IARS
STATISTICAL NEWSLETTER

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PREFACE

This is the sixth issue of the *I.A.R.S. Statistical Newsletter* and covers the activities and allied information in respect of this Institute during the quarter April to June, 1976.

I hope this *Newsletter* has been proving useful for the Agricultural Research Statisticians and other users. I would welcome and appreciate any comments and suggestions for its improvement in the subsequent issues.

I am thankful to all the officers and other members of the staff of the Institute who supplied the requisite material for this issue of the *IARS Statistical Newsletter*. I am also thankful to my colleague, Dr. Prem Narain, Senior Professor for his going through the material.

D. SINGH
DIRECTOR,
INSTITUTE OF AGRICULTURAL
RESEARCH STATISTICS,
NEW DELHI - 110012.

CONTENTS

1. NEED FOR METHODOLOGY FOR ESTIMATION OF MEAT PRODUCTION

Meat is an important livestock product and no reliable statistics on its production in the country are available. For estimating annual meat production information on the number of animals slaughtered and average meat content per animal is required. Though the former is available from the records of registered slaughter houses, it is not known for private slaughter, namely, butchers' establishments and households. Objective and representative data on meat content per animal are not available from any source.

It needs no emphasis to say that data on animal slaughter in the unorganised sector and on the meat content per animal can only be obtained through a sample survey for the conduct of which suitable sample methodology has to be developed.

With this object in view, the Institute of Agricultural Research Statistics carried out two pilot investigations, one in five typical districts of Tamil Nadu (1966-67) and the other in all the seven districts of Haryana (1968-69). These surveys were conducted for a period of one year. Brief details of these surveys are described in the following paragraphs.

Description of the surveys :

In both the surveys, districts were the strata, clusters of villages were the primary stage units and households, the second stage units. In Tamil Nadu, a cluster was of three adjacent villages and in Haryana, of two villages.

When a town entered the sample, a ward and the two adjacent villages formed a cluster in Tamil Nadu and two wards in case of Haryana. For each region of the survey, 60 PSU's were selected independently in each of the seasons of the year. In Tamil Nadu, these PSU's were equally allocated to the five strata and in Haryana, in proportion to the census livestock population in each stratum. In each month of a season, from every village of a cluster, 20 households keeping any livestock (sheep, goats, cattle, buffaloes or pigs) and five households not

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keeping livestock were selected for recording the number of animals slaughtered in the month previous to the visit. All the butchers' establishments in the selected cluster were covered. Selection of sampling units at both the stages was with equal probability without replacement.

As regards the registered slaughter houses, monthly information on the number of animals slaughtered was obtained for the year of the survey from the State Departments of Animal Husbandry for all the slaughter houses.

Due to obvious practical difficulties, collecting information on meat content per animal was confined to registered slaughter houses only.

During every month two slaughter houses were randomly selected in a district and on a randomly chosen date information was collected on the body weights and carcase weights of three animals of each species.

The sample data were available for 180 villages and 17,000 households in Tamil Nadu and for 180 villages and 21,000 households in Haryana. For estimating average meat production data were availalbe from 45 slaughter houses every season in Tamil Nadu and 35 registered slaughter houses in Haryana.

Results in brief :

In the five districts of Tamil Nadu the total number of animals slaughtered was estimated at 12.4 lakhs with a standard error of 2.5 per cent. In Haryana it was 2.2 lakhs with 11.4 per cent standard error. In Tamil Nadu, 80 per cent of animals were slaughtered in the registered slaughter houses and in Haryana, 59 per cent. In each region the slaughter in households contributed only 5 per cent, the rest being from butchers' establishments. In Tamil Nadu, in the registered slaughter houses, of the animals slaughtered 62 per cent were sheep, 34 per cent goats, 3 per cent cattle and 1 per cent buffaloes. In Haryana, 62 per cent of the animals were sheep, 31 per cent goats and 7 per cent pigs. From private slaughter in Tamil Nadu, sheep accounted for 43 per cent, goats 42 per cent, cattle 11 per cent and buffaloes 4 per cent. In Haryana, in this sector sheep accounted for 33 per cent, goats 64 per cent and pigs 3 per cent.

In Tamil Nadu, sheep and goats on an average had a body weight of 17 kg and in Haryana they weighed about 21 kg. In Tamil Nadu, the dressing percentage of sheep and goats was of the order of 61 per cent, whereas, in Haryana, for sheep it was 45 per cent and for goats 48 per cent. In both the regions the average meat content per sheep or goat was almost of the same order,

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namely, 10 kg. In Tamil Nadu, the average meat production per cattle was 106 kg. and per buffalo 111 kg. In Haryana, a pig on an average gave 34 kg. of meat.

The total annual meat production from all animals was estimated as 19,400 tonnes in Tamil Nadu and 2,518 tonnes in Haryana.

The annual meat production in Tamil Nadu was estimated with a percentage standard error of 4.3 and in Haryana with 9.5 per cent In Tamil Nadu, sheep contributed about 37 per cent to the total meat production and in Haryana, goats contributed about 59 per cent.

