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INSTITUTE OF AGRICULTURAL RESEARCH STATISTICS

STATISTICS

(I. C. A. R.)

ANNUAL REPORT
1968

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ANNUAL REPORT FOR 1968.

1.   Introduction

The Institute of Agricultural Research Statistics is the
premier institute for research and training in agricultural and
animal husbandry statistics in the country. It deals with research
methodology for the improvement of techniques in agricultural
and animal experimentation and sampling investigations. It also
carries out research projects to demonstrate the feasibility of the
techniques and to develop the methodology for evaluating the progress
and impact of important development programmes. It provides
advisory services and training in agricultural statistics, both to
agricultural and animal husbandry research workers and
professional statisticians.

The Institute made a modest beginning in 1930 as a
Statistical Section of the Indian Council of Agricultural Research
with one statistician and a limited staff. The principal function
of the statistician was to assist agricultural officers in various
States in planning experiments and in analysing data and inter-
preting the results. He was also responsible for scrutiny of the
technical programmes and progress reports of research schemes
of the Council. The activities of the statistical section entered a
new phase towards the end of 1943 when, at the instance of the
Government of India, research was initiated for developing objective
and reliable methods of collecting yield statistics of principal
food crops. This led to the development of the crop cutting survey
technique which has since been adopted by almost all the states
in the country for estimating agricultural production. In the course
of this work the statistical section had to undertake research in
sampling theory and to train a large number of statisticians and
field staff running into thousands. With the increasing activities
the Statistical Wing as it came to be called, was reorganized
with a strong sample survey unit and with two separate units
dealing with statistical applications to agricultural research and
animal husbandry research. The organization was headed by the
Statistical Adviser to the Council.

In 1945 the Council instituted regular post-graduate
training courses both for Professional Statisticians wishing to
specialize in agricultural statistics and for agricultural and
animal husbandry research workers desirous of acquiring
knowledge of simple statistical methods required most often

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in their work. Although teaching and research was integrated,a small training unit consisting of whole time Professors, Assistant Professors and demonstrators was constituted to be specially responsible for organising the various courses. The Institute soon acquired international recognition as a training and research institute in the field of agricultural statistics and was responsible for training foreign students and organizing seminars for the Food and Agricultural Organisation of the United Nations.

Valuable contributions have been made by the Statistical Wing to the problem of improvement of crop acreage and production statistics. Sampling techniques were developed for securing objective and reliable estimates of marine fish catch and of livestock numbers. By the end of 1952 the crop cutting surveys for the estimation of principal food crops were extended to practically the whole country. In January , 1953, according to the decision of the Government of India the work of the large scale sample surveys on food crops and a few other surveys was transferred from the I.C.A.R. to the Directorate of National Sample Survey in the Ministry of Finance.

In 1952 two F.A.O. experts, Dr. Frank Yates, Chief Statistician, Rothamstead Experimental Station and Dr. D.J. Finney of Oxford University, were assigned to the Government of India to review the research and training activities of the Statistical Wing and to advise them on its development. On their advice the activities of the Statistical Wing were expanded in many directions.

The organization moved into its present campus in August, 1955. The campus provides facilities of a library, class-rooms and an auditorium besides office space for its technical and ministerial staff. A hostel with usual amenities and a playground are also provided for the trainees. In view of its role as a training and research organization the Statistical Wing was designated as the Institute of Agricultural Research Statistics in 1959. The mechanical data processing unit was also added to the Institute about this time. This has been recently expanded with the addition of an I.B.M. 1620 , electronic computer and other related equipment. These developments have enabled the Institute to discharge its functions more efficiently.

1.1   Organisational structure of the Institute.

Pending completion of the reorganization of the I.jC.A.R.
the Institute is yet to be organized into appropriate divisions and
sections. At present the Institute is headed by the Sta-tistical
Adviser. He is assisted by two Deputy Advisers, One Senior
Professor, 13 Senior Statisticians and Professors, 24 Stati-sticians
and Assistant Professors and 31 Investigators, 60 Statistical
Assistants and 47 Senior Computors. In addition there were (i) field
staff consisting of 3 field officers, 7 Inspectors and 72 Supervisors
and enumerators for collection of data in pilot studies, (ii) a mechanical
data processing unit headed by an Officer on Special Duty, and
including two Programmers, 1 Mechanical Tabulation Officer,
2 Electronic Computer Operators,3 Machine Operators, 3 Supervisors
and about 50 Key Punch Operators, for mechanical processing of data.

The work is being organized broadly into five divisions with
suitable statistical staff.

1.   Statistical research in agricultural sciences.

2.   Statistical research in animal sciences.

3.   Sample survey investigations,

4.   Basic research, and training and

5.   Mechanical and electronic processing of data.

The library of the Institute is managed by an Assistant
Librarian and a lower division clerk.

The administrative sections of the Institute are headed by
an Administrative Officer. He is assisted by an Assista-nt
Administrative Officer, and three Section Officers, a Junior Accounts
Officer and other ministerial staff.

1.2 Distinguished visitors and seminars.

Seminars based on topics of research completed by officers and students of the Institute formed an essential part of the activities of the Institute as usual. In all 25 seminars were delivered in the year. Dr. P.S. Puri, Associate Professor of Statistics Purdue University, U.S.A., Dr. R.C. Bose, Professor of Statistics, University of North Caroline, U.S.A., Professor C.B. Bell, Michigan University, U.S.A., and Dr. J.N. Srivastava, Professor of Statistics, Colorado University, U.S.A., visited the Institute and delivered lectures on topics of current research.

A regional training centre on Agricultural Census Techniques for countries in Asia and Far East organised by the F.A.O., and hosted by the Government of India was conducted at the Institute from 2nd September to 7th December,1968 for imparting training in census methodology to participants from 13 countries in the region.

1.3 Research Collaboration with other institute, Universities colleges, and other institutions at National level.

Dr. G.R. Seth, Statistical Adviser visited the Ohio State University, U.S.A. to spend a term at the Department of Mathematics.

Dr. G.R. Seth as a member of Indian Delegation and Dr. Daroga Singh, Joint Director, as an observer attended the second session of the F.A.O. Commission on Agricultural Statistics for Asia and Far East held in New Delhi from December, 9 to December, 14, 1968.

Dr. Daroga Singh attended workshop and Demonstration Centre for 1970 Agricultural Census held at Washington U.S.A. from 12th May to 25th August,1968.

Shri K.C. Raut, Senior Statistician attended the International Seminar on Livestock and Livestock Products Statistics organised by F.A.O. at Moscow, U.S.S.R. from 30th September to 30th October,1968.

Shri M.P. Jha, Senior Statistician proceeded on 28th December, 1968 to Seoul (Korea) as Agricultural Statistician on an assignment under F.A.O. of the United Nations.

1.4   Fellowships and Student ships.

During the year, 21 fellowships were awarded to students
studying at the Institute in various courses and 12 fellowships
to post-graduate students were continued. Four foreign students
were also trained. The details of these awards are given later
in the report.

1.5   Advanced training.

Shri K.B.L. Rastogi, Statistician joined the Ohio State
University U.S.A., for higher studies in Computer Science
in April, 1968.

Shri J.P. Jain Statistician was awarded the F.A.O.
fellowship and joined the University of Missouri, U.S.A.,
for one year's advanced training in Genetic Statistics in June,1968.

2.   STATISTICAL RESEARCH IN AGRICULTURAL SCIENCESω

The programme of Statistical Research in Agricultural
Sciences at the Institute was continued during the year under
report. The main items of research included in the programme
were (i) Statistical analysis and summerization of data collected
under the All-India Co-ordinated Agronomic Experiments Scheme.
(ii) Analysis of experiments and preparation of compendia of
National Index of Agricultural Field Experiments. (iii) Analysis
of experiments on crop rotations. (iv) Standardization of
Horticultural Experiments for determining the size and shape
of plots for experiments on perennial crops as also for fixation
of optimum length of experimentation with these crops. The
details of activities in these various schemes are given below.

