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(भा० कृ० अ० प०)

लाइब्रेरी एवेन्यू, नई दिल्ली—११००१२

INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE

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PREFACE

This is the Thirteenth issue of IASRI Statistical Newsletter and covers the activities and allied information in respect of this Institute during the quarter January-March, 1978.

I am glad to inform that since the name of the Institute of Agricultural Research Statistics (IARS) has been changed as Indian Agricultural Statistics Research Institute (IASRI) w.e.f. 1st January, 1978, the issues of *IARS Statistical Newsletters* would hence-forth be called as "*IASRI Statistical Newsletter*".

I hope this Newsletter has been proving useful to 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 member of the staff of the Institute who supplied the requisite material for this issue of the "*IASRI Statistical Newsletter*". I am also thankful to my colleague, Dr. Prem Narain, Jt. Director, for going through the final material.

DAROGA SINGH
DIRECTOR
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NEW DELHI-110012.

भारतीय कृषि सांख्यिकीय अनुसंधान संस्थान

निदेशक

दरोगा सिंह

के निरीक्षण में सहेयोग दिया ।

श्री संस्थान के उन सब अधिकारियों तथा अन्य सदस्यों का आभारी हूँ जिन्होंने श्री कृ. सं. सां. श. सं. सांख्यिकीय सूचना-पत्र के इस अंक के लिए अधिष्ठित सामग्री प्रदान की है । मैं अपने सहकर्मों, संयुक्त निदेशक, डा० प्रमनारायण का भी कृतज्ञ हूँ जिन्होंने सामग्री

प्रकार की दिवणी और सुझावों का आभार सहित स्वगत कलगा ।

मुझे आशा है कि यह सूचना-पत्र कृषि अनुसंधान सांख्यिकीविदों तथा अन्य प्रयोक्तार्यों के लिये लाभदायक सिद्ध हो रहा है । इसके अगले अंकों में सुधार लाने हेतु मैं किसी भी

“श्री कृ. सं. सां. श. सं. सांख्यिकीय-सूचना पत्र” के नाम से प्रकाशित हूँगे ।

गया है । अतः “श्री कृ. सं. सां. श. सं. सांख्यिकीय-सूचना पत्र” का यह अंक तथा आगामी अंक बदल कर १ जनवरी, १९७८ से भारतीय कृषि सांख्यिकीय अनुसंधान संस्थान कर दिया मैं हूँ सहित सूचित करता हूँ कि कृषि सांख्यिकीय अनुसंधान संस्थान का नया नाम

विषयों तथा सतत जातकारी का विवरण है ।

अंक है और इसमें इस संस्थान से सतत-चल जनवरी-माघ, १९७८ की तिमाही की गति-भारतीय कृषि सांख्यिकीय अनुसंधान-सांख्यिकीय सूचना-पत्र का यह नैरेडवा

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1. RESPONSE TO MICRONUTRIENTS ON RICE IN ALLUVIAL SOILS

With the drive for higher agricultural production and consequent increase in intensity of cultivation, the need for extending research and experimentation on micro-nutrients such as zinc, manganese, etc. was felt in early sixties. Introduction of high yielding varieties further emphasised the problem. Accordingly, research on various aspects of the problem have been taken up and also intensified.

Experiments to evaluate crop response to micronutrients on different crops, particularly cereals in various soil groups are in progress. On high yielding and locally improved tall varieties, experiments were conducted at the model agronomic research centres to study the response to foliar spray of micro-nutrients during 1967-70. In the series 1971-76, effects of soil application of micro-nutrients were tested. On the cultivators' fields, the response to soil application of zinc is being studied since 1971. The responses to micronutrients were evaluated over a dose of nitrogen, phosphorus and potassium.

In the alluvial soils, experiments on rice were conducted at the Model Agronomic Research Centres at Varanasi, Pura Farm, Bichpuri, Masodha (U. P.); Sabour (Bihar), Fallangani, Titabar (Assam); Talab Tillo (Jammu); Kalyani, Hiragachi (W. B.) and Yemmiganur (A. P.) during 1967-70 and at I. A. R. I. (Delhi); Basudeopur, Sabour (Bihar); Masodha, Pura Farm, Varanasi (U.P.) and Titabar (Assam) during 1971-76. Results of experiments on cultivators' fields were available from Kanpur, Fatehpur, Faizabad, Gorakhpur (U.P.); Bhagalpur, Saran, Champaran, Patna (Bihar); Sibsagar (Assam); Jammu (Jammu) and Chingleput (Tamil Nadu) districts during kharif season and Chingleput and Sibsagar districts during rabi season.

Beneficial effect of foliar spray of 10 kg/ha zinc sulphate (Zn) in two sprays was observed at Varanasi, Pura Farm, Talab Tillo and Titabar during kharif and at Kalyani during rabi. The responses varied between 4-19 Q/ha but were not consistent at any of the centres. Foliar spray of 10 kg/ha manganese sulphate (Mn) also in

two sprays improved the yield only at Varanasi in one year. Higher yields were obtained at Titabar in one year to foliar spray of ferrous sulphate (Fe) at 20 kg/ha in two sprays.

Soil application of zinc sulphate (Zn) at 50 kg/ha improved the yield of Pusa 2-21 variety of rice by about 7 kg/ha at Titabar in one year. Response to soil application of neither manganese sulphate (Mn) nor sodium molybdate (Mo) was observed at any centre.

Improvement in yield between 1-3 kg/ha was observed on cultivators' fields to zinc application in all districts except Gorakhpur and Faizabad. Beneficial effect observed at Titabar and Pura Farm on kharif rice were also seen in the trials on cultivators' fields in the districts of Sibsagar and Kanpur. Consistency in response was observed in the districts of Bhagalpur (2.4 Q/ha) and Patna (2.4 Q/ha) on IR-20 and Chingleput on IET-1991 (1.5 Q/ha) and IR-20 (3.5 Q/ha) under irrigated conditions during kharif season.