The above results show that, with the sampling design adopted in these two pilot surveys, it would be possible to estimate annual meat production in any given region with a reasonable degree of precision.

2. TRAINING ACTIVITIES

(a) The final examination for the M. Sc. and Ph. D. students for the second trimester (1975-76) ending 24th April, 1976 was held during the quarter under report. The third trimester started from 21st June, 1976.

Two students, Sh. W.G. Amandry and Sh. K.C. Bhatnagar, qualified for the M.Sc. degree and one, Sh. K.C. Raut, for the Ph. D. degree.

(b) The half yearly examination of the S.C. and P.S.C. courses was held during the period under review. The final examination of the qualifying paper "General Knowledge in Agriculture and Animal Husbandry" was also held for the P.S.C.C. students. The classes of the second term of the P.S.C. and S.C. courses started from 1st May, 1976.

(c) During the quarter under review, the following seminars were held by distinguished speakers.

Name of the speaker	*Title*
1. Dr. Umed Singh, Asstt. Professor of Statistics, H.A.U., Hissar.	Compartmental models in Bio-availability I and II

2. **Dr. B.V. Sukhatme,**
   Professor of Statistics,
   Iowa State University,
   U.S.A.

   Some recent developments in
   designing surveys and analyis
   of survey data.

(d) Other Information :

A programme of specialised training course in "Agricultural Statistics" and "Socio-Economic Surveys" was arranged for the Statistical Officers Trainees deputed by the C.S.O. at the Institute from 7th to 16th June, 1976 and lectures on different topics were deliverd to the trainees by the officers of the Institute.

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3. BASIC RESEARCH

Important contributions in basic statistical methodolgy were made during the quarter under review, the details of which are given below in brief.

(i) A mathematical model involving ranking in triple comparisons was developed during the period. A test procedure was also developed to test the appropriateness of the model.

(ii) Some new variance balanced designs were evolved and their theoretical properties were investigated.

(iii) A new method of analysis of groups of experiments involving different sets of treatments with certain common treatments was developed.

(iv) A new method of systematic selection of a sample has been provided by which it has been possible to estimate the variance of the estimate.

(v) An estimation procedure in case of two stage successive sampling design has been evolved.

(vi) A statistical study on measurement of milk production coefficients with special reference to feeding and management, was made.

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4. ADVISORY SERVICE

During the quarter under review, technical advice and guidance was rendered to research workers and students of Research Institutes, Agricultural Universities and other research organisations in planning of experimental investigations and statistical analysis/computerisation of research data. Also, comments were offered on the research projects referred to the Institute by the I.C.A.R.

Some details of the technical advice and guidance given by the Institute during the quarter under review, are given below in brief :

(a) Crop Sciences :

The Jr. Statistician, C.P. R.I., Simla, the Tamil Nadu Agricultural University, Coimbatore and the Indian Institute of Horticultural Research, Bangalore were given advice in planning and designing of experiments.

(b) Animal Sciences :

1. Technical advice in regard to breeding policy and analysis of data was given to :

   (i) The Directorate of Animal Husbandry, Uttar Pradesh, Lucknow (U.P),

   (ii) The Indo—New Zealand Livestock Improvement Project, Palampur (H.P.) and

   (iii) The Central Cattle Farm, Suratgarh (Rajasthan).

2. Sh. A.D. Godbole from the Maharashtra Association for Advancement of Research, Poona was advised in regard to the statistical studies in the field of animal nutrition.

3. Sh. Harpal Singh, Ph. D. student from the Department of Animal Sciences, P.A.U., Ludhiana was given advice in regard to the statistical methodology for analysing poultry breeding data.

(c) Sample Survey Investigations :

Guidance was given to the Directorate of Marketing and Inspection (Ministry of Agriculture & Irrigation) regarding their survey on marketable surplus of rice and wheat.

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(*d*) **Data Processing** :

The Indian Society of Agricultural Statistics was given technical advice in regard to finalisation of code lists and card designs for the project "Farmers Training and Education Programme, Gujarat' for which a survey was conducted by the Directorate of Extension (Ministry of Agriculture and Irrigation).

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5. FIELD WORK

(*a*) *Field Training* : During the quarter under review, field training was imparted in connection with the projects mentioned below at the areas/places shown against them.

    (*i*) Economic and other factors influencing the fertilizer responses in the cultivators' fields—New Delhi.

    (*ii*) Pre-harvest forecasting of yield of sugarcane—Meerut district (U.P.)

    (*iii*) All India Co-ordinated Agronomic Research Project—Junagarh (Gujarat), Delhi, Kanyakumari (Tamil Nadu), Ajmer (Rajasthan) and Ludhiana (Punjab).

    (*iv*) Impact of milk supply scheme on rural economy in milk collection areas of the Greater Calcutta Milk Supply Scheme—Kalyani (W.B.)

    (*v*) Sample survey for methodological investigations into the H.Y.V.P.—Gauhati (Assam) and Bettiah of West Champaran district (Bihar).

    (*vi*) Pilot sample survey for developing a suitable sampling technique for estimation of losses of vegetables in transit and their price spread at various stages of marketing — Delhi.

