The purpose of the study is in two folds: first to attach high reliability to the system and second to design the model so that system is operable at their minimum strength encountering to its minimum stress applied on it. The Bayesian treatment

has been given to the concept by using squared error loss function and linex loss function.

C.C.S. University, Meerut

## 24. A Class of Estimators of Finite Population Mean using Incomplete Multi-auxiliary Information

Meenakshi Srivastava and Neha Garg

In sample surveys, it is usual to make use of auxiliary information to increase the precision of estimators. When information on multi auxiliary variables is available for whole population, we use usual ratio, regression and product method of estimation for estimating the finite population mean. Frequently, there may arise situation where we have information on several auxiliary variables only for some part of the population. The maximum utilization of multi-auxiliary information is carried out in such cases by stratifying the population on the basis of available multi-auxiliary information at hand.

In this paper a class of estimators is considered for estimating the mean of the finite population utilizing available incomplete multi-auxiliary information. Some special cases of this class of estimators are considered. The approximate expressions for bias and mean square error of the suggested estimators have also been derived and theoretical results are numerically supported.

Dr. B.R. Ambedkar University, Agra

## 25. Tracing Relative Importance of Explanatory Variable(s) in Regression Model

P. Goswami<sup>1</sup> and S.C. Kakaty<sup>2</sup>

Tracing out the relative importance of explanatory variable(s) in regression model attracts the agricultural researchers in recent years while dealing with problem(s) encountered in social, medical, engineering, and agricultural sciences. This paper aims at investigating the relative importance of variables in multiple regression. An attempt is made here to answer two basic important questions related to multiple regression. They

are – (a) What is the effect of changing a variable given the other variable(s) constant ? and (b) By how much is it possible to change a variable without changing the other explanatory variable(s) ?

<sup>1</sup>Sibsagar College, Joysagar

<sup>2</sup>Dibrugarh University, Dibrugarh

## 26. Modeling for Early Prediction of Sugar Production

P.K. Bajpai, Rajesh Kumar and S.S. Hassan

India by contributing 20.4% area and 18.6% production ranks second among sugarcane growing countries of the world for both area and production of sugarcane. In India, sugarcane is an important cash crop, which shares 7% of the total value of agricultural output and occupies only 2.5% of country's gross cropped area. In India, sugar industry has more than 450 sugar factories in operation is the second largest agro-based industry (next to cotton textile) located in rural areas. The industry is instrumental in generating sizeable employment in rural sector directly and through ancillary industries. It is estimated that about fifty million farmers and their dependents are engaged in the cultivation of sugarcane and another 0.5 million skilled and unskilled workers including highly qualified and trained technologists are engaged in the manufacturing of sugar. For meeting sugar demand and planning for import, export and distribution, it needs prior estimates of its production. During past years, frequent import and occasional export from India has been witnessed. Sugar production, our forecasts have not met the actual targets achieved. The prediction model developed for forecasting would help the government in precise planning to meet the sugar demand and control its prices in the market besides avoiding import. Models have been developed for early prediction of sugar production based on production, price of gur, sugar price and estimates of cane crush proportion.

*Indian Institute of Sugarcane Research, Lucknow*

## 27. Application of Hierarchical Clustering Methods for Study of Time Series Wool Production of India

Pal Singh, Md. Wasi Alam and  
Amrit Kumar Paul

In this article, Average Linkage and Single Linkage methods of hierarchical clustering algorithm have been used and compared in order to get valid clusters of wool producing states of India. This study clearly demonstrates that average linkage method provide valid four mutually heterogeneous clusters, however, single linkage method construct only two invalid clusters over the same distance measure viz. squared euclidean distance. Trend of cluster wise wool production levels over eight years have been depicted in different figures which clearly states that north eastern states like Sikkim and Arunachal Pradesh are the smallest wool producing states with stable and disappointing trend in production level, however, Rajasthan is the largest wool producer with continuous rise in production level over the eight years. This study can play an important role in formulating the policy more precisely, whose aim is to augment the wool production level of different low wool producing states of India and the national average as well.

*Indian Agricultural Statistics Research Institute,  
New Delhi*

## 28. Multiple Comparison Procedures for Location

Parminder Singh

Consider  $k$  ( $\geq 2$ ) independent populations  $p_1, \dots, p_k$  such that the population  $p_i$  is characterized by the logistic distribution function with unknown location parameter  $m_i$  and common known scale parameter  $s^2$ ,  $i = 1, \dots, k$ . In this paper, we proposed a test procedure for testing  $H_0: m_1 = \dots = m_k$  based on sample medians. Suppose that the  $k$  populations under comparison are ordered in a certain way. For example there may be a sequence of increasing dose levels of a drug. A test procedure proposed for testing  $H_0: m_1 = \dots = m_k$  against simple ordered alternative testing  $H_A: m_1 \leq \dots \leq m_k$  with

at least one strict inequality. We also extended this test procedure for  $H_0: m_1 = \dots = m_k$  against umbrella ordered alternative  $H_A: m_1 \leq \dots \leq m_h \geq \dots \geq m_h$  with at least one strict inequality. The proposed test procedures are inverted to obtain the simultaneous confidence interval for the pairwise comparison. The critical constants are computed for implement the proposed test procedures.

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*Guru Nanak Dev University, Amritsar*

### 29. Variation Pattern in *Toona Ciliata* in Himachal Pradesh

Tara Gupta, R.N. Sehgal and R.K. Gupta

The present study was conducted in Himachal Pradesh to estimate the variability components for the phenotypic character and seed traits of *Toona ciliata* among different provenances. Most of the characters differ significantly among the provenances. The characters like leaf length, number of flowers per inflorescence, inflorescence length, seed germination, seed viability after three and six months of storage had high coefficient of variability, heritability and genetic advance, indicated importance of these characters for selection. Correlation coefficient between various characters reveals highly significant linear relationship between most of the characters. Factor analysis technique was used to various phenotypical characters and seed traits of *Toona ciliata*. Thirteen traits of *Toona ciliata* were classified into three basic factors accounting for 72 per cent of the total variation. First factor was the combination of tree height, crown length, crown area, seed weight and seed width and had a maximum variation of 31 per cent indicating good opportunities in the improvement of these characters by practicing selection. Second factor found to be the combination of inflorescence length, number of flower per inflorescence, seed length with wings and dewinged seed length. Third factor was combination of leaf length, number of leaflet per leaf, crown spread and clear bole height. These three factors can be used for further breeding programmes for enhancing the overall gains for timber growth and quality seed production in *Toona ciliata*.

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*Dr. Y.S. Parmar University of Horticulture & Forestry, Naini, Solan*

### 30. Use of Statistical Methods in Evaluation and Estimation of Genetic Variability and Diversity in Some Medicinal and Aromatic Plants

R.K. Lal and S.P.S. Khanuja

In genetic improvement of medicinal and aromatic plants, breeder is mainly concerned with the field experimentation. He is always interested in getting the maximum yield with the limited resources that he possesses. In order to achieve this aim he would like to know which variety out of so many is the best, which manure and in what quantity should be used in the field, nature and amount of genetic variability and diversity present in the genetic stocks and what should be the seed rate and depth of ploughing, etc. Only trying them practically in the field, for which an experiment in the field has to be planned, can assess the values of all of them. The important consideration that has to be kept in mind in planning an experiment is that neither the experiment nor the results may be put to any sort of criticism. Statistical procedure and experimental design are only two different aspects of the same whole, and that whole is the logical requirements of the complete process of adding to natural knowledge by experimentation. Use of statistical methods in evaluation and estimation of genetic variability and diversity in one very important medicinal plant *Shankha puspi* (*Convolvulus microphyllus* Sieb. Ex. Spreng) are presented.

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*Central Institute of Medicinal and Aromatic Plants, Lucknow*

### 31. Development of Core Collection in Sesame (*Sesamum indicum* L.) Germplasm

R.K. Mahajan, I.S. Bisht and T.R. Loknathan

Sesame (*Sesamum indicum* L.) is one of the world's oldest oil crops and has been cultivated in Asia from ancient times. The breeding potential of the germplasm accession held worldwide has been hardly exploited to date. The major hindrance for the utilization of these resources is the transfer of diversity into a form that can be easily used by breeders and farmers. With this objective in view two core collections of sesame, one of

Indian sesame collection (3,129 accessions) and the other on world sesame germplasm collections (1,724 accessions) were developed.

Diversity of 3,129 Indian sesame (*Sesamum indicum* L.) accessions was studied and data were used for developing core collection. Both, the agro-ecological passport and characterization data were used for grouping of accessions into diverse groups. Shannon Diversity Index (Shanon and Weaver 1963) pooled over predominant descriptors was used as the measure of the diversity and various stratified random sampling strategies together with simple random sampling were compared for sample fraction ranging from 5 to 30%. The genetic diversity dependent strategy with sampled accessions from various strata directly proportional to the product of the diversity and logarithm of the strata size was adjudged as the best strategy with 10% sample fraction. A core set of 343 accessions was selected. Multi-site field trials were conducted for detailed evaluation of the core collection to validate its representativeness and stability of characters. Validation through molecular characterization and intercrossing between members of different groups is also being attempted. Full set of core collection was also grown at Akola regional station in the form of a demonstration field day for the benefit of sesame breeders and other researchers.

In the world collection of 1,724 accessions, the entire collection was classified into 16 groups based on continents of origin. The size of the core set was fixed at 10% of the population size, which is easily manageable by the curator. The selection of the core set was based on the following criteria such that each continent was represented:

- Accessions in continent with less than 5 accessions, if quite diverse, were directly added to the core set
- The accessions were selected in proportion to the group size for groups having more than 5 accessions
- The accessions for core set were selected using the following criteria:
  - (a) For the group size with less than 10 accessions, the accessions were sampled by equal probability sampling.
  - (b) For group size between 10-20 accessions, the accessions were sampled by Principal

Component Score Strategy (Bisht *et al.* 1998; Hamon *et al.* 1995; Mahajan *et al.* 1999). Ordination of the accession was done using Principal Component Analysis.

- (c) For group size more than 20, form number of clusters equal to the number of sampled accessions by Ward's minimum variance technique (Romesburg 1984), and then based on the group size the accession are selected following the procedure as (a) or (b) above.

The core set developed for Indian and global collections would serve both objectives of germplasm management and utilisation.

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*National Bureau of Plant Genetic Resources, New Delhi*

### **32. Robustness Aspects of Response Surface Designs Against Loss of Data**

R. Srivastava, Rajender Parsad, Manisha Jain and P.K. Batra

The optimal design theory is based on some very strict assumption(s) and ideal conditions and therefore optimal design may be rendered poor if the assumption(s) on which it is based is(are) violated. The ideal conditions may be disturbed on account of disturbances like outliers, missing observations, systematic trend in a block etc. In order to circumvent such situations one should think of designs that are insensitive or robust against some of the disturbances. Response surface designs are based on a subset of factorial combinations, their properties are susceptible to loss of data. In this investigation, therefore, an attempt has been made to study robustness aspects of modified and/or second order rotatable response surface designs obtainable from central composite designs and Balanced Incomplete Block (BIB) designs, against single missing observation. Special emphasis has been laid on designs having factors with equispaced doses. A new criterion of robustness viz. percent loss in information has been introduced. Other criteria used in this investigation are information contained in an observation, D-efficiency and A-efficiency.

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*Indian Agricultural Statistics Research Institute, New Delhi*



### 33. Multi-stage Sampling for Estimating Weighted Totals and Averages

Rajesh Kumar and Shambhu Dayal

The estimation of weighted totals and averages through sample surveys is resorted to by several agencies and for this purpose sub-sampling is also adopted. However, the literature on surveys does not provide discussion on this subject. In this paper various estimators have been developed and their efficiencies have also been obtained when multi-stage sampling is adopted for such surveys. Such sampling can also called as 'sampling of rates'.

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*Indian Institute of Sugarcane Research, Lucknow*

### 34. An Improved Ratio-cum-Product Estimator of Finite Population Mean using Known Parameters of Auxiliary Variables

Rajesh Tailor

This paper proposes a ratio-cum-product estimator of finite population mean using coefficient of variation of auxiliary variates and correlation coefficient between auxiliary variates. First order large approximations to the bias and mean squared error of the proposed estimator is obtained. Proposed estimator has been compared with simple mean estimator, usual ratio estimator, product estimator, estimators proposed by Singh (1967) and Singh and Tailor (2005). An empirical study is also carried out to examine the performance of the proposed estimator.

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*NCERT, New Delhi*

### 35. Estimation in the Block Designs

Ranjit Kumar Paul and Lalmohan Bhar

Data generated from the designed experiments is analyzed under the assumptions that the error distribution of observations is normal and homogeneous. Apart from the problem of normality, the data set may contain some outlying observations. In case of linear regression models, robust regression method is

now very popular to tackle the problem of non-normal error variance and the presence of outliers. Robust method of estimation is advocated to dampen the effect of an outlying observation. This approach is designed to employ a fitting criterion that is not as vulnerable as least squares to unusual data. The most common general method of robust regression is M-estimation, introduced by Huber (1964). In this method, the objective function to be minimized to get the parameter estimates is weighted according to the residual of each observation. However, not much work on these powerful methods in design of experiments is available in the literature. Carroll (1980) applied this technique to unreplicated factorial experiments and Chi (1994) to Cross-Over Trials. In the present investigation an attempt has been made to apply the M-estimation in the designed experiments. The method has been illustrated with an example.

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*Indian Agricultural Statistics Research Institute, New Delhi*

### 36. A Series of Group Divisible, Balanced Ternary Designs and PB Arrays using Hadamard Matrices

Roshni Tiwari and H.L. Sharma

A series of group divisible, balanced ternary designs and partially balanced arrays are constructed using Hadamard matrices. Some examples for different value of  $n$  in each case have been added.