2. METHODOLOGY FOR ESTIMATION OF AREA AND PRODUCTION OF CULTIVATED FODDER

The Government of India have been trying to develop livestock Industry in successive five year plans and a number of steps have been initiated with this objective. Its main emphasis has been to bring about livestock improvement through breeding and veterinary protection programmes. Unfortunately the impact of these efforts has not been quite significant. One of the reasons for this position is that the available resources of livestock feed in our country are far too inadequate to meet the minimum requirements of the livestock. The dairy animals in particular require high-quality greens and other nutritious feeds throughout the year. Unless efforts are made to increase the output of nutritious feed, the productive potential of the livestock cannot be realised. At present a major portion of livestock feed is obtained as a by-product in the production of various crops. Although in some progressive areas, the cultivation of fodder crops has since been taken up, steps have

to be taken to ensure increasing production of nutritious fodders. This will also involve a regular annual review of production of fodder in various parts of the country on the lines being done for food-grains at present in order to evaluate the progress of the schemes for increasing production. Realising the need for a suitable technique for estimating production, a beginning in this direction was made by I.A.S.R.I. in 1972-73 by taking up a pilot sample survey for evolving a suitable sampling technique for estimation of yield of cultivated fodders in Meerut district of Uttar Pradesh and a repeat survey in 1974-75 in Karnal district of Haryana state. Each of these surveys was carried out for a period of nearly two years. The objective of the surveys was estimation of area and production of important cultivated fodders employing sample survey techniques, to collect by enquiry data on cultivation practices followed for these crops and estimate nutrient content of cultivated fodders. The methodology to estimate area and production of cultivated fodders developed in the survey is given in this note.

METHODOLOGY

The sampling design adopted for the survey was stratified three-stage random sampling with tehsils as strata. The first stage unit was a village; field under a fodder crop, was the second stage unit and a plot of size 5 m × 5 m, the ultimate unit (third stage) of sampling. A sample of seventy-five villages distributed over the strata in proportion to area under fodder crops, was selected in each survey. The selection of villages from each stratum was done independently with probability proportion to area under cultivated fodders. For selecting the fields for the crop cutting experiments, lists of all the fodder fields in the selected village was prepared for each fodder crop separately after each sowing season, viz., kharif and rabi, field for each fodder crop was selected from the lists by simple random sampling. In each of the selected field, a plot of size 5m × 5m was demarcated randomly for crop cutting experiment. For the purpose of chemical constituents, the harvested crop from the plot was thoroughly mixed before a sample of 1 kg. was taken.

ORGANISATION OF FIELD WORK

The collection of data was done by the regular full time staff consisting of 15 field enumerators, 3 supervisors and one Inspector who exercised the administrative control on the field staff. Each supervisor was assigned five enumerators for the

purpose of supervision of field work. The supervisor also attended to field work when any enumerator proceeded on leave. This helped in collection of data at the appropriate time and timely conduct of crop cutting experiments.

For the collection of data, six forms were used which were as follows .—

- (i) General information regarding the selected village.
- (ii) Survey of fields growing fodder in the selected village.
- (iii) Particulars of random selection of fields.
- (iv) Particulars of random selection of plot.
- (v) Yield of selected plot.
- (vi) Information on cultural practices followed in the field.

Details of conduct of survey, analysis of data and the results obtained in Meerut survey have been published already and its abstract has been reported in July-Sept. 77 issue of this 'News letter'. Results of the Karnal survey have also been worked out and a report incorporating these results will be published shortly. The salient results obtained in the two surveys are presented below.

RESULTS

The estimates of area and production of major fodder crops are presented in the following tables :—

Table 1—Area in Hectares

Crop\Year	Meerut		Karnal	
	1972-73	1973-74	1974-75	1975-76
Jowar	62,842 (9.8)	43,560 (4.9)	—	21,583 (8.9)
Berseem	11,695 (12.8)	11,987 (7.4)	11,444 (8.7)	14,217 (7.8)

Note : Figures in brackets indicate per cent standard errors.

It may be inferred from the above table that the estimates of area under the pilot surveys have been obtained with reasonable precision.

Estimates of yield rates of principal fodder crops are given in table-2

Table 2—Yield in tonnes per hectare.

Crop/ Year	<i>Meerut</i>		<i>Karnal</i>	
	1972-73	1973-74	1974-75	1975-76
Jowar	18.4 (3.2)	22.2 (2.6)	—	23.5 (1.8)
Berseem	45.7 (2.2)	37.3 (3.4)	92.3 (3.0)	85.0 (3.5)

Note : 1. Figures in brackets represent per cent S.E.

2. The yield estimates for berseem represent the total yield of all cuttings.

The precision with which the estimates of these crops have been obtained clearly shows that the sampling methodology adopted can be employed for the estimation of area and production of the principal fodder crops annually.

The other fodder crops namely Bajra, Lobhea Rijka, etc., which are grown to a smaller extent are estimable with higher percentage standard errors. The methodological studies will continue for possible improvement of the technique and to cover new crops and areas.

3. TRAINING ACTIVITIES

During the quarter under report, an educational training tour programme was organised from 4.1.78 to 15.1.78 for the benefit of the students of P.S.C., S.C., and J.C., Courses. They were taken round to various Research Institutes, Universities and acquainted with research methodologies being followed in those organisations.

During the quarter, the Annual examination of J.C.C. students and Half-yearly examination of S.C.C. and P.S.C.C. students were held.

4. BASIC RESEARCH

A systematic approach to the analysis of Row-column experiments (three dimensional experiments) was attempted. Different types of balancing in such experiments were evolved. A number of series of designs were obtained for such row-column experiments. The problem of balanced factorial experiments was viewed under such designs. The efficiency factor of a block design for estimating any general contrast of treatment effects was obtained in terms of the efficiency factors of a set basic contrasts.

A suitable sampling strategy was evolved to estimate the population parameter, mean of a normal population where the number of observations taken on each unit is a random variable and is supposed to follow a Truncated Poisson distribution.

Lactation correction factor and the repeatability of economic characters were studied in Sahiwal Cows and Murrah buffaloes.

5. 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 their experimental investigations and statistical analysis/computerisation of their research data as also in regard to research projects referred to the Institute by the I.C.A.R. and other organisations. Some details of the technical advice and guidance given by the Institute during the quarter under review, are given below in brief :—

Crop Sciences :

- (i) Comments were offered on the report pertaining to Annual report of 1975-76 of AICARP, sent by the Project Coordinator AICARP.

- (ii) Shri Naqvi, Asstt. Economic Adviser was advised in regard to fertilizer responses of groundnut in cultivators' fields.
- (iii) Officers from M.A.E. Centres, Karaiyarupu and Siruguppa were given advice in the planning and designing of experiments.
- (iv) Dr. R.K. Singh, Scientist, Agronomy Division, IARI was advised in regard to the analysis of research data of residual effect of fertilizers on wheat and bajra.
- (v) Officer Incharge, Vine yards, Horticultural Crops IARI, New Delhi was advised in regard to various designs of experiments.
- (vi) Dr. V.K. Patil, Associate Dean (Instruction) Marathwada Agril. University, Maharashtra was given guidance in respect of design and analysis surface experiments.