(*b*) *Field Work Inspection* : Field work inspection/supervision was carried out during the quarter under review in connection with the projects given below in the areas/places shown against them.

    (*i*) Sample survey for estimation of area and production of cultivated fodders—Karnal district (Haryana)

    (*ii*) Economic and other factors influencing the fertilizer responses in cultivators' fields—New Delhi.

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(*iii*) Pre - harvest forecasting of yield of sugarcane—Meerut district (U.P.).

(*iv*) All India Co- ordinated Agronomic Research Project—Karamana (Kerala), Thanjavur (T.N.), Tirupati (A.P.) and Palampur (H.P.).

(*v*) Estimation of availability and cost of production of milk and its index in I.C.D. area, Bhopal (M.P.)—Bhopal (M.P.).

(*vi*) Sample survey for methodological investigation into the H.Y.V.P. — Meerut and Moradabad districts (U.P.).

(*vii*) Pilot sample surveys to estimate the production of lac—Ranchi (Bihar).

(*c*) During the quarter under review, field work of the scheme "Pilot sample survey for evolving a suitable sampling methodology for estimation of losses of vegetables in transit and their price spread at various stages of marketing in Delhi" was also initiated.

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6. ABSTRACTS OF PAPERS PUBLISHED

1. AMBLE, V.N. and JACOB, T. Development of statistics in animal sciences research in India. *Indian Jr. Animal Production Vol. 5, No. 1 - 4. March-December,. 1974.*

The article reviews the development of statistical methods and their role as important tools in the domain of animal sciences in India over a quarter of a century. The various methods developed in the fields of Animal Genetics and Breeding, Animal Productivity Studies, Standardisation of Experimental Techniques, Operations Research and Evaluation and lastly Summarisation of Planning have been reviewed. Some important areas where statistical research needs intensification have also been highlighted.

2. MEHROTRA, P. C., BANERJEE, A.K. and CHANDRA, JUGESH. Adoption of improved agricultural practices and yield performance for H.Y.V. of wheat in selected districts of West Bengal. *Food, Farming and Agriculture, Vol. VII, No 10 April, 1976, pp8-15.*

Some studies were carried out on high yielding varieties of wheat crop grown during rabi 1971—72 in the four districts of West Bengal selected under the scheme "Sample surveys for assessment of the High Yielding Varieties Programme." The

results showed that Sonalika was the most popular variety grown by the cultivators. The highest average yield recorded for Kalyan Sona variety was 31 Q/ha and for Sonalika 28 Q/ha. The increase in the average yield of H.Y.V. of wheat over the local varieties was more than 50 per cent in all the four districts. The cultivators were generally not adopting the recommended dosages of chemical fertilizers to the full extent. It was observed that there is a scope to increase the yield rates if the recommended dosages are used. About one fifth of the sampled cultivators using HYV of wheat obtained yield rates which were less than the mean yield recorded for the local varieties. The average yield generally showed an increasing trend with increased dosages of nitrogen application. About one half of the cultivators had used all the three types of fertilizers together, although the rates applied were less than the recommended levels. Majority of the cultivators had a holding size of 4 hectares or less. Crop losses due to various causes of damage were reported in a substantial number of the fields. The major causes of damage were reported as drought, plant diseases, insect pests, rats and hail storm. To avoid crop losses, there is a need to undertake adequate measures to check the occurrence of plant diseases, insect infestation and losses due to field rats.

3. MEHROTRA, P. C., BANERJEE, A.K., GUPTA. S. S. and RAJAGOPALAN, M. Agronomic practices and yield rates for HYV of rice in selected districts of Mysore State. *Food, Farming and Agriculture, March, 1976, Vol. VII, No. 9, pp. 5—9.*

A study on the performance of high yielding varieties of rice was carried out from the data collected during kharif and rabi seasons of 1970-71 in three districts of Mysore State, viz., Bellary, Mysore and Shimoga selected under the scheme "Sample surveys for assessment of the High Yielding Varieties Progromme". I.R.-8 was the most preferred variety in all the three districts. The other popular varieties were Manila and Jaya. The yield rates obtained were of a higher order during rabi season as compared to those recorded in kharif season. The average yield varied between 30.2 Q/ha to 46.6 Q/ha in the three districts during the two seasons. The average yield of HYV of rice was about 45 to 70 per cent more than the corresponding average yield of local varieties. A majority of the HYV fields received all the three types of chemical fertilizers · the doses of N, P and K applied were in the range of 75-120 kg/ha, 46-62 kg/ha and 45 - 58kg/ha respectively. The average yield generally showed an increasing trend with increased doses of fertilizer application. Use of improved agricultural practices and implements was reported in a majority of the HYV fields. Plant diseases and attack of insect pests were the major causes of damage in both the seasons in all the three districts. Sporadic cases of weed infestation, water logging and lodging of plants were also reported during rabi season.

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4. SINGH, D., SINGH, SHIVTAR and SRIVASTAVA, A.K. On repeat surveys in two stage sampling design. *Jour. Ind. Soc. Agri. Stat.. Vol. 28*, No. 1, June, 1976.