2.1   Statistical analysis and summarisation of all India
        coordinated agronomic experiments.

The all India coordinated agronomic experiments scheme
was started during Second Five Year Plan in collaboration with
I.A.R.I. and various states in the country. The work under the
scheme continued during the Third Five Year Plan. The technical
programme of the scheme was reviewed and revised at the
Annual workshop held in 1968, the new technical programme
being effective from kharif 1969-70.

The scheme is operated in two parts:-

1.   Simple fertilizer trials on cultivators'
        fields.

2.   Model agronomic experiments at research
        centres.

        The details of work under each of the two parts are
as follows:

2.1   (i) Simple Fertilizei   Trials on cultivators fields.

        The main objectives of these trials are (i) to study the
response of high yielding and locally improved crop varieties
to fertilizers (ii) to determine optimum fertilizer schedules for
important crops in different regions of the country and
(iii) to correlate crop responses with soil test values.

        With the new strategy in agriculture and consequent
emphasis on high yielding varieties a new technical programme
of the scheme was formulated at its Annual Workshop in 1967
under which it was proposed to conduct trials with high yielding
varieties in 30 districts and with locally improved varieties in
60 districts. However, out of the targetted 18000 trials, only
about half the number were actually conducted during the year.

        During 1968, statistical analysis of data for trials
conducted during 1965-66 and 1966-67 was completed and summary
tables prepared. Data for about 5000 trials under the high
yielding varieties programme as also under the existing programme
conducted during 1967-68 were coded punched and analysed. The
annual report summarising the results of trials conducted in
1967-68 was prepared and presented at the Annual Workshop
held in October, 1968. Important results obtained are as follows:-

        Application of 60 kg/ha of nitrogen on paddy crop gave
a response of about 6 Q/ha in kharif season with   dwarf
varieties as against 4.5 Q/ha obtained with locally improved
varieties. With the increase in the level of application of
nitrogen to 120 kg/ha, additional responses obtained were 5
and 3 Q/ha with the two types of varieties. In the case of wheat,
the response of dwarf varieties like PV-18 and Sonora-64 to the
application of 60 kg. N/ha was about 7 to 9 Q/ha..   At double the
dose of nitrogen, an additional yield of about 5 Q/ha was
obtained. The response to nitrogen at 60 kg/ha for hybrid
maize as well as for the local varieties was about 5 Q/ha.

For studying the soil test crop response relationship, soil test data on wheat crop from Punjab and Uttar Pradesh and on rice crop from Andhra Pradesh were utilized. Soil analysis data were not collected in the other states. The multiple correlation co-efficients of fertilizer responses to nitrogen and phosphorus with soil test values were generally low and non-significant, indicating that only a fraction of total variation in fertilizer responses could be explained by the soil test analysis.

2.1 (ii) Model agronomic experiments at research centres.

The main object of these experiments is to obtain. scientific information on effects of fertilizers and other improved agronomic practices under intensive cropping pattern. The experiments are conducted on major cereals like paddy, wheat, maize, jowar and bajra and important cash crops like cotton groundnut, etc.

During the year, 350 layout plans for kharif 1968-69 and 225 layout plans for rabi 1968-69 were prepared and sent to 48 Model Agronomic Centres for conducting experiments on high yielding varieties of cereals and also on cash crops. Statistical analysis of yield data of about 75 and 60 experiments conducted on paddy during 1965-66 and 1966-67 respectively was carried out and final tables prepared.

Two reports embodying the results of experiments conducted on wheat and crops other than paddy during 1965-66 and 1966-67 were prepared. The data of experiments conducted during 1967-68 were analysed and two reports one for kharif 1967-68 and another for rabi 1967-68 were prepared and submitted to the second Annual Workshop held in October, 1968.

Important results obtained from the data of experiments conducted during 1967-68 are given below: -

Good responses ranging from 5 to 14 Q/ha were obtained to 60 kg/ha of nitrogen on paddy crop at almost all the centres. At double the level of nitrogen, the response of paddy increased at most of the centres. However, further increase in the application of nitrogen did not show much additional response.

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Good response to the application of phosphorus at 30 kg/ha was obtained only at Purafarm and Yemmiganur being of the order of 8 - 10Q/ha. Increase in the level of application of phosphorus to 60 kg/ha. P_2O_5/ha did not give significant additional response. At the other centres, the response to phosphorous was low or absent.

There was no response to application of potash. The average yield of IR-8 ranged from 22 to 50 Q/ha and that of TN-1 from 13 to 52 Q/ha.

Differences in spacings did not show much effect on the yield on paddy.

Soil application of nitrogen gave higher response by 4 to 12 Q/ha as compared to folia spray.

On wheat, significant responses ranging between 6 and 22 Q/ha were obtained to 60 kg N/ha at most of the centres. At double the level, an additional response varying from 2 to 10 Q/ha was obtained at a majority of Centres.

Responses of the order of 6-9 Q/ha were obtained at Bagawi, Powarkheda, Bichpuri, Purafarm and Masodha, when phosphate was applied at 30 to 60 kg. P_2O_5/ha. Significant response to potash was obtained only at Purafarm.

Variety X Nitrogen interaction was found significant at Karaiyirippu and Hiragachi in kharif and at Karaiyirippu and Peravurani in rabi season with rice. Variety IR-8 gave higher response to Nitrogen at all the three centres except at Karaiyirippu during kharif season. In the kharif season, the indigenous varieties gave higher yields when no nitrogen was applied. For wheat this interaction was significant at 10 centres of which the dwarf

wheats gave high response to nitrogen at five centres. At Purafarm K - 68 gave higher yields with and without nitrogen as compared to the S - 227 and Sonora - 64. Higher seed rate in wheat crop sown on the optimum date gave higher yields at Masodha. At Purafarm and Sumerpur, the response to nitrogen decreased with delay in sowing date.

2.2   Evaluation of yardsticks of additional production.

For assessing the growth in agricultural production likely to accrue from planned development measures, a knowledge of the additional yield per unit i.e. yardsticks for various improvement measures is essential. Formulation of yardsticks of additional production for different crops is at present in hand at Institute of Agricultural Research Statistics.

During 1968, the yardsticks of additional production were evaluated at the following levels of N, P, K: 60 Kg N, 30 kg. P_2O_5 and 30 Kg K_2O/ha for tobacco, 60 Kg. N 30 Kg. P_2O_5 and 60. K_2O /ha for chillies and 100 Kg. N 50 kg. P_2O_5 and 100 kg. K_2O/ha for potato. The experiments on cultivators fields showed that the yardsticks for tobacco were low for all the nutrients being less than a quintal per hectare. The best responses on chillies (dried) were obtained in Andhra Pradesh, the yardsticks of additional production being of the order of 3 tonnes per tonne of nitrogen, 3.6 tonnes per tonne of P_2O_5 and 1.6 tonnes per tonne of K_2O. Hilly regions of Punjab showed the best response on potato, the yardstick being 66 tonnes per tonne of nitrogen, 53 tonnes of per tonne of P_2O_5 and 37 tonnes per tonnes of K_2O. In the plains, the corresponding yardsticks were a little less and also were more variable.

At research centres, the response to nitrogen was in general more than that obtained on cultivators fields. The responses to phosphorus and potash were moderate or absent.

At 50 kg. N/ha, the exotic varieties IR-8 and TN-1 and locally improved varieties of rice gave the yardstick of additional production between 10-12 tonnes per tonne of N. This was about 4 tonnes more than that obtained with local varieties in kharif season. For the mexican dwarf varieties of wheat, the yardstick of additional production was 17-19 tonnes per tonne of nitrogen while C 306 and local varieties gave about 14 tonnes per tonne of nitrogen.

No consistent results were obtained on the other crops.