Animal Sciences

- (i) Miss Gurmit Dhillon, M. Sc. student from Lady Irwin College, New Delhi was advised in regard to the statistical analysis and interpretation of the results of the data of studies on factors affecting poultry adoption.
- (ii) ICAR was rendered advice on statistical methods pertaining to the schemes in the field of animal breeding.
- (iii) Dr. Mathur, Professor of Nutrition, College of Animal Sciences, Bikaner was advised on the procedure for analysing animal nutrition data.
- (iv) ADG. (AP&B), ICAR New Delhi was rendered advice and offered technical comments on the final reports on the following projects sponsored by the ICAR and other research projects for enabling the pannel for Animal production and Breeding to scrutinize the progress of the projects.
 - (1) Improvement of broiler through mass selection-P.A.U., Ludhiana, Punjab.
 - (2) Studies on the abaptability and performance of Local x Land Race crossbred pigs-R.A.U., Bihar.

- (3) Improvement of sheep and wool on Regional Basis-Banihal/Reasi, (J & K.)
- (4) Statistical studies of data collected under the Angora Breeding scheme-Himachal Pradesh,
- (v) Shri A. D. Godbole, Deputy Director, office of the Director of Animal Husbandry, Maharashtra State, Poone-1 was advised on production of estimating the breeding work of dairy cattle.
- (vi) Dr. D. R. Rangra, Director, Central Cattle Breeding Farm, Suratgarh (Rajasthan) was advised in regard to progeny testing scheme.
- (vii) Dr. M. N. Narsimhan, Director, Central Tasar Research Station, Central Silk Board, Ranchi was advised in regard to the statistical analysis of 14×14 diallel cross on silk worm data.

Sample Survey Investigations

- (i) Advice was given to Shri J. P. Singh, Assistant Prof., OUAT, Bhubaneswar for his Ph. D. problem relating to resource allocation.
- (ii) The Director of Extension, Min. of Agriculture and Irrigation, New Delhi was advised in regard to the procedure for demarcation of plot of 0.2 hectares and calculation of yield for the All India Corp Competition Scheme.

6. FIELD WORK

(a) Field Training

During the quarter under review, field training was imparted in connection with the projects mentioned below at the places shown against them.

- (i) Post harvest forecasting of sugarcane-Kolhapur (Maharashtra).

- (ii) Experiments on cultivators' fields-U.P., Rajasthan, A.P., Maharashtra, and Karnataka states.
- (iii) Index of cost of raising calves and study of changes in rearing practices in rural areas, Haryana-New Delhi.
- (iv) Sample surveys for methodological investigations into HYVP—Punjab and Haryana (Chandigarh).
- (v) Pilot sample survey for estimation of number of pigs slaughtered and study of attendant swine practices—New Delhi.

(b) Inspection and Supervision of Field Work

During the quarter under review, inspection and supervision of the field work of the following projects was carried out at the places/areas mentioned against them.

- (i) Index of cost of raising calves and study of changes in rearing practices of bovines in rural areas, Haryana-Hissar district (Haryana).
- (ii) Sample survey for methodological investigations into H.Y.V.P.—Delhi, Patiala and Jullundur districts of Punjab State.
- (iii) Pilot sample survey to evolve a sampling methodology for estimation of losses taking place in the marketing and price spread at various stages and cost of cultivation of important vegetable crops—Delhi and Ahmadabad (Gujerat).
- (iv) Pre-harvest Forecasting of yield of sugarcane—Meerut district (U.P.) and Kolhapur distt. (Maharashtra).

7. ABSTRACTS OF PAPERS PUBLISHED

- (i) Dharamendra Kumar and Narain, P. Inbreeding in Sahival herd and its impact on economic characters. *Indian Vety. Med. J. 1*, pp. 27-34, March, 77.

The imbreading coefficient of Sahiwal cows maintained at Livestock Farm,

Chak Ganjaria, was worked out, tracing the pedigree of the cows born in 1972 at the Farm. Out of 164 cows, only 8³ cows were found to be inbred. Considering the pedigree upto five previous generations, the overall inbreeding coefficient worked out to be 9.6% ranging from 1% to 27%.

For studying the effect of inbreeding on various economic characters, the regression equations in respect of lactation yield, lactation period and calving interval were obtained as given below:—

Characters	Fitted equation
Lactation yield	$y = 1497.20 - 1415.73x + 947.64x^2$
Lactation period	$y = 286.9541 - 57.8435x - 1632.5977x^2$
Inter-calving period	$y = 421.61 + 129.57x + 626.69x^2$

On the basis of the above equations, the impact of adverse effect on these characters was worked out and predicted in quantitative terms. The lactation yield and lactation period were found to decrease by about 20% and 47%, whereas inter-calving period was estimated to increase by 19% in the inbred cows having 27% inbreeding coefficient as compared to those having 1%. Further significant cumulative adverse effect of inbreeding in the herd was observed after 4% inbreeding coefficient. Consequently, in order to avoid further inbreeding, which adversely affects vigour and reproductive performance of the herd, immediate steps need to be taken to bring fresh blood from outside so that further deterioration in the herd may be avoided.

- (ii) JAIN, J. P., NARAIN, P. Accuracy in predicting the breeding value on the basis of individuals' own merit and that of its relatives in inbred populations. *J. Anim. Sci.* 44 (12); pp. 939-946.

A study on the accuracy in predicting the breeding value of an individual for populations undergoing inbreeding with particular reference to poultry, was presented. Six procedures based on combining information from various sources were discussed in detail. The effect of inbreeding was clearly brought out in all the cases. The relative accuracies of the various procedures were discussed theoretically and numerically.

- (iii) MARUTHIRAM, B., JACOB, T., SAMPATH, S.R. and AMRITH KUMAR, M. N. Nutritional status of cross-bred cattle under village conditions-A case study. *Indian J. Anim. Prod.* 7 (1-4), pp. 58-62.