In the present paper the theory of successive sampling for two stage sampling designs has been discussed for the following two sampling schemes :

(a) Primary Sampling Units (psu's) are partially retained alongwith their secondary sampling units (ssu's.)

(b) All psu's are retained and ssu's are partially retained.

It is observed that in most of the practical situations sampling scheme (a) should be preferred over sampling scheme (b).

5. SRINATH, P.R., RAUT, K.C. and NADKARNI, U.G. Grass lands—their potentiality. *Indian Farming, April, 1976.*

In order to have an effective programme for improvement of grazing area in the country, the knowledge of the extent of area available for grazing, herbage yield and its botanical and chemical composition is necessary. From the survey carried out in Jhansi district of U. P., it was estimated that the grazing area per village was about 122 hectares in rainy season and 83 hectares in winter season, accounting for about 15 and 9 per cent of the geographical area respectively in a village. No herbage was available for grazing in summer season. Utilising the estimates of yield of herbage obtained before and after grazing, the area of grazing land and the number of cattle heads found grazing, the average consumption of herbage worked out to be 19 5 kg of greens in rainy season and 7.4 kg in winter season per cattle head per day. The herbage samples contained 30 species of grass, 9 of legumes and 5 of weeds in the rainy season ; and 17 species of grass, 8 of legumes and 5 of weeds in winter season. It was observed from the chemical analysis that nitrogen free extract, crude fibre, ash, crude protein and ether extract contents were 51.0, 25.8, 13.3, 8.2 and 1.7 per cent respectively during rainy season and in the winter season they were 53.7,27.9,10.9, 5..9 and 1.6 respectively. The survey demonstrated the feasibility of employing sampling techniques for the estimation of area, yield and botanical and chemical composition of grasslands in an area.

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7. PAPERS ACCEPTED FOR PUBLICATION

1. JAIN, J. P. and SAXENA, B. C. Milk production and its utilization in the milkshed areas of Dudhsagar Dairy, Mehsana (Gujarat). *Indian Jour. Anim Production.*

2. NARAIN, P. On Fisher's Fundamental Theorem of Natural Selection with non-overlapping generations. *Current Science, August, 1976.*

3. RAMACHANDRAN, V. and PILLAI, S. S. Multivariate ratio type estimators in finite population. *Jour. Ind Soc. Agri. Stat.*

4. SINGH, D., SINGH, H. P. and SINGH, PADAM, Pre-harvest forecasting of wheat yield. *Ind. Jour. Agri. Sci., Vol. 46. No. 11*

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8. I.A.R.S. PUBLICATIONS

1. SINGH, D., JHA, M.P., SINGH, PADAM and SINGH, H. P. Consolidated report of the pilot studies on pre-harvest forecasting of yield of cotton in Jalgaon, Baroda and Aligarh districts (1970-71 to 1974-75).

The results of the studies showed that the six biometrical characters included in the prediction model, viz., plant population, plant height, basal diameter, spread of plant, number of bolls per plant and number of branches per plant could account for only 30-40 per cent of the variation in yield. However, inclusion of yield at first picking as an additional independent of variate improved the precision considerably. A reliable estimate of kapas yield of cotton is, therefore, possible 4 to 5 months after sowing, based on plant population and yield at first picking. The four linear models tried in different scales, viz., original, logarithmic, square root and reciprocal, did not show any significant difference, indicating that there is no need for any transformation of data.

2. JHA, M.P., SINGH, PADAM, IYER, V.N. and CHANDRAHAS. Consolidated report of the pilot studies on pre-harvest forecasting of yield of wheat in Aligarh and Ludhiana districts (1970-71 to 1974-75).

Six biometrical characters, viz., plant population, number of tillers per plant, height, basal diameter, number of green leaves per tiller and length of earhead explained about 50 per cent of the variation in yield. The results further showed that plant population and number of tillers per plant are the two characters which greatly contribute towards yield. A satisfactory prediction of yield of wheat is possible two to three months after sowing of crop. As in the case of cotton, a linear regression model without any transformation of data was found equally efficient.

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9. ABSTRACTS OF DISSERTATIONS APPROVED

Ph. D.

* 1. PURI, P. D. On efficiency balanced and partially balanced designs.

The construction and analysis of block designs and factorial experiments have been presented. The methods developed in the present dissertation do not have any constraint of constant block sizes and equal replications. The designs so constructed give the experimenter more freedom in designing effective experiments even in unconventional circumstances.

Different concepts of balancing, namely, variance balance, efficiency balance and pairwise balance in incomplete block designs have been characterized. The patterns of block designs satisfying one or more of them have been discussed. The necessary and sufficient conditions for a block design to be variance balanced and / or efficiency balanced have been derived.

Various methods of construction of efficiency balanced and variance balanced designs with (*i*) equi-replicate and proper, (*ii*) varying replicates and proper and (*iii*) varying replicates and varying block sizes have been given.

Some new row-and-column designs for two-way elimination of heterogeneity have been constructed. Designs for simultaneous estimation of the effects of two non-interacting sets of treatments for two-way elimination of heterogeneity have also been obtained.