2.3   Estimation of incidence of pests and diseases:

The object of the scheme was to evolve suitable sampling and measurement techniques for estimation of incidence of pests and diseases and assessment of consequent loss in yield of crops.

Report of a pilot sample survey conducted for 4 years from 1962-63 to 1965-66 on paddy in Thanjavur district of Madras state was prepared. The survey covered all the three paddy crop seasons in the district viz., Kuruvai,Samba and Thaladi.

The incidence of almost all the pests and diseases varied over the years. Rats were observed as a major pest during all the crop seasons. Stemborer and Gall fly, and Helminthosporium were also the major pests and diseases respectively during Samba and Thaladi seasons. The peak periods for leaf disease due to Helminthosporium and dead hearts due to stemborer was about a month before the harvest whereas silver shoots due to Gall fly were at their maximum during the observation taken about two months after transplanting.

The overall percentage loss due to incidence of the major pests and diseases was found to be the maximum, for long duration varieties of Samba season being 10.5/while for each of the other two paddy crops the corresponding figure was about 4 percent. The average avoidable loss in yield in Samba paddy with the use of recommended plant protection schedule was estimated as 411 Kg/ha with S.E. of 32 kg./ha. The average increase in return by adopting the recommended plant protection schedule which would involve a recurring expenditure of about Rs.100/- per hectare per season, was of the order of Rs.188/- with S.E. of Rs.22/-.

2.4   Preparation of national index of field experiments:

The objectives of the scheme are (i) to maintain at a central place the results of all the agricultural fields experiments conducted in the country and (ii) prepare and print the compendia of these experiments periodically.

The regional staff of the scheme collected and reported the data of 2,300 experiments pertaining to the period 1960-64 during the year under report.

The results of experiments conducted during the period 1960-64 in Gujarat and Madras States for a number of years and/or at a number of places were summarised. The summarisation of experiments of Orissa State is in progress.

2.5   Statistical analysis of experiments on crop rotation.

Although a good number on crop rotation experiments were conducted in past years at various centres in India under various schemes, a complete analysis of the data was rerely taken up at these centres mainly because of the complicated methodology involved. The Institute played a poineering role in analysing such experiments with rigorous statistical techniques and bringing out full information contained in them. Data on crop rotation experiments obtained from Jabgaon, Akola, Jeur, and Chas in Maharashtra, Surat in Gujarat, and Dharwar in Mysore state were analysed at the Institute and reports prepared.

2.6

2.6   Standardisation of horticultural experiments.

The Institute has played a poineering role in solving various problems in planning and analysis of experiments on horticultural crops. Problems like determination of plots of optimum size and shape of plots for experiments on various perennial and annual crops, methods of analysing experiments with incomplete records, criteria for fixation of optimum duration of experimentation with perennial crops etc. have been tackled by the Institute in the past. Studies on the size and shape of plots for pepper, arecanut, coconut, mango, knolkhol, cabbage, bhindi and tomato have been completed.

During the year under report uniformity trial data on apple were analysed and a preliminary study of the optimum size of plot for experimentation with apple was completed. It was found that for experimentation with apple, tree-plots of two trees each could be recommended.

3.   STATISTICAL RESEARCH IN ANIMAL SCIENCES:

The Institute continued its programme of statistical research in animal sciences during the year under report. The investigations included critical examination of breeding data, standardisation of techniques for measurement and sampling and investigations for development of techniques for the study of cost of production of livestock and poultry products. Studies were carried out on the comparative performance of indigenous cattle (Bengal type) and their grades with Hariana breed. The comparative performance of various grades obtained by crossing local sheep in Kashmir with exotic rams was also studied on the

basis of data from a scheme sponsored by the I.C.A.R. Reports were prepared on the studies carried out on the estimation of Solids-not-fat (S.N.F.) and the correction factors for fat by Gerber method. The project for standardising the procedure of sampling for assessing wool quality of a single fleece as well as that of fleeces from group of sheep which was initiated earlier continued during the year. The work on the preparation of the index of animal experiments was continued. Preparation of final reports of investigations for studying the cost of production of sheep and wool in Himachal Pradesh was completed, while work on the preparation of final report concerning the investigations for studying the economics of raising cattle and buffaloes in Hissar district was continued.

3.1 Standardisation of methods for estimation of soilds-not-fat (S.N.F.) in milk.

With a view to (i) developing an appropriate formula relating S.N.F. to density and fat, (ii) estimating correction factor for fat as determined by Gerber method, and (iii) preparing temperature correction charts for density for varying fat percentages, the Council sponsored a co-ordinated scheme in 1963. Under the scheme, the chemical analysis of a large number of milk samples was carried out at four centres and the data were made available for statistical analysis during 1966.

Results on statistical studies pertaining to the estimation of an appropriate formula relating S.N.F. to fat as determined by Gerber method and density were reported last year. During the year, studies were undertaken to determine the formula for predicting SNF from known values of fat by Rose-Gottlieb method and density. The study showed that broadly there was no significant seasonal trend nor any significant difference in the formulae for the different breeds within a centre. However, the regression equations pertaining to the different centres were generally not homogeneous. This pattern of variation was more or less similar for the equations pertaining to the temperature levels, viz., $20^{\circ}C$ and $27^{\circ}C$ for density and the methods of determination of fat.

During the year, studies relating to the correction factor for fat by Gerber method were also undertaken and a report incorporating the results was prepared. The studies showed that broadly the Gerber method over estimated fat in the case of individual and bulk milk of cows and buffaloes

and under estimated fat in the case of separated milk. The
pattern of variation over seasons, breeds and centres was
the same as in the earlier study. The equations fitted for
the season wise data were pooled and correction factors
estimated.

3.2 Standardisation of the procedure of sampling from fleeces for the study of wool quality.

The project was undertaken with a view to standardising
the procedure of sampling for assessing wool quality of a single
fleece as well as that of fleeces from a group of sheep so as to
provide a basis for all scientific studies on fleece quality in
the country. As already reported the laboratory work was
carried out during the period November, 1966 to October, 1967
at the Sheep Breeding, Farm, Kamaraj Sagar, Ootacamund
(Madras). Similar studies under the project were also in
progress at Central Sheep and Wool Research Institute, Malpura
(Rajasthan) during 1967. During the year under report the
statistical analysis of the data on fibre length for 13 two-teeth
half-bred Polwarth ewes and 12 four-teeth ewes collected from
Sheep Research Station, Pashulok (Uttar Pradesh) was completed
for regional as well as composite samples. In each age group
the variation between regions was significant as estimated from
regional samples. The mean fibre length ranged from 1.65 cm.
in britch region to 8.57 cm. in wither region in two-teeth age
group and it ranged from 7.86 cm. in britch to 8.79 cm. in
back region in four-teeth age group. The analysis of data
from Pashulok pertaining to other characters and that for
Tamilnadu was in progress.

3.3 Study of comparative merits of selective breeding and grading up of local cattle.

The Indian Council of Agricultural Research sponsored
a co-ordinated scheme to be run at various farms in the country
for studying the comparative merits of improving indigenous
cattle by selective breeding and grading up with bulls of well-
defined breeds. According to the recommendations of the then
Animal Breeding Committee, the data collected at the various
centres were required to be analysed at I.A.R.S. The results
of the analysis of the data collected on Khariar(Orissa),
Umbalachery(Madras) and Red Purnea (Bihar) type of cattle
were reported in the previous years. During this year, data
on Bengal type of cattle were analysed.

3.4   Statistical analysis of sheep breeding data.

For assessing the comparative performance of various grades obtained by cross-breeding local sheep with Rambouillet rams, the data from 1952-66 pertaining to the scheme for Improvement of Sheep and Wool on Regional Basis at the Sheep Breeding Farm, Banihal-Reasi (Jammu and Kashmir) were analysed during the year under report.