A study of the nutritional status of crossbred cattle under village conditions at four cross breeding centres was made on the basis of data on DCP and TDN available through various feeds fed to the cattle. The extent of overfeeding or under feeding was assessed taking into consideration the milk yield and body weight of the animals. The results showed that animals at Vikasnagar, Chalakudy and Nayyattinkara centres were generally overfed, while those at Visakhapatnam centre were overfed to a lesser extent. It is emphasized that periodical surveys based on appropriate sampling plans should be carried out to assess the availability of feeds and their quality and the nutritional status of animals at different cross-breeding centres so as to ensure proper utilization of scarce feed resources.

- (iv) PURI, P.D. and NIGAM,A.K. Balanced block design. *Communications in Statistics*, A6(12), 1977.

In the present paper an attempt has been made to characterise and unify the three different concepts of balancing in incomplete block designs, namely (i) variance balance, (ii) efficiency balance and (iii) pair-wise balance. Simple characterizations of variance balance and efficiency balance have been given using the P matrix. A method of constructing efficiency balanced (EB) and variance balanced designs has also been presented.

- (v) PURI, P.D., NIGAM,A.K. and NARAIN, P. Supplemented block designs. *The Indian Journal of Statistics. Vol., 39. Series B, Pt. 2, pp. 189-195, 1977.*

The construction and analysis of a class of supplemented block designs which are partially efficiency balanced have been discussed. The orthogonally supplemented balanced designs are found to be a particular case of such designs. The designs are easy to construct and can be analysed with great ease. These designs are useful for plant breeding trials and are similar to augmented designs.

8. PAPERS ACCEPTED FOR PUBLICATION

- (i) BATHALA, H.V.L. and SHARMA, H.L. Measurement of leaf area in Sugarcane. *Cane Grower's Bulletin*.
- (ii) JAIN, J.P. Stochastic models for structure of dairy female population. *Jour. Ind. Soc. of Agri. Stat.*
- (iii) NARAIN, P. and KUMAR, Dharmendra. Lactation correction factors in Sahiwal cows and Murrah buffaloes. *Indian Jour. of Dairy Science, Sept.-Dec. 1978*.
- (iv) SINGH, B.N. and PANDEY, R.K. Impact of new technology on labour employment. *Monpower Journal*
- (v) SINGH, M. and DEY, A. On analysis of augmented designs. *Biometrika*.
- (vi) WIN, KYI and RAI, S.C. Analysis of experiments involving rankings in triad comparisons. *Jour. Ind. Soc. Agri. Stat.*

9. I.A.S.R.I. PUBLICATIONS

- (i) LEELAVATHI, C.R., KRISHNAN, K.S. and SARUP, SHANTI. Project report on the statistical analysis of seasonal agronomic experiments at model agronomic research centres, 1975-76.
- (ii) LEELAVATHI, C.R., KRISHNAN, K.S. and SARUP, SHANTI. Project report on the statistical analysis of seasonal agronomic experiments at model agronomic research centres, 1976-77.
- (iii) LEELAVATHI, C.R., KRISHNAN, K.S. and SARUP, SHANTI. A Monograph on crop response to micronutrients.
- (iv) RAUT, K.C. and SINGH, D. Hand Book on Methods of Collection of Agricultural Statistics in India.
- (v) SINGH, D., SINGH, PADAM and KUMAR, PRANESH. Handbook on sampling methods.

10. ABSTRACTS OF DISSERTATIONS APPROVED

Diploma

SETHI, A.S. Some studies in ratio and regression methods of estimation.

For finding the bias and variance in the usual ratio method of estimation, it is necessary that all the sample means (\bar{x}) for auxiliary character should be positive and smaller than twice the population area (\bar{X}). In populations where the auxiliary character is highly variable, this condition is not likely to be satisfied. One way out for this situation may be a proper stratification in which the above condition is satisfied within each stratum. In situations where this type of prior stratification is not done, a resort to post stratification may be worthwhile. In the present work the use of ratio estimator with post stratification has been investigated. Various alternative situations were considered and corresponding estimators of the population total, and their variance have been worked out.

In many situations, characters under study and the auxiliary characters were made of various components. Sometimes the two characters are more highly correlated for individual components rather than for the aggregate characters as such. In the present study the application of component wise ratio and regression estimators were investigated. The efficiency of suggested estimators were illustrated with the help of three examples.

(Guide : Shri. A.K. Srivastava)

M.Sc. Degree.

RAM KUMAR. Sampling approach for determining the optimum number of raingauges required to estimate the precipitation.

The present study was undertaken with the objective of determining the optimum number of raingauges required to estimate the three rainfall parameters, viz., (i) Mean annual rainfall (ii) Average daily rainfall (iii) Maximum-24 hours rainfall with a reasonable degree of precision. For the purpose of this study, the basic data pertaining to these rainfall parameters for a period of 48 years (1917-1965) from 85 rain gauge stations spread over seven coastal districts of Andhra Pradesh were collected from the Indian Meteorological Department. The data were subjected to statistical analysis using the techniques of (i) Multiple regression method and (ii) Sampling methods, For applying multiple regression method, key stations were first selected on the basis of independent order of correlation and progressively included in the regression equation one by one, whereas in the case of sampling

method, samples of varying sizes were drawn using simple random sampling and stratified sampling techniques. Stratification was done with respect to the characters, (i) Geographical boundaries, (ii) Altitude and (iii) Total annual rainfall. Equal, proportional and optimum allocation were considered for the selection of samples from different strata.

The results showed that 12, 21 and 19 rain-gauges respectively would be adequate to estimate the three parameters by regression method with $R^2 = .95$. The stratification is based on total annual rainfall resulted in higher efficiency of the estimate of mean annual rainfall by 48 per cent for a sample size of 12 rain-gauges and by 59 per cent for sample size of 16 rain-gauges selected with optimum allocation. The criteria of stratification like altitude, total annual rainfall were found to be equally efficient or less efficient for estimation of the different parameters.

A sample of 12 rain-gauges selected with optimum allocation in stratified sampling based on altitude or total annual rainfall, estimated the average daily rainfall with 6.4 per cent S.E. which was less than that obtained by any other method. With sample size of 20 rain-gauges, S.E. was 5 per cent. The standard error for the other parameters namely, maximum 24 hours rainfall was 12.6 and 10.0 per cent respectively for a sample of 12 and 20 rain-gauges.