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*Jawaharlal Nehru Agricultural University, Jabalpur*

### 37. Stability Analysis

Shivkumar M. Kareppa

Though, there are several stability measures available, however, the method suggested by Laxmi (1998) not only gives the birds eye view to determine the stability of the genotypes across the different environments, but also facilitates to classify genotypes as well as environments in favorable, unfavorable and average environment. Moreover, the method is very simple to analysis and interpretation. In the present investigation twelve genotypes of Chickpea (Desi) have

been studied under eight locations for their stability. Out of these genotypes, five genotypes *viz.*, Phule G-00108, Phule G-01103, Vijay, Vishal, and Digvijay, are exhibited average stability. However, seven genotypes *viz.*, Phule G-00109, Phule G-00110, BDNG-2025, BDNG-797, BDN-9-3, SAKI-9516, and JAKI-9218 showed low stability. None of the Chickpea (Desi) genotypes exhibited high stability in rainfed condition. The three location *viz.*, Rahuri, Washim and Aurangabad are found to be favorable environment for rainfed Chickpea. The four locations Digraj, Vadgaon, Badnapur, and Yawatmal are found to be average environment and two locations Solapur and Jalgaon, found to be unfavourable environment for rainfed Chickpea (Desi).

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*Mahatma Phule Krishi Vidyapeeth, Rahuri*

### 38. On Approximately Optimum Stratification for Compromise Allocation in Sampling with Varying Probabilities

S.E.H. Rizvi

The investigation on the effect of optimum stratification on sampling with varying probabilities under proportional allocation was taken up by Rizvi *et al.* (2004) for bivariate case. In the present paper, the same problem has been considered for two study variables  $Y_j$  ( $j = 1, 2$ ), using auxiliary information ( $X$ ) for stratification, when compromise method of allocation is envisaged. Under super population set-up, assuming that the study variables are linearly related with auxiliary variable i.e.  $Y_j = \beta_{jx}x + e_j$  ( $j = 1, 2$ ), minimal equations have been evolved and some approximate solutions have been obtained, as exact solutions are difficult to get. A cumulative cube root method for obtaining approximately optimum strata boundaries (AOSB) has been provided. Further, a comparison of proposed rule under compromise allocation technique has also been made with that of proportional allocation case.

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*S.K. University of Agricultural Sciences and Technology of Jammu, Jammu*

### 39. Small Area Estimation of Wheat Crop Yield for the Districts of Haryana State

S.C. Sethi, R.M. Sood and Bhagwan Dass

The estimates of principal crops are being obtained by using crop cut approach at the state/ district level with reasonable degree of precision. Such estimates are often associated with large sampling error due to inadequate representation of certain districts in the sample. The methodology of small area estimation is an alternative approach to get better results.

Several techniques of small area estimation are available in literature. In recent past, IASRI took up studies in the application of small area estimation of crop yields. This paper relates to a similar study on estimation of crop yields for small areas *viz.* districts in the state of Haryana. The data used was secondary collected under General Crop Estimation Survey (GCES) from Haryana state related to crop-cutting experiments of wheat crop and area figures at block level.

In this paper we have utilized synthetic method of estimation of developing block level estimates of seven districts of Haryana state for wheat crop. The estimates of the blocks yields ranges 26.08 to 32.96 Q/ha and %SE ranges 3.09 to 8.5 for synthetic estimator and 7.01 to 13.35 for usual estimator of the Hissar district. It is observed that block level estimates for wheat crop yield is fairly reasonable both with respect to consistency of results as well as with respect to efficiency of the estimates for all districts. The results are encouraging and show a lot of promise regarding the approach used.

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*Indian Agricultural Statistics Research Institute, New Delhi*

### 40. Statistical Models for Forecasting Milk Production in India

Satya Pal, Ramasubramanian V. and S.C. Mehta

Livestock plays a significant contribution to Indian national economy. The milch animals form an integral part of livestock. The milk is the main product from milch animals. Its enormous use among almost all categories of living organisms needs no emphasis. The

forecast of milk production is of paramount need for the planners/ policy makers to formulate appropriate strategies for its distribution system etc. In this paper, an attempt has been made to forecast milk production using the techniques based on time-series analysis. On comparison of results from the techniques double exponential smoothing and ARIMA(1,1,1)-models it has been observed that the forecast from the latter are slightly better than the former. Thus, from simplicity point of view, the double exponential smoothing may be preferred.

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New Delhi*

#### **41. Heterosis and Inbreeding Depression in Pea (*Pisum sativum L.*)**

Subedar Singh, J. Singh, S.K. Singh,  
R.K. Agarwal and Shailendra Pratap Singh

The present experiment was conducted to study the heterosis and inbreeding depression in pea. The nine diverse strains of pea namely HUP-16, HUVP-4, T-163, Latah, Traper, HFP-4, EC-341793, HUDP-16 and FC-1 were taken for study and nine crosses were made from these material namely HUP-16 × HUVP-4, HUP-16 × Latah, HUP-16 × HFP-4, HUP-16 × FC-1, HUP-16 × EC-341793, HUVP-4 × Traper, HUVP-4 × HUDP-16, HUVP-4 × Latah and HUVP-4 × T-163. The observations were recorded on the various quantitative traits namely, days to flowering, days to maturity, plant height, pods per plant, seeds per pod, grain yield per plant, 100 seed weight and protein content.

It is evident that HUP-16 × HUVP-4 appeared as good heterotic cross for most of the characters studied. Other than this, HUP-16 × Latah was a good heterotic cross for early maturity and the cross HUVP-4 × HUDP-16 exhibited desirable heterosis for all the other characters except protein content and earliness. Range of heterosis was higher in the case of yield/plant followed by test weight pod/plant and plant height. The crosses HUP-16 × HUVP-4, HUP-16 × Latah and HUVP-4 × HUDP-16 appeared as a potent source for developing suitable pure lines.

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*Banaras Hindu University, Varanasi*

#### **42. A Comparative Study of Rice Yield Forecast Model**

T. Rai and Chandrahas

Indian Agriculture is characterized by uncertainties of weather apart from other controllable input factors. Thus the yield in different years varies widely due to variation in weather parameters. Hence the essential requirement is to know how the changes in weather conditions during different growth stages of the crop affect the rice yield. Keeping this in view a study in rice yield is conducted for Raipur district in Chhatisgarh. Rice is the principal crop of kharif season occupying 60% of the total cropped area.

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*Indian Agricultural Statistics Research Institute,  
New Delhi*

#### **43. Double Ranked Set Sampling in the Context of Finite Population Sampling**

U.C. Sud and Dwijesh Mishra

The Double Ranked Set Sampling (DRSS) procedure has been extended to the case estimation of finite population mean under classical approach of survey sampling. In view of the complexity of the theoretical framework the sample sizes are restricted to '2'. Using real data it is empirically demonstrated that an estimator based on DRSS procedure performs better than estimators based on the Ranked Set Sampling (RSS) procedure and Simple Random Sampling (SRS) respectively.

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*Indian Agricultural Statistics Research Institute,  
New Delhi*

#### **44. Estimating Population Mean Square through Predictive Approach when Auxiliary Character is Estimated**

U.C. Sud, Prasenjit Pal and I.C. Sethi

In the context of estimation of population mean square Royall's (1970) prediction approach is extended to the case where information on auxiliary characters is not available. A double sampling procedure is proposed as an alternative under such a situation. The

efficiency of the estimator based on this scheme of sampling is compared with the one where the information on an auxiliary character for all the units in the population is collected. Optimum values of the sample sizes are also obtained. Further, an empirical study is carried out to examine the situations wherein the double sampling plan is superior.

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*Indian Agricultural Statistics Research Institute,  
New Delhi*

#### **45. Evaluation of Artificial Neural Network Applications for Data Imputation**

Ramasubramanian V.<sup>1</sup>, Ranjana Agrawal<sup>1</sup>, S.B. Lal<sup>1</sup>, V.K. Dubey<sup>1</sup>, Naresh Dutta<sup>3</sup> and G.K. Jha<sup>2</sup>

While several methods of data imputation exist, in recent times, the use of Artificial Neural Networks (ANNs) for imputation purposes has been increasingly recognized. In this study, evaluation of ANN has been done vis-à-vis some common imputation procedures. A sample of village-wise data of Karnataka state from the 2001 population census of India was taken upon the main variable i.e. number of agricultural labourers along with associated variables viz. total population, sex ratio, average household size, gender-gap in literacy rate, and work participation rate. Selected data items on the main variable for which full information was available were artificially considered as missing. Existing imputation procedures and ANN were applied to impute these values within classes which were formed based on information available upon associated variables. The results revealed that ANNs do provide a viable alternative method for imputation purposes.

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New Delhi*

<sup>2</sup>*Indian Agricultural Research Institute, New Delhi*

<sup>3</sup>*North Maharashtra University, Jalgaon*

#### **46. The Construction of Six Level Second Order Rotatable Designs**

Vineeta Singh and Tara Rani Agarwal

New methods of construction of six level second order rotatable designs are presented in this paper. The

efficiency of new design as compared to corresponding design introduced by Nigam (1977) using Balanced Incomplete Block Designs is also calculated. It is shown that the new method sometimes leads to more efficient designs with less number of design points as compared to designs constructed with the help of Balanced Incomplete Block Design introduced by Nigam (1977).

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*Dr. B.R. Ambedkar University, Agra*

#### **47. Curvilinear Models for Time Series Analysis and Prediction of Vegetable Production**

Vinod Kumar Chaudhary

Time series analysis commonly is using in engineering and technology, business management, physical sciences, earth sciences, medical sciences, agro-meteorology and agriculture sciences to knowing the real behaviour of past and to predict the future behaviour. Different statistical models are being applied by the Engineers & Technologists, Scientists & Research Workers, Planning & Policy Makers for analyzing the series data and its results are further used for making future policy and planning. In the present study different curvilinear models viz. Straight line, Exponential curve, Logistic curve were tried and fitting in time series data of 40 years data of vegetable production of India and its fitting were tested with Goodness of Fit test. It is found that straight line model has been found to be best.

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*Department of Basic Sciences, UHF, Solan*

#### **48. Estimation of Finite Population Mean using Correlation Coefficient when Variables are Negatively Correlated**

Virendra Pratap Singh and Rajesh Tailor

In this paper a dual to ratio estimator has been suggested to estimate finite population mean using correlation coefficient when variables are negatively correlated. Bias and mean squared error expressions are obtained. It has been shown that proposed estimator is more efficient than the estimators given by Srivenkataramana (1980) and Bandyopadhyaya (1980).

An empirical study is also carried out to demonstrate the performance of the suggested estimator.

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*NCERT, New Delhi*

#### **49. Estimating Population Variance using Auxiliary Information**

Vyas Dubey and H.K. Sharma

The paper deals with a difference type estimator of population variance using auxiliary information. It is found that proposed estimator is more efficient than various estimators under stringent conditions. After estimating the constants involved in the estimator, modified regression estimator has been suggested. A numerical illustration has also been made.

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*Pt. Ravishankar Shukla University, Raipur*

#### **50. Estimation of Area, Production and Productivity of Flowers in Delhi**

A.K. Gupta, M.S. Narang, V.K. Jain, U.C. Sud and K.K. Tyagi

India has a wide range of climate and soil conditions which enable cultivation of an array of horticultural crops such as fruits, vegetables, floricultural plants, plantation crops, and spices, medicinal and aromatic plants. Over the past one decade, floricultural sector has emerged as a viable diversification option for generating large foreign exchange earnings. In case the productivity of the floricultural inputs needed for this sector can be increased, it will be possible not only to fully meet the growing demand for flower but also to substantially export flowers to the world market. India has a good potential for floriculture due to favourable climatic conditions suitable for production of flowers during winter (October-March). Other factors like the geographic location, availability of cheap labour and abundant soil space puts India in an advantageous position for commercial production of flowers. At present, an objective method of reporting of area, production and productivity of flowers is not available. Although National Horticulture Board publishes area and production figures, these are not based on any

statistical/ scientific procedure. The already existing crop-cutting experiment approach being followed in case of other crops would be cost-prohibitive for developing estimates of area and production of flowers. This is due to multi-pickings involved in case of flowers. In this context, the National Statistical Commission has recommended the need to develop a suitable sampling methodology for estimation of area and production of flowers. Therefore Indian Agricultural Statistics Research Institute conducted a study entitled "Pilot sample survey to develop sampling methodology for estimation of area, production and productivity of important flowers on the basis of market arrivals" funded by the Ministry of Statistics and Programme Implementation, Central Statistical Organization, Government of India, to meet the requirement of reliable estimates on area and production of flowers based on the statistical methods with the objective to develop precise estimates of the area, production and productivity of flowers in Delhi. In this paper, the data collected in the flower growing villages of Delhi has been utilized for estimation of area, production and productivity of flowers.

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*Indian Agricultural Statistics Research Institute, New Delhi*

#### **51. Nonlinear Time Series Modelling through Self Exciting Threshold Autoregressive Approach**

Himadri Ghosh and Prajneshu

A very important family of Nonlinear time-series models, viz. Self exciting threshold autoregressive (SETAR) types of models is thoroughly studied. A heartening feature of this family is that it is capable of describing cyclical data. Formulae for computing out-of-sample forecasts are theoretically derived by recursive use of conditional expectations. As an illustration, SETAR models are then applied to describe country's lac export data during the period 1900-2000, obtained from Annual Reports of Shellac Export Promotion Council, Kolkata. Tukey's test for non-additivity and Likelihood Ratio test for linearity are used to examine linearity of the data. It is noticed that data depicts nonlinearity. It is shown that fitted model, based on minimum Akaike Information Criterion (AIC),

exhibits a threshold behaviour in the state space. Mechanistic interpretation of underlying cyclicality is provided based on fitted model. Optimal predictor is obtained for out-of-sample data based on fitted SETAR model, and the same is found to be quite satisfactory.