A new class of incomplete block designs, known as partially efficiency balanced (PEB) designs have been introduced. These designs are available in varying replicates and varying block sizes. In these designs different contrasts are estimated with different efficiencies ; as such these designs may be particularly useful for bio-assays and factorial experiments. Some methods of their construction have been discussed. The idempotent matrices have been worked out for their analysis. Simplified analysis of augmented-ED, PBIB and PEB designs have also been presented.

Some kronecker product PEB designs has been obtained by taking the kronecker product of two or more EB and / or PEB designs. The idempotent matrices of these designs have been worked out. A method of obtaining PEB designs by merging the treatments of knonecker product PBIB and PEB designs has been discussed. The kronecker product PBIB designs, turn out to be particular

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* This pertains to the quarter January-March, 1976.

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cases of kronecker product PEB designs. A simplified analysis of these designs has also been discussed. The conditions under which m-classPEB designs are reducible to m_1 classes where m_1 is some integer less than m have been given.

The theory on construction of balanced factorial expriments with varying replicates and varying block sizes has been given. The idempotent matrices have been worked out and a simplified analysis of these designs has also been given. A property (A^*) as a generalization of the property (A) of Kurkjian and Zelen (1962, 1963) has been introduced. Some methods of construction of balanced factorial experiments in varying replicates and varying block sizes have also been discussed. These methods provide a number of useful factorial designs which are more efficient than the existing ones. It has been shown that the existence of factorial designs implies the existence of PEB designs.

(Guide : Dr. Prem Narain and Dr. A.K. Nigam)

2. RAUT, K.C. A statistical study on measurement of milk-production co-efficients with special reference to feeding and management.

Formulation of programmes for improvement of dairy animals needs critical examination of data available both in farms and villages. Considering the fact that studies on buffaloes maintained under village conditions will go a long way in improving the productivity of a large majority of dairy animals in the country, attempts have been made to work out the levels of milk production, feeding and management conditions of buffaloes utilising the data collected in a large scale sample survey conducted in Dhulia region of Maharashtra. Results pertaining to lactation performances are based on data for 118 non-descript buffaloes in different orders of lactation and those on feeding and management based on data on initial stages of lactation for 129 buffaloes in winter season, 73 in summer season and 83 in rainy season.

The average lactation yield of a buffalo irrespective of its order of lactation was estimated to be 1172 kg. For about 60 per cent of buffaloes, the lactation yield was within the range of 1000 kg to 1800 kg. Only for about 3 per cent of buffaloes, the yield was more than 2000 kg. The estimated lactation length of a buffalo in the area was 301 days. The calving interval was estimated to be 456 days. The relationship between daily milk yield and stages of lactation was observed to be quadratic during initial stages of lactation and linear for later stages.

Attempts for the first time were made to give the indicators of management, their measurement technique and extent of influence on milk production. There

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was high order of association between levels of milk production and management conditions in each season. The seasonal effects with regard to management factors were studied by introducing dummy variables. Floor area available per animal was estimated. Milk yield was linearly related with housing conditions and feeding practices. Existing practices of feeding in winter season and housing conditions in rainy season had better influence on milk yield of buffaloes.

From the milk-production functions fitted, it was worked out that 7.3 kg greens, 2.5 kg dry fodder and 3.5 kg concentrates would be the optimum requirement for economic milk production in winter season. Concentrate feeding at higher level in summer and rainy seasons was found to be uneconomical. Feeding of more greens would be economical. Comparing with the prescribed nutritional standards, it was observed that buffaloes in the area were fed adequately both in terms of D.C.P. and T.D.N.

Feeding and management together explained upto 70 per cent of variation and of which 28 to 30 per cent was accounted for as due to management.

A critical discussion has been made on the findings of the investigation. Scope for further improvement in both collection of requisite data as well as the appropriate statistical methodology has been indicated. Need for conducting controlled experiments to assess the production-potentiality of animals due to efficient management has been emphasized.

(Guide : Dr. D. Singh).

Diploma

1. BHAGAVAN, S. Comparison of various estimators in sampling through Monte-Carlo methods.

Generally, sample survey statistician is faced with the problem as to how he should make the best use of available information on some auxiliary variable which is highly correlated with the variable under study. The types of population which we come across in surveys for estimating the production or extent of cultivation of agricultural commodities generally follow a linear regression relationship on auxiliary character X. Hence, in this thesis the population was assumed to be coming from a bivariate normal distribution. Four populations were generated for four different values of ρ ranging between 0.3 and 0.9 for given mean and given standard deviations. The X-observations were treated as auxiliary variates and Y-observations were treated as study variates.

The present study was aimed at finding out the suitable method of estimation when auxiliary variates are available. The study was carried out through Monte-

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Carlo methods which envisage the simmulation of populations which have the given pattern of relationship between the study and auxiliary variates for some reasonably fixed values of parameters. From each of the generated populations consisting of 200 units, corresponding to the four varying values of ρ, 200 independent samples (four sets of 50 each) for varying sample sizes were selected. Each of these samples provided estimates of population total by using three different methods of estimation along with the corresponding estimates of the variances. One estimate of the bias in the estimate of the population mean estimated through ratio and regression methods of estimation is provided by taking the difference between the average value of the estimates taken over 200 samples and the true value of the population mean. Similarly, the mean square of 200 sample values of the estimates of the population mean provides estimate of the true value of the variance of an estimate of given parameter.