Pure Rambouillet ewes were found superior to local ewes and the various grades in respect of greasy fleece weight, fineness and fleece density. The greasy fleece weight increased from 1.09 kg. to 3.13 kg, fibre diameter decreased from 29.6 microns to 19.8 microns and fleece density increased from 1120 to 4170 per square cm. as the percentage of Rambouillet blood increased from zero percent to 100 percent. The number of normal lambings for every 100 ewes put to rams was highest among half-bred ewes, being 77 percent and was lowest among 7/8th ewes, being 56 percent. The percentage of abnormal lambings varied from 10 in half-bred ewes to 15 in local ewes. The mortality rate among lambs varied from 5 percent in local sheep to 30 percent in 7/8th progeny of cross-bred sheep. The mortality rate in ewes varied from 7 percent (half-bred) to 17 percent (Pure Rambouillet). On the whole, pure Rambouillet ewes could be considered superior to the cross-bred progeny and local ewes with regard to production characteristics. Among grades available, half-bred proved superior to 3/4th in respect of adaptability.

3.5   Studies on genetic correlations and selection indices relating to cattle.

In order to estimate the genetic correlation between lactation yield and other characters, such as birth weight and age at first calving, it was propose to utilise the breeding data already available for a number of herds. During the year the data for the Red-Sindhi herd at Hosur and Bangalore, Kankerj herd at Anand and Kangayam herd at Hosur were proposed for statistical analysis.

3.6   Preparation of national index of animal experiments:

The object of the scheme is to collect and analyse data pertaining to all the experimental investigations on animals carried out at the various research centres in the country with a view to preparing a compendium of the processed results so as to enable the research workers to review the work already done in a particular subject and to plan future investigations. Data pertaining to 335 experiments conducted at I.V.R.I., Izatnagar during the period 1958-65 were collected during 1967. The work of collecting data on all experiments conducted prior to 1958 at I.V.R.I., was continued during the year. Information on 126 experiments on animal nutrition on animal physiology and 42 experiments on animal genetics and 76 on bacteriology and virology were collected. The statistical analysis of the experimental data was taken up.

3. 7   Study of economics of raising cattle and buffaloes.

The study was undertaken in Hissar district of Haryana to develop a technique for estimating the cost of raising youngstock and of maintaining adult cattle and buffaloes in a breeding tract. The study would also furnish a estimates of cost of production of milk in the area. The findings of the enquiry would be of value to rural economy in pointing out means of reducing the cost of rearing and keeping cattle and buffaloes and avoiding the prevailing wastages. The field work under the project was carried out for three years and was completed in October, 1966.

During the year under report, the statistical analysis is of data collected during the third year of the enquiry was carried out. The results in brief are as follows:-

The cost of rearing of a male cow-calf from **birth till** three years of age was estimated to be Rs.883/- including family labour and Rs.720/- excluding it. The corresponding rearing cost including and excluding family labour for a female cow-calf worked out to be Rs.573/- and Rs.430/- respectively. The cost of rearing a female buffalo-calf from birth till three years of age was estimated to be about Rs.717/- when family labour was included and Rs.582/- when it was excluded. For a male buffalo-calf, the estimates were worked out from birth till two years of age as there was hardly any male calf reared above two years of age. The cost on rearing a male buffalo-calf from birth till two years of age was. Rs.300/- including family labour and Rs.234/- excluding family labour. An additional expenditure of about Rs.256/- was to be incurred per female cow calf from three years to the age at first calving (45 months) and Rs.464/- for female buffalo-calf from three years to the age at first calving (49 months) when family labour was excluded. The corresponding additional cost for a female cow-calf and female buffalo-calf were Rs.200/- and Rs.370/-/when family labour was excluded. The average
/respectively
maintenance cost of a milch cow was Rs.1.50 per day and that of a milch buffalo was Rs.3.00. The daily expenditure on a bullock was Rs.1.90. A number of other studies such as on milk production, composition of feed and their nutritional status, cost of production of milk etc., were also carried out. Cost of production of milk, etc., have also been undertaken. Some additional studies are being made and the final report on the project is being prepared.

3.8   Study of cost of production of sheep and wool.

The object of the survey was to develop a suitable sampling technique for studying the economics of sheep rearing in relation to wool production under migratory as well as stationary types of managements in hilly tracts and to obtain estimates of different components of cost of rearing sheep and production of wool. The field work was carried out in Mahasu and Mandi districts of Himachal Pradesh for a period of two years and was completed in February, 1966.

Some of the salient results of the analysis of data collected are as follows: -

The flock size in sheep was about 50 in migratory flocks in Mandi district and only 10 to 12 in Mahasu district. In the stationary flocks the flock size was 4 to 5 in each district. In migratory flocks the annual cost of maintenance of a sheep ranged from Rs.5.45 to Rs.7.80 in Mandi district and from Rs.18.50 to Rs.20.55 in Mahasu district. In the case of stationary flocks, the maintenance cost of a sheep ranged from Rs.21.55 to Rs.31.50 in Mandi district and Rs.16.40 to Rs.17.10 in Mahasu district. The cost on labour formed the major component of cost accounting for 65 to 80 percent of the gross cost. The final report containing the results obtained was prepared.

3.9   Study of the impact of milk supply schemes on
        rural economy in milk collection areas:

Changes are likely to occur as a result of assured market and guaranteed price of milk offered by urban milk supply schemes in the rural economy in milk collection areas. With a view to developing a suitable sampling technique for assessing the changes a survey was undertaken in the milk collection areas (Meerut, Bulandshahar and Gurgaon districts) of Delhi Milk Scheme. The field work was carried out in 1967. A similar investigation was launched in the rural milk collection areas of Dudh Sagar Dairy, Mehsana (Gujarat State) and the field work was completed in December, 1968.

Some of the salient results of the preliminary analysis of data collected in Delhi Milk Scheme milk collection areas are as follows: -

In the villages supplying milk to organised agencies, 75 percent of the households were engaged in milk production, of which 33 per cent were commercial and the remaining non-commercial. Out of the commercial producers, three-fourths of

the producers supply milk to organised agencies and the
remaining one-fourth sell milk to others. About 60 percent
of the commercial milk producers in Meerut and Bulandshahr
districts and 90 per cent in Gurgaon districts supply milk
to Delhi Milk Scheme. In the villages not supplying milk to
any organised agency, although 75 per cent of the households
engaged ~~were~~ in milk production, of which only 13 per cent
were commercial.

3. 10.   Estimation of availability and cost of production of milk:

In pursurance of the recommendations of the Working
Group on Dairying, a large scale sample survey was undertaken
in Krishna delta area of Andhra Pradesh supplying milk to the
Integrated Milk Project, Hyderabad for (a) estimating the
availability of milk and its disposal in various seasons in the
area, (b) estimating the cost of production of milk alongwith
its various components, and (c) securing information on factors
which would contibute to the lowering of cost of production.
The field work under the project was in progress during the
year. The broad findings obtained so far are as follows: -

About 43 percent of the producers in the area were of
commercial class habitually selling milk and the remaining
were private maintaining cows or buffaloes for consumption
of milk at home. Of the commercial class, the majority were
cultivators accounting for three-fourths of the commercial
producers. About 57 percent of the producers maintained only
one milch animal each, and one-fourth had two animals each.
Hardly one percent of the producers maintained 10 or more
animals. Buffaloes were predominent in the area. The average
daily milk yield per buffalo in milk was about 2 kg. in winter
season, 1. 9 kg. in summer season and 1. 7 kg. in rainy season
during the year 1967-68.

3. 11   Study of cost of poultry and egg production.

The main object of the study is to develop a suitable
methodology for the estimation of cost of rearing of poultry
and egg production under commercial management conditions.

The field work under the project was initiated during
1967 in Tanda - Dasuya area of Hoshiarpur district of Punjab
State, and will continue for a period of two years. In all, about

130 commercial poultry farms selected on the basis of flock strength were kept under observation for obtaining information on various items such as feed, labour, management, etc., and transactions in birds and eggs and prices of eggs and birds at different stages from producer to consumer. Date received were scrutinised and the work of analysis was taken up.