Thus, 12 to 20 rain-gauges would seem to be adequate to estimate the different rainfall parameters with reasonable precision resulting in considerable saving of time and effort
(Guide : Shri S.K. Rahja)

11. COMPUTER SCIENCE AND NUMERICAL ANALYSIS.

(a) Computer Utilisation

The Computer Division is equipped with two computers an IBM 1620 model II and a Burroughs 4700 third generation system along with other unit record machines. During the quarter under report, the Computer Centre worked during normal hours working. The centre caters to the data processing requirements of research workers, students from various ICAR Institutes and Central Agricultural Uni-

versities and Agricultural Colleges. About 2360 jobs were processed and 1420 programmes tested on the B-4700 system. On IBM 1620, about 350 different jobs were processed and 190 programmes tested. Apart from this, block time of about three hours per day was allotted for processing the job of Tata Consultancy Services, Bombay after the normal hours of working. They utilized about 120 hours during the quarter under report.

(b) Programming Facilities

During the quarter under report, about 30 Ph. D. and 45 M. Sc. students and 34 other research workers were given help in processing of their data on the Electronic Computer. For them, about 70 new programmes were developed.

(c) Training Activities

To acquaint various scientists of different divisions of IASRI with the working of the new computer and the software available with it, a training course in computer programming was organised from 6th March, 78 to 14th April, 78. 36 scientists from different divisions of the Institute participated in this training. In addition to this, nine scientists were selected for training in operation of the new computer. During the training period each of these scientists attended the operational duty on B-4700 system for about two hours in a week. The new computer system accepts cards punched in EBCDIC codes and to meet this requirement three ICL 73/1 Punching Machines with EBCDIC punch codes were installed.

(d) M.T. Unit

During the quarter, work relating to various projects/schemes undertaken by IASRI numbering over 30, were taken up for punching and processing. M.T. Unit continued to extend punching of data processing facilities to a large number of research workers/scientists and students of IARI, and other Agricultural Institutes under ICAR and various Agricultural Universities in India. Guidance in data preparation was provided to a large number of students and scientists. During the quarter, approx, 3.5 lakh cards were punched, 9 jobs on collator, 50 reproduction and 634 listing jobs were completed.

(e) Visitor

Prof. Carl. F. Kossack, Department of Statistics and Computer Science,

University of Georgia, Athens, Georgia(U.S.A.) visited the Institute as a Consultant under the UNDP/UNESO Project during 27th December, 77 to 12th March, 78. During his stay he discussed the various activities of our Computer Centre. He visited a number of ICAR Institutes and some Agricultural Universities along with the Director, IASRI and Dr. S. S. Pillai, Head of Computer Centre. They studied the data processing requirements of these Institutes and Universities. He also gave his recommendation for installation of additional data processing equipment according to the needs of these Institutes and for the future expansion of the Computer at IASRI.

12. LIBRARY

(a) During the quarter under report, 456 books on various subjects were added to the Library of the Institute and the following reprints were procured for distribution.

Sl. No.	Author	Title	Source
1.	Singh, Daroga and Singh, Padam	New systematic sampling	Jr. Stat. Plan. & Inference, 163-177 (1976).
2.	Singh, Daroga and Raut, K. C.	Regional imbalance in livestock development.	Indian Farming, Sep. (1977).
3.	Dey, A. and Rama-Krishna, G.V.S.R.	Note on orthogonal main effect plans.	Technometrics, 19(4), Nov. (1977)
4.	Dharamendra Kumar and Narain, Prem.	Inbreeding in Sahiwal herd and its impact on economic characters.	Ind. Vet. Med. Jr. 1 (27-34), March, 1977.
5.	Gopalan, R. and Dey, A.	On robust experimental designs.	Sankhya, 38 (3) 267-299, 1976, Sr. B.

6. Jain, J. P. and Narain, Prem. Accuracy in predicting the breeding value on the basis of the individual's own merit and that of its relatives in inbred population. Ind. J. Anim. Sci. 44 (12), 939-946, Dec, 1974.
7. Khosla, R. K. Techniques for assessment of losses due to pests and diseases of rice. Ind. Jr. Agri. Sci., 47(4) April, 1977.
8. Maruti Ram, B. and Jacob, T. etc. Nutritional status of crossbred cattle under village conditions-A case study. Ind. Jr. of Anim. Prod. 7 (1-4), 58-62, March-Dec. 1976.
9. Nigam, A. K. Nearly balanced incomplete block design. Sankhya, Sr. 'B' 38 (2), 1976.
10. Puri, P. D. and Nigam, A.K. Balanced block designs. Comm. Statistics Theo. Math. A6(12) 1171-1174, 1977.
11. Puri, P.D. and Nigam, A.K. Supplemented block designs. Sankhya Sr. 'B' 39(2), 1977.
- (b) During the quarter under report, the Library remained open from 8 A.M. to 8.00 P.M. and nearly 3600 persons visited the Library for consultation.
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13. SEMINAR ASSOCIATION

The General Body meeting of the Seminar Association was held in Jan., 1978 in which the activities of the Association were reviewed. The following were elected as office bearers of the Seminar Association for the year 1978 :—

- | | |
|---------------------------|--|
| 1. Dr. Padam Singh | President |
| 2. Dr. M.G. Mittal | Secretary & Representative of the Division of Sample Survey Methodology. |
| 3. Sh. V.K. Gupta | Representative, Division of Training and Basic Research. |
| 4. Sh. H.V.L. Bathla | Representative. Division of Statistical Research in Crop Sciences. |
| 5. Sh. B.C. Saxena | Representative, Division of Statistical Research in Animal Sciences. |
| 6. Miss. Ranjana Aggarwal | Representative, Division of Crop Forecasting Methodology. |
| 7. Sh. U.N. Dixit | Representative, Division of Econometrics. |
| 8. Sh. S.N. Mathur | Representative, Division of Computer Science and Numerical Analysis. |
| 9. Sh. Chandrahas | Representative, Departmental Students. |
| 10. Sh. A.K. Vashist | Representative, Regular students. |

During the quarter, 8 Seminars were held. The details of these seminars are given below :—

Date	Speaker	Topic
20. 1. 78	Dr. M.G. Mittal, Scientist (S-1)	Some sampling strategies for overlapping clusters.
10. 2. 78	Dr. Padam Singh, Scientist (S-2)	A sampling scheme with varying probabilities without replacement.
17. 2. 78	Dr. Jagbir Singh, Sr. Professor, I.A.S.R.I.	On Minimum Variance Unbiased Estimation of Densities.
24. 2. 78	(Professor, Deptt. of Statistics, Temple University, (U. S. A.)	