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## 52. Assessing Stability of Crop Varieties with Incomplete Data

B.M.K. Raju<sup>1</sup>, V.K. Bhatia<sup>2</sup> and L.M. Bhar<sup>2</sup>

Joint regression has been very popular among plant breeders to evaluate stability of crop varieties tested under multi location-year trials. The plant breeders often finish their investigation for stability with Eberhart and Russel model (1966) though the component of deviation from linear regression is found significant for many varieties. Consequently, in such situations one cannot do ranking of all the genotypes tested with regard to stability. Eventually pair-wise comparisons with respect to stability can be made only in a subset of genotypes, whose deviations from linear regression are found insignificant. This study aims to elaborate the limitations of Eberhart and Russel model in evaluating stability of a set of varieties tested and suggest plant breeders alternative measures of stability when Eberhart and Russel model fails to comment on the stability of a good number of varieties tested. Often a problem faced by plant breeders is non-availability of data on all locations-years and varieties, which makes the data set obtained from multi environment testing (MET) unbalanced. There is a need to study the methodologies cited in literature that can handle incomplete data situations to bring out their practical relevance as on today, to develop handy computational algorithms wherever required and to compare their capabilities in evaluating stability of the varieties tested under MET. The present study focuses on these issue.

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<sup>2</sup>Indian Agricultural Statistics Research Institute, New Delhi

## 53. Repeated Measurements Designs for Bioequivalence Trials

Cini Varghese, M.N. Sonawane, Seema Jaggi and V.K. Sharma

Bioequivalence trials are conducted to investigate the degree to which clinically important outcomes after receiving a new (test) formulation resemble those of a previously well established (reference) formulation of a drug. Repeated measurements designs (RMDs) balanced for residual effects are the most recommended experimental designs for these trials. However, in bioequivalence trials, the experimenters are not interested in all pairwise comparisons among direct effects and among residual effects of formulations, but are interested in test vs. reference formulation comparisons of direct and residual effects. Here, a class of reference balanced complete sequence RMDs has been obtained for such experimental situations that are variance balanced. Further, for situations where the experimenter can not afford to continue the experiment for many periods, incomplete sequence reference balanced RMDs may be used. One such class of incomplete sequence RMDs, where number of periods is less than the number of experimental units, has been obtained which is partially variance balanced. The variances of contrasts pertaining to test vs. test and test vs. reference formulations among direct effects and residual effects have also been worked out for both the classes.

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Indian Agricultural Statistics Research Institute, New Delhi

## 54. Efficient Neighbour Balanced Block Designs for Correlated Observations

Jitendra Singh Tomar and Seema Jaggi

Neighbour balanced designs, permitting the estimation of direct and neighbour effects, are used when the treatment applied to one experimental plot may affect the response on neighbouring plots as well as the response on the plot to which it is applied. The allocation of treatments in these designs is such that every treatment occurs equally often with every other treatment as neighbours. Neighbour balanced block designs for observations correlated within a block have

been investigated. The performance of these designs for autoregressive and nearest neighbour error correlation structure is studied when generalized least square estimation is used. The efficiencies for direct and neighbour effects of the designs as compared to a neighbour balanced complete block design of Azais *et al.* is computed and tabulated for some cases. It is observed that efficiency is quiet high, in case of complete block designs for both AR(1) and NN correlation structures. In case of incomplete block designs, designs with AR(1) structure turns out to be more efficient. However, the efficiency of direct effects of treatments is more as compared to neighbour effects under both the structures.

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### 55. Robustness of BIB and GD Designs for Correlated Observations

Seema Jaggi, Rajender Parsad, V.K. Gupta and Suman Kumar

In the analysis of data from the conventional block designs, it is assumed that the fertility associated with plots within a block is constant and thus the observations are independent. There may, however, arise situations, specially in agricultural field experiments, that plots occurring close together within a block are likely to be more similar than plots occurring far away from each other as the blocks are often formed using adjacent plots within a field. The experimental plots occurring close together within blocks are therefore *correlated*. The designs developed for correlated observations are position dependent and lack within block randomization thereby sacrificing the basic principle of randomization. Also the designs require large number of blocks thereby increasing the total number of experimental units. Balanced Incomplete Block (BIB) and Group Divisible (GD) designs are incomplete block designs that are highly efficient for inferring on a complete set of orthonormalized treatment contrast when the observations are uncorrelated. Robustness of these designs has been studied for experimental situations with correlated observations. The A-efficiency of the designs under different error correlation structures is obtained. A list of BIB and GD designs for number of treatments

$v \leq 10$  giving efficiency for nearest neighbour and autoregressive error structures has been prepared for different values of correlation coefficient. These designs are seen to be quite robust and therefore can be used in the presence of correlation among observations.

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New Delhi*

### 56. Neighbour Balanced Block Designs for Test Treatments - Control Comparisons

N.R. Abeynayake, Seema Jaggi and Cini Varghese

Neighbour-balanced designs, wherein the allocation of treatments is such that every treatment occurs equally often with every other treatment as neighbours, are used when the treatment applied to one experimental plot may affect the response on neighbouring plots besides the response to which it is applied. For example, in varietal trials, the yields of the shorter varieties are often depressed because of shading from taller neighbours. Neighbour-balanced designs ensure that no treatment is unduly disadvantaged by its neighbours. Further, it is also sometimes desired to compare a set of test treatments with a control. The main interest is to estimate the contrasts pertaining to tests vs. control with high precision. Two series (one complete block and one incomplete block) of neighbour balanced block designs for comparing a set of test treatments to a control have been developed. The designs obtained are totally balanced in the sense that all the contrasts among test treatments for direct, left and right effects are estimated with same variance and all the contrasts pertaining to test vs. control for direct, left and right effects are estimated with the same variance.

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### 57. Response Surface Analysis Incorporating Neighbour Effects from Adjacent Units

Sarika, Seema Jaggi and V.K. Sharma

Response surface analysis determines a model that best fits the data collected from the design chosen,

provides reliable estimates of the response of interest and further helps in obtaining the optimal settings of the factors that produce the best response. In response surface analysis, in general, it is assumed that the observations are independent and there is no effect of neighbouring plots. But in field experiments, the neighbour (overlap or competition) effects from the treatments applied to adjacent neighbouring plots may arise. For example, if one plot receives a spray chemical treatment, wind drift may cause the effect of spray into adjacent plots. It is, therefore, assumed that the response depends not only on the treatment combinations applied to that particular plot but also depends on the treatments applied in the neighbouring plots. The response surface model, incorporating the neighbour effects from adjacent plots, has been studied. The same has been fitted to the data from an agricultural field experiment and accordingly the competition coefficient is estimated. The results have shown a substantial reduction in residual sum of squares and more precise estimates of the parameters.

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### **58. Assessment of Different Spatial Analysis Methods under Backdrop of Real Life Data**

Anurup Majumder, Arup Chattopadhyay,  
Pradip Kumar Sahu, Aatish Sahu and  
Satyabrata Pal

Existence of trend among plots within a block induces non-randomness in the observations collected from neighbouring plots. This phenomenon leads to bias in variety comparisons and can not be removed adequately by employing randomisation, replication and local control. Thus, a classical analysis of variance on data from a RBD often does not account for spatial correlation existing in neighbouring plots. The emergence of nearest neighbour techniques employed in block designs is a recourse to understand account and remove the correlation existing among neighbouring plots. A literature survey reveals an existence of several methods employing nearest neighbour (NN) analysis to estimate the variety comparisons more efficiently. The effort in this area was initiated by Papadakis and after a span of a quarter century, his works were critically

assessed and refined by Besag, Bertlett, Wilkinson, Martin, Green, Stroup, Clarke, etc. The basic input in the models was to introduce a trend effect resulting in more efficient analysis. This paper is devoted to assess the above mentioned methods under a real life situation. In fact, a trial was conducted to compare twelve (12) varieties of elephant foot yam under AICRP on tuber crops in the years 2002, 2003 and 2004 at Horticultural Farm, BCKV, Mondouri. The experimental lay-out of the trial was an RBD with three replications. The data were examined and an evidence of trend effect was confirmed. Several NN analysis methods were applied and the efficiencies of different methods were calculated. A comparative statement for assessment of different methods was prepared. It was interestingly found that the efficiency (compared with RBD) values ranged from 30% to more than 90%.

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*Bidhan Chandra Krishi Viswavidyalaya, Red and Laterite Zone, Paschim Medinipur*

### **59. Advanced Statistical Analysis of Clinical Data Related to Heart Patients**

K.L.A.P. Sarma and B. Madana Mohana Babu

Earlier the authors presented a paper relating to the fundamental and simple statistical analysis of the clinical data collected from 100 male and 100 female cardiac patients on various characteristics like: 1) Blood Sugar, 2) Serum Cholesterol, 3) Blood Pressure (Systolic and Diastolic), 4) HDL, 5) LDL, 6) VLDL and 7) Triglycerides. In the above analysis the major factors causing heart attacks are identified as: 1) Diabetic Mellitus, 2) Overweight, 3) High Blood Pressure, and 4) Physical Inactiveness. Similarly major contributing age is identified as 40 – 45, 45 – 50 and 55 – 60 years. These conclusions are drawn based on simple statistical tools. Further the data is collected at 6 different stages namely:

- 0 - Measurements at the time of first consultancy with the doctor
- 1 - Measurements after one month of consultancy
- 2 - Measurements after three months of consultancy
- 3 - Measurements after six months of consultancy
- 4 - Measurements after nine months of consultancy
- 5 - Measurements after twelve months of consultancy



In the present paper we try to apply advanced statistical techniques like ANOVA – Two-way, to identify the significant effect of treatment between stages mentioned above and paired t-test, to test the significant difference between various averages. Wherever it is possible, analysis was applied for male and female patients separately and conclusions are drawn based on the results obtained.

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### **60. Discriminant Analysis for Mung-Gram System having Same Attributing Characters towards Seed Yield**

C.A. Nimbalkar<sup>1</sup> and V.H. Bajaj<sup>2</sup>

A study was conducted to find out a predictive model through discriminant analysis in mung-gram system. The study was conducted taking days to 50% flowering, plant height, plant spread, number of branches per plant, number of pods per plant, number of seeds per pod and seed yield as independent variables. The predictive model provides the best discrimination between the mung and gram crops. Discriminant function analysis is the appropriate statistical technique when the dependent variable (group of crops) is categorical and independent variables are metric. It reveals that plant height contributed most towards seed yield in both the crops followed by number of branches and pods per plant.

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<sup>1</sup> *National Agricultural Research Project (Plain Zone), Ganeshkhind*

<sup>2</sup> *Dr. B.A. Marathwada University, Aurangabad*

### **61. Association of Characters and Path Coefficient Analysis in Pigeon Pea**

G.K. Chaudhary, M.P. Patel and S.B.S. Tikka

The information about the correlation between yield and its component is essential for crop improvement because yield is determined by many characters and if selection made only on the basis of seed yield may likely to be misleading. Therefore, the present investigation was undertaken to derive such information. The correlation and path coefficients were worked out for 63

genotypes for eleven characters at Main Pulses Research Station, Sardarkrushinagar. The correlation studies revealed that the number of branches per plant and number of pods per plant were found to be strongly and positively associated with grain yield and also among themselves. Path coefficient analysis revealed that all the characters except days to maturity, plant height and 100 seed weight showed positive direct effects. Considering correlation and path analysis revealed that the number of branches per plant and number of pods per plant showed positive and highly significant correlation with seed yield and also positive direct influence on their correlation with grain yield. Therefore these characters can be considered as important components of grain yield and selection for these characters might bring an improvement in grain yield.

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*S.D. Agricultural University, Sardarkrushinagar*

### **62. Analysis of On-Farm Experiments over Farming Situations**

D.N. Jha, P.K. Batra and Rajender Parsad

On-farm trials are conducted to test the performance of recommendations that are made on the basis of experiments conducted at research station. To conduct the on-farm trial at NARP zone level, a random sample of few farming situations (FS) within that NARP zone are selected at first stage. In the subsequent stages a random sample of few development blocks, villages and cultivators are selected. For the identification of the best technology, for a given development block, the appropriate analytical procedures needs to be developed. The analytical procedure used, at present, for combined analysis of data over farming situations ignores the variability between blocks (FS), villages (Block \* FS), treatment × block (FS). Although some researchers have taken care of these variability factors, considering all these effects as fixed. Since FS, development blocks and villages are a random sample from a totality of villages, therefore these effects and effects depending upon these factors are random. Hence, there is a need to develop the analytical procedure based on linear nested mixed effect model for analysis. Further, it is also desired to identify the treatments that are best in a given development block for a given farming situation, so that the recommendations can be

made at a smaller area level. In this study a method has been developed to analyze on-farm trials data, which assumes all factors as random except treatment in the model. By using this method, comparison of treatments within blocks and FS could be carried out and one can identify the treatments that are the best in a given development block and for a given farming situation.

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### 63. Rice Yield Forecasting using Artificial Neural Networks (ANN) Model

S. Ravichandran and P. Muthuraman

Forecasting time-series data collected over time is performed using ARIMA time-series modelling and structural time-series modelling (STM) methodologies. STM methodology has advantage over ARIMA time-series modelling methodology as STM methodology does not require stationarity of the given time-series data. Of late, Artificial Neural Network (ANN) modelling is widely utilized for modelling time-series data and subsequent forecasting. This modelling methodology is widely used in many fields of study like engineering, medical science and economics. An ANN is an information processing system that roughly replicates the behaviour of a human brain by emulating the operations and connectivity of biological neurons. It performs a human-like reasoning, learns the attitude and stores the relationship of the processes on the basis of a representative data set. Depending on the structure of the network, usually a series of connecting neuron *weights* are adjusted in order to fit a series of inputs to another series of known outputs. When the weight of a particular neuron is updated, it means the neuron is *learning*. The training is the process that neural network learns. Once the training is performed, the verification is very fast. Forecasting all-India rice production and productivity is carried out by fitting an ANN model by utilizing data on annual rice production, productivity along with total rainfall received for the period 1975-76 to 2005-06. It is verified that the ANN modelling methodology performs much better than the traditional modelling procedures such as Regression, ARIMA and STM modelling approaches. Finally, forecasts of rice production and productivity for the year

2006-07 obtained using ANN modelling methodology are 89.55 million tons and 2049 kg ha<sup>-1</sup>.