3.12 Statistical analysis of the data collected in specialised dairy farming scheme.

The Council sponsored a scheme at three centres viz. National Dairy Research Institute (Karnal), Agricultural Institute (Anand) and Bara Joint Co-operative Farm at Nasirpur (Patiala) to compare the three systems of farming viz. dairy farming, mixed farming and arable : farming. The recording of data collected from 1962-63 to 1967-68, alongwith the compilation was done by the staff at respective centres under the guidance of I.A.R.S. The analysis of data collected at Nasirpur centre during the year 1965-66 was carried out at I.A.R.S. and the results reported last year.

The analysis of data collected during the years 1966-67 and 1967-68 at the Nasirpur centre was carried out during 1968. The number of milch Murrah buffaloes maintained in Dairy farming unit , mixed farming and arable farming units was ten, six and one respectively. The area under each unit was 5 acres. The cropping pattern for growing fodder and cash crops was prepared for each unit with a view to optimising net return. The broad findings during these two years are as follows: -

	Dairy Farming		Mixed Farming		Arable Farming	
	1966-67	1967-68	1966-67	1967-68	1966-67	1967-68
Net return(Rs.)	2111	6307	3620	6580	3966	4928
Net return for Rupees 100 invested.	8.9	18.8	17.2	21.5	20.8	18,2
Average maintenance cost per milch buffalo per year(Rs).	734	774	712	704	591	697

The percentage of net return in the mixed farming unit was comparatively higher than the dairy farming unit . This was due to higher return in mixed farming unit from sale of remunerative crops as well as milk production, supplemented with less expenditure on dry fodder which was produced in the unit. The percentage of net return in dairy unit during the year 1967-68 was almost double than that in the previous year mainly due to higher milk production and higher yield of cultivated fodders. The cost of maintenance for a pair of bullocks was Rs.847/- per year during 1967-68 and was about Rs.30/- more than that in the previous year.

3.13 Statistical efficiency and operational feasibility of the sampling plan for milk recording in key village blocks.

Based on the studies carried out on the records of daily milk yield prepared of cows maintained at a number of livestock farms in the country, the I.A.R.S. prepared a sampling plan for milk recording for the purpose of estimating the annual milk production as well as the average lactation yield per animal in the various key village blocks. The present investigation was undertaken with a view to trying out the sampling plan in a few selected key village blocks for judging its statistical efficiency and operational feasibility in the field on a pilot basis. The data collected from the key village block, Karnal were analysed and results reported last year.

The field work under the project was in progress during the year in the key village blocks of Chhata (U. P.) and Mandapeta (A. P.) Majority of the animals selected for milk recording in Chhata block completed their lactation during 1968 and the relevant data on milk yield were scrutinised and the statistical analysis was in progress. The data received from Mandapeta block was taken up for analysis.

3.14 Estimation of area of grazing land and its utilisation.

The object of the investigation is to evolve a suitable sampling technique for estimation with a reasonable degree of precision the area of grazing land the average yield per unit of grazing area in different seasons, the composition of grazing available and its chemical components in each season and to obtain information on grazing practices followed in utilising the grazing area available.

The field staff under the project were recruited during December, 1968 and were given training in the conduct of the enquiry. They were also given training in botanical classification of various grasses at the the Indian Grassland and Fodder Research Institute, Jhansi. The field work of the survey were to be undertaken in Jhansi district of Uttar Pradesh.

3.15 Study of feed-milk relationship in bovines.

At present the feeding standards for milk production in bovines followed by research workers in the Country are mostly based on Morisson's recommendations. It is desirable to examine how for these standards are applicable under Indian conditions and to review them if need be. The objective of the project is to study the feed-milk-relationship with a view to working out economic optimum levels of nutrients required for milk production;

The data collected under the large scale sample surveys carried out by I.A.R.S. for estimation of milk yield as well as for estimating the cost of production of milk were critically scrutinised for the purpose. In addition part of the data collected under the survey to study the economics of raising cattle and buffaloes in Hissar district of Haryana State was also examined. The analysis of these data has been taken up.

3.16 Estimation of mortality and fertility rates among cattle and buffaloes.

For the purpose of assessing the requirements of the animal husbandry needs in five year plans a knowledge of the changes in the livestock population becomes necessary. A technique of projection that can be employed is the component projection method. This technique requires information on the number of animals in each age group for each sex, estimates of the fraction of each sex surviving each age group, estimates of the number of calves born per 1000 adult females, estimates of the fraction of those born which survive, sex ratio at birth, estimates of migrants, etc.
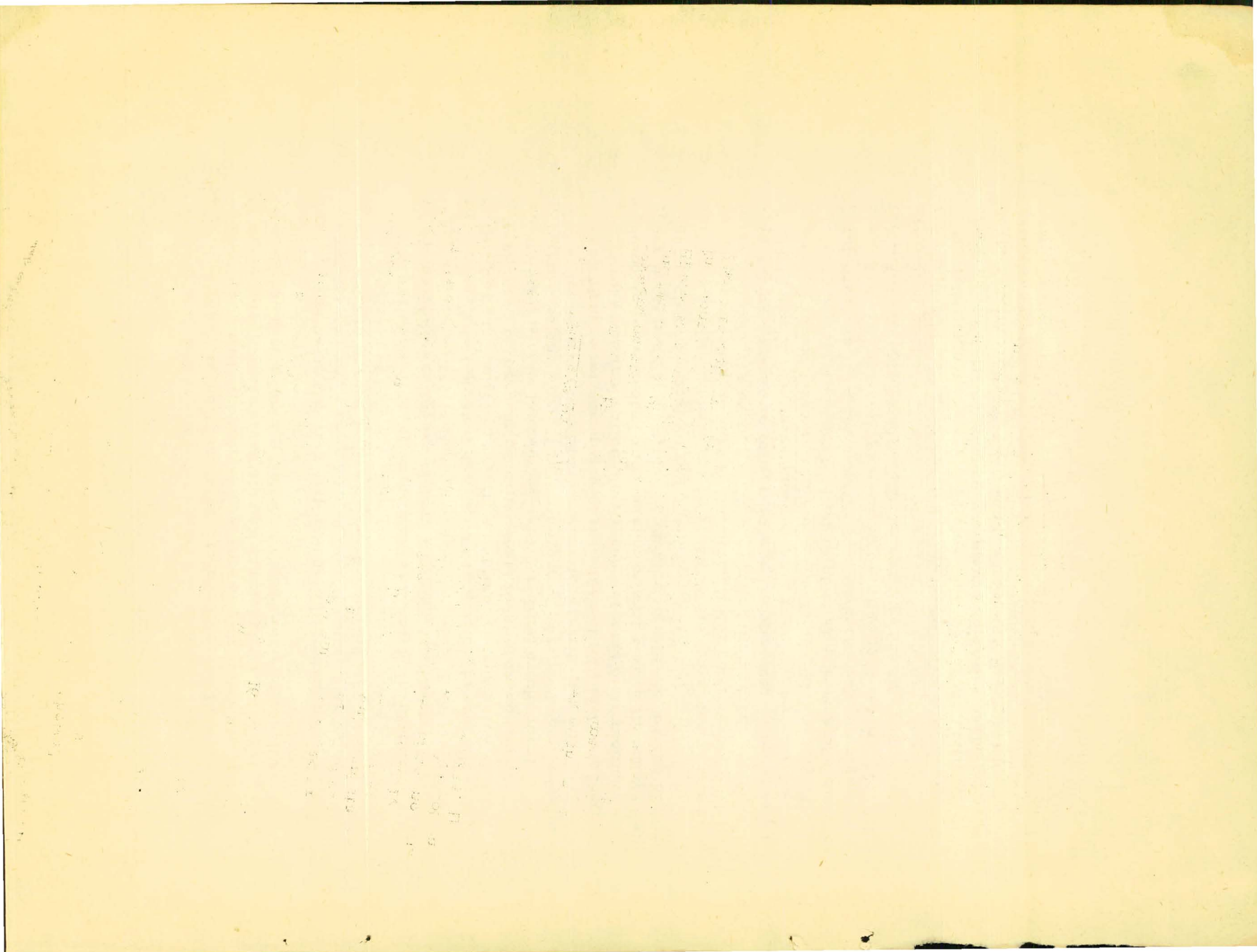
During the period under report these surveys were in operation in the districts of Krishna (Andhra Pradesh) and Tiruchirapali (Madras). A new survey was started in Faizabad (Uttar Pradesh) during January,1968. The field work of all the three surveys was completed in December,1968.