- | | | |
|-----------|---|---|
| 3. 3. 78 | Shri P. Gangadharan,
M. Sc. student | Model Building. |
| 17. 3. 78 | Dr. D.V. Subbarao,
Scientist, (S-1) | Stratification involving multi-characters. |
| 10. 3. 78 | Shri A.K. Srivastava,
Scientist, (S-1) | A PS Sampling scheme. |
| 31. 3. 78 | Shri K.S. Krishnan,
Head, Division of Statis-
tical Research in Crop
Sciences. | Some studies relating to precision of
experiments. |
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14. PAPER PRESENTED AT INTER-ORGANISATIONAL SEMINARS WORKSHOPS, ETC.

During the quarter under review, papers by the officers, members of the staff and students of the Institute, were presented at Inter-organisational seminars, workshop, etc. The titles and authorship of papers presented and the particulars of the seminars, workshops, etc. at which these were presented are given below :

- (i) *65th Session of the Indian Science Congress Association held during 2nd to 7th January, 1978 at Ahmadabad.*

SINGH, D. and PANDEY, R.K. Agricultural education and rural development.

- (ii) *Symposium on Data analysis and Statistical Computation held during the 65th session of the Indian Science Congress Association at Ahmadabad from 2nd to 7th January, 1978.*

NARAIN, P. Analysis of animal breeding data with multiple characters on computers.

- (iii) *Annual Workshop on Operational Research Projects held at N D. R.I., Karnal*

from 2nd to 4th February, 1978.

PANDEY, R.K. and RAHEJA, S.K. Evaluation of constraints in increasing yield in operational research projects and high yielding crops.

- (iv) *Workshop on Pesticides Residues with special reference to sampling techniques organised by the Division of Agricultural Chemicals at the IARI, New Delhi during March 20-21, 1978.*

NARAIN, P. Statistical basis of designing experiments for residue analysis with special reference to sampling techniques.

15. PARTICIPATION IN INTER-ORGANISATIONAL SEMINARS, WORKSHOPS, ETC.

During the quarter under review, officers of the Institute participated in inter-organisational seminars, workshops, etc. The names of the officers who participated and the particulars of the seminars, workshops, etc., are given below :

- (i) *General Anniversary Meeting of Indian National Service Academy held at Ahmadabad on 2nd January, 1978.*

Dr. P. Narain.

- (ii) *65th Session of the Indian Science Congress Association held at Ahmadabad from 2nd to 7th January, 1978.*

Dr. D. Singh, Dr. P. Narain and Dr. R.K. Pandey.

- (iii) *14th Dairy Industry Conference held at Bangalore from 18th to 20 January, 1978.*

Dr. K.C. Raut.

- (iv) *Annual Workshop on Operational Research Projects held at N.D.R.I., Karnal from 2nd to 4th February, 1978.*

Sh. S.K. Raheja, Dr. R.K. Pandey and Dr. B.B.P.S. Goel.

(v) *All India Library Seminar held at New Delhi during 13th to 15th Feb., 1978.*

Sh. S. S. Srivastava.

(vi) *5th International Wheat Genetics Symposium held at Vigyan Bhavan, New Delhi from 23rd to 28th Feb , 1978.*

Dr. P. Narain.

(vii) *Mini-Workshop on "Pesticide Residues with special refereuce to Sampling Techniques" organised by the Division of Agricultural Chemicals of the I.A.R.I., New Delhi during March 20-21, 1978.*

Dr. P. Narain.

16. MISCELLANEOUS

(a) Appointments, Promotions, transfers, etc.

Appointments.

(i) The following Scientists 'S' have been appointed to S-1 Grade of A. R. S.

w. e. f. 1. 7. 76.

1. Sh. K. R. Rajagopalachar
2. Sh. B. L. Kaul
3. Sh. H. B. Chowdhary
4. Sh. T. B. Jain
5. Sh. S. N. Arya
6. Sh. Y. R. Deshmukh
7. Sh. N. K. Ohri
8. Sh. M. L. Chaudhary
9. Sh. Satya Pal
10. Dr. Bhagat Singh
11. Shri M. S. Batra
12. Shri S. R. S. Arya
13. Shri R. L. Rastogi

- (ii) Shri P. N. Bhargava, Scientist S-2 has been appointed to S-3 grade of A. R. S. w. e. f. 1. 7. 76.

Transfers

- (i) Dr. K. L. Chawla, Audit Officer of the Northern Railway was on deputation as Accounts Officer in this Institute, has been relieved of his duties w. e. f. 26. 12. 77 (FN) to join the Post of Senior Management Analyst in the office of Indian Institute of Public Administration and Shri P. N. Vali, Audit Officer of the Northern Railway joined as Accounts Officer at I. A. S. R. I. in place of Dr. K. L. Chawla w. e. f. 10. 3. 1978 (AN).
- (ii) Shri Bharat Singh, Scientist (S) on his appointment as Programmer has been relieved of his duties at IASRI w. e. f. 12. 1. 78 (AN) to join the U.P.S.C. on foreign service terms and condition.

(b) Staff Research Council

The Staff Research Council meeting was held on the 10th January, 1978 to consider the progress of the continuing projects and to discuss the technical programmes of the new projects to be undertaken during the year 1978-79. Most of the new projects put up for approval had direct bearing on the integrated rural development. In view of the importance of crop forecasting, Director stressed that every scientist should strive in the development of proper statistical methodology in crop forecasting. Further, it was decided that the Institute should select one village located at a distance of 15 to 20 kilometers from the Institute and all possible help should be rendered to the villagers for their upliftment by the Institute's staff.

(c) Other Information

- (i) Dr. D. Singh, Director, attended Fifth meeting of the Sub-Committee for ISO/TC 69 work, E.C. 3:9 on 9th January, 1978 at New Delhi.

He delivered, at a lecture on Role of Statistics in Agril. Anim. Husbandry Research to the ISS trainees at CSO on 3rd March, 78.

He also delivered two lectures on (1) Crop Forecasting Methodology

and (2) Logic of experimentation and Statistical Inference, at Jodhpur University Extension Service on 24th & 25th Feb., 1978.

He attended High level Co-ordination Committee meeting on Crop Estimation Surveys on 17.3.78 at Chandigarh.