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*Directorate of Rice Research, Hyderabad*

### 64. An Algorithm for Linear Trend-free Designs with Two Level Factorial Experiments

Krishan Lal and Susheel Kumar Sarkar

In many experimental situations, the experimental units exhibit a smooth trend over time or space and thus random allocation of treatments to the experimental units may no longer be appropriate for obtaining the efficient estimates of the parameters. Instead systematic run orders or designs may have to be used to eliminate the effects of such trend. The resulting designs are called as *trend-free designs*. Designs eliminating trend of first order, second order are called linear, quadratic trend-free designs. In the field experiments when there is slope in field or on undulated land on hilly areas, such trends may exist. This paper, therefore, provides an algorithm for obtaining linear trend-free factorial experiments for  $k$  factors each at 2 levels. For  $k \leq 3$  experiments, each contrasts of main effects will be linear trend-free and for  $k \geq 4$  factors, each main effect contrast will be at least quadratic trend free and each two factor interaction contrast will be at least linear trend-free. This algorithm uses the technique of complementary fold over and component wise product of the contrasts of different effects.

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### 65. Modeling of Potato Yield in India: An Empirical Approach using ARCH/GARCH Model

Sanjeev Panwar<sup>1</sup>, Anil Kumar<sup>1</sup> and  
Sukhpal Singh<sup>2</sup>

This study discusses the application of nonlinear models viz. Gompertz, Logistic, Quadratic, Mercer-Morgan-Flodin (MMF), Weibull and Richards, to measure the growth and comparing with ARCH/GARCH methodology. Time series data on potato yield in India during 1950-2003 were utilized for the present study.

Statistical modeling essentially consists in constructing a model, represented by a set of equations to describe the input-output relationship among the variables of interest. From a realistic point of view, such relationships among variables in agricultural and horticultural sciences are non-linear in nature. The non-linear models are very popularly used in various fields such as population studies and animal growth in situations where growth is not symmetrical about the point of inflection.

In nonlinear models, the procedure of estimation is more computationally involved as compared to linear models. Instead of simply listing explanatory variables, in nonlinear models, the model was specified and a guess on initial values were made using different procedures given by Ratkowsky (1983). Fitting the data using different non-linear model may not be always successful as sometimes this model may fail to converge for certain data. The fitted non-linear models are compared using statistics such as Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE), Theil statistic/ One Step Ahead Forecasting (OSAF), etc. and found that both Logistic and Gompertz model are better fit to describe all India potato yield data.

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## 66. A Contribution to Universally Optimal One Sided Neighbour Effect Design

Praphullo Kumar and K.K. Singh

Particularly, in agricultural design of experiment the treatment received by a plot may affect the other response on the neighbouring plots of a same block or in the other words it may happen to affect the response on the following plot. For example of the second condition, the tall varieties may affect the other crops grown on the neighbouring plots by their shades, Bailey (2003) has developed such design concerned with the study of one sided neighbour effect. This paper gives a new series of Universally Optimal One-Sided Neighbour Effect Designs.

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## 67. Change-Over Designs for Repeated Extra Periods

R.R. Laxmi<sup>1</sup> and Shallender Singh<sup>2</sup>

When analyzing the response to treatments administered in sequence to each of a group of subjects, it is often advisable to take into account the possibility that the treatments produce residual effects in periods subsequent to their applications. Further, elimination of confounding produces the variances of contrasts between direct effects to their minimum values by Quenouille (1953). Fedrer and Atkinson (1964) have constructed designs in which variances of differences between estimates of direct effects are very nearly equal to those between estimates of first residual effects. Patterson and Lucas (1959) have given a review of other change over designs based on Latin or Youden squares. They further describe extra period designs in which treatment used in the last period of a basic change-over designs are repeated in an extra period. In this paper, the designs in which the treatment used in the period succeeding the first period and those used in the last period, each is repeated in an extra period and presented. This extra period allow to estimate the direct and the residual treatment effects. As a result the estimated result of residue and permanent effects are reduced.

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## THEME 3: AGRICULTURAL INFORMATICS

### 1. An Insight into the Similarity Aspects used on Web

Aditi Sharan<sup>1</sup> and Shashi Dahiya<sup>2</sup>

The question of similarity is a heavily researched subject in the computer science, artificial intelligence, psychology, and linguistics literature. Typically, these studies focus on the similarity between vectors, strings, trees or graphs, or simple objects. Good similarity measures are central for techniques such as retrieval, matchmaking, clustering, data-mining, ontology

translations, automatic database schema matching, and simple object comparisons.

Similarity considerations play most important role in web mining for returning the relevant web documents based on the query defined by the user. Depending on need and applications different similarity measures have been used by researchers working on web. However, in our knowledge no serious attempt has been made to address the question of similarity as such. Therefore, anyone who wants to enter into the field of web mining remains confused about the similarity issues. In this paper we made an attempt to fill this gap by covering some important similarity measures that have been used in the context of web documents, categorize them, present basic idea behind them and discuss their significance and applicability. As innumerable similarity measures have been used, therefore in no way we claim to cover all similarity measures. Instead our attempt is to provide an insight into similarity aspects on the web so that these similarity measures can be used in a more meaningful way.

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## 2. Gender Distribution of ICAR Personnel using PERMISnet

Alka Arora, Balbir Singh, Shashi Dahiya,  
Md. Samir Farooqi

PERMISnet system contains data of 26,859 ICAR personnel comprising of 4403 scientists, 7609 technical and 14847 administrative & supporting personnel. In this paper analysis has been done on PERMISnet data collected up to August 2006 to access the gender distribution of ICAR personnel. Analysis of the data reveals that male and female ratio in total staff strength is 88:12. Further examination of data revealed that female personnel are contributing 12% in scientific services, 7% in technical services and 15% in the administrative and supporting services as compared to their male counterpart. It is further observed that among different subject matter divisions, animal science and natural resource management divisions have less number of female scientific personnel. Reservation of personnel

in general, schedule caste, schedule tribe and other backward class categories shows their distribution of 77:9:2:12 in scientific, 54:20:6:20 in technical and 48:26:7:19 in administrative & supporting services.

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## 3. Support Vector Machine (SVM) for Classification of Spatial Data

Anshu Dixit and Sonajharia Minz

Spatial data mining is the process of discovering interesting and previously unknown, but useful, patterns from spatial datasets. One of the aspects of spatial data mining is to give the information about the data that a user can interpret. Classification is the most popular way to obtain a structured view of the data. In a given spatial data set (a training set) with one attribute as the dependent attribute, the classification task is to build a model to predict the unknown dependent attribute values of the future data based on other attribute values as accurately as possible. Support Vector Machine (SVM) is one example of machine learning algorithms that has emerged as one of the promising options for classification. SVM represents a group of theoretically superior machine learning algorithms that employs optimization algorithms to locate the optimal boundaries between classes. Statistically, the optimal boundaries should be generalized to unseen samples with least errors among all possible boundaries separating the classes. SVM have already been used in a wide area of applications to classify the data. This paper is an attempt to explore the applicability of support vector machines for classifying spatial data.

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## 4. Ontology based Knowledge Management in Agriculture

Anu Sharma<sup>1</sup>, Rajni Jain<sup>2</sup> and Krishna Asawa<sup>3</sup>

Efficient and effective search for knowledge requires knowledge management. Standard information retrieval

mechanisms when applied in on-line learning environments do not offer access to semantic relationships between knowledge items, and thus are unable to put query results in context. Ontology and semantic web are emerging as key technology to help user in accessing relevant information when required. This study describes an ontology-based approach for semantic retrieval of agricultural research web pages. Ontology for various concepts and relationships in agricultural research management has been proposed using Simple Hypertext Ontological Extensions (SHOE), a knowledge representation language. SHOE based annotation of a home page of an agricultural research project has been described along with tools for its semantic searching. This approach has potential for researchers, policy makers and students in agricultural and allied sciences for the retrieval of knowledge from fast growing medium like World Wide Web.

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### **5. A Windows-Based Software for Cataloguing and Generation of Repeated Measurement Designs**

Anu Sharma, Cini Varghese, A.R. Rao and V.K. Gupta

Designs in which each experimental unit receives some or all of the treatments, one at a time, over a period of time are called repeated measurements designs (RMDs). Various classes of RMDs are scattered all over literature. There is a need to catalogue these designs at one place for easy selection of a suitable design in a given experimental situation. At present, no software seems to be available for cataloguing and generation of these designs. We describe here windows based software, for cataloguing, generation and randomization of RMDs, developed using Microsoft Visual Basic 6.0 programming language for Win98/WinNT. This software is completely menu-driven and offers a user-friendly interface for its easy operability. This software is highly helpful to the statisticians and researchers in the areas like animal nutrition experiments, clinical trials in

medical research, and long term fertilizer experiments in agriculture, educational studies, bio-equivalence trials etc.

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### **6. Software for Imputation of Non-Response in Survey Data**

Anu Sharma, S.B. Lal and V.K. Mahajan

In surveys, the sampled units may not provide answers for all the survey items. Missing data are often contained in data sets and this makes prediction of the parameters difficult. Imputation is frequently used in survey research to assign values for missing item responses, thereby producing complete data sets for general analysis. This paper describes a stand alone software for imputation of non-response items in a collected survey data set based on a number of sampling designs such as simple random, stratified, cluster and stratified cluster. This software can impute non-response data items using imputation methods such as mean, zero and mean of neighboring units. The software has a spreadsheet like data management module to import input survey data from MS-Excel sheet, MS-Access database and text files. A class library containing imputation methods for above mentioned sampling designs has been developed. This software is developed using .NET framework with C# language. This is a user friendly software that generates the imputed data in a new column and can be repeatedly used to carry out imputation with different designs on same input data.

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### **7. Automatic Knowledge Acquisition System for Pulse Diseases**

Devraj<sup>1</sup> and Renu Jain<sup>2</sup>

Knowledge acquisition is one of the most difficult and error-prone task that a knowledge engineer does while building a knowledge-based system. The cost and performance of the application depends directly on the quality of the knowledge acquired. An Automatic Knowledge Acquisition System for Pulse Disease

(AKAS-PD) facilitates the encodement of expertise into a pulse disease knowledge base (PD-KB). The objective of the proposed system is to overcome the problem of knowledge acquisition for pulse disease diagnostic domain by developing an automatic system which can be used for all type of pulse crops in the country. Here, we present the design and development of an automatic user-friendly interactive knowledge acquisition system having the facilities of adding, viewing, modifying and deleting both types of knowledge (i.e. textual and pictorial). The system also assists the domain expert and the knowledge engineer to feed knowledge in the knowledge base in a structured form and in maintaining consistency of the encoded knowledge. The basic structure of the knowledge base is designed by the knowledge engineer on the basis of different types of knowledge needed for the identification and control of pulse diseases.

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<sup>2</sup>CSJM University, Kanpur

## 8. Thesaurus: A Source for Selecting Terms in Query Expansion

Hazra Imran and Aditi Sharan

The explosive growth of the World Wide Web is making it difficult for a user to locate information that is relevant to his/ her interest. Though existing search engines work well to a certain extent but they still face problems like *word mismatch*, which arises because the majority of information retrieval systems compare query and document terms on lexical level rather than on semantic level and short query: the average length of queries by the user is less than two words. *Short queries and the incompatibility between the terms in user queries and documents strongly affect the retrieval of relevant document*. Query expansion has long been suggested as a technique to increase the effectiveness of the information retrieval. Query expansion is the process of supplementing additional terms or phrases to the original query to improve the retrieval performance. The central problem of query expansion is the selection of the expansion terms based on which user's original query is expanded. Thesaurus helps to solve this problem. Thesaurus have frequently been incorporated in information retrieval system for identifying the synonymous expressions and linguistic

entities that are semantically similar. Thesaurus has been widely used in many applications, including information retrieval and natural language processing.

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## 9. Online Soil Test based Fertilizer Recommendation System for Targeted Yield using Soil Fertility Maps - An Attempt to Bridge the Web Technologies with the GIS

K.N. Singh<sup>1</sup>, N.S. Raju<sup>1</sup>, Abhishek Rathore<sup>1</sup>, Karan Singh<sup>2</sup> and A. Subba Rao<sup>1</sup>

Optimum return on the investment and minimum environmental pollution are major issues to be addressed while giving soil test based nutrient recommendations. The web based online nutrient recommendation system discussed in this paper is an online solution which provides an easy mechanism to recommend the major fertilizers N, P and K for various crops in different States based on available nutrients in the soils and for targeted yield of crops. This system is user friendly and can be operated without any scientific knowledge. The software has been developed with the help of information available from AICRP on of Soil Test Crop Response correlation (STCR) project. Software is implemented by designing a database for fertilizer recommendation for different states of the country. A user-friendly interface for the database management and efficient data retrieval has also been developed.