During the year the analysis of the data collected from the surveys carried out in Deoria (Uttar Pradesh) during 1965-66 and Baroda (Gujarat) during 1966-67 was completed. The analysis of the data collected from the surveys carried out in Bangalore (Mysore), Nizamabad (Andhra Pradesh) and Varanasi (Uttar Pradesh) during 1966-67 was taken up.

The results of the survey in Deoria district showed that although only 26 percent of the total cropped area was irrigated, 62 percent received some form of manure or fertilizer . The percentage area benefited by chemical fertilizers and Farm Yard manure was 27 and 49 respectively. Percentage area benefited by chemical fertilizers and farm yard manure for wheat was of the order of 48 and 73 respectively. The rates of application of nitrogen in terms of ammonium sulphate to irrigated and unirrigated wheat were 113 and 93 Kg. per hectare as against the recommended rates of 163 and 82 Kg. per hectare respectively.

In case of Baroda district, almost entire cropped area (96 percent) was unirrigated. However, the percentage of area receiving some form of fertilizer or manure was quite substantial being 63. The percentage of area benefited by chemical fertilizers and farm yard manure was 36 and 48 respectively. The average rate of application of nitrogen in terms of ammonium sulphate was 139 , 121 and 203 Kg. per hectare for paddy, cotton and tabacco. Corresponding recommended rates were 224, 112 and 785 Kg. per hectare.

4.2   Surveys on fruits and vegetables.

During the year under report field work of the pilot surveys on apple and other temperate fruits in Himachal Pradesh and the survey on mango and lichi in Muzaffarpur district of Bihar were completed. The third round of vegetable survey in Poona and Nasik districts of Maharashtra was initiated. The data collected from three rounds of the survey in Nainital

region of U.P. were analysed and the final report based on the analysis of the data was prepared during the year. The data for the first round of the pilot survey on apple in Himachal Pradesh were analysed. Also, the data collected from the first round of the survey on mango and lichi crops in Muzaffarpur district of Bihar were analysed during the year.

According to the programme of the work approved by the Scienfific Panels of the I.C.A.R., it was proposed to take up crop estimation survey on fresh fruit crops in Tamil Nadu from April, 1968. However, due to financial and other administrative difficulties the sanction forstarting the survey was communicated to the state only in December, 1968. The proforma and the technical details of the survey were finalized during the year under report.

4.3   Surveys on Cashewnut and Spices Crops.

The main objective of the scheme was to evolve a suitable sampling technique for obtaining reliable estimates on yield, area and cultivation practices of these Crops.

During the period under report, the surveys on cashewnut crop were in operation in the states of Andhra Pradesh and Maharashtra State. A survey on pepper crop was continued in Kerala State. Another survey on Cashewnut crop was started in Madras State in April, 1968.

The data collected during 1966-67 and 1967-68 on cashewnut crop in the States of Andhra Pradesh and on pepper crop in Kerala State were taken up for statistical analysis during the year-under report.

4.4   Pilot survey of cattle insurance (Mortality)

The Institute conducted sample surveys in the years 1966 and 1967 in Andhra Pradesh and Madras for estimating mortality rates of cattle and buffaloes for preparing a suitable scheme of Cattle Insurance. A similar survey in Rohtak district of Haryana was started in March, 1967 and completed in December, 1968. Reports on the results of these surveys are being finalised. A mortality survey was also started in Meerut district of Uttar Pradesh in December, 1968.

4.5   Assessment surveys under the I.A.D.P.

For the evaluation of the intensive agricultural district programme from its inception, a resource and production benchmark survey was carried out in all the I.A.D.P. districts just prior to or at the commencement of the Programme followed by the surveys carried out in successive crop seasons. The object of these surveys was to assess the changes brought about by the I.A.D. Programme in the agronomic practices followed by the cultivators, the extent to which new and better farming practices were being adopted by them and the consequent improvement in the yield rates of major crops in I.A.D.P. districts.

Under the assessment surveys two types of investigations are being taken up. One is an agronomic and agro-economic survey conducted every year on a suitably selected random sample of cultivator's holdings in each district. The other consists of crop cutting experiments on the principal crops grown in the various I.A.D.P. districts.

As reported earlier, the field work under the survey was started in 1961-62 in the seven districts which was extended in stages to twelve more districts. Assessment surveys have been discontinued in two districts viz. Pali and Bhandara. The programme has been initiated in Karnal district from 1st July, 1968.

During the year under report, the round of agronomic and agro-economic survey started in July, 1967 was completed in all the districts and the next round for the agricultural year 1968-69 was commenced. Crop cutting experiments on principal cereal and cash crops for the yield assessment surveys were also carried out during both the crop seasons of the year.

Analysis of the data collected under the agronomic and agro-economic survey during 1966-67 and 1967-68 was completed. The data regarding crop cutting experiments conducted during 1967-68 were also analysed while data for the kharif 1968-69 were taken up for analysis.

During 1967-68, favourable weather conditions prevailed in the country as a whole and also for many of the districts covered under the I.A.D.P. The results of crop cutting surveys under the I.A.D.P. assessment programmes indicated appreciable increases in the yield rates of food crops, particularly for wheat in Ludhiana and Shahabad districts and maize in Ludhiana district during the year.

The percentage increase for wheat varied from 28 to 36 while
for maize the corresponding increase was of the order of 25
percent over that of 1966-67. The percentage increase for
paddy ranged from 8 to 80. During the year the use of
fertilizers increased considerably in most of the I.A.D.P.
districts.

The percentage increase in the average rate of
application of chemical fertilizers varied from 30 to 94 in case
of wheat and from 47 to 113 in case of paddy. Limited information
on the high-yielding varieties was also collected from the I.A.D.P.
districts utilising the staff of the assessment surveys by
organising the crop cutting surveys on high-yielding varieties of
wheat, rice and other cereal crops. The results of the crop
cutting surveys have indicated that the yield rates for the high
yielding varieties were much higher as compared to the
indigenous varieties. It varied from 50 percent to 140 percent
in case of wheat, while the corresponding increase for paddy
over the indigenous variety varied from 25 to 100 percent.
The percentage of application of high-yielding varieties fields
under benefited by the application of chemical fertilizers varied
from 80 to 100. The rate of chemical fertilizers in these
fields were substantially higher than the corresponding rates
in the control fields. However the cultivators were still using
the fertilizers below the recomme-nded rates. The results
further indicated that there is great scope for increasing the
total production at least in those districts where there are
assured irrigation facilities.

4.6   Surveys for assessment of high yielding varieties
       programme.

The object of these surveys is to collect information on
high yielding varieties on an adequate scale and in different
parts of the country representing different agro-climatic regions.
The crops to be covered by the survey are paddy, maize, jowar,
bajra and wheat. The number of districts to be covered in each
state are fixed broadly on the basis of the area proposed to be
covered with high yielding varieties.