Dr. D. Singh, also visited Bangalore, Hissar, Nagpur, Akola in the months of Feb. & March, 1978 in connection with the assessment of computational requirements of the Universities as well as that of ICAR Institutes. Dr. Singh was accompanied by Dr. S.S. Piliyai, Sr. Scientist and Sh. Carl F. Kossack, Consultant under the UNDP/UNESCO Project.

- (ii) Dr. P. Narain, Sr. Professor delivered two lectures in the Department of Statistics, Punjab University, Chandigarh on the 13th and 14th January, 1978 on "The statistical properties of conditional distribution under steady flux of mutations".

He also delivered a series of extension lectures entitled "Utilisation of non-additive genetic variance for improvement of economic characters", at Punjabrao Krishi Vidyapeeth, Akola, Maharashtra on the 6th, 7th and 8th March, 1978.

He was appointed a member of the Standing Committee of Academic Council on "Faculty's students problems and discipline".

He had technical discussions with Dr. J.G. Rowell, of the ARC Statistics Group of the Department of Applied Biology, Cambridge.

He acted as overall Supervisor of the Agricultural Research Service Examination held from 1st to 4th February, 1978.

He attended a meeting of the Breeding Policy Committee of the Indo-Newzealand Crop Improvement Project (Operational Research Project) at H.P. University, Agricultural Complex at Palampur on the 14th February, 78.

He also attended the meeting of the Working Group on Agricultural Statistics in the Directorate of Economics and Statistics on the 25th February, 1978 and a meeting of the Executive Committee of the Indian Dairy Science Association on 1st March, 1978.

He attended a meeting of the Committee of Experts of Military Dairy Farms on the 17th March, 1978 and presented a revised plan for evolving a new breed of cattle with the help of animals available at Military Dairy Farms.

He attended the 2nd Meeting of the Achievement and Audit Committee of the Central Marine and Fisheries Research Institute, Cochin from 28th to 3rd April, 1978 and visited a number of marine fisheries research centres at Cochin, Calicut, Mangalore, Karwar and Panjim (Goa). He also attended the meeting of the Sub-Committee to decide about the continuance or otherwise of the research centers/stations of the CMFRI, Cochin during 28th to 31st March, 1978.

He was nominated a member of the Board of Studies of the Department of Statistics of Rajasthan University.

The name of Dr. Narain was included in the India's WHO's WHO 1977-78 by ALPHA Publications, New Delhi.

At the General Anniversary meeting of the Indian National Science Academy held at Ahmedabad on 2nd January 1978, Dr. Narain signed the Fellowship Register and received from Dr. R. Ramanna, Present of the Academy, the scroll certifying his election to the Academy.

- (iii) Shri S.K. Raheja, Sr. Scientist, delivered lecture to 9th batch of I.S.S. recruits on "Assessment of high yielding varieties programme" on 20th January, 1978 at C.S.O., N. Delhi.
- (iv) Dr. K.C. Raut, Sr. Scientist delivered a lecture on "Statistical research in the field of animal sciences" to the I.S.S. direct recruits at C.S.O., N. Delhi on 18th January, 1978.
- (v) Dr. S S. Pallai, Sr. Scientist visited (i) Punjab Agricultural University Ludhiana, (ii) N.D. R.I., Karnal, (iii) Haryana Agricultural University Hissar, (iv) University of Ag. Sciences, Hebbal, Bangalore, (v) Indian Institute of Agricultural research, Bangalore, (vi) Medras Veterinary College Madras, (vii) Vellayani Agricultural College, Trivandrum, (viii) Central Marine Fisheries Research Instt., Cochin, (ix) Central Institute of Fisheries technology, Cochin and (x) Central Soil Salinity Research

Institute, Karnal, to study the computational requirements of the Institutes.

(vi) Dr. A.K. Nigam, Scientist (S-2) worked as Abstractor for research papers published in inter-national journals for (i) Executive sciences Institute, U.S.A. and (ii) Zentral blatt für Mathematik.

(vii) Sh. P.C. Bose, Information System Officer attended the technical consultation of Agris. Participating Centres at Rome (Italy) from 14th to 17th march, 1978. He also made observational study tours to other Information and Documentation centres including PUDOC, WAGEN-INGEN (The Nether-lands) and Systems Division of Commonwealth Agricultural Bureaux at Slough (United Kingdom) from 18th to 25th March, 1978.

(viii) Shri A.K. Shrivastava delivered lecture on "Surveys on fruits and vegetables" to I.S.S. probationers at C.S.O.

(ix) Miss N.K. Chaudhry, Shri G.V.S.R. Krishna, Shri S.S. Shastri and Smt. Asha Saxena completed their 3 months training course at the Central Staff College, Hyderabad.

(x) During the quarter under review, the officers named below represented the Institute at the meetings of the ICAR Scientific Panels mentioned against their names :

Sh. K.S. Krishnan Scientific Panel for Agronomy and Soil Science.

Dr. K.C. Raut Scientific Panel for Dairy and Livestock products Technology.

Sh. T.J. Jacob Scientific Panel for Plant Physiology and Biochemistry.

Dr. K.G. Aneja Scientific Panel for Fisheries.