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## 10. Design and Development of Data Mart for Field Crops in India

K.K. Chaturvedi<sup>1</sup>, Anil Rai<sup>1</sup>, P.S. Pandey<sup>2</sup>, Vipin K. Dubey<sup>1</sup> and P.K. Malhotra<sup>1</sup>

A data mart on field crops in India is a logical subset of data warehouse on agricultural resources in India. This data warehouse has been developed in sub-project under National Agricultural Technology Project (NATP) entitled "Integrated National Agricultural Resources Information System". The

mission set for this project was to design and development a flexible Central Data Warehouse (CDW) of agricultural resources of the country at IASRI, New Delhi (lead center) and databases on different subjects at respective co-operating centers. The target users of information systems and decision support system developed under this project are (i) Research Managers, (ii) Research Scientists and (iii) General Users. In this project a state of art Central Data Warehouse (CDW) of agricultural resources of the country has been developed at IASRI, New Delhi. This is probably the first attempt of data warehousing of agricultural resources in the world. This provides systematic and periodic information to research scientists, planners, decision makers and developmental agencies in the form of On-line Analytical Processing (OLAP) decision support system. In this paper, an attempt has been made to present various steps that are needed in designing, developing and implementation of data mart on field crops in India. Attempt has also been made to provide an overview about the reporting and cube building through which user is enabled to do OLAP on field crop data mart of this data warehouse.

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### 11. An Application of Vague Set based Model in Students Evaluation

Karan Singh<sup>1</sup>, Shailenda S. Thakur<sup>2</sup> and K.N. Singh<sup>3</sup>

In this paper we considered three existing approaches for evaluation of students' answers scripts (traditional marking method, grading method and fuzzy evaluation method) and a better method of evaluation called VEM (Vague Evaluation Method) is a computer and vague set based approach where a vague valued (satisfaction based) marking is used. The paper shows a good and successful application of vague set theory described by Gau *et al.* (1993).

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### 12. A Perspective on the Distribution of Personnel Visited Abroad from the ICAR

Md. Samir Farooqi, Balbir Singh, Shashi Dahiya and Alka Arora

To provide accurate information of its employees instantly to the management for systematic planning and management of human resources in ICAR, making projections and catering to the personal and professional needs of its employees, an "Online Personnel Management Information System for ICAR (PERMISnet) has been developed. The site is currently hosted at the IASRI server and can be accessed through the web address [www.iasri.res.in/permisnet](http://www.iasri.res.in/permisnet). Till date personal information of about 28,186 employees of the Council (including retired personnel from the year 2002) have been entered into the system. In this paper an attempt has been made to extract the information available in the PERMISnet system till September 2006 and throw some light on the facts and figures related to visits abroad of ICAR personnel. The paper takes into account the total visits abroad by ICAR personnel from the date of joining the Council till date. The content in the paper covers different aspect of information available on visits abroad. Modal age of the personnel visited abroad from the Council at the time of visit is found to be 40 years. The results from the various tables and figures shows that large number of personnel from ICAR visited abroad from all the subject matter divisions of the Council and the number of visits from each division is proportionate to the staff strength of that particular division. The female employees in the Council constitute 12% of the total staff strength of the Council. Out of the total visits abroad from the Council the contribution of female employees is found to be 8.8% only. The Female: Male ratio of the total visits abroad by ICAR employees is 0.09 whereas the overall Female: Male ratio of ICAR employees is 0.13. This signifies that there has been no gender discrimination in total visits abroad. Maximum numbers of personnel visited abroad were found to be in the age group of 31-40 years, which accounts for 42.1 percent of the total population visited abroad. It indicates that the Council had followed the policy of encouraging and promoting visits at younger age. Also the maximum visits from the Council had been for training purpose in all the service

type and these visits have been across the continents covering the entire globe.

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### **13. Framework for Development of Decision Support System in Water Management and Crop Planning**

Mukesh Kumar<sup>1</sup>, Manoranjan Kumar<sup>1</sup> and R.K. Chauhan<sup>2</sup>

Decision Support Systems (DSS) are defined as computer-based systems that integrate data sources with modeling and analytical tools to facilitate decision making under a variety of situations. The paper describes the designing of the framework for DSS for water management and crop planning utilizing mathematical and simulation models. The structure also includes special features for users with crop management knowledge. The developed system is capable of predicting climatic data for various time periods and estimating the water requirements of different crops during the season. The system carries out feasibility analysis and evaluation of alternative options in order to arrive at an optimum course of action. A user-friendly interface enables the lucid interaction with the system and visualization of the results for the users.

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### **14. A Computer Software for Maintenance and Retrieval of Weather Information**

N.K. Chaure<sup>1</sup>, R.S. Jha<sup>1</sup>, D. Pandey<sup>2</sup> and A.K. Sahu<sup>1</sup>

Weather information is an important part of agricultural and biological research. Increase or decrease in insect/ pest population or disease incidence depends on various climatic factors as maximum temperature, minimum temperature, humidity, pan evaporation, vapor pressure, rainfall, sunshine hours, wind velocity and wind directions etc. All these different weather parameters recorded in observatory daily. Day to day maintenance and retrieval of these

meteorological data for transmitting to various agencies and researcher becomes very difficult. We have developed PC-based software for maintaining and retrieval of meteorological data. The software also generates the different kind of weather report as required by the researcher and other agencies. Proper software engineering techniques and design is adopted for the development of this software. According to the requirement and utility of weather data, software is developed in different phases like-Data Entry phase, Data Editing phase, Data Retrieval phase, Query phase, Authentication phase and Help phase. This software is developed in front end tools as Microsoft Visual Basic 6.0 and back end tools as Microsoft Access 97. The software runs under Windows 95 or its later version. The minimum hardware required to execute this software is 80486 processor and above, 16 MB RAM. User can generate various reports like, day to day, monthly mean, weekly mean, yearly mean meteorological data and general queries by using this software. The software is completely user friendly and menu driven and requires minimum key board inputs.

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<sup>2</sup>*GGDU, Bilaspur*

### **15. Cropping Systems Analysis of Indo-Gangetic Plains of India using Remote Sensing and GIS**

P.S. Pandey, G.C. Sharma and S.K. Sharma

Cropping system refers to an arrangement of crops in temporal and spatial dimensions on a given piece of land and their interactions with farm resources and available technologies. It is highly site-specific and in stricter sense, varies from farm to farm. But in broader sense, cropping systems of a region are decided by and large by a number of soil and climatic parameters which determine overall agro-ecological setting for nourishment and appropriateness of a crop or set of crops for cultivation. Under influence of all above factors, cropping systems remain dynamic in time and space, making it difficult to precisely determine their spread using conventional methods. Information on existing cropping system is vital for supporting agronomic management decisions like substitution of an existing inefficient cropping system with new improved cropping system by introduction of new crops. The



present paper deals with the integrated use of remote sensing and GIS in cropping systems analysis of Indo-Gangetic Plain (IGP) of India. In this paper, five major cropping systems of the region based on area have been identified and different resources have been characterized.

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## **16. Indian Information System as per DUS Guidelines (IINDUS) for the Protection of Plant Varieties and Farmers' Rights Authority**

R.C. Agrawal

General Agreement on Tariffs and Trade (GATT) negotiations in Uruguay Round (1984-94) led to the establishment of World Trade Organization (WTO) in January 1995, of which India is a signatory. Having ratified the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs), the Government of India decided to give effect to the clause 27.3b of World Trade Agreement in Agriculture and enacted the legislation "Protection of Plant Varieties and Farmers' Right Act 2001" (53 of 2001). The Rules of the Act were notified on 12th September, 2003 and an Authority known as "Plant Varieties and Farmers' Right Authority" was established by the notification in the Official Gazette (No. 1183 dated 11 November 2005). Under the Act the government of India has decided to implement plant variety protection regimes which seek to provide protection to plant breeders and to farmers. Thus, the Indian plant varieties protection regime introduces both plant breeders' (PBRs) and farmers rights.

The purpose of the PPV & FRA is to provide and promote an effective system for plant variety protection for India with the aim of encouraging the development of new varieties of plants for the benefit of society.

Any new variety before registration must conform to the criteria of Distinctness, Uniformity and Stability (DUS) in suitable tests before it is eligible for protection. The Department of Agriculture and Co-operation, Ministry of Agriculture has entrusted NBPGR with the "Development and Digitalization of

Extant – Notified Plant Varieties" activity. Under this activity, a software "IINDUS" (Indian Information System as per DUS Guidelines) for the documentation of the Extant notified varieties in accordance with the guidelines developed for various crops has been developed by using vb.net and Oracle relation database. The system is available on the web address <http://www.nbpg.ernet.in/nbpg/index.aspx>.

The software IINDUS has been tested by all the DUS Centres located in various ICAR Institutes and Universities. The complete data of extant and notified varieties which has been grown by DUS centres about 40) in India as per the guidelines fixed for various crops by the PPV & FRA is being documented through this software. The IINDUS shall help the PPV & FRA in identifying the reference varieties to be grown with any new variety(ies) (as a candidate) which shall be submitted for registration. The system shall be linked with the other information systems being developed for the management of the PPV & FRA activities like National Plant Variety Register, DNA Fingerprinting & Molecular Biology information system, Digital Herbarium, Gene Bank information including Bar Coding and Online e-journal.

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## **17. Knowledge Management through National Information Sharing Mechanism for Plant Genetic Resources**

R.C. Agrawal, Pratibha Brahmi and Sanjeev Saxena

The Global Plan of Action (GPA) for conservation and sustainable utilization of Plant Genetic Resources for Food and Agriculture (PGRFA) is an Food and Agriculture Organization (FAO) initiative, signed by 150 countries at Leipzig, Germany in 1996. It was adopted after serious concerns were raised about the loss of intra- and inter-specific diversity in crop plants important for world food security. It recognizes the interdependence of countries with respect to genetic resources for development of new crops varieties and bringing in new plants into agriculture. A lot of germplasm has been conserved ex situ, but it is not being utilized to its maximum potential for lack of characterization data. The GPA is a framework of

activities encompassing development of in situ conservation of PGRFA, sustaining existing collections, enhancing utilization and increasing capacity of countries regarding education, public awareness and training on these aspects. FAO has also developed a monitoring process of implementation of GPA in different countries through a mechanism called National Information Sharing Mechanism (NISM) for monitoring the implementation of GPA.

For monitoring this activity by using NISM, all activities which were coordinated by the National Bureau of Plant Genetic Resources (NBPGR) by dividing three distinct phases: (i) a preparatory phase, (ii) an implementation phase and (iii) a conclusion/reporting phase.

During the preparatory phase, work was focused on reviewing all materials, briefing and raising awareness of authorities and getting necessary permissions to undertake a collaborative information sharing process that includes the national PGR programme, the private sector, NGOs' and other public sector organizations and cross-ministerial collaboration. A committee of key stakeholders was formed to guide the GPA monitoring process and the Country Report preparation, and to identify stakeholders to be involved into this process. A total of 114 stakeholders were identified during the preparatory phase.

During the implementation phase a number of meetings and workshop were held to explain the process and build capacity of stakeholders in the use of the computer application for gathering information. Direct technical assistance to stakeholders was also provided during this phase.

During the conclusion/reporting phase, data gathered from stakeholders were analyzed and two reports were produced and discussed with participating stakeholders. A web site for describing the Mechanism and including a database search engine was developed and made available to the users. Compact discs including the complete database of the Mechanism were produced and distributed to the stakeholders involved in the process.

This paper gives details the implementation of this mechanism in India and its out come which can be a good case study for the knowledge management through computers. The efforts of India in this direction have

been greatly appreciated by the Chief Technical Advisor, FAO Regional Office, Bangkok.

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## **18. Classifying Forest Cover Type using Approximate Core**

Rajni Jain<sup>1</sup> and Sonajharia Minz<sup>2</sup>

Classification is an important research topic in the field of data mining and knowledge discovery. There have been many data classification methods including decision tree methods, statistical methods, neural networks, rough sets, etc. A reduct in rough set theory refers to the dominant attributes in a dataset. A dataset may have zero, one or multiple reducts. A classification problem utilizing information contained in a single reduct is well examined in rough set literature. However, it means ignoring the available knowledge from the multiple reducts. Approximate core is proposed as an important tool to deal with the dataset having multiple reducts. In this paper, Forest cover type, a large benchmarking dataset having multiple reducts is used for experiments. The performance parameters - accuracy, complexity, number of rules and number of attributes in the resulting classifiers are compared among various algorithms employed. The results using approximate core are comparable with the other published results for this dataset.

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## **19. Present Scenario and Future Prospects of Poultry Informatics in India**

Ram Gopal and A.K. Sachdev

Pilot studies on Poultry Informatics were initiated through collection of first hand information on the current status of poultry industry in India, developmental activities being undertaken in various states and about research endeavors, to pave way for instant retrieval of information and necessary decision making. A decline in the growth of poultry industry was recorded during the decade of nineties (5.89%) as compared to that in seventies (35.29%). Majority (23%)

of the surveyed units wanted stabilized marketing systems whereas, 21.55% of them advocated for regular knowledge of modern technologies. Information from Directors of Animal Husbandry Departments revealed that Punjab, Karnataka, West Bengal and Gujarat could be front-runners of future poultry production among the responding states. Preliminary work on research informatics at CARI indicated the possibility of instant retrieval of database for better planning and management of research programmes. Intensive work on poultry informatics could be expected to provide impetus to the poultry production activities.

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## **20. Academic Information System for Agricultural Education in India**

S.B. Lal, V.K. Dubey, R.C. Goyal, V.H. Gupta and Alka Arora

An academic information system for agricultural universities of India, capable of providing relevant information to the users of any level such as an academician, a student, a researcher or a policymaker, has been the need of the day. In the era of advanced information technology, an interactive and quick system is strongly needed which can provide the detailed information about the availability of an educational institute according to the user's specific criteria. Especially the students, having an interest to join an agricultural university, were finding it hard to get the information about these universities. Therefore, an information system is presented here, which has a detailed information base containing detailed communication information (locality details) of universities, its faculties, departments and colleges. It also has information about the various levels of courses running at universities and their colleges, admission procedures for these courses, fee requirements, category-wise reservation details etc. Also, it would be able to show the placement details and students already placed in India and abroad. National Statistical Commission (NSC) and Department of Secondary & Higher Education of the Ministry of Human Resource Development, Government of India have indicated the need of such information system which can make available a report on the educational institutions

classified by the management type, by area (rural or urban), by type of institutions (general, professional, technical or others), by category, by level of education and by type of education. The National Information System on Agricultural Education Network in India (NISAGENET), being developed and implemented at IASRI, New Delhi would be capable to meet the academic requirements.