(Guide : Dr. A.H. Manwani).

2. MALHOTRA, P.K. Selection indices in poultry.

The analysis of data collected under the I.A.R.S. project entitled 'Statistical methodology for developing efficient selection procedure in poultry breeding' from Regional Poultry Farm at Bhopal during the laying periods of 1971 and 1972 was conducted with a view to study the distributions of the scores of birds based on different selection indices. The data was first adjusted for hatch effect. Selection scores were worked out for each bird using three methods of selection viz., (a) selection on the basis of an index with optimum weights attached to the individual's performonce and its full-sib family averages, (b) selection on the basis of an index with optimum weights attached to the individual's performance and its half-sib family averages ; (c) selection on the basis of an index with optimum weights attached to individual's performance, full-sib family averages and half-sib family averages. Using these selection scores, the frequency distributions were obtained for the three curves Suitable distributions were then fitted to the data on scores.

It was observed that for the scores based on methods (a) and (b), Pearsonian Type I was the appropriate distribution whereas for the scores based on the method (c) a normal distribution was found to be appropriate. It was found that there is tendency in the distribution of selection scores to tend to normality as the information from more than two scores are combined. The variability in the scores was also found to increase when information from both the half-sib as well as full-sib families are combined with the individual's performance. This shows that selection based on the method (c) could be better exploited than those based on either (a) or (b).

(Guide : Dr. Prem Narain).

3. RAMESH, B.S. Some methodological investigations on pre-harvest forecasting of jute crop based on biometrical observations.

The objective of the study was to develop methodology to build up pre-harvest estimates of fibre yield of jute crop on the basis of biometrical observations recorded at various growth stages of the crop. The data utilised were obtained through pilot sample surveys conducted in Nadia and 24 Parganas districts, West Bengal during the years 1970-71 to 1973-74. The design of the survey was stratified multi-stage random sampling, with fields within circles as the primary stage units. All the circles in the four selected community development blocks were covered under the survey and hence a circle in a block constituted a stratum. Biometrical observations on plant density, plant height and basal diameter of the plants were recorded at four-weekly intervals upto and inclusive of the time of harvest. The period 11-15 weeks after sowing of the crop was found to be the most appropriate one to forecast the yield.

Different transformations were tried on the independent variables (i.e. on the three biometrical characters), but the prediction equations based on them showed only marginal improvement over the simple linear and log-linear equations. Between these two, log-linear was found to be superior to simple linear equation.

To forecast the yield rate for the year 1973-74, a combined regression equation based on all the three previous years' data was fitted which was found to be better than regression equations fitted on one or two years' data.

(*Guide* : *Sh. K.S. Krishnan*).

4. SINGH, R.P. On study of optimality and orthogonality in a class of fractional factorials.

In fractional factorials optimum designs do not exist for all N and n, the number of design points and the number of parameters to be estimated, and hence there is a need to select the best design for a given situation. For this purpose different efficiency criteria of optimality viz. A,D and E have been in use. A compromise has to be made for providing the set of points which perform uniformly better with respect to all the three criteria of optimality simultaneously. This led to the new concept of C-optimality which has been discussed in this thesis.

On the other hand, if the experimenter aims at minimizing the extent of non-orthogonality of different orders of effects of different factors in preference to optimality, he can adopt the tool of C- orthogonality which has also been discussed in this thesis.

The implications of these different criteria of optimality and orthogonality have been studied for the designs adopted for fertilizers trials on cultivator's fields.

(Guide : Dr. A.K. Nigam).

5. SRIVASTAVA, V.C. On some methods of construction of balanced ternary designs.

This thesis discusses some new methods of construction of balanced ternary designs. These designs are such that a treatment is allowed to appear at most twice in each block, and the variance of any estimated elementary contrast is the same.

In the first part of the thesis two series of balanced ternary designs have been constructed using balanced incomplete block designs. In the second part a new series of designs with even number of treatments is constructed using a generalised method of differences. Finally, some balanced ternary designs with variable replications and unequal block sizes are also obtained and a catalogue of useful designs has been provided.

(Guide : Dr. Aloke Dey).

M. Sc.

1. AMANDRY, W.G. Application of the principles of decision theory in the selection of sampling schemes.

This is the first attempt on the use of decision theory for the efficient utilisation of resources in sample surveys. To start with, the organiser of the survey may not be knowing the type of distribution of the population that he is sampling. The efficiency of the scheme will depend on this distribution which is designated as the state of nature. In the present study three possible states of nature, viz., Gamma, Normal and Exponential and three possible actions, viz., simple random sampling, stratified sampling with proportional allocation and cluster sampling are considered. First, the expressions for sampling variances from these populations are deduced. Then, samples were taken by the different techniques from known, normal, gamma and exponential populations. The pay off matrix was formed using the coefficients of variations from the samples and the minimax as well as Bayes' solutions obtained. The pay off matrix was also formed by using a cost function which is a linear combination of the coefficient of variation and the cost of processing the data and the corresponding solutions obtained. The solutions were also obtained by treating the case as a data problem. Further, a least square estimate of the elements of the pay off matrices is also used to obtain the minimax and Bayes' solutions.