The design followed for the survey is one of multi-stage
stratified random sampling with a block or a group of blocks
in a district covered under high yielding varieties programme
as a stratum, a village within a stratum as the primary stage

sampling unit, a cultivator growing high yielding variety as the secondary stage unit and fields growing the specified high yielding variety crop as the ultimate stage of sampling. The selection at each stage is with equal probability without replacement. The number of villages to be selected in each stratum being roughly proportional to the area under high yielding varieties in the stratum. In all 80 villages in a district are selected and this number is allocated to the different strata in proportion to the area reported under the high yielding varieties. From each village one cultivator is selected at random and from among the fields, on which he grows the high yielding varieties , one field is selected for conducting the crop cutting experiments. The plot size in a field is the same as the one in the state series of crop cutting experiments. To compare the relative performance of the local varieties as against the high yielding varieties neighbouring field growing a local variety is also selected for conducting crop cutting experiments.

For conducting the enquiry for determination of the spread of high yielding varieties and adoption of recommended practices, 30 villages are selected from the district as a sub-sample of those villages selected for crop cutting experiments. The information for this enquiry is collected from six randomly selected cultivators growing the high yielding varieties and two cultivators growing only the local varieties. In order to find out the extent to which the high yielding varieties have been taken up by cultivators at their own initiative in the areas not specifically covered under the high yielding varieties programme, a study is also carried out in such areas to a limited extent. The enquiry is confined to 10 villages from such an area in each district and to 8 cultivators within each such village.

4.7   Sample surveys for estimation of agricultural production at the block level.

As reported in the last year's report, the project was implemented in 55 districts in 11 states upto June, 1968 and thereafter its coverage was restiricted to 8 districts at the rate of one district in 8 states.

During the period under report the data collected
during rabi season of 1966-67 were analysed and reports
prepared. Also the data accumulated for kharif and rabi
seasons of 1967-68 in 55 districts were taken up for analysis.

The results of analysis of the data on rabi 1966-67
indicated that the accuracy of the estimates was badly affected
by the unfavourable weather and crop conditions which occurred
during the year. However the correlation between pre-harvest
estimates and crop-cutting estimates remained at the same
level as in the previous years in most of the states. The
estimates of yield rates were accompanied with high standard
errors as the number of experiments conducted in various
blocks was low.

4.8   Pilot survey for estimation of livestock products
       and study of livestock pra ctices.

The techniques evolved by the I.A.R.S. for estimation
of important livestock products viz. milk, wool and eggs
individually were recommended for adoption to the States. A
pilot sam ple survey for developing a suitable sampling
technique for estimation of meat production was also initiated
in Haryana State during the year under report. A direction
committee was constituted by I.C.A.R. to guide the further
work under these surveys. The committee stressed the need for
developing an integrated plan for studying the production of all
principal livestock products simultaneously, and recommended
that two additional surveys, one in northern region comprising
Punjab, Haryana and Himachal Pradesh and the other in
Andhra Pradesh representing the southern region should be under-
taken. Accordingly a pilot survey on integrated basis was initiated
in Himachal Pradesh during, 1968.

Statistical analysis of data collected from the surveys
on milk, wool and eggs conducted during 1965-67 was
also continued. The statistical analysis of the data for the
repeat surveys in Punjab, Eastern U.P. and Gujarat from a
sample of about 1000 villages in all was completed and the final
report was submitted to the Direction Committee on livestock
products. The bovine milk production in the country during
1966 was estimated at 19.18 million tonnes. This estimate was
based on 11 states covered under the surveys for estimation of
milk production in the previous years.

5. Statistical Studies in Agricultural Economics.

In Agricultural Economics, the Institute has been giving technical guidance in the statistical aspects of I.C.A.R. the agricultural economics research scheme undertaken by the various research Institute/Agricultural Universities/State Departments, etc. During 1968-69, the following three schemes were run by the various Institute indicated against each were completed.

(i) The scheme on 'Cost of Marketing and Marketing Margin in wheat in Agra' sponsored by the B.R. College, Agra, mainly aimed at finding out the cost of marketing of wheat as it moves from the producer to the consumer and margins at various levels in the Bichpuri Block, Agra district. The scheme was completed by the end of September, 1968 and its final report is still awaited.

(ii) The scheme on 'Orientation of pome and stone fruit market structures to the expanding volume fruits production in Kulu and Parvathi Valleys' of Punjab Agricultural University, Ludhiana envisaged (a) to study the operational aspects of the existing fruit market structure in Kulu Valley, (b) to identify the weak links in the market structure and (c) to measure price spreads in fruit industry. The results of this study show a sharp increase in area under the fruit crops. Their marketing depends largely on pre-harvest contract system. The price differential between the consuming and distributing marketes was found to be significant. The study recommends the setting up of a regulated market for stone and prome fruits and establishment of co-operative marketing agencies so that producers may be assured of an adequate income. Its final report was also considered by the Scientific Panel for Agricultural Economics, Statistics and Marketing at its meeting held in January, 1969 and was adopted.

(iii) The objects of the scheme on 'Economics of lift Irrigation using Electric Power in South Kanara district.'- Karnatak University, Dharwar, was to study economic benefits of lift irrigation using electric power its effects on cropping pattern, land productivity etc., magnitude of cost of the irrigated crops and their consequence and the net and the gross additional income and additional employment created, etc.

The conclusions of this study suggested that electric pump sets are cheaper to picotah and oil engines as modes of lifting water. And the operational cost per acre falls with increase in the size of holdings, and it is relatively more on higher duration crop as compared with short duration crops. Its final report was also considered by the Scientific Panel for Agricultural Economics, Statistics and Marketing at its June, 1969 meeting which has suggested some modifications to be made before the report is published.

Besides this, the scheme on 'Factors Associated with Farm and Family Investment' of Punjab Agricultural University, Ludhiana aiming at identifying the areas in which the farmer is investing his income. Particularly the increments in his income is still continuing and its progress was reviewed by the Scientific Panel and was found satisfactory.

6.   Basic Research and training.

The Institute conducts training course in agricultural and animal husbandry statistics mainly for three groups of students. The first group consists of research workers in agricultural and animal husbandry fields whose primary interest is not statistics but for whom knowledge of statistics is essential in their research work. Two courses called Junior Certificate Course and Senior Certificate Course of 6 months and 1 year duration respectively are conducted for their benefit.

The second group consists of those who have post graduate degree in Mathematics or Statistics and who wish to qualify themseleves as professional Statisticians in the field of agriculture, animal husbandry and allied sciences. The course of one year duration, is open to only those deputed by State Govts. and Research Institutes and possessing experience of handling Statistical data in a responsible capacity.

The third group consists of students who wish to qualify for the M.Sc. and Ph.D. degrees in Agricultural Statistics awarded by the Post-Graduate School, Indian Agricultural Research Institute. The major courses in Statistics for these students are offered at this Institute while the minor courses in agricultural subjects are given at the Indian Agricultural Research Institute.

During the year under report seven students were declared successful in the Professional Statistician's Certificate Course and six in Senior Certificate Course Examinations held in June,1968. Two foreign students one from Nepal and one from South Korea completed their training in I.A.R.S., qualifying in the Professional Statistician's Certificate and Senior Certificate Course respectively. Examination for five students for Junior Certificate Course (two of whom were foreign students, one each from Iraq and Phillipines) was held in January,1969. Six students were awarded M.Sc. degree in Agricultural Statistics, and they received the degrees in the convocation held at I.A.R.I. on 1st March,1969. Thesis of five students were approved form the award of Diploma in Agricultural Statistics.

In all 25 seminars on various topics of interest were delivered by officers and students of this Institute. In addition, a number of special lectures were given by several eminent statisticians from foreign universities visiting India. Dr. P.S. Puri, Associate Professor of Statistics, Purde University, U.S.A. delivered a series of 20 lectures on 'Stochastic Processes' during the months of July and August, 1968. Dr. R.C. Bose, Professor of Statistics, University of North Carolina, U.S.A., Professor C.B. Bell of the University of Michigan, U.S.A. and Dr. J.N. Srivastava, Professor of Statistics, Colorado University, U.S.A., delivered courses of lectures on various topics for the benefit of the research workers and students of the Institute.