भारत सरकार पञ्चवर्षीय योजनाओं के सुधार के लिये पिछले पांच वर्षों से लगातार प्रवर्धनीय योजनाओं के माध्यम से प्रयत्न करती रही है तथा इस माध्यम से अनेक कदम उठाये गए हैं। इनका मुख्य उद्देश्य पञ्चवर्षीय योजनाओं के माध्यम से नरस सुधार, विक्रम तथा सुरक्षा करना है। परन्तु हमारा उद्देश्य इन कारगर कदमों का परिणाम उल्लेखनीय नहीं निकलता। इस स्थिति का एक मुख्य कारण यह है कि हमारे देश में जो वर्तमान साधन हैं वे पञ्चवर्षीय योजनाओं की आवश्यकताओं को पूरा करने में बिल्कुल असमर्थ हैं। हमारी कठिनाई को पूरे वर्ष के लिए मुख्यतः उच्च स्तर का होना चारा तथा अन्य पौष्टिक आहार की आवश्यकता होती है। जब तक पौष्टिक आहार की पूर्वावधारण वर्तमान के चारे की कमता की खेती बाड़ी अधिक प्रदत्त से आरम्भ की जा चुकी है फिर भी पौष्टिक चारे की पूर्वावधारण वर्तमान में कुछ और कारगर कदम उठाने पड़ेंगे। देश के विभिन्न भागों में चारे की पूर्वावधारण का खोजाना कमता की तरह नियमित रूप से वार्षिक सिंचन के उपादान की विधि का खोजाना कमता की तरह नियमित रूप से वार्षिक सिंचन के उपादान करना पड़ेगा, ताकि चारे की पूर्वावधारण की वर्धनीयता के लिए बचाई गई सिंचनीयता की विकास की स्थिति का सुधार किया जा सके। पूर्वावधारण के अधिकतम के लिए उचित विधियों की आवश्यकता को देखते हुए, भारतीय कृषि सांख्यिकीय अनुसंधान संस्थान द्वारा १९७२-७३ में उत्तर प्रदेश के मेरठ जिले में चारे की पूर्वावधारण के अधिकतम की विधि के लिए एक प्रतिदर्श सर्वेक्षण आरम्भ किया गया तथा इसी प्रकार का एक आर्थिक सर्वेक्षण दिसम्बर १९७४-७५ में किया गया। ये दोनों सर्वेक्षण राज्य के करनाल जिले में १९७४-७५ में किया गया। ये दोनों सर्वेक्षण प्रत्येक राज्य में लगभग दो वर्षों तक चलते रहे। प्रत्येक क्षेत्र में सर्वेक्षण का उद्देश्य यथावित्त विधियों द्वारा प्रमुख चारे का उत्पादन, उत्पादक क्षेत्रों का अधिकतम पूंजीकरण द्वारा उत्पादन में अपनाई गई विधियों के अधिकतम उत्पादक क्षेत्रों की उपलब्धियों का

१०. उत्पादन चारे की वर्धनीयता के अधिकतम की विधि

श्रांकलन की विधि :—

सर्वेक्षण के लिए नमूने श्रपनाने की चयन विधि (Sampling Design) त्री-स्तरीय बहुपद चयन (Three-stage Stratified Sampling) थी जिसमें तहसील को एक खण्ड माना गया। प्रत्येक खण्ड में पहले स्तर की इकाई गांव माना गया, दूसरे स्तर की इकाई चारे के खेत को तथा अनन्तम व तीसरा स्तर एक 5×5 मीटर का भूखण्ड माना गया।

इस प्रकार प्रत्येक सर्वेक्षण में एक खण्ड में वितरित ७५ गांवों को चारे के क्षेत्र के श्रनुपात से सर्वेक्षण के लिए छांटा गया। खण्ड में गांवों का चयन एच्छिक रूप से किरतु चारे के क्षेत्र के श्रनुपात को देखते हुए किया गया। श्रव कटाई के प्रयोग हेतु खेत छांटने के लिए, चयन किये गये गांवों के चारे वाले खेतों की सूचियाँ बनाई गईं जिसको प्रत्येक रबी व खरीफ फसल के बाद तैयार किया गया तथा प्रत्येक चयन किए गए खेत में से एक 5×5 मीटर के भूखण्ड का निर्धारण यदृच्छ (Randomly) रूप से किया गया, जिसमें फसलों की प्रत्येक कटाई का प्रयोग किया जा सके। प्रत्येक भूखण्ड से कटाई का एक किलो ग्राम भार का नमूना लेने से पहले भूखण्ड में उगाई गई चारे की फसलों में रसायनिक पदार्थों का श्रच्छी प्रकार से छिड़काव किया गया।

क्षेत्रीय कार्य का संगठनात्मक रूप :—

श्रांकड़ों को एकत्रित करने का कार्य १५ गणनाकारों, ३ परिवेक्षकों तथा १ निरिक्षक द्वारा पूरे समय के श्राधार पर किया गया। निरीक्षक क्षेत्रीय कर्मचारियों पर प्रशासनिक नियन्त्रण भी रखता था। प्रत्येक परिवेक्षक के श्राधीन ५ गणनाकारों को रखा गया जो सर्वेक्षण के लिए क्षेत्रीय कार्य की देखभाल करते थे। यदि कोई गणनाकार छुट्टी पर जाता था तो परिवेक्षक उस गणनाकार की श्रनुपस्थिति में उसके कार्य की देखभाल करता था जिससे सही श्रांकड़े एकत्रित करने में बहुत सहायता मिलती थी तथा फसलों की कटाई के समय प्रयोग भी उचित प्रकार से निर्धारित समय पर किये जाते थे।

श्रांकड़ों को एकत्रित करने के लिए छः प्रकार के प्रपत्रों का उपयोग किया गया, जोकि इस प्रकार थे :—

(क) चयन किये गए गांवों से सम्बन्धित साधारण सूचनायें।

उपरोक्त तालिका से यह अनुमान लगाया जा सकता है कि क्षेत्र का आंकलन, सर्वेक्षण के अधीन उपयुक्त परिशुद्धता (Precision) के आधार पर ही प्राप्त किया गया है। प्रमुख चारे की फसलों की पैदावार की दरों का आंकलन तालिका नं० २ में प्रदर्शित किया गया है।

तालिका—२. पैदावार प्रति हैक्टर (टनों में)

फसल / वर्ष	मेरठ	करनाल
	१९७२-७३	१९७४-७५
ज्वार	१८.४ (३.२)	२२.२ (२.६)
बरसीम	४५.७ (२.२)	३७.३ (३.४)
		५२.३ (३.०)
		८५.० (३.५)

टिप्पणी :—कोष्ठकों में दी गयी संख्याएँ प्रतिशत मानक त्रुटि (Standard Error) को दर्शाती हैं। बरसीम की पैदावार का आंकलन कुल कटाइयों के जोड़ पर आधारित है।

जिस परिशुद्धता (Precision) के आधार पर इन फसलों का आंकलन किया गया है इस से स्पष्ट है कि सर्वेक्षण की इसी विधि को आधार मानकर चारे की अन्य मुख्य फसलों की वार्षिक पैदावार तथा क्षेत्र का आंकलन भी किया जा सकता है।

अन्य चारे की फसलें जैसे बाजरा, लोबिया तथा रिजका इत्यादि जिसकी पैदावार सीमित आधार पर की जाती है उन्हें भी उच्चतर प्रतिशत मानक त्रुटि (Higher Percentage Standard Error) के आधार पर जांचा जा सकता है। इस प्रकार का विधिवत अध्ययन, नई फसलों व क्षेत्रों के लिए भी हर सम्भव तकनीकी विकास जारी रखेगा।

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