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## **21. A Framework for Fast Web Download**

S.S. Hasan, P.K. Bajpai and Rajesh Kumar

One of the most dissatisfying web experiences is the slow download time of web pages which makes it unattractive and hence loss interest by the users and bogs down internet bandwidth. Although there are many factors responsible for this, we have discussed here the issues of content size on web pages. A framework has been presented for reducing the web contents from Web Designer viewpoint. Further, an application of the same has been demonstrated by developing a web site for IISR, Lucknow for dissemination of its research work and technologies related to sugarcane crop.

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*Indian Institute of Sugarcane Research, Lucknow*

## **22. File Monitoring System of Sugarcane Research**

S.S. Hasan, P.K. Bajpai and Rajesh Kumar

The present study is an attempt to design and develop File Monitoring System (FMS) to record and monitor the movement of research and establishment files (Research Projects, Field Experiments, Publication status, etc.) related to sugarcane research of Indian Institute of Sugarcane Research. Monitoring such activities will make transparency in research work environment and timely disposal of assigned Sugarcane research and administrative activities. Proper software engineering practices, the standard architecture and design has been adopted for the development and implementation of the software. The relational approach and normalization theory has helped in enforcing security

and organizational standards. The FMS solution would allow the organizations to maintain file movement information at central location, which can be used by the authorized persons in a decentralized fashion. Software has been developed keeping in mind the existing Desktop environment, thus FMS can be implemented in Microsoft Windows based environment.

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### 23. An Object-Oriented based Application Software for Analysis of Survey Data

S.B. Lal, Anu Sharma and V.K. Mahajan

Estimation of the statistical parameters for the given population of interest using various sampling schemes play a vital role when the survey results are very close to the real situation. There are various sampling schemes available such as Simple Random, Stratified, Cluster, Stratified Cluster, Two-stage sampling etc. and each have its own methods of data collection and estimations of parameters. The parameters and their variances are estimated based on the respective sampling designs. This paper describes an object oriented approach using .NET framework with C# programming language for estimation of parameters of interest. In this approach reusable class libraries have been developed for each of these sampling designs, which are available in the form of subsystem functions called class methods. These libraries contain methods for equal and unequal probabilities as well as with and without replacement available under most of the sampling scheme. These ready to use libraries can be utilized in other applications as well where sampling designs of these kinds are used as they are available in the form of dynamic link libraries (.dll). These dlls can be called just by including their reference in the software projects and passing the required parameters. These reusable libraries can be highly useful for programmers and statisticians who are involved in statistical software development.

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### 24. Knowledge Management through Expert System in Agriculture

S.N. Islam<sup>1</sup>, Hari Om Agarwal<sup>1</sup>,  
Md. S. Farooqi<sup>1</sup>, Vipin K. Dubey<sup>1</sup>,  
K.K. Chaturvedi<sup>1</sup>, H.S. Sikarwar<sup>1</sup>,  
Randhir Singh<sup>2</sup>, A.K. Sharma<sup>2</sup>, R.K. Sharma<sup>2</sup>,  
K.D. Srivastava<sup>3</sup>, J.P. Sharma<sup>3</sup> and Kirti  
Sharma<sup>3</sup>

Agriculture has emerged as a multidisciplinary complex science involving a number of crops and technology. Every crop has its own physiology and needs a specific environment and technology for its proper growth. A lot of information is generated by the scientists involved in Agricultural research which is not properly organized.

Knowledge Management is a conscious strategy of getting and extending the right knowledge to the right people at the right time; turning information into action to improve performance of Professionals. Agricultural institutions should apply modern IT based tools to the develop Information Systems, Decision Support systems and Expert Systems for Knowledge Management.

“Expert System on wheat crop management” is an integrated system which addresses all aspects of wheat crop management in India. This system is subdivided into four modules Variety selection module, Plant protection module, Cultural practices and Harvesting technology. The system has a data management module that manages the knowledge base of the expert system. It takes information from the experts, updates it, creates and updates rule for all the modules of the expert system. This is an excellent and unique example of knowledge management by an agriculture based expert system.

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## 25. An Age based Platform for Manpower Management in ICAR

Shashi Dahiya, Balbir Singh, Alka Arora and Md. Samir Farooqi

Manpower management is an important activity performed by Human Resource managers. It's a crucial task for an organization and can be influenced by many factors. Age is one such factor, based on which several important decisions can be taken. Using data from the Personnel Management Information System Network for ICAR (PERMISnet), this paper reviews the data collected on various professional parameters of personnel on the Age platform. Then it tries to provide some important results and trends related to activities performed by scientific personnel in these age groups. In, this study all the ICAR personnel have been categorized under four age groups. Under these age groups, information has been compiled for personnel under three service categories in different subject matter divisions (SMD's). The average age of female and their male counterparts has been depicted for each service category. The status of scientific personnel in Research Projects as Project Investigator, Co Principal Investigator and Associate has been studied under different age groups under the SMD's and a general trend has been depicted. A comparative study has been done on the number of publications published by personnel under different scientific categories and age groups and presented using Bar-diagram. An analysis of data has also been done to exploit the ratio between numbers of trainings organized by personnel under different scientific categories and different age groups. The ratio depicts that young scientific personnel are taking more initiatives in organizing the training programmes as course coordinator. All the results have been presented using tables or charts and most of the results envisaged that the young generation though less in number, is coming forward and taking initiatives in almost all scientific activities.

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## 26. An Information System on Long Term Fertilizer Experiments in India

Shashi Dahiya and M.R. Vats

In the last few decades the country has made impressive progress in food production which is one of the most vital sectors of Indian economy. This has been possible due to the research undertaken by different research institutes under ICAR set up and State Agricultural Universities. Consequent to the green revolution in India fertilizer use was becoming a key factor for increasing agricultural production. So, fertilizer use and consumption in agriculture was increasing rapidly, thus a need was felt for studying the impact of fertilizers not only on crop yields and quality but also on soil and environment under input intensive cropping system. A large number of long term fertilizer experiments (LTFE) on various Food, Horticulture and Commercial Crops are being conducted at different ICAR Institutes and various SAU's. Usually the information generated from these experiments is not available in compatible form at one place to the scientific community working in National Agricultural Research System (NARS). Also planners/ Research workers may be interested in this information because this will help them in planning/ conducting the future long term experiments.

Keeping the importance of this information in view, a web based information system entitled "National Information System on Long Term Fertilizer Experiments (NISLTFE)" has been developed and installed at IASRI domain <http://www.iasri.res.in:8081/nislftfe/>.

NISLTFE would generate information for various policy decisions in the context of achieving higher productivity and maintaining sustainability under modern intensive cropping system based on high external inputs of fertilizers, agro-chemicals and high yielding cultivars under irrigated/ rained conditions etc. Moreover, this information will be helpful in carrying out the mid-course modifications, without affecting the long term continuity and integrity of the on-going experiments for studying the new emerging research problems therein.

This paper will focus on the variety of information provided by NISLTFE in the form of online reports.

Emphasis will be there on parameters, such as crop, statistical design used, agro-ecosystem, weather, characters, mid course modifications and the field layout for the Long Term Fertilizer Experiments. Emphasis will also be there on the methodology provided by the system to analyze the reports data online.

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## **27. Rough Set based Cluster Analysis for Soybean Disease Diagnosis**

Shuchita Upadhyaya<sup>1</sup>, Alka Arora<sup>2</sup> and Rajni Jain<sup>3</sup>

Clustering algorithms partition the data set into group of similar objects called clusters. Description of clusters is not generated by the usual clustering algorithms. In the proposed approach reducts from the rough set theory is employed for feature selection and description of clusters. The proposed multi stage approach of cluster description involves (1) data preprocessing using rough set theory, (2) cluster formation via clustering algorithm and (3) cluster description employing rough set theory. Soybean disease, data set from agricultural domain, is taken up for the case study. Results obtained by using the proposed approach showed the removal of 14 irrelevant features out of total 35 features prior to application of standard clustering algorithm. Further, the proposed method also helped in enhancing the interpretability of clusters obtained in terms of the characteristics of soybean diseases.

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## **28. Multi Agent System for Farmers: An Approach using Temporal Ontologies**

Punam Bedi<sup>1</sup> and Sudeep Marwaha<sup>2</sup>

Knowledge based personalized systems, which can recommend suitable practices, based on the basic needs and resources of the farmers are needed for sustainable

crop production. In this paper, we present a multi agent system to assist farmers in solving the problems related to crop production. Seeing the potential of ontologies, we believe that ontologies will be build and maintained in agriculture knowledge domains for the semantic web and future applications. The presented system uses temporal ontologies that absorb the effect of the dynamic nature of domains and the changes in ontologies in addition to their other benefits. The presented multi agent system simulates the existing research and extension system in terms of agents and has different domain agents such as Farmer Agent, Extension Agent, Pathologist Agent, Entomologist Agent, Agronomist Agent Horticulturist Agent, and Economics Agent. The presented system can be scaled up by adding more domain agents specialized in different fields of agriculture for different crops.

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## **29. Task Allocation Distributed Computing Vs Distributed Database Systems: A Comparative Study**

Shuchita Upadhyaya<sup>1</sup> and Suman Lata<sup>2</sup>

Task allocation in Distributed computing systems (DCS) is an important research problem. When resource to be shared in DCS is a database that system is classified as Distributed database system (DDBS). Here it is explained along with model of allocation and development of such a model in general. Related work done and issues in this research field are explained in detail. Characteristics of task allocation in DDBS problem are mentioned. In these systems Data & operation allocation are both closely interrelated and highly dependent on each other. Procedural steps in task allocation in DDBs are given along with the current issues in this recent research area. A general development of cost model used in this area is given. General models and objective function explained in this paper can be treated as basic platform for research in this area and depending upon the concerned research area, issues, and application the modification can be introduced. An objective function can be derived by

modifying the terms present in it which in turn depend on characteristics of the system concerned e.g. Distributed computing system, distributed database system, parallel system & multiprocessors etc.

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### **30. Rapeseed-Mustard (Area, Production, Yield) Information System**

Vinod Kumar, Ashok Kumar Sharma and Arvind Kumar

The computer technology can provide innovative services in almost every human activity provided one has the capability to use them properly according to their need. Information technologies have long been viewed as having great potential for improving decision making in agriculture. As data are the rich source of information for the interpreters (managers, researchers, educationist, etc.), systematic recording of data in agriculture greatly increases the amount of information that can be extracted regarding knowledge of crop potential. The overall aim to develop computer based information system "R&M (A, P, Y) Information System" is to facilitate decision makers (researcher, planners, etc.) to know the potential and possibilities for rapeseed-mustard crop in terms of area, production and yield in world and different region of India. Although data of area, production and yield of rapeseed-mustard exist in different forms and places, they need to be assembled and documented properly for making the information user-friendly. The software has been developed using windowing environment and thus provides enough facilities to update and present data easily and conveniently. The program has been developed specifically for the rapeseed-mustard but the concept could also apply to develop production information system to other crops, and the program would serve as prototype in developing the production information system for other crop commodities.

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### **31. Development of Software for Imputation using Back Propagation Neural Networks**

V.K. Dubey<sup>1</sup>, S.B. Lal<sup>1</sup>, Ramasubramanian V. <sup>1</sup>, G.K. Jha<sup>2</sup> and Ranjana Agrawal<sup>1</sup>

In any survey or census, data are often collected on various characteristics of interest from a target population, wherein non-responses/ inconsistencies are very common. Various approaches exist for imputation of item non-response such as mean, random, regression, hot-deck etc. Imputation is the substitution of optimum value for a missing data point or a missing component of a data point. A possible and perhaps better alternative method of imputing item non-response is to use artificial neural networks (ANNs). In ANNs, input and output values of complete events are used to train a model to respond similar to the behavior revealed in the data. In this study, an attempt has been made to employ neural networks for imputation based on multi-layer perceptron architecture, trained using back propagation algorithm. The system is developed in Java open source platform independent technology. The Graphical User Interface (GUI) has been developed in Java Swing Package. The parameters of the training algorithm such as momentum, learning rate etc. can be customized by user.

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### **32. Cost Effective Solution to Bridge Digital Divide for Rural Development in India**

V.K. Dubey, K.K. Chaturvedi, Md. S. Farooqi and P.K. Malhotra

In India, the farming is diversified in nature. The packages and practices for a particular agricultural commodity of one agro-climatic region may not be effective for other regions. To attain efficiency, profitability, environmental quality concerns and sustainability in rural agriculture, region-specific localized software systems like information systems/ expert systems/ decision support systems must be made available, which can cater the specific needs of the farmers precisely.

Information and communication technologies (ICTs) are widely recognized as tools contributing to the economy of developing countries. However, in terms of being well equipped to make informed decisions on ICT architecture and choice of platform, developing countries are lagging behind, and are therefore still unable to harness the full potential of these tools in the eradication of poverty. This knowledge arrear contributes to incompatible information systems, expensive and ineffective maintenance of ICT infrastructures and resource-draining software licenses.

Open source software is available to anyone (usually at little or no cost), it does not require license fees and it may be freely re-distributed. Open source software technology is at par or better than commercial software. Everything that is needed to develop a robust data-driven web enabled information system is available in public domain with its source code.

The cost incurred in establishment of site-specific village level information kiosks using the open source software will be mostly on hardware components whereas softwares are mostly available free of cost in public domain. Thus, could be a cost effective solution for filling the gap of digital divide in rural population of India.