Regular trainees of various courses conducted by C.S.O. visited the Institute several times in different batches for specialised training in Agricultural Statistics and Sampling Techniques. The duration of these courses varied from one week to three weeks. A batch of twenty nine students of the final year (Electrical Egg.) of B.M.S. College of Engineering Bangalore, visited the Institute. Post graduate students of the Department of Statistics, Sardar Patel University, Kaira, visited the Institute.

Ten students including three office candidates were admitted to the M.Sc. course and three were admitted to the Ph.D. course. One of these candidates was sponsored by the I.A.R.S.

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7.   Data Processing.

The Institute is equipped with an Electronic Computer IBM 1620 Model II with Floating Point Arithmatic and Index Register, 3 Disk Drives, a Card Read/Punch and an On —line Printer. In addition , it has 40 Punching and Verifying machines and 10 pieces of tabulating equipment like Sorters, Collators, Reproducing Punches, Tabulators etc. in the 80 column and 40 column ranges.

During the year under report, the work of coding, punching and verification relating to the various research projects of the Institute undertaken in this Unit expressed in terms of number of cards punched and verified came to approximately 2.5 million 80 column cards and 0.25 million 40 column cards. About 800 listings and 400 tables were turned out on the tabulating equipment.

Almost the entire statistical work of the Institute carried out during the year was programmed on the Electronic Computer. The Electronic Computer was run in two shifts, throughout the year each of 6 hours duration. Besides, special shifts were organized to cope with the processing of data in peak periods.

Apart from the Institute, the equipment is used by the staff and students of I.A.R.I., the Central Agricultural Research Institute under the Indian Council of Agricultural Research, various Agricultural Universities and other bonafide scholars and research workers of Agricultural Colleges.

The students of M.Sc. and Ph.D. courses at I.A.R.S. also continued to utilize the facilities provided by the Electronic Computer Centre for the solution of their resea_rch problems and processing of the data. Thesis problems of a large number of students of I.A.R.I. belonging to various Divisions were programmed and executed on the Electronic Computor during the year.

The installation of the Electronic Computer has given a powerful fillip to the research activity not only of the Institute, but also of above mentioned Organizations which have been using the facility of this Centre. Many a research problem whichwas not formerly attempted is now being undertaken because of the computational facilities available.

More and more students are seeking the help of the Electronic Computer for programming their research problems.

The demand for time on the Electronic Computer has, therefore, been progressively increasing and it is now proposed to increase the working hours of the Centre to 18 hours a day as soon as the extra staff required for this purpose is in position. Among the outside users, mention may be made of the Agricultural Universities of Ludhiana and Pant Nagar and Rockefellor Foundation, who made intensive use of the System for the thesis work of their M.Sc. and Ph.D. students and for analysis of data collected in the various research schemes respectively. The jDirectorate of Economics and Statistics also had their research work programmed on this Electronic Computer. Particular mention may be made of the linear quadratic and exponential growth rates of area, production and productivity of various crops and states which were programmed on this Electronic Computer.

During the year under review, an extensive use of the IBM's application programmes like LP system 1620 and Universal Functions Fitter popularly known as '' STUFF '' was made. About 50 Library Programmes were received from the suppliers of this equipment viz. M/S. I.B.M. and were kept in the hiring of Computer Centre.

A course of lectures in Computer Programming was given to the Diploma and M.Sc. students of the Institute. A separate course in Computer Programming and Numerical Analysis was given to the M.Sc. students of Agricultural Engineering of the I.A.R.I.

A special course of lectures in Programming was organized for the officers and staff of the Institute. The duration of the course was $2\frac{1}{2}$ months. About 40 members of the Institute participated inthe course.

Apart from the class work, the participants of the various courses had access to the Electronic Computer for programming their class work.

Six lectures were delivered on the role of Electronic Data Processing in tabulation and analysis of Agricultural Census data to the delegates participating in the F.A.O. Training Centre on Agricultural Census Techniques for

countries in Asia and the Far East, Organised at the Institute during September/ December,1968.

8.   Advisory Work.

The Institute continued to render advisory service on statistical aspects such as supplying appropriate layout plans of field experiments, providing guidance in the analysis of data and their interpretation and offering comments on technical programmes, annual reports and final reports. During the year under report 150 annual progress reports, 60 final reports, 20 technical programmes and 8 extension proposals were scrutinised and comments offered.

Animal Husbandry Unit of the Institute rendered advice in (i) progeny testing of Hariana and Murrah bulls, Hissar, (ii) scheme for evolving a new breed of dairy cattle, Haringhata, West Bengal, (iii) plan for improvement of dairy cattle at military dairy farms, and (iv) improvement of poultry through family selection. Advice was also rendered in the analysis of data collected on various climatological aspects under studies carried out by the Animal Climatology Laboratory, I.V.R.I. and the data collected from the scheme to estimate the availability and cost of production of milk in Bangalore area.

Survey Unit offered advice to the Agricultural Department of Mandhya Pradesh in the tabulation of the data collected from the survey on banana, pappaya and citrus fruit in the selected districts of Mandhya Pradesh. Besides, comments were offered on the reports of crop cutting surveys undertaken by National Sample Surveys.

9.   Publications.

Publications by the members of the staff and students of the Institute are listed in Appendix II. These include 31 research and technical papers published in standard scientific and statistical journals.

Five approved dissertations by students prepared in part fulfilment of the Council's Diploma in Agricultural Statistics and six approved dissertations of M.Sc. students are listed in Appendix I.

A P P E N D I X - I

List of dissertations approved for the award of M.Sc. Degree and Diploma in Agricultural Statistics.

M.Sc.

1. Gurnani, M.

    Restricted Selection Indices on dairy cattle.

2. Padam Singh.

    Estimation of Marketable surplus of wheat.

3. K.N. Ponnuswami.

    Plans of diallel crosses.

4. V. Ramachandran.

    Prediction of coffee production in India.

5. Randhir Singh.

    Efficiency of successive sampling in two stage design.

6. S. Ray.

    Layout plans and analysis of confounded asymmetrical factorial designs.

Diploma

1. Banerjee, A.K.

    On a method of construction and analysis of any confounded asymmetrical factorial design.

2. Garg, R.C.

    Ratio type estimators in double sampling for two stage designs.

3.   Joshi, D. K.

On construction and analysis of qualitative-cum-quantitative experiments.

4.   Lalit Kishore.

Factorial Experiments with additional treatments.

5.   Sivaram, K.

Plans for diallel crosses and their analysis.

A P P E N D I X - II

List of papers published during the year - 1968.

1.   Abraham, T.P., Khanna, R.C. and Khosla R.K.

    Yield losses due to pests and diseases in rice crop.

    Indian Farming, June.

2.   Abraham, T.P. and Leelavathi, C.R.

    An investigation on the errors in the estimates of yardsticks of additional production from fertilizer use.

    Ind. Jour. Agri. Econ. Vol. 23 No.1.

3.   Aggarwal, K.N., Bavappa, K.V.A. and Khosla, R.K.

    A study of size and shape of plots and blocks and optimum number of pre-experimental periods on Arecanut.

    Ind. Jour. Agri. Sci. Vol. 38, No.3.

4.   Aggarwal, K.N., and Thakur, R.N.

    Effect of hill spacing and times of nitrogen application on the grain yield of maize (Zea Mars L) under rainfed conditions.

    Ind. Jour. Agri. Sci. 38.

5.   Aggarwal, K.N. and Khanna, R.C.

    Fertilizer responses of major crops in Madhya Pradesh

    Fertilizer News, 10.

6.   Aggarwal, K.N. Patel, A.I. and Patil A.R.

    Effect of spacing, seed rate and fertilizer on the yield of sorghum.

    Ind. Jour. Agri. Sci., 38.

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