(Guide : Sh. G. Sadasivan).

2. BHATNAGAR, K.C. Optimum points of stratification for estimating yields of paddy in Chingleput district of Tamil Nadu.

The dissertation deals with the problem of determining the optimum points of stratification in sample surveys for estimating the total yield of crops. The study attempts to demarcate the boundry points of strata using different methods by making use of the information on the holding size of the cultivators selected under the scheme "Sample surveys for the assessment of the High Yielding Varieties Programme" in Chingleput district of Tamil Nadu during rabi season of 1972-**73**. The results indicated that equalization of cumulative of $\sqrt{f}$ (y) method of construction of strata using regression method of estimation provides an estimate of total yield of paddy with the smallest standard error and could be used with advantage.

(Guide : Sh. A. K. Banerjee).

10. COMPUTER CENTRE

(*1*) *Computer Utilisation* : During the quarter under report, the computer worked for about 1556 hours. The time utilised by IARS, IARI and the Directorate of Economics and Statistics was 29.5 per cent, 18.7 per cent and 15.5 per cent respectively. 19.9 per cent time was shared by other ICAR institutes and the Department of Agriculture, U.P. Agricultural Universities utilised about 11.3 per cent of the time. About 80 hours were utilised for jobs on payment basis mainly by NPL and the Directorate of Marketing and Inspection, Faridabad.

(2) *Programming Facilities* : About 12 M. Sc., 25 Ph. D. and 15 other research workers from various Institutes under ICAR and Central Agricultural Universities were given help in computer programming and analysis of their research data. The Chief Scientist, Computer Centre, took some classes in Symbolic programming language for IBM 1620 for the benefit of the staff of the Computer Centre.

(*3*) *Mechanical Tabulation* : During the quarter under reveiw, work relating to various research projects of IARS, IARI and other Research Institutes under ICAR was undertaken. About 4.5 lakh cards were punched, 88 sorting jobs were done and 30 tables and 442 listings were prepared. A large number of students and research workers were guided in the data preparation for their research work.

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(4) *Other Information* : (*i*) Two contracts were signed on 11th June, 1976 with Burroughs Overseas Limited, U.S.A. for supply of B—4771 computer system, and with Tata Consultancy Services, Bombay for installation, warranty, maintenance with spare parts, etc. The delivery of the system is expected during the month of October, 1976. The system configuration and specifications are as follows.

BURROUGHS B4700 SYSTEM CONFIGURATION & SPECIFICATIONS

Style No.	*Description*	*Units*
B4771	Central processor	1
	- 4 MHZ	
	- 150 KB IC memory with error correction and 500 ns access time.	
	- I/O Sub-Sytem	
	4 million bytes per second	
	- 8 I/O Channels	
	- Floating Point	
	- Processor Accessories	
B4341	Operator Display Console Control	1
B9348-2	Operator Display Console	1
B4388-1	Disk Pack Controller	2
B4388	Host Control for Disk Pack Controller	1
B9488-2	Dual Disk Pack Drive (174-4MB, 30 ms seek)	2
B4395-2	Magnetic Tape Unit Control	2
B9499-15	Magnetic Tape Unit Exchange	1
B9499-16	Extension to MTU Exchange (2x8)	1
B9495-2	Magnetic Tape Units (1600 BPI), 9 track, P.E., 120 KB/s)	4
B4115	Card Reader Controller	2
B9116	Card Reader (80 cc, 600 cpm)	2
B4247-4	Line Printer Controller	1
B9247-14	Train Printer (1100 lpm, 132 pp)	1
95-9495-110	½" Unrecorded Magnetic Tapes 10½" Reel, 2400 'Reel with cases, autoloading	250
B9974-4	Disk Packs Accessories for peripherals such as cabling etc.	10

(*ii*) The International Development Research Centre in Ottawa, Canada donated a Hewlett Packard Calculator to the Institute. This offer was made by the President of IDRC, Dr. W.D. Hopper to the Director General, ICAR, Dr. M.S. Swaminathan during the latter's visit to Washington.

The HP 9810-A has 111 data registers and can store upto 2036 programming steps. Three read only memories (*a*) which facilitates printing of alphabetic messages (*b*) for statistical functions and (*c*) for customer definable functions have been supplied along with the calculator. The calculator has a card reader meant for reading programmes and data entered on mark sense cards into the calculator. A systems desk has also been received with the calculator which helps in inter-connecting the peripherals from a common power outlet. A large number of programmes for commonly used statistical procedures have also been supplied in the manuals received.

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11. LIBRARY

(*a*) During the quarter under review, 150 new books were added to the Library for selected reading by research clienteles of the Library.