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### **33. Data Base on Distribution of Economically Important Nematodes in India (1977-2005)**

K.N. Mathur

All India Coordinated Research Project on Plant Parasitic Nematodes with Integrated Approach for their Control in Nematology is discipline oriented and the main aim is to enhance crop production through nematodes management. The Project at present has 15 funded and one voluntary centre located in different parts of the country besides a coordinating cell located at Division of Nematology, IARI, New Delhi. Data was supplied by these centres on major and minor nematodes infecting cereals, vegetables, pulses, oilseeds and fibre and horticultural crops from various districts of major States in India for 29 years (1977-2005). Database was

created using MS-Access package and Visual Basic 6.0 for information retrieval. The database is available on CD's for offline search for the benefit of researchers.

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## **THEME 4: STATISTICAL AND COMPUTATIONAL BIOLOGY IN AGRICULTURE**

### **1. Categorization and Integration of Biological Databases: A Review**

A.K. Mishra<sup>1</sup>, T.V. Vijaykumar<sup>1</sup>,  
H. Chandrasekhran<sup>2</sup>

Biological databases represent an extraordinarily diverse collection. At one end, these databases may be high-end relational databases focused on broad topics, and multi-headed servers. At the other end main focus is on a very narrow topic, usually one in which the investigator is highly expert. The creation of biological databases represents a fundamental change in how scientific information is disseminated. Many molecular biological databases are implemented on relational Database Management Systems, which provide standard interfaces like JDBC and ODBC for data and metadata exchange.

The ontology is central to the system and plays a role in query formulation and execution. Future advances in biology depend critically on databases and that biological databases must be improved in several ways to provide adequate support for the biology of the future. In order to support human and computer-aided information integration and inference, a Knowledgebase must be trustworthy. Further, It should structure information using an ontology that is expressive and well-structured enough to support computer-aided reasoning.

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## 2. Analysis of Microarray Data

Ananta Sarkar<sup>1</sup>, Rajender Parsad<sup>1</sup>, K.V. Bhat<sup>2</sup>  
and V.K. Bhatia<sup>1</sup>

Microarray experiments have multiple sources of variation like arrays, dyes, varieties and genes. By accounting for these sources of variations, different effects due to array, dyes, genes and tissue samples (varieties) and their interactions can be estimated by means of analysis of variance (ANOVA) approach. The data normalization and inference for identifying differentially expressed genes have been integrated into a single step of linear fixed effects model. Further, effects due to arrays may be taken as random. Therefore, a mixed model methodology may provide both a formal framework and a flexible tool for identifying systematic sources of variation and differential gene expression. Although the ANOVA approach seems promising in theory, it is computationally intensive and becomes almost infeasible when the number of genes in the model gets relatively large. Alternatively, a two-stage procedure has been advocated in the literature for linear fixed effects model. It seems that no attempt has been made to give an analytical procedure using linear mixed effects models. Therefore, analytical technique(s) based on linear mixed effects model approach has been used for identifying differential gene expression from microarray experiments. All the analysis has been carried out for existing real data set using SAS 8.0 package.

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## 3. Computational Analysis of Gene Regulatory Elements using Mutual Information

Ashok Reddy and C.K. Mitra

The core promoters of protein coding genes, mitochondrial control elements and the transcription factor binding sites (TFBS) have been studied by calculating the average mutual information content. The results showed that in mouse and human, both TATA-box and TSS-region are likely to play important roles. For plant genomes, the importance of TSS-region in transcriptional initiation is more compared to the

TATA -box. In case of transcription control region of the mitochondrial genome, we additionally notice that there are other variable regions in the mitochondrial control element apart from the TSS that are also clearly involved or important. The TFBS clustering results gives us a new way to look at the protein classification-not based on their structure or function of transcription factors but by the nature of their TFBS. Details of the computations shall be presented along with their significance.

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## 4. Measurement Errors in Microarrays

Dwijesh Chandra Mishra and V.K. Bhatia

The '-omics revolution' is characterised by high throughout measurements and vast quantities of data. Unfortunately, the quality of the measurements is often overestimated and, as such, simplistic assumptions regarding the structure of the measurement errors are made subsequent to application of routine data analysis techniques. In transcriptomics by spotted DNA microarrays, it is beginning to emerge that the conceptual simplicity of the technology belies a potentially complex measurement error structure. For example it has been shown variously that the data exhibit a non-constant variance leading to the recent development of models to 'fix' the problem. Regrettably, the extent to which these error heterogeneities affect individual microarray data has not been systematically explored and, consequently, the structure of the measurement uncertainties after transformations is applied remains uncharacterized. This work presents the results of a systematic characterization of the measurement error structure for spotted DNA microarray data as well as a model that compartmentalizes the total variance exhibited by the measured intensity ratios into distinct components that can be measured independently. In particular, one of the ratio variance components, which is often ignored in microarray data analysis, is the uncertainty associated with the measurement of the ratio itself. In most microarray data, the ratio is determined as a mean or median of pixel intensities comprising a spot and no implicit information is provided about the accuracy with which this quantity is measured. In this work, the ratio

is measured as an orthogonal slope of the pixel intensities comprising the spot and a bootstrap approach is employed in determining the magnitude of the uncertainty associated with determining this ratio. Those measurements for which this value dominates the total variance are eliminated in order to maintain the distribution of errors. The structure of the measurement uncertainties is then characterized empirically using replicate measurements.

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## **5. Software for DNA Fingerprinting Analyses**

Madhu Bala

DNA fingerprinting is an approach to accurately identify crop varieties or genotypes. This technology is useful in cases involving unauthorized use of varieties, and has given insight to breeders to view distinctly between heterozygous and homozygous varieties of plant. Also, uniqueness of DNA fingerprinting helped to legally protect new varieties of plants and animals, whether they are developed by genetic engineering, tissue culture or traditional method. By this time, enormous amount of DNA fingerprint data has been stored in huge databases. These databases are storage repository for end-users.

In order to store and analyze profile tables of crops fingerprinted at NRC on DNA Fingerprinting, NBPGR a software entitled "Crop DNA Fingerprint Database" is developed using Visual basic environment at front end and MS Access at back end. It is an interactive software that store and retrieves information according to the choice of user and performs data analysis. DNA fingerprint database is designed to store and analyze profile tables of crops fingerprinted. Software is dedicated to store all necessary information regarding varieties and primers in profile tables. In addition to that, it performs some of the important statistical analyses. Module for Jaccard's, dice and simple matching coefficient analysis of the software helps to know whether two varieties are different or similar. It also helps to know the extent of similarity between varieties. Comparison may be done on one to one or one to many varieties. In order to find best informative

primer modules of polymorphic information, content and average number of bands per cultivars analyses is used. Genetic relationship among different primers is found by using gene diversity and resolving power analyses. Module of barcode generation develops band map for all primers in a particular profile table. The Help module is developed to provide working assistance to users. Facility had been developed to upload data directly from MS Excel worksheet to database. The search menu is developed to search crops, techniques, primers and varieties. Different types of reports were developed for different types of analyses. Step by step calculation report for all types of statistical analyses is also generated for convenience of the researchers/ users.

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## **6. Prospects of QTL Studies in Poultry using Novel Statistical Approaches**

Suryakant Mishra, Ram Gopal and  
Raj Vir Singh

Poultry genetics research in the recent years have been revolutionized with wide-spread applications of molecular biology and statistical tools. A significant facet of the poultry genetics involves the detection and analysis of the quantitative trait loci (QTL) using DNA based markers. With the evolution of the latest consensus linkage map of chicken genome (2004) featuring more than 4000 pursuable markers, the localization prospects of any significant QTL influencing a trait of importance, is promising. Consistent with development of the newer and newer DNA markers, it's feasible now to carry out a whole-genome scan to detect QTLs defining as low as 0.1 Standard deviation (SD) of phenotypic variation. QTL studies in poultry, necessitates few minimum requirements viz. a purpose-specific resource population; sizable number of evenly spaced polymorphic DNA markers; Genome map info and a proper analytical (statistical) model suiting to the metric-trait under investigation. Most current literatures are based on either back-crosses or the F2 inter-crosses as the resource for QTL analysis. However, efficient statistical designs like tail (bulk-sergeant) and Gradient analysis involving analysis of various phenotypic pools across the trait distribution have been reported in QTL-detection protocols. Bulk of the QTL reports in chickens have

emanated from using the micro-satellite as the marker handles. With the availability of 3 million plus SNP markers in Beijing genome database, SNP markers applied to any well-phenotyped population obviate the need for any specific resource population, for striking a large effect QTL. By the end of 2005, the cumulative reports on QTL's involved most production traits of chickens viz., Body weight, Muscle yields, multiple carcass cut-up parts, Body fats, egg number, age at sexual maturity, egg weight and other egg quality traits, feed intake apart from the disease resistance reported against important poultry diseases. Reports indicated many significant QTL's for various production traits that accounted for 0.3 to 1.0 phenotypic standard deviation and majority of the QTL's for growth traits were additive in effects barring the few that explained dominance effects. Considering the reports registered already and the numerous studies that are currently underway, the prospects of QTL oriented statistical Genomics programs are highly encouraging.

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### **7. Applications of Information Theory Models for Grouping mtDNA Reference Sequences of Species**

Reema Singh and B.K. Hooda

Information theory concepts such as Shannon's entropy and Mutual information are described and applied for the analysis of 20 complete mtDNA reference sequences of the organisms obtained from the NCBI database. Mutual information matrix and complexity of the genomic sequences have been worked out before and after alignment. Jensen-Shannon complexity of the 900 ungapped align sequences has been used for the grouping of species. Phylogenetic trees of the species considered have also been constructed using Neighbor-joining and parsimony methods. It has been observed that the species having high mutual information fall in the same group in Phylogenetic trees. A small perl script has also developed for the calculation of genomic sequences complexity.

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### **8. QTL Identification in Presence of QTL × Environment Interaction**

Nitiprasad Jambhulkar<sup>1</sup>, V.K. Bhatia<sup>1</sup> and B.M. Prasanna<sup>2</sup>

Quantitative traits are the traits controlled by many genes and each of the genes has a small effect on the trait. The loci controlling quantitative traits are referred to as QTLs (Quantitative Trait Loci) and the procedure of finding and locating the QTLs are called QTL mapping. The available literature on use of molecular markers for detecting loci influencing the performance of Maize in drought stress is very scanty in India, so the data considered belongs to Maize crop in drought stress, for the present investigation. Mapping population with 236 RILs (Recombinant Inbred Lines), using Ac7643S<sub>5</sub> (drought tolerant) and Ac7729 (drought susceptible) as male parent, at CIMMYT and evaluated in India under AMBIONET (Asian Maize Biotechnology Network), Maize Genetic Unit, IARI is considered for the present investigation. Phenotypic data on different plant characters have been utilized for the present study. Genotypic data on RILs obtained through 138 RFLP markers and a linkage map of a total length of 2250 cM with an average density of 17 cM are used for QTL detection. Genotypic data is obtained through molecular marker assay whereas phenotypic data is derived from evaluation of mapping population of the target traits of interest. The analysis is done using software QTLMapper (version 1) and it is found that marker MK28 has main-effect on four traits, marker MK28, MK101 and MK34 has main-effect on two traits. Interaction effect has also been found in different marker pairs. The results are obtained considering the main and interaction effect of markers and it is seen that for the trait Anthesis-Silking Interval one QTL is present on chromosome 1 located on marker MK13. For the trait Ear Height, three QTLs are present, first QTL on chromosome 1 located on 4cM to right from MK8, second QTL on chromosome 2 located on MK34 and third QTL on chromosome 8 located on MK101. For the trait Grain Yield two QTLs are present, first is on chromosome 2 located on 2cM to the right from MK28 and second QTL on chromosome 4 located on MK51. For the trait Ear Diameter one QTL is present on chromosome 3 located on MK35. For the trait 100 Kernel Weight one QTL is present on chromosome 2 located on 14cM to the right of MK27. For the trait

Plant Height one QTL is present on chromosome 8 located on marker MK101.

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## 9. Role of Statistics in Bioinformatics and Plant Research through Biological Databases

A.K. Singh

Besides applied mathematics, informatics, and computer science, the statistical tools are used in Bioinformatics to extract useful information from noisy data produced by high-throughput biological techniques. In statistics, there have been significant studies in gene expression microarray data, however, there is a significant scope of advances in Protein Biology, especially statistical breakthroughs in the area of Protein Structure and Prediction through significant studies in the arena of Shape Analysis, Directional Statistics and False Discovery Rates. For all this, statisticians need to be more open to learn "molecular biology", more computationally aware and ready to understand data banks, as the Data Mining is another challenging area of statistical research in view of the rapidly growing biological databases. Recently, standards in data description and exchange for plant metabolomics have been proposed (Bino *et al.* 2004), and a computer-readable data model has been developed (Jenkins *et al.* 2004).

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## THEME 5: STATISTICAL AND ECONOMIC ISSUES FOR PROSPERITY OF RURAL COMMUNITY

### 1. Trends and Structure of Employment and Earnings of Rural Women in the Changed Economic Scenario

A.K. Vasisht<sup>1</sup> and Alka Singh<sup>2</sup>

The paper examines the recent trends in employment, unemployment and earnings of rural

workforce with special attention on women workforce based on NSS data. The results do not clearly support the process of feminisation of the rural workforce in the post reform period. The reason for decline in WPR can partly be attributed to increased school enrollment of rural young girls. Still the decline in WPR of 15-59 age group should be regarded as a negative trend in the post-reform period. However, women WPR by current statuses have gone up during this period, indicating an increase of seasonal or casual work for women. The positive feature of the post-reform period is that unemployment rates by all measures have gone down sharply for women as compared to men in rural India. It was also observed that the trend towards diversification of the rural workforce has been slow both for male and female workers during the post reform period. Specifically, occupational diversification of women has remained stagnant, indicating that the option of diversification in non-agricultural employment is very limited for women. As regards the changes in employment status is concerned, the most striking feature of post reform period is increasing casualisation of rural workforce, both for males and females. This process of casualisation was more severe in case of female workers. Average daily earnings of female workers continue to be less than that of male workers. The male-female wage differentials have also not improved during the post reform period in agricultural sector.

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### 2. Dietary Pattern and Nutritional Status of Rural Households: State-wise Analysis

Ashok Kumar

Adequate nourishment in terms of quantity and quality is necessary for sustainable life. Considering dietary pattern and nutritional status of the mass population is one of the indicators of economic development, it is important to examine the changes in dietary pattern and nutritional status of the rural population. For this purpose data of two NSS rounds (43rd round (1987-88) before new economic policy and 55th round (1999-2000) the recent round of the National Sample Survey) were analysed.

The study shows that the dietary pattern of rural households in almost all states a general trend of reduction in consumption of cereal in favour of non cereal foods. The consumption of other non cereal foods like milk and milk products, egg, meat and fish, fruits and vegetables groups tend to increase in most of the states. However the shift from cereal based to non cereal based diet was not visible in all categories of landholdings uniformly. In most of the states the proportion of deficient rural house holds is higher in landless, sub-marginal and marginal class and it decreases with the size of holdings.

The findings of the study reveal that there has been a change in dietary pattern of rural households; however a major proportion of the rural households is undernourished and malnourished especially landless, sub-marginal and marginal categories of rural households. As the proportion of deficient rural households in the category of landless, sub-marginal and marginal category is higher, the analysis suggests that these rural households should be treated as target groups to raise their income to maintain their nutritional status.

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### **3. Impact Assessment of Technology Interventions in Migratory Sheep Production System in Himachal Pradesh**

D.R. Singh, Sushila Kaul and Naresh Kumar

The study was undertaken to study the impact of technology interventions on productivity, employment and income in migratory sheep production system and to investigate the status of food security of the target population in Kangra district of Himachal Pradesh. Primary data were collected from thirteen participating and thirteen non-participating farmers during the base year (2001) and after technology interventions (2004). The analysis showed that there was a marginal increase in the number of sheep on participating farm and significant increase on non-participating farms over the base year. There was also an increase in per farm and decrease in per animal cost of sheep rearing. The increase in wool productivity was 50 and 32 per cent on participating and non-participating farms,

respectively. Per farm gross and net income were also followed the same pattern. It was observed that the consumption of pulses, vegetables and fruits was very low than the quantity required by all the categories of farmers. However, a significant increase in these food items on participating farms over the base year indicated that the impact of technology intervention has resulted in improving the food security of the migratory sheep farmers.

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### **4. On Estimation of Income Inequality and Sample Bias of Gini Coefficient**

G.C. Sharma and P.S. Pandey

The Gini Coefficient of concentration along with its standard deviation and their estimates have been proposed. The asymptotic behaviour when sample and population size tend to large sufficiently, have been investigated. Further, the exact decomposition of the Gini Coefficient for total income into contributing components for each type of the factor income, has been worked out. The components of the decomposition corresponding to each type of factor income have been shown to be the product of three terms i) the share of the factor in total income, ii) a rank correlation ratio, and iii) the Gini coefficient for the distribution of income of the given factor type. The concentration ratio has been shown to be lower bound of its Gini coefficient.

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### **5. A Study of Socio-economic Development in Rajasthan**

Manju Saxena and Deepika Mahecha

The level of development of various districts of Rajasthan was obtained with the help of composite index based on 22 socio economic indicators. 32 districts of the state were included in the study. The district Jaipur was ranked 1 and the Jaiselmer was the last in the level of socio-economic development in the state.

For bringing about uniform regional development, potential targets for the various indicators had been estimated for low developed districts. The study revealed that the low developed districts required improvement of various dimensions in the most of the indicator for enhancing overall socio-economic development.

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## **6. Crop Revenue Insurance: A New Risk Management Tool**

Prawin Arya, Sivaramane, N. and D.R. Singh

Farming is highly risk prone as it is exposed to various natural calamities such as drought, flood, pest and diseases, etc. Due to these factors, yields of crops vary considerably in India. Most of the farmers are poor and have extremely limited resources, even a single crop failure pushes them in the vicious circle of poverty. Insurance against poor crop yields has been available for many years. Crop insurance with yield as the criterion for insurance can compensate the farmers for the production risk while leaving them highly risk prone on the marketing part. A new risk management tool known as crop revenue insurance can address this problem. Revenue insurance guarantees a certain level of revenue rather than just production. It protects farmers from declines in both crop prices and yields. In this study, under crop revenue insurance approach, premium rates were estimated under different indemnity levels for selected crops of Karnataka state. The methodology can provide useful information in fixing optimal premium rates for the livelihood security of the farmers.

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## **7. Empowerment in Married Male and Female Professionals – A Case Study**

Rakhee Banerjee, P.K. Sahu, M.K. Sanyal and S.R. Pal

Empowerment is such a multidimensional concept that it has been defined by various authors from various

angles. By and large, empowerment may be conceived to have three major elements like economic power, social status and above all education. According to Kabeer (1999) gender norms and economic resources are the precondition of empowerment. In any society males and females have almost equal proportion and each society has certain expectation from each of the category. For proper development of society it is required to study the gender system of the society as well as status of empowerment prevailing in the society, irrespective of gender.

It is believed that the women in formal occupation are comparatively at higher state of empowerment (mostly because of their economic power) than the women engaged in so called unproductive informal sectors. Even then the question is that are these women equally empowered with the males engaged in formal occupations? How these two groups (the working men and women) differ with respect to level of empowerment and in different empowerment related demographic, occupational, financial, social and other related activities (monitory and non-monitory)? To get suitable answer to all these questions, the present study was conducted among the daily traveling married male and female professionals. Information collected from one hundred and forty (seventy each in males and females) professionals. Empowerment was measured with the help of a suitably framed empowerment quotient for the purpose. Results indicated that women professionals were more empowered, more educated than the males earners. Regression, path, discriminant analysis along with other statistical tests revealed that factors significantly related with empowerment, also vary between the groups. To be empowered, a female need to have education, small family besides economic solvency. On the other hand for male empowerment the significant factors are occupation standard, his income in relation to total income of family and total female income of the family and attainment of fatherhood.

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### **8. Construction of a Decision Making Index for Inventory Management System using Demand and Lead -Time Distributions**

Meenakshi Srivastava and Ranjana Gupta

The aim of the present paper is to construct a decision making index for inventory management system based on demand and lead-time distributions. The proposed index utilizes the joint distribution of demand per unit lead-time. For the statistical application, the probability density function of the above distribution has also been derived. Here the distributions of demand and lead-time are taken to be exponential and gamma respectively. The numerical value of the proposed index lies between 0 and 1. The magnitude of the index indicates the degree of satisfaction or dissatisfaction etc. of customers with the system. The suggested index can be used in taking decisions for better services and also to maintain equilibrium between the inventory and demand of the customers. The application of the proposed index has been illustrated with the help of numerical example.

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### **9. Study of Technological Change in Poultry Production - An Econometric Approach**

S.P. Bhardwaj

Technological change has helped not only in raising the factor productivity but also in generating surplus for overall development. Technological Change is defined in terms of either a productivity index or a production function. The study on resource use efficiency at different levels of technology adoption assumes considerable importance in resource allocation pattern. Technological change may affect the relative economic position of the factors of production in terms of their share in total output and thus has implication on income distribution. Poultry in India is relatively more important activity, as it has low capital requirement and little gestation period. It is best suited for supplementing income of the rural population. Because of these reasons, poultry is being included in a number of central and state Govt. sponsored schemes. Technological advance over the past years has revolutionised the role and structure of poultry in India. Many studies have

shown that the basic problems related with production of eggs have been tackled gradually. The modern technologies are now available, which make poultry sustainable and viable. However the income generating modern technologies in poultry production have created problems of resource adjustment. The present study has been undertaken to examine the technological dualism i.e. prevalence of modern as well as traditional technologies in egg production. The study based on primary survey data of selected layer poultry farms spread over two districts of Punjab namely Ludhiana and Mansa. The poultry farms classified into modern farms and traditional farms on the basis of technology adopted for keeping poultry birds. The farms using cage system for keeping birds are considered as modern farms and those using floor/ deep litter system are traditional farms. The results of the study will highlight the benefits of modern technology provide a suitable ground for justifying the adoption of modern technology in poultry management in general and egg production in particular. This would also help in justifying the economic efficiency in modern as well as traditional producing units. The impact of technology on income distribution among various factors of production may be helpful in appropriate policy prescription for this sector.

The estimates of Cost and Returns on Layer Farms as obtained in the study indicated that Cage System farms were earning more profit compared to the Deep Litter System farms in both the selected districts. The result of regression analysis indicates that major factors influencing egg production are feed cost, labour cost, medicines and electricity cost. The study of regression analysis showed that on both types of farms most of the input variables except for feed cost are not properly utilized. The analysis showed that input factors are not being utilized efficiently on Deep Litter farms in both the district. However it was observed that if the poultry farms using Deep litter system shift over to Cage system of technology there will be a substantial saving in the input resources. The Chow test Statistics conducted to test the structural relationship between the two technologies proved the superiority of modern technology over the traditional one in terms of efficiency of inputs at both the Districts. Factor share analysis in districts Mansa reveals that the share of labour factor remained about 4 percent, the share of poultry feed which is a proxy variable for capital, was

maximum of about 62 percent on both types of farms. The proportionate change of ith factor share (Di) as a result of technological change reveals that there will be saving of inputs in shifting from Deep Litter to Cage Technology. The saving is observed in feed 1.00 per cent, labour 36 per cent, medicines 23 per cent and in electricity cost by 20 per cent on the poultry farms in the district. In district Ludhiana the share of labour factor remained about 4 per cent on Cage farms and about 5 per cent on Deep Litter farms, the share of poultry feed was about 76 per cent on Cage farms and 55 per cent on Deep Litter farm. The proportionate change of ith factor share (Di) as a result of technological change reveals that by shifting from Deep Litter to Cage System of Technology there will be a saving in Labour (33 per cent), Electricity cost (40 per cent), Feed (38 per cent) and in Medicine cost (11 per cent) on the poultry farms in the district.

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#### **10. Weather-based Forewarning Models for Mango Fruit-fly**

S.C. Mehta<sup>1</sup>, Amrender Kumar<sup>1</sup>, R.P. Shukla<sup>2</sup>  
and Shashi Sharma<sup>2</sup>

The weather-based forewarning models, using both qualitative as well as quantitative data have been developed. The former type of models are required when merely idea about the expected population count below or above a threshold level may be enough for taking timely control measures. The data of population counts of fruit-fly for the period 1993-94 to 2004-05 was classified into two categories i.e. dichotomous form: 0/1 for no-epidemic (popn. count < 300)/ epidemic (popn. count  $\geq$  300). Logistic regression model was fitted to forecast epidemic status of fruit-fly. The validation for the subsequent year 2005-06 revealed that the forecast status was in very good agreement with the observed one. It is feasible to forecast the epidemic status of fruit-fly well in advance. The later type of models i.e. models based on quantitative data, provide expected number of population counts which are required for some purpose (for instance, working out losses etc.). For forecasting fruit-fly population in critical periods and peak population, two types of weather-index models - experience based weather indices

& correlation based weather indices were developed. The results from the second category were very good. The regressors of this model comprised of simple/weighted totals of values of weather variables as well as their products (taken two at a time), the weights being correlation coefficients between variable to forecast and the weather variable/ the product. The matching of forecasts for critical periods with the respective observed ones was satisfactory in most of the cases. The forewarning can be given one week in advance. The forecasting for peak population is feasible at least two weeks in advance.

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#### **11. An Analytical Study of Status of Food Security in India**

Sushila Kaul

Concern for food security is a global phenomenon and all nations strive hard to provide adequate food and nutrition to their people. Issues pertaining to food security have assumed political, social and economic dimensions. In India, provision of adequate food is of prime importance in planning of agricultural growth and development. Rising population has provided an added reason to work hard in this direction. Over the years, there has been spectacular rise in food production in the country. During the year 2005-06, the extent of food production is 209.3MT. In spite of increase in income, due to planned development in the country, a large number of people are still living below poverty line. The percentage of people below the poverty line during 1999-2000 was 26.10. The available evidence indicates that a considerable segment of population is not getting even two square meals a day. The World Bank has defined Food security as "access by all people at all times to enough food for an active, healthy life". Its essential elements are the availability of food and the ability to acquire it. The present investigation is an attempt in examining the availability and pattern of consumption of food and its implication for food security. Data has been obtained from secondary sources and collected from publications of consumption surveys of National Sample Survey Organisation and Directorate of Economics and Statistics. The analysis has tentatively



shown that poor households are food insecure and efforts are needed for providing them adequate food. This can be achieved by improving food availability to the poor through Public Distribution System and other distributional measures. Ensuring adequate income to the poor households through provision of employment is a necessary step in providing food security.

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## **THEME 6: HUMAN RESOURCE DEVELOPMENT IN AGRICULTURAL STATISTICS AND INFORMATICS**

### **1. Need of IT Based Agricultural Professionals in India**

S.N. Islam and H.O. Agarwal

Agriculture in India has grown from its infancy to a full-fledged science and a complex business as well.

It has sailed the nation out of a storm of hunger, malnutrition to a safe shore of food security. Information communication technology will definitely play a very significant role in the future development of Agriculture and its professionals. For the inclusion of ICT in every discipline of agriculture, definitely we would require quality human resources in Agriculture who are qualified IT professionals. In the current situation the high profile computer experts are not aware of agriculture. In the similar fashion agriculture graduates and postgraduates have very little knowledge of computers. They form a mutually exclusive group and need to be brought closer so that agricultural professionals using IT can play an important role in crop production in future. Educational institutions need to "modify their curricula" to train students and professionals in inter-disciplinary approaches that should include IT in a professional way. This strategy will not only uplift the face of our agriculture, it will provide a substantial scope of employment and overall development.

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