(*b*) During the quarter under reveiw, the following reprints were procured for distribution by the Library.

S.N.	Author	Title	Source
1.	Narain, P.	Factor analysis in social research	Indian Jr. of Ext. Edu. Vol. XI, Nos. 3&4, July-Dec., 1975
2.	Narain, P. and Mishra, A.K.	Efficiency of selective breeding based on a phenotypic index.	Jr. of Genetics, Vol. 62, No. 2, Dec., 1975
3.	Narain, P, Subbarao, C. and Nigam, A.K.	Partial diallel crosses based on extended triangular association scheme.	Indian Jr. of Genetics and Plant Breeding, Vol. 34, No. 3, Nov., 1974

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12. MISCELLANEOUS

(a) Appointments, Promotions, Transfers, etc.

(i) Dr. A. K. Nigam, Statistician-cum-Associate Professor went on a short term foreign post-Doctoral research assignment in the Department of Statistics of the Colorado State University, U.S.A.

(ii) Sh. H.V.L. Bathala was appointed as Junior Statistician on 5th June, 1976.

(b) Staff Research Council

A meeting of the Staff Research Council of the Institute was held on 19th and 20th April, 1976.

(c) Distinguished Visitors

Dr. R.A.D. Jones, Director, Rice Research Station, Rokupr, Sierra Leone (West Africa) visited the Institute on 25th April, 1976. He was explained the research work done in the Division of Statistical Research (Crop Sciences) and was also taken round the Computer Centre and the Exhibition Room of the Institute.

(d) Other Information

(i) Dr. D. Singh, Director, attended the Management Workshop of the Directors of the Research Institutes under the administrative control of the I.C-A.R. held at the Administrative Staff College of India, Hyderabad from 27th April to 1st May, 1976.

(ii) Dr.P. Narain, Senior Professor, participated in a seminar of the Centre for Theoretical Studies, Indian Institute of Sciences, Bangalore at Nandi Hills on "Genetics and Social Organisation" from 14th to 17th June, 1976 and presented a paper entitled "A population-geneticist's view of caste" at the Seminar.

Dr. Narain also delivered on 19th, June, 1976 two lectures entitled "Efficiency of sire evaluation methods" and "Selection index and its use in livestock production" during the Summer Institute on "Methodology in Dairy Cattle Breeding and Production" organised at the N.D.R.I., Karnal.

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He was also nominated as a member of the Expert Group on Nutrition Schemes of the Department of Food, Ministry of Agriculture and Irrigation, New Delhi.

(*iii*) At the request of the Institute of Economic Growth. University of Delhi, Sh. K.S. Krishnan, Senior Statistician, was nominated as a member of Sub-group 4 of the ICSSR Working Group on "Alternatives in Agricultural Development."

(*iv*) Sh. K.V. Sathe, Programmer, delivered on 28th June, 1976 a lecture on "Computer Programming for Animal Breeding Data" at the Summer Institute on "Methodology in Dairy Cattle Breeding and Prodution" organised at the N.D.R.I., Karnal.

PERIODICAL PUBLICATIONS

ANNUAL REPORT

The Annual Reports issued by the Institute cover all the aspects of its functions and activities and provide useful information to research workers in the field of agricultural statistics.

NATIONAL INDEX OF AGRICULTURAL FIELD EXPERIMENTS

The results of statistical analysis of the data pertaining to agricultural field experiments (other than varietal trials) conducted at the various research stations all over the country are published in the form of compendia series. Two such series in respect of the various States pertaining to the periods 1948-53 and 1954-59 have already been completed and the third for the period 1960-65 is nearing completion. The experimental data for the period 1966-71 have been collected and are under process.

The prices of the different volumes are given below :-

State/Region	Series I (1948-53)	Series II (1954-59)	Series III (1960-65)
Andhra Pradesh	Rs. 12.00	Rs. 12.80	
Assam	Rs. 4.00	Rs. 6.80	
Bihar	Rs. 9.75	Rs. 21.85	
Gujarat	Rs. 6.75	Rs. 9.25	
Kerala	Rs. 7.25	Rs. 8.05	
Madhya Pradesh	Rs. 11.25	Rs. 13.70	
Tamil Nadu	Rs. 13.25	Rs. 11.70	
Maharashtra	Rs. 25.00	Rs. 24.25	
Karnataka	Rs. 14.00	Rs. 20.45	*
Orissa	Rs. 3.50	Rs. 6.30	
Punjab, Haryana, H.P and J. & K.	Rs. 19.50	Rs. 19.20	
Rajasthan	Rs. 4.00	Rs. 6.20	
Uttar Pradesh	Rs. 35.75	Rs. 42.10	
West Bengal	Rs. 7.75	Rs. 8.15	
Central Institutes.	Rs. 11.00	Rs. 16.50	
Total for the set	Rs. 184.75	Rs. 227.30	

* Prices not yet fixed.

OTHER PUBLICATIONS

For copies, please write to the Chief Administrative Officer, Institute of Agricultural Research Statistics (I.C.A.R.) Library Avenue, New Delhi-110012